DOE/EIS-0165

SUPPLEMENT TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE EXPANSION OF THE

Strategic Petroleum Reserve

Louisiana and Mississippi

May 1993
U.S. Department of Energy
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SUPPLEMENT TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT
DOE/EIS-0165

AGENCY: U.S. Department of Energy
Washington, DC

PROPOSED ACTION: Consider new brine disposal alternatives for two of the five candidate sites assessed in the Draft Environmental Impact Statement (DEIS) on the Expansion of the Strategic Petroleum Reserve (SPR).

LOCATION: Two candidate underground injection fields for brine disposal are located in St. Mary Parish, Louisiana and Perry, Forrest, and Jones Counties, Mississippi.

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ABSTRACT: The proposed expansion of the SPR, pursuant to Congressional directive (PL 101-383 and PL 101-512), would require the generation of about two billion barrels of salt brine. The brine would be disposed of primarily by ocean discharge and alternatively by deep underground injection. This Supplement evaluates two alternative underground brine injection fields at candidate sites already assessed in DOE/DEIS-165 (October 1992).

HEARINGS: Public hearings will be held at Franklin, Louisiana, and Hattiesburg, Mississippi, on dates to be announced.

COMMENT PERIOD: Comments must be received by July 26, 1993

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

Page

LIST OF TABLES

Chapter 3:

Chapter 4:

Chapter 5:

LIST OF FIGURES

Chapter 2:

Chapter 3:

The brine pipeline would traverse flat to gently rolling terrain and occasional surface waters designated as 100-year floodplains. A total of 20 to 150 acres of wetlands (estimated from Soil Conservation Service maps) could potentially be affected and floodplains could suffer a temporary change in drainage patterns. Impacts to wetlands from construction include destruction or alteration of vegetation/habitat along the right-of-way (ROW) and well areas. Construction would cause minor and temporary adverse effects to water quality and benthic habitat in the Leaf River, Bogue Homo, and Tallahala Creek. The Federally threatened or endangered gopher tortoise, eastern indigo snake, yellow-blotched sawback turtle, and the red-cockaded woodpecker are species that could use habitat along the ROW and in the well areas. One to nine small brine spills and one or two large brine spills could be expected during capacity development. Any brine spill could cause intense but localized and temporary impacts in the Leaf River, Bogue Homo, or Tallahala Creek.

Construction for the Cote Blanche brine injection field would be almost entirely within a previously disturbed marsh area, which is part of the habitat for a threatened species. Construction and operation of the brine injection field for Richton would have potential to contaminate potable groundwater and to adversely impact habitat for four threatened or endangered species. Otherwise, construction and operation and maintenance impacts associated with development of a brine injection field for Cote Blanche and Richton would be very similar. Impacts to wildlife from a brine spill could be severe due to habitat loss and possibly direct losses of adults, young, and/or eggs if breeding areas are affected. Injection at each of these sites could result in an increase in pressure in the receiving formation, but it would not be expected to significantly affect groundwater quality or impact seismicity or subsidence. Groundwater contamination due to upward migration of brine, upward flow of natural saline water, geological fracturing or readjustment of strata could be caused by construction of the brine injection wells or well failures. The potential for oil spills and brine releases into shallow aquifers (e.g., injection well failures, or upward migration of brine through fractures, faults, or abandoned wells) would be unlikely because of strict design, monitoring, and operating controls.

Comparison of Brine Disposal Alternatives With Those Assessed in the DEIS

The underground injection alternatives for Cote Blanche and Richton in this Supplement were developed as alternatives to brine disposal options involving injection and diffusion into the Gulf for the same sites. The alternatives for Cote Blanche and Richton assessed in this Supplement would pose similar, remote possibilities of injection well failure. Potential impacts due to injection well failure at Cote Blanche would be essentially the same as those identified in the DEIS. Given an injection well failure and subsequent release into an aquifer, however, because the fresh aquifer in the vicinity of the Richton injection system is heavily used, there is an increased likelihood of adverse impacts on human health should a well failure occur. The impacts associated with potential spills from brine pipelines would be significantly reduced at both Cote Blanche and Richton, in comparison to brine disposal options considered in the DEIS.

At Cote Blanche, the brine injection system would require approximately two miles of brine injection piping instead of five miles of piping associated with the brine injection option discussed in the DEIS. Additionally, the pipeline for the brine diffuser option assessed in the DEIS would be longer and would pose a greater probability of releases than the shorter piping network associated with the brine injection system.

At Richton, the brine injection alternative would be 15.4 miles longer than the injection component of the brine disposal option considered in the DEIS; however, the brine injection pipeline distance would be approximately one-quarter the length of the dual-purpose pipeline assessed in the DEIS. The shorter length would offer fewer opportunities for failure, spills, and subsequent impacts to surface water and the ecology.

1.0 NEED FOR AND PURPOSE OF THE PROPOSED ACTION

The SPR was created to provide the United States (U.S.) with sufficient petroleum reserves to reduce the impacts of any future oil supply interruption and to carry out the obligations of the U.S. under the International Energy Program. Congress mandated the creation of the SPR in the Energy Policy and Conservation Act of 1975 and established as a national goal the storage of up to one billion barrels of crude oil and petroleum products. In the early stages of the SPR program, plans were approved for the development of facilities and systems for a 750-million-barrel (MMB) Reserve. Decisions on developing the final 250-MMB increment of a one-billion-barrel program were deferred.

In 1990, Congress enacted two bills mandating DOE to undertake the planning and environmental activities necessary to develop the final 250-MMB increment of a one-billion-barrel SPR.[a] Accordingly, DOE issued a DEIS on the expansion of the SPR (DOE/EIS-0165/D, October 1992). The DEIS addressed five candidate salt domes that are under consideration. Two of the five would be selected to expand the SPR by 250 MMB. Two candidate salt domes in Texas are alternatives to each other for development of one of the expansion sites; the remaining three candidates that are alternatives to each other for development are Weeks Island in Iberia Parish, Louisiana; Cote Blanche in St. Mary Parish, Louisiana; and Richton in Perry County, Mississippi.

All proposed storage facilities involve the development and storage of petroleum in underground salt dome storage caverns. Development of such caverns is accomplished by solution mining which generates substantial quantities of saturated brine requiring disposal in an environmentally acceptable manner. After site development, additional brine disposal will be required, but at substantially lower rates and quantities, for site fill and cavern pressure control.

The DEIS assessed the environmental impacts of brine disposal into the Gulf of Mexico as the principal brine disposal method for all sites. In addition, the DEIS assessed an alternative brine disposal configuration using underground brine injection wells in lieu of ocean discharge for the Weeks Island and Cote Blanche sites. For the Richton site in Mississippi, the Department assessed a single hybrid brine disposal configuration which provided a combination of primary (high volume) brine disposal through a 96-mile pipeline into the Gulf of Mexico and a secondary (low volume) brine disposal via underground injection. Once the Richton site development was complete, the 96-mile pipeline to the Gulf would be converted to oil distribution and all subsequent brine disposal would be via the underground injection system.

Public hearings on the DEIS were held in December 1992 in Mississippi, Texas, and Louisiana. The comment period closed March 5, 1993. One of the comments received by DOE was that an underground injection system capable of meeting all of Richton's brine disposal requirements should be considered in lieu of ocean discharge due to perceived lower environmental impacts and costs.

In considering this comment, DOE concluded that, notwithstanding the substantial technical uncertainty of the proposal, it is not unreasonable. Therefore, consistent with 40 CFR Part 1502.9(c) of the Council on Environmental Quality's National Environmental Policy Act

[a] The Energy Policy and Conservation Act Amendments (1990), PL 101-383, and the Department of Interior and Related Agencies Appropriations Act for Fiscal Year 1991 (1990), PL 101-512.

(NEPA) regulations, DOE determined that it would further the purpose of NEPA to circulate this information for public review and comment in a Supplement to the DEIS. In addition, DOE is providing information in this Supplement for public comment concerning a refinement to the brine injection alternative for Cote Blanche that is environmentally substantially different from that considered in the DEIS.

2.0 PROPOSED ACTION AND ALTERNATIVES

This section briefly mentions the alternatives assessed in the DEIS and provides an overview of the new alternatives to be addressed in this Supplement to the DEIS.

2.1 Alternatives Covered in the Draft Environmental Impact Statement

The DEIS published in October 1992 provided a brief overview of the existing SPR facilities and systems in the 750-MMB reserve. The existing SPR storage facilities are centralized in three oil distribution complexes: (1) the Capline Complex, located in south-central Louisiana (Weeks Island and Bayou Choctaw); (2) the Texoma Complex, located in western Louisiana and eastern Texas (West Hackberry, Louisiana and Big Hill, Texas); and (3) the Seaway Complex located in Texas (Bryan Mound). In addition to the storage caverns and other on-site facilities (e.g., administration, laboratory, storage tanks), facilities include raw water intake structures and pipeline systems, oil fill and distribution pipeline systems, pipeline/diffuser systems or underground injection wells for brine disposal, marine terminal facilities on the Mississippi River at St. James, Louisiana, and an administrative facility in New Orleans, Louisiana.

The DEIS assessed five sites as candidates for the 250-MMB expansion: Big Hill[b] and Stratton Ridge in Texas for expansion in the SPR Seaway Complex; and Weeks Island and Cote Blanche in Louisiana, and Richton in Mississippi for expansion in the SPR Capline Complex. The assessment also included the associated crude oil fill and distribution pipelines, connections, and terminal enhancements under both 270-day and 180-day drawdown criteria; raw water intake systems for cavern leaching; and brine disposal via pipeline/diffuser system into the Gulf of Mexico and underground injection wells. The DEIS also considered the no action alternative.

In the DEIS, DOE did not designate a preference among the competing candidate sites and developed conceptual designs and addressed their environmental impacts to equal detail. DOE still has not declared a preference among the candidate sites.

With regard to the subalternatives, however, DOE is assuming for the purposes of this Supplement a 180-day drawdown criterion, as opposed to a 270-day criterion, reasoning that if the crude oil distribution facilities for 180-day drawdown are not built, the environmental impacts of a 270-day drawdown system would be within the envelope of impacts assessed.

Finally, DOE has a generic preference for brine disposal by ocean discharge for the rates required by leaching, as opposed to underground injection, based on DOE's operating experience. To date, DOE has discharged over four billion barrels of brine into the Gulf of Mexico over an eleven year period without harm to the marine environment. Less than 300 million barrels have been injected underground, this amount having been accomplished at disproportionate expense and difficulty. Underground injection technology has advanced significantly over the last ten years; however, it has never been attempted on the scale required to support leaching an SPR facility. In light of the advancements in technology and the potential site-specific environmental concerns of brine pipeline construction which could become impediments to the program, underground brine injection is being considered as a potential alternative to ocean discharge for

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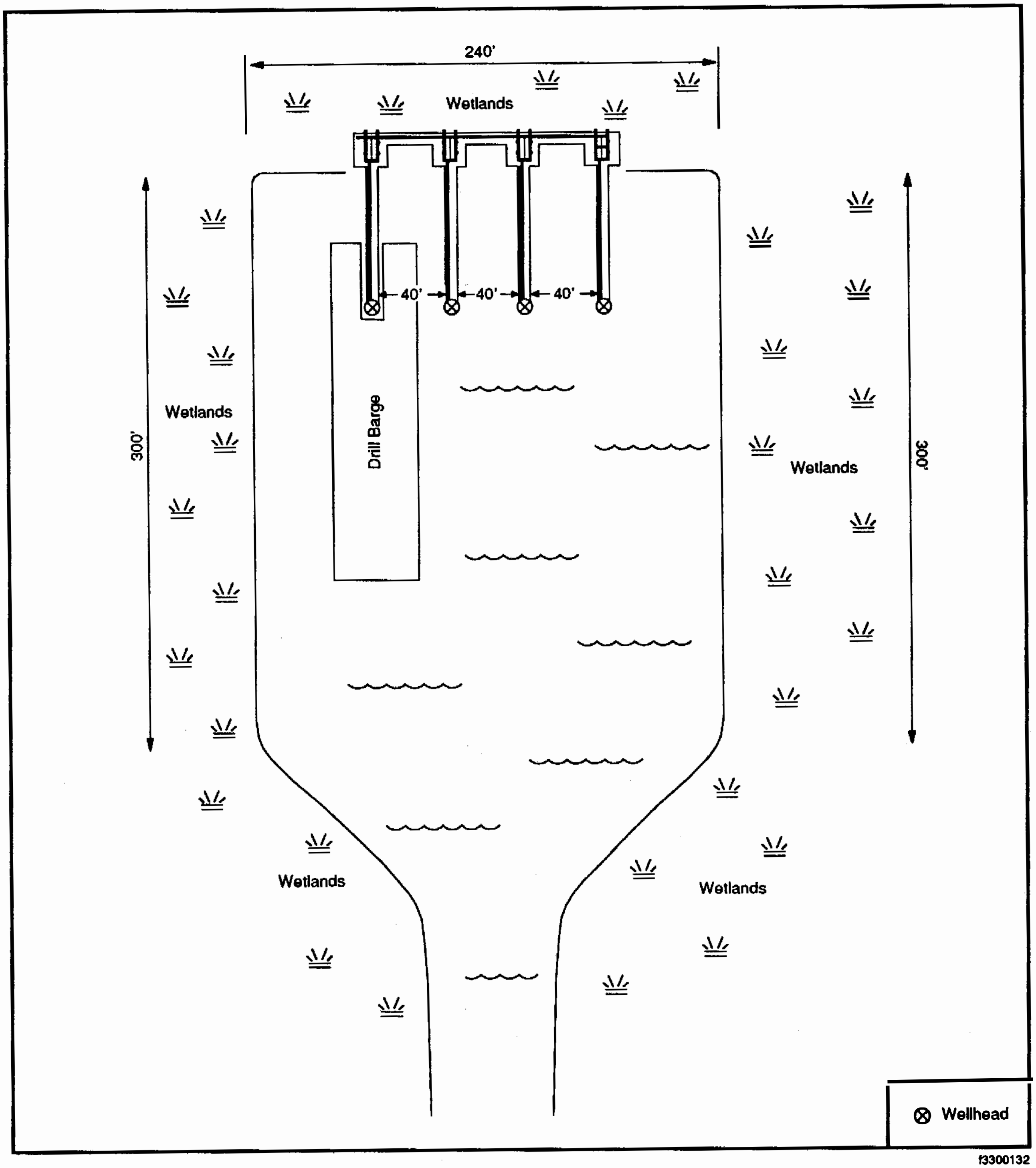
[b] While Big Hill is physically located in the Texoma Complex, for purposes of expanding the SPR, the Department considers the proposed expansion at Big Hill a Seaway Complex site because under the 180-day drawdown criterion, an oil distribution pipeline would connect Big Hill to the refining and distribution centers near Houston.

Figure 2
Typical Well Platform Site Plan for Cote Blanche



yards from the surrounding wetlands to create the six barge slips for a total project dredging requirement of up to 315,600 cubic yards.

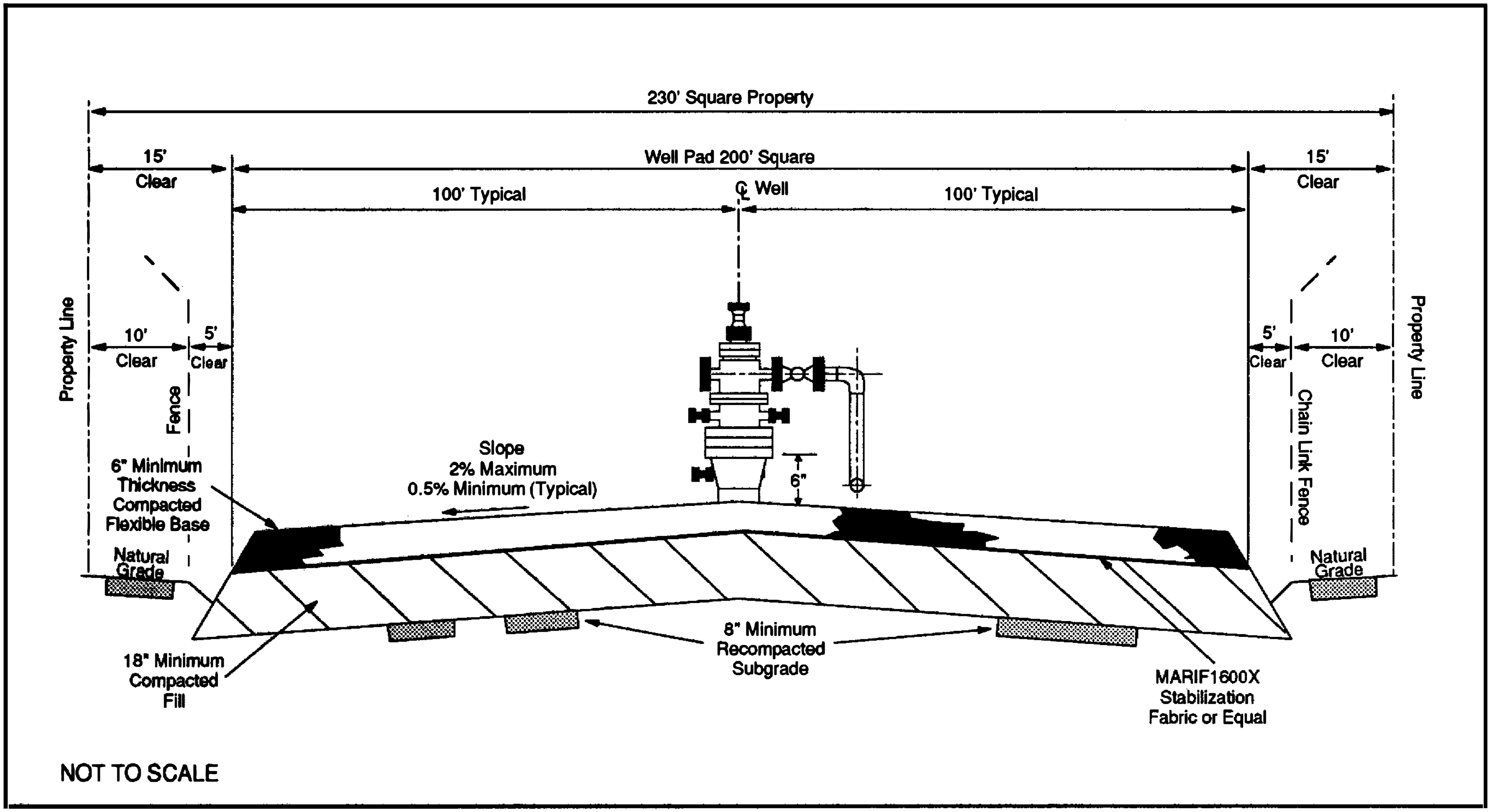
2.2.2 Brine Disposal Via Underground Injection - Richton

Richton is located in Perry County, Mississippi approximately 18 miles east of Hattiesburg and approximately three miles west of the town of Richton. The DEIS assessed the impacts of developing up to 16 storage caverns with total storage capacity of 160 MMB on a 259-acre site located on the Richton salt dome. The brine disposal alternative addressed in the DEIS would involve brine diffusion through a 96-mile pipeline to a diffuser in the Gulf of Mexico and underground injection through 15 wells on 1,000-foot centers, which would be installed along the proposed blanket oil pipeline ROW extending approximately eleven miles.

As an alternative brine disposal option, DOE is considering an underground injection field located northwest of the salt dome as the sole means of brine disposal during the development and operation of the proposed site. The brine injection system would run to the northwest from the Richton site to injection wells in Perry, Forrest, and Jones Counties (Figure 3). The components of the system would include a single 42-inch pipeline telescoping to eight inches, running west of the site for approximately eight miles and then turning northwest for approximately 18 miles along the east side of the existing Plantation Pipeline ROW. An additional 2.3 miles of service pipeline, leading from the mainline to the wellheads would also be required, for a total 28.3 miles of pipeline. The injection field would begin approximately five miles from the dome with up to 55 injection wells on 2,000-foot centers, covering 222 acres. Each of the 55 wells would be supplied by a 220-foot, eight-inch service connection and would be designed for an injection rate of 20,000 to 25,000 bbl/day. Wells would inject brine at depths ranging from 3,900 to 4,500 feet bls. Figures 4 and 5 provide typical well pad site plans and well pad sections, respectively, proposed for the underground injection system at Richton.

The oil distribution alternative considered in this Supplement for Richton would be an additional configuration to those considered in the DEIS, because the disposal of brine solely via underground injection would eliminate the construction of the dual-purpose pipeline from Richton to Pascagoula. Under this alternative, a 270-day drawdown would be accomplished by transporting 600 MBD of oil from Richton through the Liberty pipeline, where it would be routed north through the Capline pipeline. Under a 180-day drawdown, approximately 600 MBD of oil from Richton would be transported via the pipeline to Liberty and the remaining 300 MBD of oil would be transported through the pipeline to Mobile, where it would be distributed across commercial docks as assessed in the DEIS. The increase in oil transported through the Capline under this scenario would necessitate an additional dock at the St. James Terminal to account for the 36 MMB of oil displaced from the existing Bayou Choctaw and/or Weeks Island sites.

Figure 5
Typical Well Pad Section for Richton



3.0 DESCRIPTION OF AFFECTED ENVIRONMENT

This section provides an overview of relevant additional details regarding the affected environment in the vicinities of Cote Blanche, Louisiana and Richton, Mississippi to allow the assessment of potential impacts of the new brine disposal alternatives at each site.

3.1 Cote Blanche

The alternative underground injection field for Cote Blanche would consist of 24 wells connected by approximately two miles of pipeline, covering approximately 23 acres. The well platforms would be located on abandoned canals, which are in areas of intermediate to brackish marshlands directly to the east of the proposed oil storage cavern site, on the north shore of West Cote Blanche Bay. Specific elements of the affected environment are discussed below.

3.1.1 Geology

The description of the general surface and subsurface geology of the area provided in Chapter 5.4.1 of the DEIS also applies to the area of the underground injection field, which is to the east, immediately adjacent to the dome. The principal geological feature of the region is the salt dome under consideration as a candidate SPR expansion storage site. Except for the area which is uplifted, which affects those strata immediately above the salt dome, those formations underlying the area of the brine injection configuration are the same as those described in the DEIS.

The land area directly over the existing salt mine at Cote Blanche Island has shown some local subsidence on the order of several cm/yr. Local subsidence rates would be increased by the operation of oil storage caverns, but this is not expected to be a problem.[1] Subsidence just to the east of the dome (the location of the alternative brine injection field) would not be affected by cavern development, and would only be subject to regional subsidence rates.

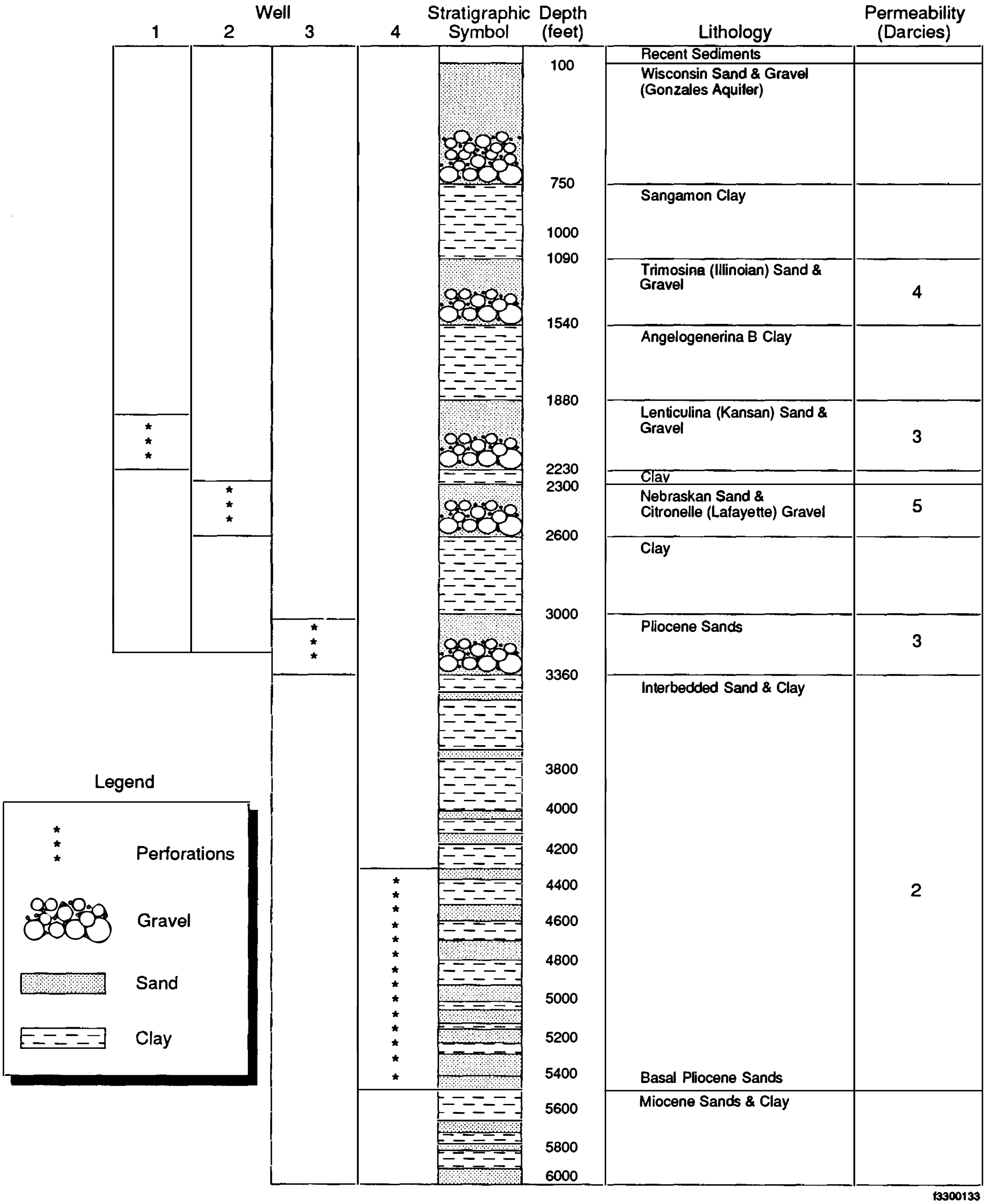
There is very little potential for serious seismic activity near the Cote Blanche injection field. There are a number of faults in the region, but the faulting is not tectonic in origin.[2] Historically, most earthquakes in the region have had seismic effects limited to areas near the immediate area of the fault. Although extremely unlikely, a strong earthquake (e.g., modified Mercalli VIII intensity) could occur anywhere along the Gulf Coast, possibly damaging pipelines.

3.1.2 Hydrogeology

Information is relatively scarce regarding groundwater characteristics in the area of the Cote Blanche brine injection field. However, because of the proximity of the injection well field to the storage caverns at both Cote Blanche and Weeks Island, the hydrogeology descriptions provided in Chapters 5.3.2 and 5.4.2 of the DEIS for Weeks Island and Cote Blanche apply generally to the area of the injection well field. Major features of the hydrogeology are summarized below.

The overlying soils around Cote Blanche consist of Frost soils found primarily on the foot slopes of the dome and Memphis soils found throughout the island. Together they form the Memphis-Frost association, which covers all of the salt dome islands in the Vermilion Bay area. Sand and gravel layers, which are found immediately off the edge of the salt dome, are found directly under the proposed injection well field.[3] Beaumont clays underlie 3 to 16 feet of surface

Figure 7
Brine Disposal Schematic at Cote Blanche



Point au Fer Shell Reef, once an oyster-producing area. Marsh Island blocks West Cote Blanche Bay and Vermilion Bay (further to the west) from the Gulf of Mexico. A submarine extension of additional reefs points northwestward for 14 miles to Rabbit Island.

All the bays are fresh to brackish and tidally influenced. None of the water bodies serve as a public water supply source. Other than recreational fishing and boating, the waters also have limited present uses. The state-designated uses for West Cote Blanche Bay include oyster propagation; the Bay is also large enough for boat or barge traffic.

3.1.3.2 Intracoastal Waterway

The portion of the ICW in the Cote Blanche area is considered a part of the Vermilion Bay hydrological basin.[10] Water in the basin flows generally east to west, driven by outflow from the Atchafalaya River. Outflow from the Vermilion Basin is primarily through Southwest Pass in Vermilion Bay to the Gulf of Mexico.[11] The average tidal range in the basin (measured in West Cote Blanche Bay) is 1.6 feet.

The salinity of the ICW varies widely, but is typically less than five parts per thousand (ppt). ICW salinity data collected by the U.S. Army Corps of Engineers from 1974 to 1981 at Vermilion Lock (approximately 30 miles west of the raw water intake (RWI) for the Cote Blanche site) range from 0.04 to 13.9 ppt, but average slightly less than two ppt.[12] Additionally, all salinity data collected in 1973 by the Corps of Engineers about five miles east of the RWI are less than one ppt (ranging from 0.05 to 0.21 ppt, with a mean of 0.11 ppt).[13] The low salinity is maintained by abundant freshwater discharge from the Atchafalaya River and Wax Lake Outlet and is protected from increases because saltwater intrusion to West Cote Blanche Bay is limited by Marsh Island.[14]

Nearly all of the ICW near Cote Blanche is bounded on both sides by marshlands. Patches of swamp forest are also present.[15] These wetlands and the adjacent bays have large populations of estuarine fish and invertebrates including shrimp, gulf menhaden, and blue crab. State-designated uses for the ICW include primary and secondary contact recreation (i.e., swimming and fishing) and the propagation of fish and wildlife. Although the state has not explicitly established uses for the waters that intersect the ICW within five miles east and west of the site, they appear to be used in the same general manner as the ICW itself.

3.1.4 Ecology

The alternate Cote Blanche brine injection system would be located within the Deltaic Plain ecosystem in the outer coastal floodplain province.[16] See Chapter 4.5 of the DEIS for a general description of the coastal plain region. The following sections describe those aspects where the ecology of the underground injection field differs from that of the Cote Blanche storage site, as described in 5.4.5 of the DEIS. The information presented here is based on a site survey of the upland areas and information from U.S. Fish and Wildlife Service (USFWS) and the Louisiana Department of Wildlife and Fisheries.

Vegetation

Figure 2 in Chapter 2 shows wetlands and upland habitats in the area surrounding the injection field. Upland habitats in the area generally include forests that contain grasses and scrub-shrub vegetation, including sweetgum, Chinese tallow tree, and white oak as dominant overstory species, with dogwood, yaupon, pecan, and honey locust being commonly observed understory species. Herbaceous species include partridge pea, blue vervain, and bitterweed.

As shown in Table 1, 52 acres (96 percent) of the 54 acres of land that would be required for construction of the brine injection field at Cote Blanche are wetlands.[17] Most of the wetlands crossed would be intertidal emergent estuarine areas; the remainder would be subtidal estuarine areas with unconsolidated bottoms and palustrine forested areas. Intertidal emergent estuarine wetlands are subject to tidal changes in water levels, are characterized by erect, rooted, herbaceous plant species, and are usually dominated by perennial plants that are present for most of the growing season.[18]

These types of wetlands can be divided into three categories based upon salinity regime: salt marsh, brackish marsh, and intermediate marsh. Most of the area potentially impacted by the construction is likely to be brackish marsh, which is generally defined as having a salinity less than ten ppt.[19] Brackish marsh in this area is dominated by saltmeadow cordgrass with varying mixtures of other species such as blackrush, saltgrass, and widgeongrass. The remaining estuarine wetlands, the subtidal unconsolidated bottom areas, are characterized by a lack of large stable substrates for plant attachment.[20] Most of the areas proposed for construction of the injection field are without vegetation due to human activity; they were altered during the construction of the abandoned canal system that was dredged in the late 1960s. Palustrine forested wetlands are defined as having woody vegetation that is at least six meters tall, and are nontidal with a salinity of 0.5 ppt or less. The particular palustrine forested wetlands potentially impacted by construction support broad-leaved deciduous trees such as tupelo, water oak, and sweetgum. The injection system would not cross any lands designated as a wildlife refuge. A detailed discussion of wetland types is provided in Appendix B of the DEIS.

Wildlife and Aquatic Life

Terrestrial wildlife sighted in the Cote Blanche area includes swamp rabbit, white-tailed deer, northern cardinal, and hawks. Other species likely to occur in the vicinity of Cote Blanche include raccoons, opossums, tree squirrels, and numerous species of ground-dwelling rodents (e.g., mice, moles, and voles). Resident and migratory nongame bird species such as warblers, vireos, and thrushes are probably abundant.

Coastal Louisiana's swamps and marshes are important wildlife areas that are particularly sensitive to changes in salinity and water level. Mammals that inhabit brackish marsh areas in Louisiana include muskrats, nutria, opossum, mink, river otter, swamp rabbits, and white-tailed deer. Brackish marsh habitat supports a wide variety of birds, including wading species such as sandpipers, egrets, herons, and bitterns that are likely to be important predator species. This habitat is heavily utilized by migratory waterfowl, especially wintering diving ducks.[21] The diverse assemblage of common amphibians and reptiles includes the mobile cooter, southern legged frog, broad-banded water snake, speckled king snake, and western cottonmouth.[22] Of the aquatic species, common macroinvertebrates include snails, oysters, crabs, clams, and shrimp. Brackish marshes also provide important nursery areas for many fish and crustacean species, including menhaden, killifish, catfish, and shrimp.

Threatened or Endangered Species

The bald eagle and Louisiana black bear are listed as endangered or threatened species in St. Mary Parish, in which the injection field is located.[23] The Louisiana black bear has been

Table 1
Types and Acreage of Wetlands Crossed by the Brine Injection Configuration for Cote Blanche

	Acres (to the nearest whole)	% of Wetland Total (to the nearest %)	% of Total
ESTUARINE WETLANDS -- TOTAL	41	79	76
A. Intertidal, emergent persistent	37	71	69
B. Subtidal, Unconsolidated bottom	4	8	7
PALUSTRINE WETLANDS -- TOTAL All palustrine wetlands are forested, broad-leafed deciduous	11	21	20
NON-WETLANDS -- TOTAL	2	--	4
WETLANDS -- TOTAL ACREAGE	52	100	96
TOTAL ACREAGE*	54	--	100

Source: Based on National Wetland Inventory Maps.
Note: Acreage estimates assume a 150-foot ROW for wetlands and 100-foot ROW for non-wetlands. Wetland acreage includes additional acreage for the well platforms (1.71 acres each) and two additional acres for each water crossing.

identified by USFWS as of particular concern because there is evidence that it uses Cote Blanche.[24] The Louisiana black bear requires a diverse habitat, usually including bald cypress or tupelo gum trees or thick understory for dens, nut- and berry-producing vegetation for food, and thick understory for cover and day beds. Bears have a large home-range size and use forested wetlands as well as upland areas (see Appendix F of the DEIS for further discussion of the habitat requirements of this species). The nearest known bald eagle nest in the area is more than one mile from the site.[25] The USFWS in Louisiana and the Louisiana Department of Wildlife and Fisheries, indicate that there are three rare plant species found within one mile of the site; these species are the Texas aster, woodland bluegrass, and broad-leaved spiderwort.[26] There are no waterbird nesting colonies or turtle nesting areas known to occur at or near the underground injection field.

Other Biological Resources of Concern

Avery Island Bird Sanctuary is located approximately 15 miles northwest of Cote Blanche. Marsh Island National Wildlife Refuge is located to the south-southwest. Shell Keys National Wildlife Refuge, an eight-acre bird nesting area, is located off the southern shore of Marsh Island. A State Wildlife Refuge and Paul J. Rainey Wildlife Sanctuary are located west of Marsh Island.

3.1.5 Floodplains

With the exception of two acres (minimal flooding), the brine injection field at Cote Blanche would be located in a coastal floodplain. The zone crossed by the brine injection field is indicative of a 100-year coastal flood area with velocity (wave action) caused by low barometric pressure and wind speed associated with a hurricane surge. The 100-year flood elevation at the Cote Blanche injection field ranges from 14 to 17 feet above sea level.[27]

3.1.6 Other Environmental Resources

There are no natural and scenic resources in the vicinity of the Cote Blanche injection well area (see Chapter 5.4.7 of the DEIS). Further, there are no cultural, historic, or archeological sites in the brine disposal area.[28] No Native American tribes exist in the area of the proposed brine system. Specific characteristics of climate, air quality and ambient noise levels, are discussed in Chapters 5.4.4 and 5.4.10 of the DEIS and the socioeconomic elements relevant to the area are described in Chapter 5.4.9 of the DEIS.

3.2 Richton

The Richton underground injection field for brine disposal would run northwest from the site through Perry, Forrest, and Jones Counties. The local terrain is flat to gently rolling.

3.2.1 Geology

The primary geological features in the area are described in Chapter 5.5.1 of the DEIS. The predominant stratigraphic units overlying the salt dome are sedimentary formations of Pliocene, Miocene, and Oligocene age, extending to a depth of approximately 655 feet, immediately over the caprock of the dome. Alluvium, which consists primarily of fine-grained sand, silt and clay, and sandy gravel, is found in the stream valleys along the pipeline route. The Citronelle Formation is of Pliocene age, has a maximum thickness of approximately 215 feet, and consists of gravelly, coarse-grained to fine-grained sand with lenses of silt, silty clay, and clay. The Hattiesburg and Catahoula formations are Miocene in age and consist of about 120 feet of very fine-grained to coarse-grained sand, clay, and chalky, sandy limestone. The predominant formation immediately over the salt dome is the Hattiesburg Formation, as the Citronelle has been mostly eroded from the surface. The Chickasawhay Formation, which is of Oligocene age, is 95 to 115 feet thick and consists of interbedded clay, fine-grained to medium-grained, and very sandy limestone that grades into limy sand.[29]

These same deposits make up the upper stratigraphic units away from the salt dome. Other sedimentary deposits that are found in the area are of middle Oligocene to Eocene age and extend to a depth of more than 5,600 feet. These stratigraphic units lie beneath the units described above. From youngest to oldest, these deposits are the Lower Vicksburg Group (middle Oligocene), the Jackson Group (late Eocene), the Claiborne Group (Eocene), the Wilcox Group (Eocene-Paleocene), and the Midway Group (Paleocene). The Midway Group, which extends to a depth of approximately 5,600 feet, overlies a sequence of Cretaceous and Jurassic sedimentary rocks with thicknesses of 9,800 to 19,000 meters.[30]

A fault that is present only at depths below the Paleocene Midway Group, known as F-7, intersects the northwestern edge of the Richton dome. Development of the fault is thought to be the result of salt dome deformation, and movement along the fault is most likely created by the migration of the salt.[31] Past seismicity evaluations have indicated that the Mississippi Salt Basin is in a region of low seismicity. In fact, the only earthquakes in recent years have occurred 45 miles from the site, to the north-northeast and south-southeast, a safe distance away from the brine injection system.

Surface soils in the area are dominated by two main soil association types. In upland areas, the Prentiss-Susquehanna-Benndale Association is the dominant surface soil. These moderately permeable surface soils are underlain by low permeability clayey soils. The other soil associations prevalent in the area, the Prentiss-Bruno-Myatt, is developed in areas dominated by terraces and floodplains. Because the Bruno is a sandy soil and the Myatt is loamy, the soil association as a whole is moderately high to highly permeable.[32] There is also some loess found on the surface.

Subsidence rates would be increased over the dome by the operation of oil storage caverns, but this is not expected to be a regional problem affecting the area of the brine injection field. Subsidence to the west and northwest of the dome (the location of the brine injection field) would not be affected by cavern development, and would only be subject to regional subsidence rates.

3.2.2 Hydrogeology

The hydrogeology of the three-county area of southern Mississippi where the brine injection system would be located is characterized by three main aquifers: the undifferentiated Miocene, the Upper Claiborne Aquifer, and the Wilcox Aquifer (Figure 8). The Lower Claiborne unit separates the Upper Claiborne Aquifer from the Wilcox Aquifer. Although sparse data exist on the hydraulic properties of the Lower Claiborne, available data suggest that appreciable horizontal flow does not occur through this unit. Thus, the undifferentiated Miocene is virtually confined from the lower water-bearing units.

In the area of the injection field, the undifferentiated Miocene begins just below the surface[33] and extends to a depth of anywhere from approximately 490 to 1,150 feet bls; freshwater begins anywhere between one to ten meters bls. The permeability of the aquifer sands is on the same scale as the regional permeability range (7.7 x 10^{-2} cm/sec to 2.7 x 10^{-4} cm/sec),[34] with the average permeability at over 200 sample wells being 3.4 x 10^{-2} cm/sec within the sands.[35] The unit contains abundant freshwater, which grades to moderately saline water with depth.[36] The undifferentiated Miocene is among the most productive groundwater sources in the region. Figure 9 shows a generalized schematic of the stratigraphy at Richton, including the permeability of each stratum, and indicates the screening depths for the injection wells.

The Upper Claiborne is characterized by a fairly low permeability (1 x 10^{-6} cm/sec)[37] and moderately saline water that grades to brine.[38] At a depth ranging from approximately 1,050 to 1,640 feet bls, the moderately saline to brine Upper Claiborne is entirely below the base of the freshwater zone at the site, which lies at approximately 590 feet bls.[39]

The virtually confined Wilcox aquifer, with localized permeabilities ranging from approximately 1 x 10^{-4} cm/sec to 1 x 10^{-6} cm/sec, extends from approximately 500 meters bls[40] to approximately 5,600 feet bls.[41] Only very saline water and brine exist in the Wilcox in the region.[42]

Figure 8
Hydrogeologic Cross-Section of the Richton Region

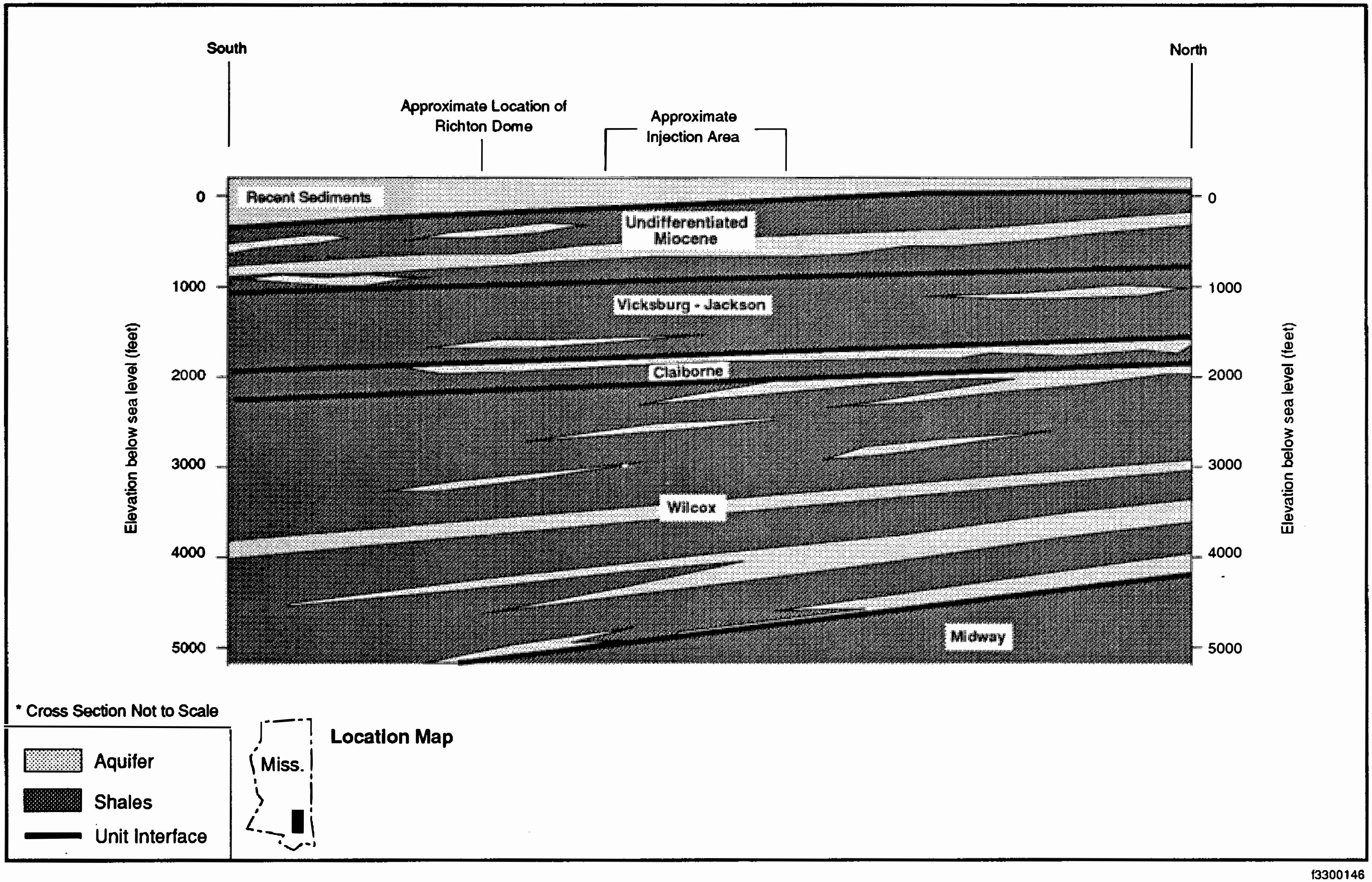
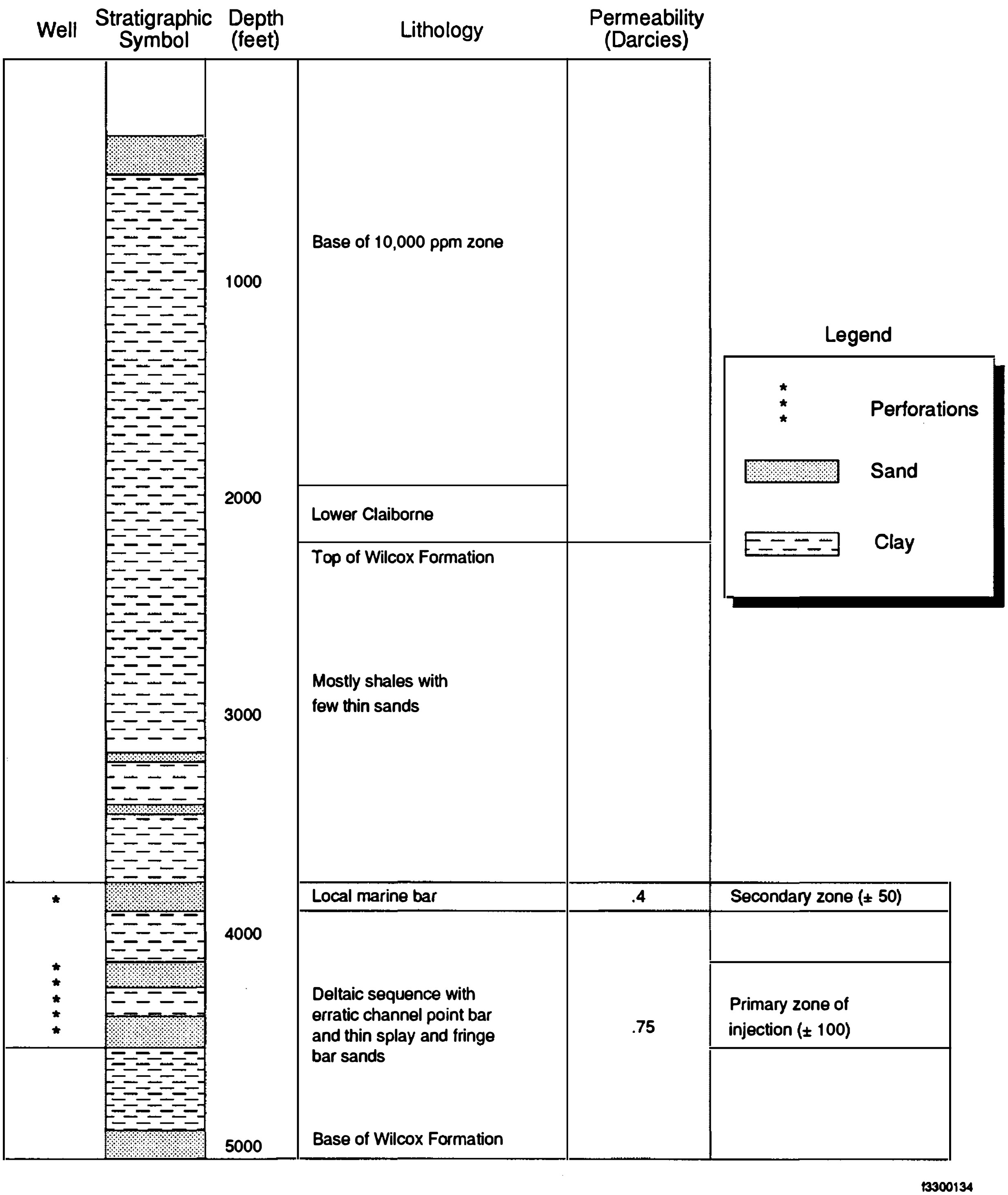


Figure 9
Brine Disposal Schematic at Richton



Groundwater flow in the area is toward the south or southeast in each unit. In the undifferentiated Miocene, groundwater flow at the site is almost directly to the south, following the downdip of the aquifer toward local discharge into the Leaf River and other streams,[43] and eventual discharge into the Gulf of Mexico.[44]

Of the three strata acting as groundwater sources below the undifferentiated Miocene in the vicinity of the Richton site, neither the Upper Claiborne Aquifer, the Vicksburg-Jackson Confining Unit (which has lenses of sands tapped approximately 30 miles to the northwest of the Richton dome), nor the Wilcox Aquifer (where brine would be injected) has wells screened within ten kilometers of any injection well location along the brine injection pipeline route. Therefore, only the undifferentiated Miocene, which is a major source of freshwater near the site and along the alternative pipeline and injection routes, is considered for analysis of the effects of potential contamination.

Using 1986 data,[45] DOE has identified potential receptor wells of accidental contamination via groundwater from the various alternatives, including both public and industrial wells. Public wells include municipal and rural domestic use wells, while industrial wells include those used for agricultural purposes and electric power generation. Wells within both a ten-kilometer (km) radius and a two-km radius of any underground brine injection well were identified. There are 48 wells within a ten-km radius of an injection well including 25 public wells; 20 industrial wells; and three wells for which the use is unknown. Most of the wells within the ten-km radius are concentrated in or near the city of Hattiesburg, generally to the southwest of the injection field.

Those receptors with wells within two kilometers of pipelines and associated injection wells have a higher likelihood of contamination in the unlikely event that accidental releases occur. Within two kilometers of the entire Richton brine injection pipeline route, there are four public wells and one industrial well.[46]

3.2.3 Surface Water Environment

The brine injection pipeline would run west of the site for approximately ten miles, then northwest for approximately 15.7 miles along the east side of the existing Plantation Pipeline ROW (Figure 3 in Chapter 2). Up to 55 injection wells would be located along the 15.7 mile northwesterly segment of the pipeline and would require a total of 2.3 additional miles of service pipeline. This pipeline would cross a total of 34 surface water bodies, more than half of which (18) are unnamed tributaries. Major water bodies crossed by this pipeline would include Bogue Homo, Tallahala Creek, and the Leaf River, which would be the largest water body crossed by the injection pipeline. Water bodies potentially crossed by the pipeline are characterized in Table 2.

3.2.4 Ecology

The general ecology is described in Chapter 5.5.5 of the DEIS. The following sections describe the ecology of the area along the brine pipeline and injection well field, including vegetation, terrestrial wildlife, aquatic life, and threatened and endangered species, where they differ from data already presented in the DEIS. The information presented here has been obtained from previous reports,[47,48] a visit to the proposed oil storage site location, and from the USFWS and the Mississippi Natural Heritage Program.

Table 2
Characteristics of Surface Water Bodies Crossed by the Injection Well Pipeline for Richton

Surface Water System	Connections	Width (ft)	Depth (ft)	Annual Avg. Flow & Monthly Range (cfs)	Downstream Distance to Nearest Public Intake (miles)	Number of Persons Served by Intake	Water Type	Uses
Harper Branch	Bogue Homo	5	1	Negligible	No downstream public intakes	None	Fresh	No known uses
Bogue Homo	Leaf River, Pascagoula River	150	2.5	624 (144-1,141)	No downstream public intakes	None	Fresh	Recreation
Buck Creek	Bogue Homo	10	2.5	45.9 (14.4-93.4)	No downstream public intakes	None	Fresh	Recreation
Pitts Branch	Gandy Lake	5	0.5	Intermittent	No downstream public intakes	None	Fresh	No known uses
Chatman Branch	Tallahala Creek	5	1	Negligible	No downstream public intakes	None	Fresh	Recreation
Tallahala Creek	Leaf River	160	2.5	887 (198-1,923)	No downstream public intakes	None	Fresh	Fish and wildlife
Third Creek	Tallahala Creek	6	1	Negligible	No downstream public intakes	None	Fresh	Recreation
Grantham Branch	Tallahala Creek	5	0.5	Negligible	No downstream public intakes	None	Fresh	No known uses
McWilliams Branch	Tallahala Creek	5	0.5	Negligible	No downstream public intakes	None	Fresh	Stock water
Chattis Branch	Tallahala Creek	5	0.5	Intermittent	No downstream public intakes	None	Fresh	No known uses
Gillis Creek	Tallahala Creek	5	0.5	Intermittent	No downstream public intakes	None	Fresh	Stock Water
Mill Creek	Tallahala Creek	5	0.5	Intermittent	No downstream public intakes	None	Fresh	Recreation
Thomas Creek	Leaf River	5	0.5	Negligible	No downstream public intakes	None	Fresh	Stock Water
Leaf River	Pascagoula River	100	6.5	1,685 (531-3,432)	No downstream public intakes	None	Fresh	Recreation and fish and wildlife
Parker Creek	Leaf River	5	0.5	Negligible	No downstream public intakes	None	Fresh	No known uses

3.2.6 Other Environmental Resources

There are no natural and scenic resources within the brine injection field (Chapter 5.5.7 of the DEIS). Information on cultural, historical, or archeological sites within the vicinity of the injection well system is forthcoming from the State Historical Preservation Office (SHPO). However, no Native American tribes are known to exist in the vicinity of the proposed brine system. Descriptions of the climate, air quality, and ambient noise levels, are provided in Chapters 5.5.4 and 5.5.10, respectively, of the DEIS. Socioeconomic elements important to the area are described in Chapter 5.5.9 of the DEIS.

The ROW for the underground injection field for Richton contains 82 acres of prime and unique farmland, as identified by the U.S. SCS. This includes 66 acres in Perry County, 7.9 acres in Jones County, and 8.1 acres in Forrest County.[55]

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Mr. G.P. Ray, District Conservationist, Hattiesburg, MS
Ms. L. Hayes, District Conservationist, New Augusta, MS
Mr. C. Pendarvis, District Conservationist, Laurel, MS

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4.0 POTENTIAL FOR OIL AND BRINE RELEASES

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 the public near the Cote Blanche and Richton underground injection operations. Accidents examined include oil spills and brine spills. The potential for other types of accidents, such as fires, hazardous chemical releases, and natural disasters, are addressed in Chapters 6.3 through 6.5 of the DEIS. The impacts of potential oil and brine spills are examined in Chapter 5 of this Supplement. 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 Chapter 8.2.2 of the DEIS.

4.1 Oil Spill Scenarios and Probabilities for Underground Injection Alternatives

The DEIS addressed the potential for releases of oil to the environment as a result of the proposed SPR expansion. This section presents oil spill probabilities corresponding to the new alternatives for underground injection for Cote Blanche and Richton. The methodologies by which historic oil spill data were used to estimate the oil spill probabilities and size distributions associated with vessels, terminals, pipelines, and storage sites are described in Chapters 6.1.1 through 6.1.4 of the DEIS, and were used in this Supplement.

Table 6 summarizes the expected number of oil spills during a fill or refill of the Cote Blanche and Richton candidate storage sites under the brine disposal alternatives. The frequency of spills from vessels, bulk storage at terminals, bulk transfer at terminals, and storage sites are a function of throughput (i.e., the storage site capacity); frequency of spills from pipelines are a function of both site capacity and pipeline length. Based on Gulf of Mexico spill data from the U.S. Coast Guard (USCG) for 1983 to 1989 and from the Army Corps of Engineers, indicate that about four spills of 0 to 20 barrels and less than one spill of more than 20 barrels could occur during fill/refill of a 160-MMB facility. Based on USCG Pollution Incident Reporting System (PIRS) data between 1983 and 1986, the average terminal spill size from above ground storage tanks was 71 barrels, the average terminal spill at the docks was eleven barrels, and the average pipeline spill quantity was 18.5 barrels. The SPR system has only experienced two oil pipeline spills, and both were less than ten barrels. For spills at storage sites, SPR environmental reports from 1987 through 1990 indicate that three spills exceeded 100 barrels, and 25 of 33 spills were less than ten barrels. For this analysis, it is assumed that it would take two years to fill a 160-MMB SPR expansion site.

The new alternative for brine disposal would not affect the number of spills expected during fill or refill of the Cote Blanche site. As described in the DEIS, oil to fill the Cote Blanche site would come via St. James Terminal, resulting in an estimated 1.7 spills during storage at that terminal. If underground injection were selected for brine disposal at the Richton site, oil to fill the Richton facility 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. This scenario corresponds to Alternative 1 for the Richton site, as identified in Chapter 6.1.5 of the DEIS.

Table 6
Expected Number of Oil Spills During a Fill or Refill for a 160-MMB Site

SPR Site	Site Capacity	Pipeline Length (Miles)	Expected Number of Spills					
			Vessel	Bulk Storage at Terminal	Bulk Transfer at Terminal	Pipeline	Storage Site	Total
Cote Blanche	160 MMB	60	4.85	1.71	5.26	0.20	4.33	16.4
Richton	160 MMB	118	4.85	2.73	5.26	0.39	4.33	17.6

During drawdown, SPR oil would be transported by DOE pipelines to refineries, commercial pipelines, and 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 Supplement, hypothetical distribution scenarios were analyzed for the Cote Blanche and Richton sites within the Capline Complex.

Table 7 shows the expected number of oil spills during drawdown in the Capline Complex for Cote Blanche and Richton, assuming the brine injection alternatives in this Supplement. Although both 180-day and 270-day drawdown criteria are considered for each site, Table 7 provides results only for the 180-day criterion, which yields the greater number of expected spills under the scenarios analyzed.

Drawdown at the Cote Blanche site would not be affected by the implementation of the underground injection alternative presented here. As in the DEIS, it is assumed that current distribution from Bayou Choctaw and Weeks Island would not change if the Cote Blanche site were selected. It is further assumed that 50 percent of the oil stored at a new 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.

For the Richton site, DOE evaluated three drawdown alternatives in the DEIS. This Supplement considers an additional drawdown alternative for Richton, because disposal of brine by underground injection would eliminate the construction of a dual use pipeline from Richton to Pascagoula. Under the alternative considered in this Supplement, approximately two-thirds of the oil from Richton would be transported via pipeline to Liberty (DOE tankage), where it would be routed north through the Capline pipeline. The remaining one-third of the oil (300 MBD) stored at Richton would be distributed across commercial docks: 250 MBD at Mobile; 35 MBD up the Capline, and 15 MBD to local refineries. The increase in oil transported through the Capline under this scenario would necessitate an additional dock at the St. James Terminal to account for 36 MMB of oil displaced from the existing Bayou Choctaw and/or Weeks Island sites. Thus, more oil would travel by ship, adding expected spills from bulk storage at terminals, bulk transfer at terminals, and vessels. The incremental increases in the estimated number of expected oil spills as a result of rerouting existing SPR oil are included in Table 7.

example, the abandoned wells would be examined to determine if they penetrate the brine disposal formation, if brine would reach the abandoned well at a pressure that is great enough to drive it upward to shallower zones, and if the abandoned well has been properly plugged. If deemed necessary based on this evaluation, any abandoned wells that could pose a problem would be properly plugged to make sure they could not serve as a conduit for upward flow.

4.2.2 Pipelines and Site Piping

As discussed in Chapter 2 of this Supplement, the alternate brine injection option for Cote Blanche would consist of a 42- to 24-inch brine disposal pipeline that would be approximately two miles long. For Richton, the brine injection field would require a 26-mile pipeline that would range from 42 inches to eight inches in diameter.

Brine spills from pipelines have been documented throughout the history of the SPR program. The historical statistics are provided in Chapter 6.2 of the DEIS. The number of brine spills greater than a barrel for the period 1982 through 1990 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, there have been four large brine spills: two spills that totaled 606,000 barrels at Bryan Mound and West Hackberry in 1985, an 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.

Assuming that these spill statistics may serve as indicators of the maximum number of potential future spills, the number and size of brine spills likely to be associated with the brine injection alternatives were estimated. These estimates are expected to be conservative because the brine handling and pipeline systems and operations and maintenance activities at future SPR facilities would be upgraded from previous systems and activities, given operating experience at the existing facilities.

Since the historical brine spill data are from the operations at five SPR sites (brine historically has not been generated at Weeks Island, the sixth SPR site active during this period), there could 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 unlikely but also could occur over the duration of site development activities. Ignoring any differences in site-specific conditions that may influence the frequency and magnitude of brine spills, historical spill data indicate that there could 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 8, it appears that brine injection operations at Cote Blanche and Richton could each result in two brine spills of 74,000 barrels or more during the lifetime of the sites. These spills, both large and small, could occur anywhere along the injection pipeline lengths at these sites.

4.2.3 On-site 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 those at the existing Big Hill site. 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 pump pond. All ponds include measures to prevent migration of contaminants to groundwater, including liners composed of high-density polyethylene, 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 are also installed around the pond system to detect any leakage to shallow groundwater.

Releases from 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 conducive to contaminant migration if such a release were not quickly detected and contained.

Several brine pond releases have 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, and Bayou Choctaw. 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 liner is torn, and elevated salinity levels have been detected in downgradient groundwater.[3] In response to these problems at West Hackberry, DOE is conducting a detailed contamination assessment and analysis of remedial alternatives.[4]

In summary, brine ponds that would be constructed 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 could 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 would be less likely.

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5.0 ENVIRONMENTAL IMPACTS AND MITIGATION

This section discusses the expected potential impacts given the brine injection alternatives and identifies potential mitigation activities.

5.1 Cote Blanche

The following sections discuss the potential impacts associated with the development of the brine injection alternative at Cote Blanche.

5.1.1 Geological Impacts

In general, the geological impacts associated with the activities at Cote Blanche would be minimal. Most potential geological impacts associated with the underground injection system at Cote Blanche are considered along with the potential hydrogeological impacts described in Chapter 5.1.2. All other potential geological impacts resulting from this alternative would be minimal and identical to those discussed in Chapter 7.4.1 of the DEIS.

Seismic activity would not be increased by the higher pressures in underground formations due to underground injection. In some seismically active regions, added pressure could result in slight deformation and gross readjustment of surrounding strata, and the subsequent activation of faults that intersect the reservoir strata. In such active regions, faults could be activated in underpressured zones where frictional resistance is overcome by hydrostatic pressure. However, DOE's Level III Design Criteria for SPR sites requires sites to be located in areas of minimal risk. Because Cote Blanche is in an area of minimal seismic risk, activation of faults due to increased pressures in deep formations would be impossible.

Change in surface subsidence rates would not occur as a result of increased pressures within deep formations due to brine injection. The impacts of increased pressure within lower formations such as the Nebraskan Sands would have little impact even on directly overlying sedimentary layers, and would not provide any uplift to counterbalance the independent subsidence of surface strata.

5.1.2 Hydrogeological Impacts

The potential sources of groundwater contamination from the Cote Blanche alternative would include injection wells, connecting pipelines, and brine ponds. The general hydrogeological conditions that exist at Cote Blanche are discussed in Chapter 3.1.2. The analysis below discusses additional groundwater impacts that might result from construction and operation of 24 injection wells configured as described in Chapter 2.2.1.

The underground injection system being considered for brine disposal at Cote Blanche would dispose of 50,000 bbl/day per well in the Trimosina (Illinoian) Sands, Lenticulina (Kansan) Sands, Nebraskan Sands and Citronelle (Lafayette) Gravels, and Pliocene Sands, using a total of 18 wells (three wells on six well platforms) injecting between 1,900 to 3,400 feet bls, and six wells (one well on each of the six platforms) injecting in the Pliocene Sands between 4,400 to 5,400 feet bls. Therefore, the injection zone would be separated from the base of the Wisconsin Sands

5.1.3.2 Operations Impacts

Brine spills from leaks during operation of the underground injection system could impact the ICW and West Cote Blanche Bay. Impacts to wetlands are discussed below in Chapter 5.1.4.2. The likelihood of brine spills is discussed in Chapter 4.2. This section discusses the potential impacts of brine spills on adjacent surface water bodies.

Brine spills could result from well equipment failure or pipeline failure. The risk of brine releases to the aquatic habitat would be minimized by features such as corrosion coating on pipes, scrupulous pipeline maintenance and monitoring, and spill contingency planning intended to prevent or mitigate migration of brine. Because the ICW and West Cote Blanche Bay are typically intermediate to brackish (salinity of five ppt or less), their salinities could be increased substantially in the event of a large brine spill.

The number and size of brine spills expected to result from the injection activities at Cote Blanche were determined based on historical spill rates and the total volume of brine that would be handled at the site (see Chapter 4.2.2). Up to nine small spills per year, and up to two larger spills could be expected over the lifetime of the facility. This is a conservative estimate because the SPR already has implemented design and operating actions which have significantly reduced the potential for future catastrophic releases of brine. Therefore, expected brine spills would likely be small and inconsequential, though larger spills are possible. Chapter 8 of the DEIS describes 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 should one occur.

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.[1] Many species have evolved means of surviving in conditions of high or highly variable salinity.[2] An undiluted brine spill could expose biota in estuarine 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, though long-term impacts to surface water or sediment quality, or to biota would not be expected.

Experience with brine spills at SPR's storage facility at Bryan Mound, Texas has shown that the severity of impacts and recovery rates for a wetland or water body depends on the rate of freshwater flushing. Freshwater movement in the ICW near Bryan Mound and the normal frequent heavy rainfall minimized adverse biological impacts (see Chapter 7.1.3.4 of the DEIS). In the event of a leak or spill in the Cote Blanche brine injection field, normal precipitation and the volume and flow of water in the ICW and West Cote Blanche Bay would be expected similarly to dilute brine below damaging concentrations in all but localized areas near the leak. 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 return quickly to normal.

5.1.4 Terrestrial Ecology and Wetlands Impacts

Species and habitat of the wetlands east of Cote Blanche salt dome could be adversely affected by construction, operation, and maintenance of the Cote Blanche brine injection system. Many of the activities and associated potential impacts are similar to those discussed in Chapter 7.1.5 of the DEIS, but are examined here in the context of the marshlands surrounding the injection field.

5.1.4.1 Construction Impacts

Construction of pipelines and injection well platforms for the brine injection field would affect 52 acres of wetlands, 37 acres of which would be estuarine emergent intertidal, four of which would be subtidal, and eleven of which would be palustrine forested wetlands. Well platform and pipeline construction can cause adverse ecological impacts to the wetlands either directly due to the dredge activity itself or indirectly due to the degradation of water quality. Pipeline and well platform construction also would destroy the wetland vegetation and benthos in the immediate vicinity (acreage described above) and could alter surface topography, water flow patterns, and hydrology.

Currently, these wetlands probably sustain populations of fish, aquatic invertebrates, and numerous bird species. There are several biological/ecological impacts that might be associated with construction of the injection system:

- Dredging for pipeline and well platform placement would destroy vegetation and benthic organisms along the 1.9 miles of pipeline ROW in the marsh and the 1.7 acres for the barge slips around each well platform. Dredging also would be conducted along the existing canals, but these areas do not support emergent vegetation.

- Dredging would increase turbidity and sedimentation, which could cause disorientation in aquatic fauna 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. This, in turn, could decrease availability of some fish foods (e.g., small invertebrates that feed on plants or algae). Laboratory tests indicate, however, that turbidity levels created by dredging are not likely to cause direct mortality.[3] Sedimentation of dredged material could have a strong negative impact on benthic invertebrates. However, the total acreage affected is relatively small and would be unlikely to have adverse consequences for the food chain of marsh. Deposition of sediment could smother some of the less robust vegetation in these areas, but this impact would probably be temporary with no permanent adverse effects.

- Construction could alter hydrology. It is possible that plant species composition following revegetation would differ from that prior to disturbance. Preventive and mitigative measures were discussed in Chapter 8 of the DEIS and would be employed in the construction of the injection well system at Cote Blanche.

5.1.4.2 Operations Impacts

Potential impacts associated with operation and maintenance of the pipeline ROWs and associated injection system would include continued loss of habitat for wildlife due to possible avoidance of platform areas; disruption and temporary displacement of wildlife during inspections and maintenance and environmental monitoring activities; and damage to species and habitat from brine spills during operation of the brine injection system. The pipeline ROWs would be inspected on a biweekly basis, and any abnormalities would be addressed immediately. Water quality sampling in barge slips and canals would be conducted by boat periodically in accordance with permit requirements. Disruption to local wildlife during inspection would be minimal when compared to the potential impacts that could occur if the pipelines were not properly maintained. Wells would be remotely monitored continuously to ensure that injection rates and pressures are within safe levels.

A brine leak from the pipeline in the wetlands during operations would result in temporary increases in salinity of adjacent soils and burned vegetation. The severity of impacts to vegetation, the extent, and duration would vary directly with the spill volume and inversely with normal flushing from rainfall and tidal inundation. In time, species succession would generally return the community to its normal composition.

A severe brine spill event at Bryan Mound that resulted in the release of 825,000 barrels caused complete devegetation of a limited area and subacute toxicity over a wider area. Eventual recovery was described in Chapter 7.1.3.4 of the DEIS. From this event, it was shown that natural flushing and succession would eventually restore these habitats to some extent, but remediation, such as revegetation and/or drainage enhancement, might be required to restore completely any poorly drained areas.

5.1.5 Potential Impacts to Threatened and Endangered Species

The primary impact to terrestrial threatened and endangered species from pipeline and injection well construction would be destruction, loss, and fragmentation of habitat in the construction ROW if pipelines are routed through or wells are located in suitable habitat for these species. At the Cote Blanche brine injection site, two species may be of concern: the Louisiana black bear and the bald eagle. Potential impacts and mitigation of impacts are discussed below.

Louisiana Black Bear

Construction and maintenance of the brine injection system may affect Louisiana black bears by fragmenting the bear's habitat. Black bears are known to occur on Weeks Island and Cote Blanche. Although neither black bear food sources nor denning sites would be expected to occur in the wetland areas where the brine injection field would be sited, the bears have an extensive home range and may traverse portions of these wetlands.

To mitigate adverse effects to black bears due to any potential habitat fragmentation, cypress seedlings could be planted along the edges of pipeline ROWs.[4] Radio-tagging could help to determine bear travel routes, and "travel corridors" could be built or enhanced in areas away from the brine injection field, allowing black bears new routes of movement.

Bald Eagle

The nearest known bald eagle nest is more than one mile from the brine injection field, so no impacts on the bald eagle are anticipated.

5.1.6 Floodplains Impacts

Construction of the brine injection field would almost entirely be within the 100-year coastal floodplain. The impacts on the floodplain would be direct, minor, and short-term. During construction of the buried pipeline, appropriate measures would be taken as specified in the permit to maintain normal patterns of surface water flow. After construction, the preexisting surface contours above the pipeline trench would be restored and maintained. Because the brine pipeline would be buried, there would be no interference with natural moderation of floods, water quality maintenance, or groundwater recharge, and there would be no change in the threat to life or property from flooding.

Similarly, the platforms, wells, and ancillary equipment would be constructed to withstand the 100-year flood, and, due to their elevation on pilings, would have no effect on the moderation of floods. There would be no alteration of natural and beneficial floodplain values.

5.1.7 Other Environmental Impacts

Construction of the brine injection system at Cote Blanche would not cause any adverse impacts to natural and scenic resources, cultural, historical, and archeological sites, Native American land, climate and air quality, or ambient noise levels. The number of construction workers required for the underground injection alternative would not vary significantly from the workers already required for existing brine disposal options for Cote Blanche as discussed in Chapter 7.5.9 of the DEIS. Therefore, no additional impacts on socioeconomics would be expected for the brine injection field.

5.2 Richton

The following sections discuss the potential impacts associated with the development of the brine injection alternative at Richton.

5.2.1 Geological Impacts

The potential geological impacts of the underground injection alternative are the same for Richton as for those discussed under the geological impacts described for Cote Blanche, Chapter 5.1.1 (i.e., impacts on seismic activity and subsidence). Other potential geological impacts along the Richton injection field could result from the development of the brine injection wells; these impacts are considered in the following section on hydrogeological impacts.

5.2.2 Hydrogeological Impacts

The potential sources of hydrogeological impacts associated with the underground injection of brine at Richton would arise from the injection wells and associated brine ponds and pipelines.

5.2.2.1 Underground Injection Wells

As outlined in Chapter 3.2.2 the hydrogeology surrounding the Richton site would be conducive to groundwater contamination and potential impacts in the unlikely event of a well failure. Fresh groundwater is found in the undifferentiated Miocene at a relatively shallow depth (approximately one to ten meters bls), and soils underlying the site are relatively permeable. Contamination of the undifferentiated Miocene, which is extensively used along the injection pipeline route, 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 migrated 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 and adversely affect aquatic organisms. While such releases are possible, the proposed design and operation of the wells would make this unlikely.

As discussed in Chapter 3.2.3, the closest injection well would be no less than five miles from the Richton site spaced on 2,000-foot centers. Each well would inject brine into the Wilcox Formation, approximately 3,900 to 4,500 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 freshwater, production 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 Chapter 5.1.2 for Cote Blanche. 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 geological formations. There also would be the 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 Chapters 6.2 and 8 of the DEIS). 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 (Chapter 4.2).

5.2.2.2 Brine Pipelines

The pipeline in the injection system 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 system could include cracks in the pipeline, leaks from valves and joints, and movement of the pipelines due to subsidence. It appears that brine pipeline failures at Richton could cause up to nine small brine spills per year and up to two larger spills over the lifetime of the facility. If unmitigated, these spills could result in the migration of brine constituents into groundwater. The impacts of such contamination would be expected to be the same as those characterized above for the brine injection wells (i.e., potential groundwater resource loss, and potential adverse impacts on human health and aquatic ecology). 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 pipeline passes near the population center of Runnelstown.

5.2.3 Surface Water and Aquatic Ecology Impacts

As at Cote Blanche, surface water bodies and their aquatic organisms in the three-county area of southern Mississippi could be adversely affected by impacts from construction and operation of the brine injection system for Richton. These are discussed separately below.

5.2.3.1 Construction Impacts

The brine pipeline would potentially cross 34 water bodies of which Bogue Homo, Tallahala Creek and the Leaf River are 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 could 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 in the water column. Organisms that live in the water could, in turn, experience toxicological and behavioral effects. Benthic organisms and habitat directly within and adjacent to the pipeline corridor would also be unavoidably destroyed. All of these impacts, however, would be expected to be temporary and confined to areas close to the pipeline ROW.

The larger waterways could 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 into 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.

5.2.3.2 Operations Impacts

Brine spills could result from pipeline ruptures or from equipment failure anywhere along the brine pipeline. Historical spill statistics indicate that the operations at Richton could result in up to nine small brine spills per year and two large spills (see Chapter 4.2). If a large brine spill did occur along the brine injection pipeline, the impacts could be similar to those described for Cote Blanche in Chapter 5.1.3.2. 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 injection 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 the Leaf River 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.

5.2.4 Terrestrial Ecology and Wetlands Impacts

Potential terrestrial ecology and wetlands impacts from construction and operation of the brine injection system at Richton are discussed below. Many of the potential impacts associated with construction and maintenance activities are similar to those discussed for Cote Blanche in Chapter 5.1.4.

5.2.4.1 Construction Impacts

The brine injection pipeline would travel northwest, within Perry, Forrest and Jones Counties. Based on hydric soil information, between 20 to 150 acres of wetlands could be crossed by the pipelines and associated well pads. The pipeline would cross numerous small tributaries, Tallahala Creek, the Leaf River, and Bogue Homo. Potential impacts would be similar to those described for Cote Blanche in Chapter 5.1.4.1.

5.2.4.2 Operations Impacts

To the extent that the pipeline ROW cuts through forested habitats or secondary growth, maintenance of a mowed (or herbicide-treated) ROW could present a barrier to movement of forest interior species and many types of reptiles and amphibians. Avoiding placement of the pipeline and well pads in forested habitats and provision of vegetation "corridors" at intervals across the pipeline ROW could help minimize potential impacts of habitat fragmentation.

Maintenance and environmental monitoring activities could also cause disruption and temporary displacement of wildlife. The pipeline ROWs would be inspected on a biweekly basis, and any abnormal observations would be addressed immediately. Disruption to local wildlife during inspection would be minimal when compared to the potential impacts that could occur if the pipelines were not properly maintained. Wells would be remotely monitored continuously to ensure that injection rates and pressures are within safe levels.

Impacts of brine spills would be similar to those discussed in Chapter 5.1.4.2 for Cote Blanche. 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. Because of the lower rainfall in the vicinity relative to the coast, natural recovery of soils and vegetation would be impeded.

5.2.5 Potential Impacts to Threatened and Endangered Species

The only Federally listed threatened or endangered species known to be located within one mile of the pipeline, the American alligator, has not been identified as a species of concern by USFWS. The American alligator is not biologically threatened or endangered, but it is listed as threatened due to similarity of appearance to the American crocodile.

Four other Federally listed threatened or endangered species are known to occur in the counties traversed by the brine pipeline: eastern indigo snake, gopher tortoise, red-cockaded woodpecker, and yellow-blotched sawback turtle. If brine injection at Richton were selected as a preferred alternative, surveys would be required to confirm the presence of any of these species along the pipeline route. Nonetheless, potential impacts and mitigation measures are discussed for each below.

Eastern Indigo Snake and Gopher Tortoise

Potential impacts on the indigo snake and the gopher tortoise are discussed together because these two species share a common habitat (i.e., the indigo snake often lives in gopher tortoise burrows).

The presence of indigo snakes and gopher tortoises near the injection field for Richton is unknown, but there is no record of a sighting within at least one mile of the injection field in Mississippi. However, if these species are present along any of the pipeline ROWs, construction could destroy the burrows that both species use. Conversely, after construction, pipeline ROWs in some areas may actually create new habitat for these species (young tortoises are found in field edges and along power lines). However, regular spraying of these areas with certain herbicides could harm the animals. Also, cleared areas created by the maintenance of a ROW provide attractive routes for all-terrain vehicles. These vehicles could be very destructive to any future burrows along the ROW.

To determine if gopher tortoises and indigo snakes are present along the pipeline ROW, surveys for gopher tortoise burrows would need to be conducted. Pipelines could be routed to avoid these burrows. In general, pipelines could be routed to avoid longleaf pine communities, which are associated with the red-cockaded woodpecker as well as the indigo snake and the gopher tortoise. Only herbicides that will not harm these species could be sprayed to maintain ROW clearings, and care could be taken to avoid the animals during maintenance activities.

Red-cockaded Woodpecker

Pipeline construction may affect red-cockaded woodpeckers. None are reported to exist within at least one mile of the pipeline ROW, but surveys would need to be conducted to confirm that none are present. The pipeline could be surveyed simply for mature stands of longleaf and loblolly pines. If no stands were found or if pipeline ROWs were routed to avoid these stands, no impacts on future populations of the red-cockaded woodpecker would be expected.

Yellow-blotched Sawback Turtle

Impacts on the yellow-blotched sawback turtle may occur if construction of the brine injection pipeline degrades water quality and that poor water quality extends into yellow-blotched sawback turtle habitat. During low flow periods, raw water intake from the Leaf River during site operations may reduce water flow enough to affect this species adversely. The yellow-blotched sawback turtle is known to occur near the confluence of the Leaf and Chickasawhay Rivers. Construction of the brine pipeline by means other than directional drilling across rivers or streams may degrade water that serves as habitat for the turtle or could directly impact the turtles. The yellow-blotched sawback turtle generally prefers rivers wide enough to receive several hours of sun, and pipelines will be directionally drilled under rivers greater than 500 feet wide, but indirect impacts may occur if silt and elevated contaminant levels from smaller upstream tributaries travel down to their habitat.

Inland oil spills or pipeline oil leaks could also affect this species adversely if the oil reached the yellow-blotched sawback turtle's habitat. However, the increased chances of spills due to the brine injection system are thought to be relatively small (see Chapter 6 of the DEIS).

Spilled brine may adversely affect the yellow-blotched sawback turtle, which typically is found in only in freshwater (i.e., riverine water as opposed to estuarine water).[5] However, these turtles are mobile and could avoid a spill which would be flushed out by the influx of freshwater.

To mitigate potential impacts, areas inhabited by the yellow-blotched sawback turtle could be identified, and pipelines could be routed to avoid these areas. Directional drilling could be used to lay pipelines under rivers inhabited by the yellow-blotched sawback turtle and under tributaries to those rivers. DOE will comply with relevant regulations and could use appropriate technology to prevent and clean up oil spills.

5.2.6 Floodplains Impacts

Impacts to floodplains from construction and operation of the brine injection system at Richton would be direct, short-term, and minimal. The brine injection pipeline would cross the 100-year floodplains associated with the Leaf River, Bogue Homo, and Tallahala Creek. Five injection well pads would be located in the Tallahala Creek 100-year floodplain, and another five would be situated in the Leaf River 100-year floodplain. DOE would take appropriate measures, as discussed in Chapter 5.1.6 for Cote Blanche, to ensure that development of the brine injection system would neither affect the natural and beneficial values of the floodplains nor be affected by it.

5.2.7 Other Environmental Impacts

Construction of the brine injection system for Richton will not cause any adverse impacts to natural and scenic resources, any known cultural, historical, and archeological sites[6], Native American land, climate and air quality, or ambient noise levels. The ROW for the injection pipeline would impact a total of 82 acres of prime and unique farmland in Perry, Jones, and Forrest Counties. The number of construction workers required for the underground injection brine disposal alternative would not vary significantly from the workers already required to implement brine disposal alternative as discussed in Chapter 7.5.9 of the DEIS. Therefore, no additional impacts on socioeconomics would be expected for this brine disposal alternative.

5.3 Comparison of Brine Disposal Alternatives With Those Assessed in the DEIS

The underground injection alternatives for Cote Blanche and Richton evaluated in this Supplement to the DEIS were compared to brine disposal options considered in the DEIS for the same sites. The sections below provide general comparisons of the environmental impacts of implementing the proposed alternatives as compared to those evaluated in the DEIS.

5.3.1 Geological Impacts

The major potential geological impacts which could result from the development of Cote Blanche or Richton would mainly be due to leaching of the caverns and not related to the methods of brine disposal. Underground injection could have negligible impacts on geology in the unlikely event of fault activation due to increased pressure in the receiving formation. Subsidence would not be affected by any activities associated with underground injection or brine diffusion.

5.3.2 Hydrogeological Impacts

The sources of potential hydrogeologic impacts associated with the brine disposal alternatives include: (1) injection wells; (2) pipeline; and (3) brine ponds.

Well Impacts. The alternatives for Cote Blanche and Richton assessed in this Supplement would pose similar, remote possibilities of injection well failure. Potential impacts due to injection well failure at Cote Blanche would be essentially the same as those identified in the DEIS. The freshwater aquifer in the vicinity of the Richton injection system is heavily used; therefore, an injection well failure and subsequent brine release into the aquifer would likely result in adverse impacts on human health.

Pipeline Impacts. The impacts associated with potential spills from brine pipelines would be significantly reduced at both Cote Blanche and Richton, in comparison to brine disposal options considered in the DEIS.

At Cote Blanche, the brine injection system would require approximately two miles of brine injection piping instead of five miles of piping associated with the brine injection option discussed in the DEIS. Additionally, the pipeline for the brine diffuser option assessed in the DEIS would be longer and would pose a greater probability of releases than the shorter piping network associated with the brine injection system.

At Richton, the brine injection alternative would be 15.4 miles longer than the injection component of the brine disposal option considered in the DEIS; however, the brine injection pipeline distance would be approximately one-quarter the length of the dual-purpose pipeline assessed in the DEIS. The shorter length would offer fewer opportunities for failure, spills, and subsequent impacts.

Brine Ponds. The potential impacts due to brine pond failure would be essentially the same as those identified and assessed in the DEIS.

5.3.3 Surface Water Impacts

The brine injection alternatives discussed in this Supplement would not affect the potential oil spill impacts associated with either the Cote Blanche or the Richton storage sites, as compared to the brine disposal alternatives assessed in the DEIS. As described in Chapter 4.1 of this Supplement, the fill and distribution routes associated with Cote Blanche under the brine injection alternative would be identical to those of the alternatives considered in the DEIS. For the Richton site, although the location of potential oil spill impacts may change under the alternative, the magnitude of these impacts would be comparable to that described in Chapter 7.5.3.4 of the DEIS.

The likelihood of spills from brine pipelines occurring under either the Richton or Cote Blanche brine injection alternatives would change with the length of the pipeline and therefore so would potential impacts, as noted above.

5.3.4 Ecological Impacts

The reconfigured Cote Blanche brine injection system discussed herein would result in the loss of approximately 52 acres of wetlands. The brine injection alternative evaluated in the DEIS would impact approximately 90 acres of wetlands. Additionally, the brine diffuser option addressed in the DEIS would impact 183 acres of wetlands.

The expanded underground injection system newly proposed at Richton would impact 50 acres of hydric soils, whereas, the underground injection component of the brine disposal option assessed in the DEIS would require less area. The brine diffuser evaluated in the DEIS, including the dual-purpose pipeline to Pascagoula, the DOE Pascagoula Terminal, and several connective pipelines associated with the Pascagoula Terminal, would impact a total of 419 acres of wetlands. In addition, the dual-purpose pipeline would impact on the habitats of numerous rare, threatened, or endangered plant and animal species, and would cross through areas in Jackson County which are designated as the Pascagoula River Wildlife Management Area. Therefore, it is reasonable to conclude that the underground injection system for Richton would cause fewer impacts to the ecology.

5.3.5 Floodplains Impacts

There would be no significant differences in direct impacts to floodplains resulting from the brine injection alternatives considered in this Supplement versus those assessed in the DEIS. At Cote Blanche, both brine injection options would require pipeline construction within the 100-year floodplain; however, the injection field assessed in this Supplement would impact a smaller area within the floodplain.

Brine disposal solely via underground injection at Richton would decrease floodplains impacts in comparison to the brine disposal option addressed in the DEIS due to the absence of construction in the floodplain along the Pascagoula pipeline, and at Pascagoula for the DOE Terminal.

5.3.6 Other Environmental Impacts

Impacts to natural or scenic resources would be similar for the Cote Blanche injection option discussed in this Supplement and that in the DEIS. Aside from the temporary and indirect conversion of 82 acres of prime and unique farmland, there would be no other environmental impacts associated with the Richton brine injection option. Additionally, the construction of a brine diffuser pipeline for Richton crossing several areas of significant communities and rare species would be eliminated.

No known cultural, historical or archeological resources or Native American tribal land would be affected by the injection alternatives for Cote Blanche and Richton. Socioeconomic factors at Cote Blanche and Richton would be the same under any of the brine disposal alternatives assessed, and therefore impacts would be identical.

5.4 Summary of Impacts

The construction and operation and maintenance impacts associated with development of brine injection fields for Cote Blanche and Richton are summarized in Table 10. Dredging to develop the brine injection field for Cote Blanche would be almost entirely within a previously disturbed marsh area, which is part of the habitat for a threatened species. Construction and operation of the brine injection field for Richton would have the potential to contaminate potable groundwater and to adversely impact habitat for four threatened or endangered species.

Table 10
Summary of Impacts for Cote Blanche and Richton Brine Injection Fields

Impacts	Cote Blanche	Richton
Geologic	No significant impacts.	No significant impacts.
Hydrogeologic	Failure of wells/pipeline in the brine injection field or leaks from brine ponds could cause groundwater contamination due to upward migration of brine, upward flow of natural saline water, geologic fracturing or readjustment of strata.	Failure of wells/pipeline in the brine injection field or leaks from brine ponds could cause groundwater contamination due to upward migration of brine, upward flow of natural saline water, geologic fracturing or readjustment of strata.
Surface Water and Aquatic Ecology	Dredging could cause adverse effects to water quality and benthic habitat in wetlands, ICW, and West Cote Blanche Bay; impacts generally expected to be minor and temporary. One to nine small brine spills and one to two large brine spills could cause intense but localized and temporary impacts in wetlands, ICW, and West Cote Blanche Bay.	Construction could cause adverse effects to water quality and benthic habitat in 34 water bodies including the Leaf River, Bogue Homo, and Tallahala Creek; impacts generally expected to be minor and temporary. One to nine small brine spills and one to two large brine spills could cause intense but localized and temporary impacts in the Leaf River, Bogue Homo, and Tallahala Creek.
Terrestrial and Wetlands Ecology	A total of 52 acres of wetlands could be affected. Impacts to wetlands from dredging include destruction or alteration of vegetation/habitat along pipeline ROW and well platform areas. It is possible that altered surface flow could result in saltwater intrusion into fresh to brackish wetlands, which would change the community structure. The threatened Louisiana black bear may traverse the area; construction and operation would result in fragmentation of habitat and some restriction of movement. No impacts to bald eagle. Impacts to wildlife from a brine spill could be severe due to habitat loss and possibly direct losses of adults, young, and/or eggs if breeding areas are affected.	A total of 20 to 150 acres of wetlands could be affected. Impacts to wetlands from construction include destruction or alteration of vegetation/habitat along the ROW and well areas. Impacts include altered surface flow and hydrology; no freshwater/saltwater interfaces would be crossed. The Federally threatened or endangered gopher tortoise, eastern indigo snake, yellow-blotched sawback turtle, and the red-cockaded woodpecker are species that may use habitat along the ROW and in the well areas. Impacts to wildlife from a brine spill could be severe due to habitat loss and possibly direct losses of adults, young, and/or eggs if breeding areas are affected.
Floodplains	Impacts would be direct, minor, and short-term.	Impacts would be direct, minor, and short-term.
Other Environmental Resources	No impacts to natural or scenic resources. No impacts to known cultural, historical, or archeological resources, or to Native American tribal land. No additional impacts to socioeconomic elements. No impacts to human health and safety.	No impacts to natural or scenic resources. Impacts to 82 acres of prime and unique farmlands; no impacts to Native American tribal land. No additional impacts to socioeconomic elements. No impacts to human health and safety.

ENDNOTES

1. U.S. Environmental Protection Agency, *Ambient Water Quality Criteria for Chloride-1988*, Office of Water Regulations and Standards, Criteria and Standards Division, Washington, DC, 1988.

2. Eckert, R. and D. Randall, *Animal Physiology: Mechanisms and Adaptations*, second edition, W.H. Freeman and Company, New York, 1983.

3. Brannon, J.M., R.M. Engler, J.R. Rose, P.G. Hunt, et al., *Selective Analytical Partitioning of Sediments to Evaluate Potential Mobility of Chemical Constituents During Dredging and Disposal Operations*, U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS, 1976, Technical Report D-76-7.

   Hubert, D.W.M., and J.M. Richards, "The Effects of Suspended Mineral Solids on the Survival of Trout," *International Journal of Air and Water Pollution*, 1963, Volume 5, pp 46-55.

4. Weaver, K.M., D.K. Tabberer, L.U. Moore Jr., G.A. Chandler, J.C. Posey, and M.R. Pelton, "Bottomland Hardwood Forest Management for Black Bears in Louisiana," *Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies,* Volume 44, 1990, pp 342-350.

5. *Ibid.*

6. Letter from Roger G. Walker, Review and Compliance Officer, Mississippi Department of Archives and History, Historic Preservation Division, March 15, 1993.

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6.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The selection of the underground injection alternative for brine disposal at either Cote Blanche or Richton would not change the primary long-term effect of the proposed action in the DEIS, i.e., to off-set the impacts of an oil supply interruption on the regional and national economies. Like the proposed action in the DEIS, most activities associated with the underground injection field would affect the environment only temporarily and, therefore, would not adversely impact environmental productivity in the long term. Because the likelihood of a well casing failure resulting in contamination of a shallow aquifer is remote, the proposed action would not adversely affect the long-term productivity of the local shallow aquifers. The deep underground formations into which the brine would be injected are not used for drinking water or for any other uses.

Following land acquisition, approximately 32 acres at Cote Blanche and 226 acres at Richton would be used temporarily to construct the brine injection systems (permanent requirements are slightly lower and are provided in Chapter 7). Construction would involve clearing, dredging, laying pipeline, extending utilities, and drilling injection wells. Ecological productivity of the injection field area would be lost as a wildlife habitat for this period. However, the construction period would also generate economic productivity in terms of the new jobs and payrolls, and purchasing of materials, supplies and services.

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7.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction of the underground injection alternative for brine disposal at either Cote Blanche or Richton would result in both direct and indirect commitments of resources. This commitment of resources would differ only marginally from the proposed action in the DEIS, because underground injection as the sole method of brine disposal is an alternative to brine diffusion in the Gulf of Mexico. The actual commitment of resources for the underground injection system at either Cote Blanche or Richton would likely be less than for brine diffusion into the Gulf of Mexico, because the pipeline lengths would be shorter. In some cases, the resource committed would be recovered within a relatively short period of time. In others, resources would be irreversibly or irretrievably committed by virtue of being consumed or by the apparent permanence of their commitment to a specific use. Irreversible and irretrievable commitments of resources can sometimes be compensated for by the provision of other resources with substantially the same use or value.

A total of approximately 23 and 222 acres for Cote Blanche and Richton, respectively, would be permanently committed for the underground injection fields. This development would be offset by the creation of the SPR facility itself and the societal benefits resulting from such a facility. The use of this land should be considered as irretrievably committed. The construction and operation of the brine disposal alternative would require an amount of construction materials, fossil fuel, electrical energy, and other resources, which would not vary significantly from the requirements described in the DEIS. These should be considered irretrievably committed to the project. In addition, human resources would be required for the construction and operation of the underground injection system. These human resources, however, would not differ significantly from the requirements already discussed in the DEIS.

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8.0 LIST OF PREPARERS AND PROFESSIONAL QUALIFICATIONS

This Supplement to the Draft Environmental Impact Statement was prepared by ICF Incorporated for the Department of Energy. The following people were responsible for various functions in compiling information for this report.

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