DRAFT

ENVIRONMENTAL IMPACT STATEMENT ON THE EXPANSION OF THE

Strategic Petroleum Reserve

Alabama, Louisiana, Mississippi, and Texas

VOLUME 2 OF 3:
CHAPTERS 6 -13

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6.0 ENVIRONMENTAL RISKS AND PUBLIC AND OCCUPATIONAL SAFETY AND HEALTH

In this section, DOE examines the probability of occurrence of accidents that might have adverse impacts on the environment or pose hazards to on-site workers or to the public near the proposed SPR expansion sites. Accidents examined include oil spills, brine spills, fires, and hazardous chemical spills; natural disasters (in particular hurricanes and floods) also are assessed. The impacts of these accidents are examined in detail in Chapter 7, under the relevant impact areas. For each type of incident, the SPR has developed safety policies and procedures, designed to lessen the probability of occurrence and to mitigate the possible consequences; they are detailed in section 8.2.2. In terms of impacts of accidents described below to on-site workers, the mitigation measures in section 8.2.5 are also designed to ensure a safe workplace. Potential consequences to on-site workers, however, range from relatively minor exposure to toxic chemicals to injury or death resulting from upset conditions (e.g., fire or explosion).

6.1 Oil Spill Sources and Expected Spill Rates

Releases of oil to the environment, whether from accidental or operational discharges, can occur when oil is produced, transported, processed, stored, or consumed. Storage of crude oil for the purpose of replacing lost oil imports could lead to releases of oil during marine transport of the oil to the United States or during transfer of the oil to terminals from tankers and from terminals to the SPR storage sites, via pipeline. If the SPR oil is required during an emergency, the oil is again transported via pipeline to terminals, from which it may enter the pipeline distribution system or may be loaded onto ships or barges for transport to refineries. Thus, oil spills could occur during the fill or refill of storage caverns, as well as during drawdown and distribution.

Filling newly constructed caverns with 250 MMB of crude oil, as proposed, would result in incremental movements of crude oil in tankers and pipelines to the proposed storage sites. Increases in pipeline use and tanker movements would increase the probabilities of associated oil spills. If drawdown is required, the SPR would have to be refilled. The oil spill risks of refill would be comparable to those of fill. Drawdown itself is complicated because the SPR crude oil is a replacement for imported oil. Drawdown and distribution result in shifts between transportation modes rather than incremental movements.

To a large degree, operational discharges of oil and accidental spills occur because of human error and are preventable. Nevertheless, historic oil spill rates can be used as a reasonable indicator of the likely future probability of oil releases to the environment resulting from operations at an expanded SPR. Historic data may result in a higher or more conservative estimate of the likelihood of an oil spill, reflecting the technology and operating procedures of the time. New regulations and technology, as well as updated procedures, may make the likely future occurrence of spills much lower.

6.1.1 Vessels

For this DEIS, data on tanker spills during the period 1983 to 1989 were obtained from the U.S. Coast Guard (USCG) and data on crude oil imports were obtained from the COE. The resulting oil spill rate, expressed in terms of spills per quantity transported, is assumed to be the expected spill rate for vessels during SPR fill, refill, or distribution. There were 154 Gulf Coast spills of crude oil reported from foreign flag tankers and 5.07 billion barrels of Gulf Coast crude oil imports, resulting in a spill rate of about three spills per 100 MMB transported. The 154 spills were distributed by location as follows: 19 spills in ocean waters, 84 in coastal waters (up to twelve miles from shore), and 51 in inland waters or harbors and on docks. Figure 6.1-1 shows the size distribution of spills for each of these locations. Table 6.1-1 presents the expected number of vessel spills, by location and size, for fill or refill of a 100-MMB storage site and a 160-MMB storage site. Vessel spill rates during distribution are expected to be the same, so the number of spills would be proportional to the amount of oil moving across the docks.

Table 6.1-1
Expected Number of Vessel Spills

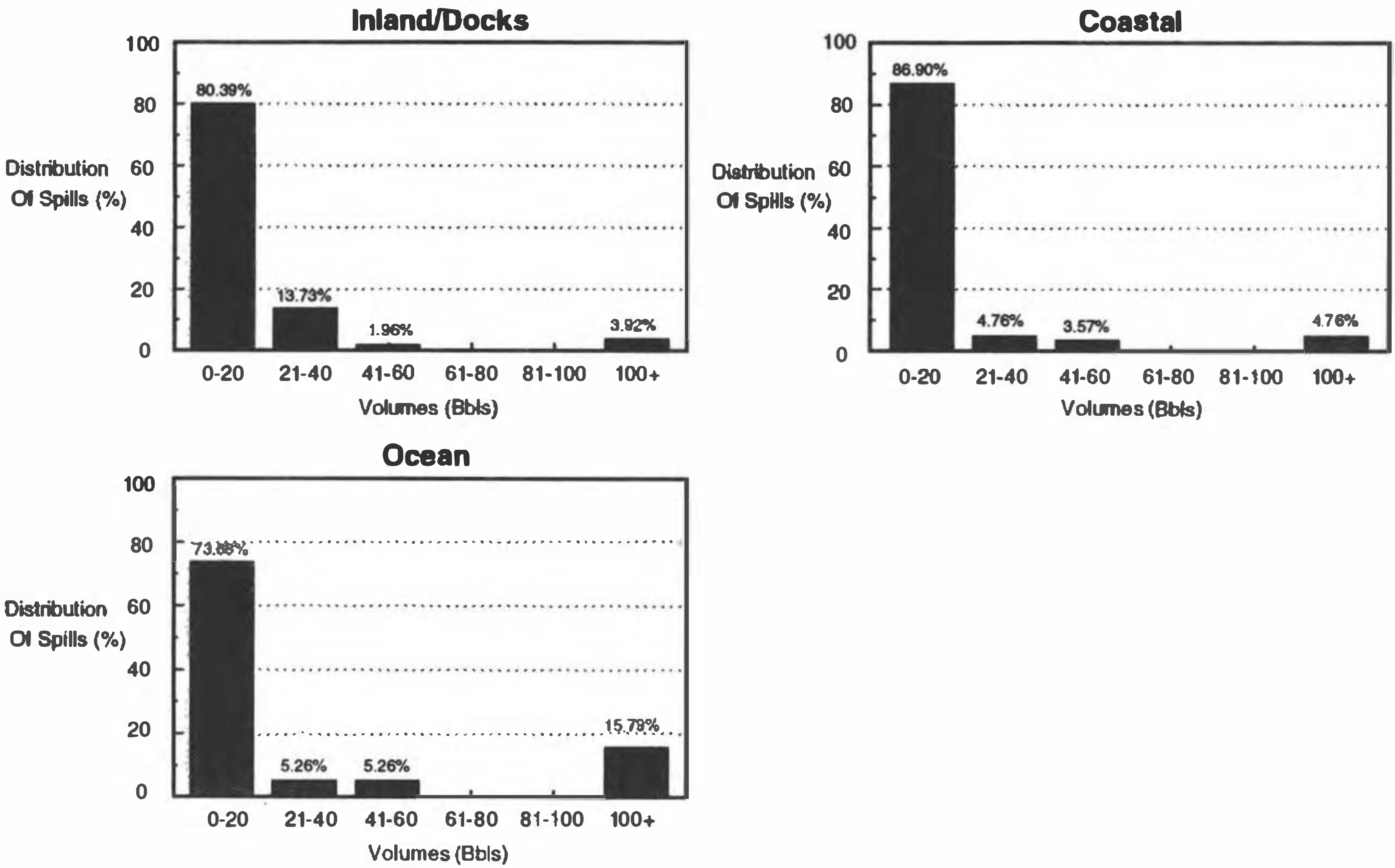
Location of Spill	Size of Spill	Number of Spills for Fill/Refill of 100 MMB	Number of Spills for Fill/Refill of 160 MMB
Ocean Spills	0 - 20 bbls 20 + bbls	0.29 0.09	0.46 0.14
Coastal Spills	0 - 20 bbls 20 + bbls	1.44 0.22	2.30 0.35
Inland/Dock Spills	0 - 20 bbls 20 + bbls	0.81 0.20	1.29 0.32
Total Spills	0 - 20 bbls 20 + bbls All sizes	2.54 0.51 3.05	4.05 0.81 4.86

Source: Coast Guard and Army Corps of Engineers data.

A different approach to calculating spill frequencies was reported in a recent study for the Port of Vancouver.[1] USCG data on vessel-related bulk liquid spills and port call data from the COE for five U.S. port areas between the years 1981 and 1989 were used to supplement data for Vancouver Harbor. Results for crude oil tankers in port areas showed an estimated 1.80 spills per 10,000 port calls. This estimate was larger than the spill rates derived in the Phase III EIS Appendix; predicted rates were 0.019 spills per 10,000 port calls in coastal waters (up to 50 miles from shore) and 0.44 spills per 10,000 port calls in ports and harbors.[2] Calculations in the Phase III EIS suggested that a 45,000-dead-weight-ton tanker with a nominal capacity of 320,000 barrels would need 313 port calls to supply 100 MMB of oil.[3] Using the results of the Vancouver study, 0.06 spills in ports would be expected for each 100 MMB of oil transported. Based on these assumptions, the estimate is much lower than the expected spill rates in Table 6.1-1, suggesting that the values in the table are conservative.

Further information on large spills is provided by an MMS study on estimated worldwide tanker spill rates.[4] The study addressed only spills of 1,000 barrels or more during the period 1974 to 1985. Total international transportation of crude oil was estimated at 107.8 billion barrels for this time period, and there were 97 reported spills offshore and 43 reported spills in harbors

Figure 6.1-1
Distribution of Foreign Flag Spill Volumes in the Gulf of Mexico



or at piers. These data correspond to spill rates of 0.090 and 0.040 spills per 100 MMB transported, respectively. For spills of 10,000 barrels or more, an estimated 0.055 spills per 100 MMB transported occur offshore and 0.016 spills per 100 MMB transported occur in harbors or at piers. These tanker spill rates are similar to rates derived in an earlier MMS study.[5] Although the MMS analyses focus on large spills, the results are consistent with data in Table 6.1-1, i.e., smaller spills have a higher frequency than larger spills and offshore spills have a higher frequency than spills in inland waters or harbors.

6.1.2 Terminals

Data from the USCG's Pollution Incident Reporting System (PIRS) for the period 1983 to 1986 provide historical oil spill rates for both bulk storage and bulk transfer operations at U.S. marine terminals.[6] According to PIRS, there were 831 oil spills from aboveground storage tanks at bulk transfer terminals during the four year period, or an average of about 208 spills per year. The total volume of oil spilled was 59,245 barrels, with an average spill size of 71.3 barrels. Based on the total capacity of aboveground storage tanks at bulk terminals of 486.9 MMB, DOE estimates that 0.43 spills per year would be expected for every one MMB of oil stored at a terminal. For purposes of this DEIS, this estimated spill rate is used to predict spills at DOE storage facilities at St. James, Liberty, and Pascagoula. The St. James and Pascagoula terminals would each have a storage capacity of 2 MMB, and the Liberty and Chevron/Pascagoula tankage facilities would each store 1.2 MMB.

For the years 1983 to 1986, the PIRS data show a total of 408 oil spills from U.S. marine bulk transfer operations. The total volume of oil spilled was 4,309 barrels, with an average spill size of 10.6 barrels. To approximate the total volume of crude oil and petroleum products moving across the docks during that period, total U.S. imports (less imports from Canada) were added to movements of Alaskan crude oil and transfers between Petroleum Administration for Defense Districts.[7] The result was a total volume of 12.4 billion barrels. Using these data to estimate future oil spill rates, 3.3 spills from terminal transfer operations would be expected for each 100 MMB moving across the docks during fill, refill, or distribution.

In the Phase III EIS, predicted spills from operations at a marine terminal were based on a fault tree analysis of similar systems and estimates of spill probabilities from diked and curbed areas.[8] The results showed a frequency of one spill per year and an average spill size of ten barrels. This average spill size is about the same as the estimate based on the PIRS historical data, and the spill rate is roughly comparable, considering that the period of fill or refill for a 100-MMB storage site is likely to last two or more years.

Published PIRS data do not provide spill size distributions for different sources of spills such as vessels, terminals, or pipelines. The size distribution of all oil spills, however, is provided for each year. These data indicate that spills of less than 10 gallons (0.24 barrels) represent about 40 percent of all spills whose size is reported, and spills of less than 100 gallons (2.4 barrels) represent about three-fourths. Because the calculated average spill size is likely to be affected by a few large, infrequent spills, the vast majority of spills are less than the average value.

6.1.3 Pipelines

According to PIRS data, there were about 450 to 600 reported oil spills per year from pipelines during the period 1977 to 1982.[9] There was a sharp decline to 166 spills in 1983 and fewer than 70 spills in each of the years 1984 to 1986. For predicting future SPR pipeline spill rates, it was assumed that national spill rates during the period 1983 to 1986 were representative. There were 326 pipeline oil spills reported in PIRS for this four-year period, and the average volume of oil spilled was 18.5 barrels per spill. Statistics on volume of liquid pipeline deliveries indicate a total of 42.4 billion barrels for the period; thus, for SPR deliveries of 250 MMB, 1.9 pipeline spills would be expected.[10] Expressed in terms of pipeline ton-miles, there were 2,266 billion ton-miles of crude oil and petroleum products transported in the period 1983 to 1986.[11] Based on a conversion factor of seven barrels per ton, the spill rate would be about 0.0021 spills per 100 MMB-miles. The expected number of spills during fill, refill, or distribution would depend on the respective pipeline lengths and volumes transported.

An earlier spill frequency study by Walter et al. (1985) gave somewhat higher results.[12] Using the DOT Liquid data base, the study showed that reported pipeline spills had declined from 506 spills in 1968 to 131 spills in 1982. For the period 1972 to 1979, the average annual number of spills was 257, and the calculated spill frequency was 0.48 spills per billion ton-miles or 0.0069 spills per 100 MMB-miles.

In contrast, a slightly lower estimate can be derived from data presented in the Phase III EIS. A pipeline spill rate of 0.00068 spills per mile per year was estimated based on DOT spill data from the early 1970s and Department of the Interior data on pipeline mileage. For filling the Big Hill site to a capacity of 140 MMB, it was assumed that the duration of use for the pipeline would be 3.58 years; thus, the pipeline spill rate would be 0.0024 spills per mile or 0.0017 spills per 100 MMB-miles.

Actual pipeline spill rates for the SPR system have been lower than expected. Only two reportable spills have occurred, and each was less than ten barrels.[13]

6.1.4 Storage Sites

SPR environmental reports for the four-year period from 1987 through 1990 present brief descriptions of all spills at the existing storage sites greater than one barrel, including both contained and uncontained spills.[14] Most spills did not enter waterways and none have resulted in environmental damage. Only three spills exceeded 100 barrels and 25 of 33 spills were less than ten barrels. Of the three spills larger than 100 barrels, all were related to piping at one site -- West Hackberry. For each of the years of SPR operation, the volume of oil spilled has been a small fraction of total throughput.

In order to compare spill rates from storage sites with spill rates from other sources, reportable spills, i.e., those that enter waterways, were identified. For the four-year period, there were four such spills, including two that were less than one barrel in size. The total amount of oil moved (received and transferred internally or sold) at the SPR sites during that period was 147.9 MMB, resulting in a spill rate of 2.7 spills per 100 MMB transferred.

6.1.5 Expected Spills at Candidate Sites

Table 6.1-2 summarizes the expected number of spills during fill or refill for each of the SPR candidate storage sites. Spills from vessels, bulk storage at terminals, bulk transfer at terminals, and storage sites are a function of the storage site capacity, and spills from pipelines are a function of both site capacity and pipeline length. For this analysis, it is expected that it will

Table 6.1-2
Expected Number of Spills During
Fill/Refill of Each Proposed Expansion Site

			Expected Number of Spills					
SPR Site	**Site Capacity**	**Pipeline Length (Miles)**	**Vessel**	**Bulk Storage at Terminal**	**Bulk Transfer at Terminal**	**Pipeline**	**Storage Site**	**Total**
Big Hill	100 MMB	24	3.04	0	3.29	0.05	2.70	9.1
Stratton Ridge	100 MMB	11	3.04	0	3.29	0.02	2.70	9.1
Weeks Island	160 MMB	67	4.85	1.71	5.26	0.23	4.33	16.4
Cote Blanche	160 MMB	60	4.85	1.71	5.26	0.20	4.33	16.4
Richton								
Alternative 1	160 MMB	200	4.85	2.73	5.26	0.67	4.33	17.8
Alternative 2	160 MMB	80	4.85	0	5.26	0.27	4.33	14.7
Alternative 3	160 MMB	83	4.85	1.71	5.26	0.28	4.33	16.4

take two years to fill an SPR expansion site. The Bill Hill and Stratton Ridge sites would not be filled via a DOE terminal, thus no spills from bulk storage at DOE terminals would be expected for those two sites (i.e., spills may occur at non-DOE private terminals, but such spills would not be incrementally affected by the proposed SPR expansion and thus are not within the scope of this DEIS). Oil to fill either the Weeks Island or Cote Blanche sites, however, would come via St. James Terminal, and 1.7 spills would be expected during storage at that terminal. There are three fill/refill alternatives for the Richton site that correspond to three drawdown scenarios. In the first fill alternative, oil would flow from the St. James Terminal through the Capline pipeline to new DOE tankage at Liberty (1.2 MMB) and through a new pipeline from Liberty to Richton; the expected number of spills from bulk storage at both St. James and Liberty would be 2.7. The second fill/refill alternative would involve oil being transported from Mobile. Because no oil would be stored at a DOE terminal under this alternative, there would be no expected spills from bulk storage at DOE terminals. In the third alternative, oil would come from the Pascagoula Terminal which would have the same bulk storage capacity as the St. James Terminal (2 MMB). As a result, the expected number of spills associated with bulk storage at the terminal under this alternative would be the same as for Weeks Island and Cote Blanche (1.7).

During drawdown, SPR oil would be transported by DOE pipelines to refineries, commercial pipelines, or marine terminals. Based on assumptions about refining demand and projected non-SPR oil shipments, the amount of SPR oil moving across the docks (i.e., bulk transfer) at marine terminals may be estimated. In this DEIS, hypothetical distribution scenarios were analyzed for both the Seaway and Capline Complexes.

For the Seaway Complex, under the 270-day drawdown criterion, the expected number of storage site, pipeline, terminal, and vessel spills related to the Big Hill expansion site during distribution would be essentially the same as the expected number of spills during fill or refill (see Table 6.1-2). The 24-mile pipeline from the Sun Terminal to the existing Big Hill site would be used for both fill and drawdown. Under a 180-day drawdown criterion, however, distribution would require a new pipeline to East Houston, and one possible pipeline route would cross Trinity Bay. Trinity Bay supports a large amount of oil and gas development, and the potential exists for pipeline construction operations to puncture one of the oil and gas pipelines that already traverse the Bay floor. Precautions that would be taken during new pipeline construction to avoid existing pipelines, however, would make such an accidental rupture very unlikely.

Expected spills for 180-day drawdown distribution scenarios for Big Hill and Stratton Ridge are compared to a current Seaway distribution scenario in Table 6.1-3. Because distribution of Bryan Mound oil would change under an expanded SPR scenario, the net effect of developing either one of these sites would be the difference between expected spills during distribution of oil from both the new site and Bryan Mound and expected spills during distribution from Bryan Mound alone under the current scenario. In the current scenario, 30 percent of the Bryan Mound oil would move across the docks at the Phillips Terminal, 70 percent would be transferred by pipeline to Texas City, and of the amount arriving at Texas City, about 30 percent would move across the docks at the ARCO Terminal.

In the expanded Big Hill distribution scenario (180-day drawdown), it is assumed that 100 MMB is transported through the new pipeline and that 40 percent of this oil moves across the docks at the OTTI Terminal. Of the oil stored at Bryan Mound, 35 percent would move across the docks at the Phillips Terminal at Freeport, 25 percent would be transferred by pipeline to Texas City, and the remainder would move through the reconverted Seaway pipeline. For the

Table 6.1-3
Expected Number of Spills During Drawdown in the Seaway Complex
Given Expansion Site Choice

Altenative Scenarios		Percentage of Oil Through Pipeline	Pipeline Length (Miles)	Percentage of Oil Across the Docks	Expected Number of Spills					
					Storage Site	Pipeline	Bulk Storage at Terminal	Bulk Transfer at Terminal	Vessel	Total
Current Scenario										
Bryan Mound	226 MMB	30% to Freeport	4	30%	6.11	0.01	0	2.23	2.06	13.4
		70% to Texas City	46	20%		0.15	0	1.49	1.37	
Big Hill Expansion Scenario										
Big Hill	100 MMB	100% to East Houston	64	40%	2.70	0.13	0	1.32	1.22	5.4
Bryan Mound	226 MMB[a]	35% to Freeport	4	35%	6.11	0.01	0	2.61	2.41	11.2
		25% to Texas City	46	0%		0.05	0	-	-	
Stratton Ridge Scenario										
Stratton Ridge	100 MMB	100% to Texas City	37	40%	2.70	0.08	0	1.32	1.22	5.3
Bryan Mound	226 MMB[a]	35% to Freeport	4	35%	6.11	0.01	0	2.61	2.41	11.2
		25% to Texas City	46	0%		0.05	0	-	-	

[a] Assumes 40 percent transferred through Seaway pipeline.

Stratton Ridge site, the distribution scenario would involve movement of 100 MMB by pipeline to Texas City, and 40 percent of this amount would move across the docks at the ARCO Terminal. Under this scenario, oil from Bryan Mound would follow the same distribution plan as in the Big Hill scenario.

Table 6.1-4 shows the expected number of oil spills during drawdown in the Capline Complex for each candidate expansion site choice. Although both a 180-day drawdown and a 270-day drawdown are considered for each site, Table 6.1-4 only provides results for the more conservative time-frame, i.e. that which yields the greater number of expected spills.

It is assumed that current distribution from Bayou Choctaw and Weeks Island would not change if either the Weeks Island site or Cote Blanche site is chosen. Under a 180-day drawdown criterion, it is further assumed that 50 percent of the oil stored at either a new Weeks Island or Cote Blanche site would move across the docks at the St. James Terminal and 50 percent would be distributed via LOCAP to refineries in southern Louisiana and via the Capline pipeline to refineries in the Midwest. Under the 270-day drawdown criterion, a greater amount of oil would be expected to move up the Capline pipeline, and fewer total spills would be expected. Therefore, the figures in Table 6.1-4 for Weeks Island and Cote Blanche are for the 180-day drawdown scenario, which yields a greater number of expected spills.

For the Richton site, there are three distribution alternatives, as shown in Table 6.1-4. In the first alternative, the 180-day drawdown yields a higher expected number of spills. About 65 percent of the oil would go via pipeline to Liberty (DOE tankage), where it would be routed through the Capline pipeline. About 27 percent would move across commercial docks (including DOE tankage) at Pascagoula, and the remainder would be refined in Pascagoula. The increase in oil through the Capline would necessitate an additional dock at the St. James Terminal to account for 36 MMB displaced from the existing Bayou Choctaw and/or Weeks Island sites. Thus, more oil must travel by ship, adding expected spills from bulk storage at terminals, bulk transfer at terminals, and vessels. It is assumed that current drawdown from Bayou Choctaw and/or Weeks Island would not change in the second and third Richton drawdown alternatives. The second alternative, also shown for a 180-day drawdown, would involve roughly a third of the oil going across commercial docks at Mobile, and the other two-thirds going to Pascagoula (DOE tankage plus terminal), where about 50 percent would go across the docks and the rest would be refined. (Under a 270-day drawdown, half of the oil would go to Mobile and half to Pascagoula.) The 270-day drawdown is the more conservative in the third scenario. In this scenario all of the oil would go to Pascagoula, and about 44 percent of it would go an additional 4.5 miles to the Chevron refinery and dock. The remainder would go an additional mile to the Greenwood Island docks.

6.2 Brine Spill/Release Scenarios and Probabilities

The leaching, filling, and maintenance of new oil storage caverns in salt domes results in the generation of large quantities of brine. During leaching, approximately seven barrels of brine would be generated for every one barrel of cavern storage space that is produced. Filling the new caverns with oil after leaching is completed would then displace almost another cavern-full of brine to the surface. After fill, a slow advancement of cavern walls resulting in slight reductions in cavern volume (i.e., cavern creep) would displace, on an irregular basis, relatively small quantities of brine that remain in the cavern. An estimate of the total quantities of brine that

Table 6.1-4
Expected Number of Spills During Drawdown in the Capline Complex
Given Expansion Site Choice

				Expected Number of Spills					
Altenative Scenarios	**Percentage of Oil Through Pipeline**	**Pipeline Length (Miles)**	**Percentage of Oil Across the Docks**	**Storage Site**	**Pipeline**	**Bulk Storage at Terminal**	**Bulk Transfer at Terminal**	**Vessel**	**Total**
Weeks Island Scenario 160 MMB	100% to St. James	67	50%	4.33	0.23	0.42	2.63	2.43	10.0
Cote Blanche Scenario 160 MMB	100% to St. James	60	50%	4.33	0.20	0.42	2.63	2.43	10.0
Richton Scenario 160 MMB									
Alternative 1 (180-day drawdown)	65% to Liberty 35% to Pascagoula Reroute of existing SPR oil[a]	118 83	0% 19%	4.33	0.26 0.10	0.25 0.67 0.42	-- 1.00 1.18	-- 0.92 1.09	10.2
Alternative 2 (180-day drawdown)	33% to Mobile 67% to Pascagoula	70 83	28% 51%	4.33	0.08 0.19	0 0.67	1.47 2.68	1.36 2.48	13.3
Alternative 3 (270-day drawdown)	100% to Pascagoula 44% to Chevron 56% to Greenwood	83 4.5 1	100%	4.33	0.28 0.01 0.00	0.63	5.26	4.86	15.4

[a]In Alternative 1, oil from Richton would go up the Capline pipeline and displace 200 MBD of oil from Bayou Choctaw and/or the existing Weeks Island site. This displaced oil (36 MMB total) would have to go over the docks at the expanded St. James Terminal. Therefore, spills from additional terminal and vessel handling are added to the spill probability presented.

would be generated during the construction and operation of each of the candidate sites is provided in Table 6.2-1.

Table 6.2-1
Estimate of Brine Generation Volumes at Candidate Sites

Candidate Site	Incremental Oil Storage Capacity (MMB)	Brine Generated During Leaching (MMB)	Brine Generated During Fill and Storage (MMB)	Total Brine Generation (MMB)[1]
Big Hill	100	780	100	880
Stratton Ridge	100	780	100	880
Weeks Island	160	1,250	160	1,410
Cote Blanche	160	1,250	160	1,410
Richton	160	1,250	160	1,410

[1] Total volume does not account for the additional quantity of brine that would be generated during a refill (i.e., the displacement of brine remaining in the cavern after drawdown).

After brine is displaced to the surface, it is routed to a series of anhydrite settling ponds for the removal of suspended solids before it is disposed. The brine goes first to a 250,000 barrel capacity anhydrite settling pond, next to a 100,000 barrel oil recovery pond, and finally to a 100,000 barrel brine disposal pond. Historically, DOE has used two methods to dispose of brine: discharge to the Gulf of Mexico and underground injection. The vast majority (94 percent) of the brine generated by the SPR in 1990 was discharged to the Gulf, while the remaining six percent was injected underground. However, if underground injection is selected as a brine disposal alternative at Weeks Island or Cote Blanche, or if Richton is developed as assessed, a substantially larger fraction of the brine generated from the proposed expansion could be disposed via underground injection.

Separate from the purposeful discharge of brine to either the Gulf or deep underground formations, there is a potential for accidental releases of brine to the environment. In particular, brine could be accidentally released to surface water or shallow groundwater from: (1) pipelines and site piping; (2) on-site brine ponds; and (3) injection well operations. The following sections describe possible release scenarios and probabilities for each of these potential sources.

6.2.1 Pipelines and Site Piping

As outlined in Chapters 2 and 3 of this DEIS, brine generated from the proposed SPR expansion would be pumped through a complex pipeline system before being finally released into the Gulf or deep underground formations. Above each cavern, brine would be brought to the surface by wells situated on diked pads and then discharged to an on-site settling pond system. From there, the brine would be pumped via underground pipeline either out to the Gulf or to off-site disposal wells. Depending on the site, the brine discharge pipeline to the Gulf of Mexico would be either 36 or 48 inches in diameter and between 16 miles and 96 miles long. At Weeks Island and Cote Blanche, where underground injection is being considered as a brine disposal alternative, the pipeline to the injection wells will be 42 inches in outer diameter and 4.8 miles long. A 24-inch pipeline would be required for underground injection of brine at Richton following conversion of the dual-purpose pipeline from blanket oil during leaching to brine disposal.

Table 6.2-2 summarizes the frequency and magnitude of brine spills from pipelines at existing SPR sites during the period 1982 through 1990. As shown, the number of brine spills greater than a barrel has ranged from 6 to 44 per year. The majority of these spills were due to corrosion/erosion of the brine pipeline, although gasket, flange, valve, weld, and other component failures were also common. Most of the spills have been small — 96 percent of the spills have been about 75 barrels, on average. However, for the nine-year period from 1982 through 1990, there have been four particularly large brine spills: two spills that totaled 606,000 barrels at Bryan Mound and West Hackberry in 1985, a 825,000-barrel spill at Bryan Mound in 1989, and a 74,000-barrel spill at Bryan Mound in 1990. The total volume of brine spilled each year has been only a small fraction (0.04 percent, on average) of the total brine transferred.

Table 6.2-2
Historical Brine Spills from Pipeline Systems at Existing SPR Sites

Year	Total # of Brine Spills > 1 bbl	Volume of Brine Spilled (bbl)	Volume of Brine Transferred in Pipeline System (MMB)	% Brine Spilled of Total Throughput
1982	43	2,792	558	0.0005
1983	44	1,632	816	0.0002
1984	17	1,975	558	0.0004
1985	16	607,282	464	0.1
1986	6	1,734	87	0.002
1987	22	608	212	0.0003
1988	6	159	> 6.3	0.00001
1989	17	825,500	591	0.14
1990	12	74,650	439	0.02
Average	20	168,480	415	0.04

Source: SPR Annual Environmental Monitoring Reports.

Assuming that the past spill statistics represent spill events that may occur in the future, the data in Table 6.2-2 can be used to estimate the likely number and size of brine spills associated with the proposed expansion. This appears to be a reasonable, though possibly conservative, assumption because the brine handling and pipeline systems at the expansion sites would be fundamentally the same, if not upgraded, compared to those employed previously. Considering that Table 6.2-2 covers the operations at five SPR sites (brine historically has not been generated at Weeks Island, the sixth SPR site active during this period), the data indicate that there will be roughly one to nine spills of brine per site per year (6 to 44 spills per year divided by five sites). Almost all of these spills would be expected to be small, on the order of 75 barrels. Much larger spills, such as 74,000 barrels or more, appear very unlikely but also may occur over the duration of expansion activities. Ignoring any differences in site-specific conditions that may influence the frequency and magnitude of brine spills, historical spill data indicate that there would be 0.001 spills of 74,000 barrels or more per million barrels of brine transferred (four spills of this magnitude divided by 3,731 MMB of brine transferred). Applying this factor to the total brine generation volumes in Table 6.2-1, it appears that proposed operations at Big Hill or Stratton Ridge would result in one spill of 74,000 barrels or more, and that Weeks Island, Cote Blanche, or Richton operations would result in two brine spills of this magnitude. These spills, both the large ones and small ones, could occur anywhere along the pipeline lengths at these sites.

6.2.2 Brine Ponds

While brine ponds at existing SPR sites vary in their construction and uses, all of the brine pond systems associated with the expansion would be patterned after the Big Hill brine ponds. At that site, the existing brine pond system consists of one anhydrite settling pond with a 250,000-barrel capacity, a 100,000-barrel oil recovery pond, and another 100,000-barrel brine disposal pond. If Big Hill is selected as one of the expansion sites, another anhydrite pond would be constructed and the existing anhydrite pond will be drained and capped with the settled solids buried in place.

Releases from the brine ponds could occur either due to failures of the liner and underdrain systems, or due to overtopping and failure of surrounding dikes. Either event could result in the contamination of underlying groundwater and/or nearby surface waters. This contamination could be allowed to continue and migrate from the source if undetected by environmental monitoring. The generally high permeability of the sandy surface soils at the candidate expansion sites, as well as the high mobility of brine constituents (e.g., chloride) in the environment, would be very conducive to contaminant migration if such a release were not contained.

Several brine pond releases have, in fact, been observed at SPR sites in the past, although none have been observed at the Big Hill ponds. For example, brine pond leakage appears to be occurring at Bryan Mound, West Hackberry, Bayou Choctaw, and Sulphur Mines. At Bryan Mound, the concrete basin underlying the brine pond is cracked, liner damage is suspected, and monitoring wells show brine contamination of shallow and deep aquifers. At West Hackberry, the concrete pond is cracked, the pond's liner is torn, and elevated salinity levels have been detected in downgradient groundwater.[15] In response to these problems at West Hackberry, DOE is conducting a detailed contamination assessment and analysis of remedial alternatives.[16] Finally, liquids collected from the underdrain beneath the Sulphur Mines brine pond have been found to contain elevated salinities (up to 210 ppt), indicative of brine migration.[17]

In summary, brine ponds that would be used at the SPR expansion sites would be better designed, monitored, and maintained than some of the existing ponds that are known to be leaking. Past experience, however, demonstrates that releases from brine ponds at the expansion sites may occur. If they do occur, it appears most likely that the releases would involve chronic, low-level seepage into groundwater. Sudden large spills due to overtopping and dike failure are less likely.

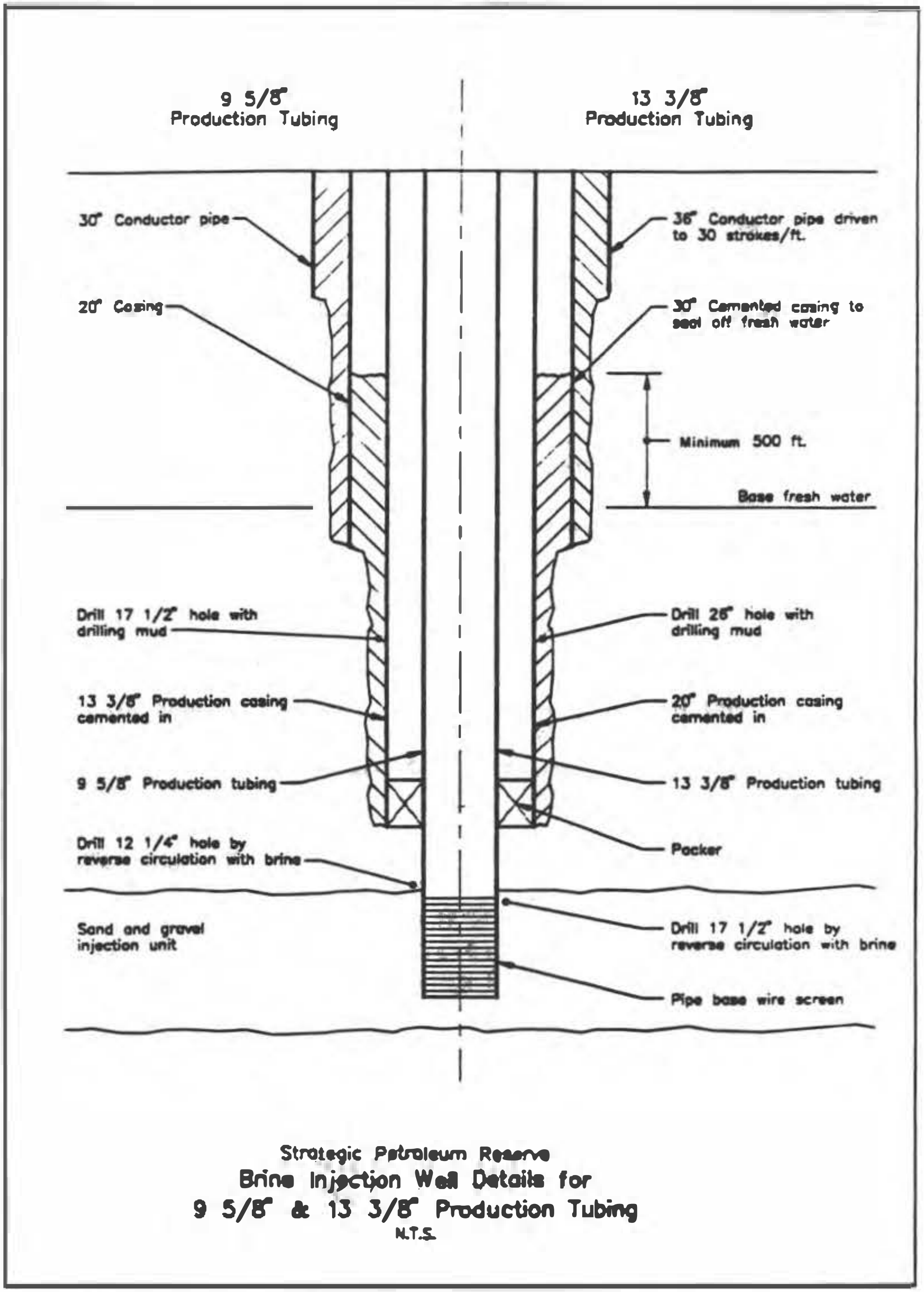
6.2.3 Injection Wells

As described in Chapter 3, deep underground injection is being considered as a brine disposal alternative at Weeks Island, Cote Blanche, and Richton. At Weeks Island or Cote Blanche, the injection system would include up to 25 injection wells spaced 1,000 feet apart along a pipeline that parallels the existing crude oil pipeline to St. James. Each well, positioned on a 180-foot by 180-foot well pad, would be drilled to a total depth of more than 1,200 feet and would be outfitted with standard equipment for Class II injection wells. This equipment would include surface casing set with cement down to a depth of 800 feet, long-string (or production) casing, a long-string casing/borehole annulus cemented completely to the land surface, injection tubing, and a packer (see Figure 6.2-1). The injection system at Richton would include 15 injection wells spaced 1,000 feet apart along the blanket oil pipeline which intersects the Hess 10-inch pipeline (the closest well would be approximately 10.6 miles west-northwest from the Richton site). Each well would be drilled to a total depth of about 5,000 feet and would be designed in the same basic manner as the proposed Weeks Island and Cote Blanche wells (i.e., surface casing set with cement through the base of fresh water, long-string casing cemented to the land surface, and injection tubing set on a packer immediately above the injection zone).

While injection well failures and subsequent releases of brine to shallow groundwater zones could occur, these releases would be possible only if several independent events occurred at the same time and went undetected. Specifically, there would have to be a tubing or packer leak, a leak in the long-string casing that would permit brine to enter the long-string casing/borehole annulus (the space between the casing and the borehole), deterioration of the cement in this annulus such that brine could flow upward inside the annulus to the surface casing, and then finally, a leak in the surface casing and deterioration of the surrounding cement. Throughout the SPR's history of brine injection operations, there has not been a single documented well failure resulting in the release of brine to shallow groundwater. Such failures, however, have been observed in Class II injection wells used by private industry to dispose of brine (i.e., produced water) generated from the production of oil and gas. Based on a review of well failure frequency data from 132 oil and gas fields that inject 12 percent of the nation's produced water, the American Petroleum Institute (API) has estimated the upper bound for potential contamination of shallow freshwater zones from injection well failures to be on the order of 1×10^{-6} events per well-year, when surface casing adequately covers these shallow zones (as will be the case for the proposed SPR wells).[18] That is, API estimates that the chance of an injection well failure resulting in shallow groundwater contamination is 1 in 1,000,000 for every year that the injection well operates. The SPR wells are likely to inject brine at a substantially greater rate than typical Class II injection wells in the oil and gas industry (the Weeks Island or Cote Blanche wells, for example, would inject 50,000 barrels per day, whereas typical industrial wells inject less than 3,000 barrels per day),[19] and thus may be more likely to experience a failure. Nevertheless, these API estimates illustrate that the probability of shallow groundwater contamination due to a well failure is very small.

Other scenarios in which injection well operations could result in the contamination of shallow freshwater zones include: (1) the upward migration of brine or natural saline formation

Figure 6.2-1
Typical Class II Injection Well Design



Source: Tom Magorian, ACRES

fluids through existing fractures or faults; (2) the fracturing of aquitards (an area of low permeability adjacent to an aquifer) that naturally separate fresh and saline groundwaters; and (3) the upward flow of brine or natural saline formation fluids through unplugged abandoned wells that penetrate the injection formation. While no quantitative estimates of the probabilities of these release scenarios are available, DOE believes that the possibility of these events is very remote, due to the engineering design and operational controls outlined in Chapter 8. For example, injection pressures and rates will be limited to levels that are safely below fracturing thresholds for receiving formations. In addition, in accordance with Class II injection well permit requirements, the area within a quarter mile around each injection well will be examined for the presence of abandoned wells. Any abandoned wells that are found will then have to be evaluated and, if necessary, properly plugged to make sure they cannot serve as a conduit for upward flow.

6.3 Fire Scenarios and Historical Fire Occurrences

In 1990, DOE performed an independent reevaluation of SPR Drawdown-Critical or Mission Essential systems and facilities in order to identify any needed upgrades to the SPR's fire protection program and to assess the need for any new fixed fire protection systems. The conclusion was reached that there are no known fire protection "show-stopper" or "eminent-danger" scenarios where a credible fire will adversely impact the SPR's mission. The SPR's fire protection program is designed to limit fire risk to the lowest practical limit.[20]

Discussed below are three possible fire scenarios: a well-pad accident, a tank fire, and a pump fire. Although the consequences of the three fire scenarios described are potentially serious, the probability of their occurrence is extremely small. The availability of both automatically activated and manually activated fire protection and shutdown systems, as detailed in section 8.2.2.3 of this DEIS, would likely extinguish fires before severe consequences occurred.

6.3.1 Well-pad Accident

The caverns used for oil storage are maintained under pressure, and therefore, a well-pad accident would have severe consequences. The only reportable fire at an SPR site that resulted in a fatality occurred in 1978, at the West Hackberry site, and was caused by such a well-pad accident. As part of a workover procedure, contractors were pulling casing out of a well. After pulling 14 joints of casing out of the hole, the mud from within the casing began flowing from the top of the casing into the hole. The mud and a packer, previously set in the lower sections of the casing, were forced up from the inside of the casing to the surface by pressure from below. Workers on the rig could not control the flow of the mud from the casing. The flow continued unchecked until the packer blew out of the casing followed by a flow of oil. An oil mist formed from the flow of oil was drawn into the air manifold intakes of the diesel engine on the rig and nearby engines causing them to overspeed. An explosion and fire occurred while two employees were still attempting to shut down the rig engine; both men were severely burned, and one later died from his injuries.[21]

The immediate cause of the accident appeared to be a poor packer seat in the casing. In addition, employees failed to follow the written workover procedure (e.g., depressurize the well prior to workover), there was an inadequate safety valve on the rig, and the site was in the construction phase so the full complement of emergency response equipment was not yet on the site. Since the time of this accident, new policies and procedures have been implemented to prevent a similar occurrence in the future.[22]

6.3.2 Tank Fire

The crude oil surge tank at Big Hill is of the double deck, open top, floating pontoon roof design and is equipped with a catenary design foam system for protection of the roof-to-shell seal area. Any involvement of this tank with fire would normally occur in the seal area; initial response should include determination of the extent of involvement of the tank with fire, and activation of the fixed foam system.[23]

In the unlikely event of a fully involved tank, consideration should be given to the possibilities of a "boil over." This could occur as heavy residuals accumulate and begin sinking towards the tank bottom that may contain water or water-oil emulsion. The result of the super heated residuals contacting the water could be "boil over." The contents of the tank could then erupt into an extremely violent, quickly expanding steam-oil froth, and send a fire ball hundreds of feet into the air and project burning oil over the sides of the tank for several hundred feet or more.[24]

In order to extinguish a fully involved tank, foam applications would be applied from ground level. In the example of a tank with a 100-foot diameter, a minimum application rate of about 790 gallons per minute would be required for about 55 minutes; such an application would require about 43,000 gallons of foam. In such a scenario, activation of the raw water injection system would release large amounts of slightly saline water at the site that could potentially reach the groundwater or surface water in the site vicinity.[25]

6.3.3 Pump Fire

The pump pad areas have many flanges, valves, and gaskets that are often manually controlled and offer the opportunity for human error. For example, valves may be left in the wrong orientation or bolts or screws may be left loose. Such error can lead to leaks and/or fires.[26]

Pumps, in general, can be shut off from a variety of locations. Once a pump or a leak is shut down, the likelihood of a fire is dramatically decreased as the source of fuel for a fire is no longer available. The Fire Safety Emergency Shutdown system automatically shuts down any area were there is a leak or a fire. Specific areas of the site can also be shutdown from the Operations Control Room or from various locations around the site. For example, if there is a leak or a fire at a specific cavern during oil fill, all pumps and valves associated with that cavern and the pipelines leading to and from it would be shut down without anyone having to go to the source of the problem. Such mechanisms ensure that a leak or a fire can be quickly contained to the initial starting point and prevent potential injury during shutdown.[27] In the event of a loss of electrical power, manual shutdown is possible.

The crude oil pumps and related pumping facilities would be protected by an automatic foam deluge system. When properly maintained, the foam system would significantly reduce the possibility of a major fire in this area. The foam deluge system would be activated by ultraviolet/infrared detectors and can come into effect in a matter of seconds. The foam deluge would quickly suppress, extinguish, and blanket pooled ground fire associated with a crude oil release. The foam deluge would contain but not extinguish three-dimensional fires[a] associated with the pump seal or piping.[28]

The probability of the occurrence of a pump fire is highly unlikely; such a fire has never occurred on an SPR site.

6.4 Risk of Hurricanes and Flooding

Hurricanes and other tropical cyclones are most prevalent in the months of August and September. High winds associated with tropical cyclones and the tornadoes that sometimes accompany such storms may cause extensive damage to frame structures. As a storm approaches the coast, there is often a rapid rise in coastal water level, or storm surge, caused by strong onshore winds. Torrential rains, flooding, and wave action can also result in damage to or loss of structures and habitats. Tropical cyclones are classified according to their wind speeds; a tropical storm generates winds of 17-33 meters per second and a hurricane generates winds of 33 meters per second or greater.[29] For the approximately 500 miles of the Texas-Louisiana-Mississippi coastline east of Corpus Christi, there have been an average of about 1.75 landfalls of tropical cyclones per 10 miles per 100 years.[30] The maximum storm scenario can be approximated by the passage of hurricane Camille, which struck the coast of Mississippi in 1969. The maximum recorded wave height was 23.5 meters; the peak gust was measured at 64 meters per second; and the storm surge tide was recorded at 7.5 meters.[31]

Extratropical storms are more common and are associated with both frontal and convective activity. Frontal passages across the Gulf Coast are sometimes accompanied by gale force winds and heavy rains. Storms associated with frontal activity are most common in December, January, and February; approximately nine passages occur per month with an average duration of approximately 26 hours.[32] Storms resulting from convective activity are most frequent in the summer months. Severe thunderstorms accompanied by high winds, hail, or tornadoes occur infrequently.

SPR sites are designed so that floods will not impact operations. At the existing SPR sites, 100-year floods have occurred and the only impact has been that access to a site was temporarily precluded due to flooding on access roads in surrounding lowlands. In one instance at Bryan Mound, high winds damaged trailers and other temporary buildings. Further impacts have been avoided by designing equipment to be resistant to damage from flooding and by implementing the storm preparation procedures detailed in section 8.2.2.5.

Big Hill. The probability that a tropical storm would occur in any one year in the 50-mile stretch of coast east of the Big Hill area is about 14 percent and the risk of a hurricane is eight percent.[33] In 1989, a total of 72 thunderstorms occurred in nearby Port Arthur; the greatest frequency is in June and July (13 and 17 occurrences, respectively).[34] The average number of thunderstorms per year in the region is 66.2, and peak activity is usually in July and August, with an average of 13.6 and 12.2 occurrences, respectively. The Big Hill salt dome rises to about eleven meters above msl, an elevation that is sufficient to maintain a minimum risk of flooding,

[a] A three-dimensional fire is one which generally includes vertical as well as one or more horizontal surfaces. It generally involves materials in motion, such as pouring, running, or dripping flammable liquids.

even during 100-year storm surges.[35] Although the site would be above flood level in even the most severe hurricanes, flood surges could temporarily block access to the site.[36]

Stratton Ridge. Tropical cyclone statistics, based on data gathered from Hobby Field near Houston, indicate that a hurricane can be expected about every seven to ten years.[37] In 1989, a total of 53 thunderstorms occurred in the nearby Houston area, and thunderstorm frequency reached a peak during July and November (eight and seven occurrences, respectively). The average number of thunderstorms per year is 60.7 and peak activity usually occurs in July and August, with an average of 10.6 and 10.1 occurrences, respectively.[38] The elevation of the Stratton Ridge site varies between three and four and one-half meters above msl. The 100-year storm surge elevation predicted at Stratton Ridge is about one meter, and the maximum surge predicted is four meters.[39] Flooding above an elevation of three meters can be expected approximately 2.5 times every 100 years. As a result, additional subsidence could present flooding problems in the future, especially during extreme storm events.[40] The flood generated by hurricane Carla in 1961 was close to the 100-year flood event and inundated the area around Stratton Ridge.

Weeks Island. The risk of a tropical storm in the 50-mile strip of coastline that includes Weeks Island and that lies roughly between New Iberia and Atchafalaya Bay is 13 percent and the risk of a hurricane is six percent.[41] In 1989, a total of 83 thunderstorms occurred in the nearby Baton Rouge area; with the highest level of thunderstorm activity in June and July (17 occurrences each month). The average number of thunderstorms per year is 71.3, and the peak of activity is usually in July and August with an average of 15.2 and 12.7 occurrences, respectively.[42] Coastal effects are more pronounced at this site compared to the Texas sites; the area experiences higher wind speeds and fewer stable periods because of coastal proximity. Storm surges of 7.5 meters have been recorded.[43] The Weeks Island salt dome has a peak elevation of approximately 52 meters above msl and is the highest point in all of southern Louisiana. The area on the salt dome for proposed SPR cavern development is significantly above the surrounding marshland, with the exception of the outside cavern row.[44] The surface elevation surrounding the cavern development site varies from 1.5 to 23 meters above msl, and fill would be required to raise the low elevations significantly above the predicted 100-year storm surge.[45] This perimeter area of the salt dome is in the 100-year floodplain and would experience coastal floods with wave action in the event of a hurricane. On the eastern side of Weeks Island, the area for SPR cavern development, the 100-year base flood elevation was determined to be four meters. This side of the island would likely be more protected from flooding than the west and south, as it is leeward from those waters coming across Vermilion Bay and Weeks Bay.

St. James Terminal. The risk of a tropical storm in the 50-mile strip of coastline that includes the St. James site and that extends roughly from Atchafalaya Bay to the Houma area is 18 percent and the risk of a hurricane is nine percent.[46] In 1989, a total of 76 thunderstorms occurred in the nearby New Orleans area, with the peak of activity in June and July (17 and 14 days per month, respectively). The average yearly total of thunderstorms is 68.6, and the usual peak of activity is during July and August, with an average of 15.0 and 12.9 occurrences, respectively.[47] The terminal is within the Mississippi river floodplain and is six meters above msl.

Cote Blanche. Tropical storm and thunderstorm activity closely parallel that of Weeks Island because of the proximity of the sites. The surface elevation of the Cote Blanche salt dome is 23 meters above msl. This surface elevation is sufficient so that flooding at the site is of little concern even during the most severe hurricanes. An exception would be the marshy areas on the southeast side of the salt dome that could potentially flood; however, this would not affect the area proposed for cavern development. In the event of a major flood, access to the site could be impeded.

Richton. From 1886 to 1984, 45 tropical cyclones entered Mississippi, virtually all of which would have affected weather conditions in the Richton area.[48] Of the 45 tropical cyclones, 25 were classified as hurricanes when landfall was reached, although none produced hurricane force winds in the Richton area. At least two of the hurricanes (Camille and Frederic) caused much damage to the coast, but they left the Richton area only "lightly damaged."[49] In 1989, a total of 71 thunderstorms occurred in the Jackson area, with peak activity in June and July (16 and 11 days per month, respectively.)[50] The average yearly total of thunderstorms is 66.7, and normal peak activity occurs in July and August, with 12.5 and 10.7 occurrences, respectively. Elevations within five miles of the dome range from 50 to 90 meters above msl. Although localized (in the vicinity, but not on the dome itself) flooding may result from either summer thunderstorms or hurricanes, the largest and most widespread flooding usually occurs in the winter or early spring, following a frontal storm that lasts several days.[51] A 24-hour rainfall of five to six inches over a large area of the Pascagoula River Basin produces severe flooding, and three to four inches will produce local flooding of small tributaries.[52]

6.5 Hazardous Chemical Spills and Releases

The volumes of hazardous chemicals used at existing SPR sites are relatively low. In the history of the program, spills of hazardous chemicals have been rare. The purpose of this section is to describe the potential for accidents resulting from improper storage, handling, or transport. Human error, container failure, or equipment malfunction would also be sources for accidents. Information and examples have been taken from the existing Big Hill site and are used below as indicative of how chemicals would be used in the construction and operation of new sites.

Table 6.5-1 presents a list of the hazardous chemicals commonly used at SPR sites. Of the substances listed in this table, those that are discussed in more detail in this section are AFFF, ammonium bisulfite, Visco 1152 biocide, and various pesticides.[53] These substances have the greatest potential for causing impacts to human health or the environment because they are used in high volumes or are used frequently or have particularly hazardous characteristics. The other materials listed in Table 6.5-1 are used in relatively low volumes, primarily in on-site laboratories as analytical reagents.

6.5.1 Uses of Hazardous Materials and Characteristics

AFFF, of which the active ingredient is butylcarbitol, is a compound used to extinguish fires. AFFF is used throughout the SPR because it is effective in covering and extinguishing hydrocarbon liquid-based fires. AFFF is maintained on the site in total quantities of 4,000 to 5,000 gallons in fixed systems and 35 to 55 gallons in portable fire systems.[54]

Pesticides (e.g., insecticides and rodenticides) and herbicides are used on the site in specific areas and usually in small quantities. Pesticides used at Big Hill are applied both by site and contractor personnel. Restricted-use pesticides (i.e., pesticides that according to EPA must be applied only by a certified pesticide applicator or persons directly supervised by a certified

Table 6.5-1
List of Hazardous Chemicals Commonly Used at SPR Sites*

1,1,1-Trichloroethane
1,1,2-Trichloro-1,2,2,-Trifluoroethane (Freon 113)
Acetylenic alcohols
Acrylate
AFFF - Aqueous film forming foam
Ammonium bisulfite
Ammonium chloride
Ammonium nitrate fertilizer
Ammonium persulfate
Bromotrifluoromethane (Halon 1301)
Butylcarbitol
Calgon, cat-floc and polymer
Carbethoxy malathion
Compressed gas (except helium, neon, argon, krypton, xenon)
Crude oil, petroleum, flammable and combustible liquid
Diesel fuel
Epoxy grout
Ethylene glycol diethyl (antifreeze)
Gasoline
Hazardous waste, liquid or solid, N.O.S. including toluene, oils, xylene
Hydrochloric acid mixture
Ink, flammable or combustible
Isopropylamine salt of glyphosphate
Oil, flammable and combustible
Paint, flammable or combustible including mineral spirits toluene, acetone, xylene
Phosphoric acid
Propane or liquefied petroleum gas
Methyl ethyl ketone (thinners)
Silica, crystalline-quartz
Small arms ammunition
Visco 1152 biocide (alkoxy quaternary ammonium chloride and isopropanol)

* This list is not necessarily comprehensive and not all chemicals listed are necessarily used at each SPR site.

Source: 1990 Tier Two forms submitted under the Emergency Planning and Community Right-to-Know Act for SPR crude oil pipelines and storage facilities in Texas and Louisiana.

pesticide applicator) are used only by contractor personnel who are licensed to handle such materials.[55] At Big Hill, the pesticides currently applied by contractor personnel are mainly nonrestricted-use pesticides and include Hubsco 147 Rat and Mouse Bait, Maxforce Roach Control System, PT110 and PT250 (insecticides), and Dursban (insecticide). In certain cases, restricted-use pesticides may be applied by contractor personnel.[56]

In general, herbicides such as Rodeo, are used along the fencelines on the site in areas that cannot be mowed due to proximity to sensitive security equipment. In these areas, herbicides are applied manually with one- or two-gallon hand-sprayers. For the most part, other areas on the site are kept free of vegetation by mowing. During the construction phase, laydown areas are kept clear of vegetation by using an aggregate-covered plastic liner.[57]

While herbicides are not used in the marshes along the pipeline ROWs, certain limited areas that cannot be mowed (e.g., wooded areas, inaccessible agricultural areas) are controlled with herbicides such as Velpar.[58] At Big Hill, a pipeline crew stationed onsite is responsible for spraying herbicides at road crossings and at valve stations located along the Big Hill crude-oil pipeline to and from the Sun terminal and along the brine discharge line. Every two or three years, a commercial aerial spraying contractor is hired to spray herbicides (Tordon K and Esteron 99) along inaccessible pipeline ROWs. This contractor meets all the requirements for aerial herbicide spraying mandated by the Texas Department of Agriculture.[59] In a recent procurement, DOE requested proposals for aerial spraying of up to 250 acres, or less than one percent of total pipeline ROWs. This is the first aerial application performed in three years, indicating the limited amounts of herbicide applications.[60]

Pesticides are used on the site to control localized outbreaks of insects and rodents. Malathion is used to control mosquitos and Diazinon is used to control fire ants. Control of fire ants is important because they can harm electrical systems. Talon is used to control rodents such as mice and rats and strychnine is used for gopher control.[61]

Visco 1152, a quaternary amine, is used to control corrosion in the oil systems by killing the bacteria that would live in the interface between the oil and the small amount of water in the pipelines. These bacteria would digest the oil and excrete acid and oxygen, leading to the corrosion of unlined pipes. The biocide is introduced into the oil so that the concentration is approximately 10 to 20 ppm. It is stored primarily in 250-gallon drums and diluted using a metered water system.[62] Visco 1152 is delivered in pallets of 1,000 gallons (i.e., four drums). There may be two pallets on the site at any time. The drums are stored in impervious diked areas that can contain the entire supply.

Ammonium bisulfite is used in the brine disposal lines as an oxygen scavenger. At Big Hill, a 50 percent solution of the chemical is stored in 5,000-gallon tanks located next to the brine ponds. The tanks are located on diked platforms that drain into the brine ponds. Ammonium bisulfite is injected in small quantities into the brine as it leaves the brine pond and enters the disposal pipeline to the Gulf. The tanks are delivered by truck and hooked directly to the brine unit.[63]

6.5.2 Spill Scenarios and Associated Impacts

Because hazardous chemicals are so diverse, a wide range of potential impacts may occur in the event of an accident or spill. In general, severe spills depend on the type of hazards posed by the chemicals and on the container size. For the most part hazardous chemicals at existing SPR sites are stored in 55-gallon drum quantities or less. (See Table 6.5-1). Because spills of laboratory agents would be contained indoors, they are not discussed further.

In the event of a fire, any AFFF released is captured in collection ponds that border each fixed fire-control system, thus preventing the compound from reaching groundwater or surface water. These collection ponds are generally large enough to retain one discharge. Problems could occur in the event of high winds or storms, when the AFFF could be blown out of the containment area. Also, if rainwater overfills the collection ponds, a release to surface water could occur. For portable fire-control systems the most severe scenario would involve spills of 55 gallons or less. Such a spill would be contained before it could reach surface water or groundwater.

While AFFF does not pose a risk to human health, it exhibits varying degrees of aquatic toxicity and has a high biochemical oxygen demand and chemical oxygen demand. If allowed to flow freely into groundwater or surface water, it could cause severe environmental consequences. The AFFF materials also contain fluorocarbon surfactants (five percent or less) that are not biodegradable. Therefore, AFFF, if discharged to adjacent surface water, could result in temporary oxygen depletion in those waters in addition to inducing toxic effects in some aquatic species.[64]

The most serious accident at an SPR site involving AFFF occurred in 1986 at the West Hackberry site when 5,000 barrels of oil flowed into a nearby lake. AFFF was used to blanket the oil on the lake. The combination of the oil spill and the foam blanket resulted in the death of 100 to 200 fish in the area.[65]

As pesticides are used in limited and controlled quantities, a severe accident scenario would involve the spill of one or two gallons of a compound during manual application. In the case of a spill, protection of aquatic systems would be a high priority because pesticides used on site such as malathion and chlorpyrifos (Dursban™) are highly toxic to fish.[66] Either pesticide may adhere to sediments, and chlorpyrifos has a potential for significant bioconcentration.[67] Malathion and chlorpyrifos have relatively low mammalian toxicities, but are moderately and highly toxic to birds, respectively.[68] A spill would require relatively uncomplicated and localized cleanup. Minor impacts to plant life would occur only in the immediate vicinity. Because contaminated soil would be collected and disposed of off the site (at an approved disposal facility), no long-term impacts on groundwater or surface water would be expected.

Visco 1152 is stored primarily in 250-gallon drums and there are at most four to eight drums on the site at any one time.[69] A potential accident would most likely involve one drum and would be relatively easy to clean up. The spill would be contained by the diked area. Minor impacts to plant life would occur only in the immediate vicinity. No impacts to ground or surface water would be expected. During an accident involving a rupture of the oil fill/distribution system, the oil itself would be of much greater concern than the biocide.

A severe accident involving ammonium bisulfite would result from the rupture of the storage tank. This spill could involve up to 5,000 gallons of the chemical. Any spill would likely be contained by the brine ponds that border the area. If the tank rupture was simultaneous with high winds or storms when the ammonium bisulfite might be blown out of the pond or rainwater might overfill the collection ponds, ammonium bisulfite could have a temporary impact on

Table 6.5-2
On-Site Potential Hazardous Substance Spill Sources and Estimated Quantities

Site	Source	Probable Maximum Spill Quantity (in gallons)
Bayou Choctaw	Laydown area Flammable materials storage building	55
	Laboratory	1
St. James Terminal	Laydown area Warehouse	55
	Laboratory	5
Weeks Island	Drum storage area	55
	Warehouse Maintenance building	1
Big Hill	Warehouse	55
	Laboratory	1
	Raw water intake structure (chemicals from oxygen scavenging system)	4900
Bryan Mound	Laydown yard	55
	Utilities Area	5
	Laboratory	1

Sources: Boeing Petroleum Services, Inc., *Spill Contingency Plan: Bayou Choctaw, St. James Terminal and Weeks Island.*
Boeing Petroleum Services, Inc., *Spill Contingency Plan: Big Hill and Bryan Mound.*

adjacent vegetation. A small area could be burned, but would likely consist of a grass that would recover quickly. As the brine is required to have some oxygen content when it is released into the Gulf, it is possible that a spill of ammonium bisulfite into the pond could necessitate aerating the brine pond prior to continuing disposal. If the brine is released unaerated into the Gulf at the same time that a transient anoxic area is present at the diffuser location, the anoxic situation could be exacerbated. In addition, there could be off-gassing of ammonia or sulfur gas from the surface of the brine.[70] Because the on-site emergency response team would be trained in proper protection in handling ammonium sulfite spills, no adverse effects on workers would be anticipated. In the event of dermal exposure, if exposed skin is immediately flushed with water, recovery should occur quickly. Ammonium bisulfite is not acutely toxic. These, however, would be temporary and short-term impacts. No long-term impacts would be anticipated.

ENDNOTES

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7.0 ENVIRONMENTAL IMPACTS

This chapter discusses the potential environmental impacts of the construction and operation of facilities and associated pipelines at the proposed SPR expansion sites.

7.1 Big Hill (Seaway Complex Site)

This section summarizes impacts that could result from the construction and operation of additional storage caverns at Big Hill and a new oil distribution pipeline from Big Hill to Houston. Specifically, this section describes potential impacts on the physical, biological, and socioeconomic environment surrounding Big Hill, that is described in section 5.1. Because under the 270-day drawdown criterion, no new pipeline construction is required, potential impacts discussed below from pipeline construction would only be experienced if a 180-day drawdown criterion was selected.

7.1.1 Geological Impacts

There are four potential adverse environmental impacts associated with SPR facility development that would be related to or affect the geology of the area where the Big Hill Site is located. These include subsidence, seismic activity, brine seepage into soils, and impacts associated with multiple uses of a salt dome. Each of these potential impacts would be insignificant, as discussed below.

7.1.1.1 Subsidence

Geologically, the potential impact of most concern would be surface subsidence. SPR sites affect local subsidence rates through two geologic closure mechanisms: (1) slabbing, and (2) cavern creep closure or halokinesis. The first mechanism, slabbing, creates loose slabs of salt on the cavern walls and roof and occurs as the result of the anisotropic properties of sheared or impure salt. At Big Hill and the other domes considered for the SPR the potential for slabbing would be greatly reduced because of the depth and purity of the salt domes.

During halokinesis, lithostatic or hydrostatic pressures are created that will enlarge or close certain areas of the cavern. The SPR Capline EIS estimated, however, that only a very small fraction of total cavern volumes at SPR salt domes would be affected by these forces, resulting in minimal localized subsidence.[1] DOE has since confirmed these estimates through semi-annual surveys of each site. The surveys, which employ differential levelling techniques, indicate that local subsidence above caverns at SPR sites occurs at annual rates of 0.03 to 0.28 feet. The rate of subsidence varies greatly not just among sites, but also at various locations at a single site, indicating the localized nature of SPR-induced subsidence.[2] Initial survey data for the existing Big Hill site indicate annual subsidence rates of 0.06 to 0.08 feet per year.[3] One possible impact of this localized subsidence is the formation of ponds over the caverns where the land surface has subsided to a level below the water table. At the Big Hill site, the top of most shallow aquifer is approximately 2 meters bls. At a subsidence rate of 0.08 feet (2.44 cm), the land surface would not be expected to reach the water table for approximately 80 years. In addition, engineering controls such as surface pavement with drainage systems would prevent the formation of such ponds.

Although additional caverns would increase the rate of subsidence, it is not anticipated that the increase will be material.[4] Some creep closure of caverns would be inevitable because of the viscoelastic nature of salt. The most drastic effects, known as primary creep deformation, would occur during construction and early operation of the cavern. The caverns would then undergo steady state, or secondary creep closure at a predictable rate throughout the life of the cavern. In the event of a drawdown of the SPR, the removed oil would be replaced with water, which minimizes the extent of cavern closure and the associated local subsidence.

In addition to monitoring the rate of subsidence at SPR sites, DOE is developing models to predict the rates of cavern creep and to develop methods for decreasing its effects. The results of the most recent study, conducted by Sandia National Laboratories for DOE, were published in June 1991.[5] This study reached several conclusions important to the future siting and operation of SPR caverns. First, the Sandia model determined that volume loss due to cavern creep increases with the depth of the cavern and that 80 to 90 percent of the volume loss occurs in the deepest 30 percent of the cavern. This discovery is significant because, if caverns in the dome are leached at shallower depths, the volume loss can be concentrated closer to the bottom of the cavern, with less axial distribution of volume loss. Also, the model predicts that reductions in cavern volume loss can be achieved by increasing the operating pressure of the cavern, thus offsetting the natural lithostatic pressures of the salt. The information derived from this model will be used to mitigate the effects of cavern creep at the proposed SPR sites.

Local subsidence would be an unavoidable impact of cavern construction and operation. There is no evidence, however, that would link the limited subsidence that occurs over the SPR sites to the regional subsidence occurring throughout the Gulf Coast region. This widespread subsidence is largely caused by the overpumping of groundwater, soil erosion, global sea level rise, and natural sediment deposition within the Gulf Coast Geosyncline.[6,7]

7.1.1.2 Seismicity

Despite the fact that the Gulf Coast is actively subsiding, there is very little potential for serious regional seismic activity. Although there are a number of active faults in the region, the faulting is not tectonic in origin.[8] Most geophysicists agree that Modified Mercalli VI earthquakes are possible anywhere along the Gulf Coast. These events are thought to originate in deep basement faults or in combination with more shallow growth faults. Movement along these faults is generally very gradual and the effects of this movement are local in nature with seismic effects limited to the immediate area of the fault. For example, in 1983 an earthquake occurred with its epicenter 17 miles north of the West Hackberry SPR site. Even though the earthquake reached Modified Mercalli V intensity near the epicenter, it was not even felt at the West Hackberry site. Although extremely unlikely in the Gulf region, a strong earthquake (e.g., Modified Mercalli VIII intensity) could result in damage to surface structures and pipelines, which could in turn result in oil spillage. However, no damage to salt storage caverns would be expected from an earthquake even of this magnitude.[9] This is true for two reasons. First, resonance rarely occurs between the cavity and the vibrating medium that contains it because of the plasticity of the salt, thus any differential movements within the rock are not amplified within the cavern. Additionally, the viscoplastic properties of salt minimize the likelihood of cavern wall fracturing because the salt tends to fill in, or "heal," any fractures that develop.[10] Information on specific faults at the Big Hill site is provided in section 5.1.1.

7.1.1.3 Potential Impacts of Brine Seepage on Soils

Brine seepage from SPR caverns is indistinguishable from the natural salinization process that occurs throughout the region from salt dome seepage of brine. In some locations, salt actually pierces the surface forming "slick spots" where no vegetation will grow. Seepage from these exposed areas would present a more significant impact than the minimal seepage that would occur as a result of SPR expansion. If a major brine spill were to occur, large areas of surface and subsurface soils would be exposed to greatly increased salt concentrations. However, the Capline EIS concluded that there is no reasonable chance of a major brine spill occurring from a storage cavern. This is true because the only possible source of release would be overfilling the cavern with water during cavern leaching, which could contribute to the failure of the seal around the fill pipe. None of this brine, however, would be expected to enter the environment.[11]

7.1.1.4 Multiple-use Impacts

Ideally, a dome without prior development of any kind is preferable to one that has been previously developed because of the many interactions that occur between various activities in a single salt dome. Possible impacts include the accidental release of light hydrocarbons as a result of tubing failure below the brine/crude oil interface, crude oil seepage, increased levels of subsidence, mine or cavern flooding, and possibly even fire or cavern collapse.

There are two small LPG storage caverns of 0.5 MMB each operated by UNOCAL in addition to the 14 existing SPR caverns in the salt dome. There are also oil fields on the northwest and southwest flanks of the dome, though no commercial oil production has ever occurred from the caprock. Future co-use impacts at the Big Hill salt dome are expected to be minimal because of the small size of the UNOCAL caverns and the fact that all other activity in the salt dome is currently under DOE's control.

7.1.2 Hydrogeological Impacts

There are three major potential sources of groundwater contamination at the Big Hill expansion site: brine ponds, oil and brine pipelines, and other material spills. Each of the sources is discussed below along with an evaluation of potential groundwater releases and associated impacts.

7.1.2.1 Brine Ponds

As described in section 3.1.1, the existing brine pond system consists of one anhydrite settling pond with a 250,000-barrel capacity, one oil recovery pond with a 100,000-barrel capacity, and one brine disposal pond with a 100,000-barrel capacity. The proposed expansion would involve the construction of one new anhydrite pond, also of 250,000-barrel capacity. The existing anhydrite pond would be drained and capped with settled solids buried in-place. All ponds include measures to prevent migration of contaminants to groundwater, including liners composed of high-density polyethylene (HDPE), underdrain systems, a natural clay bottom barrier, surrounding bentonite-clay slurry walls interfaced to the natural clay bottom, and a perimeter dike to prevent overtopping and runoff. Groundwater monitoring wells also were placed around the pond system in the Chicot aquifer in 1987 shortly after construction of the ponds.

Possible releases from tbe brine ponds include seepage through the synthetic and natural clay liners to groundwater, and overflow of brine to areas outside the synthetic liner with subsequent seepage to groundwater. It is conceivable that a brine pond leak, comparable to the one at the West Hackberry facility, could occur, resulting in elevated salinities in the shallow aquifer. This event is unlikely, however, because the Big Hill ponds contain a subliner leachate detection system that would provide early warning of brine leakage.

Monthly groundwater monitoring at Big Hill began in December 1987 at six monitoring wells for three constituents -- pH, salinity, and total organic carbon (TOC). Three wells are located upgradient of the brine pond system and three wells are located downgradient. The concentrations in the first monitoring round in 1987 (after detection of salt contamination in the underdrain system) were used as a baseline for future monitoring data. The baseline ranges for the constituents were as follows: pH ranged from 6.0 to 7.3, salinity ranged from 0 to 13.3 ppt, and TOC ranged from 3 to 12 mg/l. Environmental monitoring results since 1987 indicate that: (1) downgradient and upgradient concentrations have remained similar to each other; and (2) downgradient concentrations have remained about the same as they were initially in 1987 (i.e., there has been no observed increase). These results indicate that no migration of brine from the disposal ponds to groundwater has occurred at Big Hill, and none is expected with the additional brine disposal requirements of the expansion.

7.1.2.2 Oil and Brine Pipelines

At Big Hill, the existing 36-inch, 15-mile brine disposal pipeline would continue to be used if the site is expanded. At the end of the recent leaching phase, a two-month study confirmed that the pipeline has maintained its structural integrity and does not need to be upgraded to accommodate the proposed leaching of new caverns. Under the 270-day drawdown criterion, DOE would use the existing 24-mile crude oil pipeline to Nederland, Texas, without enhancement. Under a 180-day drawdown criterion, however, DOE would construct a new crude oil pipeline from Big Hill to East Houston via either the Trinity Bay or I-10 routes outlined in section 3.1.5. Regardless of the option chosen, all piping would be protected by a corrosion control coating and impressed current cathodic protection. Pipelines are monitored with pressure gauges and volume meters to ensure that no leakage is occurring.

Possible releases from the pipeline systems include erosion, corrosion, overpressurization, or failure of valves and joints. Conceivably, such leaks could result in the migration of contaminants into shallow groundwater. On several occasions, the Big Hill facility bas experienced minor brine and oil losses, sometimes due to pipeline or valve failure.[a] None of these leaks, however, has had a significant impact on groundwater quality, as indicated by the groundwater monitoring data. It is conceivable that a brine pipeline leak comparable to the leak at the Bryan Mound facility that resulted in extensive damage to wetlands vegetation could occur at Big Hill; however, this is unlikely because extensive monitoring of the pipelines is conducted. As detailed in sections 6.1 and 6.2, the statistical probability of spills from oil and brine pipelines at Big Hill is very low.

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[a] For example, in 1987, Big Hill reported two brine spills with a total volume of five barrels. In 1988, Big Hill reported a single one-barrel oil spill and two brine spills of a total volume of 53 barrels. In 1989, there were three reported oil spills of a total volume of 54 barrels and two reported brine spills of a total of 53 barrels. In 1990, there were eight oil spills of a total volume of 55 barrels and four brine spills of a total volume of 119 barrels.

7.1.2.3 Other Material Spills

Leaks and spills of oil and other materials may occur during regular operations. Leaks may form in cavern pad drains, bulk material storage areas, contaminated leaching wells,[b,12] and oil-field waste injection wells (these injection wells are owned by Trinity Products, Inc. but have been used occasionally by the SPR for brine that is chemically unsuitable for discharge into the Gulf of Mexico). In addition, spills may include small quantities of hazardous chemicals used as solvents, including 1,1,2-trichlorotrifluoroethane, bromotrifluoromethane, and ammonium bisulfite, or oil and grease used for equipment maintenance. Spills on the site are most likely to occur on the pump platforms and in storage areas. Environmental audits indicate that material handling and storage practices at Big Hill are effective but, in some cases, handling of waste materials requires more attention to protect against leaking and deteriorating barrels.

Potential releases to groundwater from other material spills at the facility include seepage of oil and grease into groundwater, migration of solvent and lubricant wastes, and spills and subsequent migration of solvents and solvent wastes. No evidence of such incidents during past operations has been documented and, based on handling procedures at the facility and the natural clays underlying the site, these pathways would not likely pose a significant threat to groundwater resources at the Big Hill facility.

If a sizeable release to groundwater did occur at Big Hill, it appears unlikely that it would result in any immediate human health threats. As outlined in section 5.1.2, groundwater in the area surrounding Big Hill is not presently used for human consumption. Furthermore, it appears unlikely that groundwater near Big Hill would be used as a drinking water supply in the future, because the surrounding terrain is marshy (i.e., generally unsuitable for private homes) and has been developed for oil exploration. A sizeable release to groundwater, therefore, would be more likely pose an ecological threat than a human health threat. Any groundwater contamination could migrate into surrounding marshlands and water bodies, resulting in deleterious effects to resident organisms (the nearest off-site water body is Willow Slough located almost two miles from the proposed expansion site). However, the possibility of such a release with these types of impacts is limited substantially by the controls and monitoring practices outlined in Chapter 8.

7.1.3 Surface Water and Aquatic Ecology Impacts

Potential impacts to surface waters caused by the proposed Big Hill expansion can be divided into four major categories: (1) impacts associated with continued brine disposal in the Gulf of Mexico; (2) impacts caused by continued raw water intake from the ICW; (3) effects caused by the construction of the expansion site and associated pipelines; and (4) impacts caused by accidental spills of oil and brine. Each of these categories of potential water quality and aquatic ecology impacts is addressed in separate sections below.

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[b] After construction, 28 wells that were drilled in Big Hill salt dome for the leaching of storage caverns were found to be contaminated with organic and inorganic priority pollutants. Because the interior of the salt dome is isolated from the aquifers surrounding the salt dome, the potential for contamination of the groundwater is minimal.

7.1.3.1 Brine Disposal in the Gulf of Mexico

The 100-million-barrel cavern development program would follow the same cavern leaching program used in the Phase III Big Hill cavern development.[13] Therefore, subsequent brine disposal from the proposed Big Hill expansion would entail a schedule and brine discharge rate similar to those previously experienced at Big Hill during Phase III development. In addition, brine disposal from Big Hill would occur via the existing diffuser system. As a result, water quality impacts associated with brine disposal from the Big Hill expansion are expected to be similar to those predicted and observed during brine disposal operations at the existing facility.

Two previous studies predicted the size and impacts of brine plumes at the Big Hill diffuser site before the initiation of brine discharge. A 1982 Texas A&M University study[14] described the baseline environmental conditions of the Big Hill brine diffuser area and predicted the Big Hill brine plume characteristics. In addition, NOAA ran the MIT Transient Plume Model to predict potential brine discharge impacts as part of the Phase III Development EIS (section 4.2.5.2 of that EIS).[15] Together, the studies predicted that excess salinity and associated biological impacts caused by brine discharge in the Gulf of Mexico would be confined to a 7,500-acre area around the diffuser and that impacts would not last beyond the cessation of brine disposal.

These predictions consequently were confirmed by several post-disposal monitoring studies. A brine plume tracking study at Big Hill conducted by Texas A&M in 1991 determined that the actual areal extent of the brine plume was smaller than that predicted by the models discussed above.[16] In addition, extensive post-disposal analyses of bioassays and sediment and water samples from the West Hackberry and Bryan Mound diffuser sites determined that impacts associated with brine disposal at these sites have not been significant (see Appendix I). Specifically:

- No significant biological impacts were observed at the two diffuser sites.
- Overall, levels of metals, ions, and other contaminants detected at the diffuser areas were similar to those detected at control stations.
- A general decrease in the abundance of benthic species, the most significantly impacted biological community, occurred within relatively small areas (31 to 2,000 acres at Bryan Mound and West Hackberry).
- Demersal fish, some possibly commercially important, are reliant on benthic creatures for food and, therefore, may move from the diffuser area to feed in unaffected areas.

Although similar post-disposal monitoring has not been conducted at the Big Hill diffuser site, impacts at Big Hill are expected to be similar based on the comparable size and nature of the brine plumes observed at Big Hill, West Hackberry, and Bryan Mound.

For this DEIS, DOE also analyzed available brine composition data to evaluate the potential for metals and other inorganic constituents in SPR brine to cause adverse impacts when discharged to the Gulf of Mexico. This analysis, documented in Appendix M, indicates that metals and other inorganics likely to be released along with SPR brine should not pose a significant environmental threat. Conservatively estimated concentrations of virtually every constituent near (within 123 acres of) the diffuser are below EPA criteria to protect marine organisms.

Based on this analysis, the proposed Big Hill expansion would be expected to result in a continuation of the impacts that have been analyzed and incurred previously. These impacts would include minor increases (e.g., +1 ppt) in salinity over areas as large as 6,000 acres, minor shifts in benthos abundance and diversity, and possibly a change in the feeding patterns of fish (see Appendix I for more detail).

7.1.3.2 Impacts of Raw Water Intake

The cavern leaching that would be required for a 100-million-barrel expansion at Big Hill could be considered an extension of the recently completed Phase III leaching operations. No major construction activities or alterations would be needed in the raw water intake system, and the rate of raw water intake for leaching would not be increased. Therefore, DOE expects that the minor impacts that have occurred in the past would simply continue for a longer duration. The nature and extent of these impacts are discussed in Appendix N and have been described in detail in the Texoma Complex Phase II and Phase III EISs.[17] In general, these analyses conclude that environmental impacts related to raw water intake from the ICW are inconsequential. Although the average historical leaching rates are 33 percent greater than anticipated in the Phase II and Phase III EISs, potentially leading to greater impacts than originally estimated, monitoring data confirm that current raw water intake rates have had no adverse affect on ICW water quality.

While the rate of raw water intake for leaching would not be increased to accommodate the expansion, the proposed rate of raw water intake for drawdown at Big Hill would be increased. Specifically, the proposed expansion drawdown rate of 1.5 MMBD (63 million gallons per day) would be 50 percent greater than the 1990 average daily leaching intake at Big Hill and 50 percent greater than the existing permit limit on annual water allocation for drawdown. The diversion rate to withdraw 1.5 MMB over a 24-hour day is 97.5 cubic feet per second. This rate, although larger than the existing rate, is still well below the maximum diversion rate of 175 cubic feet per second permitted by the Texas Water Commission.

The following subsections summarize the anticipated impacts caused by the proposed Big Hill raw water withdrawals, including potential hydrological impacts, water quality impacts, and impacts to biota. This information draws on the information presented in Appendix N and the Phase II and III EISs for the Texoma Complex.

Potential Hydrological Impacts

Raw water intake for the proposed expansion would be expected to produce no adverse hydrological impacts. Because the raw water intake for leaching requirements would be identical to the currently implemented intake, the hydrological regime of the ICW would be identical to the current regime. No adverse hydrological impacts have been identified from the existing raw water intake at Big Hill. Hydrological parameters are not monitored, but as determined from two independent hydrological models (see Table N.2-1 in Appendix N), the impacts are minor. Raw water intake was predicted to increase flow velocity by 0.03 feet per second near the RWI structure and 0.05 feet per second at the western end of the ICW near East Galveston Bay. The maximum depth change was predicted to be minus 0.04 feet. Changes of these magnitudes are inconsequential compared to the natural hydrological influence of rainfall and tides which can be 12 to 16 inches. The validity of these modeling predictions is supported by the fact that the intake-induced salinity changes predicted by the models agree favorably with the actual observed salinity changes. The proposed increase in raw water intake for drawdown would not be expected to increase significantly hydrological impacts in the ICW.

Potential Water Quality Impacts

Raw water intake for the proposed Big Hill facility expansion would not be expected to affect water quality in the ICW adversely. The impacts can be evaluated by comparing baseline (i.e., pre-leaching) data to monitoring data collected at the ICW during leaching (see Tables N.2-1 and N.2-2 in Appendix N). Although limited sample sizes preclude statistical comparison of the data, baseline data for all parameters are within the ranges observed during leaching. Salinity, a parameter of particular importance to biota, has not been noticeably affected. Predicted salinity changes would also be minor compared to natural variations.

During drawdown, raw water intake may be up to 50 percent greater than maximum historical leaching rates in order to meet drawdown criteria. The impacts of raw water intake at these increased drawdown rates may be greater than historical leaching impacts but are expected to remain minor in comparison to natural environmental variability, considering the small quantity of water to be removed relative to the total ICW flow.

Potential Direct Impacts to Biota

The raw water intake was designed to limit entrainment. Fish and other large animals are blocked from the intake by trash bars and traveling screens. In addition, the proposed intake velocity of 0.5 feet per second is slower than the swimming speed of most fish. Raw water intake from the ICW, however, would result in the unavoidable impingement and entrainment of planktonic and benthic organisms able to pass through the 0.5-inch mesh screens.[18] This impact and its effect on the ecology of the ICW have not been monitored during Phase III leaching, but are believed to be inconsequential (see Appendix N). The portion of the planktonic community that would be removed during leaching is small because the maximum diversion is a small (less than 2.5 percent) portion of the typical maximum ICW flow.[19] The rate of entrainment during drawdown would be greater but still relatively small. The maximum diversion currently permitted by the Texas Water Commission (175 cubic feet per second) is about 4.3 percent of the typical maximum ICW flow.

7.1.3.3 Construction Impacts

If the Big Hill site is selected as part of the SPR expansion, there would be two major construction efforts that could result in water quality impacts: (1) construction of the on-site facilities; and (2) under a 180-day drawdown criterion, construction of a new crude oil pipeline to East Houston. The potential water quality impacts associated with these construction activities are addressed below. The potential construction-related impacts to terrestrial ecology and wetlands are discussed in section 7.1.5.

Impacts Associated With On-site Construction

Construction activities at the proposed Big Hill expansion site would be likely to enhance soil erosion in the area. Proposed construction activities at Big Hill would result in the clearing and grubbing of roughly 50 acres. Based on the site-specific topography, this area is divided into two major sloping faces: a 27-acre area sloping toward the west, and a 23-acre area sloping east. As detailed in Appendix O, it is estimated that a total of 2,720 tons of soil could erode from these faces during construction activities (about 1,510 tons would erode toward the west and about 1,210 tons would erode toward the east).

As outlined in section 5.1.3.3, the proposed Big Hill site itself is dry except for two ponds (ten to 20 acres in size) located on the northern edges of the dome. These ponds could receive a slightly higher than normal sediment load during site construction, but they are not located in a position that would receive the bulk of the site's erosion. Site maps indicate, instead, that the soil eroded from Big Hill would settle in nearby marshlands and gullies. While this erosion ultimately could result in incremental sedimentation to surrounding waters, it does not appear that significant sediment loads would enter surface waters given the relative positions of marshlands and water bodies surrounding the site (the nearest permanent water body, Willow Slough, is almost two miles away).

Impacts Associated With Crude Oil Pipeline Construction

Under the DOE's 270-day drawdown criterion, no new crude oil pipeline would be constructed (the existing 24-mile pipeline to Nederland, Texas would be used for fill and distribution). Under a 180-day drawdown criterion, however, DOE would construct a new crude oil pipeline from Big Hill to East Houston following either the Trinity Bay or the I-10 route outlined in section 3.1.5.

Section 5.1.3.3 characterizes the 19 water bodies crossed by the proposed Trinity Bay pipeline route and the 26 water bodies crossed by the proposed I-10 pipeline route. Most of these water bodies are relatively small and shallow (less than 50 feet wide and 8 feet deep). The primary exceptions are Tabbs Bay, San Jacinto Bay, and the Houston Ship Channel crossed by the Trinity Bay route. These waters range from 1,400 to 8,200 feet wide and are approximately 40 feet deep along the proposed pipeline route. Additionally, Trinity Bay itself is almost 47,000 feet (roughly 9 miles) wide along the pipeline route, though only 6 feet deep.

The pipeline construction method in each of these waters would differ depending on the size and depth of the water bodies. Waterways less than 500 feet wide, which includes almost every water body that would be crossed by the Big Hill crude oil pipelines, would be crossed by digging a trench with a barge- or bank-mounted dragline. Original material excavated from the streambed would be used for backfill, while excess excavated material would be deposited on upland areas authorized by a permit. When the water bodies are in deep marshes, "floatation canals" may be dredged to accommodate barges that are used to construct and bury the pipe. Floatation canals are typically 80 to 100 feet wide and are not backfilled. A less damaging method for use in marshes is modified push ditch construction, in which shallow barges excavate a pipeline trench. The pipeline is then floated into the trench from a stationary construction barge and dredge spoil is returned to the pipeline trench.

For waterways that are more than 500 feet wide, pipelines are often constructed using the directional drilling method. In this technique, a trench is not excavated in the streambed. Instead, a pilot hole is drilled on one side of the crossing using a slanted drill rig. The pilot hole proceeds under the waterway, eventually emerging on the opposite bank, and the crude oil pipeline is then pulled through the hole. Some of the water bodies that could be crossed using this construction technique include Mayes Lake and Old River Lake, which would be crossed by the proposed I-10 route, and San Jacinto Bay and the Houston Ship Channel, which would be crossed by the proposed Trinity Bay route. Tabbs Bay and Trinity Bay, however, are too wide to permit directional drilling. The pipeline across these waters would likely be constructed by digging a trench in the Bay floors using a dragline mounted on a lay barge, and then assembling and lowering the pipeline into position.

As a result of dredging, sediments could become resuspended in the water causing a release of sediment constituents. Also, because dredged material would remain at the dredging site, sediments are available for resuspension by wave action or currents, until they are finally transported by natural forces from the area or become biologically fixed. Potential water quality impacts at a dredging site would include the following:

- **Major increases in turbidity.** The size and duration of the turbidity plume depend on the number and size of dredges in the area, the skill of the dredging operators, the length of time during which dredging occurs, bottom sediment characteristics, maintenance of the equipment, and water current conditions. Moving material either with a bucket or a chain of buckets, mechanical dredges can suspend bottom sediments and significantly increase turbidity.[20] These turbidity increases, however, are expected to be confined to areas near the dredging activity and should not persist for long periods. The dredging period itself would be short and suspended sediments expected to settle back to the bottom quickly after the construction ceases.

- **Increased suspended nutrients.** During dredging, the possible release of phosphorus and various forms of nitrogen (nitrates, nitrites, and ammonia) in the sediments could be a concern. Nutrients tend to encourage the growth of aquatic biomass (e.g., algae and plants), accelerating the eutrophication[c] or aging of waters and decreasing the degree to which light can penetrate. In the larger water bodies that have numerous connections with other waters, normal dilution should significantly reduce nutrient levels. However, if bottom sediments are rich in nutrients, adverse effects could occur in smaller waters with poor circulation.

- **Reduced dissolved oxygen concentrations.** A decrease in dissolved oxygen concentrations during dredging could take place because many of the materials in sediment are readily oxidized, thus consuming dissolved oxygen in the water. Problems with low dissolved oxygen would most likely occur in waters with high organic levels in their sediments. It is probable that most sediments would settle out within one or two days, after which only a fraction of the disturbed sediment would exert a significant oxygen demand. This period could be extended somewhat, however, if an affected water body is poorly circulated. Additionally, it

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[c] A eutrophic water body is rich in dissolved nutrients and aquatic plants, but often shallow and deficient in oxygen.

is likely that suspended sediments would have a significant effect on the dissolved oxygen content of water only in the immediate project area.

- **Increased concentrations of trace metals.** "Heavier" metals (e.g., lead) are generally less soluble and tend to adsorb on suspended solids or combine with sulfides to form insoluble salts. Consequently, such metals might not be available for biological uptake, quickly settling back down to the bottom. The "lighter" metals (e.g., nickel, chromium, and zinc) are more soluble and are less likely to adsorb onto suspended solids. Thus, dredging could increase the concentrations of lighter metals in the water column. These effects would reduce water quality for several days after completion of the dredging operations.

- **Increased organic pollutants, such as hydrocarbons and organic pesticides.** Because land in areas surrounding the proposed pipeline route is used in part for agriculture, industry, and oil and gas production, the bottom sediments in affected water bodies might be contaminated with pesticides, oil, hydrocarbons, and grease. Bottom sediments in Tabbs Bay, for example, are known to be especially contaminated with hydrocarbons.[21] These constituents subsequently might be suspended in the water column due to dredging.

- **Saltwater intrusion.** Saltwater intrusion is the inland transport of sea water facilitated by channelization or subsidence, possibly resulting in the encroachment of saltwater and brackish marsh into previously fresher habitats. Saltwater intrusion is possible near Big Hill because marshes in the area have a pronounced salinity gradient, and because canals may remain if the trenches are not properly backfilled. The potential for saltwater intrusion, however, would be minimized by the use of the least damaging construction techniques. For example, modified push ditch construction would be used preferentially to floatation canal construction which leaves larger channels. Additionally, pipeline trenches would be backfilled with sufficient native topsoil to fully restore surface topography, and plugs or bulkheads would be constructed in the pipeline canal near intersections with existing watercourses. These measures would inhibit saltwater intrusion by blocking water flow though new canals without isolating nearby marshes from pre-existing estuarine or riverine influences.[22]

Pipeline construction might also cause adverse ecological impacts, either directly due to the dredge activity itself or indirectly due to the degradation of water quality. Construction of the crude oil pipeline could minimally impact organisms in the region but could significantly affect the organisms in a concentrated area along the 150-foot wide ROW. Particular biological/ecological impacts that might be associated with dredging and dredged material disposition include:

- **Temporary destruction of benthic habitat.** Dredging activities would destroy benthic organisms (e.g., bivalves, polychaetes) and cause a temporary loss of benthic habitat within the pipeline corridor. Also, benthic organisms near the corridor could be smothered or buried by the dredging operation. A past study on the impacts of navigational dredging showed that 75 percent or more of the benthic organisms were removed from a site during channel dredging.[23] However, recolonization of the newly dredged area can be fairly rapid and the original biomass can be returned within 2 weeks to 4 months.[24]

- **Adverse effects due to increased turbidity and sedimentation.** Dredging and dredged material disposal could cause disorientation due to the confusion of organic smells and alteration of normal behavior due to physical disturbances, such as solids discharge and noise. Turbidity caused by dredging might cause a decrease in light penetration, reducing primary production and decreasing fish food. Laboratory tests[25] indicate, however, that turbidity levels created by dredging are not likely to cause direct mortality. Suspended solids also could cause abrasion of gills (causing anoxia) and decreases in catchability of finfish. Sedimentation of dredged material could have a strong negative impact when the settling occurs in an area containing sensitive organisms (e.g., oyster reefs and fish spawning or nursery areas).

- **Behavior and toxic effects caused by chemical exposure.** Depending on the chemical composition of dredged and suspended sediments, there could be a potential for exposure to a variety of contaminants, which might result in a variety of behavioral and toxicological effects. For example, the presence of hydrocarbons in sublethal levels in dredged material could interfere with the olfactory senses of finfish and shellfish and could affect food location, escape from predators, selection of habitat, and sex attraction.[26] Significant uptake of PCBs or metals released from the sediments to the water column could cause similar adverse effects, including mortality, if exposures were great enough.

- **Effects on migratory patterns.** Artificial canals created by floatation canal or modified push ditch pipeline construction could increase inland migration of estuarine and marine species of fish and crustaceans into coastal wetlands. Although increased access to inland wetlands would be beneficial to estuarine and marine species and their predators, it would increase competitive displacement of resident species. These effects of pipeline construction would be mitigated by backfilling the trenches to restore surface topography and, if necessary, by the construction of plugs or bulkheads in pipeline canals near intersections with existing watercourses. Similar structures (i.e., fixed crest weirs) have been shown to affect significantly the ingress and egress of organisms by blocking access to artificial migratory passages.[27]

In summary, pipeline construction would result in a temporary degradation of water quality and aquatic habitat in water bodies that are crossed. Water quality impacts might include increased turbidity levels, increased concentrations of suspended nutrients, reduced dissolved oxygen levels, and, depending on the composition of sediments, increased levels of metal and organic contaminants. Organisms that live in the water might, in turn, experience toxicological and behavioral effects. Benthic organisms and habitat directly within and near the pipeline corridor also would be unavoidably destroyed. All of these impacts would be temporary, however, and would be confined to areas close to the pipeline ROW. Suspended sediments are expected to settle back to the bottom, benthic habitat is expected to be restored and recolonized, and free swimming fish and crustaceans that avoided the disturbance are expected to return to the area soon after construction ceases.

Specifically with respect to the Trinity Bay route, all 19 water bodies that would be crossed by the crude oil pipeline would be affected in this manner. However, the waters that would be crossed over the widest areas and thus suffer the most disturbance include Trinity Bay, Tabbs Bay, San Jacinto Bay, and the Houston Ship Channel. Trinity Bay, San Jacinto Bay, and Tabbs Bay also are of special concern because they are high quality aquatic habitat, with portions of Trinity Bay supporting seagrass and oyster beds (see section 5.1.5.2). The proposed pipeline route would cross the seagrass beds on the eastern shore of Trinity Bay, destroying the beds directly within the 150-foot ROW. Seagrass beds not within but near the ROW on the eastern shore also might be adversely affected by increased turbidity and sedimentation. These impacts to seagrass beds would be particularly sensitive, because the total remaining area of seagrasses in the Galveston Bay system already has been reduced to less than five percent of its historic area. Construction of the proposed pipeline is not expected to adversely affect seagrasses on the western shore of Trinity Bay, because the pipeline would pass slightly more than a mile to the south of the beds known to exist on that shore. Similarly, construction of the pipeline is not expected to significantly affect oyster beds in Trinity Bay, because the closest oyster beds are approximately three miles to the south of the proposed ROW along the western shore. An additional concern about crossing Trinity Bay is the potential for pipeline construction operations to puncture one of the innumerable oil and gas pipelines that already traverse the Bay floor, possibly resulting in an uncontrolled release of oil.

Specifically with respect to the I-10 route, all 26 water bodies that would be crossed by the crude oil pipeline could experience the water quality and aquatic ecology impacts outlined above (with the possible exception of a few of the larger water bodies, such as Mayes Lake and Old River Lake, which may be crossed using the directional drilling method). The greatest impacts would likely occur in the Trinity and San Jacinto Rivers, which are the largest waters crossed by the proposed pipeline. Both of these waters have generally good water quality and are designated as high quality aquatic habitat by the State. As summarized above, however, the pipeline construction impacts in these and other waters crossed by the proposed I-10 route are expected to be temporary and confined to areas near the pipeline ROW. Controls and mitigation measures that would be employed to avoid sensitive areas and existing pipelines in the Trinity Bay are outlined in Chapter 8.

7.1.3.4 Oil and Brine Spill Impacts

Oil spills associated with operations at Big Hill could occur in the open seas, along the Gulf of Mexico coastline, or in inland water bodies near the Texoma or Seaway Complex terminals and facilities. The likelihood of oil spills as well as their anticipated size are described in section 6.1.

Brine generated by cavern leaching at Big Hill would be discharged to the Gulf of Mexico via a brine pipeline described in section 3.1.1. In the event of a spill, brine would enter surface waters or marshlands in the immediate vicinity of the Big Hill site, or along the brine pipeline route. Historic occurrence of brine spills and the expected number and size of brine spills resulting from the proposed expansion at Big Hill are discussed in section 6.2. Because the brine would intentionally be released to the Gulf, offshore brine releases are considered in section 7.1.3.1.

Ocean Spills

Oil spills to the open ocean could occur only from tankers transporting oil to or from distribution terminals. Based on historic spill rates, up to 0.4 spills to the ocean are expected to result during fill or distribution associated with Big Hill (see section 6.1). If a spill does occur, it would cause local impacts to marine organisms. The impacts of ocean spills would be relatively minor due to the large assimilative capacity of the ocean and distance from vulnerable coastal habitats. Spilled oil could be partially recovered, or else would eventually disperse by evaporation, emulsification, or sedimentation.[28] Although the effects on larger organisms that are able to avoid the oil would generally not be lethal, there would be some mortality among larger organisms (e.g., birds, fish, and mammals) unable to avoid the spill. Smaller organisms, especially planktonic organisms and epipelagic fish eggs, coming in contact with spilled oil would be more susceptible to lethal effects. These effects, however, would be temporary and only locally significant because the planktonic communities of the ocean are widespread and regenerate quickly.[29]

Based on this analysis, the impacts of ocean oil spills on populations of aquatic species resulting from the proposed Big Hill expansion would not be likely to occur, but even if they did, they would be expected to be temporary and only locally significant.

Coastal or Inland Spills

The potential impacts of oil spills and brine spills are discussed separately below.

Oil Spills. As described in section 6.1, the proposed Big Hill expansion would be expected to result in about two vessel spills of zero to 20 barrels, and less than one vessel spill of 20 barrels or more to coastal or inland water bodies during either the fill or drawdown stages. Coastal spills could occur along the Texas and Louisiana Gulf Coasts, but appear most likely in the vicinities of the Sun or ARCO terminals. Spills to inland water bodies could occur from bulk storage operations at these terminals, the transfer of oil across tanker docks, the storage of oil at the Big Hill site, or from pipelines or other facilities used to transport oil to or from the Big Hill site. The inland water bodies most at risk include Trinity Bay, Galveston Bay, San Jacinto Bay, and the Sabine River system (these water bodies would only be at risk under a 180-day drawdown criterion). These and other potentially impacted water bodies near these facilities and pipelines are characterized in sections 4.3, 5.1.3, and 5.1.5.

A critical factor affecting the impact of spills on coastal and inland waters is the fate of oil in these settings. Unlike ocean spills that are rapidly dispersed, oil spilled near the coast tends to concentrate and mix with nearshore waters. Additionally, the oil deposited in nearshore sediments persists longer than in pelagic sediments.[30] Oil is particularly persistent in low-energy, wetland habitats.[31]

Habitats of the Texas Gulf Coast are ecologically sensitive because they serve as breeding and nursery areas for resident and migratory species including fish, invertebrates, and sea turtles. Because spawning and hatching are generally temporally, as well as spatially, concentrated in coastal estuarine habitats, oil spills that coincide with mating or hatching periods could cause substantial population level impacts. Moreover, because these habitats are rich with vulnerable organisms and vulnerable life cycle stages of more resistant species, even small spills could have significant effects.[32]

The sensitivity of fish to oil spills varies by species and by age class. In general, fish are very sensitive to short-term acute exposures, but are able to metabolize sub-lethal intakes. Older age classes are able to avoid heavy contamination, and have a mucous coating that helps them resist contact with toxic oil constituents. It is the youngest age classes that are most vulnerable to oil spills. Oil may smother eggs, interfere with hatching success, or cause developmental abnormalities.[33] Many physiological, histological, and behavioral abnormalities caused by exposure to crude oil have been documented.[34] Fish species that might be affected by an oil spill in the coastal habitats of Texas and Louisiana are described in section 4.5.4. A particularly important commercial and recreational fishery is located in Galveston Bay near the ARCO terminal.

The Texas and Louisiana Coasts also are wintering habitats for many North American bird species. Spills on the Gulf Coast in the winter season, therefore, could affect a larger bird community. Aquatic birds, especially diving birds, are highly vulnerable to oil spills in coastal areas. Feathers that become coated with oil become water-logged and lose their insulative properties. As a result, birds may drown or die of hypothermia. Oil also is ingested by birds as they preen. It has recently been discovered that birds suffer stress-related effects as they attempt to detoxify the ingested oil.[35] Disturbance of valuable habitat or resources also could indirectly affect birds through increased competition. Some of the many species of migratory waterfowl that can be found along the Texas and Louisiana Gulf Coasts are listed in section 4.5.3.1.

Oil spills also might disrupt ecosystem structure and function. Differential rates of mortality resulting from spills could shift food web relationships. The result for individual organisms could be changes in resource availability, competition, and predation. On the population level, species that are dependent on impacted prey or habitats would decline, while opportunistic species might increase. Rare species, small local populations, or species that are seasonally concentrated in the impacted habitat would be the most likely to decline as a result of an oil spill.

Based on the anticipated frequency and volume of oil spills, the proposed Big Hill expansion would be likely to cause only a few small spills of oil to coastal and inland waters (see section 6.1). However, depending on when and where these spills occur, they could cause significant adverse impacts in localized areas. As a result, the potential for these impacts would be mitigated by the emergency controls, procedures, and contingency/emergency plans discussed in Chapter 8.

Brine Spills. Brine spills could result from equipment failure at the Big Hill site or from pipeline ruptures anywhere along the route of the brine pipeline. Surface water bodies that are crossed by the brine pipeline are Salt Bayou, the ICW, and a tributary to Star Lake. In addition, the brine pipeline crosses approximately five miles of marshlands. On a gradient from the Big Hill site to the Gulf of Mexico, the marshlands range from fresh-brackish to brackish.[36]

Although chloride is essential to life, it is toxic to most organisms at the high concentrations found in brine. EPA has established ambient water quality criteria for chloride for freshwater aquatic life (860 mg/l acute toxicity, 230 mg/l chronic toxicity). There is an extensive body of literature on the biological effects of elevated salinity.[37] Many species have evolved means of surviving in conditions of high or highly variable salinity.[38] The water bodies and marshes near Big Hill are characterized by highly variable salinity (euryhaline), and the organisms found there are adapted to these conditions.[39] Despite the tolerance of biota in this region to salinity changes, the chloride concentrations in brine from Big Hill (204 to 263 parts per thousand) would be an order of magnitude higher than naturally occurring concentrations. An undiluted brine spill could expose biota in affected areas to chloride concentrations well above natural levels and well above the acute and chronic criteria for aquatic life. A brine spill also could cause a significant, but temporary and localized, disruption of ecological structure and function. In many respects, the ecological disruption caused by a brine spill would be similar to the disruptions caused by an oil spill. In the impacted area a change in community compositions would occur. The affected area would initially be repopulated by heartier, salt-tolerant species. Pioneer species (i.e., species not occurring at the site prior to the spill) might colonize the site, as they did following the Bryan Mound spill.[40] In time, species succession would return the community to Gulf Coast composition. Only in the most heavily disturbed areas would habitat restoration be necessary to facilitate ecological recovery.

The impacts of a spill from the Big Hill brine pipeline can be estimated from an actual spill that occurred from the Bryan Mound brine pipeline in 1989. The potentially affected environments of these two sites are very similar. Multiple leaks in the Bryan Mound brine pipeline resulted in the release of 825,000 barrels of brine to marshlands, ponds, and the ICW over a period of eight weeks. The severity of impacts in the affected habitats was directly related to the amount of freshwater flushing. The most heavily impacted area was a poorly drained marsh in which all vegetation died. While regrowth of vegetation began in the better drained wetlands within four months of the spill, mitigation will be required to stimulate revegetation of the most severely impacted area. In contrast, there was no observed impact to surface water or sediment quality, or to biota, of the ICW despite large brine releases. In the moderately drained marshlands and ponds, chloride concentrations in surface waters and sediments had returned to normal in two months. In the poorly drained marshlands, concentrations returned to normal (pre-spill) levels in four months. The decay of organic matter in the ponds caused temporarily depressed levels of dissolved oxygen and increased temperatures.[41]

In general, a brine spill of this magnitude has been a rare event in the historical operations of the SPR (see section 6.2). No spill of this magnitude has occurred at Big Hill in the past and the potential for such a spill in the future would be limited by regular pipeline monitoring and by the existing structural integrity of the pipeline (as outlined in Chapter 3, the pipeline integrity study completed after leaching operations at Big Hill have confirmed that approximately 65 percent of all pipeline walls remained). As outlined in section 6.2, statistics on historical brine spills at SPR sites indicate that the proposed expansion at Big Hill could result in one large spill of 74,000 barrels or more. If such a spill did in fact occur, the experience at Bryan Mound shows that a large release of brine could have significant impacts on the marshlands near Big Hill, but would not seriously impact the ICW. Salt Bayou and the tributary to Star Lake are small water bodies with smaller flows than that of the ICW. A brine spill to these water bodies could cause more significant impacts, although freshwater flushing would enable natural recovery.

7.1.4 Air Quality Impacts

Air quality in the vicinity of the Big Hill site and along pipeline ROWs would likely be affected only slightly during construction. Emissions would generally be short-term and be dispersed over a small area. Most emissions during operation would also be small. The principal pollutant of concern would be volatile hydrocarbons emitted during cavern development.

7.1.4.1 Particulates, Sulfur Dioxide, Carbon Monoxide, and Nitrogen Oxides

Previous studies have provided estimates of air quality impacts for development of a 100-MMB storage facility at Big Hill and have concluded that many of the potential emissions sources would have a negligible impact.[42] The largest sources of fugitive dust emissions were estimated to be site preparation activities, such as landclearing and grading; an emission rate of about 13,000 tons per year was predicted for construction at the salt dome and terminal sites and along the pipeline ROWs. This estimate was based on a factor of 1.2 tons of dust per acre of construction per month of activity, which was derived for a semiarid climate. Thus, the factor may be considered conservative for the humid climate of the Gulf Coast.

The only other significant source of fugitive dust was associated with the use of unpaved roads during the construction phase, and an emission rate of 269 tons per year was predicted for unpaved access roads at the salt dome and terminal sites. This rate was based on representative values for silt content of the road, vehicle speed, regional rainfall, and road usage. Emissions from unpaved roads were expected to have a very local impact on ambient air quality. Exhaust emissions were anticipated from heavy-duty, diesel-powered construction equipment; automobiles and light-duty, gasoline-powered trucks; and drill rigs used for drilling new wells. Total annual emission rates were estimated to include nine tons of sulfur dioxide (SO_2), 32 tons of carbon monoxide (CO), 134 tons of nitrogen dioxide (NO_2), and nine tons of particulates. These emissions were expected to have a minimal impact on ambient air quality. Emissions from a 100-MMB expansion at the Big Hill site would be expected to be less than emissions from development of a new 100-MMB facility.

During facility operation, emissions from unpaved roads have been identified as potential sources of pollution. A one-year monitoring program measured total suspended particulate levels at five SPR storage sites and at the St. James Terminal in 1982-83.[43] The levels were found to meet primary and secondary annual and 24-hour standards at each site except for Weeks Island, where fugitive dust emissions were subsequently alleviated by paving the main entrance road. At other sites, including Big Hill, unpaved plant roads are sprinkled with water and/or chemicals (e.g., calcium chloride, Raybinder (active ingredient sodium ligno-sulfonate)) to control dust emissions. Other potential sources of emissions are the stationary diesel engines, which are used to provide power to emergency electric generators or fire water pumps and can emit small amounts of nitrogen oxides, SO_2, suspended particulates, and CO. Those engines would, however, only be used during emergencies or tests.

7.1.4.2 Volatile Hydrocarbons

During the cavern leaching process, small amounts of hydrocarbons are present in the produced brine as a result of contact with the overlying layer of oil. A portion of these hydrocarbons are in the vapor phase. As the pumped brine is introduced into the oil/brine separator or the brine ponds, the hydrocarbon vapors are emitted to the atmosphere.

The emission rate for non-methane hydrocarbons (NMHC) under any phase of cavern development is a function of hydrocarbon content in the brine and the brine pumping rate. Assuming complete volatilization of NMHC in the brine, NMHC emissions are calculated as follows:

$$\text{NMHC Emissions} = \text{NMHC in Brine (ppm} \times 10^{-6}) \times \text{Pumping Rate (bbl/day)} \times (42 \text{ gal/bbl}) \times \text{Brine Density (lb/gal)}$$

This equation conservatively assumes that all of the hydrocarbon in the extracted brine is emitted to the atmosphere at the cavern storage site. The location of these emissions would be either the oil/brine separator or the brine ponds. The pumping rate varies depending on the stage of cavern development. Pumping of brine is at a maximum during the leaching operations. A smaller amount of brine production occurs during the final fill and refill stages. Testing of the brine at the Bryan Mound caverns has shown a brine density at a fairly consistent value of 1.2 g/ml (10.0 lb/gal).[44]

Table 7.1-1 shows the NMHC emission rates that would be associated with cavern development for 100-MMB of storage. The brine NMHC concentrations were determined with a combination of measured brines at the Bryan Mound caverns during the various development phases and equilibrium solubility calculations.[45] The emission estimates assume that all of the caverns are to be of a 10-MMB capacity and that the development of all caverns at a site occur simultaneously. No adjustments for downtime or intermittent operations have been included in the estimates, and the values should be considered conservative maximum values.

Table 7.1-1
Non-Methane Hydrocarbon Emission Rates Associated with Salt Dome Cavern Development (100 MMB)

Activity	Period	Brine Production	Brine NMHC Conc.	Short-Term Emissions (g/s)	Annual Ave. Emissions (tons)
LEACH ONLY	638 days	1.5 MMBD	0.26 ppm	0.57	19.9
LEACH/FILL	539 days	1.5 MMBD	1.5 ppm	3.31	115.0
FINAL FILL	200 days	0.3 MMBD	2.6 ppm	1.15	21.9
REFILL ONLY	500 days	0.3 MMBD	1.9 ppm	0.84	29.2

Note: The above estimates are based on simultaneous development of all 10 caverns.
Source: Based on *Strategic Petroleum Reserve Phase III Development Environmental Impact Statement*, DOE/EIS-0075, Appendix C.2.

The period of greatest emissions, based on projections from data taken during leaching at Bryan Mound, would be the leach/fill process. Emissions would be lower during the leach only phase, presumably because of the rather limited area of oil/brine interface. After the leach/fill process is completed, the emissions of reactive hydrocarbons at the storage site should never exceed 30 tons per year. When the storage sites are filled and in a standby mode, the emissions would be negligible.

A relatively small quantity of NMHC emissions may be associated with other sources at salt dome cavern sites. These include internal combustion engines described above, paint vapors, tanks, valves, and seals.

The peak hourly emissions of NMHC from all sources at any storage site would be expected to be less than the emissions at the St. James Terminal during standby. As described in section 7.6.4, the results of the modeling of the St. James Terminal suggest that during standby there would be negligible impacts on the generation of ozone in the area. The potential for ozone generation due to hydrocarbon emissions at a storage site may not be the same as at the St.

James Terminal because of differences in meteorological conditions, hydrocarbon speciation, and the mixture of ozone precursors from other sources. It would appear, however, that the emissions of reactive hydrocarbons from a storage site are likely to be much too small to produce any significant impact on ozone production.

Actual emissions may be substantially lower than the conservative maximum estimates. For example, at the Sulphur Mines site, hydrocarbon emissions from the brine pond, slop oil tank, pump seals, and valves totaled 9.4 tons from 1979 to 1984.[46] According to the Emissions Inventory Questionnaire for the Bayou Choctaw site submitted in 1987, total emissions from the facility were calculated to be fewer than ten tons per year, even during fill operations.[47] At Bryan Mound, monitoring for fugitive emissions from valves and seals typically shows no "leaks" (defined as emissions exceeding 10,000 ppm). At all sites, calculated emissions based on throughput are routinely less than projected or permitted amounts.

7.1.4.3 Potential Impacts on Global Climate Change

SPR facilities are not significant sources of carbon dioxide, which contributes to global warming through the greenhouse effect, or chlorofluorocarbons and halons, which break down the stratospheric ozone layer. Emissions of hydrocarbons, the primary air pollutant associated with SPR activities, are not expected to affect global climate. Consequently, activities at the proposed SPR sites would not have a significant impact on global climate change.

7.1.5 Potential Impacts to Terrestrial Ecology and Wetlands

This section discusses potential impacts to terrestrial ecology and wetlands that could be caused by the construction and maintenance of the proposed Big Hill expansion. It is organized into separate sections addressing impacts at and nearby the site and impacts along proposed pipeline routes. Under the 270-day drawdown criterion, no pipeline construction would be required, so the only ecological impacts would be in the vicinity of the site. Under a 180-day criterion, a new crude oil pipeline to East Houston would be constructed; the ecological impacts of that pipeline are discussed in section 7.1.5.2. Potential impacts to surface water and aquatic ecology associated with these activities are discussed above (see section 7.1.3).

7.1.5.1 Potential Impacts at and Nearby the Site

The major potential ecological impacts would occur during the construction phase of the project, although potential impacts during operations and maintenance are also discussed below.

Site Construction

As part of the construction of the proposed site, vegetation within the site boundary would be partially or completely cleared, and the site would be fenced for security reasons. Based on the proposed site configuration, this could result in the loss of the use by wildlife of up to 150 acres for the lifetime of the program. Based on site visits and aerial photographs, the site is predominantly scrub-shrub uplands with interspersed open meadows (i.e., old fields in early stages of secondary succession). There are no wetlands on the proposed property.

Construction impacts on the plant communities surrounding the proposed site would likely be minimal. No threatened or endangered plants are known to occur in the general vicinity of the proposed site, although a site-specific endangered species survey would be conducted prior to any site development.

Based on soil erosion calculations presented in Appendix O, an estimated 2,720 tons of soil could be lost from the site during construction if no mitigation were performed. Approximately 1,510 tons would be transported towards the west, and 1,210 tons would be transported towards the east. The majority of this eroded soil would eventually be deposited in the margins of the wetlands south and east of the site. The wetlands in these marginal areas could be impacted by deposition of sediment around vegetation with possible smothering of some of the less robust vegetation. Because mitigation measures (as discussed in Chapter 8) would be used to reduce the total amount of soil eroding from the site, the majority of the vegetation would recover, such that the impacts would probably be temporary, with no permanent adverse effects.

Clearing and construction would result in the destruction or alteration of vegetation, displacement of terrestrial wildlife species inhabiting the 150 acres on which the site would be constructed. The number of individuals from any given species that would be displaced as a result of construction would vary depending on species-specific habitat requirements and population densities. The displacement of wildlife species from the proposed site would not be likely to impact the wildlife community of the surrounding area. Wildlife that would be displaced from the area could disperse to suitable habitats in nearby areas, which are largely undeveloped and used primarily for agriculture or limited petroleum storage.

Construction of the proposed site also could result in the destruction of individuals of smaller wildlife species, such as salamanders, skunks, snakes, and small rodents which are less visible and could be caught under operating machinery or under graded material. Additionally, increased traffic on Big Hill Road during construction could result in an increased loss of wildlife, particularly of smaller species or of the young of larger species. For example, alligators, which are common in the area, often bask in the sun along Big Hill Road; an increase in traffic could result in an increase in traffic deaths of these animals. However, construction or traffic-related losses would be unlikely to significantly impact the wildlife populations in surrounding areas given that similar adjacent areas observed during the field visit are likely to contain a large population relative to the number of individuals lost as a direct result of construction or increased traffic.

Increased traffic and human activity during construction also could disrupt movements of some wildlife species in the area. Further, increased noise could affect intra- and inter-species interactions by masking vocalizations necessary for rearing of young or for predator detection or defense. It is considered unlikely that species would suffer long-term impacts from these types of disturbances.

Site Operation and Maintenance

The site would be securely fenced for the lifetime of the program, and therefore access would be restricted for many species of wildlife. The vegetated areas of the property would be mowed frequently and would be of little value as wildlife habitat.

Operations at the site would include water intake, cavern leaching, brine disposal, and oil transport. Under normal operating conditions, impacts to terrestrial wildlife from site operations should be minimal. Vegetation in the immediate vicinity of the brine ponds could potentially be impacted by brine spray drift. The severity of impacts would depend upon the sensitivity of the vegetation species, which would most likely be restricted to natural grasses. Wildlife near the site could be disrupted by the increased human activity and traffic associated with site operations, although these are not likely to vary much from conditions at the existing site to which local wildlife has become somewhat adapted.

The potential exists for impacts to wildlife from leaks or spills from the on-site pipelines, above-ground oil holding tanks, and brine ponds. The severity of impacts would be determined largely by the severity of the spill. Spills from the raw water pipelines would have minimal impacts on local wildlife. Oil spills or brine spills could adversely affect the habitat and wildlife in the immediate vicinity of the spill. Such spills could result in immediate loss of vegetation as well as possible long-term impacts during recovery. Provided that spills are detected immediately and contained, impacts to the extensive wetlands to the south of the facility (see Figure 5.1-4) probably would be minimal. In the event that a spill is not detected quickly, vegetation, especially in poorly drained areas, would be severely impacted and it would possibly take several years to regenerate. This was the experience at Bryan Mound following a large brine spill in 1989 (see section 7.1.3.4).

The vegetation along the fenceline and in other facility areas inaccessible to a conventional mower (e.g., under some of the on-site equipment) could be controlled by spraying with herbicides. All herbicides to be used would meet all Federal, State, and local pesticide and herbicide regulations, and all herbicides used would be registered with the appropriate State agricultural agency. Provided that these herbicides are used properly, adverse impacts to off-site vegetation and terrestrial or aquatic life would not be expected.

7.1.5.2 Potential Impacts due to Pipeline Construction and Maintenance

The raw water intake and brine pipelines at the existing Big Hill site would be used during development phases of the additional caverns at the proposed site; the proposed pipeline construction, required only under a 180-day drawdown criterion, would be a crude oil distribution pipeline to East Houston. Two proposed pipeline routes are assessed: the Trinity Bay route, which is the more southern route and crosses through Trinity Bay, and the I-10 route, which crosses north of the bay along the existing I-10 ROW.

Pipeline Construction

Table 7.1-2 presents a summary of the types and estimated acreage of wetlands that would be crossed along the Trinity Bay route. The figures presented here assume a 150-foot ROW. Out of a total of 876 acres of land that could be impacted during construction of the crude oil pipeline, only 148 acres (17 percent) are wetlands. The majority of the wetland acreage is palustrine emergent, of which approximately 54.3 acres could be impacted.

Table 7.1-3 presents a similar summary for the I-10 route. Out of a total of 1,119 acres crossed by the I-10 pipeline route, 235 acres (21 percent) are wetlands. The majority of the wetlands potentially affected are palustrine emergent (115 acres), and palustrine scrub-shrub (42 acres) wetlands. Lower perennial and tidal riverine wetlands comprise 36 acres of the potentially affected ROW.

Table 7.1-2
Types and Acreage of Wetlands Crossed by the Proposed Trinity Bay Crude Oil Pipeline from Big Hill to East Houston

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE WETLANDS -- TOTAL	41	28	5
A. Subtidal, open water/unknown bottom	14	10	2
B. Intertidal	27	18	3
II. LACUSTRINE WETLANDS -- TOTAL All lacustrine wetlands for this proposed site are limnetic, open water/unknown bottom, non-tidal, permanently flooded, and diked/impounded	9	6	1
III. PALUSTRINE WETLANDS -- TOTAL	87	59	10
A. Emergent, persistent	54	37	6
B. Forested, deciduous	8	5	1
C. Open water/unknown bottom, excavated	4	3	<1
D. Scrub shrub, deciduous	10	7	1
E. Emergent/persistent scrub shrub, temporarily flooded	11	7	1
IV. RIVERINE WETLANDS -- TOTAL	3	2	<1
A. Tidal, open water/unknown bottom, permanent-tidal	1	<1	<1
B. Lower perennial, open water/unknown bottom, permanently flooded, excavated	1	<1	<1
C. Intermittent, streambed, seasonally flooded, excavated	1	<1	<1
V. UNCLASSIFIED WETLANDS	8	5	<1
VI. BAYS -- TOTAL DISTANCE CROSSED (miles)	11	--	--
VII. NON-WETLANDS -- TOTAL	727	--	83
VIII. LAND UNABLE TO CLASSIFY	3	--	<1
WETLANDS -- TOTAL ACREAGE	148	100	17
TOTAL ACREAGE*	875	--	100

*Note -- Total acreage does not include portions of the proposed pipeline that cross bays, or land that could not be classified as wetlands and uplands. Acreages assume a 150-foot ROW in all areas.

Source: Based on National Wetlands Inventory Maps.

Table 7.1-3
Types and Acreage of Wetlands Crossed by the
I-10 Crude Oil Pipeline from Big Hill to East Houston

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE WETLANDS -- TOTAL			
A. Subtidal, open water/un nown bottom B. Intertidal	<1	<1	<1
II. LACUSTRINE WETLANDS -- TOTAL All lacustrine wetlands for this proposed site are littoral, flat, and permanent tidal	5	2	<1
III. PALUSTRINE WETLANDS -- TOTAL	184	78	16
A. Aquatic bed, un nown surface, seasonal and excavated	<1	<1	<1
B. Emergent, persistent	115	49	10
C. Forested, deciduous	22	9	2
D. Open water/unknown bottom, excavated	5	2	<1
E. Scrub shrub, deciduous	42	18	4
F. Unconsolidated bottom, permanent	<1	<1	<1
IV. RIVERINE WETLANDS -- TOTAL	36	15	3
A. Tidal, open water/unknown bottom, permanent-tidal	14	6	1
B. Lower perennial	22	9	2
C. Unconsolidated bottom, permanently flooded, excavated	<1	<1	<1
V. UNCLASSIFIED WETLANDS	9	4	1
VI. NON-WETLANDS -- TOTAL	884	--	79
WETLANDS -- TOTAL ACREAGE	235	100	21
TOTAL ACREAGE	1,119	--	100

Source: Based on National Wetlands Inventory Maps. Acreages assume a 150-foot ROW in all areas.

The proposed I-10 pipeline route would not cross any wildlife refuges. However, the wetlands it would cross are used as a migratory stopover for numerous species of waterfowl and songbirds.

Potential impacts include altered surface drainage patterns and destruction of vegetation. During pipeline construction, disruption of the surrounding wetlands would be minimized, and efforts made to restore the soil over the pipelines so as to prevent alteration of surface topography and flow. Proposed preventive and mitigative measures are discussed in Chapter 8. The pipeline ROW would be allowed to revegetate naturally. It is possible, however, that the species composition would differ from that prior to construction, particularly in forested areas, where trees would be removed from pipeline ROWs.

An additional potential impact could be alteration of hydrology and introduction of saltwater into freshwater wetlands. This would result in loss of some salt-intolerant plant species, and a shift in community structure towards more salt-tolerant plant species. There are four locations along the Trinity Bay route that would cross a freshwater/saltwater interface, including (from west to east): (1) where the pipeline crosses Buffalo Bayou (also the Houston Ship Channel), (2) where it leaves Tabbs Bay (south of Baytown), (3) where it crosses Cedar Bayou (also south of Baytown), and (4) where it leaves Trinity Bay. The proposed I-10 route crosses the San Jacinto River in a northern freshwater area, and, therefore, there would be no potential for saltwater intrusion.

Based on a Gulf Coast Ecological Inventory Map (USFWS 1982), the proposed Trinity Bay route to East Houston would not cross any areas identified as potential breeding grounds or nurseries for any endangered species, and also would not cross any lands designated as wildlife refuges (see section 5.1.5.2). The proposed pipeline would cross approximately eleven miles of the northern portion of Galveston Bay, an important breeding ground for many important aquatic species, both finfish and shellfish (impacts of this pipeline construction to aquatic species are described in detail in section 7.1.3.3). Construction of the pipeline, however, is not expected to significantly affect oyster beds in Trinity Bay, because the closest oyster beds are approximately three miles to the south of the proposed ROW along the Bay's western shore. The pipeline would cross extensive beds of brackish water clams in the northern portion of Trinity Bay (these clams have no market value), as well as seagrass beds on the Bay's eastern shore. Finfish and other more mobile species would probably re-inhabit a disturbed area soon after construction is completed. Destroyed or disrupted portions of clam beds and seagrass beds would take longer to re-establish. Ecological areas of interest that would be crossed by the oil pipeline and species which may occur along the proposed pipeline route are discussed in section 5.1.5.2. Wildlife species that use areas in the projected pipeline ROW would be temporarily displaced. Abandonment of nearby nests could occur if pipeline construction occurred during the breeding/nesting season.

Pipeline Maintenance

Maintenance of the pipeline ROWs and the pipelines would be unlikely to adversely impact wildlife. Any impacts such as disruption and temporary displacement during inspections would be minimal when compared with the potential impacts that could occur if the pipelines were not properly maintained. The pipeline ROWs would be inspected on a biweekly basis, and any abnormal observations would be addressed immediately. The ROWs would be maintained by manual methods (e.g., use of tractors) and in the very small fraction of inaccessible areas by aerial application of herbicides. Provided that the limited herbicide application is done properly (e.g., herbicides are not applied to wetland areas) adverse impacts would be unlikely.

7.1.5.3 Summary of Wetlands Potentially Affected

Under the 270-day drawdown criterion, no wetlands would be affected by development of the Big Hill site.

Under a 180-day drawdown criterion, a crude oil distribution pipeline would be constructed along one of two alternative routes. If the Trinity Bay route was selected, a total of 148 acres of wetlands could be affected. The majority of these (87 acres) would be palustrine (emergent and scrub-shrub) wetlands. Approximately 41 acres of estuarine wetlands would also be affected. If the I-10 route was selected, a total of 235 acres of wetlands could be affected. For this route, the majority would also be palustrine (emergent and scrub-shrub) wetlands, with smaller amounts of riverine, lacustrine and unclassified wetlands potentially impacted.

7.1.6 Floodplains Impacts

The Big Hill site expansion is entirely outside any floodplains, and thus, site construction should have no potential impacts on floodplains. In addition, because a RWI structure is already in place at Big Hill, there would be no additional impacts from RWI structure construction or operation. All pipelines pass through a floodplain for at least some part of their length; therefore, construction crews would take measures to minimize and mitigate impacts to floodplains as discussed in Chapter 8. Normal construction would include the temporary use of fill, spoil generation, and construction of temporary platforms. Any adverse effects from pipeline construction would be minimal and temporary.

7.1.7 Natural and Scenic Resources Impacts

Big Hill is an existing an SPR facility, and site expansion would take advantage of the existing infrastructure, including the RWI and the brine disposal systems. Construction necessary to expand the facility, therefore, would be limited to preparation of the site and leaching of the new storage caverns.

Impacts to off-site natural and scenic resources would likely be minimal. If a new crude oil distribution pipeline is required, there might be visual impacts during construction, but they would be short-term because of the relatively brief pipeline construction period in any one location. McFaddin National Wildlife Refuge, the closest of the major preserves in the area, would not likely be affected by the pipeline; the remainder of the area's network of wetlands would not be significantly affected by the construction of the Big Hill expansion. The other refuges and parks in the vicinity would also not likely be affected.

7.1.8 Archaeological, Historical, and Cultural Impacts

No recorded archeological or historic sites arc located within the Big Hill salt dome project area or the proposed pipeline routes, therefore, no impact on such resources would be anticipated.[48] It is possible, however, that unrecorded sites would be encountered by the project.

7.1.9 Socioeconomic Impacts

The socioeconomic impacts of an expansion of the Big Hill SPR would be relatively minor under either a 270-day or 180-day drawdown criterion due to the size of the project relative to the regional economy. The region's existing infrastructure including housing, education, health care, and transportation systems could likely readily absorb both temporary and permanent in-migrating workers and their families. The largest economic impact could be positive through the additional flow of project money and wages into the local and regional economy.

Socioeconomic impacts would first occur during the construction phase which would be expected to take approximately three years. The initial work on facility expansion would involve site preparation, well drilling, and cavern leaching and would take between 12 and 18 months to complete. Construction of the remaining site facilities, including security and the crude oil distribution system (under a 180-day drawdown criterion) would require about 33 to 39 months. Employment levels in general would increase over the duration of the construction period. For example, during the first year of construction, manpower requirements are estimated at 45 construction workers, whereas in the third year the number of workers at the site would likely increase to 80. Under a 180-day drawdown criterion, an additional 118 workers would be used for pipeline construction during the third year. The number of workers during the third year of construction would peak at about 200 (Table 7.1-4). Under the 270-day criterion, no workers would be involved in pipeline construction in the third year.

Site construction personnel would include civil, electrical, instrumentation, and drilling engineers, pipe fitters and mechanics, subcontractors, and facility, drilling, and pipeline managers. Pipeline construction workers needed for a 180-day criterion would include welders, equipment operators, barge and diver crews, and X-ray technicians.

Upon completion of the expanded site, an additional 20 employees would be added to the current permanent work force of approximately 160 workers. These additional workers would support normal operation and maintenance activities and would include security personnel, environmental and laboratory workers, cavern engineers, safety specialists, and property managers.

7.1.9.1 Demographic Changes

Changes in local population arising from the construction and operation of the additional storage and pipeline facilities at Big Hill would occur if some workers relocate in the area. Although all construction workers would have to commute to the Big Hill site itself, most of these workers would likely be drawn from the current local work force. Another portion of the eventual work force, currently residing beyond reasonable commuting distance might relocate to the area.

Approximately 75 percent of the current Big Hill work force lives within a 30-mile radius of the site while the remaining workers live between 30 and 60 miles from the site. This impact analysis assumes that construction workers employed for a Big Hill expansion would reside in a pattern similar to the existing work force; that is, workers choosing to move into the area to work at the site would locate within a 30-mile radius.

To estimate potential demographic changes resulting from an expansion of Big Hill, a simple, linear, in-migration model was used. This model uses assumptions about worker characteristics to estimate first order demographic changes. The assumptions include the percentage of work force that would relocate to the area, family size, and percentage of school-age children per family. The family size multipliers and percentage of school age children are based on census data and on prior DOE research on construction labor force.

The model does not estimate second order demographic changes, that is, the multiplier effects of in-migration. The model was used to develop two potential scenarios. A baseline scenario represents likely events given the current socioeconomic conditions in the Gulf Coast

Table 7.1-4
Estimated Labor Force for Expansion of Big Hill

	Construction Phase						Operations Phase	
	Year One		Year Two		Year Three		Year Four	
	180-Day	270-Day	180-Day	270-Day	180-Day	270-Day	180-Day	270-Day
Site Construction	45	45	65	65	80	80	--	--
Pipeline Construction	--	--	--	--	118	--	--	--
Operation & Maintenance	--	--	--	--	--	--	20	20
Total Employees	45	45	65	65	198	80	20	20

Source: PB-KBB, Inc., ROW Study; Boeing Petroleum Services.

Region (e.g., the unemployment rate). A high impact scenario, using liberal assumptions about the degree of in-migration, was developed to set an upper limit.

The baseline scenario assumes that only 20 percent of the new workers would move from outside the region to within 30 miles of the facility. This assumption is based on the relatively high availability of skilled workers within 30 miles and the moderately high unemployment rates in this area for these job categories. Because the construction phase is fairly short term, it is assumed that only one in four relocating workers would be accompanied by family members. For those relocating with family members, average family size is assumed to be 3.3 persons and 65 percent of the children are assumed to be school age.

In the high impact scenario, the model assumes that 75 percent of all workers relocate from outside the region and that 80 percent of these workers relocate with family members. Average family size is assumed to consist of 3.6 persons, and that 65 percent of the children are of school age. In both scenarios, direct demographic impacts may be somewhat overstated in the second and third year of construction, because it is less likely that new workers would relocate or bring family members with them for such a short duration. Moreover, longer term impacts might also be less than implied by this analysis because the model assumes no out-migration of temporary workers over the duration of the project. Hence, construction workers and their families that would relocate to the region in the third year of construction are assumed to have the same impact as the permanent worker population.

The results of these assumptions are shown in Tables 7.1-5 and 7.1-6. In the baseline scenario for the 270-day drawdown criterion, total population in-migration would increase from 14 to 25 over the three years of the construction project (Table 7.1-5). This total includes 16 workers and three school-age children by the end of the third year. Under a 180-day drawdown

Table 7.1-5
Big Hill Site and Pipeline Construction In-Migration
Baseline and High Impact Scenarios

Population Category	Year One	Year Two	Year Three	
			180-Day Alternative	270-Day Alternative
Baseline Scenario				
Total Average Work Force	45	65	198	80
Total In-Migrating Workers	9	13	40	16
Total Family Members	5	8	23	9
Total In-Migrating Population	14	21	63	25
Total School Children	2	3	8	3
High Impact Scenario				
Total Average Work Force	45	65	198	80
Total In-Migrating Workers	34	49	149	60
Total Family Members	70	101	308	125
Total In-Migrating Population	104	150	457	185
Total School Children	28	40	123	42

Table 7.1-6
Big Hill Operation and Maintenance In-Migration*

Population Category	Number*
Total Additional Work Force	20
Total In-Migrating Workers	15
Total Family Members	31
Total In-Migrating Population	46
Total School Children	12

* High impact scenario used.

criterion, total in-migration would reach 63 by the end of the construction project (Table 7.1-4). This total includes 40 workers and eight school-age children.

Under the high impact scenario for the 270-day drawdown criterion, in-migration would total 185 over the three years of construction. At the time of the peak work force of 80 people, 60 workers are assumed to in-migrate bringing school-age children. The high impact case assumes that at least 60 workers would move to the area for the third year of construction and bring with them 42 school-age children.

In the high impact scenario for a 180-day drawdown criterion, in-migration would build from 104 to 457 over the three years of construction. At the time of the peak work force of 198 people, 149 workers are assumed to in-migrate (implying that only 49 local residents are hired) bringing 123 school-age children. The high impact case assumes that at least 100 workers would move to the area by the third year of construction and bring with them 123 school-age children.

To estimate the potential in-migration impact of 20 permanent workers, the high impact multipliers illustrated in Table 7.1-6 were used because it is more likely that permanent workers would locate in the area.

This analysis does not take into account potential demographic effects of other activities associated with the expansion of the Big Hill site. Much of the material and equipment needed for construction might be obtained from vendors in the area, creating additional demand for workers in industries that manufacture and/or sell necessary materials and equipment. Moreover, as the buying power of those who work on the project and in the industries supplying the project increases, the demand for goods and services in the local economy might increase. Typically, these "ripple" effects generate additional jobs in the service and trade sectors. However, these indirect impacts would not likely affect the regional demography significantly. Any additional job creation would likely be absorbed by the current resident population.

In sum, the total demographic impacts of an expansion of the Big Hill site would likely be negligible. At the peak of construction activity, it is estimated that even under the 180-day alternative, only 457 people would relocate within 30 miles of the site. Even including the additional 46 people expected to relocate for operational phase of the project, the total population increase for incorporated towns within 30 miles of the site would be about 0.2 percent (Table 7.1-7).

7.1.9.2 Economic Impacts

Direct economic impacts of SPR expansion at Big Hill would include the additional income from new jobs created during project construction, increased demand for local supplies and materials used for construction and operation, and increased expenditures in the local economy by project. These direct impacts would likely have multiplier effects on the regional economy, particularly in the local trade and services sectors.

No data are currently available on the expected payroll for the Big Hill construction and operational phases. Using prevailing wage rates in the construction industry, DOE estimates that under the 270-day drawdown criterion, approximately $2.3 million in additional income would be generated (Table 7.1-8). Under a 180-day drawdown criterion, approximately $5.7 million in additional income would be generated in the peak year of construction. The impact of these

Table 7.1-7
Population Within 30 Miles of the Big Hill Site

Incorporated City or Town	Population
10-Mile Radius	
Stowell/Winnie (WNW)*	2,545
20-Mile Radius	
Port Arthur (NE)	58,724
Nederland (NE)	16,192
Total incorporated population within 20 miles	**74,916**
25-Mile Radius	
China (NE)	1,144
Port Neches (NE)	12,974
Groves (NE)	16,513
Nome (NW)	448
Total incorporated population within 25 miles	**105,995**
30-Mile Radius	
Bridge City (NE)	8,034
Pine Forest (NE)	709
Beaumont (NE)	114,323
Vidor (NE)	10,935
Rose City (NE)	572
Bevil Oaks (N)	1,350
Anahuac (W)	1,449
Total incorporated population within 30 miles	**243,367**
Maximum Estimated In-Migration	
-- 180-day drawdown alternative	503
-- 270-day drawdown alternative	231

* Unincorporated Towns

Source: United States Geologic Survey Maps; Bureau of the Census, Department of Commerce.

Table 7.1-8
Additional Income Directly Generated from Big Hill Expansion

	Total New Jobs*	Total Annual Worker Earnings	Percent of Regional Earnings
Year 1	45	$1,300,000	0.017
Year 2	65	$1,900,000	0.024
Year 3			
180-Day Criterion	198	$5,700,000	0.075
270-Day Criterion	80	$2,300,000	0.029
Permanent	20	$570,000	0.007

* Totals for new jobs and earning are cumulative.
Source: Boeing Petroleum Services, Bureau of Labor Statistics.

earnings would be increased somewhat by the multiplier effects of local spending. Nevertheless, as seen in the table, the additional income directly generated by the project would likely be small relative to regional earnings.

There could be larger impacts on the region's economy depending on the degree to which the project procures goods and service from within the area. It is estimated that the cost of the Big Hill expansion would be between $307 million and $547 million over three years depending on the alternative selected. If as much as 30 percent of this total were spent on goods and services purchased locally, this would add between one to two percent to the region's total earnings. If multiplier effects are taken into account, the impact would be larger. However, once construction is completed the positive economic impacts of the site expansion would diminish.

7.1.9.3 Impacts on Energy Consumption

At the current Big Hill facility, the typical peak load (highest demand for power at any one instant) for drawdown would fall in the 18-22 megawatt (MW) range. Peak load figures are usually low at the beginning of a drawdown because pressure within the caverns enhances outflow of the oil; peak load levels increase near the end of drawdown when more pump power is needed. The current facility has an interruptible service contract with Gulf State Utilities. This contract includes a certain amount of firm contract power, or power excluded from interruptions, supplemented by an amount of interruptible contract power. Fees for such power are based on prices for firm power only; interruptible power is credited to the facility.

Expansion of the Big Hill facility would not cause any increase in the current demand for power, with the one exception of an additional demand for 500 kVA to meet the lighting load. Energy needs in terms of the raw water intake system would remain the same, and no new pumps would be added. GSU's 138 kV transmission line and tap line which services the DOE substation provide sufficient energy to satisfy the added demand. No new transmission lines would be needed.

7.1.9.4 Impacts of Brine Disposal on Commercial Fisheries

As detailed in Appendix Q, the Big Hill brine diffuser plume documented in tracking studies is less extensive than that predicted by modeling studies conducted prior to disposal. During development of the existing Big Hill facility, no change has been noted in commercial fishery production in the area. As verified in biological assessments for the Bryan Mound and West Hackberry diffuser locations (see Appendix Q), no direct impacts have been observed on nekton communities (e.g., shrimp and other commercial fish). The potential for impact on commercial fishery production of a Big Hill expansion would, therefore, likely be minimal.

7.1.9.5 Impacts on Transportation Systems

The primary impact on transportation systems would be the increased traffic from workers traveling to and from the site during the construction phase. Given that at the peak of construction activity, however, only about 80 workers would be at the site (the remaining work force would be away from the site on pipeline construction), and the current levels of traffic as seen in Table 5.1-10, the marginal increase in congestion would likely be minimal. These impacts would be further diffused by the fact that workers would be commuting on different routes. For example, about 30 percent of the current work force reside in Beaumont and travel to the site primarily via route Interstate 10. Another 25 percent of the workers live in the Winnie/Stowell area and travel to the site using Route 73. The remaining worker population is scattered among various other towns including Nederland and Port Arthur east of the site. Hence, if an additional 60 workers (one person per vehicle) used Interstate 10 and Route 73 from Beaumont and other towns along this route where average daily vehicle traffic volume is approximately 27,000, the percentage increase would be only about 0.2 percent. Similarly small increases would be experienced on other likely travel routes. Given the low probability of accidents along these routes, the condition of the roadways, and the small increase in vehicles relative to the current traffic flow, the increase in accidents would be negligible.

Some additional traffic, however, would arise from trucks removing vegetation from site preparation activities, as well as from construction equipment and vehicles bringing materials for use on site. The largest vehicles needed for construction would include the drilling rig (approximately 120,000 lbs) and the workover rig (about 110,000 lbs). DOE would need to obtain heavy equipment load permits to transport this equipment to the site across Federal and state highways and bridges. This additional traffic would be sporadic and short term. Obtaining a heavy equipment load permit from the State Department of Highways would not present a problem. DOE would repair any roads impacted by the transport of heavy equipment, including bridges that are currently in poor condition and which might pose safety concerns due to increased use during site construction.

Existing access roads appear to be adequate, and no additional access roads would be needed for construction. Construction of on-site roads might be required. These on-site roads would be two-lane and 20 feet wide with additional six foot shoulders.

An additional transportation impact might arise from the construction of the new crude oil pipeline (only under a 180-day criterion) which would cross several major roads. Major road crossings would be accomplished by boring tunnels beneath the road; minor road crossing would be trenched. The major impact from these activities would be temporary traffic delays during construction. Because crossings would be made beneath the roads, no major disruptions would be expected.

7.1.9.6 Housing

Expansion of Big Hill would have no significant impact on housing stock availability. There were a total of 17,043 vacant housing units in the Big Hill region and 5,211 units available in Jefferson County alone. Impacts would be very small under the 270-day drawdown criterion with only 60 new households moving into the area. Even under the high impact scenario for a 180-day criterion, the maximum number of new households in the area would not exceed 149, or the maximum number of in-migrating workers. If all of the workers were to reside in Jefferson County, they would fill less than three percent of the available housing units.

7.1.9.7 Health Care

Under the 270-day drawdown criterion, using the high impact case described above and assuming that all 185 persons would relocate to Jefferson County, the ratio of residents to physicians, and residents to hospital beds would not change. In 1990, Jefferson County had eight hospitals, 1,928 hospital beds, and 503 physicians. This translates to 476 residents per physician and 124 residents per hospital bed. For a 180-day criterion, under the high impact case, the ratio of residents to physicians, and residents to hospital beds also would not change significantly.

7.1.9.8 Education

The estimated number of additional children entering the regional school systems ranges from 20 to 135 (including children of both construction and permanent workers). The total number of school children entering the local school system is about 0.3 percent of current school enrollment of almost 45,000 students in kindergarten through high school. Given that the children would be dispersed among four counties, and two parishes, any impact would be minimal. In fact, the net impact on schools could be positive, because of the additional revenue that would likely be generated through increased payroll taxes from new workers.

7.1.9.9 Fiscal Impacts

The net fiscal impacts of developing the Big Hill facility would likely be minimal. In all, less than 200 acres of property will be acquired. Approximately $150 in property taxes were paid on this land in 1990 based on its agricultural value. While property taxes on the land will be lost to the local government if it were to become Federally owned, given that the project would generate between 80 and 198 temporary jobs and 20 permanent jobs, any shortfall in property tax would more than likely be offset by additional revenues generated from wages and property taxes paid by additional employees. Increased earnings and trade due to secondary effects would also generate local tax revenue to the state and local governments.

7.1.9.10 Emergency Response Capabilities

Consideration of emergency response capability includes the additional demands on emergency response systems resulting from increased resident population as well as emergencies that might result at a facility. Emergency response capabilities for the increased resident population have been described in Chapter 5. The projected population in-migration would likely not adversely affect existing response capabilities. DOE would develop an emergency response plan and would assume the cost of training an on-site spill response team of about 20 employees from different shifts. In addition, DOE would keep a list of major spill contractors on call and commonly enters mutual-aid agreements with local industry for equipment and personnel support during emergencies. The need for upgrades of local emergency response capabilities would not be anticipated, but costs associated with such an upgrade would fall on the local community. Further response capabilities at the sites are described in Chapter 6. This would be true for all the proposed sites, whether in the Seaway or Capline systems and also for any expansion of the St. James Terminal.

7.1.9.11 Oil and Brine Spills

Although the likelihood of an oil or brine spill is generally low (see sections 6.1 and 6.2), several negative socioeconomic impacts could occur as a result of an oil or brine spill associated with the proposed Big Hill expansion. Below, potential socioeconomic impacts resulting from oil and brine spills are discussed, and resources that could be affected are identified.

Socioeconomic Impacts of Oil Spills

The magnitude of socioeconomic impacts of an oil spill on the area surrounding an oil storage site or pipeline could vary tremendously depending on the size and location of the spill. In general, the major negative socioeconomic impacts might include:

- Loss of recreational opportunities, including fishing, hunting, boating, and swimming;
- Damage to commercial fisheries; and
- Damage to other resources and private property.

Oil spills could reduce participation in and enjoyment of recreational activities by polluting water bodies and causing beach closings. For example, some individuals might curtail their boating activity, travel further away to find less polluted water, or enjoy their boating experience less because of a decline in the aesthetic quality of the water. In addition, spills might reduce the abundance of game fish and waterfowl or reduce recreational beach use. Revenues generated from participation in such water-related activities could be diminished. Oil spills into sensitive habitats, such as spawning areas, could have an adverse impact on commercially important finfish and shellfish resources. Biological effects on populations could be linked to decreased catch rates and lower revenues generated in the commercial fishing industry. Other effects of spills into water could include disruption of public water supplies or water used for agricultural and industrial purposes. Finally, spills on land could cause contamination of soil or groundwater and damage to structures or equipment.

Oil spills could also have an indirect effect on the local economy. If an oil spill affects commercial fisheries, for example, associated industries such as fish processing and packaging also could lose income as a result of the spill. These negative economic effects could ripple through the local economy and affect such sectors as retail trade, because individuals employed in directly affected industries spend less.

A large oil spill in one of the numerous ponds, lakes, rivers, or other water bodies near the Big Hill site or along crude oil pipeline routes could affect such activities as boating, fishing, and swimming. Game birds, and other game hunted in the area, might also be adversely affected by an oil spill. The commercial fishing industry is dependent on the abundant supply of fish in the Gulf of Mexico and adjacent water bodies such as Trinity Bay. Oil spills also could affect agricultural resources near the Big Hill pipeline routes. For example, if agricultural land were damaged or irrigation water contaminated by an oil spill, the income that could have been earned from the crops on the damaged land would be considered a loss. Because rice, soybeans, and sorghum are crops grown in the area, damage to the land on which these crops are grown could result in a loss for the farmers of these crops as well as other individuals dependent on these crops. Near the Big Hill site, groundwater is used for livestock and industrial purposes, and even the temporary loss of this water could negatively affect these sectors. An extensive spill could affect several communities that draw water from the aquifers underlying proposed pipeline routes.

Socioeconomic Impacts of Brine Spills

Brine spills could result from equipment failure at the Big Hill site or from pipeline ruptures along the route of the brine disposal pipeline. The potential for a major brine spill along the pipeline would be limited because of regular pipeline monitoring and the remaining structural integrity of the existing pipeline (see section 6.2).

As with an oil spill, negative socioeconomic impacts that could result from a brine spill include:

- The cost of restoration activities to mitigate damages to resources;
- Loss of recreational facilities; and
- Loss of direct and indirect income.

Mitigation would be required to stimulate revegetation and restore habitat in the most severely impacted areas. In general, the magnitude of potential impacts in these habitats would be directly related to the amount of freshwater flushing. For example, a relatively freshwater wetland with limited outlets would be likely to be more severely affected by a brine spill than a wetland with more dynamic freshwater flow.

Costs associated with groundwater restoration also might be incurred as a result of a brine spill. Private well use in the immediate area of the Big Hill site is limited to agricultural (livestock and rice cultivation) and industrial use by oil companies. It is unlikely that a major brine spill would result in a disruption of private or public drinking water supplies, because groundwater in the area is not generally used for drinking and because there are no towns or major groundwater withdrawal centers along the brine pipeline route towards the Gulf of Mexico.

A brine spill in a water body noted for recreational use, such as a lake, pond, or river, might adversely affect recreational activities or result in a loss of recreational facilities. For example, sportfishing would be severely impacted if high brine concentrations severely damaged the indigenous fish population. Similarly, a concentrated spill near the diffuser site in the Gulf of Mexico could temporarily affect fishing in the immediate spill area.

A loss of direct or indirect income also could result from a brine spill, most likely affecting the region's fishing, agricultural, and related industries. Potential impacts associated with brine spills would be similar to the potential impacts oil spills, as described in the previous section. For example, the commercial fishing industry would be affected by a brine spill if the supply of fish were reduced or depleted following a severe spill, which then would result in an economic loss. Similarly, agriculture could be affected by a spill if a high saline concentration destroyed the vegetation necessary to sustain cattle grazing or damage soil used for crop production.

As with an oil spill, these potential socioeconomic impacts could be spread over a large area, affecting many water bodies and productive land. At least six significant water bodies are located within five miles of the site, including Little Lake, Mahaw Bayou, Spindletop Ditch, Willie Slough Gully, and Willow Slough. Key characteristics of each of these water bodies are summarized in Table 5.1-4. These water bodies predominantly are used for irrigation of surrounding rice fields. The existing brine pipeline crosses the Salt Bayou, the ICW, and a tributary to Star Lake, in addition to approximately five miles of marshlands.

7.1.9.12 Prime and Unique Farmlands

The proposed Big Hill expansion site would not affect prime and unique farmlands. The proposed Trinity Bay pipeline right-of-way would indirectly and temporarily convert a total of 380.8 acres of prime and unique farmland, as identified by the U.S. Soil Conservation Service. Of this, 116.9 acres are in Jefferson County, 192.1 acres are in Chambers County, and 71.8 acres are in Harris County. The proposed Interstate 10 pipeline right-of-way would indirectly and temporarily convert a total of 494.1 acres of prime and unique farmland, as identified by the U.S. Soil Conservation Service. Of this, 116.9 acres are in Jefferson County, 224.5 acres are in Chambers County, and 152.7 acres are in Harris County. After construction, the right-of-way will be returned to its original contours and vegetation. The proposed action would not be expected to have a lasting impact on farmlands.[49]

7.1.10 Noise Impacts

Noise impacts resulting from both construction and operation of an expansion of the storage capacity of Big Hill would likely be minor based on past experience with SPR sites, standard noise production values of construction equipment, and on standard attenuation factors. Appendix F discusses the sources of noise impacts.

7.1.10.1 Construction Noise

There are no residences or commercial activity within the impact zone of the Big Hill site. See Table 7.1-9 for a listing of impact zones used in this DEIS. Based on the fact that estimated changes in noise levels would be minor (i.e., a maximum of 67 dBA at 500 feet for 225 days) and that the only operations near the proposed expansion site are SPR-related, no major adverse impacts due to noise would be expected. Because no sound monitoring data are available for the proposed Big Hill expansion site, the estimates from Appendix H of this DEIS were used to determine potential noise impacts. These estimates are based on land uses at the site and establish a baseline from which impacts may be measured.

Current noise levels at the proposed expansion site and predicted impact zone are approximately 53 dBA as determined in the baseline analysis. Estimated changes as a result of SPR operations within the 5,000-foot radius impact zone would be negligible at a distance of less than 1,000 feet from the center of the site.

Table 7.1-9
Construction Noise Impact Zones

Area	Activity	Impact Zone Radius (feet)
SPR Expansion Sites	Drilling New Cavern Wells	5,000
	Support Facilities Construction	2,000
Pipeline Routes	Laying Pipes	1,800
	Access Road Construction	1,600

Source: SPR, *Final EIS for Capline Complex.*

A new crude oil pipeline to East Houston, required only under a 180-day drawdown criterion, would be up 62 miles in length; however, because pipeline construction proceeds at a rate of one-half mile per day, any increases in local sound levels within the pipeline impact zone would be of short duration (i.e., one to two days). No new raw water intake or brine disposal pipeline would be constructed. No major noise impacts, therefore, would be expected as a result of the Big Hill expansion.

7.1.10.2 Operational Noise

Operational noise impact zones at Big Hill were estimated based on noise readings taken near each noise source (i.e., the brine disposal pump pad, a well pad, and the raw water intake pad). A number of readings were taken at each of these locations. By adding the decibel levels from the various sources, the sound level near the brine disposal pump pad was determined to be approximately 106 dBA. Near the well pad, the sound level was estimated at 98 dBA. Thirty feet from the raw water intake pumps, the sound level was 79 dBA. These noise sources would only be present during oil fill, drawdown, or periodic equipment tests. Sound levels when the site is in stand-by mode would be considerably lower.

Using standard attenuation values for a flat surface (see the discussion of calculating attenuation in Appendix H), it was calculated that 500 feet from the brine disposal pad, noise levels would be in the range of 60 dBA. One thousand feet from the brine disposal pad, noise levels would have attenuated to 54 dBA because of atmospheric attenuation. This is only one decibel over the ambient level assumed for all of the potential SPR sites. Similarly, 500 feet from the well pad, atmospheric attenuation would reduce the noise level to the ambient level (i.e., approximately 53 dBA). At a distance of 500 feet from the RWI structure, the noise level would attenuate to 57 dBA and at 1,000 feet it would attenuate to the ambient level.

7.2 Stratton Ridge (Seaway Complex Site)

This section summarizes impacts that could result from construction and operation of an SPR storage site at Stratton Ridge and the associated raw water, brine disposal, and crude oil pipelines. Specifically, this section discusses the potential impacts on the physical, biological, and socioeconomic environment surrounding Stratton Ridge. The existing site-specific environment is described in section 5.2.

7.2.1 Geological Impacts

Like Big Hill there would be four potential adverse environmental impacts related to the geology of the land in the area of the Stratton Ridge site. These include subsidence, seismicity, potential impacts of brine seepage on soils, and impacts associated with the multiple uses of salt domes. None of these potential geological impacts would likely be significant for development of an SPR storage facility at Stratton Ridge.

7.2.1.1 Subsidence

Subsidence has occurred in the areas of the current cavern operations at Stratton Ridge, but the degree varies and predictions of future subsidence are uncertain for the proposed SPR site. Subsidence is causing a saucer-shaped depression to form over the group of caverns owned by Dow Chemical Company, Inc. The data provided by Dow for the period 1986-1990 approximate the rates being experienced at existing SPR sites on other salt domes. The extent of current cavern volume loss is such that perennially wet areas could develop at Stratton Ridge even without SPR development.[50] With SPR expansion the rate of subsidence over individual caverns would increase. Without engineering controls such as paved drainage systems, ponds could form over the individual caverns; however, these controls would be implemented to prevent these ponds from forming. Based on monitoring data from existing SPR sites, impacts associated with subsidence would be limited to the area immediately over the dome. No regional subsidence would occur as a result of SPR expansion at Stratton Ridge. For a general discussion of subsidence, see section 7.1.1.1.

7.2.1.2 Seismicity

No seismic impacts are expected as a result of SPR construction or operation at Stratton Ridge. For a discussion of seismic activity in the region, see section 7.1.1.2. For information on specific faults at the Stratton Ridge salt dome, see section 5.2.1.

7.2.1.3 Potential Impacts of Brine Seepage on Soils

As discussed in section 7.1.1.3, the occurrence of major brine seepage from leached caverns is considered extremely unlikely; therefore, no impacts from brine seepage from storage caverns would be anticipated from the development of a storage facility at Stratton Ridge.

7.2.1.4 Multiple-Use Considerations

Dow, Amoco, Conoco, and Occidental currently operate an extensive cavern field at the Stratton Ridge salt dome consisting of approximately 57 brine and petroleum product storage caverns with a wide range of capacities.[51] Because there has been prior development in the dome, the likelihood of adverse impacts increases.[52] The possibility of an accidental release of light hydrocarbons travelling through caprock fissures to an SPR site from an industrial storage site might constitute a serious potential problem.[53] It is known that corrosion problems have occurred during the existing commercial cavern operations at Stratton Ridge because of the presence of dissolved hydrogen sulfide in groundwater. This hydrogen sulfide could also travel through fissures in the caprock and lead to increased rates of corrosion at the proposed SPR site. Additionally, Dow personnel have expressed concern over having another cavern field adjacent to theirs because the stress fields created by each would overlap. In general, the stability of salt domes decreases as the number of users increases. Impacts of this decreased stability could be exhibited in the form of increased creep closure of caverns. It is difficult, however, to predict what effect, if any, the potential overlapping stress fields would have on cavern integrity at Stratton Ridge.[54]

7.2.2 Hydrogeological Impacts

Like Big Hill, there would be three potential sources of groundwater contamination at Stratton Ridge. These potential sources include brine ponds, oil and brine pipelines, and other material spills on the site. The potential groundwater impacts associated with each of these sources are described in separate sections below.

7.2.2.1 Brine Ponds

The brine disposal system would be similar to the existing Big Hill system. Brine would be pumped from the caverns to a 250,000-barrel anhydrite settling pond to allow insoluble solids to settle, then to a 100,000-barrel pond with oil skimmers to remove oil, and then to a 100,000-barrel brine disposal pond. The brine then would be piped to the Gulf of Mexico for disposal via a diffuser system. Measures to prevent migration from the ponds would include HDPE liners, underdrain systems to detect leachate, and diking to prevent run-off.

Releases that could be expected from the brine ponds include seepage through the synthetic liner to groundwater or overtopping and subsequent seepage to the subsurface. As outlined in section 5.2.2, fresh groundwater in the Upper Chicot aquifer is relatively shallow, about ten feet beneath the land surface, and heavily pumped in the area. Contamination of this shallow aquifer could result in a loss of future groundwater resources for surrounding communities (e.g., Freeport, Clute, and Lake Jackson). There currently are public, industrial, and irrigation/agricultural use wells in the immediate area. If the contamination was not contained and permitted to migrate to a downgradient drinking water well, elevated sodium levels could pose an increased risk of hypertension if consumed by humans and increased chloride levels could give the water an objectionable taste. Additionally, if not contained, brine could discharge into nearby waters and wetland areas and adversely affect aquatic organisms. The nearest downgradient water body from the site is Oyster Creek (approximately 400 feet away), which is designated by the State as a high quality aquatic habitat.

While such releases to groundwater are possible and have been observed at some existing SPR sites in the past, the improved controls planned for the brine ponds at Stratton Ridge would make this an unlikely event (see section 6.2.2).

7.2.2.2 Oil and Brine Pipelines

At the proposed Stratton Ridge facility, brine disposal would be accomplished with a 16-mile, 36-inch pipeline that terminates in the Gulf of Mexico. The only pipeline construction necessary for crude oil would be a one-mile spur from the site to the existing Bryan Mound-Texas

City pipeline. All pipelines would be protected by corrosion control coating and monitored with both pressure gages and volume meters to ensure no leakage is occurring.

Possible releases from the pipeline systems could occur due to erosion, corrosion, over pressurization, or failure of valves and joints. As outlined in Chapter 6, historical spill statistics indicate that there would be less than one expected oil pipeline spill associated with Stratton Ridge fill, refill, or drawdown. Brine pipeline failures at Stratton Ridge could cause up to eight small brine spills (of roughly 75 barrels each) and one larger spill of 74,000 barrels or more. If unmitigated, these spills could result in the migration of brine or oil constituents into groundwater. The impacts of such contamination would be expected to be the same as those characterized above for brine ponds (i.e., potential groundwater resource loss, human health risk, and aquatic ecological risk). While a large brine pipeline leak comparable to the leak at Bryan Mound could occur, the resulting damage at Stratton Ridge would not likely be as extensive because (1) monitoring of pressure gages and volume meters would be performed, (2) the brine and oil pipeline routes would not pass through many wetland environments, and (3) the pipelines would not pass within one mile of population centers except for the town of Surfside.

7.2.2.3 Other Material Spills

Leaks and spills of wastes, solvents, and other materials might occur during normal site operations. Leaks and spills could occur in storage areas, pump platforms, and cavern drain pads. Potential releases of hazardous wastes and materials at the facility would include seepage of oil and grease from equipment operation and maintenance into groundwater, spills and subsequent migration of solvents and solvent wastes, and spills or container failures from poor handling practices. Proposed material handling and spill prevention/mitigation measures would protect against major spills of these materials and their subsequent migration into groundwater (see Chapter 8). In addition, several existing facilities (e.g., Weeks Island) have requested approval for secondary spill containment structures. Construction plans at Stratton Ridge would incorporate these considerations in order to adequately protect the site from groundwater and other environmental impacts.

7.2.3 Surface Water and Aquatic Ecology Impacts

The proposed development of Stratton Ridge could cause: (1) impacts associated with brine disposal in the Gulf of Mexico; (2) impacts associated with raw water intake from the ICW; (3) effects associated with the site and pipeline construction activities; and (4) impacts associated with accidental spills of oil and brine. Each of these potential water quality and aquatic ecology impacts at Stratton Ridge is addressed in a separate section below.

7.2.3.1 Brine Disposal in the Gulf of Mexico

Appendix Q describes the methods and results of a detailed modeling analysis to estimate the magnitude and extent of excess salinity levels in the Gulf of Mexico caused by proposed brine discharges at Stratton Ridge. The modeling results predict the maximum increase in bottom salinity, the vertical extent of the resulting brine plume, and the areal extent and location of different excess salinity contours (e.g., contours of 1 ppt, 2 ppt, 3 ppt, and 4 ppt above natural ambient levels). These predictions are provided for the expected largest plume, typical, and smallest expected plume conditions, defined by different combinations of operational and oceanographic parameters.

Figures 7.2-1 and 7.2-2 show the predicted largest and typical brine plumes, respectively, at Stratton Ridge, assuming all 55 ports of the proposed diffuser are open. Critical dimensions of these plumes are summarized below in Table 7.2-1. For both sets of conditions, the vertical extent or height of the brine jet is predicted to be 18.4 feet, or 17.6 feet below the water surface. The maximum above ambient salinity is predicted to be 4.7 ppt under conservative conditions and 3.8 ppt under more typical conditions.

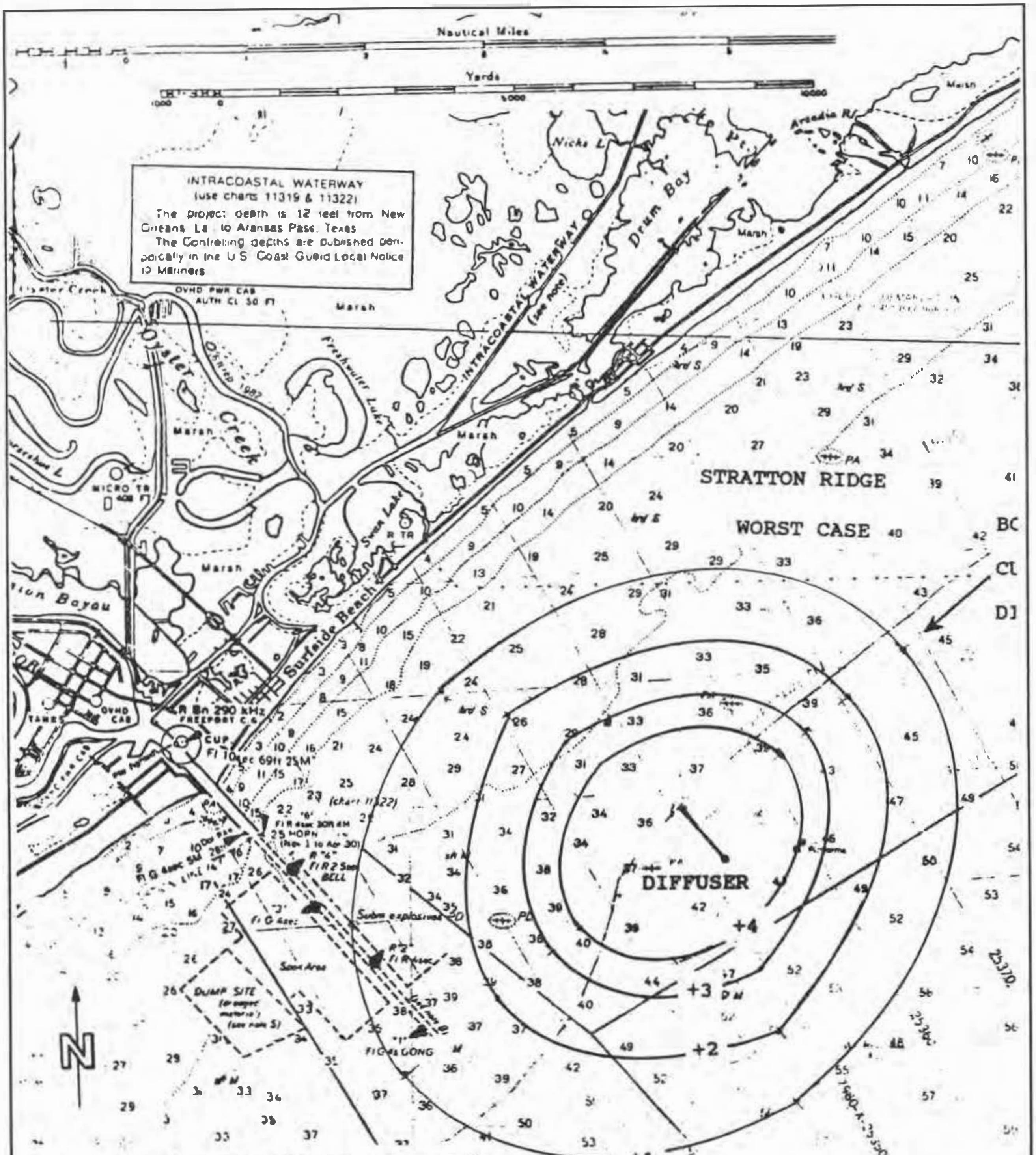
As shown in Figures 7.2-1 and 7.2-2, the plume resulting from proposed brine discharges at Stratton Ridge would not be expected to encroach on the shoreline. Under expected conservative conditions, the +1 contour would be 1.1 miles offshore from Surfside Beach at its closest point, and under more typical conditions, would remain at least 1.7 miles offshore. In actuality, the plume would likely remain even farther offshore than either of these predictions. The model used to generate these estimates conservatively assumes that the sea floor is flat, and thus does not account for the upward slope of the bottom toward the shoreline which would tend to keep the plume farther out to sea than predicted.

DOE also believes that the above predictions for the largest plume tend to overestimate the magnitude and extent of excess salinity levels because they are based on an assumed bottom current of 0.03 m/s. Current roses and joint frequency distribution tables assembled for the Big Hill diffuser site, which are believed to be representative of the proposed Stratton Ridge diffuser site, show that bottom currents as small as 0.03 m/s occur only 8 percent of the time, on average. Therefore, the vast majority of the time, bottom currents are greater than assumed in this modeling exercise and the brine plume would be expected to be smaller and less concentrated than predicted for the largest plume. Based on the frequency of the bottom current used to model typical conditions (0.09 m/s), the plume would more closely resemble the typical plume about 31 percent of the time.

To supplement this modeling analysis of excess salinity levels, DOE analyzed available brine composition data to evaluate the potential for metals and other inorganic constituents in SPR brine to cause adverse impacts when discharged to the Gulf of Mexico. This analysis, documented in Appendix M, indicates that metals and other inorganics expected to be released along with SPR brine should not pose a significant environmental threat. Conservatively estimated concentrations of virtually every constituent near the diffuser are below EPA criteria to protect marine organisms.

Although possible biological impacts associated with the brine plume have not been modeled, field monitoring results from other SPR sites (i.e., West Hackberry and Bryan Mound) that have discharged brine to the Gulf for several years provide strong evidence that the Stratton Ridge brine discharges would cause only minor biological and ecological impacts (Appendix I). Bottom dwelling creatures would likely be affected the most because their exposure to the brine plume, which tends to reside along the bottom, is the greatest. Based on field observations at the West Hackberry and Bryan Mound diffusers, the greatest impact to benthos at Stratton Ridge would likely be a depression in total abundance in an area from as little as 31 acres to as great as 2,000 acres around the diffuser. Experience shows, however, that an increase in diversity might accompany this decrease in abundance. While these changes to benthos might influence the feeding patterns of demersal fish and cause commercially important fish to shift to other areas to feed, no clear or catastrophic effects (e.g., sharp reductions in total biomass) on fish have been observed. Because of the similarity between the Stratton Ridge and Bryan Mound diffuser areas, the same biological impacts could be expected to occur at the Stratton Ridge diffuser site. In

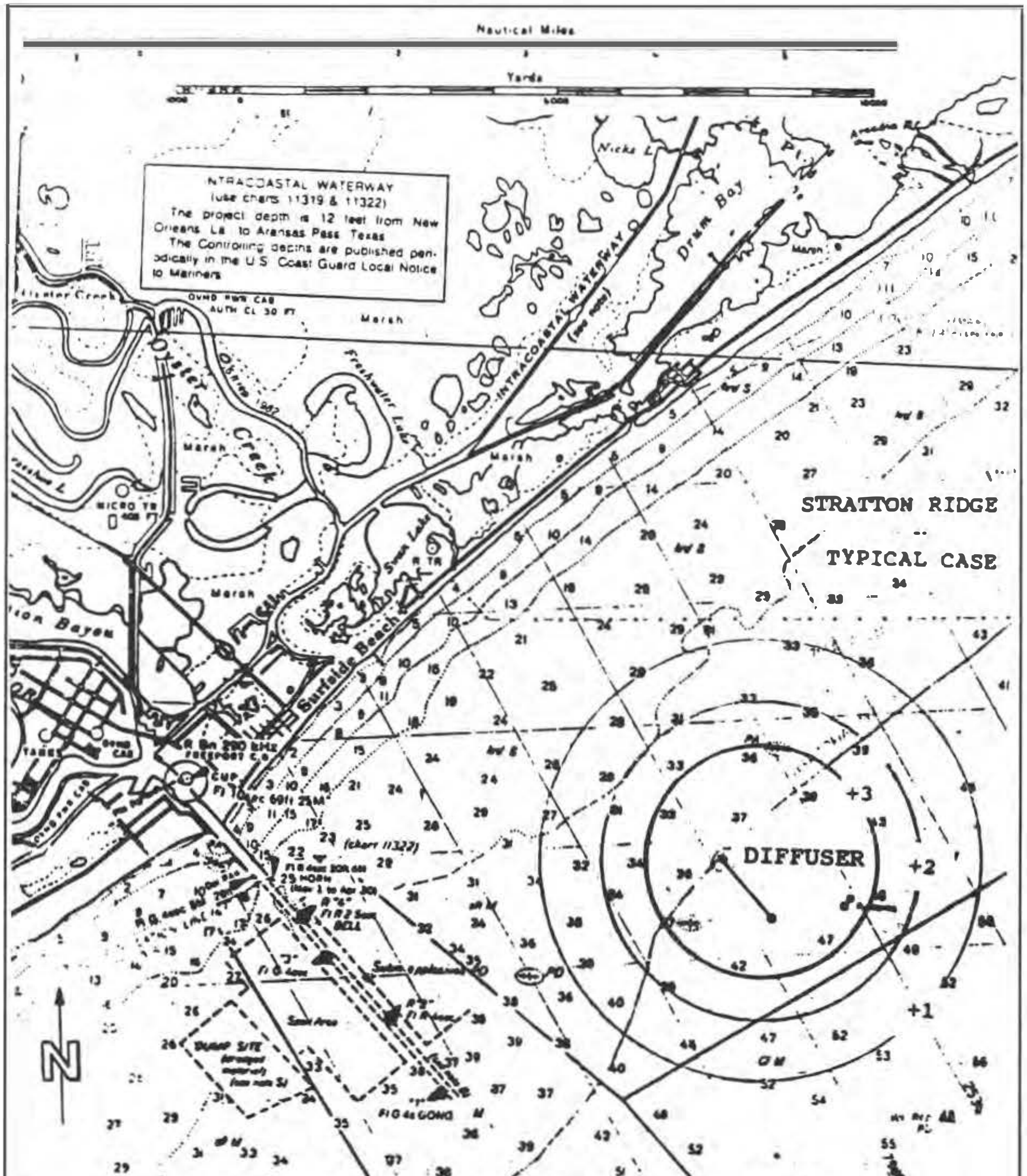
Figure 7.2-1
Predicted Extent of Largest Brine Plume Contours
for Proposed Stratton Ridge Diffuser Site



Source: Created for this draft EIS by Robert E. Randall

The diffuser terminal would be located at 28°59' W and 95°16' W.

Figure 7.2-2
Predicted Extent of Typical Brine Plume Contours
for Proposed Stratton Ridge Diffuser Site



Source: Created for this draft EIS by Robert E. Randall

The diffuser terminal would be located at 28°59' W and 95°16' W.

Table 7.2-1
Dimensions of Predicted Brine Plumes at Stratton Ridge

Excess Salinity Contour (ppt)	Areal Extent (acres)	
	Largest	Typical
+4	3,500	--[a]
+3	5,900	1,300
+2	11,400	2,700
+1	20,000	5,000

[a] The maximum above ambient salinity predicted under typical conditions is 3.8 ppt (i.e., less than +4).
Source: Randall, 1992 (Appendix Q).

addition, no sensitive biological areas appear to be located in the area that would likely be impacted around the Stratton Ridge diffuser.

7.2.3.2 Impacts of Raw Water Intake

Raw water for the development and operation of the Stratton Ridge site would be obtained at a withdrawal structure on the north bank of the ICW approximately four miles northeast of Freeport Harbor. The segment of the ICW surrounding the Stratton Ridge raw water intake structure lies less than one mile north of the Gulf of Mexico and is connected to the Gulf by a number of channels. The flow rate in the ICW near Stratton Ridge is unknown, however, expected velocities ranging from one to three feet per second correspond to flow rates of 1,500 and 5,000 cfs (using the ICW's dredged bottom width of 125 feet and depth of twelve feet deep, and assuming the channel slope is negligible). The segment of the ICW near Stratton Ridge is described in greater detail in section 5.2.3.2.

The impacts of raw water withdrawal on the hydrology, water quality, and biology of the ICW can best be assessed by analyzing impacts associated with raw water withdrawal at the existing Big Hill site. This approach is appropriate because:

- The ICW near the Big Hill and Stratton Ridge sites share similar hydrological and biological characteristics;
- The RWI structure for the Stratton Ridge site would be modeled after the existing raw water intake structure for Big Hill;
- Earlier impact studies have included hydrological and water quality modeling for impacts of raw water withdrawal at Big Hill which can be compared to limited monitoring and observations conducted during operations at Big Hill. These modeling studies and historical observations are fully described in Appendix N.

Although the similar characteristics of the ICW near the Stratton Ridge and Big Hill sites eliminate the need for additional computer modeling, calculations can be made to supplement the analysis of raw water impacts at Stratton Ridge. These calculations demonstrate that the impacts of water withdrawal at Stratton Ridge would likely be minor.

Potential Hydrological Impacts

Because of the controlled channel geometry of the ICW and identical raw water intake designs, conclusions regarding the near-field (less than 100 feet) hydrological impacts of raw water withdrawals at Stratton Ridge can be based on previous modeling studies conducted for the Big Hill site. These studies, which are summarized in Appendix N, indicate that the raw water intake would not significantly alter water depths or velocities within 100 feet. Both of the previous modeling studies predicted a maximum depth reduction of approximately one-half inch at, or near, the raw water intake. One study predicted a maximum velocity increase of 3.5 inches per second at the raw water intake. Depth and flow velocity of the ICW near Big Hill have not been monitored, however, no obvious impacts on the ICW hydrology have been observed.

At distances greater than 100 feet (far-field) from the Stratton Ridge RWI structure, the hydrological characteristics of the ICW differ significantly enough from those near Big Hill to preclude direct application of Big Hill model simulations to the Stratton Ridge. Instead, calculations were made to estimate far-field hydrological impacts by assuming 100 cfs withdrawal rate and a range of ICW flow rates. The ICW flow rates and site specific channel geometry were applied using the approach outlined in Appendix R to obtain the energy slope of the ICW. The differences between energy slopes calculated with and without a 100 cfs withdrawal were then used to estimate the vertical change in average water depth over a one-mile segment of the ICW (Table 7.2-2).

Table 7.2-2
Vertical Change in Depth Corresponding
to a 100 cfs Withdrawal for a Range of ICW Flow Rates

Flow Conditions Without Withdrawal			Flow Conditions With 100 cfs Withdrawal			Vertical Change in Depth
Q_1	V_1	S_1	Q_2	V_2	S_2	(Inches per Mile)
5000	2.22	9.43×10^{-5}	5100	2.27	9.81×10^{-5}	0.24
2000	0.89	1.51×10^{-5}	2100	0.93	1.66×10^{-5}	0.10
1000	0.44	3.77×10^{-6}	1100	0.49	4.56×10^{-6}	0.05

Q = flow rate (cubic feet per second)
V = flow velocity (feet per second)
S = slope (feet per feet)

At an ICW flow rate of 5,000 cfs (probably greater than the actual ICW flow rate), raw water withdrawal would result in a one-quarter inch vertical change over a mile of waterway. At a flow rate of 1,000 cfs (probably less than the actual ICW flow rate), there could be a vertical change of 0.05 inches over a mile of waterway. The actual vertical change, which would likely be between these estimates, would be much less than the average tidal range of 1.6 feet observed in the ICW near Stratton Ridge. As a result, the incremental change in water depth at distances greater than 100 feet from the raw water intake point would likely have a negligible impact.

Potential Water Quality Impacts

Salinity in the estuarine water in the vicinity of Stratton Ridge is generally more than 20 ppt.[55,56] These data are from locations in Matagorda Bay west of Stratton Ridge and western portions of Galveston Bay, which are interconnected with the ICW. Additional data collected at the intersection of Freeport Harbor and the ICW show salinity ranging from eight to 40 ppt.[57]

Because salinity in the waterways surrounding the Stratton Ridge raw water intake is uniformly high, the only likely scenario where water withdrawal from the proposed raw water intake would alter existing salinity conditions is if fresh water were drawn into the area. The nearest major source of fresh water is the Brazos River, which intersects the ICW approximately nine miles west of the Stratton Ridge raw water intake. However, water in the Brazos River is brackish for a distance of 25 miles inland.[58] Additionally, influence of the Brazos River on the ICW is limited by locks on each side of the intersection of the river operated by the U.S. Army Corps of Engineers to keep detritus and silt from entering the ICW. For these reasons, it is improbable that the present salinity conditions would be altered by withdrawal from the Stratton Ridge site.

Potential Direct Impacts to Biota

Impacts to biota at Stratton Ridge can be considered similar to those expected for Big Hill. This is because the design of the Stratton Ridge RWI structure would be modeled after the existing structures at Big Hill, and because the sites share similar ecological conditions. The aquatic biota at these sites include estuarine-dependant, resident species and seasonally abundant marine migrants. There are National Wildlife Refuges situated near both the sites that serve as important nursery and spawning habitats for migrant and resident fish and crustaceans.

The Stratton Ridge RWI structure would include features to limit impacts to biota. Fish and other large animals would be blocked from the intake by trashbars, and traveling screens would exclude macrocrustaceans and other organisms larger than 0.5 inches. Additionally, the intake velocity of 0.5 feet per second is slower than the swimming speed of most fish.[59] Despite these features, the raw water intake would unavoidably entrain small organisms (e.g., phytoplankters, zooplankters, larval fish, and benthic organisms) able to pass through the 0.5 inch mesh screens. At Big Hill this impact is considered minor because the volume of water removed contains a small portion of the planktonic and benthic communities of the ICW and associated wetlands.[60]

Although impacts to biota from the existing RWI structure at Big Hill have not been monitored, the effects are believed to be inconsequential. No obvious impacts have been observed, and, therefore, no significant impacts to the biotic community of the ICW would likely result from raw water withdrawal at the Stratton Ridge site.

7.2.3.3 Construction Impacts

If Stratton Ridge is selected as the Seaway site, there would be three major construction efforts that could result in water quality and aquatic ecology impacts: (1) construction of the on-site facilities; (2) construction of the raw water pipeline and intake structure; and (3) construction of the brine disposal pipeline. As outlined in section 3.2.4, crude oil from Stratton Ridge would be distributed through the existing pipeline from Bryan Mound to Texas City. Although utilization of this pipeline would require the construction of an approximately one-mile spur connecting Stratton Ridge to the existing pipeline, construction of this spur would not cause significant water quality or aquatic ecology impacts because its proposed route does not cross any water bodies.

Impacts Associated With On-site Construction

Construction activities at the proposed Stratton Ridge expansion site could result in the erosion of as much as 2,300 tons of soil from the site (see Appendix O). Conservatively assuming that none of this eroded soil would be contained, site maps indicate that about 1,100 tons would enter Oyster Creek approximately 30 feet south of the site. The remainder would settle onto the land between Stratton Ridge and Oyster Creek.

As detailed in Appendix O, conservative calculations indicate that construction-enhanced erosion would increase the suspended solids concentration in Oyster Creek by as much as 6.5 ppm. This increased concentration would be reached 12 hours after the start of construction and could remain during the rest of the clearing phase of the construction period (179.5 days), conservatively assuming rain starts at the same time the construction does and continues for 180 days duration. The suspended solids concentration in Oyster Creek then would be expected to return to pre-construction levels in about seven hours after clearing ceases and the site is revegetated or covered.

This minor increase in suspended solids would not likely cause significant adverse impacts in the affected area of Oyster Creek. Within the water column, the very small and temporary increase in suspended solids would be unlikely to interfere with the recreational and aesthetic values of the creek, significantly impede light penetration and reduce primary production, result in toxicological effects to fish, significantly alter the natural movements and migrations of fish, or prevent the successful development of fish eggs and larvae. Settleable solids that blanket the bottom of Oyster Creek might damage resident invertebrate populations, alter benthic organism density and diversity, and block any spawning beds that exist in affected areas. These adverse effects, however, would likely be temporary and limited to the area adjacent to the Stratton Ridge construction site. The resulting creek bottom would be expected to recolonize quickly to pre-construction conditions, providing as habitat the same sand and mud substrate that exists in most water bodies throughout the area.

Impacts Associated With Construction of Raw Water Intake System

The predominant waters that would be crossed by the proposed raw water pipeline on its route to the ICW are Ridge Slough and Essex Bayou. Construction of the pipeline through these waters would cause the same basic types of water quality and habitat impacts described in section 7.1.3.3 for the construction of the Big Hill oil distribution pipeline (under a 180-day drawdown criterion) across inland water bodies. Water quality impacts could include increased turbidity levels, increased concentrations of suspended nutrients, metals, and organic contaminants, and possibly reduced dissolved oxygen levels. Benthic organisms and habitat directly within and near the pipeline corridor would be unavoidably destroyed and organisms that live in the water could experience toxicological and behavioral effects. All of these impacts, however, would be temporary and confined to areas close to the pipeline ROW. These impacts would likely be particularly minor in Ridge Slough, which is intermittent and offers only limited habitat. Although Essex Bayou is a more sizeable, permanent water body, its water quality and benthic habitat also would be expected to be quickly restored following pipeline construction. Additionally, the drainage patterns of these waters would not be significantly altered by the pipeline construction, surface topography would be restored and plugs would be used as needed to prevent the intrusion of saltwater into freshwater wetlands along pipeline corridors, and plugs would be used to limit the movement of organisms through artificial migration passages left by the pipeline construction.

Construction of the raw water intake structure would require dredging in the ICW and earthmoving on the north bank of the ICW. In the area dredged, all benthic macrophytes and macrozoobenthos would be eliminated. Organisms in the ICW adjacent to the dredged area would be affected by the resuspension of sediments. Specific effects may include smothering, increased turbidity, resuspension of toxic organic and inorganic contaminants in sediments, elevated nutrient concentrations, and reduced dissolved oxygen. These impacts would be greatest in a localized area concentrated on the north bank of the ICW and would rapidly diminish downstream of the dredged area. The duration of these impacts would be limited to the duration of dredging operations. Fish and other mobile organisms could experience toxicological and behavioral effects related to the increased sediment load. However, they would be able to avoid these impacts by temporarily moving to less disturbed waters upstream of the dredged area or along the south bank of the ICW.

Dredge spoil would be deposited along the banks of the ICW in a suitable area designated and permitted by the Corps of Engineers. Preliminary plans for the construction of the Big Hill raw water intake structure called for the removal of 8,600 cubic yards of bottom sediment with the subsequent deposition of this material in a 1.8-acre area next to the dredging site.[61] This same plan can be applied to Stratton Ridge. While the deposition of this spoil would smother terrestrial vegetation in the affected area, it should not present a significant surface water or aquatic ecology threat. The disposal area would be equipped with a containment dike designed to keep the sediments from re-entering the ICW and contributing to increased turbidity and nutrient loading.

Impacts Associated With Brine Pipeline Construction

The proposed brine pipeline route would pass southeast from Stratton Ridge and extend to a diffuser approximately 3.5 miles from the Texas coastline near Freeport, Texas (see Figure 3.2-2). Impacts associated with offshore pipeline construction in the Gulf would include the same types of impacts as those associated with the construction of pipeline through inland water bodies. However, pipeline construction in the Gulf would involve different construction techniques and different physical and biological conditions. Sections 5.2.3.1 and 5.2.5.3 describe the baseline physical/chemical and biological conditions, respectively, that exist at the proposed diffuser location in the Gulf and pipeline route. Appendix J provides additional detail on the baseline conditions in the area of the proposed Stratton Ridge brine disposal pipeline and diffuser.

Pipeline construction in the Gulf of Mexico generally would require a trench that is about 20 feet below the ocean floor and twelve and six feet wide at its top and bottom, respectively. Pipeline construction differs for coastal (i.e., within water depths of twelve to 15 feet) and offshore waters (i.e., beyond water depths of twelve to 15 feet). In coastal water, a mechanical dredge (e.g., clam bucket or drag line dredge) excavates the pipeline route. Afterwards, the pipeline is sequentially assembled on a pipelay barge and then pushed off the pipe ramp. Flotation buoys keep the pipeline suspended in the water before the pipeline is allowed to descend into the ROW.

In offshore water, excavation of the pipeline ROW occurs after the pipeline is laid. The pipeline is first assembled sequentially on a lay barge with a conveyor system and then pushed into the Gulf where it is allowed to descend to the Gulf floor. A dredging sled, mounted on the stern of the trenching barge, is then lowered to the ocean floor and positioned over the laid pipe. Hydraulic jets on the sled displace the bottom material around the pipe. The pipeline then sets in the trench previously occupied by the displaced bottom material. Depending on the area's environmental sensitivity, the resulting suspended bottom material is either allowed to dissipate in the Gulf water or it is collected and disposed in a spoils area.

As a result of dredging, sediments and associated contaminants become resuspended in the water. Dredged material would remain at the dredging site, and thus be available for resuspension by wave action or currents, until it would finally be transported by natural forces from the area or become biologically fixed. Just like in inland waters, potential water column impacts in the Gulf might include temporary increases in turbidity, increases in suspended nutrients, reductions in dissolved oxygen concentrations (increased oxygen demand), and increases in the level of metals and organics (hydrocarbons) near the project area. Section 7.1.3.3 provides a detailed description of these generic categories of impacts in inland water bodies. Key differences that would be expected in Gulf waters include the following:

- **Greater suspension of bottom sediments.** The hydraulic jetting process produces more suspended solids than the mechanical dredging process, since hydraulic jetting dissipates the loosened bottom sediment in the water column. It has been estimated that the hydraulic jetting process disturbs a 200-feet wide area along the pipeline route.[62] Also, the volume of disturbed sediments is estimated to be 16,000 cubic yards per mile of pipeline. To minimize the impacts associated with this disturbance, however, a dredge pump can be used to suck the loosened material up to the surface for disposal in a spoils area or over the side of the vessel.

- **Greater dilution of suspended contaminants.** The higher energy environment (e.g., faster currents) of the Gulf of Mexico should produce a greater dilution of released nutrients than in inland water bodies, where there may be poor circulation. Therefore, contaminant concentrations should be more rapidly diluted in offshore waters.

- **Differences in sediment composition.** Although Stratton Ridge is located off the Texas coast, a LOOP estimate can be used as an indicator of the potential for increased biological oxygen demand (BOD) in the Gulf. According to the LOOP, a cubic yard of disturbed coastal Louisiana sediment could deplete 100 to 1,000 cubic yards of the surrounding water's oxygen. This estimate, however, is likely to be too high for the proposed Stratton Ridge pipeline construction because oxygen that is injected into the water during the jetting operation will contribute toward satisfying the enhanced BOD. In addition, it is probable that most sediments would settle out within one or two days, after which only a fraction of the disturbed sediment may exert a significant oxygen demand in the water column.

Disturbed sediments, therefore, could have a significant effect on the dissolved oxygen content of the water in the immediate project area, but would not be expected to affect oxygen levels on a larger scale.

Additionally, Brazos River outflow and heavy oil and gas activity could contribute higher levels of sediment contamination (e.g., metals, organics, and oil hydrocarbons) that could become available to the environment after dredging. For example, high levels of pesticides, polychlorinated biphenyls, and related organochlorines have been observed off the Mississippi River, in coastal bays, and estuaries. This potential for greater sediment contamination in offshore areas could result in larger contaminant loads being suspended in the Gulf than would be expected in some inland waters.

The potential impacts of dredging on Gulf organisms would be similar to those described for pipeline construction through inland waters. The potential impact on organisms living on or near the bottom would be greater than the potential impact to those living in the water column. Bottom habitat and organisms living directly in or near the proposed ROW would be unavoidably destroyed, either by the physical dredging process or by being smothered by settling solids. These impacts, however, would be temporary and confined to areas close to the pipeline ROW, as benthic habitat would be quickly restored and recolonized naturally after construction. No particularly sensitive bottom habitats (e.g., coral reefs, oyster reefs, and fish spawning or nursery areas) are known to exist in the proposed diffuser area or pipeline ROW. As outlined in section 7.1.3.3, sublethal levels of suspended contaminants in dredged material could potentially interfere with the olfactory senses of marine animals and affect food location, escape from predators, selection of habitat, and sex attraction.[63] Significant uptake of PCBs or metals released from the sediments to the water column could cause toxicological effects, including mortality, if exposures are great enough. As a result, marine animals would likely avoid the impacted area until completion of pipeline construction and normal conditions are restored. Free swimming fish would be expected to return to the area soon after construction ceases.

7.2.3.4 Oil and Brine Spill Impacts

Oil spills associated with operations at the Stratton Ridge site could occur in the open seas, along the Gulf of Mexico coastline, or in inland water bodies near pipelines, facilities, or the terminals at Freeport or Texas City, Texas. The likelihood of oil spills as well as the anticipated size of spills are described in section 6.1.

Brine generated by cavern leaching at Stratton Ridge would be discharged to the Gulf of Mexico via a brine pipeline and diffuser system described in section 3.2.3. In the event of a spill, brine could enter surface waters or marshlands in the immediate vicinity of the Stratton Ridge site, or along the brine pipeline route. The expected number and size of brine spills resulting from the proposed development and operation of Stratton Ridge are discussed in section 6.2. Because the brine would be intentionally released to the ocean, offshore brine releases are not considered in this section. Anticipated impacts of brine discharge are discussed separately in section 7.2.3.1 above.

Ocean Spills

Oil spills to the open ocean could occur only from tankers transporting oil to or from distribution terminals located at Freeport or Texas City, Texas. As outlined in section 6.1, 0.4 spills to the ocean are expected to result during fill at Stratton Ridge and 0.2 spills during distribution. If a spill to the ocean does occur, the impacts would be identical to those described for Big Hill in section 7.1.3.4. Namely, the impacts of an oil spill to the ocean resulting from SPR operations are expected to be localized and temporary. For this reason, and because of the low probability of an ocean spill, development of Stratton Ridge would likely not cause significant adverse impacts due to oil spills in the ocean.

Coastal or Inland Spills

The potential impacts of oil and brine spills on coastal and inland waters are discussed separately in this section.

Oil Spills. Coastal or inland spills could occur during either fill or drawdown stages of the Stratton Ridge site. The number and volume of spills expected to occur are described in section 6.1. These values and the generic impacts of coastal and inland spills are identical to those of the Big Hill site (section 7.1.3.4). The only difference between potential oil spill impacts at Stratton Ridge and Big Hill is the set of water bodies potentially affected. For Stratton Ridge, spills could occur along the Texas and Louisiana Gulf Coasts, but would be most likely in the vicinities of the ARCO Terminal at Texas City, Texas and the Phillips Terminal at Freeport, Texas. Spills to inland water bodies could occur at or near these terminals from tankers, or from pipelines or other facilities used to transport oil to or from the Stratton Ridge site. The inland water bodies most at risk would include Galveston Bay, San Jacinto Bay, Freeport Harbor, the ICW, and Oyster Creek. These and other potentially impacted water bodies near these facilities and pipelines are characterized in sections 4.3, 5.2.3, and 5.2.5.

As outlined for Big Hill, the coastal and inland waters of the Texas coastline are ecologically sensitive, serving as breeding and nursery areas for many resident and migratory species. Depending on when and where a spill at Stratton Ridge occurred, it could cause significant adverse impacts in localized areas. Based on the anticipated frequency and volume of oil spills, the proposed Stratton Ridge expansion would likely cause only a few small spills of oil to coastal and inland waters during fill (about two spills of 20 barrels or less and less than one spill of more than 20 barrels). The potential for these spills and the magnitude of expected impacts would be limited by the emergency controls, procedures, and contingency/emergency plans discussed in Chapter 8.

Brine Spills. Brine spills could result from pipeline ruptures or from equipment failure at the Stratton Ridge site or anywhere along the route of the proposed brine pipeline. Surface water bodies that could be affected by a brine leak are Oyster Creek, the ICW, Swan Lake, Stubblefield Lake, Ridge Slough, Essex Bayou, and various unnamed lakes and bayous near the proposed pipeline route. The brackish marshes that lie along much of the proposed brine pipeline route could also be affected. These waterbodies and marshes are described further in sections 5.2.3 and 5.2.5.

Historical brine spill statistics indicate that the proposed operations at Stratton Ridge could result in up to nine small brine spills per year (of about 75 barrels) and one large spill of

74,000 barrels or more. If such a large brine spill did occur at the Stratton Ridge site or along the brine pipeline route, the impacts could be similar to those observed in 1989 following a leak at the nearby Bryan Mound site. These impacts have been described in section 7.1.3.4. The experience at Bryan Mound indicates that a large release of brine could result in significant adverse effects to the marshlands near Stratton Ridge, and a temporary impact on the water bodies in the area. The severity of the impacts would depend on the volume and rate of the spill, and on the volume of freshwater flushing the affected water body. Although only minor impacts to the ICW would be expected, there could be more significant impacts to the smaller water bodies, including Oyster Creek, Swan Lake, and Stubblefield Lake.

7.2.4 Air Quality Impacts

Air quality impacts would likely be similar to those predicted for Big Hill, although emissions (e.g., fugitive dust) might be greater at Stratton Ridge because of the need for more construction. See section 7.1.4. The impacts of site construction and along pipeline ROWs would be temporary and minimal. The major pollutant of concern would be volatile hydrocarbons emitted during cavern development and fill; impacts due to these emissions would also be insignificant.

7.2.5 Potential Impacts to Terrestrial Ecology and Wetlands

This section describes the potential impacts to terrestrial ecology and wetlands that could be caused by the construction, operation, and maintenance of the proposed Stratton Ridge site. The potential impacts associated with site construction, site operation and maintenance, pipeline construction, and pipeline maintenance are discussed separately. Many of the potential impacts associated with general construction and maintenance activities at Stratton Ridge would be similar to those discussed for Big Hill (see section 7.1.5). However, some impacts may differ, because the site construction area for Stratton Ridge would be 200 acres (as opposed to 150 acres for Big Hill), and the expansion area at Stratton Ridge is relatively undisturbed in nature. To support a 180-day drawdown criterion, no additional distribution enhancements would be required.

7.2.5.1 Potential Impacts at and Nearby the Site

The major potential ecological impacts would occur during the construction phase of the project, although potential impacts during operations and maintenance are also discussed below.

Site Construction

As part of the construction of the proposed site, vegetation within the site boundary would be completely or partially cleared, and the site would be fenced for security reasons. Based on site visits and aerial photographs, the site is predominately forested with extensive stands of mature live oaks interspersed with numerous emergent wetlands. Approximately 46 acres of wetlands exist within the proposed site. Of these, 15 acres are palustrine emergent and 31 are palustrine forested. The wetlands are scattered throughout the property, and it is likely that some of these wetlands would be impacted and possibly destroyed as a result of construction activities at the site. Impacts associated with clearing and construction would be similar to those discussed for Big Hill (section 7.1.5.1): destruction or alteration of vegetation, displacement of wildlife, destruction of individuals of smaller wildlife species, and disruption of habitats due to increased traffic and human activity.

Construction impacts on the plant communities surrounding the proposed site would be minimal. No threatened or endangered plants are known to occur in the general vicinity of the proposed site, although a site-specific endangered species survey would be conducted prior to any site development.

Based on soil erosion calculations presented in Appendix O, an estimated 2,300 tons of soil could be eroded from the site during construction if no mitigation measures were used. Any eroded soil would be transported south towards Oyster Creek and would likely be deposited in the creek bed within one-half mile downstream. Some could be deposited in wetlands in undeveloped portions of the site or nearby. It is possible that vegetation in these areas could be impacted by this deposition, with possible smothering of some of the less robust vegetation. Although impacts would likely be temporary with no permanent adverse impacts to the wetlands, impacts could range from negligible to severe depending upon the extent of clearing, the amount of grading, and the types of practices implemented to minimize erosion and sedimentation. Proposed preventive and mitigative measures are discussed in Chapter 8.

Site Operation and Maintenance

The site would be securely fenced for the lifetime of the program, and therefore access would be restricted for many species of wildlife. The vegetated areas of the property would be mowed frequently, and would be of little value as wildlife habitat.

Operations at the site and associated potential impacts would be similar to those discussed for Big Hill and would likely be negligible.

The potential exists for impacts to wildlife from leaks or spills from the on-site pipelines, above-ground holding tanks, and brine ponds. The severity of impacts would be determined largely by the severity of the spill. Spills from the raw water pipelines would have minimal impacts on local wildlife. Oil spills or brine spills could adversely affect the habitat and wildlife in the immediate vicinity of the spill. Such spills could result in immediate loss of vegetation as well as possible long-term impacts during recovery. They also could impact nearby aquatic habitats such as Oyster Creek and the numerous wetlands near the site. Wildlife in Brazoria's National Wildlife Refuge could be adversely affected if the segment of the brine pipeline passing through the refuge was to rupture.

7.2.5.2 Potential Impacts due to Pipeline Construction and Maintenance

RWI, brine disposal, and oil distribution pipelines would need to be constructed as part of development of the Stratton Ridge site under the 270-day drawdown criterion. No additional construction would be required to support a 180-day drawdown criterion.

Pipeline Construction

Tables 7.2-3, 7.2-4, and 7.2-5 present a summary of the types and estimated acreage of wetlands to be crossed by these pipelines. The estimates assume a 150-foot ROW for the pipelines.

The oil distribution pipeline would be an approximately one-mile pipeline spur to the existing Bryan Mound distribution pipeline. The spur to the Bryan Mound pipeline would

Table 7.2-3
Types and Acreage of Wetlands Crossed by the Proposed Raw Water Pipeline to Stratton Ridge

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE WETLANDS -- TOTAL	41	86	33
A. Subtidal, open water/unknown bottom	2	4	1
B. Intertidal, emergent, persistent	39	82	32
II. PALUSTRINE WETLANDS -- TOTAL All palustrine wetlands for this proposed pipeline are emergent, persistent, saturated/semipermanent/ seasonal	7	14	5
III. NON-WETLANDS -- TOTAL	77	–	62
WETLANDS -- TOTAL ACREAGE	48	100	38
TOTAL ACREAGE	125	--	100

Source: Based on National Wetlands Inventory Maps. Acreages assume a 150-foot ROW.

potentially impact 6 acres of wetlands (palustrine emergent) out of a total of 16 acres of land potentially affected by the patch route. Potential impacts would include altered surface topography or water flow patterns and destruction of vegetation. It is possible that plant species composition following revegetation would differ from that prior to disturbance. Proposed preventive and mitigative measures are discussed in Chapter 8.

The proposed 16-mile brine pipeline from the Stratton Ridge site could impact 62 acres of wetlands out of a total of 139 acres of land potentially affected. The majority of the wetland acreage (55 acres) would be intertidal and subtidal estuarine wetlands. Other wetland types potentially affected would be palustrine emergent wetlands (6 acres) and intertidal, beach bar marine wetlands (1 acre).

The proposed 7-mile RWI pipeline from the ICW could impact 48 acres of wetlands out of a total of 125 acres of land potentially affected. The majority of the wetlands acreage (39 acres) is intertidal estuarine wetlands. The other major wetland type potentially affected is palustrine emergent wetlands (7 acres).

An additional potential impact could be alteration of hydrology and introduction of saltwater into freshwater wetlands. The only ROW that would cross a freshwater/saltwater interface is the shared raw water and brine disposal pipeline ROW that crosses Salt Bayou, an estuarine emergent wetland, and then crosses Ridge Slough, a palustrine emergent wetland. These two areas are separated by fewer than 500 feet. Additional saltwater intrusion could result in loss of some salt-intolerant plant species, and a shift in community structure towards more salt-tolerant plant species.

Table 7.2-4
Types and Acreage of Wetlands Crossed by the Proposed Brine Pipeline from Stratton Ridge

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE WETLANDS -- TOTAL	55	89	39
A. Subtidal, open water/unknown bottom	1	1	<1
B. Intertidal, emergent, persistent	54	88	39
II. MARINE WETLANDS -- TOTAL All marine wetlands for this proposed site are intertidal, beach bar, irregularly flooded	1	2	1
III. PALUSTRINE WETLANDS -- TOTAL All palustrine wetlands for this proposed site are emergent, persistent, non-tidal, saturated/semipermanent/seasonal	6	9	4
IV. NON-WETLANDS -- TOTAL	78	--	56
V. BAY -- TOTAL DISTANCE CROSSED	1 mile		--
WETLANDS -- TOTAL ACREAGE	62	100	44
TOTAL ACREAGE*	139	--	00

* Total acreage does not include portions of the proposed pipeline that cross bays.
Source: Based on National Wetlands Inventory Maps. Acreages assume a 150-foot ROW.

Table 7.2-5
Types and Acreage of Wetlands Crossed by the Proposed Crude Oil Spur from Stratton Ridge

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. WETLANDS -- TOTAL All that wetlands would be affected by this proposed patch are palustrine, emergent, persistent, saturated/semipermanent/seasonal	6	100	38
II. NON-WETLANDS -- TOTAL	10	--	62
TOTAL AREA	16	--	100

Source: Based on National Wetlands Inventory Maps. Acreages assume a 150-foot ROW.

Section 5.2.5.2 discusses ecological areas of interest that would be crossed by the pipelines for Stratton Ridge. The proposed pipeline spur to Bryan Mound would not cross any terrestrial areas of ecological interest. Two state endangered or threatened species, the Florida sandhill crane and the wood stork could use areas along the proposed RWI and brine pipelines as breeding/nesting areas. These species could be affected (e.g., nest abandonment, decreased reproduction success) if they are disturbed during the mating and nesting season that generally begins in late winter/early spring.

The proposed water and brine pipelines would also cross the Brazoria National Wildlife Refuge to the southeast. Temporary displacement of wildlife during pipeline construction could result in decreased nesting success due to nest abandonment and altered behavior patterns.

Pipeline Maintenance

Potential impacts associated with maintenance of the pipeline ROWs and the pipelines would be similar to those discussed for Big Hill and would be minimal.

7.2.5.3 Summary of Wetlands Potentially Affected by Construction

A total of 162 acres of wetlands would be potentially affected by development at Stratton Ridge: 46 acres of on-site palustrine emergent and forested wetlands, and 116 acres of primarily estuarine wetlands associated with pipeline construction.

7.2.6 Floodplains Impacts

Because buried pipelines would have no long-term impacts on floodplain areas and would not likely affect runoff patterns, DOE's primary concern is for the SPR site. Whereas the area along a pipeline route is backfilled to the same level and consistency as had previously existed, the permanent nature of the construction and alteration of an SPR site can, without mitigation efforts, affect drainage patterns and thus future flooding.

The Stratton Ridge site is located in a floodplain area. DOE would use rough grading as a part of site preparation. This practice consists of removing dirt from higher elevations at a site and placing it in lower sections. Rough grading could slightly change the elevation of certain site areas. Other actions that could affect floodplains include construction of roadways, wellpads, and buildings. DOE would complete all construction activities in compliance with Executive Order 11988 (floodplains management). Therefore, most impacts to floodplains from construction activities would be short-term, and none of these effects would be significant enough to increase the risk to lives or property or alter the natural and beneficial floodplain values.

Without proper mitigation, preservation, and restoration of floodplains, however, potential impacts to the floodplain could include sedimentation on or below the construction site. Sediment deposition could have a positive impact: the addition of rich nutrients to the floodplain soil and prevention of sediment-associated pathogens from entering the water. This same sedimentation, however, could destroy biological communities supported on the floodplain because it could contribute to nutrient overloading, decreased dissolved oxygen, increased water temperature, and serious impairment of photosynthetic productivity.

Although the RWI structure is located on a water body (e.g., the ICW) and therefore, within a floodplain, it would require only minimal construction area. The single requirement for the ICW is that it provide a sufficient uninterruptible supply of water. When the RWI structure is completed, water flowing in the ICW would be able to pass under the RWI structure with little or no disturbance. DOE would locate the RWI structure on the ICW at a point approximately seven miles from Stratton Ridge.[64] The structure would not significantly alter the floodplain or floodplain action. Construction of the RWI structure would require dredging about 10,000 cubic yards of spoil from the intake canal to guarantee adequate depth and uninterrupted water supply. Spoil would be placed in an upland spoil disposal area.[65] The banks near the construction area would be riprapped to prevent erosion.

All pipelines pass through a floodplain for at least some part of their length; therefore, construction crews would take measures to minimize and mitigate impacts to floodplains. Normal construction would include the temporary use of fill, spoil generation, and construction of temporary platforms. Any adverse effects from pipeline construction would be minimal and temporary and DOE would restore all floodplains to a condition consistent with their original state once construction is complete.

7.2.7 Natural and Scenic Resources Impacts

Depending upon the actual site configuration, clearing and fencing for construction would result in the loss of use by wildlife of up to 300 acres for the lifetime of the program. Approximately 46 acres of wetlands exist within the proposed site. These could potentially be impacted by increased sedimentation as a result of erosion during construction. Impacts could range from negligible to severe depending upon the extent of clearing and the amount of grading that takes place at this proposed site. Construction impacts on the plant communities surrounding the proposed site would likely be negligible.

Brazoria National Wildlife Refuge, located several miles east and south of Stratton Ridge, would not likely be impacted by the proposed site or pipelines. Bryan Beach State Park and San Bernard National Wildlife Refuge, also located near the proposed site, would not be affected.

7.2.8 Archaeological, Historical, and Cultural Impacts

Although no recorded archeological or historical sites are located in the Stratton Ridge project area, sites do exist at Stubblefield Lake, along the bank of Oyster Creek, and in the general area of the pipelines which indicate the possibility of encountering unrecorded sites within the project boundaries of Stratton Ridge.[66] While there would likely be no direct impact on these resources, it is possible that unrecorded sites would be encountered by the project.

7.2.9 Socioeconomic Impacts

The types and magnitude of socioeconomic impacts from the development of the Stratton Ridge site would likely be similar to those described for the Big Hill alternative in Section 7.1.9:

- The largest impact would be from the additional income generated directly by the jobs created and the project purchases made in the local and regional economy.

- Even under the high impact scenario, the existing infrastructure, including health care, housing, education, and transportation systems, could absorb the in-migration of workers and their families.

- Some increase in traffic would occur, particularly during the construction phase of the project.

7.2.9.1 Demographic Changes

Based on the in-migration model described in section 7.1.9.1, demographic impacts are estimated to be minimal. DOE estimates that under the high impact scenario, 674 additional people would relocate to within 30 miles of Stratton Ridge by the end of the construction phase. An additional 162 people would be expected to relocate by the fifth year when the facility would become operational bringing the total in-migration population to 836. Compared to the population of incorporated towns within 30 miles of Stratton Ridge, this level of in-migration would only increase the current population by 0.7 percent (Table 7.2-6). Demographic impacts would be even smaller under the more likely baseline scenario.

The largest demographic impacts would likely occur during the construction phase, when most of the new jobs are created. During the first year of construction, an estimated 118 workers would be needed at the site. This estimate would increase to 230 site workers by the end of the third year when construction activity would be at its peak. Also, during the third year an additional 62 workers would be involved in pipeline construction, raising the total estimated employment level to 292 workers. During the fourth year of construction, the number of employees would decrease as much of the work would be completed and no new workers would be hired until operation of the completed facility commences. The labor force requirements for the development of the Stratton Ridge facility are shown in Table 7.2-7.

The construction personnel needed for site development would be the same as those listed in section 7.1.9.1 on the Big Hill SPR expansion. In additional to construction personnel, approximately 70 permanent employees would be required to operate and maintain an SPR facility at Stratton Ridge. It should be noted that because no additional pipelines would be needed under the 180-day drawdown criterion, the manpower requirements would not differ from the 270-day drawdown criterion.

To estimate the size of the in-migrating population, DOE assumed that construction would take place over approximately four years, although all of the construction employees would be hired during the first three years. Site preparation, well drilling, and facilities for cavern leaching are estimated to be completed within 18 to 24 months. Remaining site facilities, including security and the crude oil distribution system would be built within 39 to 48 months. The crude oil pipelines would be constructed during the third and fourth years. DOE also assumed that the in-migration behavior for the Stratton Ridge construction workers would be similar to that of the Big Hill workers, that is, those workers choosing to relocate into the area would reside within a 30-mile radius of the site. Using the above assumptions and the in-migration model, DOE developed the estimates shown in Table 7.2-8.

In the baseline scenario, in-migration would increase from 38 to 91 people over the first three years of the construction project. This total includes 58 workers and twelve school-age children by the third year. In the first year, 24 workers with five school-age children would likely

Table 7.2-6
Population Within 30 Miles of the Stratton Ridge Site

Incorporated City or Town	Population
5-Mile Radius	
Clute (SW)	8,871
Lake Jackson (WSW)	22,720
Richwood (WNW)	2,730
10-Mile Radius	
Angleton (NNW)	17,140
Lake Jackson (WSW)	22,720
Freeport (S)	11,389
Total incorporated population within 10 miles	**85,570**
15-Mile Radius	
Brazoria (W)	2,717
Total incorporated population within 15 miles	**88,287**
20-Mile Radius	
West Columbia (WNW)	4,372
Total incorporated population within 20 miles	**92,659**
30-Mile Radius	
Alvin (NNE)	19,222
Hitchcock (NE)	5,868
La Marque (NE)	14,120
Total incorporated population within 30 miles	**131,869**
Maximum Estimated In-migration	760

Source: United States Geologic Service; Bureau of the Census, Department of Commerce.

Table 7.2-7
Estimated Labor Force for Stratton Ridge SPR Site

	Construction Phase				Operations Phase
	Year One	Year Two	Year Three	Year Four	Year Five
Site Construction	118	188	230	67	--
Pipeline Construction	--	--	62	62	--
Operation & Maintenance	--	--	--	--	70
Total Employees	**118**	**188**	**292**	**129**	**70**

Source: Boeing Petroleum Services, PB-KBB, Inc., *ROW Study*.

relocate. In the second year, 14 additional workers with three school-age children would likely move into the area. In the third year, 20 construction workers with four children would relocate. In the fourth year, the work force would actually decrease and no new in-migration would be expected.

Under the high-impact scenario, in-migration would rise from 274 people in the first year to a total of 674 people by the end of the third year. By the time construction activity reaches a peak at the end of the third year, 219 workers with 455 family members, including 182 school-age children would likely relocate to the area.

Although no in-migration of construction workers would be expected after the third year, there would be some in-migration of permanent workers at the beginning of the fifth year once the site is completed. Because permanent workers are more likely to relocate, DOE used the high-impact scenario for estimating in-migration for this worker population. As seen in Table 7.2-9, 53 permanent workers would likely relocate, and bring with them a total of 44 school-age children.

7.2.9.2 Economic Impacts

Direct economic impacts of developing the Stratton Ridge site would include the additional income generated from new jobs created during project construction, increased demand for local supplies and materials used for construction and operation of the facility, and increased expenditures in the local economy by project workers. These direct impacts would likely have multiplier effects on the regional economy, particularly in the local trade and services sectors.

No data are currently available on the expected payroll for the Stratton Ridge construction and operational phases. Using prevailing wage rates in the construction industry and projected manpower requirements, DOE estimates that $8.3 million in additional income would

Table 7.2-8
Stratton Ridge Site and Pipeline Construction In-Migration
Baseline and High Impact Scenarios

Population Category	Year One	Year Two	Year Three
Baseline Scenario			
Total Average Work Force	118	188	292
Total In-Migrating Workers	24	38	58
Total Family Members	14	22	33
Total In-Migrating Population	38	60	91
Total School Children	5	8	12
High Impact Scenario			
Total Average Work Force	118	188	292
Total In-Migrating Workers	89	141	219
Total Family Members	185	294	455
Total In-Migrating Population	274	435	674
Total School Children	74	118	182

be generated in the peak year of construction (Table 7.2-10). The impact of this income would be increased somewhat by the multiplier effects of local spending. Nevertheless, as seen in Table 7.2-10, the additional income directly generated by the project would be small relative to the regional economy.

There would be some potential for larger impacts on the region's economy depending on the degree to which the project procures goods and service from within the area. It is estimated that the cost of the Stratton Ridge development would be between 428 million dollars and 732 million dollars over three years. If as much as 30 percent of this total were spent on goods and services purchased locally, this would increase the region's total earnings by about five percent. If multiplier effects were taken into account, the impact would be larger. However, once construction is completed the positive economic impacts of the SPR expansion would diminish.

7.2.9.3 Impacts on Energy Consumption

Development of a facility at Stratton Ridge would be based on a ten cavern configuration. Power requirements for Stratton Ridge were extrapolated from peak load estimates for the sixteen cavern expansion at Weeks Island. Leaching at Stratton Ridge is estimated to carry a peak demand of 12.5 MW, while oil fill would require over 3.6 MW. About 13.2 MW would be

Table 7.2-9
Stratton Ridge Operation and Maintenance In-Migration*

Population Category	Number*
Total Additional Work Force	70
Total In-Migrating Workers	53
Total Family Members	109
Total In-Migrating Population	162
Total School Children	44

* High impact scenario used.

needed for oil drawdown and about 0.6 MW for storage use. Peak demand figures for booster stations and the raw water intake system were not available. HL&P's 138 kilovolt (kV) transmission line near Stratton Ridge Road would carry sufficient capacity to meet the needs of a new facility. A new substation at the site would need to be built to step down the voltage for use at the facility.

7.2.9.4 Impacts of Brine Disposal on Commercial Fisheries

Based on the experience at Bryan Mound, Big Hill, and other SPR facilities, brine disposal from Stratton Ridge would be unlikely to have any impact on fisheries in the Gulf. However, to account for this potential, DOE has developed a conservative estimate of the value of the commercial species potentially exposed to the area of increased salinity associated with the brine plume (Appendix G). Under conservative assumptions (e.g., maximum discharge, adverse environmental conditions), the estimated annual value of the exposed catch associated with the one ppt salinity contour would be approximately $230,000. A similar estimate for the three ppt salinity contour would be approximately $67,000. Estimated values for brown and white shrimp would account for 94 percent of the total estimated exposed catch for both salinity contours.

Total values would represent 0.4 and 0.1 percent, respectively, of the total annual value of the catch within the appropriate sections of the National Marine Fisheries Service (NMFS) fishery grid potentially affected by brine discharge from the Stratton Ridge diffuser. Estimated value of exposed catch at the Stratton Ridge diffuser also would be only a small percentage of the annual value of the total catch in the northern Gulf of Mexico, which is in excess of $440 million.

The negative impact of the Stratton Ridge diffuser brine plume on the potential value of fisheries would likely be very small. Most of the commercially important fish and shellfish species in the northern Gulf of Mexico can tolerate a wide range of salinities, and field studies have indicated that the existing brine diffuser at Bryan Mound has had little effect on the nekton (i.e., fish and shrimp) community inhabiting the diffuser area. As a result, DOE predicts very little negative impact on the estimated future value of the catch in the areas encountered by brine

Table 7.2-10
Additional Income Directly Generated from Stratton Ridge Development

	Total New Jobs*	Total Annual Worker Earnings	Percent of Regional Earnings
Year 1	118	$3,370,000	0.074
Year 2	188	$5,369,000	0.118
Year 3	292	$8,340,000	0.183
Permanent	70	$2,000,000	0.044

* Totals for new jobs and earnings are cumulative.
Source: Boeing Petroleum Services, Bureau of Labor Statistics.

plumes. Additional details of the assumptions and methods used in this analysis are presented in Appendix G.

7.2.9.5 Impacts on Transportation Systems

The primary impact on transportation systems would be increased traffic from workers traveling to and from the site during the construction phase. However, given that at the peak of construction activity only about 230 workers would be at the site (the remaining work force will be away from the site on pipeline construction), and the current levels of traffic as seen in Table 5.2-8, the marginal increase in congestion would likely be minimal. These impacts would be further decreased because workers would be using varying commuting routes. For example, some workers would likely reside north of the site in towns such as Angleton and West Columbia, whereas others would reside in towns and cities south of the site, such as Freeport and Clute. Lake Jackson, the largest city in the area and just five miles west of the site would be a likely choice of residence for many of the new workers. However, even if over half the workers commuted from Lake Jackson (150 workers and one person per vehicle), the traffic volume on Route 332 would increase less than two percent based on the 1990 traffic volume statistics presented in section 5.2.9.4. Given the low probability of accident occurrence and the small increase in traffic relative to current traffic flows, the increase in the number of accidents resulting from construction of a site at Stratton Ridge would be minimal.

Construction of a paved access road and on-site roads might be needed. These roads would be asphalt surfaced, two lanes, and approximately 20 feet wide with six-foot shoulders.

Some additional traffic would be created by trucks removing vegetation and other debris during the initial stages of site development as well as from construction equipment and vehicles bringing materials for facility construction. Heavy vehicles, such as large scrapers (for site clearing), a drilling rig, and a workover rig would probably exceed the 80,000 lbs load limit on state highways, and would require heavy equipment load permits to transport them to the site. These vehicles would not cross the 28,000 lbs load limit bridge crossing the ICW three miles south of Freeport. This additional traffic would be sporadic and short term, and any effect on the condition of roads or bridges would be minimal. DOE would repair those roads that are already affected by the transport of heavy equipment.

7.2.9.6 Housing

Development of the Stratton Ridge site would have negligible impact on housing availability. (The housing stock available in the Stratton Ridge region is described in section 5.2.9.5). In Brazoria County alone, there were 4,407 vacant housing units available in 1990. Under the high impact scenario, the number of new households in the region would not exceed 272. Even if no workers relocated outside Brazoria County, these additional households would fill only six percent of the empty housing units.

7.2.9.7 Health Care

Assuming, under the high impact scenario described above, that all 832 persons would relocate to Brazoria County, the ratio of residents to physicians, and residents to hospital beds, would not change significantly. In 1990, Brazoria County had four hospitals, 363 hospital beds, and 130 physicians. There are 1,468 residents per physician, and 524 residents per hospital bed. With an additional 832 residents, the ratio would change to 1,474 residents per physician and 527 residents per hospital bed, changes of 0.4 and 0.5 percent, respectively.

7.2.9.8 Education

The estimated number of additional children entering the regional school systems would range from 24 to 226 (including children of both construction and permanent workers). Even under the high impact scenario, the total number of school children entering the local school system would be less than half a percent of the current school enrollment of more than 48,000 students in kindergarten through high school. Given that the children will be dispersed among four counties and two parishes, any impact would be minimal.

7.2.9.9 Fiscal Impacts

The net fiscal impact of developing Stratton Ridge as a SPR facility is difficult to estimate. The amount of property taxes paid by the land owner in 1990 is not currently available. The revenue from the property would be lost if the property became Federally owned. However, given that the project would generate at least 292 temporary jobs and 70 permanent jobs, this small shortfall would be more than compensated by the additional tax revenue from wages and property owned by these additional employees. Increased earnings and trade due to secondary effects would also generate local tax revenue.

7.2.9.10 Emergency Response Capabilities

The projected population in-migration is not expected to adversely affect existing emergency response capabilities. Further details on potential impacts on emergency response capabilities for all the sites are provided in section 7.1.9.10.

7.2.9.11 Oil and Brine Spills

Several negative socioeconomic impacts associated with oil and brine spills should be considered regarding the proposed Stratton Ridge expansion site. As several of these impacts could be similar to those of the Big Hill expansion site, refer to the Big Hill section for a more detailed explanation.

Socioeconomic Impacts of Oil Spills

An oil spill at or near the Stratton Ridge site or along a pipeline could have a number of impacts. The existing DOE pipeline crosses several water bodies, including Chocolate Bay and Bastrop Bayou, but the proposed one-mile pipeline spur would cross none. There are also a significant number of industrial and irrigation/agricultural uses that are dependent on groundwater in the Stratton Ridge area. Since approximately 60 percent of the land in Brazoria County is used for agricultural purposes, a terrestrial oil spill could have a socioeconomic impact near the Stratton Ridge site. Rice is the primary crop, and corn, grain sorghum, soybeans, and cotton, in addition to cattle ranching, are also important. Several species of fish inhabit the Stratton Ridge region and are important for both commercial and recreational fishing.

Socioeconomic Impacts of Brine Spills

A brine spill at or near the Stratton Ridge site could affect the same water bodies within a five-mile radius of the site as noted above. The proposed brine disposal pipeline would cross Ridge Slough, Essex Bayou, and the ICW. Ridge Slough and Essex Bayou are characterized in Table 5.2-3, and the ICW is characterized in 5.2.3.2. In addition, Oyster Creek and Drum Bay, environmentally sensitive areas known for nursery grounds, are located near the proposed diffuser site in the Gulf of Mexico. Because Drum Bay is flushed only by tidal action and wind, resulting in poor circulation, a brine spill in the bay could have significant impacts. The brine pipeline would not cross within one mile of any population center, except for the town of Surfside, which is heavily dependent on aquifers for public drinking supplies.

7.2.9.12 Prime and Unique Farmlands

The proposed Stratton Ridge site would not affect prime and unique farmlands. The proposed Stratton Ridge pipeline ROW would indirectly and temporarily convert a total of 43.2 acres of prime and unique farmland, as identified by the U.S. Soil Conservation Service. After construction, the ROW would be returned to its original contours and vegetation. The proposed action would not be expected to have a lasting impact on farmlands.[67]

7.2.10 Noise Impacts

The following sections discuss potential noise impacts resulting from the development of a new SPR site at Stratton Ridge.

7.2.10.1 Construction Noise

As explained in section 5.2.10, the existing activity at Stratton Ridge is assumed to result in an ambient noise level of 55 to 60 dBA in the immediate impact area surrounding the proposed Stratton Ridge site. Using the model described in Appendix H, noise levels from construction at Stratton Ridge would likely be 68 to 73 dBA. Industrial activity is ongoing at the Stratton Ridge salt dome due to the existence of 57 privately-owned salt caverns to the north of the proposed site location. Although this industrial area is within the 5,000-foot radius impact zone, it is unlikely that significant disturbance would occur as the background noise level around the existing wells is almost certainly greater than the 53 dBA assumed for this model. Although there were two residences within the impact zone as of 1974, the change in sound levels over the ambient baseline would be minimal. Therefore, no major noise-related impacts would be expected as a result of the construction of an SPR site at Stratton Ridge.

Impacts associated with the construction of the pipelines would also be expected to be minimal. The brine disposal pipeline would extend into the Gulf of Mexico from the site, a distance of approximately 16 miles. The RWI pipeline would follow the same pipeline ROW, but would end at the ICW, a distance of approximately eight miles. Oil pipeline construction would consist only of a one-mile pipeline spur to the existing Bryan Mound line. Because of the relatively short distances and because construction progresses at a rate of approximately one-half mile per day, any impacts in a given area would be of short duration (i.e., one to two days). (For a detailed discussion of noise sources from construction activity, see Appendix H.)

7.2.10.2 Operational Noise

Operational noise levels at Stratton Ridge would be approximately 60 dBA at 500 feet from the site based on Big Hill monitoring data. Because the background level within the 5,000-foot radius impact area often exceeds 60 dBA, the net change in ambient sound levels, if any, would be minimal; therefore, no significant noise impact would be expected as a result of SPR operations at the Stratton Ridge site.

7.3 Weeks Island (Capline Complex Site)

The potential impacts associated with the development of a new facility, including associated pipelines and pump stations at Weeks Island, are discussed in the following section. Specifically, this section describes potential impacts of the physical, biological, and socioeconomic environment surrounding Weeks Island, that is described in section 5.3. Impacts from expansion of the St. James Terminal, a distribution enhancement that may be associated with a Weeks Island site, are discussed in section 7.6.

7.3.1 Geological Impacts

This section examines the potential geologic impacts that could occur as a result of SPR expansion at Weeks Island. Potential impacts associated with the proposed underground injection of brine at Weeks Island (which are both geological and hydrogeological) are considered in section 7.3.2.

7.3.1.1 Subsidence

Subsidence at Weeks Island is occurring over all existing mined areas. Based on a preliminary study conducted by Sandia National Laboratories, the average rate of subsidence over the existing SPR oil storage area at Weeks Island since 1983 has been approximately 0.11 feet per year.[68] Subsidence data at Weeks Island are tentative and would require additional surveys in order to validate the preliminary subsidence study.[69] Whenever subsidence occurs, there exists the possibility that ponds will form on the surface. However, assuming a subsidence rate of 0.11 feet (3.35 cm) per year, the surface would not reach the top of the most shallow aquifer (five meters bls) for nearly 150 years. In addition, engineering controls such as drained pavement would prevent water from collecting over the caverns.

Some tilting of the vertical shafts at the existing SPR storage mine has also occurred as a result of creep closure.[70] Impacts associated with subsidence would be limited to the area immediately over the salt dome, but may present a potential concern for cavern engineering. No regional subsidence is occurring as a result of the operating SPR site. Subsidence rates at a Weeks Island expansion site would be less than subsidence rates currently experienced at Weeks Island because the expansion site would utilize leached caverns as opposed to an abandoned salt mine. In addition, the local subsidence caused by the existing salt mine combined with the local subsidence caused by the new caverns would not result in regional subsidence. For a general discussion of subsidence, see section 7.1.1.1.

7.3.1.2 Seismicity

No seismic impacts are anticipated as a result of SPR expansion at Weeks Island. For a discussion of seismic activity in the region, see section 7.1.1.2. For specific information on faults at Weeks Island, see section 5.3.1.

7.3.1.3 Potential Impacts of Brine Seepage on Soils

As discussed in section 7.1.1.3, major brine spills from leached caverns are extremely unlikely, therefore, no impacts would be anticipated from brine seepage from storage caverns at a new Weeks Island site.

7.3.1.4 Multiple-Use Considerations

Weeks Island is the location of several different commercial mining and storage operations. The area of proposed SPR cavern development at Weeks Island is owned by Morton International, Inc. Morton currently operates a mechanically mined, room-and-pillar salt mine to the west of the proposed site that extends to a depth of -400 meters.[71] At present, Morton is completing the mining of salt at the -370 meter level and is starting production at the -300 meter level. Morton does not plan any future mining operations at the eastern end of the dome, where the proposed SPR expansion site would be located.[72] In addition, Morton operates two small, leached brine caverns northeast of the existing SPR storage facility for the production of table salt. These caverns have a total volume of approximately ten MMB but would not be used for oil storage. Substantial hydrocarbon production on the north salt overhang will eventually exceed one billion barrels and will place Weeks Island among the top three salt dome oil fields in the world.[73] The close proximity of Morton's salt mining operations, the hydrocarbon production areas at Weeks Island, and the existing SPR site limit the location of the SPR expansion site to the eastern side of the dome. SPR cavern development on the eastern side of the dome would appear to present relatively few geological impacts of concern.[74] No major geological impacts would be expected to occur at Weeks Island as a result of the co-use of the dome.

7.3.2 Hydrogeological Impacts

There are four major sources of potential groundwater contamination at the Weeks Island expansion site. These potential sources include a brine pond system, underground injection wells for brine disposal, oil and brine pipelines, and other material spills. The potential groundwater impacts that would be associated with each of these sources are described below.

7.3.2.1 Brine Ponds

If Weeks Island is selected as an expansion site, DOE would construct and operate a brine pond system patterned after the Big Hill system (Weeks Island presently does not have any brine ponds because the site's existing cavern was a room-and-pillar salt mine that did not generate any brine). As described in section 6.2.2, this system would consist of three ponds, a roughly 250,000-barrel pond for the settling of anhydrite, a 100,000-barrel oil recovery pond, and another 100,000-barrel final holding pond prior to pumpage to the Gulf of Mexico for final disposition. Measures to prevent migration from the ponds would include HPDE liners, underdrain systems to detect leaks, surrounding bentonite clay slurry walls, and a perimeter dike to prevent overtopping and runoff. The ponds also would be equipped with a series of shallow groundwater monitoring wells to help detect a leak if one should occur.

Possible releases from the proposed brine ponds include seepage through the synthetic liner to groundwater or overtopping and subsequent seepage to the subsurface. Although releases of this nature have occurred in the past at some brine ponds at existing SPR sites, the improved controls planned for the ponds at Weeks Island would make this an unlikely event (see section 6.2.2).

Unlike the Big Hill site, which has a natural clay (impermeable) layer under the brine ponds, the shallow subsurface at Weeks Island consists primarily of loose sands and gravels (section 5.3.2). As a result, if a release from the ponds at Weeks Island was to occur, it could migrate to the shallow (16 to 160 feet below land surface) groundwater relatively quickly. Contamination of this shallow aquifer could significantly increase its salinity; the groundwater is fresh down to 780 feet, the base of the Wisconsin Sands. If not contained, such an increase in salinity in local groundwater could result in a potential loss of use of DOE water supplies (DOE actively uses two wells on the island). Released brine also could discharge into nearby downgradient wetlands and surface waters, significantly raising their salinities above natural levels (waters in the area are typically fresh or slightly brackish), and causing adverse ecological effects. The closest downgradient surface water body that might be affected would be Warehouse Bayou, which ranges from 160 to 2,500 feet away from the proposed construction site. A release from the brine ponds, however, would be unlikely to pose a significant human health threat. There are no population centers within nine miles and, due to the nature of the surrounding environment (marshy) and lack of a resident local population, drinking water supply development around Weeks Island would be unlikely. .

7.3.2.2 Underground Injection Wells

The underground injection system being considered for brine disposal at Weeks Island is described in sections 3.3.3 and 6.2.3. This system would result in the disposal of one MMBD in a zone located at least 1,200 feet below the land surface (injection would be into either the Illinoian sands at about 1,200 feet or the Nebraskan at about 2,200 feet). Therefore, the injection zone would be separated from the regional freshwater base by at least 420 feet, of which 300 to 400 feet would be highly impermeable Sangamon clays. Naturally occurring waters in the receiving sands are generally unusable because of their highly saline character (both candidate injection zones contain saturated brine). The injection would occur via a maximum of 25 injection wells spaced 1,000 feet apart along the ROW of the existing crude oil pipeline to St. James.

This emplacement of brine at depths of at least 1,200 feet would result in an increase in pressure in the receiving formation, accompanied by a displacement of existing fluids and minor compression or deformation of the reservoir strata. This could result in: (1) the displacement of saline water to freshwater zones; (2) the fracturing of geologic formations, possibly including aquitards separating fresh and saline groundwaters; (3) the upward migration of brine or natural saline formation water through existing fractures and faults; (4) the upward flow of brine or natural saline formation fluids through unplugged abandoned wells that penetrate the injection zone; or (5) more unlikely, gross readjustment of surrounding strata (e.g., activation of faults in underpressured zones where frictional resistance is overcome by hydrostatic pressure). As outlined in section 6.2.3, the possibility of these events is very remote due to the proposed engineering design and operational controls. For example, injection pressures and rates would be limited to levels that are safely below fracturing thresholds; they also would be monitored continuously during injection operations to detect any sudden change that could indicate a loss of integrity in the wells or the receiving formation. In addition, in accordance with Class II injection well permit requirements, the area within at least a quarter mile around each injection well would have to be examined for the presence of abandoned wells. No abandoned wells are known to exist in the area; however, if any such wells are found, they would have to be evaluated and, if necessary, properly plugged to make sure they could not serve as a conduit for upward flow. Finally, DOE's Level III Design Criteria for SPR sites requires storage sites to be located in areas subject to minimal seismic risk. Accordingly, Weeks Island is not in a seismically active region (see section 7.1.1.2), and the potential for increased pressures caused by injection operations to activate faults in the area would be extremely remote.

There also could be a remote possibility that one or more of the injection wells could fail, resulting in the direct release of brine to shallow groundwater. Based on a review of failure rates of Class II injection wells in the oil and gas industry, the American Petroleum Institute estimates that the probability of this happening when a well is designed like the proposed Weeks Island wells (i.e., equipped with surface casing that covers shallow freshwater zones) is on the order of one in 1,000,000 for every year that the well operates (see section 6.2.3). The probability of such a failure of the proposed Weeks Island wells, however, may be somewhat greater due to the larger volume of brine to be injected by SPR operations compared to that injected into typical Class II wells used in the oil and gas industry. Despite this low probability, if such a release to shallow groundwater did occur, was not detected, and was not contained, it could result in the same types of groundwater impacts outlined above for the brine ponds. That is, there could be potential loss of use of DOE water supplies and migration into wetlands or water bodies and subsequent ecological damage. Because of the existing and likely future land and water uses in the area, potential human health impacts would not be expected.

7.3.2.3 Oil and Brine Pipelines

Sections 3.3.3 and 3.3.5 describe in detail the routes for crude oil and brine disposal pipelines at Weeks Island. Regardless of what routes are selected, both the crude oil and brine pipelines would be laid underground, and releases of oil or brine from the pipelines along these routes could seep into the underlying groundwater.

Releases from the pipeline systems could arise from erosion, corrosion, overpressurization, or failure of valves or joints. As outlined in Chapter 6, historical spill statistics indicate that the expected number of reportable oil pipeline spills associated with the Weeks Island candidate site would be fewer than one during fill, refill, or drawdown. It appears that brine pipeline failures at Weeks Island could cause up to eight small brine spills per year (of roughly 75 barrels) and two larger spills of 74,000 barrels or more. If unmitigated, these spills could result in potential groundwater resource loss and, if the contaminated groundwater discharged into downgradient surface waters, aquatic ecological risk. Because the brine pipeline route traverses swampy land that is not likely to be developed for groundwater use, releases from the brine line would not be likely to result in any adverse human health effects.

7.3.2.4 Other Material Spills

Accidental spills from normal site operations could involve small quantities of hazardous substances such as solvents (including bromotrifluoromethane and monoacrylamide), cleaning compounds, paints and paint thinners, and fuel and oil for equipment maintenance. Hazardous materials may be stored in several locations at the proposed Weeks Island facility such as the warehouse, laydown yard, and flammable storage building. Inspections at the existing site have indicated no deficiencies regarding storage of toxic and chemical substances in the warehouse. However, at the laydown yard, drums containing chemical substances would be stored outdoors, unprotected from adverse weather conditions at locations lacking impervious flooring and curbing to contain spills.[75] At the flammable storage building, no dike or other means of spill containment would be constructed at the doors of the building to prevent releases to the environment.

While accidental spills of chemicals from these storage areas have not been reported previously, there would be a possibility that such spills could occur in the future. Similar materials would be used and stored under the same types of conditions at the proposed expanded Weeks Island facility. In the event of a spill, the relatively permeable soils and shallow water table would permit ready migration to the Gonzales aquifer. However, there are circumstances that would tend to reduce the expected impact associated with these spills, if they occurred, including: (1) the quantity of material spilled should be limited; (2) generated hazardous and nonhazardous oil field wastes (i.e., the most toxic materials) would be transported off-site for disposal; and (3) requests have been submitted for construction of secondary spill containment measures, which would further reduce the likelihood of a spill migrating into the environment.[76]

7.3.3 Surface Water and Aquatic Ecology Impacts

The proposed expansion of Weeks Island could cause: (1) impacts associated with brine disposal in the Gulf of Mexico; (2) impacts associated with raw water intake from the ICW; (3) adverse effects associated with the site and pipeline construction activities; and (4) impacts associated with accidental spills of oil and brine. Each of these potential impacts at Weeks Island is addressed separately below.

7.3.3.1 Brine Disposal in the Gulf of Mexico

Appendix Q describes the methods and results of a detailed modeling analysis to estimate the magnitude and extent of excess salinity levels in the Gulf of Mexico caused by proposed brine discharges at the candidate Weeks Island diffuser site. The appendix predicts the maximum increase in bottom salinity, the vertical extent of the resulting brine plume, and the areal extent and location of different excess salinity contours (e.g., contours of 1 ppt, 2 ppt, 3 ppt, and 4 ppt above natural ambient levels). These predictions are provided for largest plume, typical, and smallest plume conditions, defined by different combinations of operational and oceanographic parameters.

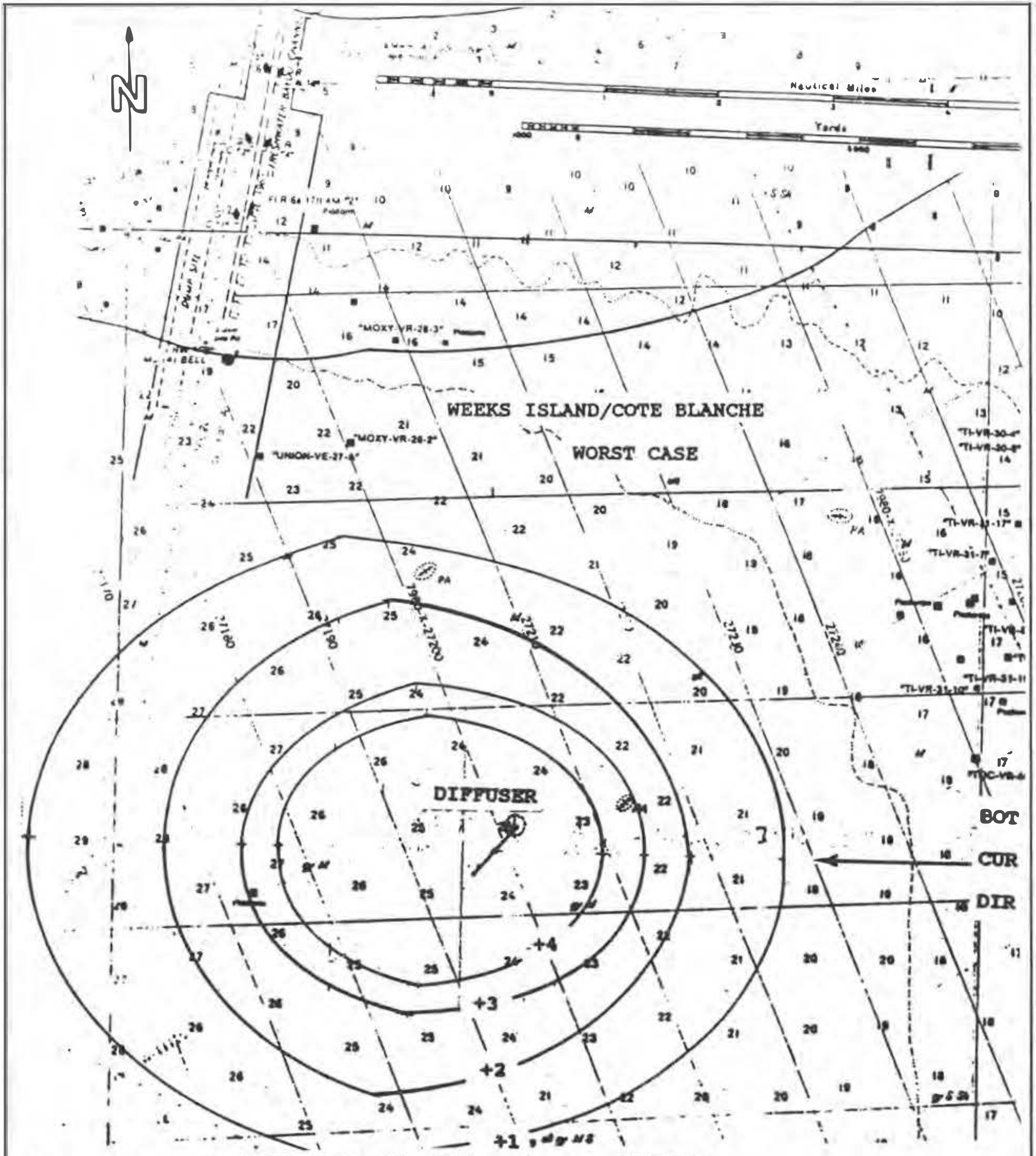
Figures 7.3-1 and 7.3-2 show the predicted largest and typical brine plumes, respectively, at the diffuser site at Weeks Island, assuming all 55 ports of the proposed diffuser are open. Critical dimensions of these plumes are summarized below in Table 7.3-1. For both sets of conditions, the vertical extent or height of the brine jet is predicted to be about 18 feet, or seven feet below the water surface. The maximum above ambient salinity is predicted to be 4.9 ppt under worst-case conditions and 3.9 ppt under more typical conditions.

Figures 7.3-1 and 7.3-2 show that the +1 ppt brine plume at the diffuser site would travel within 0.7 miles of the Freshwater Bayou Channel under the most conservative conditions, and within 1.9 miles of the channel under more typical conditions. The model used to generate these estimates, however, assumes that the sea floor is flat, and thus does not account for the upward slope of the bottom toward the shore which would tend to keep the plume farther out to sea than shown. DOE also believes that these predictions for the largest plume tend to overestimate the magnitude and extent of excess salinity levels because they are based on an assumed bottom current of 0.03 m/s. Current roses and joint frequency distribution tables assembled for the Big Hill diffuser site, which is believed to be representative of the proposed Weeks Island diffuser sites, show that bottom currents as small as 0.03 m/s occur only eight percent of the time, on average. Therefore, the vast majority of the time, bottom currents are greater than assumed and the brine plume is expected to be smaller and less concentrated than predicted for the largest plume. Based on the frequency of the bottom current used to model typical conditions (0.09 m/s), the plume will more closely resemble the typical plume about 31 percent of the time.

To supplement this modeling analysis of excess salinity levels, DOE analyzed available brine composition data to evaluate the potential for metals and other inorganic constituents in SPR brine to cause adverse impacts when discharged to the Gulf of Mexico. This analysis, documented in Appendix M, indicates that metals and other inorganics expected to be released along with SPR brine should not pose a significant environmental threat. Conservatively estimated concentrations of virtually every constituent near the diffuser are below EPA criteria to protect marine organisms.

Field monitoring results from other SPR sites (i.e., West Hackberry and Bryan Mound) that have discharged brine to the Gulf for several years provide strong evidence that the Weeks Island brine discharges would cause only minor biological and ecological impacts. Bottom dwelling creatures are expected to have the greatest exposures to brine, as the plume is negatively buoyant and tends to reside along the bottom. Based on field observations at the West Hackberry and Bryan Mound diffusers, the greatest impact to benthos at Weeks Island would likely be a decrease in total abundance in an area ranging from as little as 31 acres to as great as 2,000 acres around the diffuser. However, experience shows that an increase in the diversity

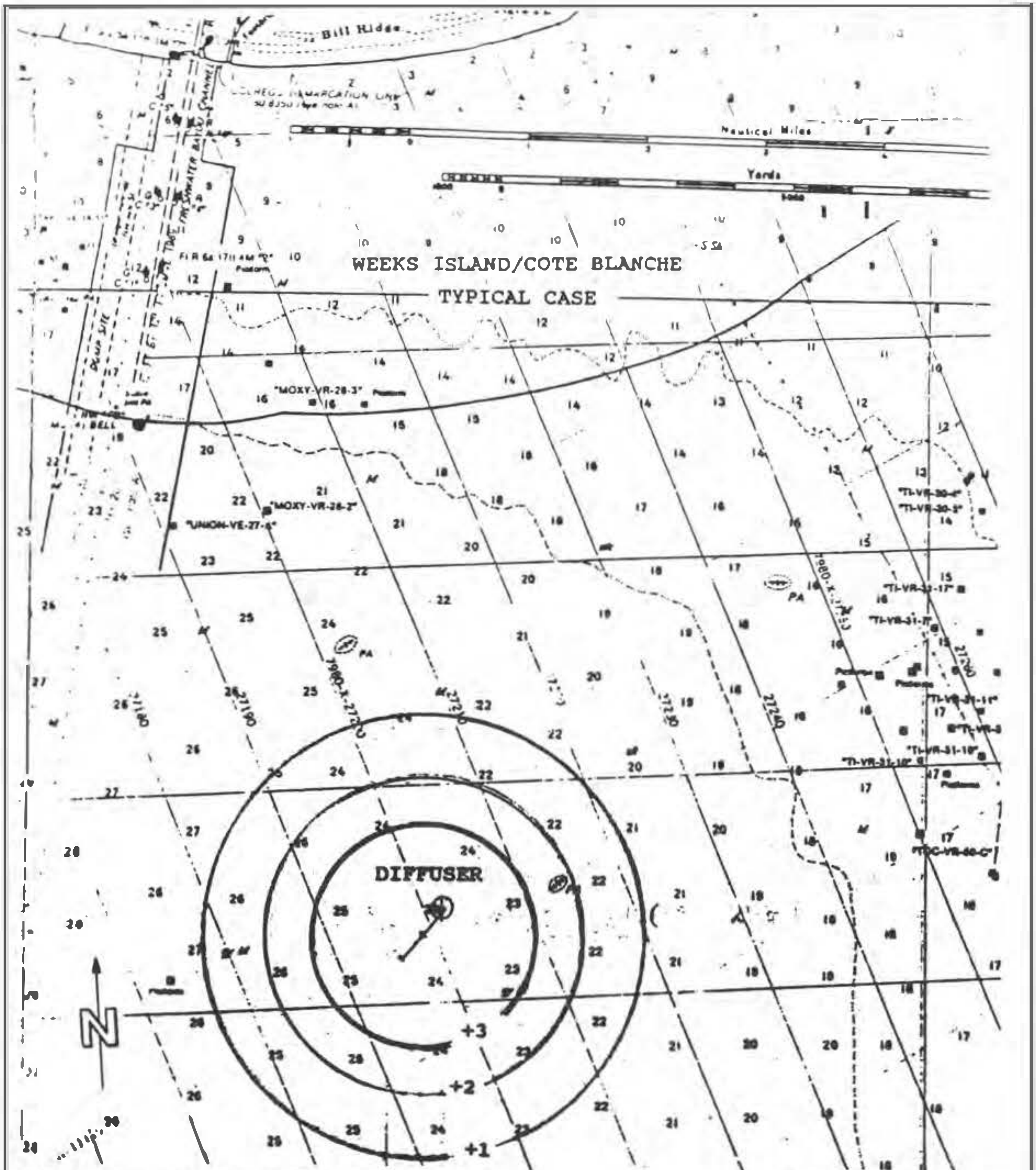
Figure 7.3-1
Predicted Largest Plume at the Weeks Island Diffuser



Source: Created for this draft EIS by Robert E. Randall

The diffuser would be located at 29°24.8' N and 92°16.1' W.

Figure 7.3-2
Predicted Typical Plume at the Weeks Island Diffuser



Source: Created for this draft EIS by Robert E. Randall

The diffuser would be located at 29°24.8' N and 92°16.1' W.

Table 7.3-1
Dimensions of Predicted Brine Plumes at Proposed Diffuser Site at Weeks Island

Excess Salinity Contour (ppt)	Areal Extent (acres)	
	Largest	Typical
+4	4,400	--[a]
+3	7,400	1,400
+2	14,100	2,900
+1	24,900	5,300

[a] The maximum above ambient salinity predicted under typical conditions is 3.8 ppt (i.e., less than +4).
Source: Randall, 1992 (Appendix Q).

could accompany this decrease in abundance. While these changes to benthos could influence the feeding patterns of demersal fish and cause commercially important fish to shift to other areas to feed, no clear or significant effects (e.g., sharp reductions in total biomass) on fish have been observed (see section 7.3.9.4). Because of the similarities of the proposed brine discharge operations and Gulf characteristics among the different sites, these same conclusions are expected to be valid for Weeks Island.

7.3.3.2 Impacts of Raw Water Intake at Weeks Island

Raw water used for the development and operation of the proposed Weeks Island site would be obtained from the ICW. Section 5.3.3.2 characterizes the baseline conditions of the relevant stretch of the ICW and connected water bodies near Weeks Island. This section describes the potential impacts to these water bodies caused by the proposed raw water withdrawal.

Applicability of the Big Hill Conclusions to Weeks Island

Both MIT and Texas A&M applied computer-based hydrodynamic models to simulate the effect of water withdrawal at the Big Hill site near Galveston Bay, Texas. The studies assessed water quality and hydraulic effects of water withdrawal from the ICW. The modeling results indicated that the effects of water withdrawal were negligible at Big Hill: the simulated changes in water level at the RWI and changes in salinity levels in the ICW were almost imperceptible. More detailed descriptions of the MIT and Texas A&M modeling studies and conclusions for Big Hill are provided in section 7.1.3.2 and Appendix N.

The results of the MIT and Texas A&M modeling studies have been confirmed by monitoring conducted during development of the Big Hill site. Raw water withdrawal at Big Hill has caused no perceptible changes in the water quality or hydrology of the ICW. Impacts of RWI on the ICW biota have not been monitored; however, direct entrainment of large aquatic organisms is limited by traveling screens that cover the intake structure and by a small intake velocity that is slower than the swimming speed of most fish. The water quality monitoring results at Big Hill, as well as the anticipated impacts to biota caused by continued raw water withdrawal at that site, are also presented in section 7.1.3.2 and Appendix N.

The ICW channel geometry at Big Hill and Weeks Island are virtually identical near the RWI. Additionally, the proposed RWI structure for Weeks Island would be modeled after the intake structure used at Big Hill. As a result, near-field (less than 100-feet distance) predictions of velocities and water depths at Weeks Island can be derived directly from previous modeling and monitoring results at the Big Hill site. Significantly, field monitoring data and experience at Big Hill have demonstrated that the near-field effects are very small (refer to section 7.1.3.2). Because geometries and flow rates at these sites are very similar, only minor hydrologic effects would be anticipated at Weeks Island. Both model results and field experience at Big Hill have indicated that the RWI structure does not significantly alter water depths or velocities.

However, the far-field results (at distances greater than 100 feet) of the Big Hill model simulations cannot be directly applied to the Weeks Island site, because the ICW system around the proposed Weeks Island intake is significantly more complex than that near the Big Hill intake. Consequently, order of magnitude estimates were developed to assess whether a potential exists for significant effects from water withdrawal at Weeks Island. These calculations were performed as a screening step to ascertain whether a more detailed study including hydrodynamic and water quality modeling should be pursued.

The sections that follow provide additional qualitative evaluation of the similarities between Big Hill and Weeks Island, and describe the methods and results of the calculations for instances in which the two sites were judged to be dissimilar. Additional detail on these methods is provided in Appendix R. Based on this evaluation, the anticipated impacts of water withdrawal at Weeks Island would likely be relatively minor and more detailed computer modeling was not pursued.

Potential Hydrological Impacts

Calculations to assess the effects of raw water withdrawal on flow in the ICW were performed using an assumed intake rate of 100 cfs, which is a conservative approximation of withdrawals at the Big Hill site (the average Big Hill intake historically has been 83 cfs or less). This intake rate is larger than the rate assumed by the Texas A&M and MIT modeling studies, and slightly larger than the maximum drawdown rate anticipated at Big Hill. To evaluate the far-field effects of this withdrawal at Weeks Island, changes in the energy slope were estimated for the channel before and after the withdrawal. This was accomplished by calculating the energy slope for a range of flow rates, as shown in Table 7.3-2 and described in more detail in Appendix R. For the specific hydraulic and geometric conditions at Weeks Island, the energy slope (S) corresponds to the slope of the water surface profile. Although flow in the ICW is non-uniform (the channel slope and energy slope are not equal), the approach outlined in Appendix R was assumed to be appropriate outside the "local" influences of the raw water intake.

As the data in Table 7.3-2 illustrate, the 100 cfs withdrawal from the ICW would have a negligible effect on the channel energy slope over a range of flow rates. Even at an initial ICW flow rate of 5,000 cfs (probably greater than the actual ICW flow rate) the change in slope associated with withdrawal of 100 cfs would translate into a decrease in water depth of only one-half inch per mile of waterway. This is too small to be considered significant, especially in comparison to the average tidal range of 1.6 feet observed in the ICW near Weeks Island.

Table 7.3-2
Vertical Change in Depth Corresponding to a 100 cfs Withdrawal for a Range of ICW Flow Rates

Flow Conditions Without Withdrawal			Flow Conditions With 100 cfs Withdrawal			Vertical Change in Depth
Q_1	V_1	S_1	Q_2	V_2	S_2	(Inches per Mile)
0	0	0	100	0.056	9.18×10^{-7}	0.06
500	0.28	1.29×10^{-6}	600	0.34	1.90×10^{-6}	0.04
1000	0.56	5.14×10^{-6}	1100	0.62	6.30×10^{-6}	0.07
5000	2.8	1.29×10^{-4}	5100	2.9	1.38×10^{-4}	0.58

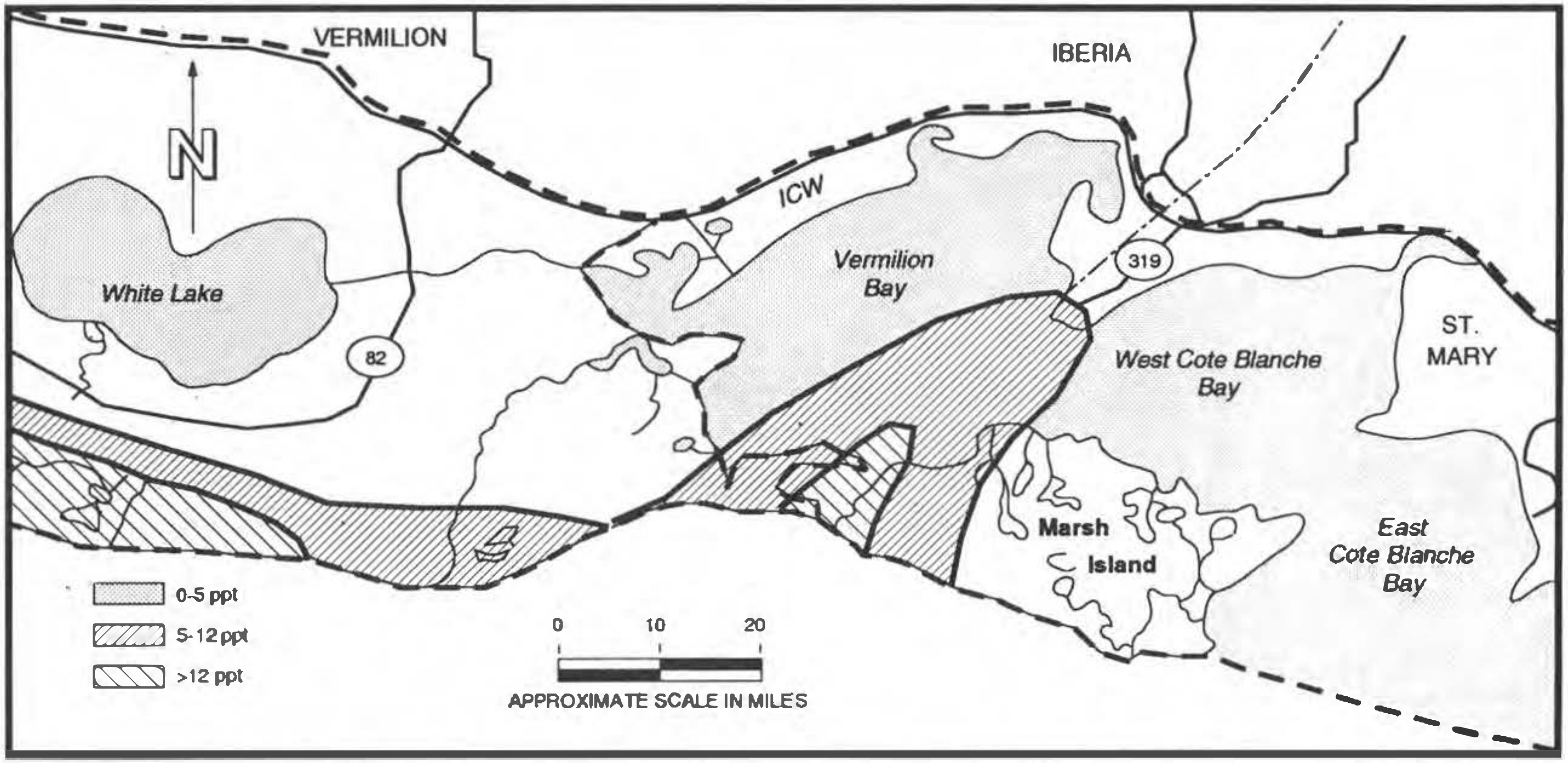
Q = flow rate (cubic feet per second)
V = flow velocity (feet per second)
S = slope (feet per feet)

Potential Water Quality Impacts

The ICW in the vicinity of Weeks Island is within an estuarine region dominated by inflow from the Atchafalaya River in the east. The region includes all of Weeks Bay, the northern extent of Vermilion Bay, and the waters of the ICW. As discussed in section 5.3.3.2, the ICW is hydraulically connected to many water bodies in this region. Vermilion and Weeks Bays are linked to the ICW by a series of peripheral canals, bayous, and lakes. A significant connection between the ICW and Weeks Bay occurs approximately two miles downstream of the proposed raw water intake. The water bodies and extensive marshlands in this region exchange water freely along much of the ICW resulting in a fairly homogeneous water quality dominated by inflow from the Atchafalaya River.

Salinity in the estuarine region that includes Weeks Island is generally less than five ppt.[77] Figure 7.3-3 shows that generally freshwater (i.e., 0-5 ppt salinity) exists throughout the entire extent of Weeks Bay and far out into Vermilion Bay. The most representative salinity data available were collected by the Army Corps of Engineers on the ICW at Vermilion Lock between 1974 and 1981 (Vermilion Lock is approximately 25 miles west of the proposed raw water intake). While these salinity data from Vermilion Lock range from 0.04 up to 13.9 ppt, the salinity is usually well below the maximum value and averages 1.76 ppt.[78] The low salinity levels are primarily attributed to freshwater inflow from the Vermilion and the Atchafalaya Rivers and high levels of precipitation (60 inches per year). Because the ICW shares relatively homogenous salinity with connecting water bodies, raw water withdrawal would not result in significant salinity changes. In an unrealistic worst-case scenario, flow from the ICW to Vermilion Bay and Weeks Bay would be significantly reduced or reversed as a result of water intake at Weeks Island. However, freshwater discharge from the Vermilion River and local precipitation would continue,

Figure 7.3-3
Salinity Distribution in Weeks and Vermilion Bays



Source: Louisiana Wildlife and Fisheries Commission, *Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana, Phase II, Hydrology and Phase III, Sedimentology.*

and the low salinity levels in waters the size of Vermilion and Weeks Bays would be unlikely to change significantly. Even if, as a result of water withdrawal at Weeks Island, water in a particular connecting channel were to flow from Weeks Bay to the ICW, the potential change in salinity would be insignificant. Waters in Weeks Bay and the ICW would remain essentially fresh.

Potential Direct Impacts to Biota

The proposed RWI structure at the Weeks Island site was modeled after the existing structure at the Big Hill site. For this reason, and because both sites are in similar estuarine ecosystems, the impacts to biota resulting from raw water withdrawal at Weeks Island would likely be identical to impacts at Big Hill. The structure at Big Hill includes features intended to limit impacts to biota. Fish and other large animals are blocked from the intake by trashbars and traveling screens with a 0.5-inch mesh. The intake velocity of 0.5 feet per second is slower than the swimming speed of most fish. Live macrocrustaceans caught by the traveling screens at the Big Hill intake structure are periodically removed and returned to the ICW.

Despite features to limit the entrainment of fish and larger organisms, raw water intake would unavoidably entrain small organisms able to pass through the 0.5-inch mesh screens. Such organisms include phytoplankters, zooplankters, larval fish, and benthic organisms. At Big Hill, this impact is considered minor[79] because the volume of water removed contains a small portion of the planktonic community of the ICW and associated wetlands. This conclusion would apply with even greater confidence to Weeks Island because the site lies within an extensive region of interconnecting aquatic habitats.

Although impacts of raw water withdrawal on the ICW biotic communities at Big Hill have not been monitored, the effects are believed to be inconsequential. No obvious impacts have been observed. Similarly, no significant impacts to the biotic community of the ICW would be expected from raw water withdrawal at the Weeks Island site.

7.3.3.3 Construction Impacts

There are three categories of construction activities at Weeks Island that could cause surface water and aquatic ecology impacts: construction of the on-site facilities, construction of the raw water intake system, and construction of crude oil and brine pipelines. Each of these construction activities is evaluated below.

Impacts Associated with On-site Construction

Appendix O presents DOE's calculations of the amount of soil that could erode as a result of on-site construction activities. For Weeks Island, the calculations indicate that the proposed clearing of 130 acres at the site could result in the erosion of approximately 23,080 tons of topsoil. This soil is expected to erode from a number of sloping faces in northeast, northwest, and southeast directions from the site, but regardless of direction, the nearest water body that could receive the soil is Warehouse Bayou (the bayou wraps around the proposed construction site such that it may receive erosion from all of the sloping faces). If this erosion was not contained, an estimated 4,850 tons of soil might actually migrate to and enter Warehouse Bayou, considering the distance from the site to the bayou.

As indicated in Appendix O, this enhanced sediment load due to site construction would increase the suspended solids concentration in a two-mile stretch of Warehouse Bayou by an estimated 80 ppm. This increased concentration would be reached 39 days after the start of construction and could remain during the remaining 141 days of the proposed clearing phase of the construction period (conservatively assuming that a rainfall event starts at the same time the construction does and continues throughout the entire construction duration). The suspended solids concentration in the ICW would then be expected to return to pre-construction levels in about 40 days after clearing ceases and the site is revegetated or covered.

This increase in suspended solids could cause significant adverse impacts in Warehouse Bayou. Although the increase would be temporary and limited to a two-mile stretch, it could be of sufficient magnitude to cause severe water quality or aquatic ecology impacts (such as significant decreases in light penetration and primary production, and adverse effects to the health, movement, and development of fish living in the bayou). Settleable solids that blanket the bottom also could result in minor shifts in the bayou's course, damage resident benthic communities, and block any spawning areas if they exist in the affected area. Bottom areas that are not totally smothered would likely recolonize quickly and offer the same general type of habitat that exists in unaffected areas. However, to help prevent the large sediment load to Warehouse Bayou and the potential impacts that it may cause, DOE would use erosion control measures when constructing the on-site facilities at Weeks Island (see Chapter 8).

Impacts Associated With Construction of the Raw Water Intake System

The RWI pipeline for Weeks Island would cross a disturbed overgrown area but no water bodies over its route to the ICW about two miles to the west. Construction of this pipeline also would not affect surrounding drainage patterns, because the pipeline trench would be backfilled and returned to the pre-construction topography. Therefore, construction of the raw water pipeline would not directly affect hydrology, water quality, or aquatic organisms around the site.

Construction of the RWI structure at Weeks Island would cause the same kinds of impacts described in section 7.2.3.3 for the construction of the RWI structure at Stratton Ridge. Specifically, in a small area on the east bank of the ICW, benthic organisms and habitat would be destroyed by dredging, sediments would be suspended in the water column causing increases in turbidity and possibly contaminant concentrations (depending on the composition of sediments in the disturbed area), and fish and other mobile organisms would likely avoid the area. Except for the small area permanently occupied by the intake structure, however, these impacts would only be temporary. No critical or unique habitats or resources are known to exist in the affected area.

Approximately 8,600 cubic yards of dredge spoil would be deposited in a suitable area that would be designated and permitted by the Corps of Engineers. Preliminary DOE plans call for the material to be deposited in a 1.8-acre area on the bank of the ICW next to the construction site, as it was when the RWI structure was constructed at Big Hill. The deposition of this spoil would kill the vegetation in the affected area, but it should not present a significant threat to surface water quality or aquatic organisms. The disposal area would be equipped with a containment dike to keep sediments from re-entering the ICW.

Impacts Associated With Crude Oil and Brine Pipeline Construction

As described in detail in section 7.1.3.3, construction of crude oil and brine pipelines would result in a temporary degradation of water quality and aquatic habitat in water bodies that are crossed. Water quality impacts might include increased turbidity levels, increased concentrations of suspended nutrients, reduced dissolved oxygen levels, and, depending on the composition of bottom sediments, increased levels of metal and organic contaminants. Organisms that live in the water may, in turn, experience toxicological and behavioral effects. Benthic organisms and habitat directly within and adjacent to the pipeline corridor also would be unavoidably destroyed. All of these impacts, however, would likely be temporary and confined to areas close to the pipeline ROW. Suspended sediments would likely settle back to the bottom, benthic habitat be restored and recolonized, no permanent obstructions would exist to impede the natural flow of water or the migration of fish, and free swimming organisms that avoided the disturbance would return to the area soon after construction ceases. In addition, pipeline trenches on land would be backfilled and returned to the natural topography to maintain existing drainage patterns and to prevent the formation of new water courses and intrusion of saltwater.

Construction of the crude oil pipeline at Weeks Island would adversely affect few water bodies. Under the 270-drawdown criterion, DOE would construct a less than one-mile spur to connect the site to the existing St. James pipeline. This spur would cross no bodies of water. While DOE also would construct a new booster station on the St. James pipeline, this station would be sufficiently removed from water bodies to avoid significant construction impacts to surrounding water bodies. In terms of a 180-day drawdown criterion, DOE would construct, in addition to the one-mile spur and one booster station, another pump station, an eight-mile spur to a reversed Texas 22" pipeline, and expanded facilities at the St. James Terminal (which would not require new pipeline construction). Each of the four water bodies that would be crossed by this eight-mile spur, Warehouse Bayou, Bayou Patout, Stumpy Bayou, and Little Valley Bayou, would experience the impacts summarized in the preceding paragraph. However, these waters do not contain any known critical or unique habitats or resources (section 5.3.3.3), and the long-term impacts to water quality and aquatic organisms would be minor.

Construction of the on-land portion of the brine discharge pipeline at Weeks Island also would cause only minor water quality and aquatic ecology impacts. Over its two-mile stretch on land, the brine disposal pipeline would cross only the ICW. This water body would not experience any significant impacts because directional drilling using land-based equipment would be used for pipeline construction (i.e., the pipeline would be pulled through a hole drilled under the ICW bottom rather than laid in a trench excavated in the bottom sediments). For this reason, there would be no impacts to barge traffic along the ICW. A second brine disposal option would involve the construction of a five-mile pipeline to injection wells along the existing ROW of the St. James pipeline. Construction of this pipeline also would not cause significant water quality impacts because it would not cross any surface water bodies.

Construction of the off-shore component of the brine discharge pipeline, however, could result in substantial impacts to oysters in affected areas. As outlined in section 5.3.5.2, virtually all of Vermilion Bay and contiguous West Cote Blanche, East Cote Blanche, and Atchafalaya Bays are State-regulated oyster seed areas (see Figure 5.3-4). While private harvest is not permitted in this area, oysters are transplanted from here to commercial leases. Some of these commercial leases lie directly south and west of Marsh Island. The brine pipeline route would cross 22 miles of oyster seed ground in Vermilion Bay. In addition, the pipeline would cross approximately 1.5

miles of oyster leases south of the Paul J. Rainey Wildlife Refuge. There presently is no active oyster harvesting, however, in the leased areas that would be crossed.

Oysters lying in and immediately adjacent to the dredged area would be destroyed. Additional indirect destruction could occur from entrainment of larval oysters during dredging, changes in salinity regimes[80] (which would be minor in this area), resuspended sediments, siltation, and increased dissolved oxygen demand. The impacts on oyster populations of larval entrainment due to hydraulic cutterhead dredging have not been clearly established. A workshop sponsored by the Army Corps of Engineers concluded that knowledge of larvae distribution and behavior is insufficient to determine whether dredging activities significantly affect larval mortality and subsequent spat settlement.[81] Models of larval entrainment offer conflicting views: Carter's model shows a twelve to 51 percent dredge-induced reduction in larval survival rates (which reduces oyster survival to seed stage by two to 19 percent);[82] the model of Carriker et al. estimates dredge-induced larval mortality to be only 0.005 to 0.3 percent.[83] It is possible to avoid larval impacts by dredging during the non-spawning season.

Impacts to oysters are considered particularly important because oyster beds are the commercial fishery most likely to be adversely affected by pipelines in the Gulf of Mexico, particularly off the Louisiana Coast.[84] The Louisiana Department of Wildlife and Fisheries has received more complaints of damage to oysters from pipeline construction than to any other commercial species, but has not performed a detailed scientific assessment of the problem.[85]

7.3.3.4 Oil and Brine Spill Impacts

The crude oil distribution enhancement being considered at Weeks Island would pose a risk to the waters adjacent to the Weeks Island and St. James sites, the water bodies crossed by the existing Weeks Island-to-St. James pipeline, waters crossed by the proposed spur to Texas 22", and waters crossed by Texas 22". In addition, the proposed crude oil distribution would pose some risk to the open ocean, coastal and inland water bodies, and to wetlands. Generally, oil spills could result from an on-site equipment failure, leakage of new or existing crude oil pipelines, a spill at terminals, or a tanker leak.

There are two proposed options for brine disposal at Weeks Island. One would involve disposal to the Gulf of Mexico via a brine pipeline and diffuser (to the west of Marsh Island). The second option is underground injection. The following analysis considers only potential brine spills from onshore and nearshore portions of the brine discharge pipelines. Potential impacts associated with the purposeful release of brine to the Gulf of Mexico are addressed in section 7.3.3.1 and potential impacts caused by the accidental release of brine from the proposed injection wells are described in section 7.3.2.2.

Ocean Spills

Ocean spills could result from tanker accidents during fill or distribution. Based on historic spill rates, 0.6 spills to the ocean could result during fill at Weeks Island and 0.3 spills during distribution (section 6.1). If a spill to the ocean did occur, the resulting impacts would be identical to the impacts from ocean spills described for Big Hill (section 7.1.3.4). Namely, there could be lethal effects to small organisms unable to avoid the spill (e.g., planktonic organisms and epipelagic fish eggs). There also would be lethal effects to a limited number of larger organisms entrained in the spill and distributional shifts of larger organisms that are able to swim away. These impacts, however, would likely be temporary and localized.

Coastal and Inland Spills

The potential impacts of oil spills and brine spills are discussed separately below.

Oil spills. Oil spills to coastal or inland waters could occur during either fill or distribution. Under the 270-day drawdown criterion, oil would be pumped in the existing pipeline between Weeks Island and St. James, upgraded with one new booster pump. Oil spills during fill and distribution thus could adversely affect water bodies near Weeks Island, waters along the existing pipeline ROW, the lower Mississippi River and associated waters in the vicinity of St. James, or the Louisiana Gulf Coast downstream from all of these waters.

It is very unlikely that water bodies near Weeks Island would be affected by on-site spills during any of the proposed activities because the Weeks Island facilities would be designed to limit the movement of oil off the site in the event of an on-site spill. If oil spilled on-site was not contained, it would follow natural runoff patterns (Appendix O) to the surrounding wetlands, to Warehouse Bayou, and to the ICW. An on-site spill that is large enough to lead to oil migrating into farther off-site waters, such as Weeks Bay and Vermilion Bay, is not considered a credible scenario.

Much of the existing 67-mile Weeks Island-to-St. James pipeline ROW passes through wetlands. Additionally, approximately 30 water bodies are crossed by the pipeline, the largest being Bayou Teche, Grand Lake, Lake Verret, Bayou Lafourche, and the Atchafalaya River. Any of these water bodies could be affected by a pipeline leak during fill or distribution. The distribution options also would involve the construction of up to two new booster stations. Water bodies near these stations would be the Charenton Drainage and Navigation Canal, Bayou Teche, Mud Lake, Belle River, Old River, Bayou Natchez, Lake Verret, and the ICW.

The St. James Terminal is located on the Mississippi River 45 miles west of New Orleans. Accidental spills at the terminal, or from tankers on the river, would pose a threat to the lower Mississippi River. In addition to the Mississippi River, seven freshwater canals and bayous are located within five miles of the St. James Terminal (Table 5.6-2). If a large spill occurred in these waters and the spilled oil was not contained, impacts to the downstream Gulf Coast, and especially the Louisiana coast of the Mississippi River Delta, could result.

An additional crude oil distribution enhancement under a 180-day drawdown criterion would be a spur connecting Weeks Island to the existing Texas 22" pipeline. This would put at risk, in addition to the waters mentioned above, the waters crossed by the spur to Texas 22". These waters would include Warehouse Bayou, Bayou Patout, Stumpy Bayou, and Little Valley Bayou (see section 5.3.3.3).

Oil spills in these coastal or inland waters could have significant biological impacts. Like the coastal wetlands and estuaries of the entire Gulf Coast, ecosystems of the Louisiana Gulf Coast are important breeding and nursery habitats to seasonal and migrant species. The Louisiana Deltaic plain is particularly productive due to the high nutritive influx from the Mississippi and Atchafalaya Rivers. Because ecological processes are spatially and seasonally concentrated in this region, the impacts of an oil spill are highly related to the specific time and place of occurrence. Regardless of its time or place, however, an oil spill would alter the ecological relationships. Discussions of the water quality and ecological impacts of oil spills in the Gulf Coast are provided in section 7.1.3.4.

As detailed in section 6.1, historical spill statistics indicate that oil spills to coastal or inland waters due to the Weeks Island expansion would be infrequent and small in volume. Nevertheless, because even small spills in coastal or inland waters can adversely affect sensitive biota, any of the proposed expansion options for Weeks Island could cause significant impacts. These potential impacts, therefore, will be mitigated by the emergency controls, procedures, and contingency/emergency plans discussed in Chapter 8.

Brine Spills. On-site brine spills could result from equipment failure, pipeline failure, or overflow of the brine ponds. Potential impacts of an on-site brine spill to aquatic habitat neighboring Weeks Island would be limited by design features intended to prevent the off-site migration of brine. If these containment features fail, however, brine spilled on-site would follow natural runoff patterns (see Appendix O) to the wetlands surrounding the Island. From the wetlands, brine could eventually reach Warehouse Bayou and the ICW.

Habitats at risk of contamination from an off-site brine pipeline leak would include approximately two miles of wetlands south of Weeks Island, the ICW, Weeks Bay, and Vermilion Bay. Because these waters are typically quite fresh (salinity of 5 ppt or less), their salinities could be significantly altered in the event of a large brine spill.

A large brine spill to wetlands could cause significant biological impacts, as documented following a leak near the Bryan Mound site. These impacts, which included complete devegetation of the most severely impacted area and subacute toxicity over a wider area, are described in section 7.1.3.4.

Study of the Bryan Mound spill showed that the severity of impacts to a wetland or water body depend on the rate of freshwater flushing. Freshwater movement in the ICW near Bryan Mound prevented significant adverse biological impacts (see section 7.1.3.4). In the event of a brine spill near Weeks Island, the volume and flow of water in the ICW, Weeks Bay, and Vermilion Bay would be expected to similarly dilute brine below damaging concentrations in all but localized areas near the leak. For instance, damage to oysters in Vermilion Bay would be expected to be limited to an isolated area near the point of brine release. Little to no mitigation, therefore, would be necessary to major water bodies affected by a spill, as benthic organisms and chloride concentrations in affected water and sediment would be expected to quickly return to normal based on the Bryan Mound experience. If the spill was allowed to migrate into Warehouse Bayou or wetlands neighboring the site, however, the potential impacts could be more significant. Natural flushing and succession would eventually restore these habitats to some extent, but mitigation might be required to completely restore any poorly drained areas.

The number and size of brine spills expected to result from proposed operations at Weeks Island were determined based on historical spill rates and the total volume of brine that would be handled at the site (see section 6.2). Up to nine small spills (on the order of 75 barrels) per year, and two larger spills of 74,000 barrels could be expected from pipeline leaks. Therefore, most expected pipeline spills would be small and inconsequential, though larger, more damaging spills are possible. Similarly, an analysis of historical release rates and engineering controls indicates that leaks and overtopping from brine ponds would not likely occur. Chapter 8 describes these controls to prevent and contain a brine spill as well as the emergency/contingency plans that would be followed to mitigate the impacts of a spill if one should occur.

7.3.4 Air Quality Impacts

Previous studies have provided estimates of air quality impacts for development of a 150-million barrel storage facility in southern Louisiana.[86] Total annual emission rates for construction vehicles and drilling rig engines were estimated to include nine tons of SO_2, 38 tons of CO, 144 tons of NO_2, and nine tons of particulates. Using the most conservative assumptions, expected peak concentrations associated with these emissions would be very small, and no exceedances of air quality standards would be expected to result. Fugitive dust emissions from land clearing, excavation, cut and fill operations, and other activities would be an estimated 0.3 tons of dust per acre of construction per month of activity. Most of the dust would be expected to settle within site boundaries or to be transient in nature; no serious environmental impact would be expected. During facility operation, most fugitive dust emissions would be expected to be caused by general service vehicle travel over unpaved roads. Assuming representative vehicle speeds and road surface silt content, the estimated dust emission would be 0.24 pounds per mile of unpaved road traveled. Overall, fugitive dust impact would be expected to be even less than during the construction phase. For a discussion of other emission sources, see section 7.1.4.

Table 7.3-3 shows the NMHC emission rates that would be associated with brine production during cavern development for 150 MMB of storage. For a discussion of assumptions underlying the emission estimates, see section 7.1.4.

Table 7.3-3
Non-Methane Hydrocarbon Emission Rates Associated With Salt Dome Cavern Development (150 MMB)

Activity	Period	Brine Production	Brine NMHC Conc.	Short-Term Emissions (g/s)	Annual Ave. Emissions (tons)
LEACH ONLY	638 days	1.5 MMBD	0.26 ppm	0.86	29.9
LEACH/FILL	539 days	1.5 MMBD	1.5 ppm	4.96	172.5
FINAL FILL	200 days	0.3 MMBD	2.6 ppm	1.72	32.8
REFILL ONLY	500 days	0.3 MMBD	1.9 ppm	1.26	43.8

Note: The above estimates are based on simultaneous development of all 15 caverns.
Source: Based on *Strategic Petroleum Reserve Phase III Development EIS, DOE/EIS-0075, Appendix C.2.*

7.3.5 Potential Impacts to Terrestrial Ecology and Wetlands

Potential terrestrial ecology and wetlands impacts from construction, operation, and maintenance of the proposed Weeks Island site and pipelines are discussed below. Many of the potential impacts associated with these activities would be similar to those discussed for Big Hill in section 7.1.5. Potential impacts associated with development and maintenance of the expansion site and with development and maintenance of the associated pipelines are discussed in sections 7.3.5.1 and 7.3.5.2, respectively. Potential impacts associated with the addition of a pump station along the St. James pipeline are discussed in section 7.3.5.3. Potential impacts to surface water and aquatic ecology associated with these activities are discussed above in section 7.3.3.

7.3.5.1 Potential Impacts at and Nearby the Site

The new Weeks Island site would cover approximately 270 acres. As part of the construction of the proposed site, vegetation within the site boundary would be partially or completely cleared for security reasons. Based on site visits and aerial photographs, the site is partially forested with stands of sweet gum, magnolias, and mature live oaks interspersed with active and fallow agricultural fields. The National Wetland Inventory map for the site indicates approximately six acres of wetlands exist within the proposed site. Based on the site visit, however, it is believed that the actual acreage of wetlands at the proposed site may be higher. The six acres are palustrine, forested, broad-leaved deciduous wetlands.

It is possible that several endangered plant species could occur at the site; these species are listed in section 5.3.5.1. The state and Federal threatened Louisiana black bear is also believed to use the site, based on an observed bear track. To avoid impacts to these species, a site-specific endangered species survey would be conducted and proper mitigation plans developed prior to any site development activities.

Site Construction

Potential impacts associated with clearing and construction would be similar to those discussed for Big Hill in section 7.1.5.1: destruction or alteration of vegetation, displacement of wildlife (which for this site includes the state and Federal threatened Louisiana black bear), destruction of individuals of smaller wildlife species, and disruption of wildlife habitats due to increases in traffic and human activity.

Extensive emergent wetlands associated with Warehouse Bayou east of the proposed site could sustain populations of aquatic life. These could potentially be impacted by increased sedimentation as a result of erosion during construction. Impacts could range from negligible to severe depending upon the extent of clearing, the amount of grading, and the types of practices implemented to minimize erosion and sedimentation. These are discussed in Chapter 8.

Based on soil erosion calculations presented in Appendix O, an estimated 23,080 tons of soil could erode from the site during construction if no mitigation measures were used. Approximately 15,700 tons could be transported to the southeast, towards Warehouse Bayou, and approximately 7,200 tons could be transported to the northeast and northwest. Wetlands associated with Warehouse Bayou encompass the northern and eastern sides of the site, and, therefore, it is likely that even with mitigation measures, sediment could impact vegetation and aquatic life in these wetlands. Wetlands act as natural sediment traps and therefore the presence of these wetlands would decrease the magnitude of surface water impacts. Deposition of sediment in wetlands, however, could smother some of the less robust vegetation, and this impact would likely be temporary with no permanent adverse impacts.

Site Operation and Maintenance

The site would be securely fenced for the lifetime of the program, and, therefore, access of many species of wildlife would be restricted. The vegetated areas of the property would be mowed frequently and would provide little food or cover for wildlife.

Operations at the site and associated impacts would be similar to those discussed for Big Hill and would likely be minimal.

The potential exists for impacts to wildlife from leaks or spills from the on-site pipelines, above-ground holding tanks, and brine ponds. The severity of impacts would be determined largely by the severity of the spill. Spills from the raw water pipelines would have minimal impacts on local wildlife. Oil spills or brine spills could adversely affect the habitat and wildlife in the immediate vicinity of the spill. Such spills could result in immediate loss of vegetation as well as possible long-term impacts during recovery. They also could impact the extensive emergent wetlands surrounding the island and nearby aquatic habitats such as Warehouse Bayou.

7.3.5.2 Potential Impacts due to Pipeline Construction and Maintenance

RWI and brine disposal pipelines would need to be constructed as part of the development of the Weeks Island site. Under the 270-day drawdown criterion, the only required crude oil enhancements would be the addition of a pump station along the existing crude oil pipeline from Weeks Island to St. James. Under a 180-day drawdown criterion, additional distribution enhancement (construction of a crude oil spur connecting the Weeks Island site to a reversed Texas 22", expansion of the St. James Terminal and a second pump station) would be required. Ecological impacts from pipeline construction and maintenance are discussed in this section, from pump station construction are discussed in section 7.3.5.3, and from the St. James Terminal expansion are discussed in section 7.6.5. Section 5.3.5 includes tables which list species and ecological areas of interest that might occur along the proposed pipeline routes.

Potential impacts from pipeline construction include altered surface topography or water flow patterns and destruction of wetland habitats. It is possible that species composition following revegetation would differ from that prior to disturbance. Preventive and mitigative measures are discussed in Chapter 8.

Construction of Brine Disposal and Raw Water Intake Pipelines

As shown in Table 7.3-4, the proposed two-mile raw water pipeline from the ICW could impact 17 acres of wetlands (42 percent) out of a total of 40 acres of land potentially affected. The wetlands are evenly divided between estuarine (intertidal and subtidal) and palustrine, forested (broad leaved and needle-leaved deciduous) wetlands. The raw water pipeline would not cross any lands designated as a wildlife refuge.

The brine disposal pipeline would be routed around the west side of Marsh Island, crossing Paul J. Rainey Wildlife Refuge, and out to the Gulf. As shown in Table 7.3-5, the proposed brine pipeline from the Weeks Island site could impact 72 acres of wetland (74 percent) out of a total of 97 acres of land potentially affected. A NWI map was not available for the portion of the brine pipeline that would cross the peninsula located between Vermilion Bay and the Gulf of Mexico. A total of 56 acres of land could be affected on this peninsula (150-foot

Table 7.3-4
Types and Acreage of Wetlands Crossed by the Proposed Raw Water Pipeline to Weeks Island

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE WETLANDS – TOTAL	8	47	19
A. Subtidal, unconsolidated bottom, excavated	2	14	6
B. Intertidal	5	33	14
II. PALUSTRINE WETLANDS -- TOTAL	9	53	22
A. Forested, broad-leaved deciduous, semipermanent-tidal	4	26	11
B. Forested, needle-leaved deciduous, semipermanent-tidal	4	27	11
III. NON-WETLANDS – TOTAL	24	--	59
IV. BAYS -- TOTAL DISTANCE CROSSED	2 miles	--	–
WETLANDS -- TOTAL ACREAGE	17	100	42
TOTAL ACREAGE*	40	--	100

Source: Based on National Wetlands Inventory Maps. Acreages assume at 150-foot ROW.
*Note: Total acreage covered does not include area in which the pipeline crosses bay water.

ROW), and based on an area map presented by Gosselink,[87] it appears that the entire peninsula is estuarine emergent wetlands. For purposes of this assessment, therefore, 56 acres of unclassified emergent wetlands have been included in the 63 acres of estuarine wetlands. Nine acres of palustrine forested wetlands could be impacted.

Brine from Weeks Island could also be injected into disposal wells along the existing ROW to St. James Terminal. The potential impacts of underground injection would likely be minimal.

The proposed brine pipeline route would cross a portion of Vermilion Bay and P.J. Rainey Wildlife Refuge. Temporary displacement during pipeline construction could result in decreased nesting success due to nest abandonment and altered behavioral patterns. Aquatic life in Vermilion Bay could be disrupted during pipeline construction. Mobile species such as finfish would probably re-inhabit the area quickly, whereas less mobile shellfish could take longer to re-establish.

Construction of Crude Oil Pipelines

Under the 270-day drawdown criterion, the only additional crude oil pipeline required would be a spur of approximately one-half mile from the proposed site to the existing DOE line at Weeks Island. Table 7.3-6 summarizes the types of acreage of wetlands crossed by this spur.

Table 7.3-5
Types and Acreage of Wetlands Crossed by the Proposed Weeks Island Brine Disposal Pipeline

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE -- TOTAL	63	88	65
A. Subtidal, unconsolidated bottom	2	3	2
B. Intertidal, emergent	4	6	4
C. Intertidal, scrub shrub	1	1	1
D. Unclassified*	56	78	58
II. PALUSTRINE WETLANDS -- TOTAL All palustrine wetland for this ROW is forested	9	12	9
III. OPEN WATER -- TOTAL DISTANCE CROSSED	39 miles	--	--
IV. NON-WETLANDS -- TOTAL	25	--	26
WETLANDS -- TOTAL ACREAGE	72	100	74
TOTAL ACREAGE**	97	--	100

Source: Based on National Wetlands Inventory Maps. Acreages assume a 150-foot ROW.
*This category includes the 56 acres on the peninsula containing Paul Rainey Wildlife Refuge and State Wildlife Refuge. No NWI map was available.
**Note -- Total acreage does not include portions of the proposed pipeline that cross bays.

As can be seen in this table, the spur could potentially affect a total of two acres of palustrine, forested wetlands out of a total of six acres crossed.

Under a 180-day drawdown criterion, an additional crude oil pipeline connecting the Weeks Island site to a reversed Texas 22", would be required. Table 7.3-7 presents a summary of the types and acreages of wetlands crossed by the proposed crude oil pipeline route from Weeks Island to Texas 22". Ninety-three (72 percent) of the 129 acres crossed by the pipeline are through wetlands. Forty-five (48 percent) of these acres are estuarine intertidal and subtidal wetlands, 17 (18 percent) are palustrine forested, and three (3 percent) are palustrine emergent. The remaining 28 acres (31 percent) are unclassified wetlands.

The crude oil spur to Texas 22" would cross from an estuarine emergent wetland to a palustrine forested wetland approximately one-half mile north of Stumpy Bayou. Construction of a pipeline across this freshwater/saltwater interface could result in loss of some salt-intolerant plant species, and a shift in community structure.towards more salt-tolerant plant species.

Table 7.3-6
Types and Acreage of Wetlands Crossed by the Proposed Crude Oil Pipeline from Weeks Island to the Existing Weeks Island-St. James Pipeline

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. WETLANDS -- TOTAL All wetlands for this ROW are palustrine, forested	2	100	34
II. NON-WETLANDS -- TOTAL	4	--	66
TOTAL ACREAGE	6	--	100

Source: Based on National Wetlands Inventory Maps.

Pipeline Maintenance

Potential impacts associated with maintenance of the pipeline ROWs and the pipelines would be similar to those discussed for Big Hill and would likely be negligible.

7.3.5.3 Potential Impacts Due to Construction of Pump Stations

Approximately five acres of wetlands would need to be cleared for construction of each pump station. As discussed in section 5.3.5, the western pump station would be located about 15 miles east of Weeks Island in a wetland area that is criss-crossed by canals. A National Wetland Inventory Map was not available and therefore, the type of wetland potentially affected by this pump station is unknown.

The eastern pump station would be located just west of Lake Verret in a palustrine, forested, needle-leaved deciduous (cypress) wetland. Lake Verret is reportedly an area heavily utilized by bald eagles. Provided that construction of this pump station does not occur in the breeding season, impacts would be unlikely. Eagles range for food over a wide area and thus loss of five acres of foraging habitat would likely have no impact.

7.3.5.4 Summary of Wetlands Potentially Affected

Under the 270-day drawdown criterion, a total of 102 acres of wetlands would potentially be impacted by development of the Weeks Island expansion site: six acres of palustrine forested wetlands associated with the site and 96 acres of wetlands (various types) associated with pipeline and pump station construction. Under the 180-day drawdown criterion, an additional 98 acres of wetlands would potentially be affected by pipeline and pump station construction.

Table 7.3-7
Types and Acreage of Wetlands Crossed by the Proposed Crude Oil Pipeline from Weeks Island to Texas 22"

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE WETLANDS -- TOTAL	45	48	35
A. Intertidal, emergent	43	46	34
B. Subtidal, unconsolidated bottom	2	2	2
II. PALUSTRINE WETLANDS – TOTAL	20	22	16
A. Emergent	3	3	2
B. Forested	17	18	13
III. UNCLASSIFIED WETLANDS	28	30	22
IV. NON-WETLANDS -- TOTAL	36	--	28
WETLANDS – TOTAL ACREAGE	93	100	72
TOTAL ACREAGE	129	--	100

Source: Based on National Wetlands Inventory Maps.

7.3.6 Floodplains Impacts

Because buried pipelines would have no long-term impacts on floodplain action and would not affect property or lives, DOE's primary concern is for the floodplain impacts on SPR sites. There is little probability that runoff patterns would be altered along a pipeline route that is backfilled to the same level and consistency as had previously existed. The permanent nature of the construction and alteration of an SPR site, however, demands that it receive most of the attention.

The Weeks Island site would be located in both floodplain and non-floodplain areas. DOE would use rough grading as a part of site preparation. This practice consists of removing dirt from higher elevations at a site and placing it in lower sections. Rough grading could change the elevation of certain site areas. Other actions that may affect floodplains would include construction of roadways, wellpads, and buildings. DOE would ensure that all construction activities in the floodplain comply with Executive Order 11988 (floodplains management), which guarantees mitigation, preservation, and restoration of floodplains. Therefore, most impacts to floodplains from construction activities would be short-term, and none of these effects would be significant enough to increase the risk to lives or property, or alter the natural and beneficial floodplain values.

Potential impacts to the floodplain could include sedimentation on or below the construction site. Sediment deposition would have a positive impact which is the addition of rich nutrients to the floodplain soil and prevention of sediment-associated pathogens from entering the water. This same sedimentation, however, could destroy biological communities supported on the floodplain because it could contribute to nutrient overloading, decreased dissolved oxygen, increased water temperature, and serious impairment of photosynthetic productivity. These potential impacts would be mitigated, the natural drainage preserved to the extent possible and the floodplains restored.

The RWI structure would be located on a water body and therefore within a floodplain. However, installation of the RWI structure would involve minimal construction area. The single requirement for the ICW is that it provide a sufficient uninterruptible supply of water. When the RWI structure is completed, water flowing in the ICW would be able to pass under the RWI structure with little or no disturbance. DOE would locate the RWI structure on the ICW at a point approximately two miles from Weeks Island.[88] The structure would not significantly alter the floodplain or floodplain action. Construction of the RWI structure would require dredging about 10,000 cubic yards of spoil from the intake canal to guarantee adequate depth and uninterrupted water supply. Spoil could be placed in an upland, spoil disposal area.[89]

All pipelines would pass through a floodplain for at least some part of their length; therefore, construction crews would take measures to minimize and mitigate impacts to floodplains as discussed in Chapter 8. Any impacts from pipeline construction would be minimal and temporary and DOE would restore all floodplains to a condition consistent with their original state once construction is complete.

7.3.7 Natural and Scenic Resources Impacts

Site construction, including clearing of vegetation within the site boundary, could result in the loss of the use by wildlife of up to 300 acres for the lifetime of the program. The displacement of wildlife species from the proposed site would not be likely to significantly impact the wildlife community of the surrounding area. Construction of the proposed expansion would not directly impact the area's wildlife preserves.

Brine disposal pipelines would cross a portion of the State Wildlife Refuge and the Paul J. Rainey Wildlife Refuge.

7.3.8 Archaeological, Historical, and Cultural Impacts

The Weeks Island site contains two recorded archeological sites within the potential impact area. Due to the archaeologically sensitive nature of the proposed project area and the potential impact of pipeline construction, the State Historic Preservation Officer recommends that a cultural resources survey be undertaken. DOE would conduct such a survey before development or construction of the site. There are no identified archaeological, historical, and cultural sites in the vicinity of the pipeline corridors.[90] It is possible, however, that unrecorded sites would be encountered by the project.

7.3.9 Socioeconomic Impacts

The socioeconomic impacts of an expansion of the Weeks Island facility would not be significant. Under the 270-day drawdown criterion or one of 180-days, the largest impact would be from the additional income generated directly by the jobs created and the project purchases made in the local and regional economy. In-migration of workers and their families would likely have only a small effect on local housing, education, health care, and transportation systems.

7.3.9.1 Demographic Changes

The total demographic impacts of developing Weeks Island would be relatively small. Because the expansion of Weeks Island facility would require construction of a raw water intake and brine disposal system, construction would require about four years to complete, about the same as for a completely new facility (e.g., Stratton Ridge). Site preparation, well drilling, and facilities for cavern leaching would be completed within 18 to 24 months. Remaining site facilities, including security and the brine disposal and raw water intake systems would be built within 39 to 48 months. Under a 180-day criterion, the crude oil pipeline spur and enhancements would be constructed during the third and fourth years.

The largest demographic impacts would occur during the construction phase, when most of the new jobs would be created. During the first year of construction, DOE estimates that 176 workers would be needed at the site. This estimate would increase to 344 site workers by the end of the third year when construction activity would be at its peak. An additional 62 workers would be hired in the third year for construction of the brine pipeline, raising the total estimated employment level to 406 workers. Under a 180-day drawdown criterion, a few additional workers could be used for the crude oil pipelines. Under both criteria, the number of employees would decrease during the fourth year as much of the work would be completed and no new workers would be hired until operation of the completed facility commences in the fifth year. The operation and maintenance of an expanded Weeks Island facility would require 104 additional permanent workers. The labor force requirements for the development and operation of the Weeks Island facility are shown in Table 7.3-8.

The estimated demographic changes from the development of Weeks Island are based on the work force requirements described above and the in-migration model depicted in section 7.1.9. DOE estimates that under the baseline scenario, 128 additional people would relocate to within 30 miles of Weeks Island by the end of the construction phase. An additional 239 people would relocate by the fifth year when the facility would become operational bringing the total in-migration population to 367 (Table 7.3-9). Under the high impact scenario, the total in-migration population would increase to 1,178. Compared to the population of incorporated towns within 30 miles of Weeks Island, this level of in-migration under the high impact scenario would only increase the current population by 0.7 percent (Table 7.3-10).

The annual level of in-migration during development of the Weeks Island facility is shown in Table 7.3-11. In the baseline scenario, in-migration would increase from 55 to 128 people over the first three years of the construction project. This total includes 81 workers and 17 school-age children by the third year. In the first year, 35 workers with seven school-age children would relocate. In the second year, 21 additional workers with five school-age children would move into the area. In the third year, 25 construction workers with five children would relocate. In the fourth year, the work force would actually decrease and no new in-migration would be expected.

Under the high-impact scenario, in-migration would be expected to rise from 408 people in the first year to a total of 939 people by the end of the third year. By the time construction activity reaches a peak at the end of the third year, 305 workers with 634 family members including 254 school-age children would relocate to the area.

Table 7.3-8
Estimated Labor Force for Weeks Island SPR Site

	Construction Phase				Operations Phase
	Year One	Year Two	Year Three	Year Four	Year Five
Site Construction	176	280	344	100	
Pipeline Construction	--	--	62	62	
Operation & Maintenance	--	--	--	--	104
Total Employees	**176**	**280**	**406**	**162**	**104**

Source: Boeing Petroleum Services, PB-KBB, Inc., *ROW Study.*

Table 7.3-9
Weeks Island Operation and Maintenance In-Migration*

Population Category	**Number***
Total Additional Work Force	104
Total In-Migrating Workers	78
Total Family Members	161
Total In-Migrating Population	239
Total School Children	64

* High impact scenario.

Table 7.3-10
Population Within 30 Miles of the Weeks Island Site

Incorporated City or Town	Population
10-Mile Radius	
Iberia:	
Jeanerette	6,250
Lydia	1,136
Total incorporated population within 10 miles	**7,386**
15-Mile Radius	
Iberia:	
Delcambre	1,978
New Iberia	31,828
St. Mary:	
Baldwin	2,379
Total incorporated population within 15 miles	**43,571**
20-Mile Radius	
Iberia:	
Loreauville	860
St. Mary:	
Charenton	1,584
Franklin	9,004
Vermilion:	
Erath	2,428
Total incorporated population within 20 miles	**57,447**
30-Mile Radius	
Lafayette:	
Broussard	3,213
Lafayette	94,440
Youngsville	1,195
St. Martin:	
St. Martinville	7,137
Vermilion:	
Abbeville	11,187
Total incorporated population within 30 miles	**174,619**
Maximum Estimated In-migration	**938**

Source: United States Geologic Survey Maps; Bureau of the Census, Department of Commerce.

Table 7.3-11
Weeks Island Site and Pipeline Construction In-Migration
Baseline and High Impact Scenarios

Population Category	Year One	Year Two	Year Three
Baseline Scenario			
Total Average Work Force	176	280	406
Total In-Migrating Workers	35	56	81
Total Family Members	20	32	47
Total In-Migrating Population	55	88	128
Total School Children	7	12	17
High Impact Scenario			
Total Average Work Force	176	280	406
Total In-Migrating Workers	132	210	305
Total Family Members	276	437	634
Total In-Migrating Population	408	647	939
Total School Children	111	181	254

Although no in-migration of construction workers would be expected after the third year, there would be some in-migration of permanent workers at the beginning of the fifth year once the site is completed. Because permanent workers would be more likely to relocate than temporary workers, DOE used the high-impact scenario for estimating in-migration for this worker population; 78 permanent workers would likely relocate and bring with them a total of 64 school-age children.

7.3.9.2 Economic Impacts

The main direct economic impacts of developing the Weeks Island site would include the additional income generated from new jobs created during site construction, increased demand for local supplies and materials used for construction and operation of the facility, and increased expenditures in the local economy by project workers. These direct impacts would likely have multiplier effects on the regional economy, particularly in the local trade and services sectors.

No data are currently available on the expected payroll for the Weeks Island construction and operational phases. Using prevailing wage rates in the construction industry and projected manpower requirements, DOE estimates that $11 million in additional income would be generated in the peak year of construction (Table 7.3-12). The impact of this income would be increased

Table 7.3-12
Additional Income Directly Generated from Weeks Island Development

	Total New Jobs*	Total Annual Worker Earnings	Percent of Regional Earnings
Year 1	176	$5,000,000	0.129
Year 2	280	$8,000,000	0.205
Year 3	406	$11,600,000	0.30
Permanent	104	$3,000,000	0.077

* Totals for new jobs and earnings are cumulative.
Source: Boeing Petroleum Services, Bureau of Labor Statistics.

somewhat by the multiplier effects of local spending. Nevertheless, as seen in Table 7.3-12, the additional income directly generated by the project would be small relative to the regional economy.

There is some potential for larger impacts on the region's economy depending on the degree to which the project procures goods and service from within the area. It is estimated that the cost of the Weeks Island development would be between $711 million and $840 million over four years, depending on the alternative selected. Even if only a small proportion of this total was spent locally, there would be some positive impact on the regional economy, although this impact would diminish after construction of the site is completed.

7.3.9.3 Impacts on Energy Consumption

The peak load at the existing Weeks facility is considerably lower than that of Big Hill because salt mines were used for caverns rather than creating caverns using leaching. Peak load during normal operation is approximately 5.8 MW during times of site equipment tests. The maximum drawdown load at the current Weeks Island facility is between 10.2 and 11.8 MW, although probably closer to 10.2 MW.

Expansion of Weeks Island would require creation of new solution-mined caverns. Based on estimates for a total number of 16 caverns, expansion at Weeks Island would have a peak demand of approximately 20 MW during leaching, 5.8 MW for oil fill, 21.1 MW during a 180-day oil drawdown, and 1 MW for storage use. Two pipeline booster stations would also be required with a peak demand of 0.05 MW for leach, fill, and storage, and 9.0 MW for drawdown. A new raw water intake system would have to be constructed, using about 4.4 MW of power during leaching and drawdown, and 0.1 MW during fill and storage. GSU's 138 kilovolt (kV) transmission line linked to the utility company's Bayou Warehouse substation with two 50 megavolt-ampere (mVA) transformers would provide sufficient capacity to power the site. The Bayou Warehouse substation would be linked to DOE's substation by a distribution feeder line that may have to be upgraded for the expansion site. No new transmission lines would be required.

7.3.9.4 Impacts of Brine Disposal on Commercial Fisheries

Although unlikely, based on ten years of experience at existing sites, there would be some potential for adverse impacts on the fisheries industry due to brine disposal in the Gulf of Mexico. To account for this potential impact, DOE has developed a conservative estimate of the potential value of catch potentially exposed to the area of increased salinity associated with the brine plume (Appendix G). Under these assumptions (e.g., maximum discharge, adverse environmental conditions), the estimated annual value of the catch associated with the one ppt salinity contour would be approximately $1,260,000. A similar estimate for the three ppt salinity contour would be approximately $370,000. Estimated values for brown and white shrimp would account for 62 percent of the total estimated value for both salinity contours; estimated values for menhaden would account for 37 percent of the total estimated catch value.

Total conservative values would represent 2.3 and 0.7 percent, respectively, of the total annual value of the catch within the appropriate sections of the NMFS fishery grid potentially affected by brine discharge from the west Weeks Island diffuser. Estimated value of catch at the west Weeks Island diffuser also would only be a small percentage of the annual value of the total catch in the northern Gulf of Mexico, which is in excess of $440 million.

The negative impact of the Weeks Island diffuser brine plume on fisheries would likely be very low. Most of the commercially important fish and shellfish species in the northern Gulf of Mexico can tolerate a wide range of salinities, and field studies have indicated that the existing brine diffuser at Bryan Mound has had little effect on the nekton (i.e., fish and shrimp) community inhabiting the diffuser area. As a result, DOE predicts very little negative impact on the estimated future value of the catch in the areas encountered by brine plumes. Additional details of the assumptions and methods used in this analysis are presented in Appendix Q.

7.3.9.5 Impacts on Transportation Systems

The primary impact on transportation systems would be increased traffic from workers traveling to and from the site during the construction phase. However, given that at the peak of construction activity only about 344 workers would be at the site (the remaining work force would be away from the site on pipeline construction), the marginal increase in traffic congestion would be insignificant. These impacts would be further minimized because workers would use a variety of commuting routes, although all workers would arrive at the site via Route 83, the only road leading into the site. Assuming the geographical distribution of new workers would be the same as current workers at the site, more than half the additional labor force would reside in New Iberia and travel along US Routes 90 and 83 to the Weeks Island site. The most recent statistics (see Table 5.3-8) show that daily volume of U.S. 90 is about 14,000, and on Route 83, it ranges from about 2,000 to 4,100. Even if all workers commuted on one or the other of these routes, the traffic volume would only increase by two percent on US Route 90 and eight to 17 percent on Route 83. Given the low accident probabilities for these routes, the resulting potential increase in accidents would be negligible.

Construction of a paved access road to the proposed Weeks Island expansion site would not be required, because the site borders state Route 83. Construction of on-site roads may be needed. These roads would be two-lane, asphalt surfaced, and approximately 20 feet wide with six-foot shoulders.

Some additional traffic would be created by trucks removing vegetation and other debris during the initial stages of site development as well as from construction equipment and vehicles bringing materials for facility construction. A drilling rig, weighing approximately 120,000 lbs, and a workover rig (almost the same weight) represent the heaviest pieces of equipment that would be transported to the site. Each of these are in excess of the 80,000 lbs load limit on state and Federal highways, and each would require a load permit to transport to the site. Obtaining permits from the Louisiana DOT would not likely pose any problems. This additional traffic, however, would be sporadic and short term, and any impact on the condition of roads or bridges would be minimal. If road conditions warrant repairs as a result of the transport of heavy equipment, DOE would bear the costs. Furthermore, if regular traffic congestion on likely commuter routes (e.g., Route 83) becomes a problem once the site is operational, DOE would increase road capacity as necessary.

7.3.9.6 Housing

Development of the Weeks Island site would have negligible impact on housing availability. (The housing stock available in the Weeks Island region is described in section 5.3.9). In 1990, there were over 7,600 vacant housing units available in the Weeks Island Region. Under the high impact scenario, the number of new households in the region would not exceed 383 and would fill only about four percent of the total available units. Some impact to the available housing stock could be felt under the high-impact scenario if all workers were to reside in Iberia Parish where only about 1,250 units were available in 1990. However, even if this low probability scenario were to take place, these workers would still only occupy 25 percent of all available units in the parish.

7.3.9.7 Health Care

Assuming, under the high impact scenario, that all 1,178 persons would relocate to either Iberia or St. Mary Parish, the ratio of residents to physicians, and residents to hospital beds, would not change significantly. In 1990, these two parishes had four hospitals, 375 hospital beds, and 123 physicians. Given the current population of 126,383 there are 1,027 residents per physician, and 337 residents per hospital bed. With an additional 1,178 residents, the ratio would change to 1,037 residents per physician and 340 residents per hospital bed, changes of 1.0 and 0.9 percent, respectively.

7.3.9.8 Education

The estimated number of additional children entering the regional school systems would ranges from 81 to 318 (including children of both construction and permanent workers). Even under the high impact scenario, the total number of school children entering the local school system would be less than 1.1 percent of the current school enrollment of more than 27,000 students enrolled in kindergarten through high school in Iberia and St. Mary Parishes.

7.3.9.9 Fiscal Impacts

The net fiscal impact of expanding the Weeks Island SPR facility is difficult to estimate. About $170 in property taxes were paid by the current land owners in 1990. The revenue from the property would be lost if the property became Federally owned. However, given that the project would generate at least 406 temporary jobs and 104 permanent jobs, this small shortfall should be more than compensated by the additional tax revenue from wages and property owned by these additional employees. Increased earnings and trade due to secondary effects would also generate local tax revenue.

7.3.9.10 Emergency Response Capabilities

Increases in the local population due to in-migration would not be expected to affect existing response capabilities. For further information on emergency response potential impacts, see section 7.1.9.10.

7.3.9.11 Oil and Brine Spills

Several negative socioeconomic impacts associated with oil and brine spills should be considered regarding the proposed Weeks Island expansion site. As several of these impacts could be similar to those of the Big Hill expansion site, refer to the Big Hill section for a more detailed explanation.

Socioeconomic Impacts of Oil Spills

Many of the water bodies near the Weeks Island site, such as Vermilion Bay and the ICW, or along pipeline routes, support recreational fishing and boating, small boat and barge traffic, and oil field service. No population centers exist within nine miles of Weeks Island, however, and development of a public water supply is unlikely. The land in the area is primarily used for agriculture and forestry, and the primary crops include sugar cane, soybeans, pecans, rice, and tabasco-red peppers. Several species of fish inhabit the Weeks Island region, important for both commercial fishing and recreational fishing, which is extremely popular in the region. Other commercially important species include crayfish, turtles, and bullfrogs.

Socioeconomic Impacts of Brine Spills

A brine spill at or near the Weeks Island site could affect the same water bodies within a five-mile radius of the site as noted above. Two brine disposal alternatives have been assessed, a pipeline and diffuser, and deep well injection into appropriate substrata. The brine pipeline route would pass west of Marsh Island into the Gulf of Mexico, crossing the ICW and Vermilion Bay. The proposed route would pass within one-half mile of present commercial harvesting, nursery, and sportfishing areas. Vermilion Bay, Atchafalaya Bay, Marsh Island, and Point au Fer Island are the dominant nearshore features surrounding the proposed pipeline and diffuser site. There are no groundwater sources located near the proposed pipeline.

7.3.9.12 Prime and Unique Farmlands

The proposed Weeks Island expansion site would not affect prime and unique farmlands. The proposed pipeline ROW would indirectly and temporarily convert a total of 1.9 acres of prime and unique farmland. After construction, the ROW would be returned to its original contours and vegetation. The proposed action would not be expected to have a lasting impact on farmlands.[91]

7.3.10 Noise Impacts

The following sections discuss potential noise impacts for development of a new SPR site at Weeks Island.

7.3.10.1 Construction Noise

Industrial activities within the 5,000-foot radius acoustic impact zone include the existing SPR site and the Morton Salt Company mine. Both of these locations are at the furthest limit of the impact zone and would likely experience no audible increase in noise levels because the background levels at these locations is most likely greater than the 53 dBA estimated to result from site construction using the model presented in Appendix H. In addition to the industrial activity within the impact zone, there were approximately 17 residences or places of business. Because of the existing industrial activity, sound level increases would be minimal and only minor noise-related impacts would be expected as a result of construction at Weeks Island. (For a more detailed discussion of noise sources from SPR site construction activity, see Appendix H.)

Under the 270-day drawdown criterion, distribution would include the addition of one booster pump to the existing Weeks Island-to-St. James pipeline and the construction of a one-mile spur to the existing pipeline. Consideration of a 180-day drawdown criterion would require an additional pump station, an additional seven-mile spur pipeline to a reversed Texas 22" pipeline, and construction of up to two new docks and tanks at St. James Terminal. At most, only eight miles of new oil distribution pipeline would be constructed. Under the proposed scenario, construction of the raw water pipeline would cover a distance of two miles and construction of the brine line would cover a distance of 41 miles, but only 1.3 miles of either pipeline would be on dry land. No major noise-related impacts are expected as a result of pipeline construction because construction proceeds at a rate of half a mile per day. Any impacts that occur as a result of pipeline construction would be of short duration (i.e., one to two days) at any given location.

As an alternative to construction of a brine disposal pipeline at the Louisiana sites, up to 25 injection wells for brine disposal could be constructed. Noise impacts would be the same as for cavern construction (i.e., minimal). Construction of each injection well would require 30 days of rig time. These wells would be constructed along the existing pipeline ROW for the pipeline from Weeks Island to St. James. Table 7.3-13, shown below, presents the maximum number of days that drilling would likely occur at Weeks Island or Cote Blanche.

7.3.10.2 Operational Noise Impacts

If a cavern-storage site is constructed, operational noise levels at Weeks Island would be estimated at 60 dBA at 500 feet from the site based on Big Hill monitoring data. Because the background level within the 5,000-foot radius impact is roughly equal to the 53 dBA background level estimated using Figure F.1-1 in Appendix H, no significant noise impact would be expected as a result of SPR operations at the Weeks Island site. Because the existing activities surrounding the SPR site are primarily industrial and because they are nearly a mile from the proposed expansion site (i.e., outside of the 5,000-foot radius impact zone), no increased noise levels would

Table 7.3-13
Drilling Time for Various Facility Sizes and Cavern Types

Number of Wells	Maximum Number of Days Drilling Would Occur for Given Activity
16 Cavern Entrance Wells	360
25 Brine Disposal Wells	188

Source: Assumptions based on SPR, *Final EIS for Capline Complex*

be expected in those areas. Noise levels at the private residences or places of business, or other buildings would be expected to increase slightly over ambient levels during oil fill and drawdown. Because these operations would be of relatively short duration and because no increase in sound levels would be expected when the site is in the stand-by mode, no major noise-related impacts would be expected as a result of the operation of an additional SPR site at Weeks Island.

7.4 Cote Blanche (Alternative Capline Complex Site)

The following sections discuss the potential impacts associated with the development of a new SPR site at Cote Blanche.

7.4.1 Geological Impacts

In general, the geologic impacts associated with the proposed activities at Cote Blanche would be minimal. Potential geological impacts associated with the proposed underground injection of brine at Cote Blanche are considered along with the potential hydrogeologic impacts described in section 7.4.2.

7.4.1.1 Subsidence

The area over the Cote Blanche salt dome has shown some local subsidence, but the effect on surface relief has been minimal. Although no monitoring data are available for subsidence at Cote Blanche, due to the proximity of Cote Blanche to Weeks Island, an estimate of future subsidence can be made. Based on the Weeks Island monitoring data, surface subsidence on the order of approximately 0.11 feet (3.35 cm) per year could be expected over proposed SPR caverns. Because groundwater at Cote Blanche can be found just below the land surface, engineering controls (e.g., drained paved areas) would be used to prevent the formation of subsidence-induced ponds over the individual caverns. Any subsidence that could result from cavern operations at Cote Blanche would not be considered a problem.[92] For a general discussion of subsidence, see section 7.1.1.1.

7.4.1.2 Seismicity

For a general discussion of seismicity in the region, see section 7.1.1.2. No impacts on seismicity would be expected from Cote Blanche.

7.4.1.3 Possible Impacts of Brine Seepage on Soils

Major brine spills from leached caverns would be extremely unlikely, as discussed in section 7.1.1.3.

7.4.1.4 Multiple-Use Considerations

The salt on the eastern edge of the existing mine is considered to be an anomalous zone with frequent gas outbursts and oil seeps; this region defines the eastern extent of any further salt mining operations at Cote Blanche. To ensure safe cavern development, adequate separation would be necessary from both this probable shear zone and from the existing salt mine. There has also been extensive oil and gas production on both the north and south flanks.

7.4.2 Hydrogeological Impacts

Like the proposed Weeks Island expansion, there are four major potential sources of groundwater contamination at the proposed Cote Blanche facility: the proposed brine settling ponds, underground (brine) injection wells, oil and brine pipelines, and surface operations (including material spills). Because of the similarities in the proposed actions at Weeks Island and Cote Blanche, as well as the similar hydrogeological conditions that exist at the two sites, the analysis of potential groundwater impacts at Weeks Island is generally applicable to Cote Blanche. In terms of potential groundwater impacts, the primary differences between the two sites would include the following.

- **Differences in crude oil and brine pipeline distances.** While the preferred crude oil distribution alternative for both Weeks Island and Cote Blanche would be to use an upgrade of the existing pipeline to St. James, the spur connecting Cote Blanche to the existing pipeline would be approximately one mile longer than the spur required to connect the Weeks Island expansion to the existing pipeline. The preferred brine disposal pipeline from Cote Blanche would cross ten miles on land before emerging offshore, whereas the brine line from Weeks Island would have a two-mile onshore component. As a result, if Cote Blanche is selected over Weeks Island, there would be a longer stretch where groundwater could be at risk from an oil pipeline leak or a brine pipeline leak.

- **Differences in shallow soil makeup and aquifer configurations.** Unlike Weeks Island, whose shallow soils consist primarily of sand and gravel with little clay, shallow soil at Cote Blanche includes patches of 10- to 30-foot clays. These clays at Cote Blanche, however, are discontinuous and probably do not provide a significant additional barrier to downward migration that does not exist at Weeks Island. Additionally, the uppermost aquifer at Cote Blanche is the Atchafalaya, followed by the Gonzales. At Weeks Island, the Atchafalaya does not exist. This difference, however, appears to have a negligible effect on contamination potential because shallow groundwater at both sites is fresh and at about the same depth.

- **Differences in present groundwater use patterns.** As outlined in Chapter 5, there are presently 21 groundwater wells located within three miles of Weeks Island, but there are only three existing wells within three miles of Cote Blanche. In both cases, the existing wells are used primarily for industrial purposes, although one of the wells near Cote Blanche does serve a market that could use the groundwater as a drinking water supply. The land surrounding the two sites is comparably marshy, such that from the standpoint of potential land use changes, the prospects of future water development in the immediate vicinity of both sites would be limited.

- **Differences in distances to surface waters.** Because both sites are in very marshy areas, the potential for groundwater contamination (if it occurs) to migrate into wetlands and cause adverse ecological effects would be basically the same. However, the nearest downgradient surface water that could receive contaminated groundwater discharges is closer to Weeks Island: as close as 160 feet from Weeks Island to Warehouse Bayou, and around 1,100 feet from Cote Blanche to West Cote Blanche Bay. Warehouse Bayou is also a smaller water body than West Cote Blanche Bay, and thus less able to assimilate any large contaminant loads. Therefore, in very general terms, if groundwater is contaminated at Cote Blanche, it would be less likely to migrate into surface water and cause adverse impacts to aquatic organisms than groundwater contamination at Weeks Island.

Overall, these differences are minor, and the nature and extent of potential groundwater impacts at Cote Blanche would be basically the same as outlined in section 7.3.2 for Weeks Island. There would be a small potential for releases of brine, oil, and other substances to usable groundwater from a variety of sources. If not detected or contained, this contamination could migrate downgradient and result in either the loss of use of groundwater by industry and/or adverse ecological effects in wetlands and water bodies. Given existing and likely future demands on groundwater in the area, it would be unlikely that any groundwater contamination originating from the site would pose a serious threat to public health.

7.4.3 Surface Water Impacts

The proposed development of Cote Blanche could cause: (1) impacts associated with brine disposal in the Gulf; (2) impacts associated with raw water intake from the ICW; (3) adverse effects associated with the site and pipeline construction activities; and (4) impacts associated with accidental spills of oil and brine. Each of these potential impacts at Cote Blanche is addressed separately below.

7.4.3.1 Brine Disposal in the Gulf of Mexico

The same brine diffuser location and discharge operations being considered for the Weeks Island expansion are being considered for Cote Blanche. Like Weeks Island, the brine pipeline and diffuser disposal option for Cote Blanche would be a pipeline route around the western side of Marsh Island out to diffuser in the Gulf of Mexico at 29°25' N and 92°16' W. The potential water quality and aquatic ecology impacts associated with Cote Blanche brine discharge at this location are summarized in section 7.3.3.1 and described in more detail in Appendix Q.

7.4.3.2 Impacts of Raw Water Intake at Cote Blanche

Raw water for the development and operation of the Cote Blanche site would be obtained from the ICW (section 5.4.3.2). The ICW near Cote Blanche is dominated by freshwater inflow from the Atchafalaya River 25 miles to the east. The flow rate in the ICW near Cote Blanche is unknown; however, expected flow velocities ranging from one to three feet per second correspond to flow rates of 1,500 and 5,000 cfs (using the dredged channel dimensions of approximately 125 feet wide and 12 feet deep, and assuming the channel slope is negligible). The following sections evaluate potential impacts of the proposed raw water withdrawal on the ICW hydrology, water quality, and biology.

Potential Hydrological Impacts

The raw water intake for the Cote Blanche site would be located on the ICW approximately five miles east of the proposed RWI for the Weeks Island Site. Because these sites are located within the same surface water and physiographic environments, the conclusions made regarding the impacts of raw water withdrawal near Weeks Island (section 7.3.3.2) can be applied to raw water withdrawal near Cote Blanche. For the Weeks Island site, far-field (at distances greater than 100 feet) impacts of a 100 cfs withdrawal were estimated over a range of assumed ICW flow rates. Hydrologic impacts were estimated using the approach outlined in Appendix R. This analysis has been repeated for Cote Blanche and the results are presented in Table 7.4-1. At a flow rate of 5,000 cfs (probably greater than the actual ICW flow rate) raw water withdrawal would result in a vertical change in depth of 0.36 inches over a mile of waterway. At a flow rate of 1,000 cfs (probably less than the actual ICW flow rate) there could be a vertical change of 0.07 inches over a mile of waterway. The actual vertical change, which would probably lie between these estimates, would be much less than the average tidal range of 1.6 feet observed in the ICW near Cote Blanche.

Conclusions regarding the near-field (less than 100 feet) hydrological impacts of raw water withdrawal at Weeks Island were based on previous modeling studies and field monitoring data collected near the Big Hill site. Because of the controlled channel geometry of the ICW and identical RWI designs, near-field effects of raw water withdrawal estimated for Big Hill can be applied to Cote Blanche as well. Previous modeling and field monitoring (see section 7.1.3.2) indicate that the raw water intake would not significantly alter water depths or velocities within 100 feet.

Potential Water Quality Impacts

As noted above, Cote Blanche is located near Weeks Island and conclusions regarding the impacts of raw water withdrawal at Weeks Island (section 7.3.3.2) may be applied to Cote Blanche. Both sites are within a region characterized by extensive marshlands with numerous interconnecting channels and water bodies, all of which are generally have salinity of below five ppt due to large freshwater inflows from the Atchafalaya River and high levels of precipitation (60 inches per year).[93] The closest salinity data collected near Cote Blanche are from Cypremort Point which separates West Cote Blanche Bay from Vermilion Bay. At this location, which is not in the ICW but Vermilion Bay, the average annual salinity ranges from 1.6 ppt to

Table 7.4-1
Vertical Change in Depth Corresponding to a 100 cfs Withdrawal for a Range of ICW Flow Rates

Flow Conditions Without Withdrawal			Flow Conditions With 100 cfs Withdrawal			Vertical Change in Depth
Q_1	V_1	S_1	Q_2	V_2	S_2	(Inches per Mile)
5000	2.8	1.28×10^{-4}	5100	2.9	1.33×10^{-4}	0.36
2000	1.12	2.05×10^{-5}	2100	1.17	2.26×10^{-5}	0.13
1000	0.56	5.12×10^{-6}	1100	0.62	6.20×10^{-6}	0.07

Q = flow rate (cubic feet per second)
V = flow velocity (feet per second)
S = slope (feet per feet)

nine ppt.[94] Additionally, all salinity data collected in 1973 by the Corps of Engineers at The Jaws, at the intersection with the ICW about five miles east of the Cote Blanche raw water intake, are fewer than one ppt (ranging from 0.05 to 0.21 ppt, with a mean of 0.11 ppt). Figure 7.3-5 shows how primarily freshwater extends far out into West Cote Blanche and Vermilion Bays.

Salinity changes due to raw water withdrawal from the ICW in this region would be insignificant. In an unrealistically conservative scenario, flow from the ICW to West Cote Blanche Bay would be significantly reduced or reversed as a result of water intake at Cote Blanche. However, freshwater discharge from the Atchafalaya River into the bay through other channels and local precipitation would continue, and the low salinity levels in waters the size of West Cote Blanche Bay would be unlikely to change significantly. Even if, as a result of water withdrawal at Cote Blanche, water in a particular connecting channel were to flow from West Cote Blanche Bay to the ICW, the potential change in salinity would be insignificant. Waters in West Cote Blanche Bay and the ICW would remain essentially fresh.

Potential Direct Impacts to Biota

Design of the Cote Blanche raw water intake structure was modeled after the existing structure at Big Hill. For this reason, impacts to biota at Cote Blanche can be considered similar to impacts at Big Hill. Because salinities in the ICW near Cote Blanche are generally lower than near Big Hill, there would be some differences in the affected aquatic communities at the sites. However, these differences are unimportant in evaluating biological impacts because the ecosystem structures are similar despite differing species compositions.

The RWI structure would include features to limit impacts to biota. Fish and other large animals would be blocked from the intake by trashbars, and traveling screens would exclude macrocrustaceans and other organisms larger than 0.5 inches. Additionally, the intake velocity of 0.5 feet per second would be slower than the swimming speed of most fish. Despite these features, the raw water intake would unavoidably entrain small organisms (e.g., phytoplankters, zooplankters, larval fish, and benthic organisms) able to pass through the 0.5-inch mesh screens. At Big Hill, this impact is considered minor because the volume of water removed contains a small portion of the planktonic and benthic communities of the ICW and associated wetlands.[95] The same would be true at Cote Blanche.

Although impacts to biota from the existing RWI structure at Big Hill have not been monitored, no obvious adverse impacts have been observed. Based on this experience and the similarities of the proposed conditions at Cote Blanche and Big Hill, no consequential impacts to the biotic community of the ICW would be expected to result from raw water withdrawal at the Cote Blanche site.

7.4.3.3 Construction Impacts

There are four categories of construction activities at Cote Blanche that could cause surface water and aquatic ecology impacts: construction of the on-site facilities, construction of the raw water intake system, construction of a bridge across the ICW, and construction of crude oil and brine pipelines. Each of these construction activities is evaluated below and compared to the corresponding impacts at Weeks Island.

Impacts Associated with On-site Construction

As detailed in Appendix O, DOE conservatively estimates that 7,100 tons of topsoil could erode from Cote Blanche as a result of the proposed site construction activities. Based on the topography at the site, approximately 3,700 tons would be expected to erode in a southeast direction and deposit on marshland that separates the site from West Cote Blanche Bay. Approximately 3,400 tons would be expected to erode in a northeast direction toward the ICW. Of this amount eroding to the northeast, DOE estimates that roughly 620 tons of soil would actually enter the ICW at a point about one-half mile from the site.

The calculations in Appendix O indicate that the enhanced sediment load due to site construction would increase the suspended solids concentration in a one-mile stretch of the ICW by an estimated 10 ppm. This increased concentration would be reached 20 days after the start of construction and could remain during the next 160 days of the proposed clearing phase of the construction period (conservatively assuming that a rainfall event starts at the same time the construction does and continues for 160 days). The suspended solids concentration in the ICW would be expected to return to pre-construction levels in about 20 days after this phase ceases and the site is revegetated or covered.

This minor increase in suspended solids would not be expected to cause significant adverse impacts in the ICW. It would be temporary, limited to no more than a one-mile stretch, and not expected to be of sufficient magnitude to cause major water quality or aquatic ecology impacts (such as interference with recreational/aesthetic values, significant decreases in light penetration, or significant effects to fish). Settleable solids that blanket the bottom of the ICW could damage resident benthic communities and block any spawning areas, to the extent they exist in the affected area. These impacts, however, would be temporary as the ICW bottom would likely recolonize quickly and offer the same general type of habitat that exists throughout the ICW in this area.

When these predicted impacts at Cote Blanche are compared to those for Weeks Island, on-site construction at Weeks Island appears to pose more of an erosion threat to surrounding waters. As outlined in section 7.3.3.3, without any engineering controls to limit erosion, on-site construction at Weeks Island would likely result in a greater increase in suspended solids concentrations (80 ppm rather than 13 ppm) in a longer stretch (about two miles rather than one mile) of Warehouse Bayou. Considering the relative sizes of Warehouse Bayou near Weeks Island and the ICW near Cote Blanche, the short-term impacts to Warehouse Bayou would likely be greater. The long-term impacts to both water bodies, however, would be minor.

Impacts Associated With Construction of the Raw Water Intake System

The RWI pipeline for Cote Blanche would cross no water bodies over its route to the ICW less than a mile to the northeast. Construction of this pipeline also would not affect surrounding drainage patterns, because the pipeline trench would be backfilled and returned to the pre-construction topography. Therefore, construction of the raw water pipeline would not be expected to directly affect water quality or aquatic organisms around the site. This is the same conclusion reached for the construction of the raw water intake pipeline at Weeks Island.

Construction of the RWI structure at Cote Blanche also would cause the same kinds of impacts described in section 7.3.3.3 for the construction of the RWI structure at Weeks Island. Only the location of the affected area of the ICW would differ. When the two proposed locations for the Weeks Island and Cote Blanche intake structures are compared, one does not offer a significant environmental advantage over the other. Neither site is known to support any critical or unique habitats or resources.

Impacts Associated With Construction of the ICW Bridge

As described in section 3.4.1, access to Cote Blanche Island would have to be improved to support fire, security, and site personnel. The likely cost-effective approach would be a two-lane, steel, built-up plate girder bridge across the ICW. Overall, the bridge would be 35 feet wide and approximately 400 feet long. The bridge also would be a cable swing-type structure to allow for ICW boat traffic. There would be no off-site road construction required because the bridge would be constructed at the existing ferry roadway.

Construction of this bridge would be expected to cause minor temporary impacts confined to areas directly within and near the construction site. A very small portion of the ICW bottom, on both the north and south banks where the bridge makes landfall and at a few points in between, could be occupied by bridge supports and removed from available habitat. Additionally, there would be a temporary disturbance of bottom sediments and increase in erosion from the affected banks, resulting in increased suspended solids levels and turbidity for a short distance downstream. There also could be some unavoidable destruction of benthic organisms that reside in the construction area, and possibly destruction and/or a temporary shift in distribution of small numbers of fish and other free swimming organisms. The affected areas, however, would represent only a very small portion of the available habitat in the ICW. Fish migration, drainage, and water movement patterns would not be permanently altered. Nor would the bridge block a sufficient amount of sunlight to adversely affect primary production in the area.

Impacts Associated With Crude Oil and Brine Pipeline Construction

In terms of crude oil and brine pipeline construction, the general types of water quality and aquatic ecology impacts and the specific water bodies that could be affected are almost identical for Weeks Island and Cote Blanche. The only difference would be the spurs that would have to be constructed to connect the two sites to the existing pipeline to St. James. The spur from Cote Blanche would travel about two miles northeast, crossing only the ICW. The spur from Weeks Island would travel about one mile south, and while it would cross wetlands, it would not cross any permanent water bodies. Otherwise, the discussion of impacts for Weeks Island in section 7.3.3.3 applies equally for Cote Blanche. Pipeline construction should not have an impact on water quality, benthic habitat, or barge traffic along the ICW, because directional drilling would be used from land-based equipment.

When Weeks Island and Cote Blanche are compared in terms of crude oil distribution and brine disposal alternatives, pipeline construction for Cote Blanche would be slightly more extensive than that for Weeks Island. In addition to the above difference between the spur connections to the existing crude oil pipeline to St. James, the brine discharge pipeline from Cote Blanche would travel ten miles on land, crossing numerous unnamed waters in wetlands and the ICW in two places before entering Weeks Bay and heading around the west of Marsh Island to the Gulf of Mexico. In contrast, the onland portion of the brine discharge pipeline from Weeks Island would follow only the last two miles of this proposed route from Cote Blanche, crossing only the wetlands to the south of Weeks Island and the ICW to the west before entering Weeks Bay. Therefore, construction of the brine disposal pipeline from Cote Blanche could affect more water bodies and aquatic habitat than the route from Weeks Island.

7.4.3.4 Oil and Brine Spill Impacts

The generic types of water quality and aquatic ecology impacts associated with crude oil and brine spills have been discussed in detail in section 7.1.3.4 for Big Hill. Only the spill probabilities and the specific water bodies that could be affected would differ from one site to the next. Therefore, this section focuses on how Cote Blanche compares to Weeks Island with respect to these two considerations.

As for Weeks Island, it is very unlikely that water bodies near Cote Blanche would be affected by on-site spills because the Cote Blanche facilities would be designed to limit the movement of oil or brine off the site in the event of a spill. If crude oil or brine was released to the environment at Cote Blanche, however, it could migrate into either the ICW, if the spill occurred on the north side of the site, or onto marshlands separating the site from West Cote Blanche Bay, if it occurred on the south side of the site. An on-site spill that is large enough to lead to significant contamination in West Cote Blanche Bay is not considered a credible scenario. In general, the ICW is larger and more capable of assimilating a spill than Warehouse Bayou, which would likely receive oil or brine if spilled at Weeks Island. However, the habitat and resources in the ICW are perhaps more valuable than those in Warehouse Bayou. For example, the ICW supports extensive recreational uses. Warehouse Bayou offers more limited habitat and is used primarily for barge traffic. In terms of on-site oil spill probabilities, about 4.3 spills would be expected during fill, refill, or drawdown at either Weeks Island or Cote Blanche (see section 6.1). In terms of on-site brine spills, such as from the on-site brine ponds, the expected frequency and magnitude of spills at Weeks Island and Cote Blanche would be equally very low (see section 6.2).

Because crude oil distribution at Weeks Island and Cote Blanche would utilize the same pipelines and terminals (only the spurs connecting the two sites to the existing St. James pipeline would differ), the same water bodies that may be affected by a spill from Weeks Island's crude oil pipelines would also be at risk if Cote Blanche was selected. In addition, the two sites differ only slightly in terms of the expected frequency of crude oil spills from the pipelines (see section 6.1). Therefore, Cote Blanche and Weeks Island cannot be distinguished on this basis and the description of oil spills from pipelines provided in section 7.3.3.4 for Weeks Island applies equally to Cote Blanche.

In terms of off-site spills from brine disposal pipelines, the expected frequency and magnitude of spills are the same for both Cote Blanche and Weeks Island. However, the onland portions of the brine disposal pipelines at the two sites differ (the offshore portions are identical). The pipeline from Cote Blanche crosses ten miles between Cote Blanche Island and Weeks Island, crossing the ICW in two places and numerous unnamed water bodies in wetlands before entering Weeks Bay. In contrast, the onland portion of the brine discharge pipeline from Weeks Island would follow only the last two miles of this proposed route from Cote Blanche, crossing only the wetlands to the south of Weeks Island and the ICW to the west before entering Weeks Bay. Therefore, the brine pipeline from Cote Blanche would present a greater potential for impacts from spills than the pipeline from Weeks Island.

7.4.4 Air Quality Impacts

Air quality impacts would likely be similar to those predicted for Weeks Island in section 7.3.4. The overall impacts due to emissions during site and pipeline ROW construction as well as during cavern development and fill would be insignificant.

7.4.5 Potential Impacts to Terrestrial Ecology and Wetlands

Potential terrestrial ecology and wetlands impacts from construction, operation, and maintenance of the proposed Cote Blanche site and pipelines are discussed below. Many of the activities and associated potential impacts are similar to those discussed for Big Hill in section 7.1.5, but are examined here in the context of the areas surrounding Cote Blanche.

7.4.5.1 Potential Impacts at and Nearby the Site

The proposed site would occupy approximately 300 acres. Because the site is currently accessible only by ferry, a bridge would need to be constructed across the ICW to provide access to the site. Based on site visits and aerial photographs, the site is predominately forested with dense stands of very young forest with a moderately heavy understory. Based on the National Wetland Inventory map for the site, there are no wetlands within the proposed site boundary.

Site Construction

As part of the construction of the proposed site, vegetation within the site boundary would be completely or partially cleared, and the site would be fenced for security reasons. It is possible that several endangered plant species could occur at the site; these species are listed in section 5.4.5.1. To avoid impacts to these species, a site-specific endangered species survey would be conducted prior to any site development activities.

Potential impacts associated with clearing and construction would similar to those discussed in section 7.1.5.1: destruction or alteration of vegetation, displacement of wildlife, destruction of individuals of smaller wildlife species, and disruption of wildlife habits due to increased traffic and human activity.

There are extensive estuarine wetlands east of the site associated with Cote Blanche Bay. These wetlands are likely to sustain populations of fish, aquatic invertebrates, and numerous bird species. Those nearest to the site potentially could be impacted by increased sedimentation as a result of erosion during construction. Based on soil erosion calculations presented in Appendix O, an estimated 7,110 tons of soil could erode from the site during construction if no mitigation measures were in place. Roughly half of this would be transported to the northeast, and the remainder would be transported to the southeast. Emergent wetlands are located adjacent to the proposed site in these areas, and it is likely that the majority of the soil eroded from the site would be deposited in these wetlands, preventing it from reaching surface water. Deposition in wetlands could smother some of the less robust vegetation in these areas, but this impact would probably be temporary with no permanent adverse impacts. Impacts to the wetlands as a whole would likely be negligible.

Site Operation and Maintenance

The site would be securely fenced for the lifetime of the program, and therefore access of many species of wildlife would be restricted. The vegetated areas of the property would be mowed frequently, and would provide little food or cover for wildlife.

Operations at the site and associated potential impacts are similar to those discussed for Big Hill and would probably be negligible.

The potential exists for impacts to wildlife from leaks or spills from the on-site pipelines, above-ground holding tanks, and brine ponds. The severity of impacts would be determined largely by the severity of the spill. Spills from the raw water pipelines would have minimal impacts on local wildlife. Oil spills or brine spills could adversely affect the habitat and wildlife in the immediate vicinity of the spill. Such spills could result in immediate loss of vegetation as well as possible long-term impacts during recovery. They also could impact the extensive estuarine wetlands surrounding the island.

7.4.5.2 Potential Impacts Due to Pipeline Construction and Maintenance

Raw water intake, brine disposal, and a crude oil pipeline spur would need to be constructed as part of development of the Cote Blanche site under the 270-day drawdown criterion. Under a 180-day drawdown criterion, additional distribution enhancements (construction of a connection from the existing Weeks Island site to the Texas 22" pipeline, expansion of the St. James Terminal, and a second pump station) would be required. Because the ecological impacts of these enhancements are discussed above (see section 7.3.5.2 for the Texas 22" crude oil line, section 7.6.5 for the terminal expansion and section 7.3.5.3 for the pump station), only impacts for Cote Blanche-specific pipelines are discussed in this section.

Construction of Raw Water Intake and Brine Disposal Pipelines

As shown in Table 7.4-2, the proposed RWI pipeline from the ICW could impact seven acres of wetland (62 percent) out of a total of twelve acres of land potentially affected. The wetlands potentially affected are all intertidal, emergent, estuarine wetlands.

Table 7.4-2
Types and Acreage of Wetlands Crossed by the Proposed Raw Water Pipeline to Cote Blanche

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. WETLANDS -- TOTAL All wetlands for this proposed site are estuarine, intertidal, emergent, persistent, and irregularly flooded	7	100	62
II. NON-WETLANDS -- TOTAL	5	--	38
TOTAL ACREAGE	12	--	100

Source: Based on National Wetlands Inventory Maps. Acreages assume a 150-foot ROW.

As with Weeks Island, the brine disposal pipeline for the Cote Blanche site would be routed around the west side of Marsh Island. Most of the pipeline route impacts would be the same as those described for Weeks Island in section 7.3.2, and the acreage of wetlands impacted is presented in Table 7.4-3. Of the 265 total acres crossed by the pipeline, 183 (69 percent) are wetlands. The majority of wetlands potentially impacted would be estuarine (111 acres) with lesser amounts of palustrine forested, interspersed with palustrine emergent and scrub-shrub wetlands. Brine could also be injected into disposal wells along the existing ROW from Weeks Island to St. James. The potential impacts of injection would probably be minimal.

The raw water intake pipeline would not cross any lands designated as a wildlife refuge or other areas identified as breeding grounds of endangered species. The brine pipeline route would cross a portion of Vermilion Bay, and P.J. Rainey Wildlife Refuge. Wildlife species that use areas in the projected pipeline ROW would be temporarily displaced. Abandonment of nearby nests could occur due to disruption during the breeding season.

Construction of Crude Oil Pipeline Spur

Development of the Cote Blanche site would require construction of a 1.65-mile pipeline to the existing DOE oil distribution pipeline to Saint James. As shown in Table 7.4-4, 22 acres of estuarine wetlands and six acres of palustrine forested wetlands out of a total of 37 acres of land would be affected by constructing this spur. Potential impacts would include altered surface topography or water flow patterns and destruction of vegetation. The spur would cross a freshwater/saltwater interface from palustrine forested emergent to estuarine emergent, near the

Table 7.4-3
Types and Acreage of Wetlands Crossed by the Proposed Cote Blanche Brine Disposal Pipeline

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE -- TOTAL	111	61	42
A. Subtidal, unconsolidated bottom	10	5	4
B. Intertidal, emergent	44	24	17
C. Intertidal, scrub shrub	1	1	<1
D. Unclassified*	56	31	21
II. PALUSTRINE WETLANDS -- TOTAL	72	39	27
A. Emergent	2	1	1
B. Forested	70	38	26
C. Scrub Shrub	1	<1	<1
III. OPEN WATER -- TOTAL DISTANCE CROSSED	39 miles	--	--
IV. NON-WETLANDS -- TOTAL	82	--	39
WETLANDS -- TOTAL ACREAGE	183	100	69
TOTAL ACREAGE*	265	--	100

Source: Based on National Wetlands Inventory Maps. Acreages assume a 150-foot ROW.
*As detailed in section 7.3.5.2, this category includes the 56 acres on the peninsula containing Paul J. Rainey Wildlife Refuge and State Wildlife Refuge. No NWI map was available.
**Note -- Total acreage does not include portions of the proposed pipeline that cross bays.

tie-in location to the existing crude oil line. Construction could alter hydrology and introduce saltwater into these freshwater wetlands. This would result in the loss of some salt-intolerant species and a shift in community structure toward more salt-tolerant species. It is possible that plant species composition following revegetation would differ from that prior to disturbance. Preventive and mitigative measures are discussed in Chapter 8.

Pipeline Maintenance

Potential impacts associated with maintenance of the pipeline ROWs and the pipelines would be similar to those discussed for Big Hill would likely be negligible.

7.4.5.3 Summary of Wetlands Potentially Affected by Construction

There are no wetlands on the proposed Cote Blanche site. Under the 270-day drawdown criterion, a total of 223 acres of wetlands could be affected, 140 acres of which would be estuarine emergent, subtidal, and intertidal, and 83 of which would be palustrine forested wetlands.

Table 7.4-4
Types and Acreage of Wetlands Crossed by the Proposed Crude Oil Pipeline from Cote Blanche to the Existing Weeks Island-St. James Pipeline

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE WETLANDS -- TOTAL	22	79	66
A. Intertidal, emergent	16	56	47
B. Subtidal, unconsolidated bottom	7	24	20
II. PALUSTRINE WETLANDS -- TOTAL All palustrine wetland for this ROW is forested.	6	22	18
III. NON-WETLANDS -- TOTAL	6	--	17
WETLANDS -- TOTAL ACREAGE	28	100	83
TOTAL ACREAGE	37	--	100

Source: Based on National Wetlands Inventory Maps. Acreages assume a 150-foot ROW.

Under a 180-day criterion, an additional 98 acres of wetlands would be affected by construction of the spur to the Texas 22" pipeline and an additional pump station.

7.4.6 Floodplains Impacts

Because buried pipelines would have no long-term impacts on floodplain action and would not affect property or lives, DOE's primary concern is for the floodplain impacts on SPR sites. There is little probability that runoff patterns would be altered along a pipeline route that is backfilled to the same level and consistency as had previously existed. The permanent nature of the construction and alteration of an SPR site, however, demands that it receive most of the attention.

The proposed Cote Blanche site is located within a floodplain. DOE would use rough grading as a part of site preparation. This practice consists of removing dirt from higher elevations at a site and placing it in lower sections. Rough grading could change the elevation of certain site areas. Other actions that could affect floodplains include construction of roadways, wellpads, and buildings. DOE would ensure that all construction activities in the floodplain complied with Executive Order 11988 (floodplain management), which guarantees mitigation, preservation, and restoration of floodplains. Therefore, most impacts to floodplains from construction activities would be short-term, and none of these effects would be significant enough to increase the risk to lives and property, or alter the natural and beneficial floodplain values.

Without proper mitigation, preservation, and restoration of floodplains, however, potential impacts to the floodplain could include sedimentation on or below the construction site. Sediment deposition's positive impact would be the addition of rich nutrients to the floodplain soil and prevention of sediment-associated pathogens from entering the water. This same sedimentation, however, could destroy biological communities supported on the floodplain because it could contribute to nutrient overloading, decreased dissolved oxygen, increased water temperature, and serious impairment of photosynthetic productivity.

The RWI structure would be located on a water body (e.g., the ICW) and therefore, within a floodplain. However, installation of the RWI structure would involve minimal construction area. The single requirement for the ICW is that it has a sufficient uninterruptible supply of water. When the RWI structure is completed, water flowing in the ICW would be able to pass under the RWI structure with little or no disturbance. DOE would locate the RWI structure on the ICW at a point approximately 1 mile from Cote Blanche.[96] The structure would not significantly alter the floodplain or floodplain action. Construction of the RWI structure would require dredging about 10,000 cubic yards of spoil from the intake canal to guarantee adequate depth and uninterrupted water supply. Spoil could be placed in an upland spoil disposal area.[97]

All pipelines pass through a floodplain for at least some part of their length; therefore, construction crews would take measures to minimize and mitigate impacts to floodplains. Normal construction would include the temporary use of fill, spoil generation, and construction of temporary platforms. Any adverse impacts from pipeline construction would be minimal and temporary, and DOE would restore all floodplains to a condition consistent with their original state once construction is complete.

7.4.7 Natural and Scenic Resources Impacts

As with Weeks Island, site construction, including clearing of vegetation within the site boundary, could result in the loss of the use by wildlife of up to 300 acres for the lifetime of the program. Construction impacts on the plant communities outside of the proposed site would likely be minimal. Clearing and construction of 15 storage caverns and necessary infrastructure would result in the displacement of terrestrial wildlife species inhabiting the 300 acres on which the site would be constructed, although the overall impacts on wildlife in the area would be minimal.

Brine disposal pipelines may cross a portion of the Paul J. Rainey Wildlife Refuge and the State Wildlife Refuge. Other preserves would not likely be affected.

7.4.8 Archaeological, Historical, and Cultural Impacts

Because of the proximity of three archaeological sites to the proposed project area and the potential impacts of pipeline construction, the State Historic Preservation Officer recommends that a cultural resources survey be undertaken.[98] DOE would conduct such a survey before construction of the site.

7.4.9 Socioeconomic Impacts

The impacts of developing of a SPR facility at Cote Blanche would be small relative to the region's economy. Under both alternatives, the largest impact would be from the additional income generated directly by the jobs created and the project purchases made in the local and regional economy. In-migration of workers and their families would likely have only a small effect on local housing, education, health care and transportation systems.

7.4.9.1 Demographic Changes

Because the SPR expansion at Cote Blanche expansion would involve developing a new facility, construction is expected to take about four years to complete. Site preparation, well drilling, and facilities for cavern leaching would be completed within 18 to 24 months. Remaining site facilities, including security and the crude-oil distribution system would be built within 39 to 48 months. The crude oil pipelines would be constructed during the third and fourth years.

The largest demographic impacts would occur during the construction phase, when most of the new jobs are created. During the first year of construction, DOE estimates that 176 workers would be needed at the site. This estimate increases to 344 site workers by the end of the third year when construction activity would be at its peak. An additional 62 workers would be hired during the third year for construction of the brine line, raising the total estimated employment level to 406 workers. Under a 180-day drawdown criterion, this number could increase slightly for crude oil pipeline construction. It should also be noted that development of the Cote Blanche site would require construction of a bridge over the ICW. Building the bridge, however, would only require about 60 days to complete and involve about 24 workers and would not be expected to affect either the overall employment level or duration of the construction phase.

During the fourth year of construction the number of employees would decrease as much of the work would be completed and no new workers would be hired until operation of the completed facility commences in the fifth year. The operation and maintenance of a new facility at Cote Blanche facility would require 104 additional permanent workers. The labor force requirements for the development and operation of the Weeks Island facility are shown in Table 7.4-5.

The estimated demographic changes from the development of a Cote Blanche SPR facility are based on the work force requirements described above and the in-migration model discussed in section 7.1.9. DOE estimates that under the baseline scenario, 128 additional people would relocate to within 30 miles of Weeks Island by the end of the construction phase. An additional 240 people would relocate by the fifth year when the facility would become operational bringing the total in-migration population to 368. Under the high impact scenario, the total in-migration population would increase to 1,178. Compared to the population of incorporated towns within 30 miles of Cote Blanche Island, this level of in-migration under the high impact scenario would only increase the current population by 1.1 percent (Table 7.4-6).

The annual level of in-migration during development of the Cote Blanche facility is shown in Tables 7.4-7. In the baseline scenario, in-migration would increase from 55 to 128 people over the first three years of the construction project. This total includes 81 workers and 17 school-age children by the third year. In the first year, 35 workers with seven school-age children would relocate. In the second year, 21 additional workers with five school-age children would move into

Table 7.4-5
Estimated Labor Force for Development of Cote Blanche SPR Site

	Construction Phase				Operations Phase
	Year One	Year Two	Year Three	Year Four	Year Five
Site Construction	176	280	344	100	--
Pipeline Construction	--	--	62	62	--
Operation & Maintenance	--	--	--	--	104
Total Employees	**176**	**280**	**406**	**162**	**104**

Source: Boeing Petroleum Services, PB-KBB, Inc., *Row Study*.

the area. In the third year, 25 construction workers with five children would relocate. In the fourth year, the work force would actually decrease and no new in-migration would be expected.

Under the high-impact scenario, in-migration would be expected to rise from 408 people in the first year to a total of 939 people by the end of the third year. By the time construction activity reaches a peak at the end of the third year, 305 workers with 634 family members, including 254, school-age children would relocate to the area.

Although no in-migration of construction workers would be expected after the third year, there would be some in-migration of permanent workers at the beginning of the fifth year once the site is completed. Because permanent workers would be more likely to relocate than temporary workers, DOE used the high-impact scenario for estimating in-migration for this worker population. As seen in Table 7.4-8, 78 permanent workers would relocate, and bring with them a total of 64 school-age children.

7.4.9.2 Economic Impacts

The main direct economic impacts of developing the Cote Blanche site would include the additional income generated from new jobs created during site construction, increased demand for local supplies and materials used for construction and operation of the facility, and increased expenditures in the local economy by project workers. These direct impacts would likely have multiplier effects on the regional economy, particularly in the local trade and services sectors.

No data are currently available on the expected payroll for the Cote Blanche construction and operational phases. Using prevailing wage rates in the construction industry and projected manpower requirements, DOE estimates that $11 million in additional income would be generated in the peak year of construction (Table 7.4-9). The impact of this income would be increased

Table 7.4-6
Population Within 30 Miles of the Cote Blanche Site

Incorporated City or Town	Population
15-Mile Radius	
Iberia:	
Jeanerette	6,205
Lydia	1,136
St. Mary:	
Baldwin	2,379
Charenton	1,584
Franklin	9,004
Total incorporated population within 15 miles	**20,308**
20-Mile Radius	
Iberia:	
Delcambre	1,978
New Iberia	31,828
Total incorporated population within 20 miles	**54,114**
30-Mile Radius	
Iberia:	
Loreauville	860
St. Mary:	
Bayou Vista	4,733
Berwick	4,375
Morgan City	14,531
Patterson	4,736
Lafayette:	
Broussard	3,213
Youngsville	1,195
St. Martin:	
St. Martinville	7,137
Vermilion:	
Abbeville	11,187
Erath	2,428
Total incorporated population within 30 miles	**108,509**
Maximum Estimated In-migration	**1,178**

Source: United States Geologic Survey Maps; Bureau of Census, Department of Commerce.

Table 7.4-7
Cote Blanche Site and Pipeline Construction In-Migration
Baseline and High Impact Scenarios

Population Category	**Year One**	**Year Two**	**Year Three**
Baseline Scenario			
Total Average Work Force	176	280	406
Total In-Migrating Workers	35	56	81
Total Family Members	20	32	47
Total In-Migrating Population	55	88	128
Total School Children	7	12	17
High Impact Scenario			
Total Average Work Force	176	280	406
Total In-Migrating Workers	132	210	305
Total Family Members	276	437	634
Total In-Migrating Population	408	647	939
Total School Children	111	181	254

somewhat by the multiplier effects of local spending. Nevertheless, as seen in Table 7.4-11, the additional income directly generated by the project would be small relative to the regional economy.

There would be some potential for larger impacts on the region's economy depending on the degree to which the project procures goods and service from within the area. Depending on the alternative selected, it is estimated that the cost of the Cote Blanche development would be between $758 million and $890 million over four years. However, the positive economic impacts would diminish once construction is completed.

7.4.9.3 Impacts on Energy Consumption

Creation of a new facility at Cote Blanche would require similar power demand as that for an expansion at Weeks Island. Up to sixteen caverns would be leached at Cote Blanche with a peak demand of about 20 MW. Peak demands for oil fill would approach 5.8 MW; drawdown would require about 21.1 MW, and oil storage would use 1 MW. Two pipeline booster stations would also be required for Cote Blanche each with a peak demand of 0.05 MW for leach, fill, and storage, and 9.0 MW for drawdown. A newly constructed RWI system would require about 4.4 MW of power during leaching and drawdown, and 0.1 MW during fill and storage.

Table 7.4-8
Cote Blanche Operation and Maintenance In-Migration
Baseline and High Impact Scenarios*

Population Category	Number*
Total Additional Work Force	104
Total In-Migrating Workers	78
Total Family Members	161
Total In-Migrating Population	239
Total School Children	64

* High impact scenario used for both scenarios.

CLECO's transmission line running north to south near Cote Blanche would serve the facility. The transmission line would be sufficient to handle the power demands of a facility at Cote Blanche. A CLECO or DOE substation may have to be constructed at Route 83 near Cote Blanche. Distribution lines would have to be run to and from the DOE facility in a loop.

7.4.9.4 Impacts on Fisheries

Although unlikely, based on ten years of experience at existing SPR sites, there would be some potential for adverse impacts on the fisheries industry due to brine disposal in the Gulf of Mexico. To account for this potential impact, DOE has developed a conservative estimate of the potential lost catch due to the area of increased salinity that would be associated with the brine plume (Appendix G). Under these assumptions (e.g., maximum discharge, adverse environmental conditions, total loss of fishery within brine plume), the estimated annual value of the lost catch associated with the one ppt salinity contour would be approximately $1,702,000. A similar estimate for the three ppt salinity contour would be approximately $507,000. Estimated losses for brown and white shrimp would account for 62 percent of the total estimated loss for both salinity contours; estimates losses for menhaden would account for 37 percent of the total estimated loss.

Total worst-case losses would represent 3.1 and 0.9 percent, respectively, of the total annual value of the catch within the appropriate sections of the National Marine Fisheries Service (NMFS) fishery grid potentially affected by brine discharge from the Cote Blanche diffuser. Estimated lost catch at the Cote Blanche diffuser also would be only a small percentage of the annual value of the total catch in the northern Gulf of Mexico, which is in excess of $440 million.

The impact of the Cote Blanche diffuser brine plume on fisheries would be expected to be much less than the above conservative estimate. Most of the commercially important fish and shellfish species in the northern Gulf of Mexico can tolerate a wide range of salinities, and field studies have indicated that the existing brine diffuser at Bryan Mound has had little effect on the nekton (i.e., fish and shrimp) community inhabiting the diffuser area. Additional details of the assumptions and methods used in this analysis are presented in Appendix G.

Table 7.4-9
Additional Income Directly Generated from Cote Blanche Development

	Total New Jobs*	Total Annual Worker Earnings	Percent of Regional Earnings
Year 1	176	$5,000,000	0.129
Year 2	280	$8,000,000	0.205
Year 3	406	$11,600,000	0.30
Permanent	104	$3,000,000	0.077

* Totals for new jobs and earnings are cumulative.
Source: Boeing Petroleum Services, Bureau of Labor Statistics.

7.4.9.5 Impacts on Transportation Systems

The primary impact on transportation systems would be increased traffic from workers traveling to and from the site during the construction phase. However, given that at the peak of construction activity only about 344 workers would be at the site (the remaining work force will be away from the site on pipeline construction), and the current levels of traffic, the marginal increase in congestion would not be significant. These impacts would be further mitigated because workers would be using varying commuting routes, although all workers would arrive at the site via Route 83, the only road leading into the site. Assuming the geographical distribution of new workers would be similar to that of current workers at Weeks Island, more than half the additional labor force would reside in New Iberia and travel along routes US 90 and 83 to the Weeks Island site. The most recent statistics (see Table 5.4-5) show that daily volume of U.S. 90 is about 14,000, and on route 83, it ranges from about 2,000 to 4,100. Even if all workers commuted on one or the other of these routes, the traffic volume would only increase by two percent on US 90 and eight to 17 percent on Route 83. Because Cote Blanche is further east than Weeks Island, it is more plausible that workers would live in towns to the east, including Franklin, Patterson, and Morgan City. These workers would commute to the site via the eastern flank of Route 83 rather than from the western flank used by workers commuting from New Iberia. Given the low probability of accidents on these routes, the potential increase in accidents would be negligible.

Some additional traffic, however, would be created by trucks removing vegetation and other debris during the initial stages of site development as well as from construction equipment and vehicles bringing materials for facility construction. Large scrapers used for clearing the site, as well as a drilling rig and workover rig, would probably exceed the 80,000 lbs load limit on surrounding state and Federal highways. These vehicles would require heavy equipment load permits from the Louisiana Department of Transportation to transport them to the site. This additional traffic would be sporadic and short term, and would likely have minimal impacts on roads and bridges. DOE would bear the costs of repairing roads adversely impacted by heavy construction equipment.

A bridge over the ICW would be constructed, following the same route as taken by the ferry. The bridge would begin at the ferry dock, cross the ICW, and lead to a two-lane paved access road to the site that would also require construction. The access road would be approximately 20 feet wide with additional six-foot shoulders.

7.4.9.6 Housing

Development of the Cote Blanche site would have negligible impact on housing availability. (The housing stock available in the Cote Blanche region is described in section 5.5.9.5). In 1990, there were over 17,000 vacant housing units available in the Weeks Island Region. Under the high impact scenario, the number of new households in the region would not exceed 305. Some impact on the available house stock might occur if under the high-impact scenario all workers chose to relocate in St. Mary Parish. Even under this low probability scenario, these workers would only occupy about 32 percent of all available housing units.

7.4.9.7 Health Care

Assuming, under the high impact scenario described above, that all 1,178 persons would relocate to either Iberia or St. Mary Parish, the ratio of residents to physicians, and residents to hospital beds, would not change significantly. In 1990, these two parishes had four hospitals, 375 hospital beds, and 123 physicians. Given the current population of 126,383 there are 1,027 residents per physician, and 337 residents per hospital bed. With an additional 1,178 residents, the ratio would change to 1,037 residents per physician and 340 residents per hospital bed, changes of 1.0 and 0.9 percent, respectively.

7.4.9.8 Education

The estimated number of additional children entering the regional school systems would range from 81 to 318 (including children of both construction and permanent workers). Even under the high impact scenario, the total number of school children entering the local school system would be less than 1.1 percent of the current school enrollment of more than 27,000 students enrolled in kindergarten through high school in Iberia and St. Mary Parishes.

7.4.9.9 Fiscal Impacts

The net fiscal impact of developing the Cote Blanche SPR facility is difficult to estimate. The amount of property taxes paid by the land owners in 1990 is not currently available. The revenue from the property would be lost if the property became Federally-owned. However, given that the project would generate at least 406 temporary jobs and 104 permanent jobs, this small shortfall should be more than compensated by the additional tax revenue from wages and property owned by these additional employees. Increased earnings and trade due to secondary effects would also generate local tax revenue.

7.4.9.10 Emergency Response Capabilities

Local response capabilities are not expected to be affected by any potential increase in the local population resulting from worker in-migration. Section 7.1.9.10 contains more information on potential emergency response impacts for all the sites.

7.4.9.11 Oil and Brine Spills

Several negative socioeconomic impacts associated with oil and brine spills should be considered regarding the proposed Cote Blanche expansion site. As several of these impacts could be similar to those of the Big Hill expansion site, refer to Big Hill section for a more detailed explanation.

Socioeconomic Impacts of Oil Spills

An oil spill at or near the Cote Blanche site or along a pipeline could negatively affect several water bodies or agricultural land. Specific impacts would be similar to those described in section 7.3.9.11 for Weeks Island.

Socioeconomic Impacts of Brine Spills

The proposed alternative brine pipeline and diffuser sites would be similar to those noted for Weeks Island, except that additional resources could be potentially impacted by a brine pipeline between the Cote Blanche and Weeks Island sites.

7.4.9.12 Prime and Unique Farmlands

The proposed Cote Blanche site would not affect prime and unique farmlands. The proposed pipeline ROW would indirectly and temporarily convert a total of 1.9 acres of prime and unique farmland. After construction, the ROW will be returned to its original contours and vegetation. The proposed action is not expected to have a lasting impact on farmlands.[99]

7.4.10 Noise Impacts

The following sections discuss potential noise impacts that would be associated with the development of a new SPR site at Cote Blanche.

7.4.10.1 Construction Noise Impacts

The only activity near the Cote Blanche salt dome within the 5,000-foot radius noise impact zone is the North American Salt Company mine. Little or no audible increase in noise levels would be expected at the existing mine because the background noise level at the mine is likely to be greater than the 53 dBA (i.e., 55 to 65 dBA, as discussed in section 5.5.10). Using Figure F.1-1 described in Appendix H, noise levels from construction at Cote Blanche would be in the 67 to 73 dBA range at 500 feet from the site. Noise levels would increase slightly but noise-related impacts would be minimal.

As with Weeks Island, the preferred alternative for oil distribution is the construction of a two-mile spur to the existing Weeks Island-St. James pipeline and the addition to the pipeline of a booster pump. Additional enhancements under the 180-day drawdown criterion would be the construction of a seven-mile spur from the existing Weeks Island facility to the Texas 22" pipeline, and an additional booster pump station. Raw water pipeline construction would cover a distance of approximately one mile. Brine line construction would cover a distance of 46 miles, but only 0.95 miles of this distance would be on dry land. No major noise related impacts are expected as a result of pipeline construction because it would proceed at a rate of 0.5 miles per day. Any impacts as a result of pipeline construction would be of short duration. Alternatively, injection wells could be constructed in the ROW from St. James to Weeks Island, the impacts would be the same as for cavern construction (i.e., minimal). For a summary of the maximum expected durations of drilling activities at the proposed sites in the Capline Complex, see section 7.3.10.

If Cote Blanche was chosen as the expansion site, the St. James Terminal which serves as an oil distribution link for the site would be expanded under a 180-day drawdown criterion by the addition of two docks and tanks. See the discussion of the noise impacts of the St. James Terminal expansion in section 7.6.10.

7.4.10.2 Operational Noise Impacts

Operational noise levels at Cote Blanche would be 60 dBA at 500 feet from the site based on Big Hill monitoring data. Because the background level within the 5,000-foot radius impact zone would be greater than the 53 dBA level used to develop the model explained in section 4.9, no significant acoustical impact would be expected as a result of SPR operations at the Cote Blanche site. Because the existing activities surrounding the proposed SPR site are industrial, no increased noise levels would be expected in those areas, even though the mining activity is within the predicted 5,000 foot impact zone. During oil fill and drawdown, noise levels around the four residences or places of business within the impact zone would be expected to increase slightly. However, these increases would be minor and of short duration.

7.5 Richton (Capline Complex Site)

The following sections discuss the potential impacts associated with development of a new SPR site at Richton.

7.5.1 Geological Impacts

This section examines the potential geological impacts that could result from an SPR expansion at the Richton dome. Under one of the possible oil distribution options for the Richton site, a bulk oil storage terminal would be constructed at the Port of Pascagoula, near the mouth of the Mississippi River. Potential geologic impacts associated with the construction of the Pascagoula Terminal would be limited to the possibility of the contamination of surface and subsurface sedimentary layers in the event of an oil spill. Because there is no salt dome storage at the site (i.e., it would serve as an oil distribution center), significant geologic impacts are not expected. Potential geological impacts that would be associated with the proposed underground injection of brine at Richton are considered in section 7.5.2.

7.5.1.1 Subsidence

There is no evidence of localized subsidence occurring over the salt dome at present, although the Richton dome is subject to the same regional subsidence as the other proposed sites (i.e., subsidence caused by factors not associated with SPR cavern development or storage). Subsidence resulting from cavern development would be expected to be roughly comparable to that experienced at the existing SPR sites. That is, subsidence at the site would most likely be in the range of 0.05 to 0.28 feet per year over the storage caverns. Because groundwater can be found just below the land surface, engineering controls (e.g., drained paved areas) would be used to prevent the formation of subsidence-induced ponds over the individual caverns. Impacts of subsidence would be limited to the area immediately over the salt dome with no additional regional subsidence expected as a result of cavern development. For a general discussion of subsidence, see section 7.1.1.1.

7.5.1.2 Seismicity

Past seismicity evaluations have indicated that the Mississippi Salt Basin is in a region of low seismicity. In recent years, there have been two nearby earthquakes with a Modified Mercalli Intensity (MMI) of V to VI. One of these occurred 45 miles south-southeast of the site and the other occurred 45 miles north-northeast of the site. Neither of these earthquakes were within the geologic setting of which Richton is a part. Maximum historical shaking at the site is estimated at V to VI on the MMI scale. For specific information on faults at Richton, see section 5.5.1.[100] Evidence for two other possible faults has been observed in the sediment layers overlying the dome, but this minor movement may not extend into the salt. Potential impacts associated with earthquakes at the Richton site would be limited to damage of surface facilities and pipelines. Because the earthquake potential for the region is so low and because a major earthquake would be necessary to cause significant damage to an SPR site, no major impacts would be expected from seismicity at Richton.[101]

7.5.1.3 Potential Impacts of Brine Seepage on Soils

As discussed in section 7.1.1.3, major brine spills from leached caverns would be extremely unlikely, therefore, no impacts would be anticipated from development of a Richton SPR site.

7.5.1.4 Multiple-Use Considerations

There is no existing activity or historical mining or oil production at Richton, so co-use impacts would not be expected at the proposed SPR site. Many sulfur exploration wells have been drilled into the salt dome, and oil and gas fields exist to the north and south of the salt dome; however, because this activity is not within the actual salt column of the Richton dome, no co-use impacts would be produced by SPR development.

7.5.2 Hydrogeological Impacts

There would be five potential sources of groundwater contamination associated with the proposed SPR site at Richton: brine ponds, underground injection wells, oil and brine pipelines, other material spills on-site, and the oil storage terminal at Pascagoula. The potential groundwater impacts associated with each of these sources are described in separate sections below.

7.5.2.1 Brine Ponds

The Richton brine pipeline and diffuser system would be similar to the existing Big Hill system. Brine would be pumped from the caverns to an anhydrite pond to allow insoluble solids to settle and then to a second pond with oil skimmers to remove oil. The brine then would be piped to the Gulf of Mexico for disposal. Measures to prevent migration from the ponds would include HDPE liners, underdrain systems to detect leachate, and diking to prevent run-off.

Releases from the brine ponds could include seepage through the synthetic liner to groundwater or overtopping and subsequent seepage to the subsurface. As outlined in section 5.5.2, the hydrogeology at the Richton dome site would be conducive to groundwater contamination and impacts in the event of such a release. Fresh groundwater is found in the Upper Aquifer at a relatively shallow depth (approximately one meter bls), and soils underlying the site are relatively permeable. Contamination of the Upper Aquifer, which is extensively used within a 10-kilometer radius of the site, could result in a loss of groundwater resources for surrounding areas. There are currently public, domestic, industrial, and agricultural wells in the area. If the contamination was not contained and was permitted to migrate to a downgradient drinking water well, elevated sodium levels could pose an increased risk of hypertension if consumed by humans and increased chloride concentrations could give the water an objectionable taste. Additionally, if not contained, brine could discharge into nearby surface waters such as Harper's Branch Creek (which runs through the proposed site), and adversely affect aquatic organisms. While such releases are possible and have been observed at some existing SPR sites in the past, the improved controls planned for the brine ponds at Richton dome make this an unlikely event (see section 6.2.2).

7.5.2.2 Underground Injection Wells

After leaching is complete at Richton and the brine disposal pipeline through Pascagoula has been converted to a crude oil pipeline, DOE would dispose of additional volumes of brine generated from cavern maintenance and refill in underground injection wells. The blanket oil pipeline from Richton to the Hess 10-inch pipeline would be converted to brine service and 15 disposal wells would be installed along the ROW. The closest injection well would be approximately 10.6 miles from the Richton site, at the intersection with the Hess 10-inch oil pipeline, with the remaining wells spaced on 1,000-foot centers along the pipeline toward the west-northwest. Each well would inject brine into the Wilcox Formation, at least 2,000 feet below the ground, and would be outfitted with state-of-the-art Class II injection well equipment (i.e., surface casing set with cement through the base of fresh water, long-string casing cemented to the land surface, injection tubing, and a packer).

The generic types of impacts associated with the underground injection of brine have been discussed in section 7.3.2.2 covering the proposed injection wells at Weeks Island. These include a number of potential impacts associated with the emplacement of brine at great depths, such as the displacement of natural saline formation water into freshwater zones, the upward migration of brine into usable shallow groundwater, the fracturing of geologic formations, and very unlikely, readjustment of the surrounding strata. There also would be a remote possibility that one or more of the injection wells could fail, resulting in the direct release of brine to shallow groundwater. These releases and resulting impacts, however, would be considered very unlikely given the engineering, monitoring, and regulatory controls that would be employed (see section 6.2 and Chapter 8). Historical release statistics for brine injection operations associated with industrial oil and gas production also suggest that a direct release to shallow groundwater from wells like the ones that would be used at Richton would be a rare occurrence (section 6.2).

7.5.2.3 Oil and Brine Pipelines

At the proposed Richton site, the brine disposal pipeline would consist of an 82-mile, 42" dual-purpose pipeline to Pascagoula connected to a 14-mile brine-only pipeline, terminating in a diffuser in the Gulf of Mexico. Crude oil pipelines being considered include: a 118-mile, 36" pipeline tie-in to the Capline pipeline near Liberty, Mississippi; a 70-mile, 24" pipeline to the Hess Ten-Mile station in Alabama; the dual-purpose pipeline to Pascagoula; and various short pipeline spurs in the Pascagoula area to connect to the DOE Pascagoula Terminal as well as other commercial docks. All pipelines would be protected by corrosion control coating and monitored with both pressure gages and volume meters to ensure that no leakage is occurring.

In the event that these controls fail, potential releases from the pipeline systems could include cracks in the pipeline, leaks in the valves and joints, and movement of the pipelines due to subsidence. As outlined in Chapter 6, historical spill statistics indicate that the proposed Richton operations would result in 4.3 oil spills at the Richton site and less than one spill from pipelines. It appears that brine pipeline failures at Richton could cause up to eight small brine spills (of roughly 75 barrels) and two larger spills of 74,000 barrels or more. If unmitigated, these spills could result in the migration of brine or oil constituents into groundwater. The impacts of such contamination would be expected to be the same as those characterized above for the brine ponds (i.e., potential groundwater resource loss, human health risk, and aquatic ecological risk). If a large brine pipeline leak comparable to the leak at Bryan Mound did occur, the resulting damage at Richton could be significant because (1) the depth to the usable aquifer is shallow (less than one meter), (2) groundwater is used extensively in the region, and (3) the proposed pipelines pass near population centers such as Liberty, Tyler, Runnelstown, Rainy, Pascagoula, Wilmer, Millertown, and Mobile.

7.5.2.4 Other Material Spills

Leaks and spills of wastes, solvents, and other materials could occur during regular operations. Leaks and spills could occur in storage areas, pump platforms, and cavern drain pads. Potential releases of hazardous wastes and materials at the facility would include seepage of oil and grease from equipment operation and maintenance into groundwater, spills and subsequent migration of solvents and solvent wastes, and spill or container failures from poor handling practices. Proposed material handling and spill prevention/mitigation measures would protect against major spills of these materials and their subsequent migration into groundwater (see Chapter 8). In addition, several existing facilities (e.g., Weeks Island) have requested approval for secondary spill containment structures. Construction plans at Richton would incorporate these considerations in order to adequately protect against groundwater and other environmental impacts.

7.5.2.5 Pascagoula Terminal

The terminal at the Jackson County Airport near Pascagoula would consist of five aboveground storage tanks, each with a capacity of 0.4 MMB. Measures to prevent oil migration from these tanks would be identical to those used at the existing St. James Terminal, including secondary containment structures capable of holding the entire volume of any one tank, concrete pads underlying each tank, and high-level alarms that notify the control room when a tank is in danger of overflowing. Historical spill statistics indicate that oil spills from these tanks would be very rare — only two spills would be expected during fill/refill and 0.6 spills or less would be expected during drawdown.

If a spill from these tanks was not contained and allowed to migrate off of the concrete storage pads, oil could seep through the moderately permeable loamy sands that exist in the area and contaminate the water table aquifer that exists about two feet below the land surface. If this shallow groundwater contamination also was not contained, the oil would in turn follow the natural groundwater flow direction to the southeast. The oil would tend to migrate along the top of the water table in a thin "pancake" rather than sink to greater depths, although some of the oil's constituents could eventually "leach" from the oil and migrate into the deeper freshwater aquifers that underlie the Pascagoula area. While in shallow groundwater, the oil contamination would not likely pose a significant human health threat or seriously degrade groundwater uses, because the water table aquifer is not a major source of freshwater in the area (groundwater that is used for drinking and industrial purposes is generally pumped from the deeper Citronelle and Graham Ferry Aquifers at depths that range from 135 to 375 feet below the land surface). The shallow oil contamination, however, could discharge into the wetlands surrounding Bangs Lake to the southeast of the site and cause localized impacts to any exposed plants and animals.

7.5.3 Surface Water and Aquatic Ecology Impacts

Just like the other candidate expansion sites, development of the site at Richton could cause four categories of impacts to surface water and aquatic organisms: (1) impacts associated with brine disposal in the Gulf of Mexico; (2) impacts associated with raw water intake from the Leaf River; (3) impacts associated with construction activities; and (4) impacts associated with accidental spills of crude oil or brine. Each of these potential impacts is addressed below.

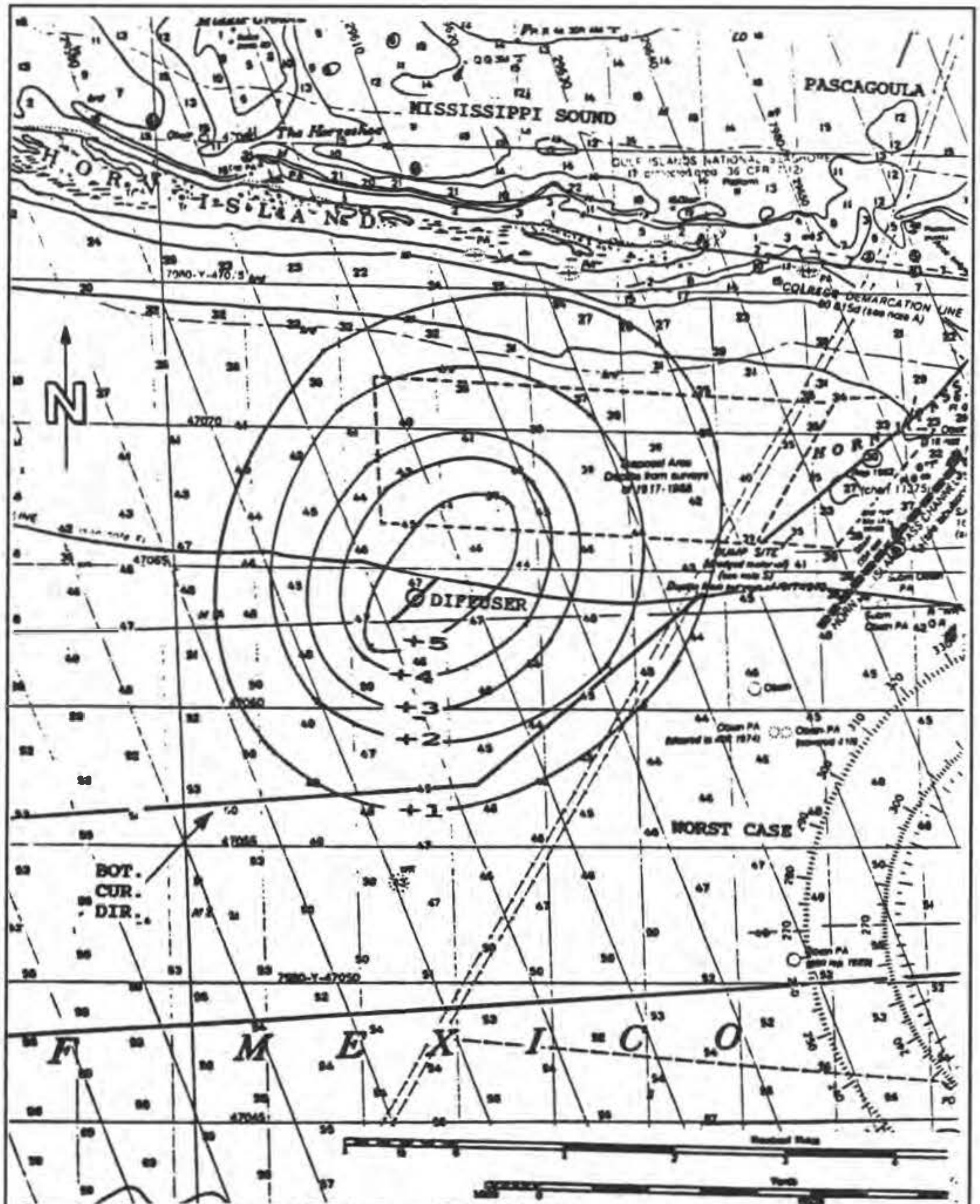
7.5.3.1 Brine Disposal in the Gulf of Mexico

Appendix Q describes the methods and results of a detailed modeling analysis that estimates the magnitude and extent of excess salinity levels in the Gulf of Mexico that would be caused by proposed brine discharges at Richton. The appendix predicts the maximum increase in salinity, the vertical extent of the resulting brine plume, and the areal extent and location of different excess salinity contours (e.g., contours of 1 ppt, 2 ppt, 3 ppt, and 4 ppt above natural ambient levels). These predictions are provided for largest, typical, and smallest plume conditions, defined by different combinations of operational and oceanographic parameters.

Figures 7.5-1 and 7.5-2 show the predicted largest and typical brine plumes, respectively, at the Richton diffuser site, assuming all 55 ports of the proposed diffuser are open. Critical dimensions of these plumes are summarized below in Table 7.5-1. The vertical extent or height of the brine jet is predicted to be about 17 feet above the bottom (and about 30 feet below the water surface) for both the conservative and typical conditions. The maximum above ambient salinity is predicted to be 5.3 ppt under conservative conditions and 4.9 ppt under typical conditions.

Figure 7.5-1 shows that, under conservative conditions, the +1 ppt brine plume resulting from discharges at Richton could extend 3.7 miles from the center of the diffuser and remain approximately 0.5 mile from the Horn Island shoreline and about 1.4 miles from the Horn Island Pass channel entrance. In addition, each salinity contour of the predicted brine plume covers portions of the dredged material disposal areas offshore of Horn Island. The plume would be elongated in a northeast direction, the predominant direction of bottom currents in the area, but would not enter Mississippi Sound. Figure 7.5-2 shows that, under more typical conditions, the brine plume would remain about 1.4 miles from the Horn Island shoreline and about 2.2 miles from the Horn Island Pass Channel. DOE believes, however, that an actual plume would not likely travel as far toward shore as the two plumes predicted by the model. Because the model

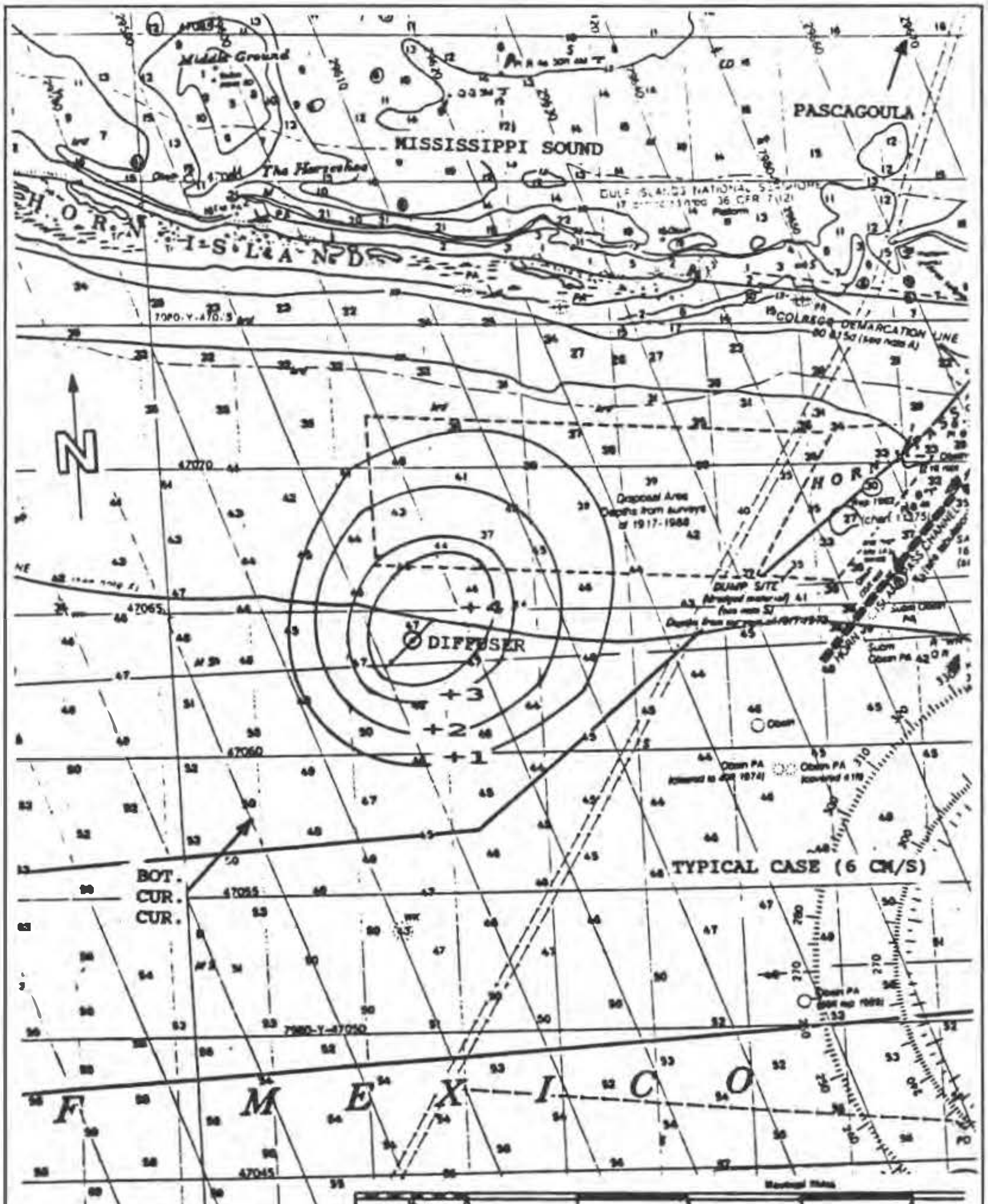
Figure 7.5-1
Predicted Areal Extent of Largest Brine Plume Contours for Proposed Richton Diffuser Site



Source: Created for this draft EIS by Robert E. Randall

The diffuser terminus would be located at 30° 10.40' N and 88°37.33' W.

Figure 7.5.2
Predicted Areal Extent of Typical Brine Plume Contours for Proposed Richton Diffuser Site



Source: Created for this draft EIS by Robert E. Randall

'The diffuser terminus would be located at 30°10.40' N and 88°37.33' W.

Table 7.5-1
Dimensions of Predicted Brine Plumes at Richton

Excess Salinity Contour (ppt)	Areal Extent (acres)	
	Largest	Typical
+5	1,400	--[a]
+4	3,200	1,300
+3	5,300	2,200
+2	10,300	4,300
+1	18,100	7,700

[a] The maximum above ambient salinity predicted under typical conditions is 4.9 ppt (i.e., less than +5).
Source: Randall, 1992 (Appendix Q).

conservatively assumes that the sea floor is flat, it does not account for the upward slope toward the Horn Island shoreline, which would tend to keep the plume further out to sea than predicted.

The largest and typical plume predictions likely overestimate the magnitude and extent of excess salinity levels because the predictions are based on relatively small bottom currents (0.03 m/s and 0.06 m/s, respectively). Bottom current data measured just offshore of Horn Island indicate that these current speeds occur 34 percent of the time. Greater bottom currents, between 0.08 m/s and 0.12 m/s occur 22 percent of the time. When the bottom currents are greater than the 0.03 m/s and 0.06 m/s assumed in this modeling analysis, the brine plume would be smaller than predicted.

Although possible biological impacts associated with the excess salinity plume have not been modeled, field monitoring results from other SPR sites (i.e., West Hackberry and Bryan Mound) that have discharged brine to the Gulf for several years provide strong evidence that the Richton brine discharges would cause only minor biological and ecological impacts (see Appendix I). Bottom dwelling creatures would be expected to be affected the most because their exposure to the brine plume, which tends to reside along the bottom, would be the greatest. On the other hand, low impacts to shrimp and fish would be expected because of the creatures' intrinsic dynamism and the fact that the maximum observed brine salinities would be below levels known to cause mortality or evoke avoidance responses in laboratory tests. The predicted salinity increases also would be relatively small compared to natural salinity fluctuations in the area (i.e., indigenous creatures are accustomed to wide salinity variations).

Based on field observations at the West Hackberry and Bryan Mound diffusers, the greatest impact to benthos at the Richton diffuser would be expected to be a depression in total abundance in an area from as little as 31 acres to as great as 2,000 acres around the diffuser. Experience shows, however, that an increase in diversity could accompany this decrease in abundance. While these changes to benthos could influence the feeding patterns of demersal fish and cause commercially important fish to shift to other areas to feed, no clear or catastrophic effects (e.g., sharp reductions in total biomass) on fish have been observed. Because of the similarities of the proposed brine discharge operations and Gulf characteristics among the different sites, these same conclusions would be valid for Richton.

These field observations are supported by the analysis in Appendix M, which evaluates available brine composition data to determine the potential for metals and other inorganic constituents in SPR brine to cause adverse impacts when discharged to the Gulf of Mexico. This analysis indicates that metals and other inorganics expected to be released along with SPR brine should not pose a significant environmental threat. Conservatively estimated concentrations of virtually every constituent near (within 123 acres of) the diffuser are below EPA criteria to protect marine organisms. Also, no critical or unique habitats or resources (e.g., oyster or seagrass beds) are known to exist at the Gulf bottom in the area of the proposed diffuser, and the seagrass beds on the north side of Horn Island should not be adversely affected because the brine plume would be expected to remain more than 0.5 mile south of the island and out of Mississippi Sound. Similarly, even under conservative conditions, the brine plume would remain at least 3.5 miles from the least tern nesting area in Horn Island Pass.

Another unique concern associated with the proposed brine discharges from Richton is the potential for the Richton brine to be contaminated with dioxin. As described in sections 5.5.3.2 and 7.5.3.2, the proposed raw water source for Richton, the Leaf River, has been contaminated by releases of dioxin from a paper mill four miles upstream at the town of New Augusta. A fraction of the dioxin withdrawn from the Leaf River during the leaching phase would be discharged to the Gulf of Mexico through the brine diffuser. The State Department of Environmental Quality, however, has never detected dioxin concentrations in the Leaf River above the State limit of $1x10^{-9}$ mg/l (which is one-tenth the federal ambient water quality criterion for dioxin).[102] Therefore, the release of dioxin from the brine diffuser would not be expected to significantly affect water quality or aquatic organisms in the Gulf. The dioxin levels in the brine would be below State criteria to begin with and would he further diluted by at least 37 times (as discussed in Appendix M) when released in the Gulf via the brine diffuser.

7.5.3.2 Impacts of Raw Water Intake

Raw water for development and operation of the Richton site would be supplied by a ten-mile, 48" pipeline from a RWI station on the Leaf River. The RWI station would be located on the north bank of the Leaf River approximately four miles east of New Augusta and approximately 450 feet downstream from Bogue Homo, a major tributary to the Leaf River. A detailed description of the Leaf River in the vicinity of the proposed raw water intake can be found in section 5.5.3.2. The following sections address the potential impacts of the proposed withdrawal on the Leaf River hydrology, water quality, and biota.

Potential Hydrological Impacts

Two categories of hydrological impacts would be a concern for the Richton RWI. The first includes the potential impacts to water depth and velocity, which have been addressed in previous sections for the other four candidate sites. The second includes potential impacts to water availability, which is not an issue and is not addressed for the other candidate sites.

Water Depth and Velocity. For the Richton site, far-field (at distances greater than 100 feet) impacts of a 100 cfs withdrawal were estimated over a range of Leaf River flow rates: the minimum flow required to meet maximum planned withdrawal (660 cfs); the eight-year average of minimum annual flow rates (720 cfs); the eight-year average of mean annual flow rates (3,869 cfs); and the eight-year average of maximum annual flow rates (30,100). Hydrologic impacts were estimated using the approach outlined in Appendix R and the results are summarized in Table 7.5-2.

As shown in this table, the vertical change in water depth caused by the proposed withdrawal would be very small for all of the Leaf River flow rates considered. The depth changes would range from a decrease of 0.06 inch per mile of river to 1.9 inches per mile of river. Vertical changes of these magnitudes are much smaller than natural water level variations - between December 1983 and August 1991, the maximum and minimum observed water levels differed by about 28 feet.[103] Any hydrological affects on the Leaf River would be experienced to a lesser extent by Bogue Homo, which flows into the Leaf River about 450 feet upriver from the proposed raw water intake structure.

Because of the identical RWI structure designs at the Richton and Big Hill sites, conclusions regarding the near-field (less than 100 feet) hydrological impacts of raw water withdrawals at Richton can be based on previous modeling studies and field monitoring data collected near the Big Hill site. These studies (see section 7.1.3.2) indicate that RWI would not significantly alter water depths or velocities within 100 feet.

Water Availability. The Richton site is the only candidate SPR site that would rely on a natural water body as a source of raw water. Raw water for the other candidate sites would be obtained from the ICW. The significance of this distinction is that flow, and possibly water supply for the Richton site, is less predictable.

The quantity of water that may be withdrawn from the Leaf River would be constrained by a State of Mississippi regulation administered by the Mississippi Department of Environmental Quality's Bureau of Land and Water Resources. The regulation defines a minimum threshold for withdrawal called the $7Q_{10}$, which represents a streamflow for which there is a 100 percent chance that every ten years there will be seven consecutive days below that flow. According to State regulations, water cannot be withdrawn if flow in the Leaf River falls below this $7Q_{10}$ value. Two sets of historical flow records have been studied to determine whether the Leaf River can be expected to consistently meet DOE's raw water requirements and State permit limits.

The first set of data was collected by the USGS between December 1983 and August 1991 at the New Augusta gaging station (02474560) on the Leaf River, four miles upstream of the proposed RWI structure. The minimum daily flow rate observed during this period was nine MMBD (580 cfs). The maximum planned withdrawal rate would be 1.15 MMBD (75 cfs), considerably less than the minimum observed Leaf River flow rate. Based on the data from New Augusta, the $7Q_{10}$ for the Leaf River in the vicinity of the proposed RWI structure is 580 cfs (about nine MMBD). Any flow in excess of this $7Q_{10}$ may be withdrawn, as long as the withdrawal does not exceed the maximum withdrawal rate requested in the permit. Therefore, the minimum Leaf River flow required to meet maximum planned withdrawal would be 10.15 MMBD (nine MMBD + 1.15 MMBD), or 660 cfs. The occurrence of flow rates below 660 cfs is expected to be infrequent based on the data collected from the New Augusta gaging station. Between December 1983 and September 1990, daily flows less than 660 cfs were observed only nine times, all during the months of June and July 1988. Therefore, the New Augusta data indicate that adequate flow rates for maximum withdrawal could be expected for 99.6 percent of

Table 7.5-2
Vertical Change Corresponding to a 100 cfs Withdrawal for a Range of Leaf River Flow Rates

Flow Conditions Without Withdrawal			Flow Conditions With 100 cfs Withdrawal			Vertical Change in Depth
Q_1	V_t	S_t	Q_2	V_2	S_2	(Inches per Mile)
660	0.38	3.62×10^{-6}	735	0.43	4.49×10^{-6}	0.06
720	0.42	4.31×10^{-6}	795	0.46	5.25×10^{-6}	0.06
3,869	2.24	1.24×10^{-4}	3,944	2.28	1.29×10^{-4}	0.3
30,100	17.4	7.53×10^{-3}	30,175	17.5	7.56×10^{-3}	1.9

Q = flow rate (cubic feet per second)
V = flow velocity (feet per second)
S = slope (feet per feet)

the days of withdrawal. If the Leaf River flow would fall below 660 cfs, withdrawal could be suspended or reduced in accordance with the $7Q_{10}$ regulation.[104]

Upon reviewing the results from these data from New Augusta, the Mississippi Department of Environmental Quality (DEQ) expressed concern that the seven-year period represented by the data is not statistically significant. Therefore, DEQ compiled another set of flow data for the period 1939 to 1991 from a gaging station downstream on the Leaf River at McLain, MS. At the same time, DEQ used long-term data available from two upstream stations, one located near Mahned on the Leaf River and the other located at Runnelstown on Tallahala Creek, to estimate a statistically significant $7Q_{10}$ of 503 cfs for the Leaf River at New Augusta. This DEQ analysis indicates that, during the 52-year period represented by the data, there have been seven different years, ranging between 1952 and 1968, in which flow in the Leaf River fell below the $7Q_{10}$ for at least one day. During these years, the number of days below the $7Q_{10}$ ranged from two to 56 days (i.e., flow above the $7Q_{10}$ was available 85 to 99.5 of the time). Over the entire 52-year period, there have been a total of 160 days in which the Leaf River flow has fallen below the $7Q_{10}$ (i.e., flow above the $7Q_{10}$ has been available 99.2 percent of the time). Overall, these DEQ results indicate that, in accordance with State regulations, flow in the Leaf River should be sufficient to permit withdrawal around 99 percent of the time, although there may be a dry year in which withdrawals would not be permitted for as much as 15 percent of the time. Such a dry period has not occurred since 1968, but if it were to occur again in the future, the DEQ data suggest that it would most likely occur in the fall.[105]

This variability in the Leaf River flow would not significantly affect the potential for the proposed RWI structure at Richton to impact the environment directly. However, these results do indicate that the Leaf River in this area would not be a 100 percent available supply source.

The raw water withdrawals of Richton, therefore, could limit the availability of water for other competing demands.

Potential Water Quality Impacts

The proposed raw water withdrawal would not be expected to affect the Leaf River water quality. Except under extreme low flow conditions (when withdrawal would not likely be permitted by State regulations), the amount of water that would be removed would be only a small fraction of the water available. As a result, the withdrawals would not significantly affect the Leaf River's dilution or assimilative capacity. In addition, unlike the other candidate SPR sites that would withdraw water from the ICW near the coast, the potential for the Richton RWI to alter the local salinity regime would not be a concern because all of the waters in the immediate area are fresh.

Water quality monitoring in the Leaf River by the Mississippi DEQ shows that criteria for pesticides, nutrients, pH, and siltation are occasionally exceeded, causing the river to partially meet suitability criteria for fishing and the propagation of fish and aquatic wildlife. However, DEQ has issued a commercial fishing ban and a fish consumption advisory for bottom-feeding fish in a 15.2 mile segment of the river beginning four miles upriver from the proposed RWI. The cause of the ban and advisory is dioxin contamination originating from a paper mill at the town of New Augusta.[106] Although the RWI could conceivably reduce the downstream migration of dioxin by removing contaminated water, suspended sediment, and small organisms, most of the dioxin would remain in the river because the volume of the withdrawal would be a small percentage of the Leaf River flow (this effect would be more significant during periods of low flow). Furthermore, the majority of the dioxin would remain in the river in deposited sediments and the tissue of organisms too large to be entrained by the raw water intake.

Potential Direct Impacts to Biota

Although the RWI structure would include design features that reduce impacts to biota (i.e., trashbars and traveling screens with a 0.5-inch mesh), some impacts would be unavoidable. The most important impact of raw water withdrawal on the biota of the Leaf River would be the entrainment or impingement of small organisms (e.g., zooplankton, phytoplankton, aquatic insects, small crustaceans, and larval fish and amphibians). Such organisms small enough to pass through the 0.5-incb mesh screens would be killed. Slightly larger organisms could become impinged on the screens, and although they would be returned to the Leaf River hourly by station personnel, some mortality or injury would be expected. Large fish, mammals, and other large animals would be excluded from the RWI structure by trashbars, and likely would be able to out-swim the anticipated intake velocity of 0.5 feet per second.[107]

7.5.3.3 Construction Impacts

If Richton is selected, there would be four major construction efforts that could result in water quality and aquatic ecology impacts: (1) construction of the on-site facilities; (2) construction of the raw water pipeline and intake structure; (3) construction of the crude oil and brine disposal pipelines; and (4) construction of a crude oil storage terminal in Pascagoula. Potential impacts associated with each of these construction efforts are described in separate sections below.

Impacts Associated With On-site Construction

Construction activities at the proposed Richton site would likely result in the erosion of 10,800 tons of soil from the site (Appendix O). Conservatively assuming that none of this eroded soil is contained, site maps and drainage patterns indicate that about 690 tons of this soil could migrate into Bogue Homo via Harpers Branch and Linda Creek. The remainder would be likely to either settle in the beds of Harpers Branch or Linda Creek before reaching Bogue Homo, or get deposited along the intermittent creek beds of Fox Branch and Pine Branch before reaching Thompson Creek approximately five miles from the construction site.

As detailed in Appendix O, conservative calculations indicate that construction-enhanced erosion would increase the suspended solids concentration in Bogue Homo by about 2 ppm. This increased concentration would be reached ten hours after the start of construction and could remain during the rest of the clearing and grubbing phase of the construction period (179.5 days), conservatively assuming rain starts at the same time the construction does and continues for 180 days. The suspended solids concentration in Bogue Homo then would be expected to return to pre-construction levels in about seven hours after clearing and grubbing is completed and the site is revegetated or covered.

This minor increase in suspended solids would not be expected to cause significant adverse impacts in the affected area of Bogue Homo. Within the water column, the very small and temporary increase in suspended solids would be unlikely to interfere with the recreational and aesthetic values of Bogue Homo, significantly impede light penetration and reduce primary production, result in toxicological effects to fish, significantly alter the natural movements and migrations of fish, or prevent the successful development of fish eggs and larvae. Settleable solids that blanket the bottom of Bogue Homo may damage resident invertebrate populations, alter benthic organism density and diversity, and block any spawning beds that exist in affected areas. These adverse effects, however, would be expected to be temporary and limited to the areas near the vicinity of the outfalls of Harpers Branch and Linda Creek. The resulting bottom of Bogue Homo in these affected areas would be expected to quickly recolonize to pre-construction conditions.

Impacts Associated With Construction of the Raw Water Intake System

The RWI pipeline would cross no permanent water bodies over its route to the Leaf River to the south of the site. Construction of this pipeline also would not affect surrounding drainage patterns, because the pipeline trench would be backfilled and returned to the pre-construction topography. Therefore, construction of the raw water pipeline is not expected to directly affect water quality, hydrology, or aquatic organisms around the site.

Construction of the RWI structure at the Leaf River would cause the same kinds of impacts described in section 7.2.3.3 for the construction of the RWI structure at Stratton Ridge. Specifically, in a small area on the north bank of the Leaf River, benthic organisms and habitat would be destroyed by dredging, sediments would be suspended in the water column causing increases in turbidity and possibly contaminant concentrations (e.g., the sediments in this area may be contaminated by dioxin released from a paper mill four miles upstream at the town of New Augusta), and fish and other mobile organisms would likely avoid the area. Except for the small area permanently occupied by the intake structure, however, these impacts would only be temporary. No critical or unique habitats or resources are known to exist in the affected areas.

Using the Big Hill RWI structure as a model, approximately 8,600 cubic yards of dredge spoil would be deposited in an uplands area designated and permitted by the Corps of Engineers. The deposition of this spoil would kill the vegetation in the affected area, but it should not present a significant threat to surface water quality or aquatic organisms.

Impacts Associated With Crude Oil and Brine Pipeline Construction

As described in section 5.5.3, the proposed crude oil pipeline to the Liberty Station would cross 23 water bodies, of which Bogue Homo, the Leaf River, and the Pearl River are the most substantial. The crude oil pipeline to Ten-Mile, Alabama would cross 25 water bodies, including Thompson Creek, Big Creek, and the Escatawpa River. The dual-purpose brine and oil pipeline to Pascagoula would cross 24 inland water bodies, including Thompson Creek, the Chickasawhay River, and the Escatawpa River, before entering Mississippi Sound and continuing out to the Gulf of Mexico south of Horn Island. A spur from this pipeline would cross Bayou Casotte to tie into the state's proposed new docks on Greenwood Island. Finally, a blanket oil (and later injection well) pipeline would cross eight water bodies, of which Bogue Homo is by far the most substantial.

Almost all of the inland waterways that would be crossed by these pipelines are relatively small, generally less than 50 feet wide and four feet deep. These relatively small waterways would be crossed by digging a trench in the bottom sediments with a barge- or bank-mounted dragline. Original material excavated from the streambed would be used for backfill, while excess excavated material would be deposited on upland areas authorized by a permit. Water quality impacts from this type of construction may include increased turbidity levels, increased concentrations of suspended nutrients, reduced dissolved oxygen levels, and, depending on the composition of bottom sediments, increased levels of metals and organic contaminants. Organisms that live in the water may, in turn, experience toxicological and behavioral effects. Benthic organisms and habitat directly within and adjacent to the pipeline corridor also would be unavoidably destroyed. All of these impacts, however, would be expected to be temporary and confined to areas close to the pipeline ROW as described in the pipeline construction sections for the other candidate sites.

The larger waterways that would be crossed, including the waters named in the first paragraph of this section, would be crossed using directional drilling. This construction method is substantially less damaging, as the pipeline would be pulled through a hole drilled underneath each water body rather than laid in a trench dug in the bottom sediments. Pipeline construction impacts to these waters would likely be very minor and limited to potentially enhanced erosion along the stream banks where drill rigs would be operated.

In the offshore areas in Mississippi Sound and the Gulf of Mexico, the brine discharge pipeline would be constructed with a jet sled. After first assembling the pipeline on a lay barge and lowering it into position on the bottom, hydraulic jets on the dredging sled would displace the bottom material around the pipe. The resulting suspended bottom material would either be allowed to dissipate in the water or be collected and disposed in a spoils area. As a result of this dredging, sediments and associated contaminants would become resuspended in the water, temporarily affecting water quality in the area. While there could be some associated toxicological and behavioral effects among free swimming organisms, most of these organisms would likely avoid the area and experience minimal impacts. Bottom habitat and organisms living directly in or near the proposed offshore ROW would be destroyed, either by the physical dredging process or by being smothered by settling solids. These impacts, however, also would be expected to be temporary and confined to areas close to the ROW, as benthic habitat is likely to be quickly restored and colonized naturally after construction. No particularly sensitive bottom habitats (e.g., oyster beds or seagrass beds) are known to exist in the proposed pipeline ROW or diffuser area.

Impacts Associated with Pascagoula Terminal Construction

As outlined in Appendix O, conservative calculations indicate that roughly 2,030 tons of soil would be eroded in a southeastern direction from the proposed Pascagoula Terminal site during the construction phase. The nearest surface water body in this direction is Bangs Lake, which is located about one mile away. Site-specific topographic maps indicated that the area between the construction site and Bangs Lake is very flat with a slope of less than 0.15 percent. Moreover, there are wetlands immediately to the east of the construction site and a drainage ditch that surrounds the south and east sides of the airport, which separates the airport wetlands from the wetlands associated with Bangs Lake farther to the southeast. Therefore, most of the soil lost from the construction site is likely to be deposited in the drainage ditch, airport wetlands, and other areas between the site and Bangs Lake. It is very unlikely that significant quantities of sediment-laden runoff associated with site construction would reach Bangs Lake or any other permanent water body directly.

7.5.3.4 Oil and Brine Spill Impacts

Given the plans being considered for handling Richton's brine and oil, the waters that would be at risk from contamination from a brine or oil spill include:

- The open ocean crossed by oil tankers;
- Waters adjacent to the Richton site;
- Waters adjacent to off-site oil storage or handling locations, such as the Liberty storage facility, the St. James Terminal, the oil storage tanks at Ten-Mile, the docks at Mobile, and the docks and the terminal at Pascagoula; and
- Waters that would be crossed by pipelines to Liberty, St. James, Ten-Mile, and Pascagoula.

Key characteristics of these waters are summarized in Chapter 5. The potential impacts of brine and oil spills to these waters are described below, with separate sections devoted to ocean spills and spills to coastal and inland water bodies.

Ocean Spills

Oil spills to the open ocean could occur only from tankers transporting oil to or from the proposed docks in St. James, Pascagoula, and Mobile. Based on historic SPR spill rates, up to 0.6 spills to the ocean are expected to result during fill or distribution associated with Richton (see section 6.1). If a spill does occur, it would cause local impacts to marine organisms. The impacts of ocean spills are relatively minor due to the large assimilative capacity of the ocean and distance from vulnerable coastal habitats. The effects on larger organisms (birds, fish, and mammals) that are able to avoid the oil would generally not be lethal, although there would be some mortality among larger organisms that became entrained in the oil. Smaller organisms, especially planktonic organisms and epipelagic fish eggs, coming in contact with spilled oil also would be susceptible to lethal effects. These effects, however, would be temporary and only locally significant because the planktonic communities of the ocean are widespread and regenerate quickly. Based on this analysis, the impacts of ocean spills on populations of aquatic species resulting from the proposed development of Richton are not likely to occur, but even if they did, the resulting impacts are expected to be temporary and only locally significant.

Because brine would only be handled in coastal and inland areas (i.e., it would not be transported by tanker in the open ocean), there is no potential for the proposed Richton operations to result in an uncontrolled brine spill in the open ocean. The purposeful release of brine via the diffuser in the Gulf of Mexico is described in section 7.5.3.1 and potential impacts associated with a brine pipeline leak shoreward of the diffuser are described in the following section.

Coastal or Inland Spills

The potential impacts of oil spills and brine spills are addressed separately below.

Oil Spills. Coastal or inland spills of oil could occur during either fill or drawdown stages of the Richton site. In general, such spills associated with Richton operations would likely be infrequent and small, based on historical spill statistics and proposed spill containment and control plans. As outlined in section 6.1, development of the Richton site would be expected to result in 4.3 oil spills at the site itself, as many as 5.3 spills from transfer operations at tanker docks, and as many as 2.7 oil spills from bulk storage operations at terminals. Containment systems at these sites would be designed to prevent the off-site migration of oil in the event of an on-site spill, and historical spill statistics indicate that there would be on average less than one oil spill during fill or drawdown from off-site pipelines associated with Richton. Therefore, while a small number of oil spills associated with Richton development would likely occur, these spills are expected to be contained and prevented from causing significant impacts in surrounding waters. If a spill was allowed to enter off-site waters, however, it could cause significant adverse water quality and aquatic ecological effects depending on when and where the spill occurred (as described in detail in section 7.1.3.4).

Brine Spills. Brine spills could result from pipeline ruptures or from equipment failure at the Richton site or anywhere along the route of the proposed brine pipeline. Historical spill statistics indicate that the proposed operations at Richton could result in up to nine small brine spills per year (of about 75 barrels) and two large spills of 74,000 barrels or more (see section 6.2). If such a large brine spill did occur at the Richton site or along the brine pipeline route, the impacts could be similar to those observed in 1989 following a leak at the Bryan Mound site. These impacts have been described in section 7.1.3.4. The experience at Bryan Mound indicates that a large release of brine could result in significant adverse effects to the wetlands and water bodies crossed by the Richton brine pipeline. The severity of the impacts would depend on the volume and rate of the spill and on the volume of freshwater flushing in the affected water body. Therefore, relatively large waters, such as Thompson Creek, the Chickasawhay River, the Escatawpa River, and Mississippi Sound would likely experience short-term increases in salinity in areas near the point of release, resulting in distributional shifts in mobile organisms and lethal effects to the most exposed organisms. Water quality and aquatic communities, however, would be expected to return to normal shortly after the spill in these large water bodies. More significant and longer-term impacts could occur in smaller waters that are not regularly flushed.

7.5.4 Air Quality Impacts

Air quality impacts for the Richton site would be expected to be similar to those predicted for Weeks Island in section 7.3.4, except that emissions would occur from tanks and terminals associated with Richton, e.g., at Liberty and/or at Pascagoula. The terminal construction alternative at Pascagoula would produce the greatest impacts on air quality; the impacts from the terminal would be similar to those predicted for St. James (see section 7.6.4.) The principal pollutant of concern at the terminal would be volatile hydrocarbons during the fill, drawdown, and distribution phases of SPR operations. Other emissions (particulates, sulfur dioxide, carbon monoxide, and nitrogen oxides) would occur chiefly during site construction and would cause only short-term effects over a small area.

The volatile hydrocarbon emissions estimated below for the Pascagoula Terminal would include releases from tanks, pump seals, valves, and flanges. Tanker emissions are not included in the calculations for volatile hydrocarbon emissions because the docks which would be used are commercially-owned. In addition, sufficient information to estimate emissions from associated operations (e.g. lab hoods, motor vehicles, solvent baths) was not available although these are assumed to be minor.

Methods similar to those presented in Appendix S were used to calculate projected air emissions for the Pascagoula Terminal. Although the same equations were used, some adjustments were made to correct for site-specific differences. For example, the number of tanks which would be active during fill and drawdown was assumed to be five 400,000-barrel tanks.

A summary of the hydrocarbon emissions from the Pascagoula Terminal is shown in Table 7.5-3. These emissions are estimated for three different activity scenarios at the terminal: standby, drawdown, and fill. Of the three activity scenarios, drawdown would be the most significant potential time period for hydrocarbon emissions. Fill would be expected to occur at a maximum average rate of 50,000 barrels per day over a period of eight years. The annual emission rates would be for a single calendar year during fill operations. Drawdown assumes a 180-day cycle, but is presented on an annualized basis. Both fill and drawdown would be projected to occur a maximum of five times over the life of the project. Emissions during standby would be negligible because of the minimal maintenance and operational activities at the terminal.

The emission estimates in Table 7.5-3 are based on emission factors for total hydrocarbons. Reactive hydrocarbons may be determined by identifying specific classes of hydrocarbon species. The speciation of hydrocarbons at the Pascagoula Terminal is assumed to be the same as for the St. James Terminal in Table 7.6-2.

While the emission levels would be low when compared with those calculated for the St. James Terminal, tanker emissions were not included for Pascagoula. However, tanker emissions from commercial and state-owned docks during loading/unloading would presumably be similar to those for similar operations at St. James, and therefore the overall impacts to air quality would be short term.

Table 7.5-3
Emissions of Total Hydrocarbons from the Pascagoula Terminal During Different Project Phases

	Standby		Drawdown		Fill	
SOURCE	**lb/hr**	**tons/year**	**lb/hr**	**tons/year**	**lb/hr**	**tons/year**
Tanks (5-0.4 MMB)	0.40	1.77	31.02	5.00	41.00	9.287
Pump Seals	0.37	1.61	0.37	1.61	0.37	1.61
Valves	0.23	1.02	0.23	1.02	0.23	1.02
Flanges	0.54	2.35	0.54	2.35	0.54	2.35
TOTAL	**1.54**	**6.75**	**32.16**	**9.98**	**42.14**	**14.25**

7.5.5 Potential Impacts to Terrestrial Ecology and Wetlands

Potential terrestrial ecology and wetlands impacts from construction and maintenance of the proposed Richton site and pipelines are discussed below. Many of the potential impacts associated with general construction and maintenance activities are similar to those discussed for Big Hill in section 7.1.5, however, in this section site-specific considerations for Richton are discussed.

7.5.5.1 Potential Impacts at and Nearby the Site

Development of a 160-MMB site at Richton would require approximately 300 acres of land. Impacts to terrestrial ecology from site construction, operation, and maintenance are discussed below.

Site Construction

As part of the construction of the proposed site, vegetation within the site boundary would be partly or completely cleared to accommodate construction activities as well as for security reasons. Based on a site visit and other documentation, the site is predominately forested with second or third growth stands of slash pine and other southern yellow pines (e.g., long-leaf and loblolly pines).

Wetlands at the site were identified based on a NWI map and then verified during a site visit. Based on these sources, approximately 30 acres, or ten percent of the site is wetlands, which include palustrine forested broad-leaved deciduous and needle-leaved evergreen wetlands, associated with three intermittent streams or drainages. Additionally, a palustrine forested (deciduous) and emergent wetland roughly 400 feet across is located in the middle of the southern portion of the site. This is believed to drain into Pine Branch southeast of the site. Some of the wetlands at the site could sustain aquatic communities. These wetlands and any aquatic life inhabiting them could be impacted by increased sedimentation as a result of erosion during construction. The largest palustrine forested wetland along the eastern portion of the site, and the large emergent wetland in the south-central portion of the site, extend into the middle of the site, and, therefore, it is likely that some portion of wetland would be impacted and possibly destroyed as a result of site construction. Some of the smaller wetlands associated with intermittent streams are located near the perimeter of the site and it would be likely that impacts to them could be avoided. Impacts to wetlands could range from negligible to severe depending upon the extent of clearing, the amount of grading, and the types of practices implemented to minimize erosion and sedimentation. These are discussed in Chapter 8.

Construction impacts on the plant communities surrounding the site would likely be minimal. No threatened or endangered plants are known to occur at the proposed site, although a site-specific endangered species survey would be conducted prior to beginning any site preparation work. Based on soil erosion calculations presented in Appendix O, an estimated 10,800 tons of soil could be eroded from the site during construction. Approximately 6,300 tons could be transported towards the northwest and west and 4,500 tons could be transported to the northeast and east. Given that wetlands are areas of topographic lows, it is likely that the majority of eroded soil would be deposited in the forested wetlands associated with intermittent drainages in the areas, and a small portion would reach the larger water bodies of Bogue Homo and Thompson Creek. Given the large area over which this deposition would occur, permanent impacts to wetlands would be unlikely. The primary impact would be deposition of sediment around wetland vegetation, with possible smothering of some of the less robust vegetation. This impact would probably be temporary, with no adverse impacts to wetlands as a whole.

Potential impacts associated with clearing and construction would be similar to those discussed for Big Hill in section 7.1.5.1: destruction or alteration of vegetation on-site, displacement of wildlife, destruction of individuals of smaller wildlife species, and disruption of habitat due to increased traffic and human activity. These impacts would be expected to be minimal.

Site Operation and Maintenance

Operations at the site and associated potential impacts would be similar to those discussed for Big Hill and would likely be negligible. The site would be securely fenced for the lifetime of the program, and therefore access of many species of wildlife would be restricted. The vegetated areas of the property would be mowed frequently, and would be of little value as wildlife habitat.

The potential exists for impacts to wildlife from leaks or spills from the on-site pipelines, above ground holding tanks, and brine ponds. The severity of impacts would be determined largely by the severity of the spill. Spills from the raw water pipelines would have minimal impacts on local wildlife. Oil spills or brine spills could adversely affect the habitat and wildlife in the immediate vicinity of the spill. Such spills could result in immediate loss of vegetation as well as possible long-term impacts during recovery. They also could impact nearby aquatic habitats such as Pine Branch and wetlands at or near the site.

7.5.5.2 Potential Impacts due to Pipeline Construction and Maintenance

For either a 270-day or 180-day drawdown criterion, an RWI pipeline to the Leaf River and a dual-purpose pipeline to Pascagoula would be required. There are two other major proposed pipelines, the Liberty route or the Mobile route, in addition to several short pipeline spurs in the Pascagoula area that are proposed under the various alternatives for crude oil distribution. Further, a dual-purpose pipeline (blanket oil and/or brine injection) would be constructed to the Hess 14" pipeline.

RWI Pipeline Construction

A ten-mile pipeline would proceed south from the site to the RWI structure on the Leaf River. The acreage of wetlands affected by this ROW are listed in Table 7.5-4. Of the 161 acres of land crossed by the RWI pipeline, 17 acres are wetlands. Of the 17 acres of wetlands, 14 (82 percent) are open water palustrine; about one acre of emergent palustrine, forested palustrine, and lower perennial riverine wetlands would also be crossed. The rest of the acreage crossed (144 acres) is primarily upland forest. Potential impacts would include the destruction of vegetation and altered surface water drainage patterns. During pipeline construction disruption of the surrounding wetlands would be minimized, and efforts would be made to restore the soil over the pipelines so as to prevent alteration of surface topography and surface water flow. These preventive and mitigative measures are discussed in Chapter 8. The pipeline ROW would be allowed to revegetate naturally, and it is possible that species composition could differ from that prior to construction.

No endangered species are known to occur along this pipeline ROW.

Pipeline to Brine Injection Field and Hess 10-inch Oil Pipeline Connection Construction

The 13.6-mile pipeline from the site to the brine injection field (and 15 brine injection wells), and to the connection with the Hess 10-inch oil pipeline at 10.6 miles, would proceed west from the site for a few miles, and then northwest, all within Perry County and Jones County. NWI maps were not available for the quadrangles crossed by the pipeline (Barrontown MS, and Ovett MS). USGS 7.5 minute topographic maps of these quadrangles were examined for potential wetlands. Based on this examination, no symbols for wetlands were found within the ROW of the pipeline, although the pipeline would cross numerous small tributaries, Tallahalla Creek, and the Bogue Homo River. These crossings were evaluated as wetlands, and the total acreage of wetlands affected by this ROW was estimated to be approximately four; the pipeline crosses an estimated 190 acres of uplands. Using these topographic maps has probably resulted in a slight underestimation of wetlands affected along the pipeline route because it is likely that there are wetlands on either side of the Bogue Homo, and possibly associated with the small tributaries as well. Potential impacts would be the same as those discussed above for the RWI pipeline. The pipeline would not cross any wildlife refuges, national or state parks, or other similar areas of ecological concern. Saltwater intrusion into freshwater wetlands would be unlikely because the pipeline would cross only freshwater water bodies. Endangered species of concern include the gopher tortoise, a species which prefers dry, sandy upland areas, and indigo and black pine snakes, both of which utilize gopher tortoise burrows for shelter (Appendix D).

Table 7.5-4
Types and Acreage of Wetlands Crossed by the Proposed Raw Water Intake Pipeline

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. PALUSTRINE WETLANDS – TOTAL	16	94	10
A. Emergent	1	6	<1
B. Forested	<1	6	<1
C. Open water	14	82	9
II. RIVERINE WETLANDS – TOTAL All riverine wetlands for this ROW are lower perennial	<1	6	<1
III. NON-WETLANDS – TOTAL	144	–	89
WETLANDS – TOTAL ACREAGE	17	100	11
TOTAL ACREAGE	161	–	100

Source: Based on National Wetlands Inventory Maps. Acreages assume a 150-foot ROW.

Dual-Purpose Pipeline Construction

After branching east from the ROW shared with the raw water pipeline, the dual-purpose pipeline would proceed east and then south for approximately 76 additional miles towards Pascagoula. The types and acreages of wetlands that would be affected by this ROW are presented in Table 7.5-5. This pipeline would cross a total of 1,256 acres of land, 353 acres (28 percent) of which are wetlands. Of the wetlands, two hundred and nine acres (59 percent) are palustrine forested wetlands. Other wetlands potentially affected are estuarine (subtidal and intertidal) and lacustrine (limnetic) wetlands. NWI maps were not available for two quadrangles crossed by the pipeline (Neely, MS and Leaksville, MS). USGS 7.5 minute topographic maps of these two quadrangles were examined for potential wetlands. Based on this examination an additional four acres of wetlands that could be impacted were identified. Estimation from the topographic maps may have resulted in an underestimation of wetlands acreages affected along this pipeline route. Potential impacts would be the same as those discussed above for the RWI pipeline. The pipeline would cross the Escatawpa River, which is an estuarine water body. Wetlands on either side of it are designated as freshwater palustrine wetlands and therefore an additional potential impact would be that of saltwater intrusion into freshwater wetlands. This would potentially impact a small portion of freshwater wetlands adjacent to the river in the vicinity of the pipeline crossing.

The Mississippi Department of Wildlife, Fisheries, and Parks' Natural Heritage Program[108] has identified areas of concern crossed by the pipelines. The dual-purpose pipeline would cross the Leaf and Chickasawhay Rivers, which are areas utilized by the State endangered and Federal threatened yellow-blotched sawback turtle. The gopher tortoise, also a State

Table 7.5-5
Types and Acreage of Wetlands Crossed by the Proposed Dual-Purpose Pipeline

	Acres (to nearest whole acre)	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE WETLANDS -- TOTAL	38	11	3
A. Subtidal	4	1	<1
B. Intertidal	34	10	3
II. LACUSTRINE WETLANDS -- TOTAL All lacustrine wetlands for this ROW are limnetic	23	6	2
III. PALUSTRINE WETLANDS -- TOTAL	288	82	23
A. Aquatic bed	1	<1	<1
B. Emergent	35	10	3
C. Forested	209	59	17
D. Scrub Shrub	39	11	3
E. Open Water	4	1	<1
IV. UNCLASSIFIED WETLANDS	4	1	<1
V. NON-WETLANDS -- TOTAL	903	--	72
WETLANDS -- TOTAL ACREAGE	353	100	28
TOTAL ACREAGE*	1,256	--	100

Source: Based on National Wetlands Inventory Maps. Two USGS 7.5 minute topographic maps were used in place of wetlands maps for this assessment. Acreages assume a 150-foot ROW.

*Note Total acreage does not include portions of the proposed pipeline that cross bays, or land that could not be classified as wetlands and uplands.

endangered and Federal threatened species, is reported to occur along the pipeline near Merrill (George County). Four other species of concern that occur along the pipeline are myrtle holly, Chapman's butterwort, climbing fetter-bush, and narrow-leaf Barbara's button. The area from the Chevron Refinery north to Basin, Mississippi (Jackson County) is considered to be a region of significant wetlands, including pitcher plant flats, swamps, and bayheads, all of which provide habitat for numerous rare, threatened, or endangered plant and animal species. The pipeline would skirt east of the wetlands associated with the Pascagoula River, but it would cross through areas in Jackson County which are designated as the Pascagoula River Wildlife Management Area, and could affect an area referred to as Pascagoula River Bluffs, which is designated by the State as a unique plant association.[109]

Crude Oil Pipeline Construction

There are two other major crude oil pipelines proposed under various distribution options for Richton. One is a 118-mile pipeline to Liberty and the other is a 70-mile pipeline to Hess Ten-Mile Station. The potential impacts from pipeline construction along these routes are discussed below.

Pipeline to Liberty. The crude oil pipeline to Liberty would proceed south and then west approximately 118 miles. Table 7.5-6 shows the acreage of wetlands that would be crossed by the crude oil pipeline. Wetland maps were not available for this route, and therefore, the wetland acreage was estimated using soil surveys and hydric soils lists for each county through which the pipeline would cross (hydric soils are one of three criteria used to determine the presence of a wetland, and therefore, may provide a reasonable estimate of wetlands crossed). The acreage estimates were obtained by measuring the distance of pipeline that crosses hydric soils, and converting area using an assumed 150-foot ROW. As can be seen in this table, the pipeline would cross a total of 2,140 acres of land, 178 (eight percent) of which are likely to be wetlands. A soil survey was not available for Perry County; based on topographic features on a USGS 7.5 minute quadrangle map, it appears that roughly four-tenths of a mile, or about 7 acres of wetland could be affected by pipeline construction along this portion. As with the other pipelines for the Richton site, the primary wetland type affected would likely be palustrine forested wetland. Potential impacts would be the same as those discussed for the RWI pipeline. Saltwater intrusion into freshwater wetlands would be unlikely because the pipeline would be located far inland (north) of any saltwater bodies.

The crude oil pipeline to Liberty could potentially impact 15 endangered or threatened species reported to be found in the counties through which the pipeline would cross (Appendix D). In particular, the pipeline crossing of the Pearl River would be of concern due to the presence of the ringed sawback turtle. This pipeline would also cross Percy Quin State Park, just north of Lake Tangipahoa. It would not cross any other areas identified as areas of ecological interest.

Pipeline to Ten-Mile Station. The other major crude oil pipeline considered under various distribution options would be a pipeline to Ten-Mile Station near Mobile, Alabama. This pipeline would share the same ROW as the dual-purpose pipeline south for approximately 42 miles, and then would branch off east towards Mobile. Table 7.5-7 shows the acreage and types of wetlands that would be crossed by this crude oil pipeline. The acreage estimates were obtained assuming that for the 42 miles of ROW that would be shared with the Pascagoula pipeline, an additional 20 feet in width would be necessary. For the remaining 28 miles to Ten-Mile Station, a 150-foot ROW was assumed. As shown in Table 7.5-6, the pipeline would cross a total of 573 acres of land, 88 (15 percent) of which are wetlands. Again, the primary wetland type affected would be palustrine forested wetlands, which comprise 48 acres (55 percent) of the wetlands. Palustrine emergent wetlands would comprise an additional 29 acres (33 percent) of the wetlands crossed. Other wetland types potentially impacted would be palustrine scrub-shrub (6 acres), palustrine open water or unconsolidated bottom (2 acres), and small (<1 acre) portions of lacustrine, riverine, and unidentified wetlands. Potential impacts would be the same as those discussed for the RWI pipeline. Saltwater intrusion into freshwater wetlands would be unlikely because the proposed pipeline would cross only freshwater wetlands and water bodies. No areas of ecological concern were identified by any Mississippi or Alabama state agencies. The use of this pipeline would also require construction of a pump at the point where the pipeline branches

Table 7.5-6
Estimated Acreage of Wetlands Crossed by the Proposed Crude Oil Pipeline to Liberty

County	Total Acres in this County Crossed by Pipeline[b]	Acres of Wetland (based solely on hydric soil) Crossed by Pipeline[c]
Amite	252	1
Pike	418	34
Walthall	256	6
Marion	430	57
Lamar	336	40
Forrest	230	33
Perry[a]	218	7
TOTAL	2,140	178

[a] A soil survey for Perry County is not available; acreage estimate is based on topographic map.
[b] Acreage calculated by multiplying pipeline length by 150 feet, the assumed width of the pipeline ROW.
[c] In the absence of wetland maps, wetland acreage was estimated using soil surveys and hydric soil lists for each county.

off away from the brine/crude oil line to Pascagoula and crosses east toward Mobile. This pump would be constructed on approximately five acres of upland area. Palustrine forested wetlands are located to the north of the proposed site; impacts to these would likely be minimal.

Pipelines Associated with the Pascagoula Terminal. Selection of an alternative that requires a Pascagoula Terminal would also necessitate construction of several connective pipelines within the Pascagoula area that would attach to or run parallel to the dual-purpose 42" brine/crude oil pipeline. The types and acreage of wetlands that would be affected by these ROWs (and expansions of the 150-foot ROW established for the 42" crude oil/brine pipeline) are presented in Table 7.5-8. These ROWs or expansions of the established dual-purpose ROW will cross a total of 63 acres of land, 45 acres (71 percent) of which are wetlands. Twenty-one acres (47 percent) of the wetlands are palustrine and characterized by emergent vegetation, and 15 acres (33 percent) are palustrine and forested. Other wetlands potentially affected are estuarine intertidal (4 acres), and palustrine scrub/shrub wetlands (5 acres). Potential impacts would be the same as those discussed for the RWI pipeline. The 42" oil pipeline from the meter at Greenwood Island crosses the Bayou Casotte Channel, an estuarine water body. Wetlands on the eastern side of this crossing are designated as an impounded area of palustrine emergent wetlands, which are freshwater wetlands. Therefore, an additional potential impact would be that of saltwater intrusion into freshwater wetlands (the fact that these wetlands are identified as existing within an impounded area suggest that the integrity of these wetlands may have been negatively impacted by past activities in the Pascagoula area). Past developments in the Pascagoula area have resulted

Table 7.5-7
Types and Acreage of Wetlands Crossed by the Proposed Crude Oil Pipeline to Mobile

	Acres (to nearest whole acre)[a]	% of Wetland Total (to nearest %)	% of Total
I. PALUSTRINE WETLANDS – TOTAL	85	96	15
A. Forested	4	55	8
B. Scrub-shrub	6	6	1
C. Emergent	29	33	5
D. Open water or unconsolidated bottom	2	2	<1
II. LACUSTRINE WETLANDS – TOTAL	<1	1	<1
III. RIVERINE WETLANDS – TOTAL	<1	1	<1
IV. UNIDENTIFIED WETLANDS – TOTAL	<1	2	<1
V. NON-WETLANDS – TOTAL	485	–	85
WETLANDS – TOTAL ACREAGE	88	100	15
TOTAL ACREAGE	573	–	100

Source: Based on National Wetlands Inventory Maps.

[a] Acreage was calculated by multiplying distance crossed by pipeline by the assumed width of the pipeline ROW. For the portion of pipeline from Richton to the Hess 14" pipeline, the pipeline would share the Pascagoula ROW; an additional 20 feet of ROW would be required. From Hess 14" pipeline to Mobile, a 150-foot ROW would be required.

in substantial wetland losses. In the Special Management Plan for the Port of Pascagoula, the Mississippi Coastal Program Special Management Task Force has noted the ecological importance of the wetlands in the Pascagoula port area (see section 5.5.5.2) and declared it "imperative that the remaining systems be protected and, in cases where losses are unavoidable, that these losses be mitigated."[110]

The 150-foot ROW for the 42" oil pipeline that crosses east from a meter located on the southern end of Greenwood Island crosses first a four-acre section of estuarine intertidal wetlands, then five acres of the Bayou Casotte Channel, a 12-acre impounded area that supports palustrine wetlands, and finally developed upland areas before connecting to the dual-purpose pipeline at a point just south of the boundary of the Chevron Refinery. Two short spurs of 30" oil pipeline would be built from meter stations west of the refinery; these would attach to a 42" oil pipeline that would be built parallel to the 42" brine/crude oil pipeline as it runs along the western boundary of the Chevron Refinery. Of these pipeline sections, the 150-foot ROW for the proposed southern meter hook-up would cross a five-acre section of palustrine scrub/shrub wetlands. The ROW for the proposed northern meter hook-up would be placed in developed upland sections of the Pascagoula area. Where the 30" oil pipeline and the 42" dual-purpose pipeline run parallel, the ROW would not cross any wetlands.

Table 7.5-8
Types and Acreage of Wetlands Crossed by the Pipelines Associated with the Proposed Crude Oil Terminal

	Acres (to nearest whole acre)[b]	% of Wetland Total (to nearest %)	% of Total
I. ESTUARINE WETLANDS -- TOTAL All estuarine wetlands for this ROW are intertidal and emergent	4	9	6
II. PALUSTRINE WETLANDS -- TOTAL	41	91	65
A. Forested	15	33	24
B. Scrub-shrub	5	11	8
C. Emergent	21	47	33
III. NON-WETLANDS – TOTAL	18	--	29
WETLANDS -- TOTAL ACREAGE	45	100	71
TOTAL ACREAGE[a]	63	--	100

Source: Based on National Wetlands Inventory Map

[a] Total acreage does not include the portion of the proposed pipeline that crosses the Bayou Casotte Channel

[b] Acreage for ROW of pipelines that run parallel to the ROW already established for the 42" brine/crude oil pipeline is calculated using only the acres covered by the expansion of this ROW to accommodate two pipelines (ROW expanded from 150' to 170') or three pipelines (ROW expanded from 150' to 190')

A 42" oil pipeline would connect to the 30" oil pipeline group, and would run from the north-western corner of the Chevron Refinery east, along the ROW established for the 42" brine/crude oil pipeline, to the proposed crude oil terminal. This section of two parallel pipelines (with a 170' ROW) does not cross any wetlands. A 12" oil pipeline would also parallel this 42" oil pipeline from within the Chevron Refinery to the proposed terminal. From the point where this third pipeline begins to parallel the other two, the ROW would be expanded to 190 feet. Only the acreage of wetlands crossed by these extra 40 feet of ROW are included in the calculation of the acreage crossed by the 42" and 12" oil pipelines that would be built in association with the crude oil terminal. The 40-foot ROW would cross two acres of palustrine forested wetlands (directly north of the Chevron site) and nine acres of palustrine emergent wetlands. The 190' ROW for the sections of the 12" oil and the two 42" oil pipelines that cross from the ROW associated with the 42" crude oil/brine pipeline west to the proposed terminal would cross 13 acres of palustrine forested wetlands. The area from the Chevron Refinery north to the proposed crude oil terminal is part of a region considered to support significant wetlands, including pitcher plant flats, swamps, and bayheads, all of which provide habitat for numerous rare, threatened, or endangered plant and animal species.

Pipeline Maintenance

Potential impacts associated with maintenance of the pipeline ROWs and the pipelines would be similar to those discussed for Big Hill and would be expected to be minimal.

Crude Oil Terminal Construction and Maintenance

The proposed crude oil terminal would be located on an approximately 60-acre upland portion of the old Jackson County Airport area. The 2,020 foot by 1,250 foot tank farm would be constructed in the northeastern quadrant of the airport area, between an existing access road to the north, and palustrine forested wetlands to the east. The airport area is separated from palustrine forested wetlands to the east by an existing drainage ditch. This drainage ditch, along with the onsite wetlands, may serve as a hydrologic buffer between the off-site wetlands and construction activities associated with the construction of the crude oil terminal. If not mitigated, soil erosion resulting from construction activities would likely be retained in these wetlands (Appendix M). Impacts to the on-site wetlands from such erosion could be severe. Fourteen endangered or threatened species are reported as possibly occurring in Jackson County; some these may occur in the old Jackson County Airport area (Appendix D).

7.5.5.3 Summary of Wetlands Potentially Affected by Construction

Approximately 30 acres of wetlands would be located within the proposed site boundary for Richton and could potentially be impacted if the site is developed. In addition, if the Richton to Liberty oil distribution pipeline was selected, a total of 552 acres of wetlands could be affected by pipeline construction. The majority of these (approximately 400 acres) would be palustrine forested wetlands, with lesser amounts of palustrine scrub-shrub and palustrine emergent wetlands potentially affected. If the Liberty route was selected, no additional pipelines would be required to attain the 180-day drawdown. The addition of a pump station and one dock and one tank at St. James would not impact any additional wetland areas.

If the Richton to Mobile oil distribution pipeline was selected, a total of 462 acres of wetlands could be affected. The majority of these (approximately 271 acres) would be palustrine forested wetlands, although 118 acres of emergent wetlands and 24 acres of lacustrine wetlands also could be affected. The construction associated with a proposed crude oil terminal in Pascagoula to attain a 180-day drawdown criterion under this option could impact 45 additional acres of wetlands. Most of these wetlands are either palustrine forested or palustrine emergent. Sections of estuarine intertidal and palustrine scrub/shrub wetlands could also be impacted. The majority of these impacts would likely result from construction of connective pipelines; construction of the proposed terminal itself would be expected to have little impact.

If the Pascagoula terminal distribution alternative were selected, 419 acres of wetlands could be affected. The majority of wetlands possibly impacted by the dual purpose pipeline from Richton to Pascagoula would be palustrine forested (approximately 209 acres); sections of other types palustrine wetlands, emergent wetlands, and lacustrine wetlands could also be affected. The 45 acres of wetlands in Pascagoula that could possibly be impacted by construction of pipelines associated with the crude oil terminal are described above. If the Pascagoula terminal alternative were selected, no additional enhancements would be required to meet a 180-day drawdown criterion.

7.5.6 Floodplains Impacts

Because the Richton site would be entirely outside any floodplains, site construction would have no potential impacts on floodplains. The RWI structure would be located on a water body and, therefore, in a floodplain. However, installation of the RWI structure would involve minimal construction area. When the RWI structure is completed, water flowing in the Leaf River would pass with little or no disturbance. Construction would require dredging about 10,000 cubic yards of spoil, which could be placed in an upland spoil disposal area. All pipelines pass through a floodplain for at least some part of their length; therefore, construction crews would take measures to minimize and mitigate impacts to floodplains. Any adverse impacts from pipeline construction would be minimal and temporary.

The proposed tank farm in Pascagoula is located in a floodplain. DOE would ensure that all construction activities in the floodplain complied with Executive Order 11988 (floodplain management), which guarantees mitigation, preservation, and restoration of floodplains. Therefore, most impacts to floodplains from construction activities would be short-term, and none of these effects would be significant enough to increase the risk to lives and property, or alter the natural and beneficial floodplain values.

Without proper mitigation, preservation, and restoration of floodplains, however, potential impacts to the floodplain could include sedimentation on or below the construction site. The positive impact of sediment deposition would be the addition of rich nutrients to the floodplain soil and prevention of sediment-associated pathogens from entering the water. This same sedimentation, however, could destroy biological communities supported on the floodplain because it could contribute to nutrient overloading, decreased dissolved oxygen, increased water temperature, and serious impairment of photosynthetic productivity.

7.5.7 Natural and Scenic Resources

Lands associated with the Richton site are sometimes used for recreational purposes such as hunting; construction of an SPR facility would preclude such activities. However, other nearby recreational areas are available. The boundary of the De Soto National Forest lies approximately four miles from the site. This forest contains the Leaf Wilderness Area and Black Creek Wilderness Area, which are over 20 miles from the site. There would be no direct impacts from SPR development on these areas. Moreover, it would be unlikely that development and operation of the site would significantly change the nature of these areas or available recreational resources.[111]

No known threatened or endangered species or critical habitat occur in the project area. Should future studies document the presence of any threatened or endangered species, appropriate measures to avoid impacts would be implemented in consultation with state fish and game agencies and the USFWS. No threatened or endangered aquatic species are known to occur in affected portions of streams or ponds within the Richton dome area or immediately downstream.[112]

Several areas that could be crossed by pipelines contain significant communities and rate species that could be disturbed by ROW construction. Any impacts to wetlands or sensitive species would be mitigated through proper engineering controls and construction techniques.[113]

7.5.8 Archaeological, Historical, and Cultural Resources

Construction of access roads and well pads, pipeline routes, leaching operations, and buildings could disturb both surface and subsurface cultural deposits. Other anticipated undertakings that could disturb cultural resource sites would include land clearing procedures, grading, topsoil removal, placement of landfill, erosion control, and site restoration measures. No sites within the dome area are listed in, have recently been nominated to, or are classified as eligible for, nomination to the National Register of Historic Places, according to the State Historic Preservation Officers for Mississippi and Alabama. DOE would conduct an archaeological resources survey before construction of the site. Several known and unrecorded sites may lie near the proposed pipeline routes; in final pipeline routing and construction, DOE would mitigate potential impacts to these resources.

7.5.9 Socioeconomic Impacts

The types and magnitude of socioeconomic impacts from the development of the Richton site would likely be similar to those described for other new sites such as Cote Blanche or the Weeks Island alternatives.

- The largest impact would be from the additional income generated directly by the jobs created and the project purchases made in the local and regional economy.
- Even under the high impact scenario, the existing infrastructure, including health care, housing, education, and transportation systems, could absorb the in-migration of workers and their families.
- Some increase in traffic would occur, particularly during the construction phase of the project.

7.5.9.1 Demographic Changes

Based on the in-migration model described in section 7.1.9.1, demographic impacts would be minimal. DOE estimates that under the high impact scenario, 939 additional people would relocate to within 30 miles of Richton by the end of the construction phase. An additional 239 people would relocate by the fifth year when the facility would become operational. However, compared to the population of incorporated towns within 30 miles of Richton, this level of in-migration would only increase the current population by 0.8 percent (Table 7.5-9). Demographic impacts would be even smaller under the more likely baseline scenario.

The largest demographic impacts would be expected to occur during the construction phase, when most of the new jobs would be created. During the first year of construction, DOE estimates that 176 workers would be needed at the site. This estimate increases to 344 site workers by the end of the third year when construction activity would be at its peak. Also, during the third year an additional 62 workers would be involved in pipeline construction, raising the total estimated employment level to 406 workers. During the fourth year of construction, however, the number of employees would decrease as much of the work would be completed and no new workers would be hired. The labor force requirements for the development of the Richton facility are shown in Table 7.5-10.

The construction personnel needed for site development would be expected to be the same as those listed in, for example, section 7.3.9.1 on the Weeks Island site. In addition to construction personnel, approximately 104 permanent employees would be required to operate and maintain an SPR facility at Richton.

Table 7.5-9
Population Within 30 Miles of Richton

Distance from Site	Population
10-Mile Radius	6,393
20-Mile Radius	54,560
25-Mile Radius	98,219
30-Mile Radius	142,997
Maximum estimated In-Migration	939

Source: Donnelly Marketing Corporation, 1991.

To estimate the size of the in-migrating population, DOE assumed that construction would take place over approximately four years, although all of the construction employees would be hired during the first three years. Site preparation, well drilling, and facilities for cavern leaching would be completed within 18 to 24 months. Remaining site facilities, including security and the crude oil distribution system would be built within 39 to 48 months. The crude oil pipelines would be constructed during the third and fourth years. DOE also assumed that the in-migration behavior for the Richton construction workers would be similar to that of the Big Hill workers, that is, those workers choosing to relocate into the area would reside within a 30-mile radius of the site. Using the above assumptions and the in-migration model, DOE developed the estimates shown in Table 7.5-11. The in-migration assumptions are the same as those described for the in-migration model in section 7.1.9.1 for the Big Hill expansion.

In the baseline scenario, in-migration would increase from 55 to 128 people over the first three years of the construction project. This total includes 81 workers and 17 school-age children by the third year. In the first year, 35 workers with seven school-age children would relocate. In the second year, 21 additional workers with five school-age children would move into the area. In the third year, 25 construction workers with five children would relocate. In the fourth year, the work force would actually decrease and no new in-migration would be expected.

Under the high-impact scenario, in-migration would be expected to rise from 408 people in the first year to a total of 939 people by the end of the third year. By the time construction activity would reach a peak at the end of the third year, 305 workers with 634 family members, including 254 school-age children, would relocate to the area.

Although no in-migration of construction workers would be expected after the third year, there would be some in-migration of permanent workers at the beginning of the fifth year once the site is completed. Because, permanent workers would be more likely to relocate, DOE used the high-impact scenario for estimating in-migration for this worker population. As seen in Table 7.5-12, 78 permanent workers would relocate, and bring with them a total of 64 school-age children.

Table 7.5-10
Estimated Labor Force for the Proposed Richton SPR Site

	Construction Phase				Operations Phase
	Year One	Year Two	Year Three	Year Four	Year Five
Site Construction	176	280	344	100	0
Pipeline Construction	0	0	62	62	0
Operation & Maintenance	0	0	0	0	104
Total Employees	**176**	**280**	**406**	**162**	**104**

Source: Boeing Petroleum Services, PB-KBB, Inc., *Row Study*.

Under certain alternatives, DOE would construct a 2-MMB oil storage terminal at Pascagoula. Construction of this terminal would take place over 15 to 18 months and would involve between 75 and 100 construction workers. Development of this storage terminal would not have any impact on the demographics of Pascagoula area because duration of the project would be too short and the manpower requirements too small so as to result in in-migration of new workers. Similarly, the permanent work force would be primarily limited to a few security personnel and would not require any influx of new workers.

7.5.9.2 Economic Impacts

Direct economic impacts of developing the Richton site would include the additional income generated from new jobs created during project construction, increased demand for local supplies and materials used for construction and operation of the facility, and additional expenditures by project workers. These direct impacts would be expected to have multiplier effects on the regional economy, particularly in the local trade and service sectors.

No data are currently available on the expected payroll for the Richton construction and operational phases. Using prevailing wage rates in the construction industry and projected expenditures in the local economy by project workers, DOE estimates that $11.6 million in additional income would be generated in the peak year of construction (Table 7.5-13). These direct impacts would be expected to have multiplier effects on the regional economy, particularly in the local trade and services sectors. Nevertheless, as seen in Table 7.5-11, the additional income directly generated by the project would be expected to be small relative to the regional economy.

There would be some potential for larger impacts on the region's economy depending on the degree to which the project procures goods and service from within the area. It is estimated that the cost of the Richton development would be between $428 million and $732 million over

Table 7.5-11
Richton Site and Pipeline Construction In-Migration
Baseline and High Impact Scenarios

Population Category	Year One	Year Two	Year Three
Baseline Scenario			
Total Average Work Force	176	280	406
Total In-Migrating Workers	35	56	81
Total Family Members	20	32	47
Total In-Migration	55	88	128
Total School Children	7	12	17
High Impact Scenario			
Total Average Work Force	176	280	406
Total In-Migrating Workers	132	210	305
Total Family Members	276	437	634
Total In-Migration	408	647	939
Total School Children	111	181	254

three years. If as much as 30 percent of this total were spent on goods and services purchased locally, this would increase the region's total earnings by a maximum of 13 percent. If multiplier effects were taken into account, the impact would be larger. However, as in tbe case of the other sites, economic benefits to the region would diminish after site construction is completed.

Development of a terminal at Pascagoula would cost an estimated $75 million. Although some materials and service might be purchased from vendors in the Pascagoula area, any economic benefits from the terminal would occur primarily during the construction period. The permanent work force would be too small to have a significant impact on the area's economy.

7.5.9.3 Impacts on Energy Consumption

Development of a new site at Richton would require creation of new caverns like the expansion at Weeks Island. Leaching of sixteen new caverns would demand a peak load of approximately 20 MW, while oil fill would require 5.8 MW. As in the case of Weeks Island and Cote Blanche, a peak demand of about 21.1 MW would be needed for drawdown and about one MW for oil storage. Peak demand figures for booster stations and the RWI system were not available. DOE is considering one option of tapping one of SMEPA's two transmission lines that are nearest to the site. This option would require negotiation with other members of the co-op

Table 7.5-12
Richton Operation and Maintenance In-Migration
Baseline and High Impact Scenarios*

Population Category	Number*
Total Additional Work Force	104
Total In-Migrating Workers	78
Total Family Members	161
Total In-Migration	239
Total School Children	64

* High impact scenario used for both scenarios.

prior to initial use of SMEPA power. Another option under consideration involved tapping into Mississippi Power's transmission line, although the line is further from the site. Either option would involve sufficient capacity to power such a site at Richton. Another substation, which either would be built by DOE or by a utility power company, might be needed at the site to step down the voltage of the nearby transmission lines.

In addition, under the alternatives that would involve development of a DOE terminal at Pascagoula, approximately a peak demand of 7,500 KW would be needed during drawdown. DOE would connect the terminal by tapping into one of Mississippi SMEPA's transmission lines near the proposed site.

7.5.9.4 Impacts of Brine Disposal on Commercial Fisheries

Although unlikely, based on ten years of experience at existing SPR sites, there would be some potential for adverse impacts on the fisheries industry due to brine disposal in the Gulf of Mexico. To account for this potential impact, DOE has developed a conservative estimate of the potential value of the catch that may be exposed to the area of increased salinity associated with the brine plume (Appendix G). Under these assumptions (e.g., maximum discharge, adverse environmental conditions), the estimated annual value of the catch associated with the one ppt salinity contour would be approximately $340,000. A similar estimate for the three ppt salinity contour would be approximately $100,000. Estimated values for brown and white shrimp would account for 98 percent of the total estimated value for both salinity contours.

These values would represent 0.8 and 0.2 percent, respectively, of the total annual value of the catch within the appropriate sections of the National Marine Fisheries Service (NMFS) fishery grid potentially affected by brine discharge from the Richton diffuser. Estimated value catch at the Richton diffuser also would be a small percentage of the annual value of the total catch in the northern Gulf of Mexico, which is in excess of $440 million.

Table 7.5-13
Additional Income Directly Generated from Richton Development

	Total New Jobs*	Total Annual Worker Earnings	Percent of Regional Earnings
Year 1	176	$5,000,000	0.29
Year 2	280	$8,000,000	0.47
Year 3	406	$11,600,000	0.68
Permanent	104	$3,000,000	0.18

* Totals for new jobs and earnings are cumulative.
Source: Boeing Petroleum Services, Bureau of Labor Statistics.

DOE estimates that there will be very little impact on the value of the catch from the areas affected by the brine plume. Most of the commercially important fish and shellfish species in the northern Gulf of Mexico can tolerate a wide range of salinities, and field studies have indicated that the existing brine diffuser at Bryan Mound has had little effect on the nekton (i.e., fish and shrimp) community inhabiting the diffuser area. Additional details of the assumptions and methods used in this analysis are presented in Appendix G.

7.5.9.5 Impacts on Transportation Systems

The primary impact on transportation systems would be increased traffic from workers traveling to and from the site during the construction phase. However, given that at the peak of construction activity only about 344 workers would be at the site (the remaining work force will be away from the site on pipeline construction), and the current levels of traffic as seen in Table 5.5-10, the marginal increase in congestion would likely be minimal. Impacts on the town of Richton would be minimized because access to the site would be provided by state highways with access roads outside Richton's city limits. Given the low probability of accidents and the small increase in traffic relative to existing traffic flow patterns, the expected increase in accidents resulting from development of a site at Richton would be negligible.

Some additional traffic, however, would be created by trucks removing vegetation and other debris during the initial stages of site development as well as from construction equipment and vehicles bringing materials for facility construction. The largest pieces of equipment required for construction would be the drilling rig and the workover rig, each weighing approximately 120,000 lbs. Heavy equipment load permits would be needed to transport these rigs across state and Federal highways to the site. This additional traffic, however, would be sporadic and short term. DOE would repair any roads adversely affected by the transport of heavy construction equipment to the site. It is unclear whether planned construction on bridges between Laurel and Richton would have any effect on transportation of this equipment or on local traffic patterns.

Construction of a paved access road and on-site roads might be necessary. Those roads would be asphalt-surfaced, two lanes, about 20 feet in width, and would have six-foot shoulders.

An additional transportation impact could arise from the construction of the new crude oil pipeline which would cross several major roads. Major road crossings, however, would be accomplished by directional drilling which involves boring tunnels beneath the road; minor road crossing would be trenched. The major impact from these activities would be temporary traffic delays during actual construction. Because crossings would be constructed beneath the roads, no major disruptions would be expected.

7.5.9.6 Housing

Development of the Richton site would have a limited impact on housing availability. For the purpose of this analysis, it is assumed that most in-migrants would locate in Forest, Jones, or Perry counties. In 1990, of the 3,700 vacant housing units in the eight county Richton region, 2,659 were in these three counties. Sixty-eight percent (1,818) of the units were available for rent. Under the high impact scenario, even assuming all workers remaining in this area after construction was completed, the number of new households in the region would not exceed 383. Assuming all workers would relocate to these three counties, the additional households would fill only 21 percent of the empty housing units available for rent in the three counties (14 percent of the total available for rent or sale).

7.5.9.7 Health Care

Under the high impact scenario described above, assuming all 1,178 persons relocate to Richton area, the ratio of residents to physicians, and residents to hospital beds, would not change significantly. In 1990, in the eight county Richton area there were eight hospitals, 1,206 hospital beds, and 275 physicians. There are 832 residents per physician, and 190 residents per hospital bed. With an additional 1,178 residents, the ratio would change to 836 residents per physician and 191 residents per hospital bed.

7.5.9.8 Education

The estimated number of additional children entering the regional school systems would range from 81 to 318 (including children of both construction and permanent workers). Even under the high impact scenario, the total number of school children entering local school systems would be less than one percent of the current school enrollment of more than 26,200 students in kindergarten through high school in systems serving Jones, Forrest, and Perry Counties. Given that the children would be dispersed among four cities in three counties, any impact would be minimal.

7.5.9.9 Fiscal Impacts

The net fiscal impact of developing Richton as a SPR facility is difficult to estimate. The amount of property taxes paid by the land owner in 1990 is not currently available. The property tax revenue from the property would be lost if the property became Federally-owned. However, given that the project would generate at least 406 temporary jobs and 104 permanent jobs, this small shortfall would be more than compensated by the additional tax revenue from wages and property owned by these additional employees. Increased earnings and trade due to secondary effects would also generate local tax revenue.

7.5.9.10 Emergency Response Capabilities

Worker in-migration would not be expected to affect the response capabilities in the Richton area. Further information on emergency response impacts are included in section 7.1.9.10.

7.5.9.11 Oil and Brine Spills

Several negative socioeconomic impacts associated with oil and brine spills should be considered regarding the proposed Richton expansion site. As several of these impacts could be similar to those of the Big Hill expansion site, refer to the Big Hill section for a more detailed explanation.

Socioeconomic Impacts of Oil Spills

An oil spill at or near the Richton site or along a pipeline could negatively affect several water bodies, but no public water intakes exist within a five-mile radius. Land in the area is primarily used for agriculture and forestry, and the primary crops include corn, sorghum, soybeans, and wheat. Several species of fish inhabit the Richton area, and they are important for both recreational and commercial fishing.

Socioeconomic Impacts of Brine Spills

A brine spill at or near the Richton site could affect the same water bodies within a five-mile radius of the site as noted above. The Richton brine pipeline would be unique in that it could serve as an additional crude oil distribution pipeline in the future. The proposed pipeline would cross at least 24 water bodies, including the Escatawpa River and Chickasawhay River. These water bodies are characterized in Table 5.5-5. An offshore brine spill could have a large economic impact, since commercial fisheries are an important part of the economy of coastal Mississippi. In addition, a shrimp population exists in the area of the proposed diffuser site, which could be adversely affected by a spill.

7.5.9.12 Prime and Unique Farmlands

The proposed Richton site would directly convert approximately 4.2 acres of prime and unique farmland. Because of this relatively small area, the proposed action is not expected to impact the prime and unique farmlands of the region. The proposed pipeline ROW to Pascagoula would indirectly and temporarily convert a total of 907.4 acres of prime and unique farmland, as identified by the U.S. Soil Conservation Service. This would include 83.2 acres in Amite County, 59.3 acres in Forrest County, 92 acres in George County, no acres in Greene County, 90 acres in Jackson County, 82.2 acres in Lamar County, 95.1 acres in Marion County, 95.5 acres in Perry County, 180.6 acres in Pike County, and 129.5 acres in Walthall County.[114] The proposed pipeline ROW to Mobile, Alabama would indirectly and temporarily convert a total of 119.5 acres of prime and unique farmland, as identified by the U.S. Soil Conservation Service. This would include 69 acres in George County, Mississippi, and 50.5 acres in Mobile County, Alabama. After construction, the ROW would be returned to its original contours and vegetation. The proposed action would not be expected to have a lasting impact on farmlands.[115]

7.5.10 Noise Impacts

The following sections discuss potential noise impacts associated with the development of a new SPR site at Richton.

7.5.10.1 Construction Noise Impacts

The primary noise sources within the 5,000-foot radius noise impact zone are Mississippi State Highway 42 and State Highway 15. Only a small increase in noise levels would be expected in the impact zone because the background noise levels produced by traffic on the highways are likely comparable to the 53 dBA estimate generated using Figure F.1-1. No major noise-related impacts would be expected as a result of the construction of an SPR site at Richton because the area is heavily wooded and because the nearest residence or place of business is some distance from the site.

The raw water pipeline would cover ten miles between the Leaf River and the site. Brine disposal during cavern leaching would be achieved through the construction of a 96-mile pipeline extending to the Gulf of Mexico, the first 82 miles of which would be converted to serve as an oil fill/distribution pipeline following the completion of cavern construction. Also, as part of the oil distribution system for Richton, a 118-mile pipeline to a tie-in with the Capline pipeline could be constructed. One alternative route for the oil distribution pipeline would involve the construction of approximately 70 miles of pipeline to the southeast of the site to the Hess Ten-Mile Station. Another pipeline alternative would include the construction of a 42" pipeline, which would extend from Richton to a DOE oil storage terminal at the Port of Pascagoula in Pascagoula, Mississippi for oil distribution, and into the Gulf of Mexico for brine disposal. This pipeline would be approximately 82 miles in length and would be used for both brine disposal during cavern construction and oil distribution during drawdown. No major noise related impacts would be expected as a result of pipeline construction because it would proceed at a rate of 0.5 miles per day under any of the alternatives. Any noise impacts as a result of pipeline construction would be of short duration (i.e., one to two days) in any given area. As mentioned above, the third pipeline alternative would involve the construction of a DOE-owned terminal consisting of five tanks. The noise levels likely to be produced by this construction would be roughly equal to the predicted noise levels for construction of support facilities at the SPR cavern sites (i.e., 68 dBA at 500 feet). Because background levels in the Pascagoula area are already in the 58 to 68 dBA range, no significant increase in sound level would be expected as a result of the construction of the tank farm. Additionally, little or no noise disturbance to the nearest residence or place of business (approximately one-half mile from the proposed site) would be expected.

In addition to the pipeline options discussed above, brine disposal during site operation could be achieved through the construction of up to 15 injection wells. Noise impacts associated with the construction of these wells would be similar to those caused by well construction in the Capline Complex. See Table 7.3-13 for a summary of the maximum duration for drilling activities.

7.5.10.2 Operational Noise Impacts

Operational noise levels at Richton would be 60 dBA at 500 feet from the site based on Big Hill monitoring data. Minor increases in sound levels would be expected during oil fill and drawdown. However, because the background level within the 5,000-foot radius impact zone is comparable to the 53 dBA level, no significantly increased noise levels would be expected in the impact zone. If the DOE terminal is constructed at the Port of Pascagoula, only minor increased noise levels would be expected, based on SPR experience at the St. James Terminal. Sound levels produced by the operation of the DOE terminal would likely be less than or equal to the existing background level. For this reason, no significant operational noise impacts would be expected.

7.6 St. James Terminal (Capline Complex Distribution Enhancement)

Certain drawdown and distribution scenarios for the Capline Complex would include expansion of the St. James Terminal by constructing up to two new docks and tanks. The potential impacts are discussed in the following sections.

7.6.1 Geological Impacts

Potential geologic impacts associated with the expansion of the St. James Terminal would be limited to the possibility of the contamination of surface and subsurface sedimentary layers in the event of an oil spill. Significant geologic impacts would not be expected.

7.6.2 Hydrogeological Impacts

There are five major sources of potential groundwater contamination at the St. James Terminal expansion site. These potential sources include oil storage tanks, other above-ground storage tanks, a retention pond, on-site pipelines, and other material spills. Underground storage tanks also are present at the facility; however, in response to new regulations on underground storage tanks, these tanks are currently being replaced and would not be affected by the proposed expansion. The potential groundwater impacts associated with each source are described below.

7.6.2.1 Oil Storage Tanks

Six oil storage tanks (also referred to as surge tanks) are used presently at the terminal to temporarily store crude oil during fill and withdrawal operations.[116] Four of the tanks have a capacity of 0.4 MMB each, while the remaining two have a capacity of 0.2 MMB each. The St. James expansion would add up to two 0.4-MMB storage tanks.

Measures to prevent oil migration from all of these storage tanks would include secondary containment structures capable of containing the entire volume of any one tank, concrete pads underlying each tank, and high-level alarms that notify the control room when any tank is in danger of overflowing.[117] If a release did escape these controls, the potential for oil to migrate into shallow groundwater would be further limited by the very low permeability of surface and subsurface soils at the site. The uppermost aquifer directly beneath the site, the Gramercy aquifer located between 180 and 250 feet below the land surface, is overlain by a 100-foot silty clay loam and clay loam confining bed that would help inhibit groundwater contamination (see section 5.6.2). During the ten years that the St. James Terminal has been in operation, very few releases of one barrel or more of oil from the storage tanks have been documented, and in general, these releases were contained by the secondary containment structures at the facility. No migration to the groundwater has been documented.

Nevertheless, if released oil was not contained and did reach the groundwater, the resulting contamination could limit present and potential future uses of groundwater in the immediate area. Although the Mississippi River is the major source of freshwater in the region, fresh and slightly saline groundwater near the site is also used for drinking, irrigation, and industrial purposes. As described in section 5.6.2, there are currently 33 wells within a three-mile radius on the same side of the Mississippi as the St. James Terminal. These wells, which are used for a variety of purposes, could be contaminated during times (e.g., the spring) when the Mississippi River stage is high and groundwater flows generally westward from the terminal site away from the river. During other times of the year (e.g., the fall), when the river stage is low, any groundwater contamination originating from the site could discharge directly into the Mississippi. Because the Mississippi River has a very large assimilative capacity, the relatively small contaminant loads that might seep into the river under a reasonable spill scenario would not be expected to significantly affect downstream human uses of the river. Ecological impacts caused by groundwater contamination, however, could be more severe because the area adjacent to the Mississippi at the St. James docks (in the immediate vicinity where groundwater discharges to the river) is considered a freshwater wetland.

7.6.2.2 Other Aboveground Storage Tanks

In addition to the oil storage tanks, several other aboveground tanks are used for the storage of chemicals. These include: (1) a 1,000-gallon diesel tank at the emergency generator; (2) a 500-gallon and 250-gallon diesel tank at the fire pumps at Dock No.1; (3) a 200-gallon diesel tank at the new fire water pump building; and (4) a 500-gallon tank used to store corrosion inhibitor at the pig trap/separator area. The expansion at St. James would add up to two additional tanks (one at each new dock). These tanks would sit on concrete pads and have some form of secondary containment (e.g., dikes or collection basins). The containment dike around the 200-gallon diesel tank at the new fire water pump formerly had a drain that discharged outside the containment area into a surface drainage ditch. However, DOE recently has redirected this drain to a closed sump.

The preceding discussion of potential releases from aboveground oil storage tanks is applicable to the other aboveground tanks. However, two further considerations apply: (1) the containment dike around the 200-gallon diesel tank at the new fire water pump is not of sufficient size to contain the whole volume of the tank; and (2) the containment dike surrounding the corrosion inhibitor tank is pervious (it is made of limestone), so any spill or leak may not be contained completely. Nevertheless, no significant releases from these tanks resulting in groundwater contamination have been observed in the past.[118] If expanded operations at St. James did result in a large release from these tanks and subsequent groundwater contamination, the impact from this contamination would be similar to that described for the aboveground oil storage tanks.

7.6.2.3 Retention Pond

There is one 2.1 million-gallon retention pond at the facility that holds stormwater runoff from the terminal after processing by oil/water separators. The water is analyzed for specific pollutants by ultraviolet light detection devices at both the inlet and outlet of the pond. In addition, the pond has an oil boom at the inlet end to remove any oil remaining from the oil/water separators. Any oil that is removed is then transferred to the slop-oil sump. The retention pond is operated in a batch mode (i.e., flow through the pond is not continuous). Additionally, the pond is not lined because it is designed to handle only stormwater runoff.

If the St. James Terminal would be expanded, the operation and size of the retention pond would remain the same. However, the increased input of collected stormwater would require the present pond to be dredged to its original configuration.

Possible releases from the pond would include seepage from the pond bottom and overflow of liquids to areas outside the pond with subsequent seepage to groundwater. While no such releases have been observed in the past, the impacts associated with this migration if it ever does occur in the future would be minor because (1) the retention pond would contain only stormwater runoff and only runoff that has gone through oil separation (i.e., contained liquids are not of extremely poor quality); (2) a thick confining layer underlies the site, limiting migration to groundwater; (3) the retention pond is currently equipped with an oil boom to remove oil; and (4) ultraviolet light oil detection devices are currently installed at both the inlet and outlet to detect oil remaining in the water, alerting the operators to redirect the water back through the oil/water separators.

7.6.2.4 On-site Pipelines

Three sets of underground pipelines and valves presently exist at the terminal site: (1) pipelines connecting each storage tank to valved manifolds that transfer oil from the tanker docks to the storage tanks or to the pipelines to Weeks Island, Bayou Choctaw, the Capline terminals, or the LOCAP system; (2) a series of motor-operated and manually operated valves controlling oil flows through the pipeline; and (3) five booster pumps used to move oil to connected locations (e.g., Bayou Choctaw, tanker docks).[119] All pipelines are monitored with both volume meters and pressure gauges to ensure no leakage is occurring. Expansion of the facility would result in additional pipelines connecting the new surge tanks to the tanker docks and the existing pipeline systems.

Reported spills during 1989 and 1990 could be attributed to leaks in pipeline joints and valves. No pipeline or valve releases, however, have resulted in significant impacts to the groundwater in the past. If a large spill does occur in the future, it could conceivably result in groundwater contamination and the subsequent loss of use of groundwater resources near the site. Such contamination also could result in ecological damage, as the downgradient area adjacent to the Mississippi is considered a freshwater wetland. In general, the potential for substantial releases and impacts of this nature would be limited by the routine pipeline monitoring that would be conducted and the impermeable subsurface soil that would protect groundwater beneath the site.

7.6.2.5 Other Material Spills

Other locations at the St. James Terminal used for storage of hazardous chemicals are the flammable storage building and the drum storage area, both located in the laydown yard. An earlier inspection noted no deficiencies in storage practices at the flammable storage building.[120] An impervious floor and curbing have been installed in the building to contain spills. However, at the drum storage area, drums containing chemical products are currently stored out-of-doors and are unprotected from adverse weather conditions at locations that lack impervious flooring and curbing. Present plans include construction of four prefabricated, weatherproof, steel, chemical storage buildings with chemically resistant epoxy-coated surfaces, sprinkler systems, explosion-proof lighting, and fiberglass floor grating. These buildings also will have secondary containment for groundwater protection.[121]

Potential releases to groundwater from these other storage areas would include leaks from drums and spills during handling. Accidental spills of chemicals in these storage areas have not been reported previously; however, there would always be a possibility that such spills could occur in the future. In the event of a spill, impacts from the releases should be minor because (1) any chemical spills would be of limited quantity; (2) the thick confining layer underlying the St. James Terminal would limit migration to groundwater; and (3) the containment systems described above should prevent any spills from causing significant groundwater contamination.

7.6.3 Surface Water Impacts

Potential impacts to surface water caused by the proposed expansion of the St. James Terminal would include construction impacts and adverse effects caused by oil and other hazardous substance spills. These two categories of potential surface water impacts are addressed in separate sections below.

7.6.3.1 Construction Impacts

Expansion of the St. James Terminal would require the construction of additional on-site storage facilities (e.g., two 0.4-MMB storage tanks and miscellaneous support equipment) and up to two new tanker docks on the Mississippi River. The extent of potential impacts associated with these separate construction efforts would differ, as detailed below.

Impacts Associated With On-Site Construction

As detailed in Appendix O, conservative calculations indicate that roughly 520 tons of soil would be eroded in a southwesterly direction from the site during construction of expanded on-site facilities at the St. James Terminal. The surface water bodies nearest to the construction area are the Mississippi River (about one mile to the east) and the St. James Canal (roughly two miles to the southwest). There would be no potential for sediment-laden runoff to enter the Mississippi River because (1) it is not in the surface runoff direction, and (2) the river's bank adjacent to construction area is protected by a large levee. Although the St. James Canal is located in the expected direction of surface runoff and erosion, the site-specific topography and distance to the canal indicate that it would not be likely to receive an enhanced sediment load due to site construction. Instead, soil eroding from the site would be expected to be deposited in the flat agricultural area between the construction site and the St. James Canal.

Impacts Associated With Dock Construction

Dock construction would require significant dredging in the Mississippi River. The dredged area for two docks would be 2,600 feet long by 1,100 feet wide by 40 feet deep, with construction of the tanker docks requiring removal of no more than 1.85 million cubic yards of sediment.[122] This dredge volume is significantly larger than was called for in any of the prior

SPR EISs for dock construction. The location of the two new docks would be adjacent to the south side of the existing docks.

Dredging in the Mississippi River is typically performed using a suction or bucket dredge, and removed sediments are relocated to a deep portion of the river. Dredging for the proposed construction would take 17 months to complete, and maintenance dredging would be required at least annually thereafter. The Army Corps of Engineers would not require an EIS for dredging activities in the river because it would add no new foreign materials to the river and turbidity and suspended solids concentrations are already high.

Possible impacts to water quality resulting from these dredging activities would include the same basic categories of impacts outlined above for the construction of pipelines through inland water bodies (see section 7.1.3.3). These impacts and their anticipated extent in the Mississippi are summarized below.

- **Increased turbidity.** The length of time over which dredging occurs, bottom sediment characteristics, water current conditions, and the size and number of dredges used are all factors that would determine the size and duration of the turbidity plume. Increases in turbidity would be expected to be limited to the area where dredging occurs. An EIS for the initial SPR construction at St. James estimated, based on maintenance dredging studies conducted in Alabama, that suspended solids concentrations would be less than 100 mg/l at distances greater than 400 feet downstream from dredging activities. This level is comparable to the suspended solids concentrations normally observed in the Mississippi River.[123] This estimate, however, may understate the downstream distance that could be affected at St. James because it is based on removal of 200,000 cubic yards of sediment, approximately one tenth the spoil volume that would be removed during the proposed dock construction.

- **Increased suspended nutrients.** Dredging activities could release nutrients (phosphorus, nitrate, nitrite, and ammonia) stored in bottom sediments. Elevated nutrient concentrations promote increased growth of algae and plants, which could lead to reduced levels of dissolved oxygen and light penetration. However, because of the large flow of the Mississippi River (average of 468,000 cfs), dilution would be expected to quickly reduce concentrations of any released nutrients to ambient levels.

- **Reduced dissolved oxygen levels.** Oxidation of sediment bound materials could result in reduced dissolved oxygen levels during dredging activities. This would be of special concern for sediments of high organic content. Increased nutrients could also indirectly result in low dissolved oxygen concentrations, due to the increased oxygen demands of inflated populations of plants and plankton. The large dilution capacity of the Mississippi River, however, would likely reduce concentrations of these contaminants to insignificant levels within a short distance from the immediate project area. Also, a previous EIS addressing the impacts of dredging in the Mississippi River found that spoil material similar to that expected from the St. James dock construction did not release significant amounts of oxygen demanding materials.[124]

- **Elevated trace metals concentrations.** Data from the initial EIS for SPR construction at St. James[125] show that leach tests of Mississippi River sediments contain concentrations of lead in excess of EPA water quality criteria for aquatic life.[d] Some metals tend to adsorb to suspended solids or form insoluble sulfide salts, and thus are not available for uptake by resident biota. Other metals (e.g., zinc) are more soluble and remain bioavailable. Within a short distance downstream from the construction activity, concentrations of all metals would be expected to be diluted to non-harmful levels.

- **Increased organic pollutants.** Because of the extensive use of the lands along the Mississippi River for industrial, agricultural, and transportation purposes, various organic contaminants (e.g., pesticides) may exist in bottom sediments. Because of the river's large scouring capacity, however, sediments are constantly being relocated and are fairly homogeneously mixed. As a result, no unusually high or localized sediment contamination would be expected to be suspended by the proposed dredging. Leach test results of sediments, reported in the initial SPR EIS for St. James, show that parathion concentrations exceed EPA chronic water quality criteria for aquatic life within the affected area,[126] but any contaminants that might be re-suspended by dredging would be expected to settle to the bottom or be diluted to non-harmful levels a short distance downstream.

Currently the only operable public water intake within ten miles of the existing docks is located directly across the Mississippi River from the existing St. James site, serving approximately 675 people in Convent. This intake, however, is almost one-half mile upstream from the proposed new docks. Prior dredging activities for the existing St. James docks did not negatively impact municipal intakes, even though the intakes that existed at the time were substantially closer downstream (five and seven miles) than the nearest downstream intake today.[127] Overall, the proposed dredging operation at St. James would not be expected to significantly affect water quality at the existing intake at Convent because the intake would be upstream from the dredging. Also, within two miles of the existing SPR docks, there are no downstream tributaries that could be affected by the proposed new dock construction.

The proposed dredging activities would permanently alter the benthic habitat in the docking areas, because following the initial dredging action, maintenance dredging of the area would be required to maintain the depth. Additionally, benthic habitat around the site would be smothered by the settling of sediment suspended by the continuing dredging activity. Nevertheless, the effects of dredging and subsequent settling on aquatic biota would be expected to be minimal because a productive community of river-bottom dwellers does not exist, due to the constantly turbid condition of the river that inhibits light penetration and the existing sediment load that smothers sessile organisms.[128] The increased turbidity also could result in the hindered ability of fish to attain food (i.e., impaired vision). These animals, however, are adapted to the naturally turbid conditions of the Mississippi River (e.g., catfish sense food primarily by smell), and would not be expected to be affected significantly. While there could be toxicological effects to fish in the immediate project area due to exposure to suspended contaminants, the large

[d] More recent metal and organic concentration data for Mississippi River sediments than that found in the 1977 Supplement to the EIS for Weeks Island and Cote Blanche are not available from the Army Corps of Engineers or from the Louisiana Department of Environmental Quality.

dilution capacity of the river and the fact that fish would likely avoid the area when it is being disturbed would help limit the potential for these adverse effects.

Finally, the conceptual design for the St. James expansion would call for disposal of the 1.85 million cubic yards of dredge spoils in a natural depression in the river bottom. Although a specific disposal location has not been selected, it would be designated and permitted by the Corps of Engineers to avoid impacts to the drinking water intake upstream at Convent. This disposal would smother the benthic community that presently exists in the affected area. However, as mentioned above, a productive community of river-bottom dwellers does not exist and whatever organisms that naturally live in the river would be expected to quickly recolonize the disposal area.

7.6.3.2 Spill Impacts

While on-site spills of oil and other hazardous substances at the St. James facility would be possible (e.g., releases from oil storage tanks, oil transfer operations at the docks, drum storage areas, etc.), the potential for such spills to adversely affect water bodies would be substantially limited by the on-site containment structures, spill response procedures, and distance and direction to nearby surface waters. Assuming a large spill escaped containment and migrated off-site, the closest water body in the direction of the site's drainage is the St. James Canal located 1.6 miles away. Given this distance and the fact that the terrain between the site and the canal is very flat and used for agriculture, it would be unlikely that an on-site spill would result in significant contamination of this canal.

A potentially more significant spill scenario would be the release of oil at the tanker docks on the Mississippi, such as a tanker accident or equipment failure during tanker loading and unloading. There are currently two docks on the Mississippi River at the St. James Terminal, each with three loading and unloading arms. Under the 180-day drawdown criterion, a proposed expansion could double the capacity of existing facilities by adding two new docks. Reasonable spill quantities have been estimated at 2,000 barrels for each dock and 1,700 barrels for each loading arm,[129] although spills as large as 60,000 barrels have been considered possible.[130] Such a spill would create a slick on the Mississippi over 20 miles long. Spills of this size would be unlikely, however, due to precautions required by EPA Oil Pollution Prevention regulations (40 CFR Part 112). These precautions would include spill containment dikes (scupper systems) at each dock capable of retaining spills of 667 barrels of oil. Additionally, a spill contingency plan has been prepared for the terminal. The low probability of major spills would be further supported by historical spill rates, as no major spills to surface waters have occurred at the St. James Terminal.

The Mississippi River is the only surface water body that could directly receive a tanker or dock spill. No water bodies intersect the Mississippi River within five miles downstream of the St. James Terminal. Although there are many tributary confluences further downstream, an oil spill would remain primarily in the Mississippi River and would not significantly affect these tributaries. Marshlands and distributaries of the Mississippi Delta, however, could be impacted by an oil spill.

If an oil spill to the Mississippi River were to occur at the St. James Terminal, there could be significant biological impacts. Most types of organisms could experience toxic effects from the ingestion of oil. Oil clogged in respiratory systems of animals could cause suffocation, and similarly, smothering could interfere with gas exchange by plants. Birds and mammals that become coated with oil might die from hypothermia as the insulative capacity of feathers or fur would be lost. Additional biological impacts of oil spills are described in section 7.1.3.4. Implementation of the spill contingency plan, which includes deployment of booms and other oil recovery equipment, would serve to minimize the extent of biological damage.

7.6.4 Air Quality Impacts

Air quality in the vicinity of the St. James Terminal would likely be impacted only slightly during expansion of the site. The principal pollutant of concern would be volatile hydrocarbons from tanker unloading and loading operations during SPR fill, drawdown, and distribution.

7.6.4.1 Particulates, Sulfur Dioxide, Carbon Monoxide, and Nitrogen Oxides

Previous studies have provided estimates of impacts in the vicinity of terminal facilities constructed at St. James and have concluded that the air quality would be slightly affected during site preparation and construction.[131] The sources of emissions would likely be short-term and over a small area. The air quality during construction would be affected primarily by fugitive dust and general construction vehicles.

The sources of fugitive dust emissions would likely result from construction activities associated with landclearing, excavation, cut and fill operations, and other activities. Field measurements in a semiarid climate at similar construction sites yield an estimate of 1.2 tons of dust per acre of construction per month of activity. Since ground moisture in southern Louisiana is twice the semiarid level and dust emissions are often inversely proportional to the square of ground moisture, dust emissions during construction at St. James were estimated to be 0.3 tons of dust per acre of construction per month of activity. It was concluded that most of the dust would settle within the terminal boundaries and that the fugitive dust from the terminal area would not seriously impact the environment.

The diesel and gasoline engines on machines and heavy vehicles used during construction would likely emit sulfur dioxide, carbon monoxide, nitrogen oxides (NOx), and particulates. Vehicular emission rates during construction would include 0.02 g/sec of sulfur dioxide, 1.37 g/sec of carbon monoxide, 0.212 g/sec of nitrogen dioxide, and 0.015 g/sec of particulates. These emissions would likely result in very small ambient air concentrations.

The previous estimates for St. James were based on the assumption that constructed facilities would include four 200,000-barrel oil surge tanks in addition to one of the following expansions: one dock, three 500,000-barrel oil surge tanks, and one 3.2-mile pipeline; or one dock, ten 150,000 barrel oil surge tanks, and one seven-mile pipeline. Expansion of the existing terminal, including construction of new docks and storage tanks, would be expected to have even fewer air quality impacts than the original construction.

7.6.4.2 Volatile Hydrocarbons

Volatile hydrocarbon emissions at the St. James Terminal would be primarily associated with the loading and unloading of crude oil from tankers. Other sources of emissions would include surge tanks, fugitive emissions (from pump seals, valves, and flanges), fuel tanks, internal combustion engines, and vehicles. The assumed fill/discharge rate would be 37,000 barrels per hour. During the peak hour of drawdown, one 200,000-barrel tank and three 400,000-barrel tanks would be assumed to be active, and during the peak hour of fill, one 200,000-barrel tank and one 400,000-barrel tank would be assumed to be active. It is assumed that some crude oil would remain in the tanks during standby. Surge tank calculations were based on equations from EPA Report AP-42.[132] Total emissions were calculated through summation of the rim seal loss and withdrawal loss. An atmospheric pressure of 14.75 psia and a wind speed of 8 mph were used as average values. The volume weighted mean of Reid vapor pressure (8.0), temperature (74°F), and gravity (36.8 API), and a maximum observed temperature (91°F) were assumed. The tanks would be assumed to have a white external surface and a lightly rusted internal surface. Tanks would be fitted with external floating roofs equipped with a primary metallic shoe seal and a secondary rim mounted seal. These seals would be assumed to be in good condition. Maximum emission rates assumed a liquid density of 7.0 lb/gal. During drawdown operations, the surge tank calculations are based on a crude oil temperature of 100°F.

Tanker hydrocarbon emissions during unloading would be caused by ballasting operations. Historical data from St. James Terminal during 1980, 1981, and 1982 demonstrated 53 percent and 47 percent of the crude oil was unloaded through dock #1 and dock #2, respectively. Ships with non-segregated ballast tanks unloaded 72 percent of the crude oil at St. James during that time and were thus responsible for the ballasting emissions. These figures were used to adjust the hydrocarbon emissions figures for the docks. An estimate of 0.42 lb of hydrocarbon emissions per 1,000 gallons ballast was used in the calculation of hydrocarbon emissions from tanker ballasting.[133] The 1983-1990 dock logs do not contain crude oil transfer rates. Based on earlier operational experience, however, the maximum unloading rate across each dock is 37,000 barrels per hour, and this rate is used for maximum emissions from tanker ballasting. Tanker hydrocarbon emissions during loading operations are calculated using AP-42. The oil temperature is assumed to be 100°F, the oil has a molecular weight of 50 lb/lb-mole, the vapor growth factor is 1.02, and an emission factor of 0.60 lb/1,000 gal was used for hydrocarbons from tanker space occupied by previous cargo. This emission factor is based on the assumption that half the tankers are not clean, consistent with data presented in AP-42.

Emission rates for pump seals, valves, and flanges were based on AP-42. For ship exhaust, an emission rate of 0.16 lb/hr is assumed for each tanker. During fill, one tanker would be present daily for 1.35 hours; during drawdown, four tankers would be assumed to be present for 785 hours per year. Maximum emission rate from 18 fuel supply tanks with capacities varying between 200 gallons and 2,000 gallons would depend on how many are filled simultaneously and the type of emission control. For calculating maximum hourly emission rate, the assumed worst-case would be the filling of station gasoline tanks with limited control (80 percent control efficiency). For calculating annual emissions, it was assumed each tank was filled one time per year.

Evaporative emissions are also estimated for several minor sources, including fourteen 200-gallon corrosion inhibitor tanks; internal combustion engines on emergency generators, dock fire water and water supply pumps, machinery tractors, other equipment, and compressors; and crude oil sampling and gauging. Laboratory fume hood exhaust would emit 0.7 lb/br and the annual rate would be based on one hour per day of hood use. Emissions from solvent baths used for gun cleaning would be approximately one liquid quart/event; emissions of two pounds per 24 hours were assumed as a worst-case. Hydrocarbon exhaust emissions from lawn and garden vehicles would be routinely equivalent to those of two motor cars. Emissions from 36 government and 50 personal motor vehicles would be associated with mobilization and demobilization of personnel at the St. James Terminal. An emission model was evaluated for 1990 model year automobiles. Emissions for hydrocarbons would be approximately 0.0022 lb/mi. The vehicles are assumed to operate for two hours per day at 25 mph.

A summary of the hydrocarbon emissions from the St. James Terminal is shown in Table 7.6-1 and sample calculations are presented in Appendix S. These emissions are estimated for three different activity scenarios at the terminal: standby, drawdown, and fill. Of the three activity scenarios, tanker loading during drawdown would be the most significant potential source of hydrocarbon emissions. Drawdown would be conservatively based on complete distribution of all of the oil stored in the Capline Complex and up to 42 percent of the oil passing through the St. James Terminal. Fill would be expected to occur at a maximum average rate of 50,000 barrels per day over a period of eight years. The annual emission rates would be for a single calendar year during fill operations. Both fill and drawdown would be projected to occur a maximum of five times over the life of the project. Emissions during standby would be negligible because of the general lack of activity at the terminal.

The emission estimates in Table 7.6-1 are based on emission factors for total hydrocarbons. Reactive hydrocarbons may be determined by identifying specific classes of hydrocarbon species. The speciation of hydrocarbons from the St. James Terminal is based on a report published by EPA.[134] The hydrocarbon speciation profile used for the St. James Terminal is presented in Table 7.6-2. Approximately 90 percent of the emitted hydrocarbons would be reactive (i.e., capable of contributing to the production of photochemical pollutants such as ozone). The table also indicates that small amounts of hazardous air pollutants such as hexane, benzene, and toluene could be emitted at St. James.

An assessment of ozone impacts caused by the release of precursor emissions from the expansion of the St. James Terminal has been performed using the maximum emission estimates presented in Table 7.6-3 as input to the Urban Airshed Model (UAM), the EPA-recommended photochemical model for ozone assessment. See Appendix T. An existing UAM modeling data base for the Baton Rouge ozone nonattainment area, prepared for Louisiana DEQ to simulate the May 24-25, 1990 ozone episode, was used. The May 24-25, 1990 episode is characterized by light northerly winds early on the 24th, shifting to light southeasterly flow for the remainder of episode. Maximum ozone concentrations were measured northwest of Baton Rouge, at the New Roads monitor. For this analysis, two UAM simulations are necessary for assessing impacts on ozone; one simulation with the expanded terminal emissions, and one without. A base case simulation with the existing terminal emission configuration (without expansion) was compared with a simulation in which the terminal expansion-related emissions were added to the modeling inventory. Although a two-day simulation was performed, the assessment of ozone impacts should be derived from the results of the second day only (May 25); the influence of user-specified (and possibly errant) initial conditions on the first day make the results on this day highly uncertain.

The simulation results show hourly ozone concentrations increasing (for this particular meteorological episode - May 25, 1990) by as much as 6 parts per hundred million (pphm), in a small area near Carville. A comparison with the base case ozone concentrations, depicted with the use of "difference isopleths" (Figure 7.6-1), shows areas of ozone increases downwind of the terminal during daylight hours, with small decreases (in magnitude and extent) in ozone concentrations adjacent to the area of increase. Although the area of ozone increase would be small, the magnitude of the increase would be relatively large, resulting in an expanded area of calculated concentrations above the National Ambient Air Quality Standard of 12 pphm for ozone

Table 7.6-1
Emissions of Total Hydrocarbons from the St. James Terminal During Different Project Phases

	Standby		Drawdown		Fill	
SOURCE	**lb/hour**	**tons/yr**	**lb/hour**	**tons/yr**	**lb/hour**	**tons/yr**
Tanks (2-200K bbl)	0.110	0.480	8.780	1.180	5.880	0.780
Tanks (6-400K bbl)	0.480	2.110	19.000	5.020	4.570	3.390
Tanker Dock	0.000	0.000	1510.0	593.17	163.17	28.970
Tanker Dock	0.000	0.000	1510.0	593.17	163.17	28.970
Tanker Dock	0.000	0.000	1510.0	593.17	163.17	28.970
Tanker Dock	0.000	0.000	1510.0	593.17	163.17	28.970
Pump Seals (10)	0.460	2.010	0.460	2.010	0.460	2.010
Valves (584)	0.292	1.280	0.292	1.280	0.292	1.280
Flanges (1200)	0.672	2.940	0.672	2.940	0.672	2.940
Ship Exhaust	0.000	0.000	0.640	0.250	0.160	0.039
Fuel Tanks (18)	12.000	0.048	12.000	0.048	12.000	0.048
Inhib. Tanks (14)	0.020	0.002	0.020	0.002	0.020	0.002
I.C. Engines	0.280	0.014	0.280	0.014	0.280	0.014
Oil Measurement	0.200	0.036	0.200	0.036	0.200	0.036
Lab Hood	1.400	0.256	1.400	0.256	1.400	0.256
Solvent Bath	0.160	0.002	0.160	0.002	0.160	0.002
Grounds Vehicles	0.110	0.040	0.110	0.040	0.110	0.040
Motor Vehicles	4.740	1.730	4.740	1.730	4.740	1.730
TOTAL	**20.92**	**10.95**	**6,088.8**	**2,387.5**	**683.62**	**128.4**

Table 7.6-2
Hydrocarbon Speciation for the St. James Marine Terminal Emissions[1]

Species Name	Molecular Weight	Percent By Weight
Isomers of Hexane	86.17	5.10
Isomers of Heptane	100.20	5.00
Isomers of Octane	114.23	0.40
Isomers of Pentane	72.15	11.20
Methane	16.04	8.80
Ethane	30.07	2.70
Propane	44.09	16.10
N-Butane	58.12	20.80
Iso-Butane	58.12	9.30
N-Pentane	72.15	10.10
Hexane	86.17	4.70
Heptane	100.20	2.00
Benzene	78.11	2.40
Toluene	92.13	1.40
Total		**100.00**

Source: U.S. Environmental Protection Agency, 1988. Air Emissions Species Manual Volume 1: Volatile Organic Compound Species Profiles. EPA-450/2-88-003a.

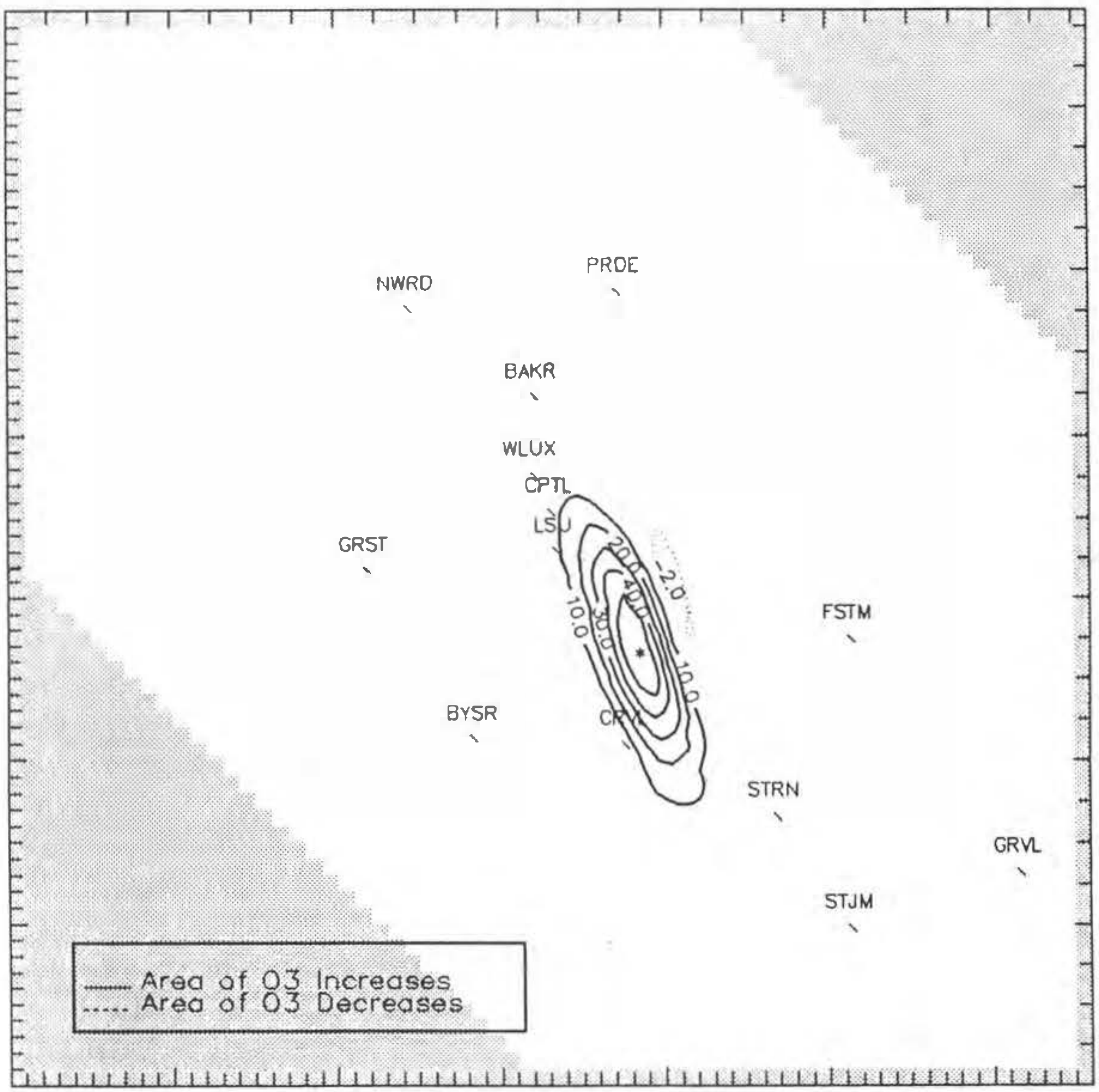
[1] VOC species profile No. 0297 (EPA, 1988) was specified for the St. James Terminal SCC code (40400304).

near the central Baton Rouge area (Figure 7.6-2). The resulting increase in ozone would be expected in this area of the modeling domain because the emissions in the area are dominated by large low-level NOx sources, resulting in low hydrocarbon-to-NOx ratios, making the area near the terminal hydrocarbon limited. Because ozone formation in this area is limited by the amount of available reactive hydrocarbons, any increase in hydrocarbons would be expected to result in an increase in ozone concentrations. The increases would also be expected for another reason; the maximum emissions from the tanker dock are emitted in the UAM simulation from 0700 to 1200, an ideal time period for fresh hydrocarbons to react with emitted NOx to form ozone downwind of the facility during the morning hours and in the afternoon, when ozone concentrations reach their peak.

Table 7.6-3
Maximum Drawdown Emissions (pounds/hour) of Total Hydrocarbons from the St. James Terminal During Ozone Episode (May 24-25, 1990 -- Local Time (CST))

SOURCE	1500-0600	0600-0700	0700-1200	1200-1400	1400-1500
Tanks (2-200K bbl)	0.16	0.16	8.78	0.16	0.16
Tanks (6-400K bbl)	0.68	0.68	19.0	0.68	0.68
Tanker Dock	0	0	1510.00	0	0
Tanker Dock	0	0	1510.00	0	0
Tanker Dock	0	0	1510.00	0	0
Tanker Dock	0	0	1510.00	0	0
Pump Seals (10)	0.46	0.46	0.46	0.46	0.46
Valves (584)	0.29	0.29	0.29	0.29	0.29
Flanges (1200)	0.67	0.67	0.67	0.67	0.67
Ship Exhaust	0	0.64	0.64	0.64	0.64
Fuel Tanks (18)	0	0	2.00	2.00	0
Inhib. Tanks (14)	0.02	0.02	0.02	0.02	0.02
I.C. Engines	0	0	0.28	0.28	0
Oil Measurement	0	0	0.15	0.15	0.
Lab Hood	0	0	1.05	1.05	0
Solvent Bath	0	0	0.16	0.16	0
Grounds Vehicles	0	0	0.11	0.11	0
Motor Vehicles	0	4.74	0	0	4.74
TOTAL	2.3	7.7	6,073.6	6.7	7.7

Figure 7.6-1
Ozone Difference Plots: Base Case with St. James
(May 25, 1990 -- 1600-1700 LST)
(ppb)



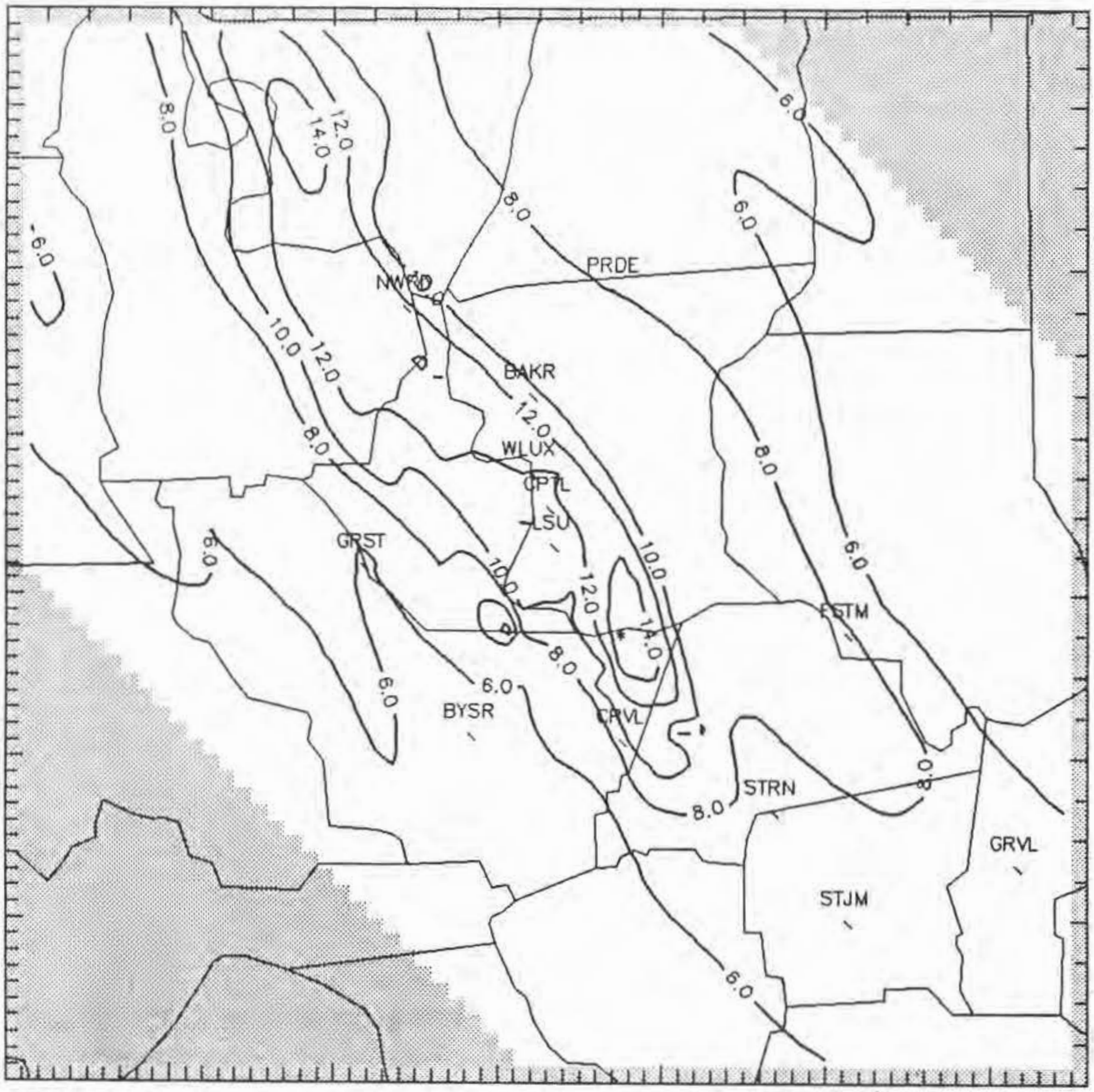
NWRD - New Roads
PRDE - Pride
BAKR - Baker
WLUX - WLUX Port Allen

CPTL - Capitol
LSU - Louisiana State University
GRST - Gross Tete
BYSR - Bayou Sorrell

CRVL - Carville
FSTM - French Settlement
STRN - Star North
GRVL - Garyville
STJM - St. James

Maximum Value = 60.59 ppb
Minimum Value = -2.91 ppb

Figure 7.6-2
Ozone Concentrations: Base Case with St. James
(May 25, 1990 -- 1600-1700 LST)
(pphm)



NWRD - New Roads
PRDE - Pride
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CPTL - Capitol
LSU - Louisiana State University
GRST - Gross Tete
BYSR - Bayou Sorrell

CRVL - Carville
FSTM - French Settlement
STRN - Star North
GRVL - Garyville
STJM - St. James

Maximum Value = 15.56 pphm
Minimum Value = 2.92 pphm

The UAM has been applied to assess ozone impacts for one historical ozone episode with emissions for 1990. Simulation of additional episodes might produce similar results, although this episode was chosen for this analysis because the transport patterns on these days show potential impacts in areas in vicinity of downtown Baton Rouge. A more refined estimate of impacts could be performed for a future year, when the terminal would be expected to be fully operational, and when additional controls have been placed on other nearby industrial and mobile sources in the Baton Rouge area as a result of on-going ozone attainment strategies. Performing a similar impact sensitivity simulation for a future year might lead to a smaller increase in ozone, because the future-year base case emission inventory may change significantly from the 1990 emission levels used in this analysis. In addition, because of the timing in the release of the maximum hydrocarbon emissions for tanker loading during morning hours (0700 to 1200), a worst-case scenario has been simulated. If the process were shifted to the late afternoon, evening, or early nighttime hours, the hydrocarbons released at these times would be well dispersed by the time they would react during the daylight hours, resulting in significantly smaller increases in ozone concentrations downwind of the terminal facility.

7.6.5 Ecological Impacts

Potential ecological impacts from construction and maintenance of the two proposed additional docks and two 400,000-barrel storage tanks at St. James Terminal are discussed in the following sections. The major potential ecological impacts would likely be related to site preparation and construction of dock facilities.

7.6.5.1 Impacts from Terminal Facilities Construction and Maintenance

The two additional storage tanks proposed for the terminal facility at St. James would be constructed on existing DOE-maintained property, thereby not requiring DOE to acquire additional land. Additional storage tanks would be constructed on approximately 25 acres of cleared and mowed grass area on the eastern edge of the St. James Terminal, between the existing terminal facility and Mississippi State Highway 18. The existing terrestrial flora and fauna in this area are species which can tolerate disturbed conditions. After construction is complete, most displaced birds and small mammals would move back into the area and no impacts would be anticipated from routine maintenance.

7.6.5.2 Impacts from Dock Facilities Construction

Construction of two additional dock facilities at the St. James Terminal would require about twelve acres for the dock and road facilities. The extent of dock-site clearing operations along the river would be dependent on the vegetation encountered at the proposed location. Site preparation would also include removal of approximately six inches of top soil from the river bank (above the normal water level); this soil would probably be used as fill during construction of the containment levee around the storage terminal.

Bank degradation above the water level in the river would affect the biotic populations living in or on the bank. There is some shrub and tree (primarily willow) vegetation which provides wildlife habitat adjacent to the planned dock sites. This vegetation would be destroyed or disturbed.

The two additional tanker docks and berthing areas which would be constructed on the Mississippi River near the St. James Terminal would also require dredging of an estimated 1.85 million cubic yards of material from the river bed. The option for disposal of the spoils from dredging would be dispersal of the dredged material in the river channel in depressions in water depths greater than 50 feet. This procedure is standard practice for channel maintenance dredging.[135] The resulting increased turbidity in the river would be evident for several hundred yards downstream; however, these conditions would be temporary, lasting the period of the dredging and a few days after its completion. Adverse impacts would be local and negligible. Plankton populations in this part of the river would generally be expected to be low. Plankton are carried along with the river currents and therefore the plankton found in the river near the terminal have been displaced from upstream backwater areas.[136] Fish would avoid the extremely turbid areas in the main channel and the fish species found in the Mississippi River are well adapted to high turbidities usually present in the water columns. Fish production in the river would not likely be affected.

Aquatic macrophytes do not form an established bank community on the Mississippi River in the project area because of fluctuating water levels and steep banks; therefore, impacts to aquatic macrophytes would be minor.

During dredging activities, pesticides and heavy metals in the sediments would be widely dispersed in the water column and in large measure could be reabsorbed on sediments downstream. Background levels of these pollutants are high in the lower Mississippi. Construction of the docks would result in some redeposition downstream and in some increase of these pollutants in suspension downstream. Aquatic life in these downstream areas could potentially be impacted by the increased concentration of these chemicals in the water column and surface sediments.

7.6.6 Floodplains Impacts

Adding two docks at the St. James Terminal would require dredging of approximately 1.85 million cubic yards. The spoils of the dredging would be dispersed by depositing them in river-bottom depressions to prevent interference with floodplain drainage. No adverse effects on floodplains would be expected.

7.6.7 Natural and Scenic Resources Impacts

The proposed expansion of the St. James Terminal would be unlikely to adversely impact natural or scenic resources. The Louisiana Natural Heritage Program conducted a data base search of the St. James expansion project area and found no threatened or endangered species or critical habitat in the area. In addition, no parks, wildlife refuges, or unique resources would be expected to be affected by the expansion at St. James.[137]

7.6.8 Archaeological, Historical, and Cultural Resources

The construction of additional tanks or docks at the St. James Terminal would be unlikely to affect archeological, historical, or cultural resources in the area. The Louisiana State Historical Preservation Offices have identified no recorded archeological or historical sites located within the proposed St. James Terminal project area. If any material suggesting archeological, historical, or cultural significance would be encountered during construction, DOE would report the findings immediately to appropriate state agencies for further examination and take appropriate steps to protect or preserve such material.[138]

7.6.9 Socioeconomic Impacts

The extent and type of socioeconomic impacts resulting from the expansion of the facilities at St. James would likely be limited. Further, to the degree that there are socioeconomic impacts they would likely be temporary, intermittent, and relatively positive as:

- The St. James Terminal would be an expansion of an existing facility adding up to two docks to the existing two docks and up to two 400,000-barrel tanks to a tank farm that currently has a storage capacity of 2,000,000 barrels in six tanks.

- Although there would be impacts during construction, other than during fill and drawdown, there would not be significant activity at the facility.

- The site at which the expansion would occur is owned by the Department of Energy and located in a industrial area that could accommodate additional workers during the construction period. The parish has experienced unemployment rates that exceed both the Louisiana and national averages.

No demographic impacts would be expected to result from the expansion of the St. James facility. The labor force requirement for construction of the facility would be approximately 135 workers over a period of 17 months. This total includes 62 workers for heavy construction (e.g., equipment operators, carpenters), 50 mechanical workers (e.g., pipefitters, painters), and 23 electrical workers. DOE estimates that there would be sufficient labor available in the region to fulfill these needs. Furthermore, the relative short duration of the project would discourage workers from relocating to the area.

Direct economic impacts of expanding the St. James facility would include the additional income generated from new jobs created during project construction and increased demand for local supplies and materials used for construction of the facility. No data are currently available on the expected payroll for the St. James expansion construction. Given the small size of the project, the overall economic impact on the region would likely be minimal. Expansion of St. James would also have no impact on routine energy consumption. The only facilities being added are docking or storage facilities which would come into use only during fill and drawdown operations.

The primary impacts on transportation systems would result from workers commuting during construction. Given the relatively small number of workers commuting on major transportation arteries, the effects would not likely be noticed. Because no in-migration would be expected to occur, there would be no impacts on housing, education, and health care associated with the terminal expansion. The net fiscal impact of expanding the St. James Terminal would be limited to the tax revenues from wages and expenditures by the additional employees mentioned above. Because it is already a DOE-owned site, no property tax revenue would be lost.

Several negative socioeconomic impacts associated with oil spills should be considered regarding the proposed St. James Terminal expansion site. Several of these impacts could be similar to those of the Big Hill expansion site, which are described in more detail in section

7.1.9.11. Because no brine would be generated or disposed at the St. James Terminal site, there would be no potential for socioeconomic impacts from brine spills.

Water bodies in the vicinity of the St. James Terminal are used for primary and secondary contact recreation, agriculture, and commercial traffic, and the Mississippi River serves as a public water source. Each of these surface water uses could be temporarily disrupted by an oil spill. Numerous groundwater wells exist within a three-mile radius of the St. James Terminal site, and those wells would be potentially affected by an undetected leak of oil from tanks or piping. In addition to a large industrial concentration, land in the area is primarily used for agriculture, and a terrestrial oil spill could also have socioeconomic impacts on activities such as sugar cane cultivation and cattle grazing.

7.6.10 Noise Impacts

The following section discusses the potential noise impacts that would be associated with expanding the St. James Terminal to accommodate the increased fill and drawdown requirements associated with a 1-billion barrel SPR.

7.6.10.1 Construction Noise Impacts

Construction activity at the terminal would involve dredging the Mississippi River, construction of on-site roads, construction of the dock extension, and construction of two additional tanks. Noise levels produced by dock and tank construction would be roughly equal to the predicted noise levels for construction of support facilities at the other sites (i.e., 68 dBA at 500 feet). Construction of roadways and dredging of the river would produce noise levels roughly comparable to road construction at the other sites (i.e., 68 dBA at 500 feet). Because background levels at the site are considerably higher than the 53 dBA that is estimated to result from construction using the model presented in Appendix H, the noise impacts of the expansion construction would be both temporary and insignificant.

7.6.10.2 Operational Noise Impacts

Operational noise sources at the St. James Terminal would be the two additional large pumps (17,500 gpm). These pumps would be expected to produce noise levels comparable to the levels measured near the pumps at the Big Hill site (i.e., 106 dBA) near the pump. Because these pumps are identical to existing pumps at the site, the change in the sound levels would be expected to be minimal, with an expected ambient sound level of 57 dBA at 500 feet from the pumps. Based on the background sound levels at the St. James Terminal, and the fact that 57 dBA is lower than some of the baseline readings taken at 500 feet from the site, no adverse impacts due to noise would be expected as a result of the operation of the expanded St. James Terminal. Operational noise levels would be considerably lower when the site is in a stand-by mode (i.e., when no tankers are loading or unloading).

7.7 Impacts of No Action Alternative

The No Action alternative to the proposed expansion would limit SPR storage capacity to the currently available 750 MMB and would limit distribution during an SPR drawdown to a maximum of 4.5 MMBD. Environmentally, the No Action alternative would limit the impacts from SPR construction and operation to those that have already occurred or that will occur as part of the 750 MMB program at the existing SPR sites in the Capline, Seaway, and Texoma Complexes. Therefore, the environmental impacts described in sections 7.1 through 7.6 would not occur and the existing environment, as described in Chapter 5, would be maintained. However, without a sufficiently large strategic reserve, an embargo or other disruption of normal crude oil supplies could have an adverse impact on the petroleum industry, the economy, and national security. In addition, the No Action alternative would be contrary to the national goal for the storage of up to one billion barrels of crude oil and petroleum products and to the intent of EPCA of 1975 and its amendments of 1990.

The No Action alternative could directly affect the nation's capability to deal effectively with a disruption in the international oil supply. Due to increasing U.S. oil consumption and declining domestic crude oil production, U.S. dependence on crude oil imports is rising. By the year 2000, U.S. crude oil requirements (including the U.S. Virgin Islands and Puerto Rico) are projected to be about 14.5 MMBD and total crude oil imports are projected to rise to 9.5 MMBD. In the event of a major disruption in the U.S. oil supply, an adequately sized national crude oil reserve could provide a greater storage buffer and, thus, sustain national economic stability. On the other hand, with a more limited supply, a decrease in U.S. economic activity and the attendant rise in unemployment would be more likely to occur.

Under the No Action alternative, environmental impacts at the Cote Blanche, Stratton Ridge, and Richton proposed sites and portions of the Big Hill and Weeks Island sites would not occur as described in the previous sections of Chapter 7. These sites would remain with the existing private owners, would continue to be available for commercial salt or brine production, could be developed as petrochemical production and/or storage sites by the private sector, or could be subdivided and developed for other purposes. The environmental impacts that would otherwise result from an SPR expansion to one billion barrels would not occur under the No Action alternative include:

- **Geological Impacts.** There would be no increase in the likelihood of more local subsidence, seismic activity or brine seepage into soils at the proposed expansion sites. In addition, the potential impacts associated with the multiple uses of the different salt domes would remain as they are now.

- **Hydrogeological Impacts.** The relatively small potential for releases of brine and oil to useable groundwater from a variety of sources (e.g., brine settling ponds, underground brine injection wells, and oil and brine pipelines) would be avoided at the proposed sites.

- **Surface Water Impacts.** Several potential surface water impacts would be avoided as a result of No Action. Brine discharge in the Gulf of Mexico, raw water intake from the ICW, and construction activities potentially affecting surface water would not be necessary. In addition, there would not be an increase in the potential for oil and brine releases from pipelines to surface water.

- **Air Quality Impacts.** Although air emissions (e.g., hydrocarbons, dust, carbon monoxide) from the proposed SPR construction and operation activities generally are expected to be small, they would not occur in the event that the No Action alternative is selected.

- **Impacts on Terrestrial Ecology and Wetlands.** The No Action alternative would avoid the further destruction of wetlands and forests, the displacement of wildlife, destruction of smaller wildlife species, and the disruption of wildlife habits that would occur as a result of site and pipeline construction. The No Action alternative would avoid impacts to threatened and endangered species. In addition, the increased likelihood of oil or brine spills would not occur.

- **Floodplain Impacts.** No Action would eliminate SPR site construction at the proposed sites and site preparation would not be necessary. Therefore, mitigation, preservation, and restoration of floodplains would no longer be a consideration.

- **Impacts on Natural and Scenic Resources.** As a result of No Action, the brine disposal and oil pipelines would not be constructed across certain wildlife preserves.

- **Archaeological, Historical, and Cultural Impacts.** Precautionary measures would not be necessary to preserve or protect archaeological or historic material if they should be discovered before or during site construction. At some sites, a cultural resources survey would be avoided.

- **Regional Socioeconomic Impacts.** If No Action occurs, regional work force requirements would be eliminated and in-migration during and after facility construction would not occur. Additional income and demand for supplies and materials for facility construction and operation would not result.

- **Noise Impacts.** Although noise-related impacts would be minor and/or of short duration, the No Action alternative would eliminate the potential for their occurrence.

Under the No Action alternative, these environmental impacts would be avoided for the local areas surrounding the SPR expansion sites. Although some impact areas are potentially significant, the overall impacts of SPR expansion could be summarized as relatively insignificant. On the other hand, limiting the size of the SPR to 750 MMB could adversely affect the U.S.'s ability to adapt to an interruption in the foreign oil supply. In the event of such a supply interruption, an adequate strategic reserve would promote national socioeconomic stability and help avoid the hardships that accompany decreased economic activity.

7.8 Comparison of Alternate Sites

In the summary Tables 7.8-1, 7.8-2, 7.8-3, and 7.8-4, and the text that follows, the five candidate sites are compared to each other with respect to each of the impact areas. The St. James Terminal expansion is a distribution enhancement for the proposed Capline Complex sites, and, therefore, the potential impacts of its expansion are summarized as under the Capline Complex sites.

7.8.1 Geological Impacts

Geological impacts associated with the five candidate sites are expected to be limited to local subsidence over the storage caverns. Because a site in the Capline Complex would have more storage caverns than a site in the Seaway Complex, the area affected by subsidence would be proportionally greater. No significant geological impacts related to pipeline and terminal construction are expected. There are no anticipated cumulative impacts on the Region's geology from the proposed action.

7.8.2 Hydrogeological Impacts

Site development, pipeline construction, and terminal construction (where needed) at each of the five candidate sites under either drawdown criteria would not be expected to cause significant impacts to groundwater quality or flow (Tables 7.8-1, 7.8-2, and 7.8-3). There could be unique hydrogeological impacts at Weeks Island or Cote Blanche, however, if underground injection is used as an alternative to Gulf discharge for brine disposal at these sites. Brine injection at Weeks Island or Cote Blanche would emplace one MMBD of brine in a highly saline formation that is at least 1,200 feet below the ground and separated from shallow fresh groundwater by a 300 to 400-foot thick layer of highly impermeable clay. Smaller quantities of brine generated from cavern maintenance and refill at Richton also would be injected at least 2,000 feet underground in a highly saline formation. Injection at any of these sites would result in an increase in pressure in the receiving formation, but it would not be expected to significantly affect groundwater quality or local seismicity.

In terms of site operations and maintenance (Table 7.8-4), the potential for groundwater contamination and impacts also would be low at all five candidate sites. There are minor differences between the sites in terms of hydrogeological conditions and distances to surface waters that could receive contaminated groundwater discharges in the event of a release to shallow groundwater; however, these differences are generally immaterial recognizing that the engineering design and monitoring of pipelines, ponds, caverns, and other possible release sources make the potential for significant releases to groundwater very low at all five sites. The principle distinguishing feature among the sites is the substantially longer new crude oil and brine discharge pipelines that would be required at Richton, which would make the potential for releases to groundwater from these pipelines somewhat greater at Richton than at the other sites. No cumulative impacts on the Region's hydrogeology would be expected as a result of the proposed action.

7.8.3 Surface Water and Aquatic Ecology Impacts

Under the 270-day drawdown criterion, the principal differences that exist between the candidate sites in terms of potential surface water and aquatic ecology impacts would be associated with site and pipeline construction (Tables 7.8-1 and 7.8-2). In general, adverse effects to surface water and aquatic ecology due to construction would be expected to be substantially less at Big Hill than at the other sites because Big Hill would require the least amount of construction. Site construction at Big Hill, for example, would be very unlikely to result in enhanced sediment loads to surface waters. In contrast, if not controlled, erosion due to site construction would be a potential concern at Weeks Island, where nearby Warehouse Bayou could receive large sediment loads, and at Stratton Ridge, where adjacent Oyster Creek presently provides high quality aquatic habitat. Similarly, no new pipelines would be needed at Big Hill under the 270-day drawdown criterion. Construction of new crude oil, brine discharge, and raw water pipelines at the other sites, however, would temporarily affect water quality and benthic habitat in a number of water bodies. Of particular note would be the large number of waters that would be temporarily affected by the lengthy crude oil and brine pipelines at Richton and the 22-mile stretch of Vermilion Bay that would be crossed by the proposed brine discharge pipeline from Weeks Island or Cote Blanche. Potential impacts in Vermilion Bay would be a particular concern because the Bay serves as an oyster seed ground.

In terms of other categories of surface water and aquatic ecology impacts under the 270-day drawdown criterion, the five candidate sites would be substantially similar. For example, brine discharge into the Gulf from each site would cause minor (+1 ppt) increases in salinity in approximately 5,000 to 7,700 acres without significant impacts to biological communities (see Appendix E) or commercial fisheries (see Appendix G). In addition, raw water intake at each site would cause only minor changes in hydrology, water quality, and biology in the supplying water body — the ICW in the case of Big Hill, Stratton Ridge, Weeks Island, and Cote Blanche, and the Leaf River in the case of Richton.

Under the 180-day drawdown criterion (Table 7.8-3), proposed pipeline construction at Big Hill would pose a greater surface water and aquatic ecology threat than the proposed system enhancements at the other sites. Construction of the Trinity Bay crude oil pipeline from Big Hill to East Houston would temporarily affect water quality and benthic habitat in 19 water bodies, including Trinity Bay. The crossing of Trinity Bay would be of particular concern because it would disturb one the few remaining seagrass beds in the Bay and because care would have to be taken not to puncture any of the innumerable pipelines that already traverse the Trinity Bay floor. As an alternate to the Trinity Bay route, construction of the I-10 crude oil pipeline at Big Hill would temporarily affect 26 water bodies, but none of these waters are believed to contain any sensitive resources like Trinity Bay. Additional crude oil pipeline construction, construction of the new terminal at Pascagoula, and expansion of the St. James Terminal that would be required to meet the 180-day drawdown criterion at Weeks Island, Cote Blanche, or Richton would not be expected to cause significant surface water or aquatic ecology impacts. Because the impacts at any of the proposed sites would be ephemeral, no cumulative impacts would be experienced.

7.8.4 Air Quality Impacts

Major air quality impacts associated with site development or pipeline and terminal construction are temporary fugitive dust emissions from site clearing, facility construction, and use of unpaved roads. The Big Hill site would require the least amount of clearing, and Cote Blanche and Richton the most. Pipeline construction would not be needed for Big Hill under the 270-day drawdown criterion, but some construction would be required under either 270-day or 180-day drawdown criteria for all other sites; the greatest amount of pipeline construction would be required for Richton. Construction of up to two new docks and tanks may be needed under a 180-day drawdown criterion for any of the Capline Complex candidate sites. Substantial volatile hydrocarbon emissions would be expected at the St. James Terminal and/or the Pascagoula Terminal during drawdown and distribution, but predicted effects on ozone concentrations would be temporary and limited in geographic extent. Emissions from the storage sites and from the St. James Terminal and Pascagoula Terminal during standby or fill would be much smaller. Because air impacts would be short-lived, no cumulative impacts on the Region's air quality would result from the proposed action.

7.8.5 Terrestrial Ecology and Wetlands Impacts

The most significant predicted ecological impacts would be those of wetland and habitat loss associated with site construction (see Table 7.8-1). The primary impacts to vegetation from construction of the site are destruction of on-site vegetation and impacts to off-site vegetation from soil erosion and sedimentation. Weeks Island and Stratton Ridge are located in more unique habitats than the other sites. At Stratton Ridge, there are several diverse ecological communities, including emergent and forested wetlands, open parkland forest, and abandoned farmland and orchards. The Weeks Island site is comprised of a combination of agricultural land and mature live oak and magnolia forest. The proposed site locations at Big Hill, Cote Blanche, and Richton are located in areas with few, if any, unique ecological communities.

Potential impacts to wildlife from construction of the proposed sites could include destruction of individuals of smaller or less mobile species of wildlife, displacement of wildlife, and disruption of behavior due to increased traffic and human activity. The diverse vegetative communities at Stratton Ridge and Weeks Island probably support a wider diversity of wildlife than at the remaining sites, and, therefore, impacts to wildlife would likely be greatest at these sites. In addition, nearby suitable habitat would be more readily available at Big Hill, Cote Blanche, and Richton. At Stratton Ridge, much of the area surrounding the proposed site is already cleared and used for livestock grazing, and would be of marginal value to displaced wildlife. At Weeks Island, the proposed site would be on an increasingly heavily used island, and available habitat on the island is limited.

There are two types of on-site ecological resources that are of particular concern: (1) wetlands and (2) species which are threatened or endangered. At two sites, Stratton Ridge and Richton, there are more on-site wetlands (46 and 30 acres, respectively) than at the remaining sites (Weeks Island has six acres, and Big Hill and Cote Blanche have none). At Weeks Island and Cote Blanche, however, impacts to nearby off-site wetlands from increased sedimentation would be more likely. Site-specific endangered species surveys have not yet been conducted, and, therefore, there may be threatened or endangered species that have not yet been identified. Current documentation indicates the possible presence of seven plant species at or near Weeks Island, and three at or near Cote Blanche. No plant species have been documented for Big Hill, Stratton Ridge, or Richton. At three of the sites (Weeks Island, Cote Blanche, and Richton), existing documentation indicates the possible presence of terrestrial threatened or endangered species. The Louisiana black bear may inhabit Weeks Island and Cote Blanche. At Richton, there are three threatened or endangered species which may occur on or near the site: eastern indigo snake, black pine snake, and gopher tortoise. Although at Stratton Ridge there are no known terrestrial threatened or endangered species on-site, threatened bald eagles reportedly nest on Oyster Creek near the site. Thus, Big Hill is the only site where current documentation does not indicate the possible presence of such species.

The primary impact assessed from pipeline construction (Table 7.8-2 and 7.8-3) would be disturbance of wetlands in the 150-foot construction ROW. Because these wetlands would be restored and revegetated, impacts would likely be temporary. The greatest amount of wetland acreage would be associated with Richton (slightly more or less than 500 acres, depending on the selected option). The least wetland acreage would be associated with Big Hill under the 270-day drawdown criterion where no pipeline construction would be required. For the remaining sites (Big Hill under 180-day drawdown; Stratton Ridge, Weeks Island, and Cote Blanche under either drawdown criteria), the wetlands acreage affected would range from approximately 100 acres to approximately 200 acres. Of these options, Big Hill with construction of the I-10 crude oil pipeline has the greatest wetland acreage (235 acres potentially affected) and Cote Blanche under the 270-day criterion has a similar amount of acreage (223 acres). The I-10 route from Big Hill also has the greatest potential for salt water intrusion with four newly constructed crossings between fresh and salt water areas. Pipeline construction for other sites and for the Trinity Bay route from Big Hill would require only one or two such crossings. Because threatened or endangered species surveys have not been conducted for pipeline ROWs, the biological assessment of potential impacts in Appendix F has been limited to species that USFWS has identified as likely to be of concern.

Potential impacts associated with operation and maintenance of the sites and pipelines (Table 7.8-4) would include continued loss of habitat for wildlife due to restricted access and lack of vegetation on the site; disruption of wildlife surrounding the site due to increased traffic, noise, and human activities; loss or impairment of vegetation and wildlife from leaks or spills; and disruption and temporary displacement of wildlife during inspections. These impacts would be of generally lower magnitude than those associated with site development, and as discussed above, could be more significant at Stratton Ridge and Weeks Island due to the ecological diversity of these sites. Some cumulative impacts are possible at Weeks Island because of other industrial and agricultural development at and near the proposed site. Specifically, implementation of the proposed action could further reduce the available habitat for some terrestrial species and affect their population areas in the long-term. At Cote Blanche, the new bridge could also lead to impacts because of increased access and traffic in and around the wetlands. Cumulative impacts at the other sites would not be expected.

7.8.6 Floodplains

If a site were to be selected solely on the basis of floodplain location, Big Hill in Texas and Richton in Mississippi would be the preferred sites. Big Hill and Richton are located in a non-floodplain areas and therefore would be preferable to Stratton Ridge, Weeks Island, and Cote Blanche which are in floodplain areas (see Table 7.8-1). Although the length of pipeline construction varies significantly between sites, pipeline construction and operation are not major concerns in terms of floodplain impacts. Construction impacts would be temporary and the maintenance of underground pipelines would not have long-term impacts on floodplains. Accordingly, no cumulative impacts would be expected.

7.8.7 Natural and Scenic Resources

None of the proposed sites would be located on or in the immediate vicinity of significant natural and scenic resources. Several of the proposed pipeline ROWs, however, would cross through such areas. For Stratton Ridge, the proposed raw water and brine disposal pipelines would be located near the Brazoria National Wildlife Refuge. The proposed brine disposal pipeline from Weeks Island and Cote Blanche (note that the same ROW applies for the two sites) would cross the P.J. Rainey Wildlife Refuge owned by the National Audubon Society and the State Wildlife Refuge. The proposed crude oil pipeline from Richton to Liberty would cross through a short portion of Percy Quin State Park; the route would use an existing ROW. The impacts to these resources are predicted to be insignificant. Cumulative impacts to the Region's natural and scenic resources are also predicted to be insignificant.

7.8.8 Historical and Cultural Resources Impacts

No impacts to any identified historical and cultural resources are expected during site development or pipeline and terminal construction, but a cultural resources survey would be needed to identify possible additional resources at any of the Capline sites and pipeline routes. No cumulative impacts are expected.

7.8.9 Socioeconomic Impacts

Socioeconomic impacts are expected to vary only slightly across the five alternate sites. In all cases, the overall economic impact is expected to be somewhat positive. Development of new or expanded sites would generate between 100 and 300 temporary construction jobs and up to 100 permanent jobs, thus stimulating the local economy, albeit, minimally.

Most of these jobs would be filled by workers currently residing within a commuting distance of the site. Some workers, however, especially permanent workers, might move from another region to a city or town near the site. These workers and their families would place some additional burden on existing public services and will fill vacant housing. The SPR expansion at all candidate sites, however, would lead to regional population increases of only one percent, and these impacts should be minimal. For example, because the entire Gulf region has been strongly affected by the recent economic recession, there would be sufficient vacant housing near the candidate sites to accommodate in-migrating workers. Only at Cote Blanche and Richton would the new residents fill more than 10 percent of the vacant housing even under the high-impact scenario.

The major positive benefit from the SPR expansion would be the increase in personal income generated by the newly created jobs. The estimated levels of additional personal income generated by the SPR expansion would range from $5.7 million at Big Hill to $11 million at Weeks Island, Cote Blanche, or Richton. Further economic benefits would be generated as these newly employed workers spend their disposable income for locally produced goods and services. However, because these impacts are primarily short term, no cumulative impacts on the Region's economy are predicted.

7.8.10 Noise Impacts

Short-term increased sound levels would be expected during construction at any of the candidate sites, with comparable sound levels during pipeline and terminal construction. More potential noise receptors (e.g., residences) would exist at Weeks Island than at other sites but sound levels are expected to be minimal at these receptors. Greatest overall effects may be expected at Richton because of the length of associated pipelines and tank construction. During fill and drawdown, temporary increased sound levels would occur at any of tbe sites, however, no cumulative impacts would result.

Table 7.8-1
Summary Comparison of Impacts Associated With Site Development

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Geological	Local subsidence limited to area immediately over 9 storage caverns.	Local subsidence limited to area immediately over 10 storage caverns.	Local subsidence limited to area immediately over up to 16 storage caverns.	Local subsidence limited to area immediately over up to 16 storage caverns.	Local subsidence limited to area immediately over up to 16 storage caverns.
Hydrogeological	No significant impacts to groundwater quality or flow.	No significant impacts to groundwater quality or flow.	No significant impacts to groundwater quality or flow. As an alternate to brine discharge in the Gulf, underground injection would emplace one MMBD of brine in a highly saline formation at least 1,200 feet below the ground; no significant impacts to shallow fresh groundwater are expected due to injection controls and overlying Sangamon clays.	No significant impacts to groundwater quality or flow. As an alternate to brine discharge in the Gulf, underground injection would emplace one MMBD of brine in a highly saline formation at least 1,200 feet below the ground; no significant impacts to shallow fresh groundwater are expected due to injection controls and overlying Sangamon clays.	No significant impacts to groundwater quality or flow. Small quantities of brine generated from cavern maintenance and refill would be injected at least 2,000 feet underground in a highly saline formation; no significant impacts to shallow fresh groundwater due to injection controls.
Surface Water and Aquatic Ecology	Enhanced erosion during site construction unlikely to significantly increase sediment loads to surface waters. Brine discharge would continue to cause minor increases (+1 ppt) in bottom salinity in 6,000-acre area in Gulf with no significant biological impact. Raw water intake would cause minor changes in ICW hydrology, water quality, and biology.	Of the soil estimated to erode from the site during construction, about 1,100 tons may erode into Oyster Creek, causing minor and temporary increases in suspended solids/turbidity and disruption of benthic community. Brine discharge would cause minor increases (+1 ppt) in bottom salinity in 5,000-acre area in Gulf with no significant biological impact. Raw water intake would cause minor changes in ICW hydrology, water quality, and biology.	Of the soil estimated to erode from the site during construction, about 4,800 tons may erode into Warehouse Bayou, causing major but temporary increases in suspended solids/turbidity; benthic community expected to recover in all but most affected areas. Brine discharge would cause minor increases (+1 ppt) in bottom salinity in 5,300-acre area in Gulf with no significant biological impact. Raw water intake would cause minor changes in ICW hydrology, water quality, and biology.	Of the soil estimated to erode from the site during construction, about 620 tons of soil may erode into the ICW, causing minor and temporary increases in suspended solids/turbidity and disruption of benthic community. Brine discharge would cause minor increases (+1 ppt) in bottom salinity in 5,300-acre area in Gulf with no significant biological impact. Raw water intake would cause minor changes in ICW hydrology, water quality, and biology. Construction of ICW bridge may cause minor and temporary impacts to water quality and aquatic organisms; small portion of ICW bottom removed from available habitat by bridge supports.	Of the soil estimated to erode from the site during construction, about 690 tons of soil may erode into Bogue Homo, causing minor and temporary increases in suspended solids/turbidity and disruption of benthic community. Brine discharge would cause minor increases (+1 ppt) in bottom salinity in 7,700-acre area in Gulf with no significant biological impact. Raw water intake would cause minor changes in Leaf River hydrology, water quality, and biology; intake not expected to interfere with plans to augment freshwater supplies to Pascagoula.

Table 7.8-1
Summary Comparison of Impacts Associated With Site Development

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Air Quality	Short-term increased fugitive dust emissions resulting from clearing of 150-acre site and use of unpaved roads. No significant impacts from vehicle and machinery emissions.	Short-term increased fugitive dust emissions resulting from clearing of 200-acre site and use of unpaved roads. No significant impacts from vehicle and machinery emissions.	Short-term increased fugitive dust emissions resulting from clearing of 270-acre site and use of unpaved roads. No significant impacts from vehicle and machinery emissions.	Short-term increased fugitive dust emissions resulting from clearing of 300-acre site and use of unpaved roads. No significant impacts from vehicle and machinery emissions.	Short-term increased fugitive dust emissions resulting from clearing of 300-acre site and use of unpaved roads. No significant impacts from vehicle and machinery emissions.
Terrestrial Ecology and Natural and Scenic Resources	Clearing and/or grubbing of 150 acres of scrub-shrub uplands and a few stands of mature live oaks. No on-site wetlands. Destruction or alteration of vegetation, displacement of wildlife, destruction of individuals of smaller species, and disruption of habitats due to increased traffic and human activity. No recorded occurrence of rare, threatened, or endangered species onsite.	Clearing and/or grubbing of 200 acres of diverse ecological communities (emergent and forested wetlands, open parkland forest, and abandoned farmland and orchards). Unavoidable impacts to on-site wetlands (34 acres palustrine emergent and 12 acres palustrine forested wetlands). Diverse vegetative communities likely support a wider diversity of wildlife than Big Hill. Impacts could include destruction or alteration of vegetation, displacement of wildlife, destruction of individuals of smaller species, and disruption of habitats due to increased traffic and human activity. No recorded occurrence of rare, threatened, or endangered species onsite. A bald eagle nest reportedly exists on Oyster Creek near the site; impacts from site construction would be negligible.	Clearing and/or grubbing of 270 acres cleared agricultural land and mature live oak and magnolia forest. Potential loss of 6 acres of palustrine forested and estuarine wetlands onsite. Potential impacts to some adjacent wetlands from increased sedimentation. Destruction or alteration of vegetation, displacement of wildlife, destruction of individuals of smaller species, and disruption of habitats due to increased traffic and human activity. Impacts could be especially severe for the threatened Louisiana black bear and endangered bald eagle, both of which may use the site and for the seven rare, threatened, or endangered plant species that occur at or near the site.	Clearing and/or grubbing of 300 acres dense, young, deciduous forest. Potential impacts to some adjacent wetlands from increased sedimentation. Destruction or alteration of vegetation, displacement of wildlife, destruction of individuals of smaller species, and disruption of habitats due to increased traffic and human activity. Impacts could be especially severe for three rare, threatened, or endangered plant species which may occur at or near the site: Texas aster, woodland bluegrass, and broad-leaved spider wort. The threatened Louisiana black bear may also use the site.	Clearing and/or grubbing of 300 acres of even-aged slash pine stands and natural long-leaf/slash pine forest. Unavoidable loss of 5 acres of palustrine forested and emergent wetlands associated with intermittent streams, and increased sedimentation. Destruction or alteration of vegetation, displacement of wildlife, destruction of individuals of smaller species, and disruption of habitats due to increased traffic and human activity. Impacts could be especially severe for three rare, threatened, or endangered species which may occur on or near the site: eastern indigo snake, black pine snake, and gopher tortoise.
Floodplains	No floodplains on proposed site.	Approximately 100-150 acres currently in floodplain would experience change in elevation and site drainage due to rough grading.	Approximately 100-150 acres currently in floodplain would experience change in elevation and site drainage due to rough grading.	Approximately 200-300 acres currently in floodplain would experience change in elevation and site drainage due to rough grading.	No floodplains on proposed site.

Table 7.8-1
Summary Comparison of Impacts Associated With Site Development

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Historical and Cultural	No impacts.	No impacts.	Cultural resources survey needed. No impacts to identified resources, but possible impacts to unrecorded sites.	Cultural resources survey needed. No impacts to identified resources, but possible impacts to unrecorded sites.	Cultural resources survey needed. No impacts to identified resources, but possible impacts to unrecorded sites.
Socioeconomic	Less than 1 % increase in population. Approximately $5.7 million in additional personal income. 1-2 % increase in regional earnings due to demand for local supplies and materials. Less than 1 % increase in local traffic volumes, with minimal effect on congestion and traffic accident rates. 3 % increase in use of vacant housing units. Less than 1 % increase in school enrollment.	Less than 1 % increase in population. Approximately $8.3 million in additional personal income. 5 % increase in regional earnings due to demand for local supplies and materials. Less than 2 % increase in local traffic volumes, with minimal effect on congestion and traffic accident rates. 6 % increase in use of vacant housing units. Less than 1 % increase in resident to hospital bed and physician ratios. Less than 1 % increase in school enrollment. Loss of $100 in property tax. Potential loss of less than 1 % of fish catch. No prime and unique farmland directly converted.	Less than 1 % increase in population. Approximately $11.0 million increase in additional personal income. Some impact on regional earnings due to demand for local supplies and materials. 2 % and 8 % increase in local traffic volumes, with minimal effect on congestion and traffic accident rates. 4 % increase in use of vacant housing units. 1 % and less than 1 % increase in resident to hospital bed and physician ratios. Less than 1 % increase in school enrollment. Potential loss of less than 1 % and 3.1 % in fish catch. No prime and unique farmland directly converted.	1.1 % increase in population. Approximately $11.0 million increase in personal income. Increased demand for local supplies and materials, and increased expenditures. 2 % and 8 % increase in local traffic volumes, with minimal effect on congestion and traffic accident rates. 32 % increase in use of vacant housing units. 1 % and less than 1 % increase in resident to hospital bed and physician ratios. Less than 1 % increase in school enrollment. Potential loss of less than 1 % and 3.1 % in fish catch. No prime and unique farmland directly converted.	Less than 1 % increase in population. Approximately $8.3 million increase in personal income. 13 % increase in regional earnings due to demand for local supplies and materials. 15 % increase in use of vacant housing units. Less than 1 % increase in school enrollment. Minimal fiscal impacts. Potential loss of less than 1 % and 3.1 % in fish catch. 4.2 acres of prime and major farmland directly connected.
Noise	Short-term increased sound levels of 65 to 70 dB at 500 ft from the sound source and short-term increased sound levels of up to 100 dB near the sound source during construction of a 150-acre site.	Short-term increased sound levels of 65 to 70 dB at 500 ft from the sound source and short-term increased sound levels of up to 100 dB near the sound source during construction of a 200-acre site.	Short-term increased sound levels of 65 to 70 dB at 500 ft from the sound source and short-term increased sound levels of up to 100 dB near the sound source during construction of a 270-acre site.	Short-term increased sound levels of 65 to 70 dB at 500 ft from the sound source and short-term increased sound levels of up to 100 dB near the sound source during construction of a 300-acre site.	Short-term increased sound levels of 65 to 70 dB at 500 ft from the sound source and short-term increased sound levels of up to 100 dB near the sound source during construction of a 300-acre site.

Table 7.8-2

Summary Comparison of Impacts Associated With Pipeline and Pump Station Construction Under the 270-Day Alternative

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Geological	No construction required.	No significant impacts.	No significant impacts.	No significant impacts.	No significant impacts.
Hydrogeological	No construction required.	No significant impacts to groundwater quality or flow.	No significant impacts to groundwater quality or flow.	No significant impacts to groundwater quality or flow.	No significant impacts to groundwater quality or flow.
Surface Water and Aquatic Ecology	No construction required.	No impacts from crude oil pipeline construction (one-mile spur does not cross water bodies). Construction of raw water system would cause temporary adverse effects to water quality and benthic habitat at crossings of the ICW, Ridge Slough, and Essex Bayou. Construction of brine pipeline would cause temporary adverse effects to water quality and benthic habitat where the pipeline crosses the ICW, Ridge Slough, Essex Bayou, and a 3.5-mile stretch in the Gulf of Mexico; no particularly sensitive resources (e.g., seagrass or oyster beds) in pipeline ROW.	No impacts from construction of crude oil pipeline spur or booster stations (spur crosses no water bodies and booster stations distant from water bodies). No impacts from raw water pipeline construction (pipeline crosses no water bodies); construction of raw water intake structure would cause temporary adverse effects to water quality and benthic habitat in localized area of the ICW. Construction of brine pipeline would cause adverse effects to water quality and benthic habitat where it crosses the ICW, a 22-mile stretch in Vermilion Bay, and a 15-mile stretch in the Gulf of Mexico; although impacts generally expected to be minor and temporary, oyster beds in pipeline ROW in Vermilion Bay may be severely affected.	Construction of crude oil pipeline spur would cause temporary adverse effects to water quality and benthic habitat in the ICW; no impacts from construction of booster stations (stations distant from water bodies). Impacts from construction of raw water intake system same as for Weeks Island (i.e., no impacts from raw water pipeline construction, but temporary adverse effects to water quality and benthic habitat in localized area of the ICW due to construction of raw water intake structure). Impacts from construction of brine pipeline same as for Weeks Island, except Cote Blanche pipeline will cross ICW twice (rather than once) and cause adverse effects to water quality and benthic habitat in additional unnamed waters in wetlands.	Construction of crude oil pipeline to Liberty would cause temporary adverse effects to water quality and benthic habitat at the crossings of 23 water bodies, of which the Leaf River, Pearl River, Amite River, Tallahala Creek, and Tangipahoa River are the most substantial. Construction of crude oil pipeline to Ten-Mile, AL would cause temporary adverse effects to water quality and benthic habitat at the crossings of 25 water bodies, of which the Escatawpa River and Big Creek are the most substantial. No impacts from raw water pipeline construction (pipeline crosses no water bodies); construction of raw water intake structure would cause temporary adverse effects to water quality and benthic habitat in localized area of the Leaf River. Construction of crude oil and brine pipeline would cause temporary adverse effects to water quality and benthic habitat at the crossings of 24 inland water bodies (including the

Table 7.8-2
Summary Comparison of Impacts Associated With Pipeline and Pump Station Construction Under the 270-Day Alternative

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Surface Water and Aquatic Ecology (Continued)					Escatawpa and Chickasawhay Rivers), an eight-mile stretch of Mississippi Sound, and the Gulf of Mexico south of Horn Pass; no particularly sensitive resources (e.g., seagrass or oyster beds) in pipeline ROW. Construction of the blanket oil pipeline to the Hess 10" line would cause temporary adverse effects to water quality and benthic habitat at the crossings of eight water bodies, of which Bogue Homo is the most substantial. Construction of other pipeline spurs in the Pascagoula area are not expected to increase significantly sediment load to surface waters. Construction of tankage at Liberty and/or Chevron/ Pascagoula are not expected to increase significantly sediment load to surface waters. Construction of the Pascagoula Terminal is not expected to significantly increase sediment loads to surface waters.
Air Quality	No construction required.	Short-term increased fugitive dust emissions from construction of up to 24 miles of pipeline.	Short-term increased fugitive dust emissions from construction of up to 58 miles of pipeline.	Short-term increased fugitive dust emissions from construction of up to 50 miles of pipeline.	Short-term increased fugitive dust emissions from construction pipelines (length depends on selected alternative) and new tanks or terminal at Pascagoula.

Table 7.8-2
Summary Comparison of Impacts Associated With Pipeline and Pump Station Construction Under the 270-Day Alternative

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Terrestrial Ecology and Natural and Scenic Resources	No construction required.	116 acres of wetlands could be affected. Impacts to wetlands from pipeline construction include destruction or alteration of vegetation/habitat along the ROW. It is possible that altered surface flow could result in salt water intrusion into freshwater wetlands, which could kill salt-intolerant species and change the community structure. The proposed brine pipeline would cross one freshwater/saltwater interface, indicating a low potential for saltwater intrusion. Endangered species survey needed for pipeline ROWs. Proposed water and brine pipelines cross Brazoria National Wildlife refuge, areas used by migrating waterfowl and songbirds. Species that rely on this refuge as a breeding, nesting, or feeding ground will be disrupted during pipeline construction.	A total of 96 acres of wetlands could be affected. Impacts to wetlands from pipeline construction include destruction or alteration of vegetation/habitat along the ROW. It is possible that altered surface flow could result in saltwater intrusion into freshwater wetlands, which would kill salt-intolerant species and change the community structure. No freshwater/saltwater interfaces crossed, indicating that the potential for saltwater intrusion is negligible. Endangered species survey needed for pipeline ROWs. No impacts to rare, threatened, or endangered species known at this time. Brine pipeline crosses P.J. Rainey Wildlife Refuge. Impacts to species using this wildlife refuge are the as those for Stratton Ridge.	A total of 223 acres of wetlands could be affected. Impacts to wetlands from pipeline construction include destruction or alteration of vegetation/habitat along the ROW. It is possible that altered surface flow could result in saltwater intrusion into freshwater wetlands, which would kill salt-intolerant species and change the community structure. No freshwater/saltwater interfaces crossed, indicating that the potential for saltwater intrusion is negligible. Endangered species survey needed for pipeline ROWs. No impacts to rare, threatened, or endangered species known at this time. Brine pipeline crosses P.J. Rainey Wildlife Refuge. Impacts to species using this wildlife refuge are the as those for Stratton Ridge.	552 acres of wetlands could be affected if the Liberty route is selected. 462 acres could be affected if the Mobile route is selected. 419 acres could be affected if the Pascagoula terminal alternative is selected. Impacts to wetlands from pipeline construction include destruction or alteration of vegetation/habitat along the ROW. It is possible that altered surface flow could result in saltwater intrusion into freshwater wetlands, which would kill salt-intolerant species and change the community structure. The dual-purpose pipeline crosses two freshwater/saltwater interfaces, and therefore, the overall likelihood of saltwater intrusion is low to moderate. The proposed crude oil pipeline to Liberty would cross through a short portion of Percy Quin State Park in an existing ROW. The dual-purpose pipeline crosses Leaf and Chickasawhay Rivers, areas used by the Federal threatened yellow-blotched sawback turtle. Gopher tortoise and 4 plant species are other endangered or threatened species that could occur along this pipeline. Most likely impacts are destruction of individuals. Construction of a DOE terminal at the Jackson County Airport site would avoid wetlands.

Table 7.8-2
Summary Comparison of Impacts Associated With Pipeline and Pump Station Construction Under the 270-Day Alternative

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Floodplains	No construction.	Temporary change in drainage patterns from pipeline construction.	Temporary change in drainage patterns from pipeline construction.	Temporary change in drainage patterns from pipeline construction.	Temporary change in drainage patterns from pipeline construction.
Historical and Cultural	No construction required.	No impacts.	Cultural resources survey needed. No impacts to identified resources, but possible impacts to unrecorded sites.	Cultural resources survey needed. No impacts to identified resources, but possible impacts to unrecorded sites.	Cultural resources survey needed. No impacts to identified resources, but possible impacts to unrecorded sites.
Socioeconomic	Impacts resulting from operations and maintenance will be some percentage of the impacts resulting from site construction. See Table 7.7-1 for overall impacts.	43.2 acres of prime and unique farmland would be temporarily and indirectly converted. Impacts resulting from operations and maintenance will be some percentage of the impacts resulting from site construction. See Table 7.7-1 for overall impacts.	1.9 acres of prime and unique farmland would be temporarily and indirectly converted. Impacts resulting from operations and maintenance will be some percentage of the impacts resulting from site construction. See Table 7.7-1 for overall impacts.	1.9 acres of prime and unique farmland would be temporarily and indirectly converted. Impacts resulting from operations and maintenance will be some percentage of the impacts resulting from site construction. See Table 7.7-1 for overall impacts.	Construction of pipeline to Liberty would result in a total of 907.4 acres of prime and unique farmland temporarily and indirectly converted. Construction of pipeline to Ten-Mile, AL, would result in a total of 119.5 acres of prime and unique farmland temporarily and indirectly converted. Impacts resulting from operations and maintenance will be some percentage of the impacts resulting from site construction. See Table 7.7-1 for overall impacts.
Noise	No construction required.	Short-term increased noise levels of 61 to 69 dBA at 500 ft during construction of 24 miles of pipeline.	Short-term increased noise levels of 61 to 69 dBA at 500 ft during construction of up to 58 miles of pipeline.	Short-term increased noise levels of 61 to 69 dBA at 500 ft during construction of up to 50 miles of pipeline.	Short-term increased noise levels of 61 to 69 dBA at 500 ft during construction of 222 miles of pipeline.

Table 7.8-3
Summary Comparison of Impacts Associated With Pipeline and Pump Station Construction Under the 180-Day Alternative

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Geological	No significant impacts.	Same as 270-day.	Same as 270-day.	Same as 270-day.	Same as 270-day.
Hydrogeological	Same as 270-day.	Same as 270-day.	Same as 270-day.	Same as 270-day.	Same as 270-day.
Surface Water and Aquatic Ecology	Construction of the Trinity Bay crude oil pipeline would cause temporary adverse effects to water quality and benthic habitat at the crossings of 19 water bodies. including San Jacinto Bay, Tabbs Bay, and a nine-mile stretch of Trinity Bay; Trinity Bay crossing would likely destroy seagrass beds in a 150-foot ROW on the Bay's eastern shore, but is not expected to affect oysters; crossing Trinity Bay also raises the possibility of puncturing an existing submerged pipeline. resulting in an uncontrolled release of oil and associated impacts. Construction of the I-10 crude oil pipeline would cause temporary adverse effects to water quality and benthic habitat at the crossings of 26 water bodies, of which the Trinity and San Jacinto Rivers are the most substantial.	Same as 270-day.	Construction of crude oil pipeline spur to the Texas 22" pipeline would cause temporary adverse effects to water quality and benthic habitat at the crossings of four small water bodies, Warehouse Bayou, Bayou Patout, Stumpy Bayou, and Little Valley Bayou. Construction to expand the St. James Terminal (the alternate to the spur to Texas 22") is not expected to significantly increase sediment loads to surface waters. Construction of two new docks at St. James would cause temporary adverse effects to water quality in the Mississippi River; initial and maintenance dredging in 2,600 foot by 1,100 foot area for dock construction and subsequent dredged material disposal in the Mississippi would permanently alter benthic habitat, but overall impacts to bottom dwellers expected to be minimal.	Construction of crude oil pipeline spur to the Texas 22" pipeline would cause the same impacts as the spur for Weeks Island, except construction of the spur from Cote Blanche also would cause temporary adverse effects to water quality and benthic habitat at crossings of the ICW and additional unnamed waters in wetlands. Expansion of the St. James Terminal (the alternate to the spur to Texas 22") for Cote Blanche operations would cause the same impacts as those described for Weeks Island. Impacts from construction of raw water intake and brine discharge pipelines would be the same as under the 270-day alternative (the same pipeline construction would be required under the 180-day alternative).	Expansion of the St. James Terminal with one new dock is not expected to increase significantly sediment loads to surface waters. Construction of meter stations and pipeline connections to commercial and proposed state-owned docks in Pascagoula is not expected to increase significantly sediment loads to surface waters.

[a] This summary table addresses only components of the proposed action that are not required under the 270-day drawdown criterion but that are required to support a 180-day drawdown criterion. These impacts are, therefore, in addition to those summarized in Table 7.8-2.

Table 7.8-3
Summary Comparison of Impacts Associated With Pipeline and Pump Station Construction Under the 180-Day Alternative

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Air Quality	Short-term increased fugitive dust emissions from construction of up to 62 miles of pipeline.	Same as 270-day alternative.	Same as 270-day alternative with an additional 7 miles of pipeline or new docks and tanks at St. James.	Same as 270-day alternative with an additional 7 miles of pipeline or new docks and tanks at St. James.	Same as 270-day alternative with a new dock and tank at St. James.
Terrestrial Ecology and Natural and Scenic Resources	Trinity Bay route: 148 acres of palustrine emergent and scrub/shrub wetlands potentially impacted; or I-10 route: 235 acres of wetlands potentially impacted. Impacts to wetlands from pipeline construction include destruction or alteration of vegetation/ habitat along the ROW. It is possible that altered surface flow could result in saltwater intrusion into freshwater wetlands, which could kill salt-intolerant species and damage the community structure. The Trinity Bay route crosses approximately 4 freshwater/saltwater interfaces, indicating a moderate potential for saltwater intrusion. The I-10 route does not cross any freshwater/salt-water interfaces. No known occurrences of rare, threatened, or endangered species along either route.	Same as 270-day alternative.	In addition to the wetlands potentially affected by construction under the 270-day alternative, 98 acres of wetland could be affected by pipeline construction. Types of impacts are the same as those discussed under the 270-day alternative. The Texas 22" pipeline would cross one freshwater/saltwater interface, indicating the potential for saltwater intrusion is low. St. James Terminal expansion: no wetlands affected. Area is already disturbed; impacts to vegetation/ habitat and terrestrial wildlife would be minimal. Eastern pump station is located near Lake Verrett, an area heavily used by endangered bald eagles.	Same as Weeks Island.	Same as 270-day, plus St. James Terminal expansion (1 dock and 1 tank only) and an additional pump station. If either of the Liberty alternatives are selected, no additional wetlands would be affected. 45 additional acres of wetlands could be affected if the Mobile alternative is selected. No additional wetlands impacts if Pascagoula only option is selected. Same endangered species impacts as 270-day alternative.

Table 7.8-3
Summary Comparison of Impacts Associated With Pipeline and Pump Station Construction Under the 180-Day Alternative

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Floodplains	Temporary change in drainage patterns from pipeline construction.	Same as 270-day.	No impacts to floodplains from St. James Terminal expansion. Temporary change in drainage patterns from pipeline construction.	Same as Weeks Island.	No impacts to floodplains from St. James Terminal expansion. Temporary change in drainage patterns from pipeline construction.
Historical and Cultural	No impacts.	Same as 270-day.	Same as 270-day.	Same as 270-day.	Same as 270-day.
Socioeconomic	Construction of the Trinity Bay pipeline would result in a total of 380.8 acres of prime and unique farmland temporarily and indirectly converted. Construction of the I-10 pipeline would result in a total of 494.1 acres of prime and unique farmland temporarily and indirectly converted. Impacts resulting from operations and maintenance would be some percentage of the impacts resulting from site construction. See Table 7.7-1 for overall impacts.	Prime and unique farmland impacts same as 270-day. Impacts resulting from operations and maintenance would be some percentage of the impacts resulting from site construction. See Table 7.7-1 for overall impacts.	Prime and unique farmland impacts same as 270-day. Impacts resulting from operations and maintenance would be some percentage of the impacts resulting from site construction. See Table 7.7-1 for overall impacts.	Prime and unique farmland impacts same as 270-day. Impacts resulting from operations and maintenance would be some percentage of the impacts resulting from site construction. See Table 7.7-1 for overall impacts.	Prime and unique farmland impacts same as 270-day. Impacts resulting from operations and maintenance would be some percentage of the impacts resulting from site construction. See Table 7.7-1 for overall impacts.
Noise	Short-term increased noise levels of 61 to 69 dBA at 500 ft during construction of up to 62 miles of pipeline.	Short-term increased noise levels of 61 to 69 dBA at 500 ft during construction of 24 miles of pipeline.	Same as 270-day alternative with an additional 7 miles of pipeline and new docks and tanks at St. James.	Same as 270-day alternative with an additional 7 miles of pipeline and new docks and tanks at St. James.	Same as 270-day alternative with a new dock and tank at St. James.

Table 7.8-4
Summary Comparison of Impacts Associated With Operations and Maintenance

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Geological	Local subsidence limited to area immediately over 9 storage caverns.	Local subsidence limited to area immediately over 10 storage caverns.	Local subsidence limited to area immediately over up to 16 storage caverns.	Local subsidence limited to area immediately over up to 16 storage caverns.	Local subsidence limited to area immediately over up to 16 storage caverns.
Hydrogeological	Groundwater contamination and associated impacts very unlikely.	Like Big Hill, groundwater contamination and associated impacts very unlikely; however, aquifer use patterns and proximity to Oyster Creek make potential human health and ecological impacts more of a concern at Stratton Ridge than Big Hill.	Groundwater contamination and associated impacts very unlikely, even if the St. James Terminal is expanded as a distribution alternative.	Potential groundwater contamination and impacts essentially the same as for Weeks Island; differences between the sites include (1) slightly longer crude oil pipeline spur and longer brine discharge pipeline (i.e., greater risk of pipeline release to groundwater) for Cote Blanche, and (2) farther distance to downgradient surface water (i.e., smaller potential for ecological impacts in surface water caused by the discharge of contaminated groundwater) at the Cote Blanche site.	Like Weeks Island and Cote Blanche, groundwater contamination and associated impacts very unlikely; primary differences include (1) substantially longer crude oil and brine discharge pipeline (i.e., greater risk of pipeline release to groundwater) at Richton, and (2) except for nearby intermittent streams, a farther distance to downgradient surface water (i.e., a smaller potential for ecological impacts in surface water caused by the discharge of contaminated groundwater) at the Richton site.

Table 7.8-4
Summary Comparison of Impacts Associated With Operations and Maintenance

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Surface Water and Aquatic Ecology	Because oil spills from vessels in the open ocean and spills from crude oil pipelines are very unlikely, significant oil spill impacts to the ocean and waters crossed by crude oil pipelines are not expected. Infrequent, small (<20 barrel) oil spills either from vessels or from handling operations at terminals could result in severe though localized and temporary impacts in coastal/inland waters, depending on spill location and timing; waters near terminals in Nederland, TX and/or, under the 180-drawdown scenario, terminals in Houston, TX appear to be at greatest risk. Infrequent, small (<20 barrel) oil spills at Big Hill site not expected to significantly affect water bodies because waters are distant and not likely to be contaminated by such spills. Anticipated one to eight small (≤ 75 barrel) brine spills and one larger (≥ 74,000 barrel) brine spill could cause intense but localized and temporary impacts in Salt Bayou and Star Lake at points where they are crossed by the brine discharge pipeline.	Because oil spills from vessels in the open ocean and spills from crude oil pipelines are very unlikely, significant oil spill impacts to the ocean and waters crossed by crude oil pipelines are not expected. Infrequent, small (<20 barrel) oil spills either from vessels or from handling operations at the terminal in Texas City, TX could result in severe though localized and temporary impacts in coastal/inland waters, depending on spill location and timing; waters adjacent to the terminal appear to be at greatest risk. Infrequent, small (<20 barrel) oil spills at Stratton Ridge site could result in severe though localized and temporary impacts in Oyster Creek, if not contained. Anticipated one to eight small (≤ 75 barrel) brine spills and one larger (≥ 74,000 barrel) brine spill could cause intense but localized and temporary impacts in Oyster Creek, the ICW, Swan Lake, Stubblefield Lake, Ridge Slough, Essex Bayou, and various unnamed lakes and bayous crossed by the proposed brine discharge pipeline route.	Because oil spills from vessels in the open ocean and spills from crude oil pipelines are very unlikely, significant oil spill impacts to the ocean and waters crossed by crude oil pipelines are not expected. Infrequent, small (<20 barrel) oil spills either from vessels or from handling operations at the St. James Terminal could result in severe though localized and temporary impacts in coastal/inland waters, depending on spill location and timing; the lower Mississippi River appears to be at greatest risk. Infrequent, small (<20 barrel) oil spills at Weeks Island site could result in severe though localized and temporary impacts in Warehouse Bayou, if not contained. Anticipated one to eight small (≤ 75 barrel) brine spills and two larger (≥ 74,000 barrel) brine spills could cause intense but localized and temporary impacts in Warehouse Bayou, the ICW, Weeks Bay, and Vermilion Bay; potential localized impacts to oysters of particular concern for a brine pipeline leak in Weeks and Vermilion Bays.	Because oil spills from vessels in the open ocean and spills from crude oil pipelines are very unlikely, significant oil spill impacts to the ocean and waters crossed by crude oil pipelines are not expected. Infrequent, small (<20 barrel) oil spills either from vessels or from handling operations at the St. James Terminal could result in severe though localized and temporary impacts in coastal/inland waters, depending on spill location and timing; the lower Mississippi River appears to be at greatest risk. Infrequent, small (<20 barrel) oil spills at Cote Blanche could result in severe though localized and temporary impacts in the ICW, if not contained. Brine spill risks and impacts essentially the same as for Weeks Island, except that brine pipeline leak at Cote Blanche could also cause intense but localized and temporary impacts in additional unnamed waters in wetlands between Weeks Island and Cote Blanche.	Because oil spills from vessels in the open ocean and spills from crude oil pipelines are very unlikely, significant oil spill impacts to the ocean and waters crossed by crude oil pipelines are not expected. Infrequent, small (<20 barrel) oil spills either from vessels or handling operations at the terminals in Liberty, Pascagoula, or Ten-Mile could result in severe though localized and temporary impacts in coastal/ inland waters, depending on spill location and timing; waters adjacent to the terminals appear to be at greatest risk. Infrequent, small (<20 barrel) oil spills at Richton site could result in severe though localized and temporary impacts in Bogue Homo, if not contained. Anticipated one to eight small (≤75 barrel) brine spills and two larger (≥74,000 barrel) brine spills could cause intense but localized and temporary impacts in any of the waters crossed by the proposed brine pipeline (24 inland water bodies and Mississippi Sound).

Table 7.8-4
Summary Comparison of Impacts Associated With Operations and Maintenance

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Air Quality	Negligible air quality impacts during standby. Volatile hydrocarbon emissions during fill of 9 caverns, but no significant impacts on air quality.	Negligible air quality impacts during standby. Volatile hydrocarbon emissions during fill of 10 caverns, but no significant impacts on air quality.	Negligible air quality impacts during standby. Volatile hydrocarbon emissions during fill of up to 16 caverns, but no significant impacts on air quality. For 180-day drawdown, substantial volatile hydrocarbon emissions possible at St. James, but no long-term impacts on air quality.	Negligible air quality impacts during standby. Volatile hydrocarbon emissions during fill of up to 16 caverns, but no significant impacts on air quality. For 180-day drawdown, substantial volatile hydrocarbon emissions possible at St. James, but no long-term impacts on air quality.	Negligible air quality impacts during standby. Volatile hydrocarbon emissions during fill of up to 16 caverns, but no significant impacts on air quality. For certain drawdown scenarios, substantial volatile hydrocarbon emissions possible at St. James or Pascagoula, but no long-term impacts on air quality.

Table 7.8-4
Summary Comparison of Impacts Associated With Operations and Maintenance

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Terrestrial Ecology and Natural and Scenic Resources	Vegetation on-site will be mowed frequently and will be of little value as habitat for many species. The site will be fenced for the lifetime of the project and therefore access will be restricted for many wildlife species. Wildlife near the site could be disrupted by increased human activity and traffic. There could be an increased number of animals lost due to increased traffic. Impacts to wildlife from an oil or brine spill on-site could be severe due to habitat loss and possibly direct losses of adults, young, and/or eggs if breeding areas are affected. Potential impacts to birds and mammals from an oil spill include hypothermia or drowning due to oil-coated feathers or fur, and direct toxic effects from ingestion of oil while preening. Large scale impacts might include disruption of ecosystem structure and function. There are no wetlands on the proposed site and therefore no impacts from site maintenance are predicted. Impacts from site operation and maintenance are not expected provided that no endangered species occur on-site.	Vegetation on-site will be mowed frequently and will be of little value as habitat for many species. The site will be fenced for the lifetime of the project and therefore access will be restricted for many wildlife species. Wildlife near the site could be disrupted by increased human activity and traffic. There could be an increased number of animals lost due to increased traffic. Impacts to wildlife from an oil or brine spill on-site could be severe due to habitat loss and possibly direct losses of adults, young, and/or eggs if breeding areas are affected. Potential impacts to birds and mammals from an oil spill include hypothermia or drowning due to oil-coated feathers or fur, and direct toxic effects from ingestion of oil while preening. Large scale impacts might include disruption of ecosystem structure and function. Wetlands on the proposed site that remain following construction are unlikely to be impacted from site maintenance. Impacts from an oil or brine spill on-site could kill vegetation and aquatic life in the wetlands. Site operation and maintenance activities could disrupt any bald eagles nesting nearby.	Vegetation on-site will be mowed frequently and will be of little value as habitat for many species. The site will be fenced for the lifetime of the project and therefore access will be restricted for many wildlife species. Wildlife near the site could be disrupted by increased human activity and traffic. There could be an increased number of animals lost due to increased traffic. Impacts to wildlife from an oil or brine spill on-site could be severe due to habitat loss and possibly direct losses of adults, young, and/or eggs if breeding areas are affected. Potential impacts to birds and mammals from an oil spill include hypothermia or drowning due to oil-coated feathers or fur, and direct toxic effects from ingestion of oil while preening. Large scale impacts might include disruption of ecosystem structure and function. The threatened Louisiana black bear is known to use the site, and the endangered bald eagle could occur on-site but has not been observed. Site operation and maintenance would result in continued loss of habitat for the lifetime of the project. Increased human activity could further decrease habitat value of remaining portions of the island.	Vegetation on-site will be mowed frequently and will be of little value as habitat for many species. The site will be fenced for the lifetime of the project and therefore access will be restricted for many wildlife species. Wildlife near the site could be disrupted by increased human activity and traffic. There could be an increased number of animals lost due to increased traffic. Impacts to wildlife from an oil or brine spill on-site could be severe due to habitat loss and possibly direct losses of adults, young, and/or eggs if breeding areas are affected. Potential impacts to birds and mammals from an oil spill include hypothermia or drowning due to oil-coated feathers or fur, and direct toxic effects from ingestion of oil while preening. Large scale impacts might include disruption of ecosystem structure and function. Same as for Weeks Island except that the Louisiana black bear is not known to occur on-site. Any threatened, endangered, or rare plant species remaining following site construction could be destroyed from an on-site oil or brine spill.	Vegetation on-site will be mowed frequently and will be of little value as habitat for many species. The site will be fenced for the lifetime of the project and therefore access will be restricted for many wildlife species. Wildlife near the site could be disrupted by increased human activity and traffic. There could be an increased number of animals lost due to increased traffic. Impacts to wildlife from an oil or brine spill on-site could be severe due to habitat loss and possibly direct losses of adults, young, and/or eggs if breeding areas are affected. Potential impacts to birds and mammals from an oil spill include hypothermia or drowning due to oil-coated feathers or fur, and direct toxic effects from ingestion of oil while preening. Large scale impacts might include disruption of ecosystem structure and function. The three species of concern that could occur on-site, gopher tortoise, black pine snake, and eastern indigo snake, are unlikely to remain on-site following site constuction. Any individuals that do remain are unlikely to be impacted by site operation and maintenance activities.

Table 7.8-4
Summary Comparison of Impacts Associated With Operations and Maintenance

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Terrestrial Ecology and Natural and Scenic Resources (cont'd)	270-day: Impacts from maintenance of existing pipelines will be minimal. The probability of impacts to wetlands from potential oil or brine spills is related to the length of the pipeline and the amount of pipeline that crosses or is immediately upgradient from a wetland. 180-day: Trinity Bay route crosses 87 acres wetlands. I-10 route crosses 235 acres wetlands.	An oil or brine spill into Oyster Creek would likely kill fish, a major component of the eagle's diet. Impacts would probably be minimal because the eagle has a very large foraging range. 270-day: Impacts from maintenance of pipelines will be minimal. Impacts same as Big Hill, except 68 acres of wetlands crossed by brine or oil pipeline. 180-day: Same as 270-day.	Any threatened, endangered, or rare plant species remaining following site construction could be destroyed from an on-site oil or brine spill. Wetlands on the proposed site that remain following construction are unlikely to be impacted from site maintenance. Impacts from an oil or brine spill on-site could kill vegetation and aquatic life in the wetlands on-site and adjacent to the proposed site. 270-day: Same as Stratton Ridge, except 79 acres of wetlands crossed by brine or oil pipeline. 180-day: 98 additional acres wetlands crossed by brine or oil pipeline.	Wetlands on the proposed site that remain following construction are unlikely to be impacted from site maintenance. Impacts from an oil or brine spill on-site could kill vegetation and aquatic life in the wetlands on-site and adjacent to the proposed site. 270-day: Same as Stratton Ridge, except 216 acres wetlands crossed by brine or oil pipeline. 180-day: 98 additional acres wetlands crossed by brine or oil pipeline.	These species are ground-dwelling animals that could be impacted in the event of an on-site oil or brine spill. Nests and young in underground burrows could be destroyed. Severity of impacts would depend upon the type and magnitude of the spill. Wetlands on the proposed site that remain following construction are unlikely to be impacted from site maintenance. A spill on-site could impact vegetation and aquatic on-site and in the intermittent streams that drain the site. 270-day: Same as Stratton Ridge, except 531 acres wetlands crossed if Liberty route is selected, or 441 acres wetlands affected if Mobile route is selected. 180-day: if Liberty route is selected, no additional wetlands will be affected. If Mobile route is selected, no additional wetlands would be expected to be impacted.
Floodplains	No impacts.	No impacts.	No impacts.	No impacts.	No impacts.
Historical and Cultural	No impacts.	No impacts.	No impacts.	No impacts.	No impacts.

Table 7.8-4
Summary Comparison of Impacts Associated With Operations and Maintenance

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Socioeconomic	Impacts resulting from operations and maintenance will be some percentage of the impacts resulting from site construction. See Table 7.8-1 for overall impacts. Potential oil and brine spills might result in: Costs associated with restoring natural resources Costs associated with groundwater restoration and alternative water supply Loss of recreational facilities Loss of direct and indirect income, particularly in the fishing, agricultural, and related industries. In addition, oil spills might result in: Cleanup costs for governments, businesses, and private parties Decrease in value and use of private property Adverse effects to physical characteristics of facilities or resources Six significant water bodies are located within five miles of the site which are used for irrigation. The pipelines will cross 19-26 water bodies which are used for recreational and commercial purposes. All of these could potentially be impacted by spills.	Impacts resulting from operations and maintenance will be some percentage of the impacts resulting from site construction. See Table 7.8-1 for overall impacts. Oil and brine spills: same as Big Hill, plus: At least 28 water bodies are located within five miles of the site which are used for irrigation. All of these, plus a significant number of industrial and irrigation/agricultural uses, could potentially be impacted by spills. Approximately 60 % of the land near the site is used for agriculture. This land could be significantly impacted by an oil spill.	Impacts resulting from operations and maintenance will be some percentage of the impacts resulting from site construction. See Table 7.8-1 for overall impacts. Oil and brine spills: same as Big Hill, plus: At least 31 water bodies are located within five miles of the site. Pipeline construction could cross four water bodies. All of these could potentially be impacted by spills. All of these water bodies support recreational fishing and boating, small boat and barge traffic, and oil field service. A terrestrial oil spill could have significant impact near the site because the land is primarily used for agriculture and forestry. At least 68 species of fish inhabit the area, all of which are important for commercial and recreational fishing.	Impacts resulting from operations and maintenance will be some percentage of the impacts resulting from site construction. See Table 7.8-1 for overall impacts. Oil and brine spills: same as Big Hill, plus: At least 14 water bodies are located within five miles of the site. Pipeline construction could cross four water bodies. All of these could potentially be impacted by spills. All of these water bodies support recreational fishing and boating, small boat and barge traffic, and oil field service. A terrestrial oil spill could have significant impact near the site because the land is primarily used for agriculture and forestry. At least 68 species of fish inhabit the area, all of which are important for commercial and recreational fishing.	Impacts resulting from operations and maintenance will be some percentage of the impacts resulting from site construction. See Table 7.8-1 for overall impacts. Oil and brine spills: same as Big Hill, plus: At least 26 named water bodies are located within five miles of the site. Pipeline construction could cross 37 water bodies. All of these could potentially be impacted by spills. All of these water bodies support recreational purposes. A terrestrial oil spill could have significant impact near the site because the land is primarily used for agriculture and forestry. At least 50 species of fish inhabit the area, all of which are important for commercial and recreational fishing.

Table 7.8-4
Summary Comparison of Impacts Associated With Operations and Maintenance

Impacts	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Noise	Increased sound levels of 75 to 106 dB at the site attenuated to approximately 60 dB at 500 ft from the source during oil fill and drawdown of 9 caverns. Negligible noise increases during standby.	Increased sound levels of 75 to 106 dB at the site attenuated to approximately 60 dB at 500 ft from the source during oil fill and drawdown of 10 caverns. Negligible noise increases during standby.	Increased sound levels of 75 to 106 dB at the site attenuated to approximately 60 dB at 500 ft from the source during oil fill and drawdown of up to 16 caverns. Negligible noise increases during standby.	Increased sound levels of 75 to 106 dB at the site attenuated to approximately 60 dB at 500 ft from the source during oil fill and drawdown of up to 16 caverns. Negligible noise increases during standby.	Increased sound levels of 75 to 106 dB at the site attenuated to approximately 60 dB at 500 ft from the source during oil fill and drawdown of up to 16 caverns. Negligible noise increases during standby.

ENDNOTES

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12. U.S. Department of Energy, Environmental Survey Preliminary Report for the Strategic Petroleum Reserve: Texas and Louisiana Gulf Coast, Environment, Safety, and Health, Office of Environmental Audit, Washington, DC, January 1989, Document Number DOE/EH/OEV-34-P.

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Mr. D.M. Mathis, District Conservationist, Lucedale, MS.
Mr. W.I. Keys, District Conservationist, Leakesville, MS.
Mr. P.D. Caves, District Conservationist, Escatawpa, MS.
Mr. J.T. Monroe, District Conservationist, Purvis, MS.
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8.0 REGULATORY REQUIREMENTS AND MITIGATION MEASURES

8.1 Regulatory Requirements

The SPR sites selected for development would establish mitigation plans, as appropriate, to ensure that any potential impacts are minimized. Environmental laws and regulations promulgated by Federal and State governments provide important requirements for permits and environmental monitoring. In addition, based on experience with the existing SPR sites, DOE will establish engineering and operational controls that minimize potential impacts.

8.1.1 Regulations Related to Geological/Hydrogeological Impacts

The primary regulation applicable to the SPR that protects groundwater resources is the Underground Injection Control (UIC) Program established under the Safe Drinking Water Act (SDWA). Waste-related regulations, discussed below, also protect groundwater resources.

If the alternative of brine disposal by underground injection is used for the selected Capline site in Louisiana or Mississippi, the underground injection wells would require permits.[a] Federal authority for regulating underground injection wells is established by the SDWA, and in 1982 Louisiana received the authority to grant underground injection permits. The program is administered by the Louisiana Department of Natural Resources. In March 1989, Mississippi received authority to grant underground injection control permits. The program in Mississippi is administered by the Mississippi Department of Environmental Quality and the Oil and Gas Board. In general, State-administered programs tend to be more stringent than those under Federal authority.

Wells that dispose of brine from cavern creation in salt domes have been classified at existing SPR facilities as Class II hydrocarbon storage wells. Compared to federally run programs, Louisiana has the same general requirements for inspections and permitting of Class II wells. The permit would establish operating requirements for maximum operating pressure, monitoring requirements for brine characteristics prior to disposal, and procedures for demonstrating well mechanical integrity. The testing procedures that are required to establish well integrity in Louisiana are more sophisticated than those required by Federal programs and provide additional assurance that impacts would be mitigated. Moreover, Louisiana requires more detailed geologic information in permit applications than the Federal program. Class II wells in Mississippi are administered by the Mississippi Oil and Gas Board. This Mississippi program meets all of the threshold requirements of the Federal program and has the added ability to be more stringent if needed on a case by case basis with regard to requirements for plugging, monitoring, and testing. The permit review process and associated permit requirements would ensure that no groundwater resources would be affected adversely by the underground injection of brine.

8.1.2 Water Quality Related Regulations

Potential adverse impacts on water quality at SPR sites would be mitigated in part due to environmental requirements of several regulations. The Federal Water Pollution Control Act

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[a] Because underground injection is not being considered as a brine disposal alternative for Seaway Complex site, Texas state UIC programs are not addressed.

Amendments of 1972 (FWPCA) established the basis for controlling toxic discharges. In 1977, the Clean Water Act (CWA) updated the FWPCA and provided for more extensive control of pollutant discharges. The Water Quality Act of 1987 further expanded the discharge regulations that had been established. The Oil Pollution Act (OPA) of 1990 represents the most recent development in the protection of water quality. In addition to the OPA, there are provisions of the CWA that cover discharges of oil. The combination of permitting requirements for routine discharges and reporting requirements for upset conditions ensures that potential impacts to water quality are avoided or promptly mitigated. Additional reporting requirements for accidental spills are discussed in section 8.1.5.

8.1.2.1 National Pollutant Discharge Elimination System

One program that significantly affects the SPR program is the CWA's National Pollutant Discharge Elimination System (NPDES). The NPDES permit program is the CWA's major vehicle to attain its goals of controlling the types and concentrations of substances present in discharges to water bodies. EPA has delegated permitting authority for the NPDES program to some States; however, Texas and Louisiana do not have NPDES permitting authority. Mississippi has had permitting authority for the NPDES program since the mid-1970's. The Mississippi program is administered through the Mississippi Department of Environmental Quality. Applicants must apply to the Permit Board for NPDES approval in accordance with the Mississippi wastewater permit regulations. Historically, NPDES permits for SPR sites monitor discharges including brine discharge to the Gulf of Mexico, stormwater runoff from tank, well, and pump pads, and effluent from package sewage treatment plants.

As a provision of its NPDES permit, an SPR site or terminal may be required to test and report data for a total of seven conventional and nonconventional pollutants in its discharges: oil and grease, total dissolved solids, total suspended solids, pH, dissolved oxygen, biochemical oxygen demand, and chemical oxygen demand. Sites and terminals also may be required to monitor flow and velocity and to test for other priority pollutants based on the indicated likelihood that the pollutant will be present in the discharge from a site. The parameters that are monitored vary by site and discharge; compliance ranges are established for each of the parameters. Appendix I includes tables that indicate the parameters for the brine discharge permits at the existing sites. The permit also specifies monitoring procedures that define the frequency, method, and location of the monitoring.

8.1.2.2 State Water Discharge Programs

Both Texas and Louisiana issue State water discharge permits that correspond to the federally administered NPDES program. In Texas, the authority to develop water quality standards was established by the Texas Water Code, Chapters 26 and 27 (Texas Administrative Code, Title 31, Chapter 307). The State water discharge permitting authority is the Texas Water Commission (TWC). The Louisiana Environmental Quality Act, Title 30, established the authority for the Louisiana Department of Environmental Quality (LDEQ) to develop State water quality regulations. These water quality standards are found in the Louisiana Administrative Code, Title 33, Part IX. In both Texas and Louisiana, the regulations set specific numerical water quality criteria (e.g., pH and total dissolved solids) for individual water bodies located in their respective States. Although the conditions for the State permits are basically parallel to the requirements found in the NPDES permits, in some cases, the requirements are more stringent than the Federal requirements. Both Texas and Louisiana have state antidegradation policies, whereby the state can approve or reject applications for discharges that would increase pollutant loads to the water in the state. Mississippi has no such policy. In Mississippi, in addition to the NPDES program, there are also state water quality regulations. The Mississippi water quality criteria establish specific numerical water quality standards for individual Mississippi waters. Any new SPR facility or terminal would be required to apply for both the State and Federal permits for water discharges.

SPR compliance records for State and Federal permits have been excellent. Inspections in 1990 by both the TWC and LDEQ revealed some limited administrative oversights and deficiencies. Yet, the overall wastewater discharge compliance results showed that of 11,131 analyses performed, only 19 noncompliances were determined (99.8% compliance).[1] In addition, no notices of violation were issued. This outstanding compliance record demonstrates the ability of the SPR program to conform to its regulatory requirements and suggests that any new facility could perform as well.

8.1.2.3 Section 304(l) Waters -- Toxic "Hot Spots"

Another requirement that bas potential to affect the expansion of the SPR program is the 304(l) list of toxic "hot spots." This list, prepared in response to provisions in the Water Quality Act of 1987, identifies water bodies contaminated with priority pollutants (listed in section 307(a) of the CWA) and the source facilities responsible for the contamination. Each State was required to submit to EPA a list of proposed water bodies for the 304(l) list. After a public comment period, the list of identified water bodies was finalized, and an individual control strategy (ICS) was developed for each of the point sources contributing to contamination in each water body. As part of the ICS, the NPDES permit of a source facility can be modified to control discharges that contaminate the water bodies. In addition, NPDES permits for new sources on such a water body may be more restrictive.

None of the water bodies currently listed on the 304(l) lists for Texas or Louisiana are in the vicinity of the proposed expansion sites. In Mississippi, the Leaf River is considered a toxic "bot spot" but only below New Augusta. The Richton site would draw water above New Augusta and so section 304(l) would not affect the proposed expansion. The listing of 304(l) water bodies and source facilities initially was planned as a one-time event. However, current litigation may change the application of the law and it is possible that water bodies into which SPR discharges would occur could be listed. In this event, the SPR NPDES permit application would receive more critical review, and any additional provisions needed to ensure protection of the receiving water body would be included as permit requirements, providing for mitigation of potential impacts.

8.1.3 Air Quality Related Regulations

Pursuant to the Clean Air Act, EPA has promulgated National Ambient Air Quality Standards (NAAQS) for six air pollutants, including ozone (see 40 CFR Part 50). These standards establish a maximum ambient air concentration level for each pollutant; the current NAAQS for ozone is 0.12 parts per million (ppm) for a one-hour averaging time. If one or more pollutants exceeds the NAAQS in a given area, the area is classified as "nonattainment." To facilitate pollution control planning, the Clean Air Act authorizes the EPA Administrator to subdivide each State into Air Quality Control Regions (AQCRs); a State may then alter the boundaries of the AQCRs with the approval of the Administrator. Any State in which a nonattainment area is located must submit a State Implementation Plan (SIP) to reduce the concentration of all pollutants to the acceptable level in the AQCR containing the nonattainment area. The State must design the SIP to bring the area to attainment status within a statutorily established time frame. "Attainment" areas, whose pollutant concentrations are equal to or below the NAAQS level, are subject to the Prevention of Significant Deterioration program, which establishes a system of maximum allowable incremental increases in pollution levels over time in order to preserve air quality.

In 1990, significant amendments to the Clean Air Act were enacted for the first time since 1977. Certain provisions on attainment of NAAQS will affect areas proposed for SPR expansion. Specifically, ozone nonattainment areas are divided into classes that have different deadlines and schedules for compliance. The classes also affect required control measures and the definition of "major" air pollution sources. In addition, the Act contains a specific provision that requires EPA to promulgate standards for emission of volatile organic compounds (VOCs) and other air pollutants from tanker loading and unloading. The Coast Guard already has promulgated a regulation to control VOC emissions from the loading and ballasting of bulk liquid cargo tanks with petroleum or chemicals (54 FR 41366, October 8, 1989).

Under State law in Texas, Louisiana, and Mississippi, the SPR sites and terminals will be required to apply for and comply with air permits. For example, existing sites in Texas are covered by construction and operating permits issued by the Texas Air Control Board, and some Louisiana sites are required to submit Emission Inventory Questionnaires to the Louisiana Department of Environmental Quality. In Mississippi, the Mississippi Air Quality Standards adopt the primary and secondary NAAQS with few exceptions. The Mississippi Air and Water Pollution Control Act requires permits for use and operation of equipment. These permits are reviewed by the Mississippi Department of Environmental Quality and the Permit Board. Thus, potential impacts to air quality, by emission of VOCs causing increases to ambient concentrations of ozone, will be mitigated by compliance with existing and new regulatory requirements.

For any new facility in Louisiana that may contribute to the deterioration of air quality across state boundaries, written notice must be provided to all nearby states at least 60 days in advance of the day construction is permitted to begin. To begin construction, the owner or operator of the new facility must advise the administrative authority in writing of his/her intentions as well as supply a permit request that describes the new facility and the steps that will be taken to protect the air quality of the State against new pollution or an increase in existing pollution. No construction or operation of the facility that may result in the emission of air contaminants may occur until the permit request has been approved, an appropriate permit fee has been paid, and a certificate of approval (permit) for the work has been received from the administrative authority.

Any person planning to construct a facility in Texas that may release air contaminants must obtain a construction permit. The application for the permit must show that the emissions from the proposed facility will comply with the rules and regulations of the Texas Air Control Board and will meet the standards set forth by EPA under the Clean Air Act, including the lowest achievable emission rates specified under section 111. It must also be shown that the facility will use the best available control technology to reduce or eliminate emissions. The law includes special provisions for facilities located in nonattainment areas, covering VOC emissions and all other air contaminants. Fees based on the estimated capital cost of construction of the new facility will be charged. If a construction permit is obtained, the facility must apply for an operating permit within 60 days after the facility has begun operation. The application must show that all terms of the construction permit were met and that the facility is operating in accordance with all applicable State and Federal air quality regulations.

8.1.4 Regulations Related to Ecological Resources

Regulations discussed in this section are designed to protect specific sensitive environments.

8.1.4.1 Permits for Actions in Wetlands

By the authority of the CWA section 404, the U.S. Army Corps of Engineers (COE) has established permit requirements for any discharge of dredged or fill material into waters of the United States. The waters of the United States by definition include wetlands. COE generally issues permits on the condition that the applicant develops a plan to mitigate any adverse impacts on a wetland.

The section 404 permit review process provides a structure for an applicant, in consultation with other Federal and State agencies, to evaluate potential strategies for mitigating impacts to wetlands and construct a wetland mitigation plan. Mitigation approaches can be consolidated into four steps known as avoidance/minimization, restoration, enhancement, and creation. Avoidance and minimization consist of avoiding construction in wetland areas by placing as many structures as possible in upland areas and minimizing temporary disturbances. Wetland restoration involves converting wetlands that have undergone significant deterioration (due to hydrological modification, filling, contamination, etc.) back to their natural functioning capacity. Enhancement involves selectively modifying a wetland to upgrade one desirable attribute, such as waterfowl habitat, over another, such as flood control. Wetland creation is the construction of a wetland where one does not currently exist; this is often the most controversial of the mitigation options because of disagreements about its effectiveness, long-term viability, and the standards that should be used for determining its success.

COE decides whether a permit should be granted based on two standards: guidelines for CWA section 404(b)(1) and the "public interest review." Some activities associated with the proposed action will be pre-approved under COE "general" permits, which cover a certain action or class of actions, such as the laying of minor pipelines.

The section 404(b)(1) guidelines may be summarized by three conditions, which hold that COE should not grant a permit: (1) if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem; (2) if the project will cause or contribute to significant degradation of the waters of the United States; and (3) unless appropriate and practicable steps (i.e., mitigation) have been taken that will minimize potential adverse impacts on the aquatic ecosystem.

The public interest review centers on a determination of whether a project is "not contrary to the public interest." If the proposed action may alter an important wetland, COE must determine whether "the benefits of a proposed alteration outweigh the damage to the wetland resource;" whether "the proposed alteration is necessary to realize those benefits;" and whether "the proposed activity is primarily dependent on being located in, or in close proximity to, the aquatic environment and whether feasible alternative sites are available." In this review, COE will consult with the Fish and Wildlife Service, the National Marine Fisheries Service, the Soil Conservation Service, appropriate State conservation agencies, and EPA. COE must give the comments and recommendations of those agencies "full consideration" in deciding whether to issue the permit. In addition, section 404(c) gives EPA the authority to prohibit, withdraw, or restrict the specification of a section 404 discharge site. The section 404(c) authority, called the EPA veto, allows EPA to prevent COE from granting a permit to a project.

The permitting process ensures that an appropriate mitigation plan for the proposed project is developed. Consultations between DOE and other relevant Federal and State agencies are conducted in finalizing the plan. The mitigation plan will include a statement of the objectives of the mitigation; an assessment of the wetland values or resources that will be lost as a result of the action and of those that will be replaced; a geographical description of the site; a detailed description of the activities that will occur; a monitoring and maintenance plan; a contingency plan; and a guarantee that the work will be performed as planned and approved. As a result of this process, impacts to wetlands are minimized.

8.1.4.2 Executive Orders Regarding Wetlands and Floodplains

Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands, require each Federal agency to issue or amend existing procedures and regulations to ensure consideration of flood risks and wetlands protection in decision making. In compliance with these orders, DOE, in 1979, issued regulations designed to minimize impacts to floodplains and wetlands. The regulations are applicable to all DOE activities and require the Department to identify proposed actions in floodplain/wetland areas, provide the opportunity for public review, prepare floodplain/wetlands assessments, and issue statements of findings for actions in floodplains. If DOE finds that no practicable alternatives to locating in the floodplain/wetland are available, the Department is required to design or modify its action in order to protect facilities located in floodplains and to minimize potential harm to the floodplain or wetland. Compliance with these Executive Orders and related regulations will assist SPR in its effort to minimize any environmental impacts in the area. For further discussion of wetlands and floodplains regulations, and DOE's mitigation plans, see Appendix P.

8.1.4.3 National Flood Insurance Program

The proposed site locations will be subject to the provisions of the 1968 National Flood Insurance Act, as amended. The goals of the technical standards in the Act are to:

- Constrict the development of land which is exposed to flood damage, where appropriate;
- Guide the development of proposed construction away from locations that are threatened by flood hazard;
- Assist in reducing damage caused by floods; and
- Otherwise improve the long-range land management and use of flood-prone areas.

Any structure within a flood-prone area must either be flood-proofed or flood-protected to meet the technical requirements applicable to the proposed SPR expansion. To be flood-protected, the facility must be isolated from the flood waters by a stable berm or levee embankment that will not readily erode in a flood. Flood-protective berms or levee embankments can affect the watercourse if a flood occurs. In order to minimize these effects, it must also be shown that any encroachment within the floodway does not increase the water surface elevation of the base flood by more than one foot at any point in the immediate vicinity of the facility (based on a 100-year survey of floodplain water levels and boundaries).

In coastal areas with potentially serious flood water levels, new construction or expansion is restricted to the landward side of mean high tide and at a distance sufficient to create a safety buffer consisting of a natural vegetative or contour strip. The use of fill for structural support in these areas is forbidden. In addition, structures must be designed to withstand flooding without substantial hydraulic consequences.

8.1.4.4 Coastal Zone Management

A major development in the area of coastal management since 1979 has been the completion of state Coastal Zone Management Programs as mandated by the Coastal Zone Management Act of 1972. The goal of these programs is to preserve, protect, develop, and, where possible, to restore or enhance the resources of the Nation's coastal zone. Louisiana's Coastal Zone Management Program, completed in 1980, is administered by the Coastal Management Division within the Louisiana Department of Natural Resources. Through this program, land use within the coastal zone is regulated by a permit system. The process requires an assessment of individual and cumulative impacts from proposed development and other activities on coastal areas and resources, with the final decision on permit approval made by the Secretary of the Department of Natural Resources. Another major development in the protection of Louisiana's coastal wetlands is the enactment, in 1980, of the Louisiana Coastal Wetlands Conservation, Restoration and Management Act requiring the development of a State plan for protecting and restoring coastal wetlands. Developed by the Wetlands and Conservation Authority within the governor's office, the plan is administered by the office of coastal restoration and management within the Louisiana Department of Natural Resources. Under this plan, the administering agency is required to review and modify coastal permits prior to issuance to assure that such activities will not significantly impact coastal wetlands.

The Texas Coastal Management Plan establisbes the Coastal Coordination Council (CCC), which will serve as the administrating body for the Texas plan. The CCC is charged with promulgating the rules and regulations for the Coastal Management Plan. Their guidelines state that if a Federal action is deemed inconsistent with the goals and policies of the plan, the CCC will refer the matter to the appropriate Federal official to pursue a resolution. This required coordination between Federal and State representatives will assist DOE in its efforts to minimize any impacts that result from SPR activity in the region.

The Mississippi Coastal Wetlands Protection Law, administered by the Mississippi Department of Wildlife Conservation, describes Mississippi's public policy to preserve the natural state of the coastal wetlands and their ecosystems by preventing despoliation and destruction except where a specific alteration would serve a higher public interest. A permit is required from the Commission on Wildlife Conservation for any regulated activity that would affect the coastal wetlands. Permits must include a description of the activity, area, and a statement of environmental impact of the proposed activity on the coastal area. Some activities are excepted from the permit requirement. The Mississippi Coastal Management Rules, completed in 1988, are administered by the Bureau of Marine Resources within the Mississippi Department of Wildlife Conservation. These rules provide the administrative mechanism to carry out the policy on the coastal wetlands. They describe the powers and duties of the Commission on Wildlife Conservation as well as the permit process and the permit exclusions. There is an exclusion from the permit requirement for any activity affecting wetlands that is associated with or is necessary for the transportation of oil when that activity is conducted under a current and valid permit granted by another Mississippi agency.

8.1.4.5 Coastal Barrier Resources Act

The Coastal Barrier Resources System was established under the Coastal Barrier Resources Act of 1982. Its purpose is to minimize the loss of human life, wasteful Federal revenue expenditures, and damage to fish, wildlife, and other natural resources associated with certain coastal barriers, by restricting Federal expenditures that could encourage development of coastal barriers. The act prohibits all new Federal expenditures and financial assistance within the units of the System, with certain exceptions. If an agency's expenditures fall under one of the excepted activities, the agency may make the expenditures, after consultation with the U.S. Fish and Wildlife Service.

The SPR expansion may qualify for the exception for energy projects. Under this exception, a Federal agency, after consultation with DOI, may make expenditures for "any use or facility necessary for the exploration, extraction, or transportation of energy resources which can be carried out only on, in, or adjacent to coastal water areas because the use or facility requires access to the coastal water body." If the SPR expansion qualifies for an exception, DOE must consult with the Fish and Wildlife Service and allow the opportunity to provide written comment. The comments provided during this consultation will assist DOE in minimizing impacts to the coastal barrier.

8.1.4.6 Endangered Species Act

The Endangered Species Act of 1973 (ESA) protects wildlife and plants that are endangered or threatened with extinction. The ESA requires Federal agencies to ensure that the actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of an endangered or threatened species, or adversely modify or destroy their critical habitats. As discussed in Chapter 4, DOE has identified several endangered or threatened species in the counties affected by the proposed SPR expansion.

Under the ESA, DOE must determine whether a threatened or endangered species, or its critical habitat, will be affected by the proposed action. DOE must consult with the U.S. Fish and Wildlife Service for terrestrial and freshwater species and with the National Marine Fisheries Service for marine species. If it is determined that endangered or threatened species will be affected, DOE must take appropriate mitigation measures. Thus, potential impacts to endangered or threatened species or their critical habitats will be minimized through the consultation and mitigation measures required by the ESA. Details on species formally designated as endangered or threatened in the counties and parishes where the proposed action may occur are listed in Appendix D. Biological assessments for species potentially affected by the proposed action as identified by NMFS and USFWS are provided in Appendices E an F, respectively; preliminary mitigation measures for these species are also in Appendices E and F. Additional measures would be developed, if necessary, after the sites are selected and a specific endangered species survey is conducted.

8.1.4.7 Farmland Protection Policy Act

The Farmland Protection Policy Act requires that DOE minimize any impacts on farmland identified as prime and located in the proposed SPR site regions. Local Soil Conservation Services offices have been delegated the authority to review descriptions of proposed activity in the area and determine the extent of impacts on prime farmland. If the project will affect prime farmland, DOE must prepare a report which analyzes the extent of the impacts on the farmland and the degree of retrievability the farmland will retain upon completion of the proposed project. DOE's compliance with this legislation will further assist in the Department's efforts to minimize all environmental impacts in the proposed SPR expansion regions.

8.1.4.8 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) is designed to protect fish and wildlife when Federal actions result in the control or structural modification of a natural stream or body of water. The FWCA requires Federal agencies to take into consideration the effect that water-related projects would have on fish and wildlife and take action to prevent loss or damage to these resources. Before undertaking such a project, agencies must consult with the U.S. Fish and Wildlife Service as well as the state wildlife resources agency to develop measures to prevent, mitigate, or compensate for project-related losses to fish and wildlife.

For actions that involve construction of levees or other activities that may alter water flow, DOE will consult with the agencies designated by the FWCA. Reports and/or recommendations made by the U.S. Fish and Wildlife Service or the State agency will be incorporated into the mitigation action plan, to be developed for the selected sites.

8.1.4.9 Other Sensitive Environment-related Regulations

No species protected under the Marine Mammals Protection Act are likely to be affected by the operation of the SPR.

In addition, there are no areas protected under the Wild and Scenic Rivers Act within the areas bounded by the SPR sites.

8.1.5 Waste Management and Spill Response Related Regulations

Requirements of the Resource Conservation and Recovery Act of 1976 (RCRA) and the Hazardous and Solid Waste Amendments of 1984 (HSWA) are likely to affect proposed SPR sites only in certain circumstances. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986 requirements represent further advances in environmental legislation, however, they also will have only a limited impact on SPR sites. RCRA and CERCLA have limited applicability to the SPR sites both because of the small quantity of hazardous waste generated and because SPR sites as Federal facilities are exempt from certain requirements. Though the impact of these laws on the SPR program is not extensive, the presence of these laws reflects increasing public concern about protection of the environment from improper handling and disposition of hazardous waste.

8.1.5.1 Resource Conservation and Recovery Act (RCRA)

Current RCRA regulations govern hazardous waste treatment, storage, disposal, and transportation, non-hazardous waste management, and underground storage tanks (USTs). Under RCRA Subtitle C, facilities must treat, store, and dispose of hazardous waste in accordance with certain administrative and technical requirements. In Texas, Louisiana, and Mississippi, the State has the authority to administer the RCRA hazardous waste program, and all three States have incorporated Federal regulations into their own laws. Because the oil stored at SPR sites is not a waste, RCRA Subtitle C regulations do not affect the storage of crude oil at SPR sites. In addition, wastes associated with the subsurface storage of oil, such as sludges or tank bottoms generated at SPR sites may be exempt from RCRA hazardous waste regulations.[b]

If a proposed SPR site did generate RCRA hazardous wastes, RCRA Subtitle C requirements may apply, depending on the quantity of hazardous waste produced. Most SPR sites generate hazardous waste in the form of spent solvents and contaminated rags and equipment. Sites that generate less than 100 kg/month of hazardous waste are exempt from Subtitle C requirements. (In Louisiana, however, they are subject to Chapter 21 of the Louisiana Hazardous Waste Rules, under which they must notify the State in writing that they are claiming small-quantity generator status.) Sites that generate between 100 kg and 1,000 kg per month are exempt only from the administrative requirements of Subtitle C. Currently, all SPR sites that generate hazardous wastes claim the small-quantity generator exemption. If a site does not qualify for this exemption, it will be subject to hazardous waste regulations including permitting requirements, minimum technology requirements for storage tanks, and disposal restrictions. In addition, whenever any quantity of hazardous waste is stored at a facility, the site must meet container labelling and storage requirements. Shipping papers or manifests are required when the hazardous waste is sent off site.

Non-hazardous solid wastes must be managed in accordance with RCRA Subtitle D requirements. In Texas, Louisiana, and Mississippi, the State has established regulations governing the management of these wastes.

RCRA Subtitle I regulates petroleum products and hazardous substances stored in underground tanks. UST regulations include performance standards for new tanks and regulations for leak detection and prevention, closure, financial responsibility, and corrective action at underground tank sites. SPR sites that have USTs must comply with these requirements; however, given current design parameters, it is unlikely that the proposed sites will have underground tanks.

In summary, RCRA regulations and related State regulations are likely to apply to proposed SPR sites only if they begin to generate large quantities of hazardous waste or have underground storage tanks. In any cases where RCRA compliance is required, the requirements

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[b] Telephone conversation with EPA Section Chief for Oil and Gas Wastes, Dan Derkics, January 15, 1991; see *Regulatory Determination for Oil and Gas and Geothermal Exploration, Development and Production Wastes*, 53 FR 25454, July 6, 1988.

will contribute to the mitigation of any potential environmental impacts from hazardous waste generation at the site and leaks from underground tanks.

8.1.5.2 Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA's primary purpose is to provide funding and enforcement authority for cleaning up abandoned hazardous waste sites throughout the United States and for responding to hazardous substance releases. Through SARA, Congress enacted significant revisions to CERCLA that expanded the scope and coverage of the law. Title III of SARA, also known as the Emergency Planning and Community Right-to-Know Act, is designed to compel State and local governments to develop plans for responding to unanticipated environmental releases of substances identified as hazardous. Title III also requires businesses that use certain substances to notify State and local emergency planning entities of the presence of those substances in their facilities and to report on the inventories and environmental releases of those substances. In addition, the statute requires that such chemical information be made publicly available.

Federal facilities, such as SPR storage sites, must comply with CERCLA. Under CERCLA section 103, facilities or vessels must report to the National Response Center a release of a reportable quantity (RQ) or more of any several hundred hazardous substances defined in CERCLA section 101(14). The number of hazardous substances (excluding petroleum) at SPR facilities is limited. Under DOE Order 5480.14, the wastes from selected SPR sites were tested and determined not to require reporting under CERCLA. In addition, field surveys of SPR sites did not reveal the presence of any abandoned hazardous wastes that could result in a reportable release or necessitate a CERCLA response action. Although CERCLA section 101(14) generally exempts petroleum from the section 103 reporting provisions,[c] the CWA requires discharges of oil from facilities or vessels into U.S. waters to be reported to the National Response Center.

SARA Title III expands the emergency reporting requirements of CERCLA to include notification to State and local response authorities for releases of CERCLA hazardous substances, or releases of any one of 360 extremely hazardous substances (EHSs). Although Federal facilities, such as the SPR sites, are exempt from Title III provisions, existing SPR facilities generally have elected to participate in Title III efforts and the following Title III activities when appropriate:

- Emergency Planning (Sections 301-303);
- Emergency Release Notification (Section 304); and
- Hazardous Chemical Reporting (Sections 311-312).

Under the Title III emergency planning provisions, each State has appointed a State emergency response commission (SERC) to coordinate State-wide chemical emergency planning activities. The SERCs established emergency planning districts and coordinated local emergency

[c] The petroleum exclusion applies to crude oil, petroleum feedstocks, and refined petroleum products, even if a designated hazardous substance is a constituent of such products, or is normally mixed with or added to them during refining. Hazardous substances that increase in concentration as a result of contamination of the petroleum during use, however, are not considered part of the petroleum and are not excluded from reporting.

planning committees (LEPCs). LEPCs are responsible for developing and updating local emergency response plans. As part of the local planning efforts, facilities that use or store one of the 360 EHSs above threshold planning quantities (TPQs) must notify the LEPC of the presence of these chemicals and participate in emergency planning activities. Under section 304, facilities must notify SERCs and LEPCs of releases of EHSs or CERCLA hazardous substances that equal or exceed the designated RQ. Section 311 requires that facilities submit Material Safety Data Sheets (MSDSs) for each on-site chemical to the SERC, LEPC, and fire department. Under section 312, facilities must provide annual inventories of these same hazardous chemicals on a Tier One or Tier Two inventory form.

The environmental staff at existing SPR facilities have determined that their inventories of EHSs do not meet or exceed the relevant TPQs. SPR facilities have provided MSDSs and Tier II chemical inventory forms for each on-site chemical to the appropriate SERC, LEPC, and fire department located near sites or pipelines. These reports provide a tool for LEPCs to develop and update emergency plans, and for emergency response organizations, such as fire departments, to plan training exercises and response activities for possible chemical emergencies. In addition, SPR facilities notify the LEPC in case of a petroleum release, and have coordinated their contingency planning efforts for petroleum releases with the LEPC and local fire department. In addition, certain States, such as Louisiana, require notification of petroleum releases under State law.

Because the proposed SPR sites will be similar to the existing sites in configuration and in use of hazardous materials, it is expected that the CERCLA compliance status will be similar, and that DOE will continue to disclose information under SARA Title III reporting guidelines.

8.1.5.3 Oil Pollution Act of 1990 (OPA)

Significant regulatory developments affecting the SPR program will result from the landmark OPA, which was signed into law on August 18, 1990. The OPA is a comprehensive statute designed to expand oil spill prevention activities, establish new Federal authority to direct responses to oil spills, and improve spill preparedness and response capabilities.

The majority of the spill prevention features of the OPA address spills from tank vessels. These provisions include double-hull requirements for most new vessels, stricter licensing requirements for tank vessel personnel, and new vessel manning and safety standards. Existing tankers without double hulls are to be phased out by size, age, and design beginning in 1995, and will be required to be escorted by two towing vessels in specially designated high-risk areas. Most tankers without double hulls will be banned by 2015.

The OPA requires the Federal government to "ensure effective and immediate removal of a discharge, and mitigation or prevention of a substantial threat of a discharge, of oil or a hazardous substance" into the navigable waters of the U.S., adjoining shorelines, and the exclusive economic zone. For spills large enough to pose a substantial threat to the public health or welfare, the Federal government is now required to direct all public and private efforts to remove the discharge or to mitigate or prevent the threat of the discharge.

Under the OPA, owners and operators of facilities and vessels have major new responsibilities for spill preparedness. The OPA requires the owner or operator of a vessel or facility to "prepare and submit a plan for responding, to the maximum extent practicable, to a worst case discharge, and to a substantial threat of such a discharge of oil." This requirement applies to all tank vessels and offshore facilities, as well as to any onshore facility that, "because of its location, could reasonably be expected to cause substantial harm to the environment by discharging into or on the navigable waters, adjoining shorelines, or the exclusive economic zone." The Federal government is required to issue regulations implementing the response planning requirements by August 1992.

Taken together, these provisions of the OPA will contribute to a reduction both in the frequency of oil spills from SPR facilities and in the magnitude of any related environmental impacts. Because the analysis in this DEIS is based on spill frequency data from the period before the passage of the OPA, the projected impacts may be overestimated.

8.1.5.4 Revisions to EPA's Spill Prevention, Control, and Countermeasure Program

The Oil Pollution Prevention regulation, also known as the Spill Prevention, Control, and Countermeasure (SPCC) rule, is designed to prevent discharges of oil from onshore facilities and to contain such discharges when they occur. The SPCC program, which is administered by EPA, requires owners and operators of certain facilities storing oil to prepare SPCC Plans for the prevention and mitigation of oil spills.

In response to the 1988 Ashland Oil spill in Floreffe, Pennsylvania, an interagency SPCC Program Task Force was created to examine the SPCC program and to recommend changes that would reduce the potential hazards caused by similar spills from oil storage facilities. The task force recommended that EPA: (1) clarify that certain provisions, which are described in the Oil Pollution Prevention regulation in terms that could be interpreted as discretionary, are required practices; (2) establish additional technical requirements for facilities subject to the regulation; (3) expand the scope of the regulation to include requirements for facility-specific oil spill contingency planning; and (4) gather information about potentially regulated facilities to develop an inventory of facilities subject to the regulation.[2]

EPA adopted a two-phased strategy to revising the Oil Pollution Prevention regulation to incorporate the task force recommendations. EPA published the Phase I Notice of Proposed Rulemaking on October 22, 1991. If finalized as proposed, the Phase I revisions would incorporate two recommendations from the SPCC Task Force: (1) clarification of certain language from the existing rule by changing the word "should" to "shall" in many provisions; and (2) notification by SPCC-regulated facilities to EPA for purposes of developing an inventory of facilities subject to the regulation. Phase II revisions to the Oil Pollution Prevention regulation are expected to implement the OPA facility response plan requirement, as well as other more substantive SPCC Task Force recommendations.

By strengthening the SPCC program as a whole, the proposed and pending revisions to the Oil Pollution Prevention regulation are expected to reduce the number and impact of oil spills at SPR facilities, resulting in reduced risk and adverse impacts to the environment.

8.1.6 Regulations Related to Archaeological and Cultural Resources

The Historic Sites Act of 1935, The National Historic Preservation Act (NHPA) of 1966, and the Archeological and Historic Preservation Act of 1974 are designed to protect the Nation's historical heritage from extinction. DOE has identified significant archaeological sites at or near some of the proposed SPR expansion sites. The NHPA requires that DOE:

- Identify cultural resources on or eligible for inclusion on the National Register of Historic Places;
- Determine the effect a proposed activity will have on the identified cultural resources; and
- Avoid, minimize, or mitigate any adverse effects during implementation of the action.

As required by the NHPA, DOE will determine whether the archaeological sites identified at or near the proposed expansion sites are on or eligible for the National Register of Historic Places. If any of these cultural resources are on or eligible for the National Register, DOE will identify possible effects of the proposed expansion on these resources. If the expansion will have an effect on these resources, DOE will take measures to minimize potential impacts.

8.2 Measures to Mitigate Environmental Impacts

As described in earlier chapters, the expansion of the SPR would lead to environmental impacts. Although some of these environmental impacts would be unavoidable (e.g., removal of vegetation during site construction), many could be mitigated through the use of appropriate engineering designs, good operating procedures, and well-developed emergency plans. For example, properly installed containment dikes could prevent the spread of oil onto the ground in the event of an accidental spill. Similarly, the use of appropriate ditching techniques could limit the loss of topsoil from pipeline construction. The following sections describe the measures DOE would implement in order to minimize environmental impacts from construction, routine operational activities, and accidents.

8.2.1 Mitigation of Impacts During Construction and Operation

DOE would mitigate impacts throughout construction and operation of the SPR expansion sites. At SPR sites, mitigation techniques can be divided into three categories: (1) impact avoidance, including preventative steps, site selection, and care in locating structures; (2) minimization, meaning the use of low-impact methods or containment measures; and (3) restoration, which includes replanting, rehabilitation, and other post-damage mitigation. Mitigation of impacts to wetlands would be required under the project's CWA section 404 permit; therefore, wetland mitigation, while not the only type of mitigation, would be a subject of particular concern in this section. Before any construction occurs, site-specific field surveys would be conducted to delineate the presence of species of particular concern (e.g., rare, threatened, or endangered) and any historical or archeological sites. If either species or sites are located, mitigation measures would then be implemented.

8.2.1.1 Impact Avoidance

This mitigation option consists of avoiding damage to sensitive areas, such as wetlands, by concentrating activities and construction in less sensitive areas. This would be accomplished by "clustering" the buildings, utilizing "low-impact" construction techniques and materials (e.g., using specially modified all-terrain vehicles that exert little pressure on sensitive soils), and by carefully scheduling the timing of construction so that it does not interfere with, for example, bird mating and nesting seasons.[3] Impact avoidance is often the preferred mitigation option because it costs significantly less than other mitigation options, such as restoration or wetland creation.[4] Specific impact avoidance techniques could include:

- Conducting an endangered species and other biological (e.g., seagrass bed) survey to determine the presence and sensitivity of critical habitat in order to avoid damage to sensitive flora and fauna in the project area.

- Conducting a similar survey to ensure that the project will not destroy any unstudied cultural, historical, archaeological, or commercial resources, such as oyster beds.

- Installing pipelines in existing ROWs where possible, thereby avoiding unnecessary duplication of clearing efforts.

- Conducting magnetometer surveys to avoid puncturing existing buried pipelines.

- Avoiding construction during mating, nesting, and young-bearing seasons. Carefully timed construction can reduce greatly the impact to sensitive wildlife.

- Locating facilities (such as roads, bridges, buildings, and dredged spoils disposal areas) so that previously cleared areas are used first and sensitive areas are avoided.

If after the surveys detailed above are conducted, areas of concern were identified (e.g., endangered species habitat), DOE would consider options for relocating the construction activities (e.g., rerouting pipeline).

8.2.1.2 Impact Minimization

Minimization of impacts includes any action designed to have as little direct impact on the environment as possible. This is often used in conjunction with actions that cannot be avoided, such as the laying of pipelines or emissions associated with oil storage. For instance, oil storage cannot be avoided at an SPR site; but volatile organic compound (VOC) emissions can be minimized by proper housekeeping procedures and other mitigation measures. DOE would employ a number of impact minimization techniques that were used during the construction and operation of existing SPR sites, including:

- Installing air emission controls, such as double seals, or conducting regular valve and pump maintenance, where possible. For instance, installing an external floating roof with primary and secondary seals on the blanket oil tank minimizes VOC emissions.

- Installing brine pond liners and underdrain systems to prevent leaks and perimeter dikes to avoid overtopping and runoff.

- "Double-ditching" during construction, which minimizes the mixing of surface and subsurface soils by back-filling with top spoil. This will help reduce erosion and accelerate natural revegetation.

- Using "push-ditch" construction methods rather than flotation canals for pipelines crossing wet areas. Flotation canals often result in the creation of permanent open-water habitat and the loss of marsh areas.

- Using horizontal directional-drilling of pipeline under waterways, roads, and other permanent obstructions. This can help minimize impacts to adjacent areas. It can also help avoid existing pipelines, such as the numerous pipelines that already cross Trinity Bay in Texas.

- Minimizing sediment transport and erosion by grading, diking, and installing interceptor ditches so that migrating sediment will not smother wetland areas or significantly affect receiving water bodies (e.g., Warehouse Bayou near the Weeks Island expansion site).

- Constructing water-control structures to prevent saltwater intrusion into fresh or intermediate marshes. This can help preserve the native flora and fauna.

- Permitting breaks in spoil banks to allow water drainage. This will help minimize potential alterations in the area's surface water patterns.

- At the raw water intake point on the ICW and Leaf River, using trashbars and traveling mesh screens; reducing intake velocity; and periodically removing live macrocrustaceans caught in screens.

- Not leaving any permanent obstructions in water bodies crossed by pipelines, so as to not affect the natural migration patterns of fish.

- Controlling possible surface subsidence by filling the leached cavern quickly, as well as controlled, slow cavern leaching during construction.

8.2.1.3 Restoration

Restoration involves rehabilitation of impacted areas that have undergone significant change (due to hydrological modification, filling, contamination, etc.) back to their natural functioning capacity. At the SPR expansion sites, DOE would restore impacted areas to their prior functioning capacity, to the extent practical. Restoration usually involves some of the following activities:

- Revegetation of disturbed areas and restoring natural contours.[5] This will restore ecological, aesthetic, and hydrologic values.

- Returning pipeline trenches to the natural topography which maintains natural drainage patterns and prevents the formation of new water courses where the pipelines cross surface waters. This is a particular concern in areas where the pipelines will cross agricultural lands (e.g., rice fields), which are highly dependent on water from natural drainage.

- Retention of removed topsoil on the site to control erosion and restore sloped areas.
- Restoration of hydrology (e.g., removing dikes and levees created during pipeline construction).
- Restoration of soil and substrate (e.g., excavating and grading the site to the correct elevation, contouring to the correct shape, removing toxins, salvaging and transplanting wetland soils, fertilizing, etc.).
- Modification of vegetation (allowing natural revegetation, seeding or planting desired species, eradicating undesired species, controlling of herbivores and disease, installing buffers and protective structures, etc.).
- Revegetation of the site to limit erosion and runoff and restoring river and lake shorelines to their original contour at pipeline crossings to reduce future flooding.
- Mid-course corrections (controlling predators and weeds, adjusting elevation and water regime, adjusting soil profile, etc.).
- Monitoring (coordinating agency and in-house efforts in particular goal-oriented increments).[6]

8.2.1.4 Mitigation in Wetland Areas: Enhancement and Creation

As discussed earlier in this chapter, DOE may be required by its CWA section 404 permit to mitigate any impacts to wetlands resulting from SPR activities. To compensate for damage to wetlands resulting from SPR construction and operation, the Corps of Engineers may require that DOE enhance or create wetlands off the site. DOE would use these two mitigation techniques to the extent necessary, as stipulated in the section 404 permit.

Enhancement involves selectively modifying an area to upgrade one desirable attribute, such as waterfowl habitat, over another, such as flood control. For example, rather than attempt to replicate a forested wetland, which may take over 50 years, it could be prudent to create a marsh that could be established in a shorter period of time and that may be more valuable to fish or wildlife that the previous wetland.[7] This process could involve, for example, the purchase of areas adjacent to existing refuges, enhancing their habitat value, and deeding them to the care of an appropriate regulatory agency in perpetuity.[8]

Wetland creation is often the most controversial of the mitigation options available because of disagreements within the scientific and regulatory communities as to its effectiveness, long-term viability, and standards for determining the success of these efforts. It is often difficult, if not impossible, to recreate the delicate interdependencies among wetlands plants and animals; in addition, the range of these functions and interdependencies is not fully known.

Certain types of wetlands are better candidates for replications than others. More simple wetland systems with less species diversity, such as bogs and salt marshes, are the best candidates for replication. Other types of wetlands, such as forested wetlands, have a more complex hydrological regime and a greater diversity of plants and animals, take a long time to develop, and are therefore more difficult to recreate and maintain.[9] For further discussion of mitigation in wetland areas, see Appendix P.

8.2.1.5 Mitigation in Floodplains

To ensure that the agency complied with Executive Order 11988 (floodplain management), which guarantees the mitigation, preservation, and restoration of floodplains, DOE would follow the Water Resources Council's Floodplain Management Guidelines when planning its mitigation strategy for the proposed SPR sites. Those plans would include:

- the use of minimum grading requirements to save as much of the site from compaction as possible;
- relocating nonconforming structures and facilities out of the floodplain;
- returning the site to normal contours;
- preserving free natural drainage when designing and constructing bridges, roads, fills, and large built-up centers;
- maintaining wetland and floodplain vegetation buffers to reduce sedimentation and delivery of chemical pollutants to the water body;
- constructing impoundments to minimize any alteration in natural drainage and flood flow; and
- controlling the practice of clear-cutting.

DOE would minimize impacts upon floodplains by backfilling onshore ditches so that there is no appreciable difference in elevation between the pipeline ROW and surrounding areas after settling and by using double ditching techniques to conserve topsoil and facilitate revegetation. While constructing the pipeline, crews would place excavated material in areas where water drainage would not be affected and no damming of water courses would occur. When placing the excavated materials, crews would create gaps at a minimum of every 500 feet to allow for natural drainage.[10] There would be little probability that runoff patterns would be altered along a pipeline route that is backfilled to the same level and consistency as had previously existed. For further discussion of mitigation in floodplains, see Appendix P.

8.2.1.6 Mitigation of Potential Impacts on Rare, Threatened, or Endangered Species

As described above, before any construction activities commence, a site-specific endangered species survey would be conducted. The information in this Draft EIS, specifically Appendix D, would guide the ecological field team. If habitat currently used by a particular species were encountered, a mitigation plan would be developed. The first approach considered by DOE would be to relocate the construction, either spatially (e.g., changing pipeline route to avoid a cluster of terrestrial plants) or temporally (e.g., scheduling construction activities for a time period when migrating birds would not be present). If avoidance were not feasible, and other suitable mitigation options were available, DOE would consider these options.

For example, for some species it may be possible to capture individuals and relocate them -- either in a suitable alternate habitat or back in the original habitat once construction is complete. Another alternative for mobile species might be enhancement of nearby habitat, such that the habitat range was expanded prior to the construction. After reviewing the results of the endangered species field survey, DOE would work closely with state and Federal agencies to ensure the protection of rare, threatened, or endangered species.

8.2.2 Mitigation of Environmental Impacts from Accidents

DOE would take every precaution to prevent accidents from occurring at SPR expansion sites. DOE, however, recognizes the possibility of accidents or equipment failures, and would implement a wide range of engineering design measures to limit environmental damage from such an event. These engineering measures would be based on experience gained at the existing SPR sites and, in some cases, would represent improvements over current designs. In addition, SPR expansion sites would have in place emergency response plans to limit potential environmental damage from events such as fires, oil spills, brine spills, major accidents, hurricanes, floods, and even terrorist actions. These plans would include designation of responsibilities, procedures for reporting site emergencies, and procedures for responding to emergencies including evacuation, notification, and response to incidents. DOE would update emergency plans as needed and ensure that all site personnel receive appropriate training.

Most accidents are preventable; prevention may take the form of procedures that ensure the safe operation of facility equipment and proper handling of hazardous materials, or hardware that contains or minimizes the impact so that the environment is not harmed. For example, SPR sites would implement rigorous housekeeping procedures to prevent spills of hazardous materials used for routine operating and maintenance activities (e.g., machine solvents). A detailed description of the type and likelihood of accidents possible at SPR sites (including oil spills, brine spills, fires, and hazardous chemical spills, and natural disasters) can be found in Chapter 6. New SPR sites would incorporate engineering measures to mitigate each type of accident.

8.2.2.1 Oil Spills

Releases of oil to the environment, whether from accidental or operational discharges, can occur when oil is transported or stored. All expansion sites would have a range of spill containment equipment, including:

- Well pads around each storage cavern that are capable of holding up to 35,000 barrels of oil; this secondary containment structure will prevent a potential major oil spill into the surrounding environment.

- Instrumentation to monitor cavern pressures continuously to aid in detection of leaks.

- Dikes around crude oil storage tanks, well pads, and brine ponds to contain spills or overflow.

- Surge relief systems on pipelines to prevent excessive pressure. In the event of a flow blockage or pressure event, these systems will help prevent a pipeline rupture or valve failure.

- Cement lining of brine pipelines to limit erosion and corrosion.

- Facilities to enable the pigging of oil lines prior to commissioning. This will help operators determine the integrity of the pipelines before initiating operations.

- Containment trays for pig traps in order to catch dripping oil when the pig is removed.

- Valve protection for oil/water separators.

In addition, all new pipelines would be buried underground except where terrain makes burial impractical. This design measure would minimize corrosion and the potential for pipeline damage from accidents and severe weather events. To prevent oil spills during severe flooding, all site facilities that could not withstand flooding would be located above the 100-year floodplain elevation.

Each SPR site also has a Spill Contingency Plan. These plans differ in the site-specific information they contain, but follow parallel outlines. The new site would have a Spill Contingency Plan similar to the one prepared for the Big Hill/Bryan Mound sites.

The Big Hill/Bryan Mound Spill Contingency Plan provides detailed directions for personnel to follow from the discovery of the spill to the after action report. It contains specific information about site facilities, environs, and off-site pipelines, identifies potential spill sources. and explains possible impact of spills on surrounding areas. The plan prepares and organizes personnel into clearly defined authority and responsibility levels, and provides information on techniques to estimate the size of the spill and strategies and equipment to use in cleanup.

The SPR site manager is the On-Scene Coordinator in the case of an oil spill. Each SPR site has an Emergency Response Team (ERT) composed of a cross-section of personnel selected by the Site Manager to perform assigned functions during emergencies. One person per shift is designated the team leader. At least two team members are on the site at all times and are available and trained to respond immediately to an emergency. Each site also has a site command center, from which the Site Manager can coordinate cleanup operations.

A matrix with location and size of spill on one axis and access to the spill on the other helps the Site Manager judge what level of response is needed. For minor spills, an individual or the onduty ERT may be sufficient. Subsequent levels of response are the offduty ERT, spill clean up contractors, personnel from other sites, the Regional Response Team advisor, and the Regional Response Team. Procedures for individuals assigned specific duties and responsibilities during oil spill response are detailed in the plan. Spill response involves the following steps:

- Isolating the spill source and stopping the oil flow;
- Determining the spill response factors of size and accessibility;
- Mobilizing manpower and equipment based on the spill response level;
- Taking precautionary safety, security, and environmental protection measures;

- Notifying project personnel, federal and state agencies as required by law, landowners and local authorities affected by the spill, and those who will be required to assist in containment and cleanup; and
- Managing control and cleanup efforts.

Controlling a spill involves stopping the oil's spread and confining all or most of it to a certain area, and diverting the spill flow, when necessary, to avoid damage to an environmentally sensitive area or to redirect the flow to a place where it can be more efficiently contained. There are several methods that can be used to clean up a spill, depending on whether the spill was to land or to water. On land, hose streams can sometimes be used to "herd" oil to an area where it can be recovered. On water, boom may be slowly pulled in a teardrop fashion to move the oil to a pumping area. Some oil-saturated earth and vegetation may be treated biologically in place or scooped up and removed, and all equipment used in the cleanup must be properly cleaned of oil.

8.2.2.2 Brine Spills

The leaching, filling, and maintenance of new oil storage caverns in salt domes would produce large quantities of brine. Aside from the purposeful discharge of brine to either the Gulf or deep underground formations, there would be a potential for accidental releases of brine to the environment. In particular, brine could be accidentally released to surface water or shallow groundwater from: (1) pipelines and site piping; (2) on-site brine ponds; and (3) injection well operations.

Pipelines and Site Piping. As has been the practice at existing SPR sites, brine pipelines would be designed, operated, and maintained in a manner to help ensure structural integrity. For example, the brine pipelines would be lined with protective coating (such as concrete) to prevent corrosion/erosion, lines would be hydrostatically tested on a regular basis, in-pipe pressures would be routinely monitored and kept within design specifications, corrosion inhibitors and/or oxygen scavenging chemicals would be injected into the brine, and corrosion would be monitored frequently through visual inspection, leak detection, and testing. Brine diffusers would be fitted with a flexible discharge hose to prevent interference with and damage to fishing equipment.

Brine Ponds. While brine ponds at existing SPR sites vary in their construction, all of the brine pond systems associated with the expansion would be patterned after the Big Hill brine ponds. All of the ponds would include measures to prevent migration of contaminants to groundwater, including high-density polyethylene liners, underdrain systems, a natural clay bottom barrier, surrounding bentonite-clay slurry walls interfaced to the natural clay bottom, and a perimeter dike to prevent overtopping and runoff. If, however, a release from the brine pond does occur, DOE would be able to detect it because all ponds would be equipped with a series of shallow groundwater monitoring wells. Monitoring will be discussed in greater detail later in this chapter.

Injection Wells. If used in the SPR expansion project, injection well equipment would include surface casing, set with cement, to a depth of 800 feet, intermediate casing, an intermediate casing/borehole annulus cemented completely to the land surface, injection tubing, and a packer. Together with periodic mechanical integrity tests and continuous injection pressure/rate monitoring, these design features would make the potential for accidental brine releases from injection wells very unlikely.

8.2.2.3 Fires

Contingency planning and fire protection and extinguishing equipment are necessary and important parts of SPR site operations. Information and examples in this section are based on the Big Hill site. The construction and operation of Big Hill is analogous to what would occur at an expansion site.[11]

The Big Hill Prefire Plan provides the ERT with the primary tactics and strategies for combating fire emergencies. This plan contains specific information on each facility, structure, and potential hazard area on the site. This information is provided to help the ERT Leader make quick decisions concerning fire fighting objectives and priorities during a fire emergency.

The potential for loss of life and personal injury is the first consideration during fire. After rescue, the next concern is containing the fire and preventing the fire from spreading to other uninvolved areas.

In the unlikely event of a major fire involving a building or structure, the local fire department is immediately notified. ERT members that are also trained members of a paid fire department and meet the qualifications outlined in National Fire Protection Association (NFPA) 1500 may assist and participate in interior structural fire fighting.

Primary fire protection responsibilities include the protection of the SPR crude oil reserves. In responding to a crude oil release, spill control procedures are established. The presence of hydrogen sulfide (H_2S) and other flammable vapors must be considered. AFFF is used to blanket and seal crude oil spills when ignition is an immediate concern because of inclement weather conditions or other unpredictable circumstances. AFFF also should be applied to crude spills when gas analyzer readings ten feet outside of the perimeter fire exceed 20 percent of the lower flammable limit for flammable vapors, ten ppm for H_2S, or both.

If a pressured oil storage cavern and well head failure are involved, a controlled burn is allowed from the well head until the pressure is relieved via the site's emergency shutdown (ESD) system and AFFF is used to blanket and extinguish all crude oil ground fire and maintain foam protection. The application of foam will contain but not necessarily extinguish a three-dimensional fire associated with a crude oil release that is under pressure.

Automatic sprinkler systems have been installed in all major structures. Properly maintained, automatic sprinklers significantly reduce the possibility of a major structural fire. The electrical substations serving Big Hill are protected by fixed water deluge systems. In the event of a fire, a heat actuating device will automatically activate the water deluge system. Fire water for Big Hill can be supplied in two ways. The primary fire water system is provided from an 800,000-gallon freshwater tank, of which 720,000 gallons are dedicated for fire emergencies. The tank supplies a jockey pump that maintains line pressure, a primary 2,500-gpm electric-driven pump and a backup 2,500-gpm diesel-driven pump. The primary electric and backup diesel-driven pumps are designed to sequentially start automatically with a loss of fire water line pressure. A cross connection between the raw water injection system and the fire water system provides an additional source of fire water to back up or supplement the primary fire water system during fire emergencies.

The crude oil pumps, meters, and related facilities are protected by automatic foam deluge systems. Properly maintained, the foam system in conjunction with the ESD system significantly reduces the possibility of a major fire in this area. The foam deluge system protects the area by designated zones that are activated by ultraviolet/infrared detectors. By design, the system will support the total flow required for three zones. The foam deluge can quickly suppress, extinguish, and blanket pooled ground fire associated with a crude oil release. The foam deluge will not extinguish three-dimensional fires.

At Big Hill, the crude oil surge tank is protected by a manually activated fixed catenary foam system for protection of the roof to shell seal area of the tank. The foam solution is supplied from the foam building and system that also supplies the foam deluge system for the crude oil pumping facilities. Foam solution will be directed and contained in the seal area of the floating roof by fixed discharge heads and a foam dam attached to the roof.

The Operations Control Room is protected with Halon 1301 as well as sprinklers. The properly maintained Halon system further reduces the possibility of a serious fire. Cross-zoned smoke detectors that quickly detect fire in the very early stages actuate the Halon system to provide extinguishment before a rapid fire spread.

Oil storage cavern well pads are protected with fixed monitors. Fixed monitors can be effective in cooling and protecting exposed but uninvolved areas of the fire such as pipes and valves to prevent distortion. Water spray from the monitors will begin to fill diked areas and could also break up any foam being applied.

Hose reels are interconnected into the foam system protecting the crude oil pumping facilities and surge tank to provide foam solution for hand line applications as required.

8.2.2.4 Hazardous Chemical Spills and Releases

Hazardous chemicals are generally purchased on an as-needed basis. Distribution of all hazardous chemicals on the site is controlled by property procedures in which warehouse personnel issue working quantities of chemicals with records to account for them at all times. Material Safety Data Sheets (MSDS) are kept on the site for each hazardous chemical. These sheets describe the material, give its physical characteristics, indicate its toxicity and associated hazards, and indicate appropriate first aid and any special response required for handling a spill.[12]

All site personnel who are on-site ERT members or who encounter hazardous chemicals in their work areas receive training in spill response. This program is given to all site operation and maintenance personnel when they begin work at the site or whenever a new hazardous substance is introduced on the site.[13]

Various procedures have been developed in order to increase safety regarding spills. These procedures include Spill Contingency Plans with spill reporting procedures; site-specific Spill Prevention, Control, and Countermeasure 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. Compliance with Federal, State, and local laws, regulations, and permits has been accomplished in part by implementation of these plans and procedures.[14]

Spill flow directions and pathways for each site have been investigated and are well documented. Although varying somewhat among sites, each site has on band an array of equipment and materials to control and clean up on-site and off-site spills. Each also has a primary and an alternate area that can become the site command center in the event of a spill, and some sites have other facilities that may be useful during spill response, control, and cleanup operations.[15]

Proper operation of the SPR with respect to the environment involves several types of reports and reporting procedures. 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 chemical spilled, immediate and potential impacts of the spill, and spill location (e.g., wetland or waterbody). 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 on-site DOE representative. Verbal notification to the appropriate regulatory agencies are submitted after cleanup, unless otherwise directed by the DOE or appropriate regulatory agency.[16]

8.2.2.5 Hurricanes/Flooding

Examples of preparations for hurricanes, thunderstorms, storm surge, and flooding have been taken from the procedures developed for the existing Big Hill facility, which would be analogous to those at expansion sites. To date these hazards have not contributed significantly to environmental risks at existing SPR sites.

The basis of the Big Hill hurricane preparation plan is the Emergency Planning Group, consisting of site management, the shift supervisor, and the site manager. The Emergency Planning Group implements prehurricane season preparations and ensures that proper precautions are taken before, during, and after a hurricane to keep personnel, equipment, and the site safe and secure. The Emergency Planning Group has the discretion to decide the optimal and necessary hurricane preparations and has the authority to conduct special staff meetings when storm conditions could impact the area or when current storm conditions change. Individually, the shift supervisor is responsible for tracking storms, maintaining a hurricane status board, and maintaining a log sheet for storm coordinates. The site manager decides which storm condition code to declare for the site, conducts special staff meetings, and calls for support and evacuation if necessary.[17]

A system of storm condition codes, which are based on weather advisories issued by the National Weather Service, indicate to the staff the level of preparation appropriate for the potential damage of each storm. The condition code is posted in select locations throughout the site. The codes range from green (hurricane season in effect, no storm approaching) to red (hurricane will strike site area within 72 hours; plant will be shut down 18 hours before hurricane force winds). A white code signifies the beginning of recovery operations once the storm has passed. Actual preparations include emptying brine ponds, boarding windows, securing all loose equipment, gathering supplies and tools, refueling vehicles, and ensuring that all fire and other emergency equipment is in working order.[18]

The emergency plan at the Big Hill site also contains certain precautions for avoiding damage from lightning associated with thunderstorms. The control room operator reports weather information to the shift supervisor, who may instruct the control room operator to broadcast a weather alert over the site radio network. At this point, the shift supervisor would order all outside, nonessential activities and oil transfer activities to be ceased; additionally, all personnel would take shelter inside a building.[19]

The emergency plan includes preparations for storm surge and flooding as well, which consist primarily of monitoring activities to ensure that any floods are reported and that employees are removed from potential flood areas.[20]

8.3 On-going Environmental Monitoring

Expansion of the SPR program would increase the potential for damage to the environment from releases of oil, brine, and other materials (e.g., hazardous materials used for operation and maintenance). To limit, and where possible to prevent, adverse environmental impacts, DOE would implement a comprehensive monitoring program at all new or expanded sites. This program would be based on the operational experience gained over the last decade at existing SPR facilities. For example, environmental monitoring is regularly conducted at current sites both for permit compliance and as a management tool to provide the information necessary to limit undetected releases of wastes or materials into the environment. Under existing procedures, sampling is conducted to monitor quality of air, surface water, and groundwater. DOE would expect to conduct similar monitoring programs at expansion sites.

8.3.1 Air Quality Monitoring

Based on experience at the existing SPR facilities, the predominant air emissions are VOCs from valves, pumps, tanks, tankers, and brine ponds. These would be monitored at expansion SPR sites using an organic vapor analyzer. Efforts to monitor air quality would include:

- Measuring and estimating hydrocarbon emissions from valves, tanks, pumps, tankers, and brine pumps. Hydrocarbon emissions are generally dependent on the volume of oil throughput, with minimal emissions occurring during periods of storage. Therefore, hydrocarbon emission monitoring will concentrate on equipment used in oil transfer.

- Measuring fugitive air emissions from the blanket oil tank, oil recovery tank, sump tank, fuel tanks, and valve stems and pump seals. VOC emissions will be calculated using AP-42, "Compilation of Air Pollutant Emission Factors," which is based on monthly throughput of crude oil, average temperature, and vapor pressure.

- Inspecting floating roofs on oil storage tanks, routinely operated valves, and other equipment.[21]

8.3.2 Water Quality Monitoring

Water quality would be monitored at SPR expansion sites in order to provide early detection of any surface water quality degradation that may result from SPR operations. Surface water monitoring would consist of sampling at a number of monitoring stations, and testing them for pH, salinity, temperature, dissolved oxygen, and oil and grease. Locations for monitoring stations would ensure testing of discharge from sewage treatment plants, stormwater from well pads, and along canals and sensitive areas in the vicinity. As required under Federal and State permits, DOE would test brine discharge to the Gulf of Mexico, stormwater runoff from tank, well, and pump pads, and effluent from package sewage treatment plants. The parameters monitored and frequency of monitoring would vary by site and type of discharge.

In addition to testing water discharges, DOE would sample surface waters at SPR expansion sites to monitor general water quality. This sampling would be conducted to ensure that the surface waters do not become contaminated as a result of undetected leaks or runoff. Surface water monitoring would be conducted for the following parameters, although, not all parameters will be analyzed at all sites:

- pH
- Salinity
- Temperature
- Total Suspended Solids
- Total Dissolved Solids
- Dissolved Oxygen
- Biochemical Oxygen Demand
- Chemical Oxygen Demand
- Oil and Grease
- Flow

Groundwater monitoring would also be conducted at SPR expansion sites. Based on past operating experience, a number of monitoring wells would be installed around the facility to detect leakage from brine ponds, which could contaminate nearby aquifers. SPR expansion sites would also include monitors for resistivity/conductance and soil hydrocarbon vapor testing for brine and crude oil soil contamination, respectively. Confirmation of contamination would be made through groundwater sampling.

8.3.3 Cavern Integrity Monitoring

Because one potential source of adverse environmental impacts would be leakage of crude oil from storage caverns, DOE takes significant steps to ensure that no such leakage occurs. Prior to storage of oil in a newly leached cavern, DOE conducts a two phase test to demonstrate that total leakage from a particular cavern will be less than 100 barrels per year. This is accomplished first through hydrostatic testing designed to check the response of the entire cavern to gross leakage. The second phase of the test is a nitrogen well leak test that is designed to test small leaks in the last cemented casing, casing seat, casing hanger, and wellhead.

Once the caverns are in the long-term storage mode, monitoring is continued on a quarterly basis and includes surveys to determine the total depth and logging of at least the bottom 100 feet of the cavern. Caverns are also maintained in a narrow pressure band so that the potential volume from a sudden wellhead failure would not exceed the capacity of the wellhead dike. Based on experience at current SPR sites, in order to maintain desired cavern pressure, it is generally necessary to bleed small quantities of brine every 60 to 90 days.

ENDNOTES

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13. *Ibid.*

14. Boeing Petroleum Services, Inc., *1990 Annual Site Environmental Report, U.S. Strategic Petroleum Reserve,* U.S. Department of Energy, Strategic Petroleum Reserve Project Management Office, New Orleans, LA, June 1991, Document Number D506-02799-09.

15. Boeing Petroleum Services, Inc., *Spill Contingency Plan: Bayou Choctaw, St. James Terminal, and Weeks Island,* U.S. Department of Energy, Office of Strategic Petroleum Reserve, December 1986, Document Number D506-01026-04/0705.

16. Boeing Petroleum Services, Inc., *1990 Annual Site Environmental Report, U.S. Strategic Petroleum Reserve,* U.S. Department of Energy, Strategic Petroleum Reserve Project Management Office, New Orleans, LA, June 1991, Document Number D506-02799-09.

17. Boeing Petroleum Services, Inc. Big Hill Emergency Response Procedures, U.S. Department of Energy, Strategic Petroleum Reserve, New Orleans, LA, June 1988, Document Number D506-01150-08, pp 5.1-5.4.

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19. *Ibid.*, pp 8.1, 8.2.

20. *Ibid.*, pp 6.1, 6.2.

21. Boeing Petroleum Services, Inc., *1990 Annual Site Environmental Report, U.S.* Strategic Petroleum Reserve, 1990 Annual Site Environmental Report, U.S. Department of Energy, Strategic Petroleum Reserve, Project Management Office, New Orleans, LA, June 1991. Document Number D506-02799-09.

9.0 UNAVOIDABLE ADVERSE IMPACTS

The purpose of this chapter is to summarize the unavoidable adverse impacts that would result from the construction at the candidate sites or associated pipelines and terminals and from operations and maintenance after any applicable mitigation measures have been taken.

9.1 Site Development

This section and Table 9.1-1 present the primary impacts resulting from site development at the candidate sites, the mitigation measures that would be taken, and the unavoidable impacts that would likely remain.

9.1.1 Geology

Minor subsidence at all sites would be unavoidable; however, engineering designs such as surface drainage systems would be used to prevent the ponding of water on the caverns due to rainfall with subsequent percolation to shallow aquifers. In addition, caverns could be leached at shallow depths to limit on-site subsidence.

9.1.2 Hydrogeology

The principal hydrogeological impacts associated with site development would be the emplacement of brine and associated pressure increases and fluid displacement in the deep subsurface at sites where underground injection is used as a brine disposal method (potentially Weeks Island, Cote Blanche, or Richton). These impacts would be limited by a number of controls and design features, including wells equipped with state-of-the-art safety features (e.g., surface casing set with cement through upper aquifers, long-string casing cemented to the land surface, injection tubing, and a packer), controls on injection pressures and rates, and proper well placement relative to potential migration pathways (faults and abandoned wells).

9.1.3 Surface Water and Aquatic Ecology

Enhanced erosion due to site construction activities could lead to the migration of up to approximately 5,000 tons of soil into adjacent surface water bodies. The impacts associated with these enhanced sediment loads would be minimized by preventing soil from actually migrating into surface waters by installing interceptor ditches and erosion control nets, grading sites to minimize erosion, and revegetating/stabilizing cleared areas as soon as possible.

Brine discharges in the Gulf of Mexico would create an excess salinity plume of 1 ppt above ambient levels over 5,300 to 7,700 acres. These minor salinity increases would be achieved through the use of a diffuser designed to maximize dilution in the Gulf. Based on past experience and field monitoring data that confirm that such SPR brine discharges do not cause significant impacts, no additional mitigating measures would be necessary.

Raw water intake at each of the sites would cause minor changes in the hydrology and water quality in the ICW or, in the case of Richton, the Leaf River. While a small portion of the surrounding plankton and other small organisms would be unavoidably entrained, tbis entrainment would be substantially limited by the use of trash bars and traveling 0.5-inch mesh screens, and by

Table 9.1-1
Summary of Impacts and Associated Mitigation Measures Associated with Site Development at the Candidate Sites

Impact Areas	Primary Impact	Mitigation Measures	Unavoidable Impact
Geology	Local subsidence limited to area immediately over storage caverns	Engineering designs such as surface drainage systems to prevent the formation of ponds on caverns Leach caverns at shallow depths to limit subsidence	Minor subsidence
Hydrogeology	At Weeks Island or Cote Blanche, injection would emplace one MMBD of brine in a highly saline formation at least 1,200 feet below the ground; smaller quantities of brine would be injected at least 2,000 feet underground at Richton	Injection controls, intermediate and surface casing, periodic mechanical integrity tests, and monitoring	Reduced primary impact
Surface Water and Aquatic Ecology	Increased erosion during site construction into surface water (tons) Big Hill 0 Weeks Island 4,850 Stratton Ridge 1,100 Cote Blanche 620 Richton 690	Grading, stabilizing, diking, installing interceptor ditches, use of previously cleared land, double-ditching, revegetation, retention of topsoil	Reduced erosion
	Brine discharge will cause minor increases (+1 ppt) in bottom salinity in area around diffuser in Gulf (acres) Big Hill 6,000 Weeks Island 5,300 Stratton Ridge 5,000 Cote Blanche 5,300 Richton 7,700	None	Same as primary impacts
	Raw water intake would cause minor changes in hydrology, water quality, and biology in the Leaf River (Richton site) or the ICW (other four sites)	Intake limits, trash bars and traveling screens, would return organisms caught on screens to water	Reduced primary impact
Air Quality	Short-term increased fugitive dust emissions resulting from clearing site, assuming 1.2 tons per acre of construction (tons/month) Big Hill 180 Weeks Island 324 Stratton Ridge 240 Cote Blanche 360 Richton 360	Use state-of-the-art dust suppression techniques	Reduced particulate emissions

Table 9.1-1 (Continued)
Summary of Impacts and Associated Mitigation Measures Associated with Site Development at the Candidate Sites

Impact Areas	Primary Impact	Mitigation Measures	Unavoidable Impact
Terrestrial Ecology and Natural and Scenic Resources	Site preparation and clearing would lead to destruction or alteration of vegetation, displacement of wildlife, destruction of individuals of smaller species, and disruption of habitats due to increased traffic and human activity	Revegetation, modification of vegetation, avoid activity during nesting, mating, and breeding seasons, conduct endangered species survey	Some loss of flora and fauna at sites
	On-site wetland areas could be permanently filled (acres) Big Hill 0 Weeks Island 6 Stratton Ridge 46 Cote Blanche 0 Richton 30	Locate permanent facilities on non-wetland areas	Reduced primary impact
	Potential for impacts to rare, threatened, or endangered species	Conduct endangered species survey prior to construction; identify species present and needed mitigation	Avoid impacts to rare, threatened, or endangered species
Floodplains	Change in elevation and site drainage due to rough grading in floodplains (applicable for Stratton Ridge, Weeks Island, and Cote Blanche only)	Creation of breaks in spoil banks, restoration of natural contours, retention of removed topsoil, restoration of hydrology, grading to correct elevation, contouring	Reduced primary impact
Socioeconomics	Some in-migration of workers; few impacts on local infrastructure and services; small positive impact on local/regional economies	None	None
Noise	Short-term increased sound levels of 65 to 70 dB at 500 ft from the sound source and short-term increased sound levels of up to 100 dB near the sound source during construction	None	Same as primary impact

limiting the intake to a low rate from which most fish can swim away. Further, the hydrology and water quality would not be adversely affected due to projected withdrawal rates.

9.1.4 Air Quality

Short-term increases in fugitive dust emissions ranging from 180 to 360 pounds per month would result from site clearing. State-of-the-art dust suppression techniques would be used to reduce particulate emissions.

9.1.5 Terrestrial Ecology and Natural and Scenic Resources

Site preparation and clearing would lead to destruction or alteration of vegetation, displacement of wildlife, destruction of individuals of smaller species, and disruption of habitats due to increased traffic and human activity. To avoid such impacts to rare, threatened, or endangered species, a site survey would be conducted and specific mitigation measures identified. Such destruction would be mitigated by revegetation, modification of vegetation, and the avoidance of construction activity during nesting, mating, and breeding seasons. The result would be a small loss of flora and fauna at the sites.

In addition, on-site wetland areas ranging from 6 to 46 acres may be filled. An attempt would be made to locate permanent facilities on non-wetland areas to minimize the affected acreage.

9.1.6 Floodplains

A change in elevation and site drainage could occur as a result of rough grading in floodplains. Breaks in spoil banks would be created, natural contours would be restored, removed topsoil would be retained, hydrology would be restored, and grading would be used to correct elevation in order to reduce the impact to floodplains.

9.1.7 Socioeconomics

While some in-migration of workers would occur, there would be few impacts on local infrastructure and services. In addition, there would be a small positive impact on local and regional economies. As a result, no mitigative measures would be necessary.

9.1.8 Noise

Only short-term, slightly increased sound levels would occur at and nearby the sound source during construction. No mitigative measures would be necessary.

9.2 Pipeline and Terminal Construction

This section and Table 9.2-1 present the primary impacts associated with pipeline and terminal construction at the candidate sites, the mitigation measures that would be taken, and the unavoidable impacts that would likely remain. Because primary impacts to geology, hydrogeology, and socioeconomics would be negligible, these impact areas are not included in the summary table.

Table 9.2-1
Summary of Impacts and Associated Mitigation Measures Associated with Pipeline and Terminal Construction at the Candidate Sites

Impact Areas	Primary Impact	Mitigation Measures	Unavoidable Impact
Surface Water and Aquatic Ecology			
270-Day Criterion	Construction of crude oil pipeline would cause temporary adverse effects to water quality (i.e., increased turbidity, re-suspension of toxic chemicals/metals) and alter or destroy benthic habitat in water bodies crossed	Use of least damaging construction techniques where possible (directional drilling, modified push-ditch), water control structures, restoration of hydrology (removing dikes/levees and backfilling to restore topography), field surveys prior to construction to identify/avoid sensitive areas, use existing ROW where possible	Reduced primary impact
	Construction of the RWI system would cause temporary adverse effects to water quality (i.e., increased turbidity, re-suspension of toxic chemicals/metals) and alter or destroy benthic habitat in the ICW, Leaf River, and waters crossed by pipelie	Same as above	Same as above
	Construction of brine pipeline would cause temporary adverse effects to water quality (i.e., increased turbidity, re-suspension of toxic chemicals/metals) and alter or destroy benthic habitat in the ICW, all water bodies crossed, and localized portions of the Gulf of Mexico	Same as above	Same as above
180-Day Criterion	Trinity Bay crude oil pipeline would cause temporary adverse effects to water quality and benthic habitat at the crossings of 19 water bodies; limited destruction of seagrass beds in Trinity Bay	Use of least damaging construction techniques where possible (directional drilling, modified push-ditch), water control structures, restoration of hydrology (removing dikes/levees and backfilling to restore topography), field surveys prior to construction to identify/avoid sensitive areas, use existing ROW where possible	Reduced primary impact
	Trinity Bay pipeline would cause potential puncturing of an existing submerged pipeline, resulting in an uncontrolled release of oil and associated toxic effects on aquatic flora and fauna	Conduct magnetometer survey, use horizontal directional drilling under waterways	Reduced primary impact
	I-10 crude oil pipeline would cause temporary adverse effects to water quality and benthic habitat at the crossings of 26 water bodies	Same as above	Same as above
	Construction of two new docks at St. James Terminal would cause temporary adverse effects to water quality in the Mississippi River, and permanently alter the benthic habitat in dock area	Limit extent and duration of dredging, properly dispose of dredge spoils	Reduced water quality impact to Mississippi River

Table 9.2-1 (Continued)
Summary of Impacts and Associated Mitigation Measures Associated with Pipeline and Terminal Construction at the Candidate Sites

Impact Areas	Primary Impact	Mitigation Measures	Unavoidable Impact
Air Quality 270-Day Criterion	Short-term increased fugitive dust emissions from construction of new pipeline ROWs and storage tanks	Dust suppression techniques	Reduced primary impact
180-Day Criterion	Same as above plus new docks and tanks at St. James	Same as above	Same as above
Terrestrial Ecology and Natural and Scenic Resources 270-Day Criterion	Numerous acres of palustrine forested, estuarine, emergent, and open-water, and lacustrine and riverine wetlands would be adversely affected by pipeline construction Site — Pipeline ROWs (acres) — Wetlands (acres) Big Hill — N/A — 0 Stratton Ridge — 165 — 116 Weeks Island — 128 — 91 Cote Blanche — 254 — 218 Richton (if Liberty) — 2,994 — 552 (if Mobile) — 2,501 — 462 (if Pascagoula) — 1,603 — 419 St. James Terminal — N/A — 0 Pipeline ROWs are total easement (i.e., permanent, construction, and temporary construction) In addition, at Weeks Island and Cote Blanche five acres of wetlands would be effected by pump station construction	Wetlands enhancement, use of double-ditching, grading, diking, interceptor ditches, push-ditch construction, water control structures; removal of temporary obstructions; revegetation; salvaging and transplanting wetlands soils	Reduced wetlands impacts
	Potential disruption of habitats for rare, threatened or endangered species which may use the areas along pipeline ROWs; impacts could include habitat destruction, disturbed mating or nesting behavior, decreased breeding success, habitat abandonment, and destruction of individuals	Conduct endangered species survey prior to construction; identify species present and needed mitigation (e.g., re-route pipelines to avoid specific habitats known to be used by rare, threatened, or endangered species; avoid construction during pollination, mating, breeding, and young-rearing seasons)	Impacts to rare, threatened, or endangered species are avoided
	Several pipelines cross wildlife refuges or wildlife management areas; species using these areas could experience disrupted breeding, nesting, or feeding behaviors	Avoid construction during mating, breeding, and young-rearing seasons	Reduced primary impact

Table 9.2-1 (Continued)
Summary of Impacts and Associated Mitigation Measures Associated with Pipeline and Terminal Construction at the Candidate Sites

Impact Areas	Primary Impact	Mitigation Measures	Unavoidable Impact
180-Day Criterion	Additional acres of palustrine forested, estuarine, emergent. and open-water, and lacustrine and riverine wetlands would be adversely affected by pipeline construction Pipeline ROWs (acres) / Wetlands (acres) Big Hill (if Trinity Bay) 936 / 148 (if I-10) 1,020 / 235 Stratton Ridge N/A / 0 Weeks Island 133 / 93 Cote Blanche 133 / 93 Richton (if Liberty) N/A / N/A (if Mobile and Liberty line) 1490 / 170 (if Pascagoula) N/A / N/A St. James Terminal N/A / 0 Pipeline ROWs are total easement (i.e., permanent, construction, and temporary construction) In addition, at Weeks Island and Cote Blanche five acres of wetlands would be effected by the construction of a second pump station Additional impacts would be as described above for the 270-day criterion	Wetlands enhancement, use of double-ditching, grading. diking, interceptor ditches; water control structures; removal of temporary obstructions; revegetation; salvaging and transplanting wetland soils Same as for 270-day	Reduced wetlands impact Same as for 270-day
Floodplains 270-Day Criterion	Temporary change in drainage patterns from construction of ROWs	Restoration of hydrology, breaks in spoil banks, revegetation, restoration of natural topography	Reduced primary impact
180-Day Criterion	Same as above	Same as above	Same as above
Noise 270-Day Criterion	Short-term increased noise levels of 61 to 69 dBA at 500 ft during construction of pipeline	None	Same as primary impact
180-Day Criterion	Same as above	Same as above	Same as above

9.2.1 Surface Water and Aquatic Ecology

Construction of crude oil pipelines, RWI pipelines, and brine pipelines would cause temporary adverse effects to water quality (i.e., increased turbidity, re-suspension of toxic chemicals and metals) and alter or destroy benthic habitats in the water bodies crossed. These waters include numerous inland waterways, the ICW, and the Gulf of Mexico. Mitigation measures used to reduce the impacts would include the use of least damaging construction methods where possible (directional drilling and modified push-ditch construction), water control structures to prevent saltwater intrusion and the formation of new watercourses and migration pathways, and backfilling pipeline trenches on land to restore natural topography and drainage patterns. Pipeline construction also would be preceded by field surveys of ROWs to identify and avoid particularly sensitive features, such as oyster beds in Vermilion Bay and seagrass beds and submerged pipelines in Trinity Bay.

Construction of new docks at the St. James Terminal would cause temporary adverse effects to water quality in the Mississippi River and permanently alter the benthic habitat in the dock area. These impacts would be minimized by limiting the areal extent and duration of dredging. In addition, dredge spoils would be disposed in an appropriate location and manner so as to minimize adverse effects.

9.2.2 Air Quality

Short-term increased fugitive dust emissions would result from the construction of new pipeline ROWs, docks, and storage tanks. Dust suppression techniques would be used to mitigate the impacts.

9.2.3 Terrestrial Ecology and Natural and Scenic Resources

Numerous acres of wetlands could be adversely affected by pipeline, pump and meter station and terminal construction. In order to mitigate these impacts, methods such as double-ditching, grading, diking, excavation of interceptor ditches, push-ditch construction, installation of water control structures, removal of temporary obstructions, revegetation, salvaging and transplanting wetlands soils, and wetlands enhancement, would be employed.

In addition, there would be the potential for the disruption of habitats for species, that may use the areas along pipeline ROWs; impacts could include habitat destruction, disturbed mating or nesting behavior, decreased breeding success, habitat abandonment, and destruction of individuals. To avoid such impacts to rare, threatened, and endangered species, endangered species surveys would be conducted and appropriate mitigation measures would be identified. Effort also would be taken to limit impacts to species that inhabit wildlife refuges or wildlife management areas that would be crossed by pipelines.

9.2.4 Floodplains

Temporary changes in drainage patterns along the pipeline ROWs resulting from pipeline and terminal construction would be mitigated by the restoration of hydrology, breaks in spoil banks, revegetation, and restoration of natural topography.

9.2.5 Noise

Short-term, slightly increased noise levels that would occur during pipeline construction would have negligible impacts. As a result, no mitigative measures would be necessary.

9.3 Operations and Maintenance

This section and Table 9.3-1 present the primary impacts resulting from operations and maintenance at the candidate sites, the mitigation measures that would be taken, and the unavoidable impacts that would likely remain.

9.3.1 Geology

Local subsidence would be limited to the area immediately over storage caverns. Oil fill would be expedited to minimize the imbalance of pressure. In addition, operational pressure would be increased to balance inward pressure, minimizing subsidence.

9.3.2 Hydrogeology

Spills of oil or brine at the candidate sites could result in shallow groundwater contamination. The potential for these spills and the resulting impacts, however, would be minimized through a number of engineering controls, including liners and underdrain systems to prevent and detect brine pond leaks, secondary containment devices around above-ground storage units, regular monitoring of pipeline integrity, and ambient groundwater monitoring.

9.3.3 Surface Water and Aquatic Ecology

Infrequent and small oil or brine spills from vessels, storage sites, pipelines, or at terminals could result in severe though localized and temporary impacts in nearby water bodies. Dikes around wellpads, oil storage tanks, and brine ponds; surge relief valves on pipelines; cement linings in pipelines; wellpads around each cavern; corrosion inhibitors in pipelines; anhydrite settling to control brine pipeline erosion; and monitoring are among the efforts that would be made to reduce the potential for spills and related impacts.

9.3.4 Air Quality

Volatile hydrocarbon emissions ranging from 3.31 to 4.96 grams/second would occur as a result of brine extraction during leach/fill operation. Substantial emissions also would occur from tanker loading during drawdown. Caverns would be developed in stages, rather than simultaneously, air emission controls would be employed, and tanker loading would be scheduled to minimize ozone production in order to reduce air emissions and air quality impacts.

9.3.5 Terrestrial Ecology and Natural and Scenic Resources

Vegetation on the site would be mowed frequently and would be of little value as habitat for many species. Wildlife near the site could be disrupted by increased human activity and traffic; there could be an increased number of animals lost due to increased traffic. Minimal impacts would result from the maintenance of existing pipelines.

Table 9.3-1
Summary of Impacts and Associated Mitigation Measures Associated with Operations and Maintenance at the Candidate Sites

Impact Areas	Primary Impact	Mitigation Measures	Unavoidable Impact
Geology	Local subsidence limited to area immediately over storage caverns	Expedite oil fill to minimize imbalance of pressure Increase operational pressure to balance inward pressure	Reduced subsidence
Hydrogeology	Limited contamination of groundwater due to spills/leaks of oil or brine	Liners and underdrains beneath brine ponds, containment systems around above-ground storage facilities, pipeline lining and monitoring, groundwater monitoring	Reduced potential for spills and minimized spill contamination
Surface Water and Aquatic Ecology	Infrequent, small (<20 barrel) oil spills either from vessels or from handling operations at terminals could result in severe though localized and temporary impacts in coastal/inland waters, depending on spill location and timing	Dikes around tanks, high-level alarms on tanks, surge relief on pipelines, cement lining of pipelines	Reduced potential for spills and minimized spill contamination
	Infrequent, small (<20 barrel) oil spills at storage sites could result in severe though localized and temporary impacts in nearby water bodies	Cement well pads around each cavern, monitoring cavern pressure, dikes around oil storage tanks	Reduced potential for spills
	Anticipated one to nine small ($\leq$ 75 barrel) brine spills and up to two larger ($\geq$ 74,000 barrel) brine spills could cause intense but localized and temporary impacts in adjacent water bodies and in waters that are crossed by the brine discharge pipeline	Perimeter dikes around brine ponds, brine pond liners and underdrain systems, protective coating for pipelines, setting of anhydrite to minimize erosion, hydrostatic testing of pipelines, use of corrosion inhibitors, shallow groundwater monitoring wells	Reduced potential for spills
Air Quality	Volatile hydrocarbon emissions from extracted brine during leach/fill <u>Quantities of NMHC (grams/second)</u> Big Hill 3.31 Stratton Ridge 3.31 Weeks Island 4.96 Cote Blanche 4.96 Richton 4.96 Significant volatile hydrocarbon emissions from tanker loading during drawdown, assuming new tanks and docks at St. James; and from tanks at Pascagoula assuming construction of a DOE terminal	Development of caverns in stages, rather than simultaneously; air emissions controls; scheduling of tanker loading to minimize ozone production	Reduced air emissions and air quality impacts

Table 9.3-1 (Continued)
Summary of Impacts and Associated Mitigation Measures Associated with Operations and Maintenance at the Candidate Sites

Impact Areas	Primary Impact	Mitigation Measures	Unavoidable Impact
Terrestrial Ecology and Natural and Scenic Resources	Vegetation on-site would be mowed frequently and would be of little value as habitat for many species	None	Same as primary impact
	Impacts to wildlife from an oil or brine spill on-site could be severe due to habitat loss and possibly direct losses of adults, young, and/or eggs if breeding areas are affected; potential impacts to birds and mammals from an oil spill include hypothermia or drowning due to oil-coated feathers or fur and direct toxic effects from ingestion of oil while preening; large scale impacts might include disruption of ecosystem structure and function; threatened, rare, or endangered species could also be affected	Well pads around each cavern, monitoring cavern pressure, dikes around crude oil storage tanks and well pads, surge relief on pipelines, and cement lining of brine pipelines to prevent corrosion; perimeter dikes around brine ponds, brine pond liners and underdrain systems, protective coating for pipelines, hydrostatic testing of pipelines, use of corrosion inhibitors, and shallow groundwater monitoring wells to identify brine plumes quickly	Reduced primary impact
	Impacts from an oil or brine spill on-site could kill vegetation and aquatic life in the wetlands on and adjacent to sites and terminals	Same as above	Same as above
Socioeconomics	Potential oil and brine spills might result in • costs associated with restoring natural resources • damage to the fishing, agricultural, recreational, and related industries.	Dikes around well pads, surge relief on pipelines, cement lining of pipelines; cement well pads around each cavern, monitoring cavern pressure, dikes around oil storage tanks; perimeter dikes around brine ponds, brine pond liners and underdrain systems, protective coating for pipelines, hydrostatic testing of pipelines, use of corrosion inhibitors, shallow groundwater monitoring wells	Reduced primary impact
	In addition, oil spills might also result in damage to private property	Same as above	Same as above
Noise	Increased sound levels of 75 to 106 dB at the site attenuated to approximately 60 dB at 500 ft from the source during oil fill and drawdown of caverns	None	Same as primary impact

Impacts to wildlife and vegetation from an oil or brine spill on the site and at a terminal could be severe due to habitat loss and possibly direct losses of adults, young, and/or eggs if breeding areas are affected. Potential impacts to birds and mammals from an oil spill include hypothermia or drowning due to oil-coated feathers or fur and direct toxic effects from ingestion of oil while preening. Large scale impacts from spills might include disruption of ecosystem structure and function. Efforts to reduce the potential for spills and to minimize these impacts would include well pads around each cavern; cavern pressure and pipeline monitoring; dikes around crude oil storage tanks, well pads, and brine ponds; surge relief valves on pipelines; cement lining of brine pipelines; brine pond liners and underdrain systems; the use of corrosion inhibitors; anhydrite settling to reduce the potential for brine pipeline erosion; and the use of shallow groundwater monitoring wells to detect brine spills.

9.3.6 Socioeconomics

Potential oil and brine spills could result in costs associated with restoring natural resources, and damage to the fishing, agricultural, and related industries. In addition, oil spills might also result in damages to private property.

9.3.7 Noise

Increased sound levels at the site would be attenuated from the source during oil fill and drawdown of caverns. No mitigation measures would be taken.

10.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

This chapter (1) analyzes the relationship between local short-term use of the environment and maintenance and enhancement of long-term productivity and (2) discusses tradeoffs. Specifically, it summarizes the effects of the proposed action on national and regional economic activity and adverse impacts on environmental productivity.

10.1 Effect on National and Regional Economic Productivity[a]

The primary long-term effect of the proposed action would be to offset the impacts of an oil supply interruption on the regional and national economies. Because the SPR expansion facilities would be located in a region containing many crude oil pipelines and refineries, the oil stored would be immediately available to those sectors most severely impacted by an interruption. Thus, immediate production halts of refined petroleum products at both the regional and national levels would be prevented. Furthermore, the additional available oil supplies would be advantageous to authorities as they develop solutions for an interruption of long duration.

The construction and operation of additional (or expansion) SPR facilities in the Seaway or Capline Complexes would most likely not have any impacts, either detrimental or beneficial, on the long-term economic productivity of the regional or national economy. Increased regional demand for goods and services resulting from the construction of new or expanded SPR facilities would be only short-term, and it is unlikely that suppliers would alter productive capabilities to meet this temporary demand. Regional economic productivity would only be altered if all of the following conditions were true: firms in the region were trying to expand plants and equipment; suppliers were already operating at or near capacity rates of production; and supplies needed at the SPR facility had to be purchased in the region. Under these circumstances, purchases for the construction and operation of an SPR facility would utilize resources demanded for expansion by other firms in the region. Economic productivity might also be altered if, in the future, the salt used by SPR cavern creation is needed by the salt mining industry or for other uses. This is particularly true at Stratton Ridge, where the salt dome is currently used by the chemical industry, and at Weeks Island, where salt mining is currently performed.

10.2 Adverse Impacts on Long-Term Environmental Productivity[b]

Environmental productivity may be adversely affected due to impacts on land, water, and air quality. Most activities associated with SPR expansion would affect the environment only temporarily and, therefore, would not adversely impact environmental productivity in the long term.

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[a] Economic productivity is defined here as the ability of the economy to produce goods and services.

[b] Environmental productivity is defined here as the ability of the environment to support the growth and reproduction of flora and fauna and their habitats.

10.2.1 Impacts on Land

Construction and operation of an SPR site and pipelines would alter land use, topography, floodplains, and wetlands, and therefore could affect environmental productivity. Cavern creation activities for all five sites, such as well drilling, would minimally increase local subsidence, which could cause changes in topography. Site clearing and grading and road and building construction would result in changes to topography and land use patterns and would therefore disturb or destroy the habitats of several plant and animal species. Such alteration may adversely impact the long-term environmental productivity in the immediate site vicinity. Dredging and spoil deposition associated with the raw water intake structure, which would occur at all sites except Big Hill, could adversely impact habitats temporarily; however, no long-term effects on environmental productivity would be expected.

At Big Hill, raw water intake, brine disposal systems, and several roads, buildings, and tanks are already in place. Continued use of these systems would not affect current environmental productivity. Development of an SPR facility at the Richton site would require the use of approximately 4.2 acres of prime farmland during the life of the project, thus producing minor adverse effects on the environmental (and economic) productivity of this land. No prime or potential prime farmland will be affected at any of the other proposed sites. At several of the sites (i.e., Richton, Weeks Island, and Stratton Ridge), on-site wetland areas would be permanently disturbed, decreasing the environmental productivity. At all sites, associated pipelines and other off-site construction could cross wetland areas; however, permanent decreases in environmental productivity are not predicted.

If Richton is selected, DOE oil storage tanks could be required to be constructed at Liberty and/or at Chevron/Pascagoula. Construction of these tanks would alter the topography of the area and therefore may cause minor adverse impact on long-term environmental productivity. At Pascagoula, the land area for a proposed DOE-owned and operated bulk storage terminal is previously disturbed, and no adverse impacts on long-term productivity would be expected.

Construction of up to two additional docks at the St. James Terminal would occur primarily on the Mississippi River; therefore, few changes to land or land use patterns would result. Construction of on-site storage tanks would take place on DOE-owned property that is not otherwise productively used, and this construction would not affect environmental productivity over the long term.

Construction of pipelines could adversely affect the habitats of several species through changes in topography and drainage patterns. Special consideration of potential for impacts to threatened or endangered species is necessary. Appendices E and F assess potential for impacts to such species. Because DOE would develop mitigation plans in coordination with USFWS and NMFS, no long-term adverse impacts are predicted. However, because these changes would be only temporary and ROWs would be restored to original topography, no effects on long-term environmental productivity would result. Several of the pipeline routes would cross areas delineated as prime or potentially prime farmland and, thus, there may be minor, short-term adverse effects on productivity.

10.2.2 Impacts on Water Quality

Construction activities associated with the brine, raw water, and crude oil fill and distribution systems would result in temporary increases in turbidity and siltation in water bodies traversed and could affect habitats of several species. However, because these impacts would be temporary, few effects on long-term environmental productivity would result. Resource use and depletion associated with the withdrawal of water from the ICW would have negligible adverse impacts on environmental productivity, because the maximum withdrawal rate produces changes in currents and salinity that are too small to cause noticeable effects on aquatic biota. At Richton, raw water intake from the Leaf River could cause minor changes in hydrology, water quality, and biology. In addition, water quality in the Leaf River is generally higher than in the ICW. At sites where a new raw water intake structure would be constructed, disposal of dredge spoil could have a minor adverse impact on water quality, which may result in minor short-term effects on environmental productivity.

Any significant increases in salinity in the Gulf of Mexico due to brine disposal would be localized. Impacts to aquatic biota would be short-term; long-term environmental productivity would not be affected. Spills of brine or oil from SPR pipelines could have a negative effect on water quality and could adversely affect environmental productivity in the short term.

Construction of a crude oil pipeline from Big Hill across Trinity Bay could adversely impact submerged aquatic vegetation and thus long-term environmental productivity. At Weeks Island and Cote Blanche, construction of the brine pipeline would cross oyster seed beds and could have adverse impacts on oyster communities and thus on environmental productivity. Because no new raw water and brine disposal systems would be required at Big Hill, impacts on water quality at this site would be minor. Underground injection of brine would not affect environmental productivity at any of the sites where this method of brine disposal is under consideration.

At the St. James Terminal, potential impacts on surface water resulting from the construction of two new docks, such as increased turbidity, increased suspended nutrients, and reduced dissolved oxygen levels, would be temporary and therefore would not affect long-term environmental productivity of the Mississippi River. Dredging activities would permanently alter the benthic habitat in the docking and turning areas, because maintenance dredging would be required. However, the effects on long-term environmental productivity would be minimal because a productive community of river-bottom dwellers does not currently exist. In the Pascagoula area, the DOE-operated terminal would not include docks and, therefore, the potential impacts to water quality would be minimal.

10.2.3 Impacts on Air Quality

Adverse impacts on air quality would be minor and short-term. Some short-term increased fugitive emissions would be expected during site clearing, use of unpaved roads, and pipeline construction. Volatile hydrocarbon emissions would be expected during cavern fill. However, emissions would be above recommended standards on-site only for at most short periods and always below recommended standards off-site; impacts would be negligible in the long term. This would be the case at any of the five candidate sites. Thus, long-term environmental productivity would not be affected.

Air quality in the vicinity of the St. James Terminal would be impacted only slightly by the expansion, primarily due to substantial emissions of volatile hydrocarbons possible from tanker loading operations. In the Pascagoula area, operation of a terminal would also lead to increased hydrocarbon emissions. These effects would not be significant enough to impact long-term environmental productivity.

11.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

This chapter discusses the amounts and types of resources which would be irreversibly and irretrievably committed if the proposed expansion of the SPR is undertaken.

11.1 Introduction

The following sections describe the types of resources that would be committed to SPR expansion, and provides an overview of the resources potentially required for each candidate site.

11.1.1 Affected Resources

Development of facilities for the expansion of the SPR would require that some resources be irreversibly committed to the project. For example, plants and animals may be destroyed on or near the developed site; construction materials would be used that could not be recovered or recycled; and energy and other materials would be consumed or reduced to waste products.[1] Although some material resources (e.g., scrap metal) might be retrieved after completion of the project's life cycle, most would be permanently expended and could not be returned to their original value or made available in the future for their original use. The types of resources considered and affected by the proposed expansion of the SPR are material resources, including both renewable and nonrenewable materials, natural resources, and human resources.

The estimated resource requirements for each new candidate site are based on the quantities and types of resources used for the recently completed Big Hill site, although adjustments were made to account for some differences in specific requirements which vary from site to site. The proposed expansion at the existing Big Hill site, which primarily involves the leaching of additional caverns and the possible construction of a new crude oil distribution pipeline, would require fewer resources than the other candidate facilities.

The following section summarizes the level of development that would be required at each alternative site, focusing on the types of resources that would be consumed during the process of site development (natural resources, manmade materials, energy, personnel, etc.). In general, SPR expansion would result in the following resource usage:

- commitment of a large area of land, which for most of the candidate sites is presently undeveloped, and for many candidate sites includes some wetland acreage;
- temporary degradation of air quality during construction and drawdown activities;
- extensive use of water resources during cavern leaching and drawdown;
- commitment of large quantities of steel and concrete for both on-site and off-site construction;
- permanent loss of a large volume of salt as a result of leaching the salt domes for cavern construction;

- loss of a very small percentage of crude oil during construction and operation due to minor spills, incomplete recovery, and evaporation;

- use of significant energy resources for the leaching caverns, construction of pipelines, and drawdown;

- commitment of a continuous labor force for three to four years for construction of each facility; and

- major capital investment for development of each site.

11.1.2 Site Overview

Development of an SPR site will require site preparation (clearing, grading, and stabilizing land), the creation of storage caverns, and the development of several operating systems, including:

- crude oil fill and distribution pipelines;

- an RWI system including pipelines and an intake structure;

- a brine disposal system consisting either of pipeline/diffuser or pipeline/ underground injection wells; and

- support structures and equipment, including administrative buildings, laboratories, security buildings, site roads, an electrical substation, and a fire safety system.

While the Big Hill expansion site would require no modification of existing systems, each of the new sites and the Weeks Island "expansion" would require the development of all systems. Below, each site is briefly described and the resources required to develop the site are identified.

The existing Big Hill site would be expanded to increase the storage capacity by adding nine additional storage caverns. Because the expansion would be able to use existing facility systems, including the RWI and the brine disposal systems, commitment of resources for the Big Hill expansion would consist primarily of site preparation and construction of caverns. Under a 270-day drawdown criterion, no oil distribution enhancements are required; however, a 180-day drawdown criterion would require the construction of a crude oil distribution pipeline to the Houston area. In general, Big Hill would require commitment of fewer resources than the development of the other sites.

Stratton Ridge would be a new site, requiring a large commitment of resources. Stratton Ridge construction requirements are the same for both 270-day and 180-day drawdown criteria. All facilities at Stratton Ridge would need to be developed, including leaching ten 10-million barrel capacity storage caverns; construction of an RWI structure, a brine disposal system, and a crude oil receipt/distribution system; and construction of other facility infrastructure. The oil pipeline would require construction of only a short spur (approximately one mile) to connect with the existing DOE pipeline for the Bryan Mound facility.

The proposed Weeks Island facility would be located near the existing site, but would require essentially all the resources that would be committed to developing a new site. The current facility uses a former salt mine for crude oil storage, while the expanded storage capacity would require leaching new caverns and the construction of RWI and brine disposal systems. This would require extensive facility and system construction. A pipeline for crude oil distribution currently exists from Weeks Island to St. James Terminal, and under a 270-day criterion, only the addition of a pump station would be needed to enhance distribution capability. A 180-day drawdown criterion would require that an additional spur be built to a reversed Texas 22" pipeline to access the LOOP Clovelly Terminal and a second pump station be added to enhance the existing DOE pipeline. Expansion of the St. James Terminal would also be necessary under a 180-day criterion and would entail the construction of up to two new docks and two additional 400,000-barrel oil storage tanks, requiring a relatively large commitment of resources.

Cote Blanche would also be a new site, requiring a commitment of resources similar to those for Weeks Island and Stratton Ridge. Construction scenarios for 270-day and 180-day drawdown criteria would be almost identical to those for Weeks Island. Cote Blanche would, however, require additional construction of a bridge to the site crossing the ICW.

Richton would be a new site, requiring a resource commitment similar to that for Weeks Island, Stratton Ridge, and Cote Blanche, with new crude oil pipelines required to Liberty, Mobile or Pascagoula, and possible construction of 1.2 MMB of oil storage tankage at Liberty and/or Chevron/Pascagoula, and a DOE 2 MMB bulk storage terminal in Pascagoula.

11.2 Land Resources

11.2.1 Land Use

Development or expansion of any SPR facility at any of the new or existing sites would require construction on land that is presently undeveloped. Some of the land is currently used for farming, grazing, or recreation; however, none has ever been used for industrial purposes. At several of the sites, the salt dome is currently being used for other industrial uses (salt mining, oil drilling, or oil storage); however, this activity has not resulted in the development of any of the land proposed for use in the SPR expansion. Some land would be used temporarily, such as for roads necessary for construction, but most of the land use would represent an irreversible commitment of land, especially the land upon which the facility itself is constructed.

11.2.2 Amount and Types of Land Committed

The amount of land that would be committed during construction would include land used for site construction, pipeline construction, and road construction, although road construction would require only a minor amount of land acreage. While not all the acreage required for construction would actually be developed, standard security measures require that the entire site be enclosed in fencing; this would effectively preclude use of that land for the project lifetime. The land required for site and pipeline construction would include both dry and wet lands. Temporary easements would be required during construction, but only permanent easements would be considered as irretrievable resources. Total permanent acreage that would be committed for each site is shown in Table 11.2-1. Wetland acreages affected are listed for site construction only; for pipelines, wetlands will only be temporarily disturbed so the commitment is not irreversible and irretrievable. For all sites except Stratton Ridge, the amount of land required for construction would be greater under a 180-day drawdown criterion than under a 270-day drawdown scenario because of the greater length of pipelines required.

The irretrievable commitment of land at the Big Hill expansion would include 150 acres for on-site construction. The existing brine and RWI pipelines would be utilized for the Big Hill expansion, and no new brine or raw water pipelines would be added. Under a 270-day drawdown criterion, no new crude oil pipelines would be required; under a 180-day drawdown criterion, a 58-mile crude oil pipeline would be constructed from Big Hill to Houston. Construction of the pipeline would require up to 373 acres of additional land depending on the pipeline route selected.

The irretrievable commitment of land at the Stratton Ridge site would include 200 acres for on-site facility construction, 46 acres of which are wetlands. Pipeline construction would include a 0.85-mile crude oil pipeline spur, and a joint ROW for the RWI and brine disposal pipelines and require an additional 71 acres of land for permanent easements.

The irretrievable commitment of land at the Weeks Island expansion site would include 270 acres for on-site facility construction, 6 acres of which are wetlands. DOE is considering two options for brine disposal: underground injection or disposal via a diffuser in the Gulf; only one disposal option would be used. The injection option would require an additional 25 acres, for construction of 25 wells along the crude oil pipeline ROW, with each requiring one acre. If injection wells are not used, the brine disposal pipeline would be built and would require about 31 acres for permanent easements. Construction would also include an RWI structure and pipeline (within the brine pipeline ROW), a spur to the existing DOE Weeks Island to St. James pipeline, and a new pump station along the pipeline. Acreage requirements for these components would total 12 acres. Under a 180-day drawdown criterion, additional land requirements totaling 143 acres would be required for an additional pump station, expansion of the St. James Terminal, and a crude oil pipeline spur ROW.

The irretrievable commitment of land at the Cote Blanche site would include 300 acres for on-site construction, none of which are wetlands. Also, construction of an access bridge to the site would require an additional 217 acres, with an unquantified number of wetland acres. DOE is considering brine disposal options identical to those under consideration for Weeks Island: injection wells (an additional 25 acres) or brine disposal via a pipeline into the Gulf. Pipeline construction at Cote Blanche would include RWI, brine, and crude oil distribution pipelines. Under a 270-day drawdown criterion these structures would require an additional 143 acres of land.

Development at Richton would require 300 acres for facility construction, 30 acres of which are wetlands. Pipeline construction under a 270-day criterion would include an RWI, a dual-purpose pipeline to Pascagoula connecting to the Chevron Refinery and dock 7 with extension offshore to a brine diffuser location. In addition, either a 118-mile crude oil distribution pipeline to Liberty, a pipeline to connect to commercial distribution facilities at the Port of Mobile, Alabama, or the construction of a DOE-owned and operated terminal in Pascagoula, along with connection to the two proposed Greenwood Island docks would be required. All options would also require a 10-mile pipeline to provide blanket oil during the leaching phase. Following the completion of cavern creation and fill, the pipeline to Pascagoula would be converted to crude oil and subsequent brine disposal requirements would be met using underground injection. Under a 180-day criterion, all options would require distribution

Table 11.2-1
Commitment of Land for Sites and ROWs (acres)

Site	Site Construction (Total acres/ wetland acres)	Terminal and Tankage Construction	RWI Structure	Pump Station	Crude Pipeline ROW[d]	Brine Pipeline ROW[e]	RWI Pipeline ROW[f]
Big Hill Site with 270-day Configuration	150/0						
Additions for 180-day: Trinity Bay Route <u>or</u> I-10 Route					357 373		
Stratton Ridge[a]	200/46		5		6	60	Within Brine ROW
Weeks Island, 270-day	270/6		5	5	2	31	Within Brine ROW
Additions for 180-day		66		5	42		
Cote Blanche Site with 270-day Configuration[b]	517[c]/>0		5	5	12	69	4

[a] At Stratton Ridge, the distribution configurations are the same under 180-day and 270-day criteria.

[b] To meet a 180-day criterion, the same distribution enhancements would be required at Cote Blanche as at Weeks Island, therefore, land commitments required for the Weeks Island 180-day configuration apply.

[c] Includes acreage for permanent easement for bridge over ICW. Because conceptual engineering is still ongoing, it is not possible to quantify the acres of wetlands permanently committed at this time. It is likely, however, that some portion of the acreage affected will be in wetland areas.

Table 11.2-1 (Continued)
Commitment of Land for Sites and ROWs (acres)

Site	Site Construction (Total acres/ wetland acres)	Terminal and Tankage Construction	RWI Structure	Pump Station	Crude Pipeline ROW[d]	Brine Pipeline ROW[e]	RWI Pipeline ROW[f]
Richton, with 270-day Configuration:							
Liberty Route or	300/30	60	5	5	1,182[g]	64	76
Mobile Route or	300/30	30	5	5	943	64	76
Pascagoula	300/30	60	5	5	496	64	76
Additions for 180-day Configuration							
Liberty Route or		33		5			
Mobile Route or		60			35		
Pascagoula					25		

[d] At Richton, the dual-purpose pipeline to Pascagoula is included in the crude pipeline ROW total.

[e] The pipeline to the brine disposal wells is included in the brine pipeline ROW. Under the Pascagoula option, the pipeline also serves as a blanket oil pipeline.

[f] Easement acres include portion of ROW shared by RWI and dual-purpose pipelines.

[g] At Richton, crude oil pipeline ROW and brine pipeline ROW are the same.

enhancements: the Mobile pipeline option would include the DOE terminal and connection to the Greenwood Island docks; and the last option would include additional pipeline connections to the Port of Pascagoula Public Terminal dock G and a reversed CAI-Ky pipeline, the Liberty pipeline option would include a pump station and require the addition of a dock to St. James.

Under a 270-day drawdown criterion, St James Terminal would not be expanded. Under a 180-day drawdown criterion, the irretrievable commitment of land for the St. James Terminal expansion would be approximately 33 acres for on-site construction of one additional dock and one tank. The expansion at St. James would be to enhance distribution capability of the SPR Capline Complex, and no additional construction of pipelines would be required. In addition, under certain alternatives, DOE would construct a 2-MMB oil storage terminal at Pascagoula that would require a commitment of approximately 60 acres of land and 1.2-MMB bulk storage tankage at Liberty and/or Chevron/Pascagoula, each requiring approximately 30 acres of land.

11.3 Air Resources

Negative air quality impacts at all SPR expansion sites are expected to be insignificant, except at the St. James Terminal.[2] Emissions would be short-term and, for the most part, limited to a small area. More detailed information about air impacts can be found in section 7.1.4. The following sections discuss the types and amounts of pollutants which would result from construction and operation of the facilities.

11.3.1 Particulates, Sulfur Dioxide, Carbon Monoxide, and Nitrogen Dioxide

Land clearing and use of unpaved roads would be the major sources of fugitive dust emissions. Total emissions could reach a peak of several hundred tons per month. Emissions would also be generated from the use of diesel-fueled heavy equipment, gasoline-fueled light duty vehicles, and drill rigs. Emissions from these sources for all sites would be expected to be about 9 tons per year of particulates and 9 tons per year of SO_2, and would be expected to range from 32 to 38 tons per year of CO and from 134 to 144 tons per year of NO_2. It would not be expected that these emissions would result in violations of air quality standards. There would be some emissions of SO_2, CO, NO_2, and particulates during site operations (mainly caused by traffic on unpaved roads), however, these would be expected to be less than during construction.

11.3.2 Volatile Hydrocarbons

Because not all oil is removed from brine during withdrawal, some volatile hydrocarbons are present in the produced brine. Most NMHC would be emitted during the cavern leach/fill operations. Some NMHC emissions would also be associated with other activities at the site, but these emissions would be relatively minor. NMHC emissions at all sites during leach/fill are estimated to be approximately less than 5 grams per second. During standby periods, NMHC emissions would never be expected to exceed 30 tons per year. As described in section 7.4.4, negligible impacts on the generation of ozone would be expected as a result of these emissions.

Additional emissions that would occur at the St. James Terminal would be associated with the loading and unloading of crude oil from tankers. There would be other sources of emissions, including fugitive emissions from pumps, seals, and valves, as well as fuel tanks and vehicles. As shown in Table 7.4-1, the highest rate of hydrocarbon emissions would be expected during the drawdown phase, when oil would be loaded onto tankers. Hydrocarbon emissions during this phase are estimated to be 2,361 tons per year, which would include all emission sources. During standby, when there would be very little activity at the terminal, emissions are only estimated to be 13.4 tons per year. Emissions from St. James Terminal would have short-term negative impacts on air quality over a smaller area during tanker loading. If DOE were to build a terminal at Pascagoula, the air quality impacts would be of the same order of magnitude and duration as those at St. James.

11.4 Water Resources

There are two primary uses of water during construction and operation at SPR facilities, leaching and fill/withdrawal. Water use could be considered an irretrievably committed resource for each of the storage facilities, but there would be no significant water resources required for the St. James Terminal, as neither leaching or fill/withdrawal would occur on site. Below is a discussion of what on-site activities require water, and the amounts that would be required at the facilities.

Leaching salt domes to develop caverns for crude oil storage requires a large commitment of raw water. The caverns are leached by pumping raw water supplied by the RWI structure into one of two wells drilled into the salt dome. After the water is used for leaching, it is saturated with salt, and the brine is disposed into the Gulf of Mexico through a pipeline/diffuser system or via pipeline/underground injection. This water is not truly irretrievable, as it is returned to the Gulf or underground formations, and may in the distant future be recycled to the ICW (or Leaf River for Richton). For purposes of this analysis, however, water use is considered to be irreversible because the recycling of water in the atmosphere or through aquifer discharge occurs over such extensive time periods.

Raw water is also used in the oil withdrawal process, or drawdown. In this process, raw water is pumped into a cavern, in which oil is stored, in order to displace the oil. Oil is then transported via pipelines for distribution. SPR sites would be built to accommodate five drawdown cycles. Water which would be used for oil displacement in one cycle would then itself be displaced with the addition of new oil during the next fill.

Leaching requires a volume of water equal to approximately seven times the potential storage capacity of the leached cavern (i.e., seven barrels of water/barrel of stored oil). Quantities of water that would be required for leaching storage caverns at the alternative sites are shown in Table 11.4-1. Fill/withdrawal cycles require a water volume approximately equal to the displaced volume of oil (i.e., 1 barrel of water/1 barrel of oil). Water requirements for fill/withdrawal are also shown in Table 11.4-1.

11.5 Material Resources

Material resources committed for development of the SPR expansion sites would include construction materials, salt, and oil. The following sections discuss the uses and amounts of each material resource required for development or expansion of the facilities.

11.5.1. Construction Materials

Steel and concrete are the primary materials that would be required for construction of the oil storage facility, site buildings, pipelines, raw water and brine disposal systems, and other

Table 11.4-1
Water Required for Construction and Operation at SPR Sites

	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Leaching (MMB)	630	700	1,120	1,120	1,120
Fill/Withdrawal (MMB)	473	525	840	840	840
Total (MMB)	1,103	1,225	1,960	1,960	1,960

infrastructure at each site. These materials, once used in this construction, may be retrievable in some form in the future, but would have a greatly reduced economic value and limited construction value. Thus, for the purposes of this DEIS, these materials are considered to be irretrievable resources. Estimated steel and concrete requirements are shown in Table 11.5-1. Because facility design has not been completed for any of the candidate expansion sites, steel and concrete estimates are preliminary. Assumptions have been made based on previous site designs.[3] The estimates presented here should be considered representative of the quantities of materials required; they do not represent a current site design. The quantities for the St. James Terminal are based on estimates that include material only for construction of two docks and two storage tanks.[d,4]

11.5.2 Salt Resources

Oil storage caverns are created in salt domes by leaching the salt to create space in which to store crude oil. The salt, which is potentially economically valuable, would be disposed of either in the Gulf or in appropriate underground formations in the form of brine. Because the salt would be leached and disposed of in a manner that destroys its original economic value, this salt resource would be irreversibly committed to the project.

The amount of salt lost would have a volume equal to the storage capacity of the oil storage caverns. The volume of salt that would be lost during leaching was calculated using an average density of 2.16 g/cm^3 for salt[5]. The total volume of salt lost during cavern creation would be:

- 34.0 million tons of salt at Big Hill
- 37.8 million tons of salt at Stratton Ridge

[d] To meet a 180-day drawdown criterion, the same distribution enhancements would be required at Cote Blanche as at Weeks Island.

Table 11.5-1
Construction Materials

Site	Steel (tons)	Concrete (ft^3)
Big Hill Site with 270-day Configuration	19,297	14,400
Additions for 180-day:		
Trinity Bay Route or	22,964	236,821
I-10 Route	36,798	317,812
Stratton Ridge	44,295	591,241
Weeks Island, 270-day	59,300	286,860
Additions for 180-day	5,893	34,600
Cote Blanche Site with 270-day Configuration[1]	58,078	279,683
Richton, with 270-day Configuration:		
Liberty Route or	205,774	1,247,673
Mobile Route or	163,779	981,375
Pascagoula[2]	107,006	661,173
Additions for 180-day Configuration		
Liberty Route or	1,081	41,418
Mobile Route[2] or	5,214	63,481
Pascagoula	3,492	20,504
St. James Terminal	1,198	82,836

1 To meet the 180-day criterion, the same distribution enhancements would be required at Cote Blanche as at Weeks Island.
2 These options include materials for a DOE requirement for construction of a terminal at Pascagoula.

- 60.5 million tons of salt at Weeks Island
- 60.5 million tons of salt at Cote Blanche
- 60.5 million tons of salt at Richton

11.5.3 Oil

Oil resources can be lost during SPR facility development and operation through incomplete recovery, evaporation, and spills. The oil stored in storage caverns would not be enclosed in any type of container. When the oil is extracted from the caverns during the withdrawal process, a very small percentage of the oil (i.e., less than 5×10^{-3} percent) is lost due to the impossibility of fully recovering 100 percent of the stored oil from the confines of the cavern. During fill/withdrawal cycles, pumping oil through pipelines potentially heated by solar radiation increases the potential for evaporation losses. A certain percentage of the oil (i.e., less than 3×10^{-2} percent) would be lost due to evaporation. In any operation involving petroleum products, there is a potential for large amounts of oil to be lost due to spills and leaks. The frequency and severity of potential impacts from oil spills is discussed in Chapter 6. During normal operation, however, a very small amount of oil (i.e., approximately 6×10^{-4} percent) would be lost through minor spillage occurring at joints, connectors, and other points along the operation channels.

All these losses would be considered to be irreversible and irretrievable. The total amount of oil lost is estimated to be approximately 0.03 percent[6] of the total storage capacity of any site for each fill/withdrawal cycle. The total oil losses for five drawdown cycles are shown in Table 11.5-2. The quantity of oil lost at each site, however, is insignificant when compared to the total amount of oil stored at each site. In general, the amount of energy used for the development of each site would be about two percent or less of the total amount of energy that would be stored at each site. For the terminal expansion, the percentage is slightly higher at 2.8 percent.

Table 11.5-2
Oil Losses (Five Drawdown Cycles)

	Big Hill	Stratton Ridge	Weeks Island	Cote Blanche	Richton
Incomplete Recovery (MB)	20.7	23.0	36.8	36.8	36.8
Evaporation (MB)	103.5	115.0	184.0	184.0	184.0
Spills (MB)	2.7	3.0	4.8	4.8	4.8
TOTAL (MB)	126.9	141.0	225.6	225.6	225.6

11.6 Energy and Energy Equivalents

All energy used during construction and operation would be irretrievable. Relative to the potential energy stored in the form of crude oil in the caverns, the energy consumed during construction and operation would be very small.

The comparison of the amount of energy used during construction of a storage facility with the amount of energy stored there could be done by converting energy requirements to equivalent barrels of oil. The next sections below discuss the activities which require a large energy input and compare the energy equivalents of construction activities with the stored energy.

11.6.1 Description of Energy Uses During Site Development

The energy consumption at an SPR site can be divided among three major activities: site preparation, production of construction materials, and site operations, including oil fill and withdrawal. Preparation of the site would involve leaching the caverns to prepare them for oil storage. Because of the size and number of caverns, pumping such a large volume of water would require a major commitment of energy resources. The energy consumption for operating the site and transporting oil is estimated from the Phase III estimates for oil fill/withdrawal cycles[7]. The energy requirement for production of appropriate construction materials is estimated by calculating the energy consumption for producing the major construction materials, concrete and steel. Concrete production requires approximately 265 kilowatt hours (kWh) per cubic foot of product, and steel production requires approximately 11,730 kWh per ton of product.[8] The total energy that would be required for all aspects of site construction and five fill/withdrawal cycles, is shown in Table 11.6.1. Because a 270-day drawdown criterion requires less pipeline construction for each site than a 180-day criterion, the 270-day drawdown criterion requires a lower energy commitment.

11.6.2 Conversion of Energy Requirements to Oil Equivalents

To compare the energy that would be required for site preparation and operation with the energy stored at facilities, the energy (kWh) that would be consumed during site preparation and operation are converted to barrels (bbl) of oil equivalents. In this way, it is possible to compare the stored energy with the energy required to store it until withdrawal. Energy requirements are converted using 1,600 kWh per equivalent barrel of oil.[9] The total energy equivalents are shown in Table 11.6-1.

11.7 Labor Resources

Development of expansion sites for the SPR would require a significant commitment of labor resources over the construction period, and a smaller staff during the operations period. This labor is irretrievable. Labor resources are presented in Table 11.7-1. The following sections discuss the types of labor required and the patterns of employment.

11.7.1 Construction

Construction of the proposed SPR expansion facilities would require a commitment of labor resources for a period of approximately four years. Over this period, the work force would fluctuate due to sequential activities, including facility development, cavern leaching, RWI and brine disposal system construction, and pipeline construction. The work force would nearly double from the first year to the third year. Peak employment would occur during the third or fourth year, during concurrent construction of on-site facilities and pipelines. The total labor commitments required for construction are calculated from the estimated total hours of labor contributed over those four years.

11.7.2 Operation and Maintenance of Site

A relatively small staff would remain as permanent employees at each site. These staff would be responsible for performing fill/withdrawal operations, and maintaining equipment, as well as general administrative functions. In addition, there would be a permanent security force

Table 11.6-1
Energy Commitment

Site	Total Energy (kWh)	Energy Equivalents (bbl)	Percent of Energy Stored
Big Hill Site with 270-day Configuration	1.57×10^9	981,000	1.0
Additions for 180-day:			
Trinity Bay Route <u>or</u>	5.30×10^8	331,000	0.4
I-10 Route	7.20×10^8	450,000	0.5
Stratton Ridge	2.09×10^9	1,306,000	1.3
Weeks Island, 270-day	3.09×10^9	1,931,000	1.2
Additions for 180-day	8.00×10^7	50,000	0.3
Cote Blanche Site with 270-day Configuration	3.08×10^9	1,925,000	1.2
Richton, with 270-day Configuration:			
Liberty Route <u>or</u>	5.03×10^9	3,143,000	2.0
Mobile Option <u>or</u>	4.73×10^9	2,956,250	1.8
Pascagoula[1]	4.33×10^9	2,706,250	1.7
Additions for 180-day Configuration			
Liberty Route <u>or</u>	2.4×10^7	14,800	<0.1
Mobile Route[1] <u>or</u>	7.8×10^7	48,766	<0.1
Pascagoula	4.64×10^7	29,000	<0.1
St. James Terminal	3.60×10^7	22,500	2.8

[1] These options include DOE requirements for a terminal at Pascagoula.

of approximately 60 personnel at each site. The security staff is included in the operation estimate in Table 11.7.1, except for Big Hill, where the operations estimate would be in addition to staff already at the site, and does not include additional security staff.

11.8 Capital

Completion of construction would also require a large commitment of capital resources. All of this capital would be irretrievable because the energy, labor, and materials used for construction would be irretrievable. The largest investment would result from the actual

Table 11.7-1
Commitment of Labor Resources

Site	Total Construction (man-years)[a]	Annual Operation and Maintenance (man-years)[b]
Big Hill, 270-day	190	20
Big Hill, 180-day	308	20
Stratton Ridge	727	130
Weeks Island, 270-day	1,024	164
St. James, 180-day	135	0
Cote Blanche, 270-day	1,024	164
Richton	1,024	164
Terminal	118	0

[a] The total construction period ranges from 3 to 5 years. Man-years presented are total for site development as described in Chapter 7.

[b] Man-years presented are for the annual operation and maintenance and only includes permanent on-site employees.

construction of pipelines, caverns, and site facilities, although land acquisition and engineering also require a large input. These estimates do not include the value of the stored oil, nor the costs associated with oil transport. The capital that would be required for expansion of the SPR is estimated to range from $307 million to $547 million for a 90 to 100 million barrel storage site to over $840 million for a 160 million barrel storage site.

11.9 Summary

Expansion of the SPR to one billion barrels would require an irretrievable and irreversible commitment of many types of resources, including land, water, air, construction material, salt, energy, labor and capital. Relative to the amount of energy stored in the additional 250-MMB capacity facilities, the commitment of resources is, for the large part, insignificant. Some resources such as air would be slightly impacted by expansion, and would not require a significant commitment of resources. Compared to the total potential storage capacity for five drawdown cycles, the energy required for construction and operation would be less than two percent for most alternatives; however, development would require a very large commitment of capital resources, as well as labor and land.

ENDNOTES

1. U.S. Department of Energy, *Strategic Petroleum Reserve, Final Supplement to Final Environmental Impact Statement, Phase III Development, Texoma and Seaway Group Salt Dome (Cameron Parish, Louisiana and Brazoria and Jefferson Counties, Texas)*, October 1981, Document Number DOE/EIS-0075, p 8-1.

2. U.S. Department of Energy, *Strategic Petroleum Reserve, Final Impact Statement, Texoma Group Salt Domes (West Hackberry Expansion, Black Bayou, Vinton, Big Hill), Cameron and Calcasieu Parishes, Louisiana and Jefferson County, Texas*, November 1978, Document Number DOE/EIS-0029, p C6-16.

3. U.S. Department of Energy, *Strategic Petroleum Reserve, Final Supplement to Final Environmental Impact Statement, Phase III Development, Texoma and Seaway Group Salt Dome (Cameron Parish, Louisiana and Brazoria and Jefferson Counties, Texas)*, October 1981, Document Number DOE/EIS-0075, Chapter 8.

4. PB-KBB, *St. James Terminal Dock No. 1 Quantities Estimate*, December 20, 1991.

5. Whitten, D.G. and J.R. Brooks, "Table of Minerals," in *The Penguin Dictionary of Geology*, Penguin Books Ltd., London, England, 1988.

6. U.S. Department of Energy, *Strategic Petroleum Reserve, Final Supplement to Final Environmental Impact Statement, Phase III Development, Texoma and Seaway Group Salt Dome (Cameron Parish, Louisiana and Brazoria and Jefferson Counties, Texas)*, October 1981, Document Number DOE/EIS-0075, p 8-7.

7. U.S. Department of Energy, *Strategic Petroleum Reserve, Final Supplement to Final Environmental Impact Statement, Phase III Development, Texoma and Seaway Group Salt Dome (Cameron Parish, Louisiana and Brazoria and Jefferson Counties, Texas)*, October 1981, Document Number DOE/EIS-0075, Chapter 8.

8. U.S. Department of Energy, *Strategic Petroleum Reserve, Final Supplement to Final Environmental Impact Statement, Phase III Development, Texoma and Seaway Group Salt Dome (Cameron Parish, Louisiana and Brazoria and Jefferson Counties, Texas)*, October 1981, Document Number DOE/EIS-0075, Chapter 8.

9. U.S. Department of Energy, *Strategic Petroleum Reserve, Final Supplement to Final Environmental Impact Statement, Phase III Development, Texoma and Seaway Group Salt Dome (Cameron Parish, Louisiana and Brazoria and Jefferson Counties, Texas)*, October 1981, Document Number DOE/EIS-0075, p 8-7.

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13.0 CONSULTATION, COORDINATION, AND DEIS CIRCULATION

As a requirement of the NEPA process, DOE has consulted with Federal agencies with jurisdiction by law or special expertise with respect to any environmental impacts involved and with appropriate State and local agencies with authority to develop and enforce environmental standards. These agencies and their respective relevant jurisdictions are presented in Table 13.0-1. Meetings held to date with these agencies are listed in Appendix A. No Native American tribes were consulted since none of the alternatives would affect a reservation.

As a further requirement of the NEPA process, DOE is circulating this DEIS to: the Federal and State agencies listed in Table 13.0-1; the congressional delegations of affected districts; congressional committees with jurisdiction over the SPR; identified affected landowners; interested individuals; local libraries; county and parish governments; regional and local newspapers, trade journals, television and radio stations; and to the parties listed below.

Local Agencies

Mayor of New Iberia, LA
Port of Iberia, New Iberia, LA
Lafourche Basin Levee District, Donaldsonville, LA
Waterway District, Hattiesburg, MS
Pearl River Basin Development District, Jackson, MS
Jackson County Port Authority, Jackson, MS
City of Moss Point, MS
Lower Neches Valley Authority, Beaumont, TX
Velasco Drainage District, Clute, TX
Mayor of Clute, TX
Mayor of Lake Jackson, TX
Brazos River Harbor Navigation District, Freeport, TX
Brazoria County Floodplain Administrator, Angleton, TX
City Manager, Port Arthur, TX
Port of Port Arthur, Port Arthur, TX

Organizations

Alabama Conservancy
Alabama Wildlife Federation
American Petroleum Institute
Association of Texas Soil and Water Conservation Districts
Atchafalaya Delta Society
Audubon Society (National Organization's Sanctuaries Department, New Orleans, Acadiana, Houston, and Pine Woods Chapters)
Bayou Preservation Association
Citizens' Environmental Coalition (Houston)
Coalition to Restore Coastal Louisiana
Coastal Conservation Association, Inc.
Congressional Information Service
Ducks Unlimited
Freeport League

Organizations (Continued)

Galveston Bay National Estuary Program
Galveston Bay Foundation
Gulf Coast Conservation Association
Gulf Coast Fishermen's Environmental Defense Fund
Gulf Coast Research Lab (Ocean Springs, MS)
Gulf States Marine Fisheries Commission
Iberia Parish Environmental Advisory Committee
International Chemical Workers Union, Region 6
League of Women Voters (Houston and New Orleans chapters)
Legacy Foundation
Louisiana Association of Conservation Districts
Louisiana Coalition for Action for Clean Air
Louisiana Coastal Cleanup
Louisiana Environmental Action Network
Louisiana Wildlife Federation
Marine Advisory Service (Galveston)
Mississippi Archaeological Association
Mississippi Wildlife Federation
Mississippi Association of Conservation Districts
National Federation of Federal Employees, Local 759
National Wetlands Research Center
Nature Conservancy (Louisiana, Mississippi, and Texas Field Offices)
Protecting Environmental and Ecological Resources
St. Mary Environmental Control Committee
Save Our Wetlands
Sierra Club (Delta, Houston, and Galveston groups)
Sportsmen Conservationists of Texas, Inc.
Texas A&M University Department of Wildlife and Fisheries
Texas Association of Conservation Districts
Texas Committee on Natural Resources
Texas Environmental Coalition
Texas Organization for Endangered Species
Wildlife Society (Louisiana, Mississippi, and Texas chapters)

Industries and Commercial Enterprises

Amoco (Clute, TX)
Andrews and Kurth
Carey Salt Company
Chevron U.S.A. Products Company (Pascagoula)
Coastal Land, Inc.
Conoco, Inc. (Houston)
Cockrell Oil Corporation
Dow USA, Texas Operations (Freeport)
Dow Hydrocarbons and Resources, Inc. (Houston)
Dow Pipeline Company (Houston)
Dow Chemical (Plaquemine, LA)

Industries and Commercial Enterprises (Continued)

Entergy Corporation
Hammer, Inc.
Hazel and Thomas
Intectran
Landau Associates, Inc.
Maersk, Inc.
Montague, Pittman, Rogers & Schwartz
Morton International (New Iberia, LA)
McDermott, Will & Emery
Nederland Chamber of Commerce
North American Chemical Company (Mission, KS)
Occidental Petroleum (Houston)
Phillips Petroleum Company (Houston)
South Mississippi Planning and Development District
Subra Company, Inc.
Texaco E&P, Inc. (Manvel, TX)
Texas Brine Company
Texas Shrimp Association
Thompson, Hine, and Flory
Unocal Corporation (Nederland)
Vinson and Elkins
Walk, Haydel and Associates, Inc.
Western Seafood

Table 13.0-1
Agencies Consulted by DOE

Agency	Site(s) under Jurisdiction[1]	Jurisdictional concerns applicable to project
FEDERAL		
U.S. Environmental Protection Agency Region 6, Dallas, Texas Region 4, Atlanta, Georgia	BH, SR, CB, WI R	Protection of the nation's air, water, and land resources. Certifies state programs for the environmental control of waste discharges or emissions. In proposed action, concerns include: • Water quality management under the Clean Water Act. • Compliance with §403 required by same. This section concerns NPDES permits. • §404 permit review required by same. This section concerns discharge of dredged or fill material into navigable waters. • Surface public water supply and underground water source quality under the Safe Drinking Water Act. • Compliance with the Clean Air Act through a state agency with approved State Implementation Plan (SIP). • SPCC plan review for each oil handling facility. • Certification of compliance with RCRA. • NEPA Environmental Impact Statement review. • Floodplain/wetland assessments review (E.O. 11988 and E.O. 11990). • Protection of threatened or endangered species under §7 of the Endangered Species Act. • Protection of archaeological or historical elements eligible for nomination to the National Register under the Historic Preservation Act.
U.S. Department of the Army U.S. Army Corps of Engineers Galveston District, Galveston, Texas New Orleans District, New Orleans, Louisiana Mobile District, Mobile, Alabama	BH,SR CB, WI R	Issues permits for activities affecting navigable waters. In proposed action, concerns include: • Discharge of dredged or fill material. • Construction in wetlands or floodplains. • Construction of fixed structures on the continental shelf. • Floodplain/wetland assessments review (E.O. 11988 and E.O. 11990). • Permits for §10 or Rivers and Harbors Act.

Table 13.0-1
Agencies Consulted by DOE (Continued)

Agency	Site(s) under Jurisdiction[1]	Jurisdictional concerns applicable to project
U.S. Department of the Interior U.S. Fish and Wildlife Service (USFWS)		Protection of fish and wildlife. Concerns include: • Fish and Wildlife Coordination Act consultation. • Endangered Species Act consultation. • Effects on migratory birds.
Region 2, Albuquerque, NM	BH,SR	• CWA §402 and §404 permit review. • Floodplain/wetlands assessments review.
Region 4, Atlanta, GA	CB, WI, R	• Review of Rivers and Harbors Act §10 obstruction to navigation permits. • A national wildlife refuge program has been established under the Federal Land Policy and Management Act. Refuge use permit must be obtained for crossing a refuge with a pipeline.
U.S. Department of Agriculture Soil Conservation Service		
Temple, TX	BH, SR	Can provide information on prime farmland in the impacted area. CEQ policy statement requires DOE to preserve prime farmland during construction and operation of project.
Alexandria, LA	CB, WI	
Jackson, MS	R	
U.S. Department of Commerce National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Baton Rouge, LA	WI, CB, R	Protection of marine fisheries. Consultation is required under Endangered Species Act.
National Marine Fisheries Service, Habitat Conservation Division, Galveston, Texas	BH,SR	
STATE		
Texas		
Railroad Commission	BH,SR	Issues permits for drilling and oil pipelines. Receives reports on oil storage and pipeline operations from agencies with permits.
Department of Parks and Wildlife	BH, SR	Protection of recreational areas within the state; protection of fish and wildlife and their habitats. Specific to the proposed action are the following: • Protection of animals and plants not listed as threatened or endangered on the Federal list. • Protection of beaches. • Review of §404 permit applications. • Providing information to Water Commission on permits to store, take, or divert water. • Providing information on fish and wildlife resource.

Table 13.0-1
Agencies Consulted by DOE (Continued)

Agency	Site(s) under Jurisdiction[1]	Jurisdictional concerns applicable to project
Water Commission	BH, SR	Responsible for protection of state's water resources. Issues permits for discharges to state waters and for storing taking, or diverting water. Reviews federal permit applications.
General Land Office	BH, SR	Responsible for management of state-owned land. Issues easements required to use state-owned lands for pipeline installation. Approves ROWs for pipelines crossing public lands. Administers coastal zone management program.
Air Control Board	BH, SR	Administers clean air laws to control and abate air pollution. Issues permits for construction and operation of on-site and off-site facilities that emit air contaminants.
Department of Highways and Public Transportation	BH, SR	Involved with policies and procedures for pipeline ROWs crossing highways.
Historical Commission	BH, SR	Provides consultation on identification of archaeological and cultural resources sites.
<u>Louisiana</u>		
Office of Cultural Development	CB, WI	Responsible for historical, cultural, and archaeological resource preservation.
Department of Wildlife and Fisheries	CB, WI	Jurisdiction over state's natural resources; mandated to protect, conserve, and replenish wildlife and fishery resources; consulted for operations such as dredging, activities affecting oyster beds.
Department of Environmental Quality	CB, WI	Administers permit programs for regulation of air quality, water pollution control, solid waste disposal, and hazardous waste management.
Department of Transportation and Development	CB, WI	Issues additional construction permits as necessary and permits related to transportation issues.
Department of Natural Resources	CB, WI	Coastal zone management. Jurisdiction over state lands affected by project. Drilling permits.
Geological Survey	CB, WI	Consulting authority for underground injection, subsidence, soil impacts, geology, technical feasibility of drilling.
Department of Public Safety	CB, WI	Administers state laws for fire protection, emergency response, hazardous materials transportation.
<u>**Mississippi**</u>		
Department of Environmental Quality	R	Administers permit programs for regulation of air quality, water use, water pollution control, solid waste disposal, and hazardous waste management.

Table 13.0-1
Agencies Consulted by DOE (Continued)

Agency	Site(s) under Jurisdiction[1]	Jurisdictional concerns applicable to project
Bureau of Marine Resources	R	Administers coastal zone management program.
Department of Wildlife, Fisheries, and Parks	R	Jurisdiction over state's natural resources; mandated to protect, conserve, and replenish wildlife and fishery resources.
Department of Archives and History, Historic Preservation District	R	Responsible for historical, cultural, and archaeological resource preservation.
<u>Alabama</u>		
Department of Environmental Management	R (Mobile pipeline)	Administers permit programs for regulation of air quality, water use, water pollution control, coastal zone management, solid waste disposal, and hazardous waste management.
Historical Commission	R (Mobile pipeline)	Responsible for historical, cultural, and archaeological resource preservation.
Department of Conservation	R (Mobile pipeline)	Jurisdiction over state's natural resources; mandated to protect, conserve, and replenish wildlife and fishery resources.

[1] BH = Big Hill, SR = Stratton Ridge, WI = Weeks Island, CB = Cote Blanche, R = Richton.