DOE/EIS-0021

Final Environmental Impact Statement

(Final of Draft EIS, FEA-DES-77-10 and of
Draft Supplement to Final EIS, FEA-FES-76/77-6)

STRATEGIC PETROLEUM RESERVE

Seaway Group Salt Domes

(Bryan Mound Expansion, Allen,
Nash, Damon Mound and West Columbia)

Brazoria County, Texas

U.S. DEPARTMENT OF ENERGY

June 1978
Volume 1 of 3

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Brazoria County, Texas

Responsible Official

James L. Liverman
Acting Assistant Secretary for Environment

U.S. DEPARTMENT OF ENERGY
Washington, DC 20545

June 1978
Volume 1 of 3

Volume 1

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SUMMARY

STATEMENT TYPE: ( ) Draft (X) Final Environment Statement

PREPARED BY: The Strategic Petroleum Reserve Office, Department of Energy, Washington, D.C. 20461

1. Type of Action: ( ) Legislative (X) Administrative

2. Brief Description of the Proposed Action:

This project is part of the Strategic Petroleum Reserve (SPR) program currently being implemented by the Department of Energy (DOE). Creation of the SPR was mandated by Congress in Title I, Part B of the Energy Policy and Conservation Act of 1975, P.L. 94-163, for the purpose of providing the United States with sufficient petroleum reserves to minimize the effects of any future oil supply interruption.

In September, 1977, the Federal Energy Administration (FEA) issued a Draft Environmental Impact Statement (EIS) for the Seaway Group of salt domes (DES 77-10) for the development of crude oil storage facilities for the Strategic Petroleum Reserve in the Gulf Coast region of Southeastern Texas. On October 1, 1977, the U.S. Department of Energy was created under the Department of Energy Organization Act of 1977 and the programs and responsibilities of the FEA were transferred to the new Department. As such, this Final EIS is being issued by the Department of Energy. This Final EIS discusses the environmental impacts of developing and operating a 100 million barrel crude oil storage facility at one or more of five candidate sites in the Seaway Group. The primary site for Strategic Petroleum Reserve (SPR) development in this group is an expansion of the existing Bryan Mound storage facilities by 100 million barrels. The other four candidates are new sites. They are the Nash salt dome in Fort Bend County, Texas, and the Allen, Damon Mound and West Columbia salt domes in Brazoria County, Texas. One of these four sites may be developed as an alternative, or in addition to the expansion of existing storage at Bryan Mound.

The primary brine disposal system for the project, diffusion in the Gulf of Mexico, was first proposed in the Draft Supplement, Final Environmental Impact Statement, Bryan Mound Salt Dome issued by the FEA in July, 1977. However, discussion of this proposal was omitted from the Final Supplement issued by the Department of Energy in December, 1977 in order that ongoing scientific analyses of the potential environmental impact of brine diffusion in the Gulf could be completed. This document serves to finalize this proposal and therefore responds to comments concerning brine diffusion which were received during the comment period on the Draft Supplement as well as those received on the Draft Seaway Group EIS.

3. Summary of Environmental Impacts and Adverse Environmental Effects:

This site specific EIS analyzes the environmental impacts which would occur during site preparation and operation of oil storage facilities at each of the five locations.

The construction activities necessary to develop storage cavities, terminal facilities and pipelines required for the Seaway Group of SPR sites would result in topographical modification of the site areas due to onsite fill, excavation and surface grading; degradation of water quality due to increased sediment load caused by resuspension during dredging and by erosion; degradation of air quality due to fugitive dust, vehicle emissions and paint vapors; and impacts to the aquatic and terrestrial flora and fauna resulting from construction activities. These impacts are expected to be short term and would terminate soon after completion of project construction.

The most significant impacts of project operation would be the impacts on air quality due to hydrocarbon emissions associated with tanker loading and unloading; impacts on water quality due to brine disposal in the Gulf of Mexico and due to possible oil and brine spills; and impacts on flora and fauna resulting from such oil and brine spills.

Most of these impacts are expected to result regardless of which of the sites are developed. However, the extent of the impacts may vary depending on the lengths of pipelines constructed to connect with water supply, brine disposal and oil distribution systems.

4. Alternatives Considered

Alternative Sites

Allen
Damon Mound
Nash
West Columbia

Alternative Facility Components (all five candidate sites)

Alternative Raw Water Supply Systems
Alternative Brine Disposal Systems
Alternative Oil Distribution Systems
Alternative Power Supply System

5. Comments on the Draft EIS for the Seaway Group Were Received From the Following Agencies, Companies and Organizations

Federal:

U.S. Army Corps of Engineers
U.S. Department of Agriculture
U.S. Department of Commerce, National Oceanic and Atmospheric Administration - National Ocean Survey and National Marine Fisheries Service
U.S. Environmental Protection Agency

Advisory Council on Historic Preservation

State:

No comments were received from state government agencies.

Local:

No comments were received from local government agencies.

Other:

No comments were received from other organizations.

6. Comments on the Draft Supplement, Final EIS, Bryan Mound Salt Dome were received from the following Agencies, Companies and Organizations

Federal:

U.S. Army Corps of Engineers
U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service
U.S. Energy Research and Development Administration
Federal Power Commission

State:

Texas Parks and Wildlife Department

Local:

No comments were received from local government agencies.

Other:

Brownsville - Port Isabel Shrimp Producers Assoc.
Dow Chemical Company
Port Isabel Shrimp Assoc.
Ralph M. Parsons Laboratory for Water Resources and Wildlife
Texas Environmental Coalition

7. Date Final EIS Made Available to EPA and the Public

This Final EIS was made available to the Environmental Protection Agency and to the public in July, 1978.

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CHAPTER 1.0

BACKGROUND

1.1 INTRODUCTION

This document is a site-specific Final environmental impact statement (EIS) for five proposed candidate sites from the Seaway Group of salt domes located in southeastern Texas. The Seaway Group draft EIS (DES 77-10) was filed with the Council of Environmental Quality (CEQ) and made available to the public in September, 1977. This project is part of the Strategic Petroleum Reserve (SPR) program currently being implemented by the Department of Energy (DOE), formerly the Federal Energy Administration (FEA). Creation of the SPR was mandated by Congress in Title I, Part B of the Energy Policy and Conservation Act of 1975, P.L. 94-163 (the Act), for the purpose of providing the United States with sufficient petroleum reserves to minimize the effects of any future oil supply interruption.

On February 16, 1977, FEA transmitted the SPR Plan to Congress as Energy Action No. 10. The plan described the manner in which the Program was to be implemented. As an amendment to the Plan, an acceleration of the development schedule became effective under FEA Energy Action No. 12 on April 18, 1977. Whereas the Act required the attainment of an Early Storage Reserve volume of 150 million barrels (MMB) of oil in storage by the end of 1978, and an SPR volume of 500 MMB of oil in storage by the endof 1982, the present accelerated schedule has established new targets of attaining 250 MMB by the end of 1978 and 500 MMB by the end of 1980. In addition, a second amendment to the Plan proposing expansion of the SPR to one billion barrels was presented to Congress as DOE Energy Action No. 2, which became effective on June 12, 1978. These initiatives are an itegral part of the President's National Energy Plan and represent a major effort to provide the U.S. with protection against the consequences of a severe petroleum supply interruption as soon as practicable.

A final programmatic environmental impact statement (FES-76-2) adressing the effects of the SPR program as a whole, was filed with the CEQ and made available to the public on December 16, 1976. That statement considers several different types of storage facilities, including the use of existing solution-mined cavities in salt formations and conventional mines, the use of existing and the construction of new conventional surface tankage, and the use of surplus tanker ships. A draft supplement to the final Environmental Impact Statement was filed with the CEQ and made available to the public in September, 1977. The supplement addresses the impacts of an expansion of the SPR program to a total of 1000 MMB. The programmatic EIS and its draft supplement should be consulted for a description of each of these storage methods and the potential impacts which might result from its use. The programmatic EIS also assesses the cumulative impacts which could be expected from use of various combinations of the different facility types.

A total of nine sites were identified as candidates for the Early Storage Reserve program by means of a screening process involving the application of six criteria.* Five of these alternative sites were considered for the purpose of selecting early storage sites to supply oil to refineries on the Gulf Coast, the East Coast, and in the Caribbean. They include the West Hackberry salt dome (Cameron Parish, Louisiana), the Bayou Choctaw salt dome (Iberville Parish, Louisiana), the Bryan Mound salt dome (Brazoria County, Texas), the Cote Blanche salt mine (St. Mary Parish, Louisiana), and the Weeks Island salt mine (Iberia Parish, Louisiana). Final Environmental Impact Statements on all five candidate sites (FES 76/77-4 through FES 76/77-8, December 1976, January 1977) have been filed with the CEQ and made available to the public so that the environmental impacts associated with the possible use of these sites may be compared with one another. In addition, four final supplements addressing design changes for all five candidate sites (April, May, August and December, 1977) have been filed with CEQ. A sixth Gulf Coast site, the Sulphur Mines salt dome (Calcasieu Parish, Louisiana) was identified as a

*These criteria are existing storage capacity (or potential storage capacity for SPR), distribution accessibility, technical feasibility, potential environmental concerns, ease of acquisition and cost. Section II.E.I of the programmatic EIS describes in detail how the criteria were applied to approximately 300 salt domes and approximately 300 existing mines to select 32 candidate sites, including the eight candidate early storage sites.

candidate site to provide additional existing storage capacity when the requirements of the accelerated schedule became known. The Final EIS (DOE/EIS -0010) was made available to the Environmental Protection Agency in April, 1978. The other three candidate sites, Central Rock Mine (Fayette County, Kentucky), Ironton Mine (Lawrence County, Ohio), and Kleer Mine (Van Zandt County, Texas), were considered for distribution to inland refineries. Final EISs for these sites (FES 76/77-9 and FES 76/77-10, July 1977 and FES 77-2, September, 1977), also have been made available. To date, five sites (West Hackberry, Bayou Choctaw, Bryan Mound, Weeks Island and Sulphur Mines) have been selected for use in the SPR.

Three groups of candidate sites are being considered for the purpose of selecting additional SPR storage sites. Most of the sites are centered around three major inland pipeline terminals which transport U.S. and foreign crude oil from the Gulf Coast region to the upper midwest area refineries. These distribution centers include the Seaway Pipeline Terminal (Freeport, Texas), the Texoma Pipeline Terminal (Nederland, Texas), and the Capline Pipeline Terminal (St. James, Louisiana). The candidate sites of each group would use the particular pipeline terminal associated with that group as the proposed location of an SPR terminal for distribution of the stored oil. A portion of the stored oil would be distributed through the pipeline to the upper midwest markets while the remainder would be distributed to local refineries and loaded onto tankers at the terminal for distribution to the East Coast and the Caribbean.

This EIS considers the development of SPR storage capacity at five sites located in the Seaway pipeline area. The proposal for development within the Seaway Group is the expansion of Bryan Mound salt dome located in Brazoria County, Texas. Since Bryan Mound has already been selected for development of 63 MMB of early storage, expansion of this site by 100 MMB would give a group total of 163 MMB. This document includes an analysis of the construction and operation of an offshore diffuser system for the disposal of brine into the Gulf of Mexico. This component of the system was initially proposed in the July, 1977 draft supplement to the Bryan Mound EIS (FES 76/77-6).

The five Seaway candidate sites, included in this document, provide the potential for a total of 563 MMB of storage space. DOE presently projects that between 163 MMB and 263 MMB will be needed for the Seaway system as a result of the expansion of the SPR, although at present it appears that a practical limitation on expansion of the Seaway Group above 200 MMB may be imposed by the capacity of Freeport Harbor. DOE Energy Action No. 2 provides that at least 750 MMB of the one billion barrel system will be stored in underground facilities. The decision has not yet been made regarding the type of storage facilities for the final 250 MMB. That decision may affect the ultimate size of the Seaway Group. The capacity ultimately required may be derived through development of a combination of two of the candidate sites, or encreased development of a single site.

1.2 PRESENTATION FORMAT

This EIS For the Seaway Group is in three volumes. Volume 1 contains summary descriptions of the project (Chapter 2.0), of the environment (Chapter 3.0), and of the project's probable impacts (Chapter 4.0). Chapter 5.0 is a review of mitigative measures and unavoidable adverse impacts. The relationship between local short-term uses of the environment and long-term productivity is discussed in Chapter 6.0. Those commitments of resources which are irreversible and irretrievable are discussed in Chapter 7.0. Chapter 8.0 is a summary of the proposed and alternative actions, and Chapter 9.0 lists the agencies contacted, the various permits and licenses required, and discussion of comments received on the draft EIS.

Volume II contains Appendices A and B. These provide details concerning the project description and the existing environment (regional and site specific), which were summarized in Chapters 2.0 and 3.0, respectively.

Volume III contains Appendices C through J. Appendix C provides details concerning the probable impacts which were summarized in Chapter 4.0. Appendices D through J are technical appendices containing backup data and methodology used in compiling the report, and Appendix K contains comments on the draft EIS received from Federal, state and local government agencies.

CHAPTER 2.0

DESCRIPTION OF PROJECT

2.1 INTRODUCTION

2.1.1 Group Description

Five salt domes in southeastern Texas - Bryan Mound, Allen dome, West Columbia dome, and Damon Mound in Brazoria County and Nash dome in Fort Bend County - are under consideration for development for the SPR program for the Seaway Group (Figure 2.1-1). They were selected from among many potential salt domes on the basis of their capacity, the technical feasibility of development, environmental concerns, the ease of access to distribution facilities. The Seaway Group is designed to have at least 163 MMB of crude oil storage capacity in solution-mined caverns. This oil would be distributed to inland refineries by the SEAWAY, Inc.,* Pipeline system, and to East Coast, Caribbean and Gulf Coast refineries by tankers from Brazosport (Port of Freeport, Texas). Distribution points are the SEAWAY Tank Farm at Jones Creek, and the SEAWAY and DOE docks in Brazos Harbor and Freeport Harbor.

This document describes the results of an environmental analysis of the five sites in the Seaway Group. Present plans are that one of these five sites would be developed, but additional Seaway sites may be developed, if necessary, to meet SPR objectives.

At Bryan Mound, 63 MMB of existing storage capacity is presently being modified for the early storage phase of the SPR program. The proposed development plan is to expand Bryan Mound by an additional 100 MMB, so the site would have a total capacity of approximately 163 MMB. Development of 100 MMB of storage capacity at either Allen dome, West Columbia dome, Damon Mound or Nash dome is an alternative to the

*In order to clearly differentiate between the Seaway Group SPR Program and SEAW
in this EIS.

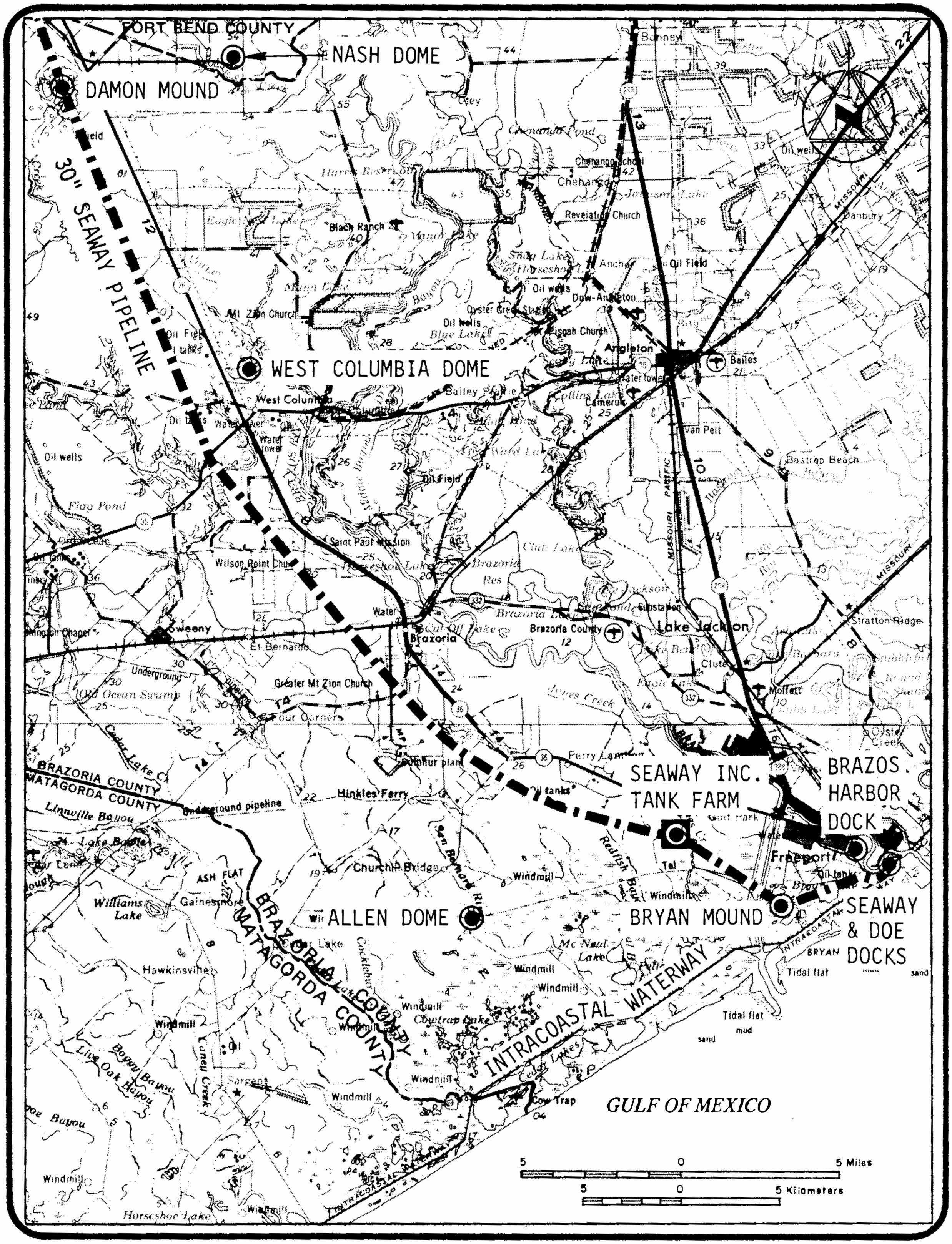


FIGURE 2.1-1 Seaway Group salt dome location map - showing proposed site (Bryan Mound) and four alternative candidate sites.

100 MMB expansion of Bryan Mound. Expansion of the Seaway Group to 163 MMB storage capacity will require increased use of the Bryan Mound early storage facilities, and construction of new docks, storage caverns, and other facilities to handle the expanded SPR capacity.

Impacts associated with SPR utilization of the early storage facilities and construction and use of new facilities are described in this EIS.

2.1.2 Program Description

The engineering design of SPR program facilities is based on the conservative assumption that the reserve will be cycled five times (i.e. five fills, five withdrawals) during the project's 20 to 25 year lifetime. This is considered to be conservative because the reserve oil would be withdrawn only during a severe interruption in the normal import supply. Due to the existence of the strategic reserve, the likelihood of a severe supply interruption is expected to be reduced. Thus, the caverns would likely never grow to their ultimate design capacity.

This EIS considers the total SPR program with five cycles of storage. This is a "worst-case" assumption which includes the impacts of all storage cycles.

2.2 CRUDE OIL STORAGE IN SALT DOMES

2.2.1 Introduction

Salt domes are attractive sites for petroleum storage caverns because of the relatively low cost of construction, the geologic stability of caverns, and because salt is highly impermeable (making it a suitable material in which to store petroleum products). The domes which occur along the Gulf Coast of the United States are particularly desirable storage cavern sites. They are commonly in areas of previous industrial development for oil or gas wells or drilling operations, with readily available pipeline distribution systems, and many of them are within 200 feet of the earth's surface, reducing costs of drilling required to construct the caverns.

Caverns for proposed storage may be one of three types. They may be developed by conversion of conventional room and pillar salt mines, or existing solution-mined caverns, or they may be constructed by solution mining of new caverns. The first two types will be utilized during the early storage phase, while new solution-mined caverns would be required to complete the storage requirements of the SPR program.

New caverns are constructed by injecting raw (unsaturated) water into the salt mass and allowing the water to leach (or dissolve) the salt. As raw water is injected, brine (salt saturated water) is forced out of the salt mass and a cavern is formed. The brine produced would exceed industry's needs for feedstock and would be disposed of either by injection into deep salt water bearing sands or by diffusion in the Gulf of Mexico. Crude oil would be stored by injecting it into the caverns under pressure to displace the brine. During an oil supply interruption, the stored oil would be forced out of the caverns by displacing it with raw water and distributed to refineries via the SEAWAY Pipeline or tankers from docks in Freeport Harbor.

Although storage of crude oil in salt dome caverns does not present major technical problems, the technique has been more extensively utilized in other countries. In the United States, such caverns have primarily been used for storage of fuel oil and LPG products such as propane and ethylene.

Other petroleum hydrocarbons such as fuel oil, diesel oil, and crude oil have been stored in caverns in salt deposits for several years in Germany and France. Salt cavern storage in Germany is based on the same methods of construction and operation planned for the Seaway Group of SPR storage sites. Over 30 MMB of Germany's strategic crude oil stock is in leached storage caverns. Some of these caverns have been filled for seven years and continue to provide safe and economical storage.

2.2.2 General Construction Techniques

The new storage to be developed at each site will be a series of leached caverns of about 10 MMB capacity each. (Drilling difficulties may reduce the volume of 10 to 20 percent of the caverns.) An oil storage cavern is basically a large subterranean pressure vessel connected to the surface by two vertical concentric casing strings (pipes) (Figure 2.2-1). Because oil will float on brine, the oil line must connect to the top of the cavern and a brine/raw water line to the bottom.

Control of cavern construction and oil withdrawal operations would be established at a central plant area, and each cavern would be linked to the central plant by water, brine, and oil pipelines. Raw water for each site would be supplied via pipeline from an offsite source, which could include nearby streams or lakes, subsurface aquifers, or the Gulf of Mexico.

Both cavern leaching and crude oil injection require disposal of the displaced brine. It would be piped to the Gulf of Mexico or to injection wells for subsurface disposal. Depending on proximity to potential users and other factors, such as the chemical constituents of the salt, some brine might also be sold as feedstock to nearby chemical plant operators. However, reluctance on the part of local industry to accept brine (or provide the high quality water necessary to produce brine suitable for their uses) at the rates and volumes necessary for leaching and operation make this use unlikely.

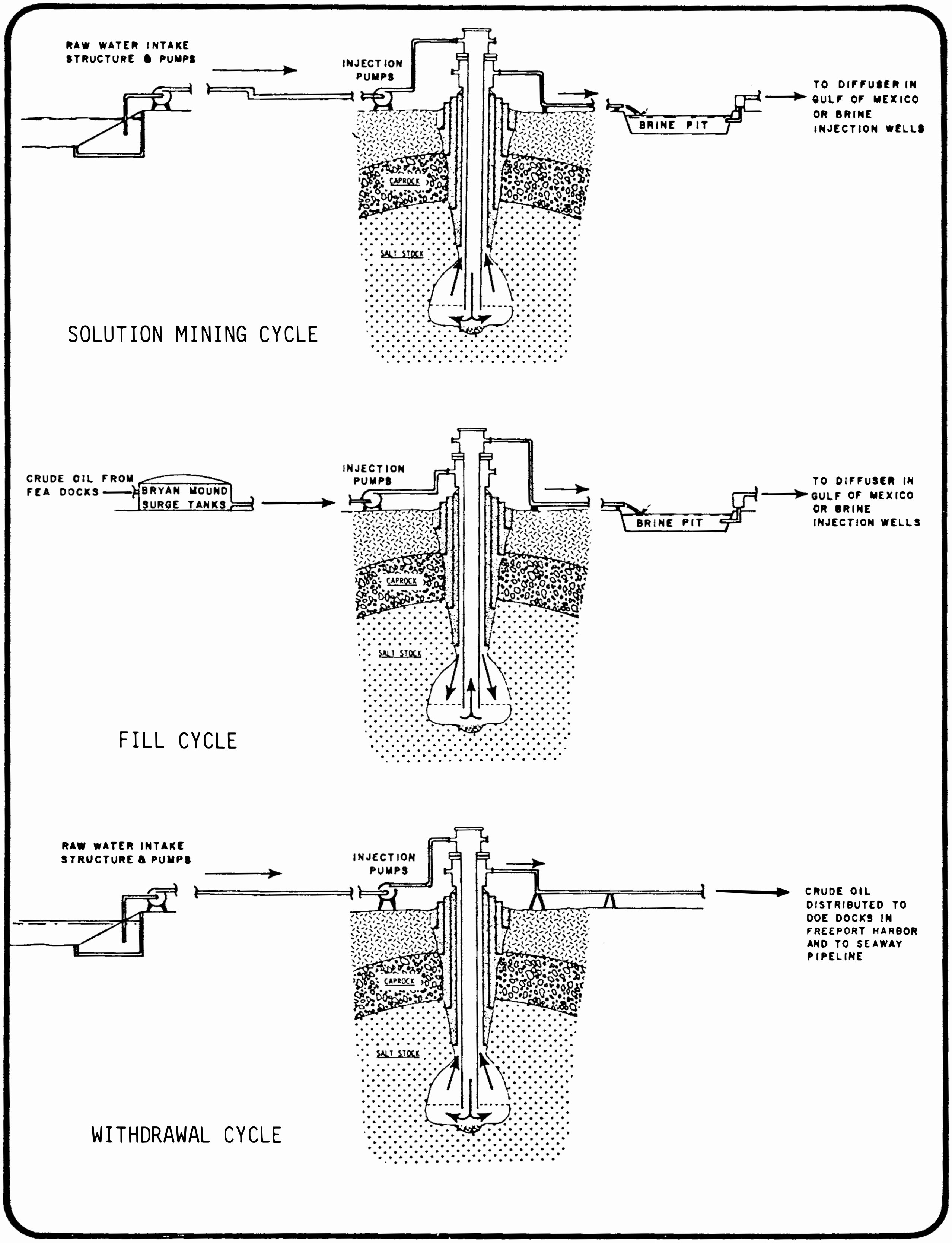


FIGURE 2.2-1 Schematic representation of SPR facility cperation

Oil distribution would be handled through the terminal facilities (including docks and storage tanks) and pumped via pipeline to and from each storage site. Crude oil entering cavern storage would be received from the terminal facilities. During crude oil withdrawal, the oil would be pumped to the terminal facilities for transfer to tankers docked in Freeport Harbor or to the SEAWAY Pipeline.

An 800-foot design spacing of storage cavities has been selected which would allow a minimum of 400 feet between adjacent caverns after all fill cycles. A distance of 600 feet would be allowed from any cavity to the estimated extremity of the dome flanks. A minimum salt barrier of 500 vertical feet would be provided between the ceiling of each storage cavity and the caprock. Caverns would be approximately 1000 feet in height and, for a 10 MMB capacity, would be initially leached to 275 to 300 feet in diameter.

Before leaching operations can begin, an entry well must be drilled, usually with conventional oil well drilling rigs. Well diameters are determined by the desired leaching and oil withdrawal rates (caverns are leached at a rate of about 15,000 barrels per day per well, and SPR oil withdrawal requirements call for emptying each cavern in 163 days). After the drilled hole penetrates the dome caprock, at least 500 additional feet are drilled into the salt before the final casing is placed and grouted. The bottom of this casing defines the top of the cavern to be developed. Drilling then proceeds to the bottom of the sump (a space below the cavern itself where insoluble material may settle out and not impair operation of the storage cavern).

Drilling equipment is then removed and the leaching string inserted. This consists of two pipes of different diameters, the smaller of which fits concentrically into the larger.

Leaching a storage cavern of the desired size and shape is accomplished by varying both the rate of raw water input and the positions of the two casings within the well. Blanket material (oil) is used to prevent the ceiling of the cavity from being leached away from the bottom of the outer string. (Blanket oil is any noncorrosive, lighter-than-water substance used to occupy the space in the topmost portion of the cavern. Blanket oil or, more correctly, blanket material - gas, propane, butane, diesel oil or crude oil - prevents leaching of the cavern roof around the outer casing and can be adjusted to control the shape of the cavern.) It usually requires about 24 months to leach a cavern of the required 10 MMB capacity. Two significantly different methods of cavern development may be used in the SPR program: leach-then-fill and leach/fill.

The fundamental technique of cavern development with the leach-then-fill method is to expose the salt in a drilled hole, inject raw water into the hole, allow time for the water to dissolve the salt, and displace the resulting brine by injecting more raw water. The hole enlarges as the salt dissolves, eventually forming a cavern. Blanket oil is used to protect the roof of the cavern as noted previously. Once leaching is complete, crude oil is then injected.

By using crude oil as blanket material, and employing appropriate combinations of direct/indirect circulation and intermittent adjustment of casings, it is possible to store crude oil during the leaching period. This method of cavern development is called leach/fill. With it, the cavern is developed from the top down. Initially, about 10 percent of the cavern design capacity is leached; crude oil is then added as blanket material and leaching continues. When the cavern reaches the 10 MMB design capacity, 9 MMB of crude oil is already in storage. The leach/fill process is still an untried technology in this country, and DOE plans to verify it through a test well before it is implemented for the general program. This technology is being used successfully in West Germany for the creation of a storage facility.

Oil injection rates and water supply rates for the simultaneous leach and fill process would be somewhat less than those required for the separate leach then fill process. Brine disposal rates would essentially be the same during cavern leaching which presents higher brine rates than cavern filling. Therefore, the separate leach then fill process would present the worst-case for environmental impact consideration, and it is this more extreme case which is assumed in this document for environmental impact assessment purposes.

Pipelines will transport raw water, brine, and crude oil to and from the storage site. Pipeline construction techniques will depend on the type of terrain to be crossed and will include conventional dry land and push-ditch methods. Conventional dry land construction methods would be used through portions of pipeline routes where heavy construction equipment can be supported. The push-ditch method of construction would be used in freshwater swamp portions of pipeline routes where the ground can support marsh buggy-mounted excavating and backfilling equipment, but cannot support conventional dry land pipeline construction equipment.

2.2.3 Operation

Crude oil to fill the SPR storage cavities will arrive at terminals in Freeport Harbor by tanker. Docks on the river can handle ships up to 50,000 DWT (light-loaded). Surges in the oil distribution system would temporarily be stored in surge tanks at Bryan Mound. The oil would be metered at the dock and also at the storage site for leak detection purposes.

All SPR storage sites would be designed to accommodate five (5) fill and withdrawal cycles. This assumption was made to establish engineering and safety criteria in absence of any method to predict the actual usage of the SPR over the lifetime of the project. For leached cavity facilities, the cavern capacity enlarges during each cycle, due to the introduction of fresh water; however, only the original design capacity for each cavity would be refilled. The fact that a smaller percentage of fresh water would be introduced into the cavern during successive fill operations somewhat reduces the continued leaching process.

When the storage facility at each site has been completed and the crude oil is in storage, there would be an interim period during which the only activities at the site would be security and maintenance checks. Readiness for activation during an emergency, however, requires keeping personnel available.

During that standby storage period, all equipment would be serviced and tested on a regular basis to insure proper working order. Maintenance crews would be on duty on a 24-hour basis.

It is possible that certain national emergencies could occur before the planned total reserve capacity of the SPR is met. In order to prepare for such a contingency, the facilities are designed to provide for oil return bypass valves to allow immediate recovery of oil already stored.

The SPR program provides for an emergency deliverability of stored oil over a 5-month period. The Seaway Group has a design capacity of 1 MMB per day. The facility's systems would be designed to handle this maximum capacity.

Crude oil stored in every cavity would be withdrawn by injecting raw water into the bottom of the cavity, displacing the oil through the annular space at the top of the cavity. The oil would leave each site at a pressure capable of transporting the oil via pipeline to the Bryan Mound distribution terminal. After an oil supply interruption has ended, refill of the SPR storage facility is planned. The rate of fill would depend on the availability of crude, but is currently planned for fill over a 24-month period. Refill is assumed to begin six months after the end of the supply interruption.

The refill process is the reverse of the recovery process. The crude oil is injected into the top of the storage cavity, thus displacing the brine, which, in turn, goes to the brine disposal system. The brine disposal system and oil distribution system are designed for cavern leaching and oil withdrawal, respectively. These capacities are in excess of requirements during refill periods.

2.2.4 Development Timetable

The Seaway Group SPR facilities would consist of both the early storage phase development currently under construction and new storage caverns at one or more of the Seaway candidate sites.

The present schedule for development of the required 100 MMB Seaway Group SPR capacity requires the leaching of five or six new caverns capable of storing 50 MMB of crude oil during the first 32 months of the program. Filling of these caverns would then proceed while the remaining caverns were leached.

The development timetable (Figure 2.2-2) shows the relationship of solution mining to cavern filling. Estimates of water supply and brine disposal rates (534 MB/D) indicate that five to six caverns could be leached simultaneously. At this rate, site development could be completed in about 62 months (including initial fill).

2.2.5 General Safety Measures

Safety measures common to the oil industry will be employed during all phases of the project. Protective control devices will be installed on wellheads and on all major pumping equipment. Fire pumps and extinguishers will be available at critical points. Buried pipelines will be coated with a protective coating. The main storage facility acreage will be enclosed with a security fence. These and other precautions will serve to protect the employees, the public, and the environment.

2.2.6 Termination and Abandonment

When the oil storage capacity would no longer be needed, it is intended that the facilities continue to serve a beneficial use. Storage of light petroleum products, LPG, or other industrial products is a possibility. If no users can be found for the short term, the facility could be mothballed for later use.

Ultimately, the facility would be abandoned. Surface equipment would be removed and sold offsite. Brine injection wells and cavity access would be sealed with concrete, a common oil field procedure. No long-term surveillance or maintenance is anticipated.

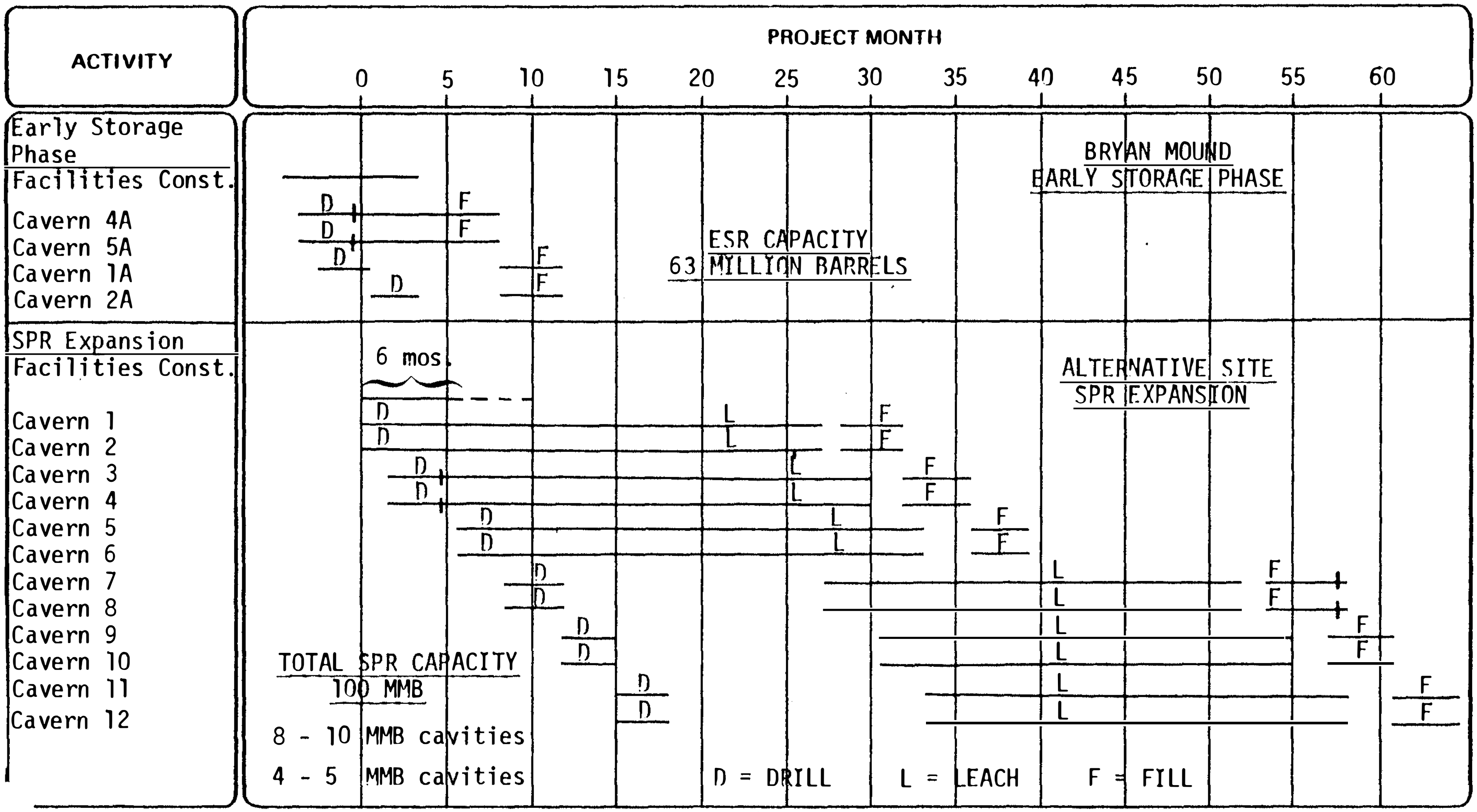


FIGURE 2.2-2 SPR development timetable.

2.3 PROPOSED SITE - BRYAN MOUND

The proposed SPR facility at Bryan Mound could store a total of 163 MMB of crude oil for the Seaway Group. Early storage facilities capable of storing 63 MMB are under construction and will be completed and filled by December 1978. Expansion of the Bryan Mound storage facility by 100 MMB could take up to five years from construction startup. Most of this time would be required to solution mine new storage cavities. Details of the planned development at Bryan Mound are presented in Section A.3 of Appendix A. The following sections summarize the most significant aspects of both early storage and expansion development.

2.3.1 Early Storage Facilities at Bryan Mound

Facilities for the early storage phase of the SPR program are currently being developed at Bryan Mound. A total of 63 MMB of crude oil will be stored in four existing caverns developed by Dow Chemical Company to obtain brine feedstock for chemical plant operations.

Crude oil pipelines are being constructed to connect the dome with the SEAWAY Docks at Brazosport and the SEAWAY Tank Farm. In the event of a severe oil supply interruption, necessitating drawdown of the SPR, crude oil would be withdrawn from storage and piped to the SEAWAY Tank Farm (to be made available to inland refineries) or back to the docks for shipment to Gulf Coast, Caribbean or East Coast refineries via tanker. Other major support facilities to be constructed as part of the early storage phase include: a raw water intake and injection system; a deep well backup brine disposal system; four 200,000 barrel floating roof storage tanks; a central pumping plant; and an electrical power system (Figure 2.3-1).

The raw water intake is to be located on the Brazos River Diversion Channel and will provide water for displacement of the stored crude oil. Displaced brine will be passed through a brine pit and pumped to five brine injection wells (each with a 1000-gallon-per-minute capacity) which will provide backup for brine disposal.

The four storage tanks, suitably diked for spill protection, will act as surge tanks to provide a continuous flow to or from cavern storage.

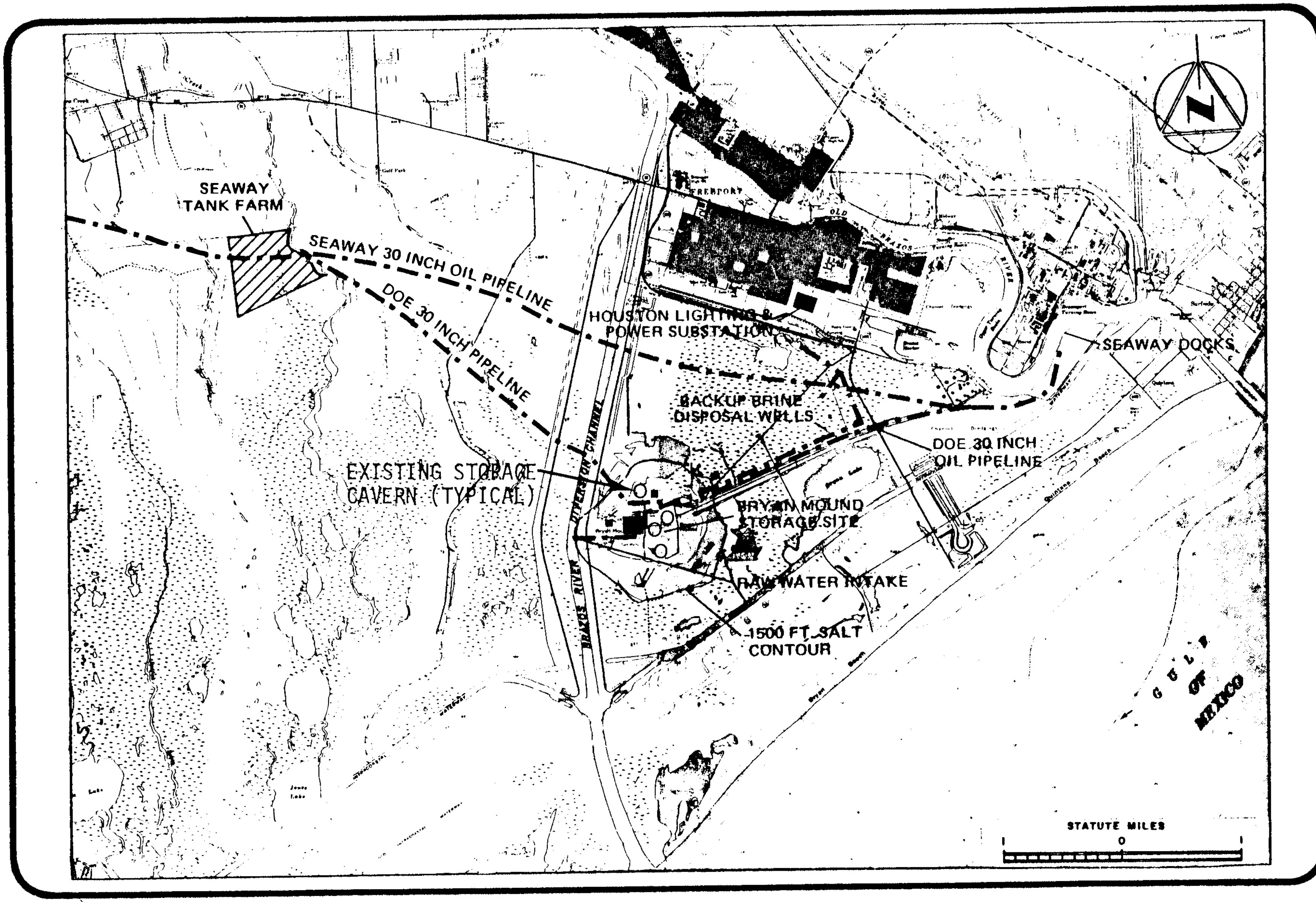


FIGURE 2.3-1 Bryan Mound early storage facilities - assessed in FES 76/77-6. Facilities noted (proposed) were assessed in the July 1977 Draft Supplement.

The central pumping plant and connecting pipelines on-site provide for all of the transfers of raw water, crude oil and brine. Power from the Houston Lighting and Power Company (HL&P) substation in Freeport would be supplied to an on-site transformer via a 1.5-mile transmission line.

Some of these support facilities would be constructed and placed in operation as soon as late 1977. A detailed description of the early storage phase facilities at Bryan Mound and their environmental impacts is provided in the final EIS (FES 76/77-6) and final supplement (December, 1977) and acreages required are listed in Table 2.3-1.

2.3.2 Site Location and Characteristics

The Bryan Mound salt dome (Figures 2.3-2 and 2.3-3), is in the southeastern part of Brazoria County, Texas, about three miles southwest of Freeport, 45 miles southwest of the Texas City/Galveston area, and 65 miles south of Houston. The Brazos River Diversion Channel borders the site to the west, and the Intracoastal Waterway and the Gulf of Mexico lie one and two miles to the south, respectively. The dome has an actual surface expression which rises about 15 feet above the surrounding marshland (Figure 2.3-2). The 150 acre early storage facility is enclosed by barbed wire fencing to keep out grazing cattle. The -1500 foot salt contour encloses about 730 surface acres at the Bryan Mound site.

Bryan Mound lies at the southwestern vertex of a triangular area south of Freeport protected by levees. A paved road from the city of Freeport runs along the top of the levee beside the Brazos River Diversion Channel and past the entrance to the storage site. A shell road passes through the center of the storage site, and continues on top of the South Freeport Hurricane Protection Levee to Freeport Harbor.

The site has recently been used for brine solution mining by Dow Chemical Company. Numerous oil and gas wells generally define the dome, but hydrocarbon production ceased in 1964. Sulfur mining operations were conducted on the dome from 1912 through 1935, and a pilot plant removed a small amount of sulfur during 1967-1968. As a result of these activities, many areas of the dome were filled, graded, or otherwise modified before DOE's initial development of the early storage phase

TABLE 2.3-1 Land requirements - Bryan Mound proposed SPR storage site.

	Total Miles Pipeline Row	Excavation (c.y.)	Fill (c.y.)	Required Right-of-Way and Affected Habitat (Acres)						Number of Water Crossings	Total Acreage Impacted Constr/Maint[a]
				Cleared Land Constr/Maint[a]	Fluvial and Oak Woodlands Constr/Maint[a]	Coastal Prairies Constr/Maint[a]	Brackish to Freshwater Marsh Constr/Maint[a]	Shell Ramp Barrier Flat Constr/Maint[a]	Coastal and Inland Waters Constr/Maint[a]		
A. SPR Facilities											
1) Storage Site											
a) Pipelines to Cavern Wellheads	5.7	30,300	---	24/18	---	---	---	---	---	---	24/18
b) Cavern Wellhead Pads	---	---	Minimal	12/12	---	---	---	---	---	---	12/12
c) Containment Dikes at Cavern Wellheads	---	---	700	---	---	---	---	---	---	---	---
2) Off Site											
a) Pipeline connections to Brazos Harbor	0.6	6,000	---	4/3	---	---	4/3	---	---	---	8/6
b) New Tanker Docks	---	1,050,000	---	14/14	---	---	---	---	---	---	14/14
c) Brine Disposal to Gulf Diffuser	7.5	177,300	---	---	---	20/14	.2/.1	1/.5	142/0	2	163/15
Sub-Total SPR Facilities	13.8	1,263,600	700	54/47	---	20/14	4/3	1/.5	142/0	2	221/65
B. Early Storage Facilities											
1) Storage Site	---	---	---	30/30	---	---	---	---	---	---	30/30
2) DOE 30" Oil Pipeline											
a) Bryan Mound to Seaway Tank Farm	4.1	27,400	---	---	---	39/30	8/6	---	---	---	47/36
b) Bryan Mound to Seaway Docks	4.0	36,500	---	19/14	---	4/3	21/16	---	---	---	44/33
3) Backup Brine Injection Wells											
a) Pipeline Excavation	2.3	30,700	---	---	---	---	---	---	---	1	---
b) Roadways to Wellheads	---	---	564,000	---	---	---	---	---	---	---	---
c) Wellhead Pads	---	---	5,000	1/1	---	---	4/4	---	---	---	5/5
4) Crude Oil Storage Tanks	---	---	96,000	24/24	---	---	---	---	---	---	24/24
Sub-Total Early Storage Facilities	10.4	94,600	665,000	74/69	---	43/33	33/26	---	---	1	150/128
Total Land Requirements-Early Storage plus SPR at Bryan Mound	24.2	1,358,200	665,700	128/99	---	63/47	37/29	1/1	142/0	3	371/193
C. Alternatives to Proposed Systems											
1) Crude Oil Distribution (Phillips Dock)	0.5	2,500	---	6/6	---	---	---	---	---	---	6/6
2) Brine Disposal (Wells)											
a) Pipeline Excavation	3.6	57,000	---	---	---	---	42/31	---	---	---	42/31
b) Roadways to Wellheads	---	---	42,300	---	---	---	---	---	---	---	---
c) Wellhead Pads	---	---	19,000	---	---	---	19/19	---	---	---	19/19
3) Brine Disposal to 12.5 mi Gulf Diffuser	14.2	274,600	---	---	---	20/14	.2/.1	1/.5	305/0	2	326/15

[a]Construction Right-of-Way/Maintenance Right-of-Way

TABLE 2.3-1 continued.

				Required Right-of-Way and Affected Habitat (Acres)							
	Total Miles Pipeline	Excavation (c.y.)	Fill (c.y.)	Cleared Land Constr/Maint[a]	Fluvial and Oak Woodlands Constr/Maint[a]	Coastal Prairies Constr/Maint[a]	Brackish to Freshwater Marsh Constr/Maint[a]	Shell Ramp Barrier Flat Constr/Maint[a]	Coastal and Inland Waters Constr/Maint[a]	Number of Water Crossings	Total Acreage Impacted Constr/Maint[a]
4) Brine Disposal to Dow Plant 8	USES EXISTING FACILITIES										
5) Groundwater Supply Wells											
a) Pipeline Excavation	8.7	57,000	---	---	---	49/36	---	---	---	3	49/36
b) Roadways to Wellheads	No Additional Land or Fill Required										
c) Wellhead Pads	---	---	Minimal	---	---	20/20	---	---	---	---	20/20
6) Water Supply from Dow Plants	6.0	31,700	---	2/2	5/5	28/28	---	---	2/0	---	37/35
7) Power Supply	USES EXISTING FACILITIES										
8) Oil Line to VLCC Monobouy	30.0	---	---	---	---	---	---	---	---	---	---
a) 50' ROW Land	---	10,800	---	---	---	---	---	3/3	10/0	---	13/3
b) 200' ROW Gulf	---	369,000	---	---	---	---	---	---	727/0	---	727/0

[a]Construction Right-of-Way/Maintenance Right-of-Way

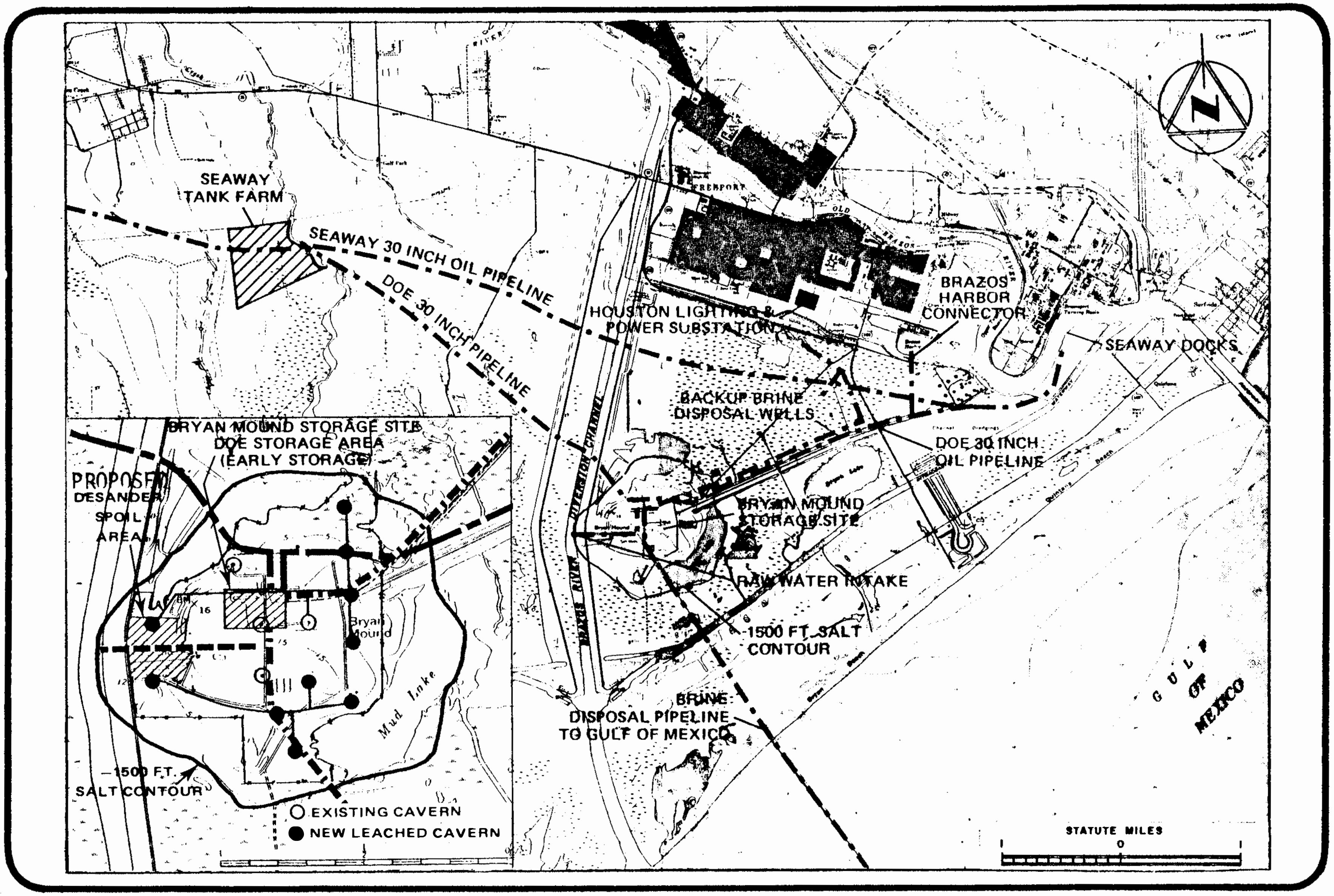


FIGURE 2.3-2 Vicinity and site map - Bryan Mound (proposed site for Seaway SPR development).

FIGURE 2.3-3 Air photo of Bryan Mound - showing location of -1500 foot salt contour and boundary of proposed expanded Seaway SPR site.

facilities. Dow Chemical Company had been using about 150 acres for their brining operations, and this area has been included in the early storage phase of the SPR program.

2.3.3 On-Site Facilities

The general physical plant for the proposed SPR facility at Bryan Mound consists of storage caverns, the central pumping and control facility, and crude oil distribution, raw water supply, and backup brine disposal systems. The pumping facility, oil and water systems are being built at Bryan Mound for early storage phase of the SPR; during site expansion and operation, continued use of these systems is planned.

New on-site facilities proposed for the Bryan Mound SPR expansion would consist of ten to twelve new storage cavities and their crude oil, raw water, and brine pipeline connections to the central pumping and control areas. The wellhead at each new cavern would be diked to contain minor operational spills (up to 2000 gallons). New access roads would be constructed to each wellhead and the pipelines buried along them. Expansion of Bryan Mound would require the use of about 240 acres in addition to that used for the early storage phase. Of these, 36 acres would be graded or otherwise disturbed during site development. Land requirements for both SPR and early storage facilities are summarized in Table 2.3-1.

2.3.4 Off-Site Facilities

The off-site facilities required for operation of the expanded Bryan Mound SPR development are 1) the two new tanker docks at Brazosport, and the associated pipelines and pumping equipment, and 2) the brine disposal pipeline to the Gulf of Mexico's 5.8 statute mile (5.0 nautical mile) diffuser.

2.3.5 Alternative Facilities

In designing the expansion of Bryan Mound for the SPR program, a number of alternative facilities and systems were considered. Acreages affected by these alternatives are summarized in Table 2.3-1.

2.3.5.1 Crude Oil Distribution System

Construction of a single point mooring (SPM) monobuoy for docking very large crude carrier (VLCC) tankers in deep water off the Freeport coast has been considered. This facility would be similar to the proposed SEADOCK, Inc. SPM. Construction of an SPM for the SPR program would also require considerable additional surge tankage on the site.

Long lead times for construction and licensing uncertainties associated with such facilities reduce its viability as an SPR option. Licensing work on SEADOCK has been in progress for at least five years.

If SEADOCK's SPM is constructed, the SEAWAY Docks in Brazosport would have surplus capacity. Since SEADOCK has been designed only for offloading tankers, loading out of crude oil during a supply interruption would be done in Brazosport. Conversion of SEAWAY Docks for DOE use might then be practical.

A second alternative would be to use the existing Phillips Petroleum Company docks on a space-available basis. A connecting pipeline to the existing DOE line to Bryan Mound would be required.

2.3.5.2 Raw Water Supply

An alternative to the proposed use of the Brazos River Diversion Channel as a source of raw water would be the withdrawal of ground water from the Evangeline aquifer, at depths of approximately 1200 feet. The water in this aquifer is not potable in the Freeport area. The region has been experiencing subsidence associated with extensive withdrawal of potable water from near-surface strata. An additional withdrawal of large quantities of water might serve to aggravate this regional problem.

Raw water might also be supplied from Dow Chemical Company's Harris and Brazoria Reservoirs. A pipeline would be required between Dow plant "B" in Freeport and the Bryan Mound site.

2.3.5.3 Brine Disposal System

An alternative brine disposal system would entail brine injection into deep subsurface salt water bearing sands. Brine ponds built for the early storage phase would allow insolubles to settle out and minimize chances of damaging the pumps or clogging the wells. Nineteen injection wells in addition to the five backup wells for the early storage phase would be constructed were this alternative selected.

A second alternative would be the use of a brine diffuser 12.5 statute miles (10.9 nautical miles) offshore from Bryan Mound in the Gulf of Mexico. The first 5.8 miles would follow the course of the proposed diffuser with the extension following the same general bearing.

A third alternative would be to supply part of the brine as feedstock to Dow Chemical Company plants in Freeport. Existing pipelines from the site to the plants would be utilized. As part of the early storage phase, brine from the existing caverns is currently being delivered to Dow as the caverns are being filled with oil. However, the Brazos Diversion Channel could not provide raw water of the quality necessary to produce brine which could meet the specifications necessary for the chemical feedstock. Therefore, use of this alternative would have to be coupled with use of water from the Dow Reservoirs. Moreover, Dow has not expressed a willingness to receive brine at the rates and volumes necessary for leaching new caverns.

2.3.5.4 Power System

An alternative to the use of HL&P power would be the construction of onsite generating capacity. Gas turbine generators, an exhaust stack and a fuel reserve equal to four day's consumption would be required.

2.4 ALTERNATIVE SITE - ALLEN DOME

The alternative SPR facility at Allen dome could store 100 MMB of crude oil for the Seaway Group. Initial fill could be completed approximately five years after start of construction. Crude oil could be delivered to Allen dome via the surge tanks at Bryan Mound.

2.4.1 Site Location and Characteristics

The Allen dome site is in southern Brazoria County, Texas (Figures 2.4-1 and 2.4-2), about 15 miles west of Freeport, 70 miles south of Houston, and 7 miles north of the Gulf of Mexico; the SEAWAY Tank Farm is eight miles to the east and Brazosport is about 14 miles east of Allen dome. The San Bernard River borders the site on the east.

Allen dome covers 300 surface acres enclosed by the -2000-foot salt contour (Figure 2.4-1) and has been cleared for pasture, with only scattered groves of trees. Property near the site along the San Bernard River has already been partitioned and developed for residential and vacation home lots.

Existing paved roads provide access to the site, but additonal roads would have to be constructed in the plant area.

2.4.2 On-Site Facilities

On-site facilities required for operation of Allen dome site would consist of: ten to twelve storage caverns with diked wellheads; crude oil, raw water and brine pipelines to wellheads (buried alongside access roads); central pumping and control facilities; a crude oil distribution system; a raw water supply system; a brine disposal system including a brine pit and three backup injection wells; and a power distribution system for use with commercially supplied power.

Since this dome is smaller in area than others of the Seaway SPR Group, the designed storage caverns would be higher and narrower than those proposed for the other Seaway sites. Cavern height would be 1700 feet and initial diameter 200 feet (600-foot centers between wells). After the projected five fill-withdrawal cycles, cavern diameters would

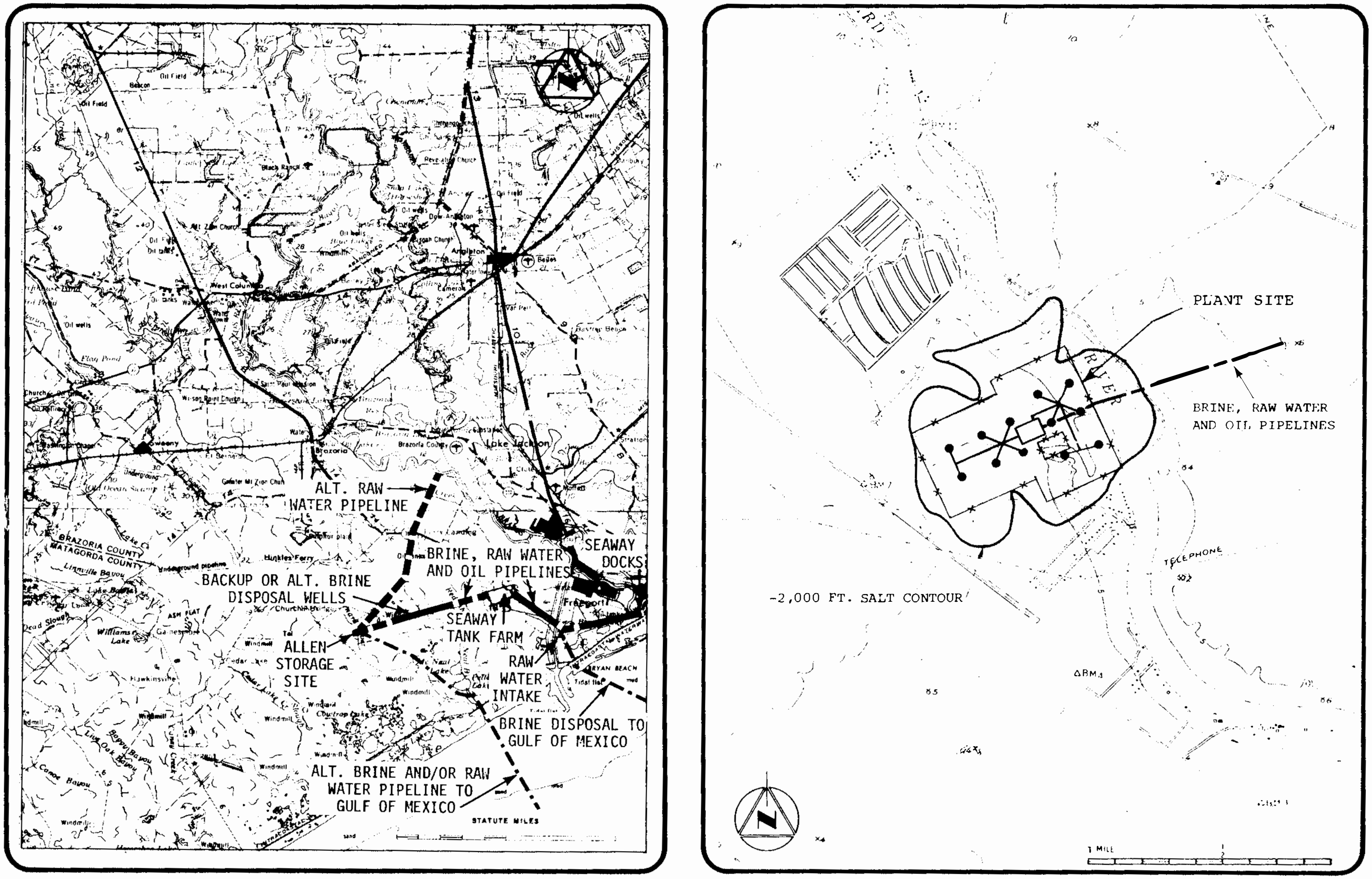


FIGURE 2.4-1 Vicinity and site map - Allen dome candidate SPR storage site (alternative site).

FIGURE 2.4-2 Air photo of Allen dome candidate SPR storage site (alternative site).

reach about 300 feet, still leaving a 300-foot wall around every cavern. If Allen dome were selected for SPR development, the configuration of salt body would have to be further defined before development begins.

The area which would be dedicated to the alternative SPR facility at Allen dome would be approximately 184 acres. About 17 percent of this area, or about 31 acres, would be regraded into road and pipeline alleys, drill pads and the plant area (Figure 2.4-1).

An area of about 10 acres would accommodate equipment and facilities for leaching and operating the storage caverns. This area would include the main pump and control buildings, the warehouse and office complex, diked blanket oil and raw water tanks and a lined brine pit. A material and equipment yard would adjoin the plant area. All plant facilities and wellheads would be appropriately fenced.

Land requirements for both SPR and early storage facilities are summarized in Table 2.4-1.

2.4.3 Off-Site Facilities

Operation of the alternative SPR site at Allen dome would require increased use of the raw water intake and crude oil distribution systems constructed at Bryan Mound for the early storage phase development (Figure 2.2-3). The two new DOE tanker docks at Freeport Harbor and their associated pipelines and pumping equipment would be constructed as part of the SPR program for the Allen dome site development.

Off-site facilities related to the storage of crude oil at Allen dome (Figure 2.4-1) would encompass: raw water intake and brine disposal pipelines connecting Bryan Mound and Allen dome; brine disposal pipeline to a Gulf diffuser 5.8 miles offshore; bi-directional crude oil pipelines between the SEAWAY Tank Farm and the site; and high-voltage transmission lines connecting Allen dome with the Community Service Company's Brazoria substation, 12 miles to the north.

2.4.4 Alternative Facilities

In designing the Allen dome alternative site for the SPR program, a number of alternative facilities and systems were considered. Acreages affected by these alternatives are summarized in Table 2.4-1.

TABLE 2.4-1 Land requirements - Allen dome candidate SPR storage site (alternative site).

	Total Miles Pipeline Row	Excavation (c.y.)	Fill (c.y.)	Required Right-of-Way and Affected Habitat (Acres) Cleared Land Constr/Maint[a]	Fluvial and Oak Woodlands Constr/Maint[a]	Coastal Prairies Constr/Maint[a]	Brackish to Freshwater Marsh Constr/Maint[a]	Shell Ramp Barrier Flat Constr/Maint[a]	Coastal and Inland Waters Constr/Maint[a]	Number of Water Crossings	Total Acreage Impacted Constr/Maint[a]
A. SPR Facilities											
1) Storage Site											
a) Central Plant Area	---	---	380,560	---	---	10/10	---	---	---	---	10/10
b) Brine Surge Pond	---	---	(included above)	3/3	---	---	---	---	---	---	3/3
c) Plant Access Road	---	---	}	---	---	1/1	---	---	---	---	1/1
d) Onsite Roads and Pipe Alleys	1.8	27,720	} 28,800	---	---	5/5	---	---	---	---	5/5
e) Cavern Wellhead Pads	---	---	}	---	---	12/12	---	---	---	---	12/12
f) Containment Dikes at Cavern Wellheads	---	---	840	---	---	---	---	---	---	---	---
2) Offsite											
a) Backup Brine Injection Wells	Follows Proposed DOE Right-of-Way										
1) Pipeline Excavation	1.9	9,780	---	---	---	23/17	---	---	---	---	23/17
2) Roadways to Wellheads	---	---	---	---	---	---	---	---	---	---	---
3) Wellhead Pads	---	---	3,090	---	---	3/3	---	---	---	---	3/3
b) Oil, Brine and Raw Water Pipelines to Seaway Tank Farm	8.0	126,720	---	---	2/2	84/63	12/9	---	1/0	6	99/74
c) Brine and Raw Water to Bryan Mound	4.1	54,800		Follows Proposed DOE Right-of-Way							
d) Brine Disposal to Gulf of Mexico diffuser from Bryan Mound	7.5	177,300	---	---	---	20/14	.2/.1	1/.5	142/0	2	163/15
e) Pipeline Connection to Brazos Harbor	0.6	6,000	---	4/3	---	---	4/3	---	---	---	8/6
f) New Tanker Docks	---	1,050,000	---	14/14	---	---	---	---	---	---	14/14
Sub-Total SPR Facilities - Allen Dome -	23.9	1,452,320	413,200	21/20	2/2	158/125	16/12	3/1	143/0	8	341/160
B. Early Storage Facilities at Bryan Mound	10.4	94,600	665,000	74/69	---	43/33	33/26	---	---	1	150/128
Total Land Requirements- Early Storage plus SPR at Allen Dome	34.3	1,546,920	1,078,200	95/89	2/2	201/158	49/38	1/1	143/0	9	491/288
C. Alternatives to Proposed Systems											
1) Brine Disposal (Wells)	Follows Proposed DOE Right-of-Way										
a) Pipeline Excavation	3.2	19,000	---	---	---	---	---	---	---	---	---
b) Roadways to Wellheads	---	---	Minimal	---	---	---	---	---	---	---	---
c) Wellhead Pads	---	---	19,000	---	---	19/19	---	---	---	---	19/19
2) Brine Disposal (Directly to Gulf of Mexico 5 mi diffuser)	13.4	197,472	---	---	---	17/13	76/57	---	141/0	2	234/70

[a] Construction Right-of-Way/Maintenance Right-of-Way

TABLE 2.4-1 continued.

	Total Miles Pipeline Row	Excavation (c.y.)	Fill (c.y.)	Required Right-of-Way and Affected Habitat (Acres): Cleared Land Constr/Maint[a]	Fluvial and Oak Woodlands Constr/Maint[a]	Coastal Prairies Constr/Maint[a]	Brackish to Freshwater Marsh Constr/Maint[a]	Shell Ramp Barrier Flat Constr/Maint[a]	Coastal and Inland Waters Constr/Maint[a]	Number of Water Crossings	Total Acreage Impacted Constr/Maint[a]
3) Brine Disposal via tank farm and Bryan Mound to 12.5 mi diffuser	14.2	274,600	---	---	---	20/14	.2/.1	1/.5	305/0	2	326/15
4) Raw Water (Brazos River)	5.0	26,540	---	---	45/34	61/46	---	---	---	---	106/80
5) Raw Water (San Bernard River)	---	140	---	---	1/1	5/3	---	---	---	---	6/4
6) Raw Water (Ground water supply wells)	Follows Proposed DOE Right-of-Way										
a) Pipeline Excavation	5.5	28,800	---	---	---	---	---	---	---	---	---
b) Roadways to Wellheads	---	---	Minimal	---	---	---	---	---	---	---	---
c) Wellhead Pads	---	---	---	---	---	22/22	---	---	---	---	22/22
7) Raw Water (Gulf of Mexico)	13.4	197,472	---	---	---	17/13	76/57	---	141/0	2	234/70

onstruction Right-of-Way/Maintenance Right-of-Way

2.4.4.1 Crude Oil Distribution System

Alternatives to the proposed crude oil distribution system are the same as those described in paragraph 2.3.4.1.

2.4.4.2 Raw Water System

Ground water could be withdrawn from the saline Evangeline aquifer; such action, however, might aggravate an already severe ground subsidence problem.

Second, surface water could be taken from the San Bernard River adjacent to the Allen dome site. Although the river discharge is subject to wide variations, it is tidal estuary at the site and sufficient supplies should be available at all river stages. This alternative would require construction of an on-site intake structure.

Third, saline water could be obtained via pipeline directly from an intake in the Gulf of Mexico.

Fourth, an intake structure and desander could be constructed on the Brazos River upstream of Freeport. The water would have to be purchased from the Lower Brazos River Authority, and previous riparian commitments could limit water availability during periods of low river flow.

2.4.4.3 Brine Disposal System

An alternative to the 5.8 mile brine diffuser would be a Gulf diffuser 12.5 miles offshore using the Bryan Mound facilities, or brine could be disposed of via a pipeline from the Allen dome site directly to a diffuser in the Gulf of Mexico. This system would be independent of the Bryan Mound brine disposal system.

A third alternative would be deep well injection of the brine into deep saline aquifers. This alternative would require an additional 19 wells, located along the pipeline right-of-way between the site and the SEAWAY Tank Farm.

2.4.4.4 Power System

An alternative to the purchase of commercial power would be construction of an on-site generator, with a fuel tank (to hold a four-day supply) and a 50-foot exhaust stack.

2.5 ALTERNATIVE SITE - WEST COLUMBIA DOME

The alternative SPR facility at West Columbia dome could store 100 MMB of crude oil for the Seaway Group. Initial fill would be completed approximately five years after start of construction. Crude oil would be delivered to West Columbia dome via the surge tanks at Bryan Mound.

2.5.1 Site Location and Characteristics

The West Columbia dome is in west central Brazoria County, Texas (Figures 2.5-1 and 2.5-2), approximately 45 miles southwest of Houston and a mile north of West Columbia. The Brazos River is about 3 miles southeast, the San Bernard River 3-1/2 miles southwest and Varner Creek about a half-mile east of the site. SEAWAY Tank Farm is located about 23 miles to the southwest.

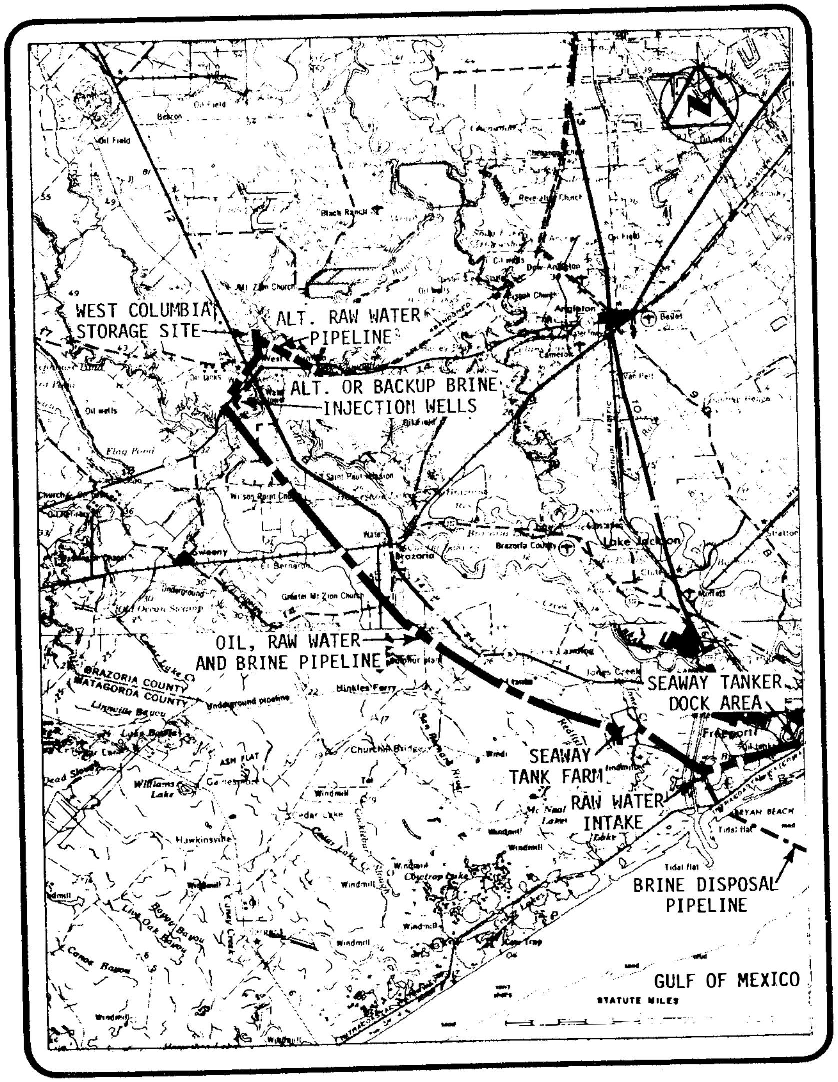
West Columbia dome covers about 350 surface acres within the -2000-foot salt contour (Figure 2.5-1). A marsh occupies the center of the dome, and the remainder is in grassland; there are few trees on the site. Most oil production in the immediate area is centered north of the site, although there are a few nearby wells to the south and east.

Local paved roads provide good access to the site; State Highway 36 runs along the western edge of the dome. New roads will be needed only on the site itself.

2.5.2 On-Site Facilities

On-site facilities required for operation of the West Columbia dome site would consist of: ten to twelve storage caverns with diked well-heads; crude oil, raw water and brine pipelines to wellheads (buried alongside the access roads); central pumping and control facilities; a crude oil distribution system; a raw water supply system; a brine disposal system including a brine pit and three backup injection wells; and a power distribution system for use with commercially supplied power.

The area dedicated to the alternative SPR facility at West Columbia dome would be about 232 acres. About 13 percent of this area, or 30 acres, would be regraded for road and pipeline alleys, drill pads and the plant area (Figure 2.5-1).



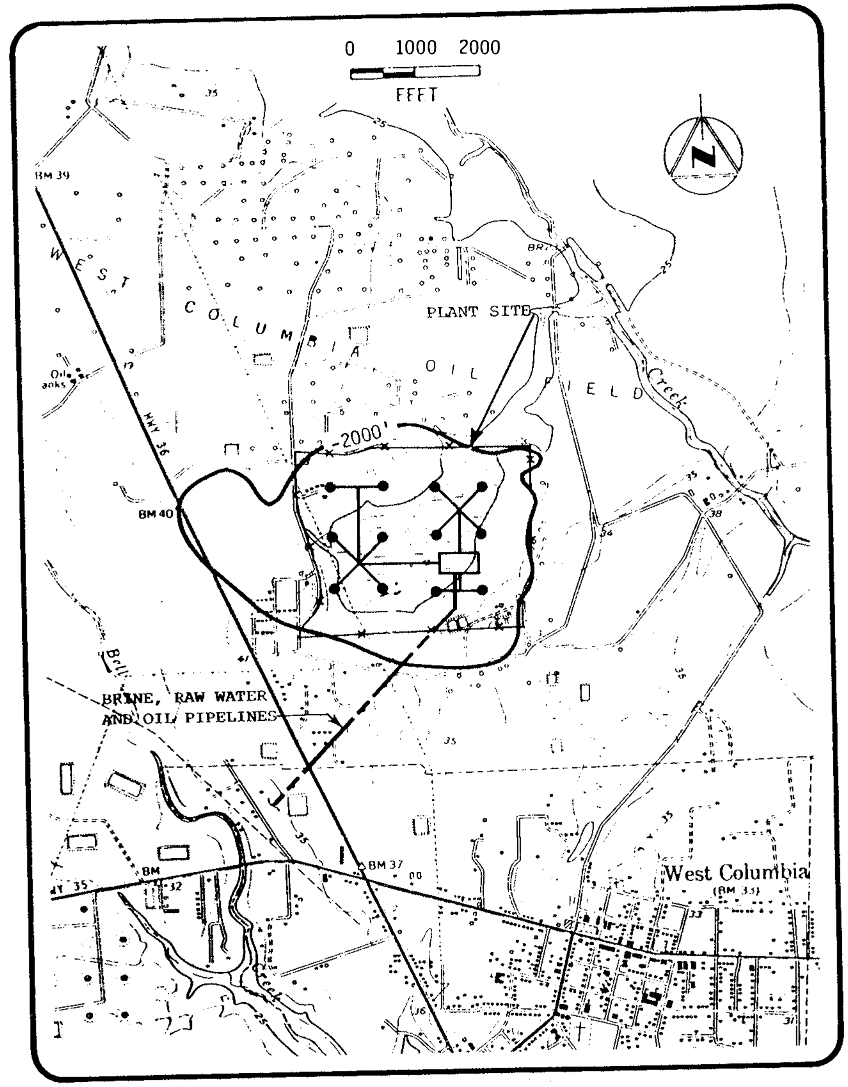


FIGURE 2.5-1 Vicinity and site map - West Columbia dome candidate SPR storage site (alternative site).

FIGURE 2.5-2 Air photo of West Columbia dome candidate SPR storage site (alternative site).

The plant area would accommodate equipment and facilities for leaching and operating the storage caverns. Included here would be the main pump and control buildings, the warehouse and office complex, diked blanket oil and raw water tanks and a lined brine pit. All plant facilities and wellheads would be appropriately fenced.

Land requirements for both SPR and early storage facilities are summarized in Table 2.5-1.

2.5.3 Off-Site Facilities

Operation of the alternative SPR site at West Columbia dome would require increased use of the raw water intake and crude oil distribution systems constructed at Bryan Mound for the early storage phase development (Figure 2.2-3). The two new DOE tanker docks at Freeport Harbor and their associated pipelines and pumping equipment would be constructed as part of the SPR program for the West Columbia dome site development.

Off-site facilities related to the storage of crude oil at West Columbia dome (Figure 2.5-1) would encompass: raw water intake and brine disposal pipelines connecting Bryan Mound and West Columbia dome; a brine disposal pipeline to a diffuser in the Gulf of Mexico 5.8 miles offshore; bidirectional pipelines between the SEAWAY Tank Farm and the site; and a half-mile high voltage transmission line connecting the site with Community Public Service Company's West Columbia substation.

2.5.4 Alternative Facilities

In designing the West Columbia dome alternative site for the SPR program, a number of alternative facilities and systems were considered. Acreages affected by these alternatives are summarized in Table 2.5-1.

2.5.4.1 Crude Oil Distribution System

Alternatives to the proposed crude oil distribution system are the same as those described in paragraph 2.3.4.1.

2.5.4.2 Raw Water System

An alternative raw water source would be ground water from the saline Evangeline aquifer. Present ground water use in the immediate

TABLE 2.5-1 Land requirements - West Columbia dome candidate SPR storage site (alternative site).

	Total Miles Pipeline Row	Excavation (c.y.)	Fill (c.y.)	Required Right-of-Way and Affected Habitat (Acres): Cleared Land Constr/Maint[a]	Fluvial and Oak Woodlands Constr/Maint[a]	Coastal Prairies Constr/Maint[a]	Freshwater Marsh Constr/Maint[a]	Brackish to Freshwater Marsh Constr/Maint[a]	Shell Ramp Barrier Flat Constr/Maint[a]	Coastal and Inland Waters Constr/Maint[a]	Number of Water Crossings	Total Acreage Impacted Constr/Maint[a]
SPR Facilities												
1) Storage Site												
a) Central Plant Area	---	---	16,200	---	---	---	10/10	---	---	---	---	10/10
b) Brine Surge Pond	---	---	19,000	---	---	---	3/3	---	---	---	---	3/3
c) Plant Access Road	---	---	400	---	---	---	---	---	---	---	---	---
d) Onsite Roads and Pipe Alleys	2.2	34,000	8,400	---	---	---	5/5	---	---	---	---	5/5
e) Cavern Wellhead Pads	---	---	17,800	---	---	---	12/12	---	---	---	---	12/12
f) Containment Dikes at Cavern Wellheads	---	---	840	---	---	---	---	---	---	---	---	---
2) Offsite												
a) Backup Brine Injection Wells	Follows Proposed DOE Right-of-Way											
1) Pipeline Excavation	2.3	12,150	---	---	---	---	---	---	---	---	6	---
2) Roadways to Wellheads	---	---	Minimal Fill	---	---	---	---	---	---	---	---	---
3) Wellhead Pads	---	---	---	---	---	3/3	---	---	---	---	---	3/3
b) Oil, Brine and Raw Water Pipelines to Seaway Tank Farm	23.0	364,320	---	---	149/112	130/98	---	---	---	---	---	279/210
c) Brine and Raw Water Pipelines to Bryan Mound	4.1	54,800	---	Follows Proposed DOE Right-of-Way								
d) Brine Disposal to G.O.M. diffuser from Bryan Mound	7.5	177,300	---	---	---	20/14	---	.2/.1	1/.5	142/0	2	163/15
e) Pipeline Connections to Brazos Harbor	0.6	6,000	---	4/3	---	---	---	4/3	---	---	---	8/5
f) New Tanker Docks	---	1,050,000	---	14/14	---	---	---	---	---	---	---	14/14
Sub-Total SPR Facilities - West Columbia Dome -	39.7	1,700,370	62,640	18/17	149/112	153/115	30/30	4/3	1/1	142/0	8	437/277
Early Storage Facilities at Bryan Mound	10.4	94,600	665,000	74/69	---	43/33	---	33/26	---	---	1	150/128
Total Land Requirements Early Storage plus SPR at West Columbia Dome	50.1	1,794,970	727,640	92/86	149/112	196/148	30/30	37/29	1/1	142/0	9	647/416
Alternatives to Proposed Systems												
1) Brine Disposal (Wells)												
a) Pipeline Excavations	3.2	19,000	---	Follows Proposed DOE Right-of-Way								
b) Roadways to Wellheads	---	---	Minimal	---	---	---	---	---	---	---	---	---
c) Wellhead Pads	---	---	Minimal	---	17/17	2/2	---	---	---	---	---	19/19
2) Brine Disposal to G.O.M. 12.5 mi diffuser	14.2	274,600	---	---	---	20/14	---	.2/.1	1/.5	305/0		326/15
3) Raw Water (Brazos River)	3.0	16,200	---	---	34/25	4/3	---	---	---	1/0	1	39/28
4) Raw Water (Groundwater Supply Wells)												
a) Pipeline Excavation	5.9	31,200	---	---	---	---	---	---	---	---	---	---
b) Roadways to Wellheads	---	---	Minimal	---	---	---	---	---	---	---	---	---
c) Wellhead Pads	---	---	Minimal	---	19/19	3/3	---	---	---	---	---	22/22

[a]Construction Right-of-Way/Maintenance Right-of-Way

vicinity of West Columbia dome is not extensive, but the region has been experiencing problems of ground subsidence caused by extensive withdrawals in other areas. An additional withdrawal of large quantities of ground water might aggravate this regional problem.

A second alternative would be to withdraw surface water from the Brazos River near East Columbia, using an intake structure and desander similar to that constructed at Bryan Mound for the early storage phase of the SPR development. The water would have to be purchased from the Lower Brazos River Authority, and previous riparian commitments could limit water availability during periods of low river flow.

2.5.4.3 Brine Disposal System

An alternative pipeline would run to the Gulf of Mexico 12.5 miles offshore from Bryan Mound. Another alternative brine disposal system would be deep well injection into deep saline water bearing sands. This would require the construction of 19 additional injection wells, which could be located along the pipeline right-of-way between the site and the SEAWAY Tank Farm.

2.5.4.4 Power System

An alternative to the purchase of commercial power would be the construction of an on-site generator. This alternative would also require construction of an on-site fuel tank (to hold a four-day supply) and a 100-foot exhaust stack.

2.6 ALTERNATIVE SITE - DAMON MOUND

The alternative SPR facility at Damon Mound dome could store 100 MMB of crude oil for the Seaway Group. Initial fill would be completed approximately five years after start of construction. Crude oil would be delivered to Damon Mound via the surge tanks at Bryan Mound.

2.6.1 Site Location and Characteristics

The Damon Mound dome is in western Brazoria County, Texas, within a mile of the Brazoria-Fort Bend County line (Figures 2.6-1 and 2.6-2). The small town of Damon, 36 miles from the Gulf of Mexico, overlies a portion of the mound on the east. The Brazos River passes 9 miles east of the dome and the San Bernard River is about 4 miles to the west. SEAWAY tank farm is 32 miles southeast of the site.

Damon Mound is clearly defined, rising about 80 feet above the surrounding terrain. Approximately 1500 surface acres are enclosed by the -2000-foot salt contour (Figure 2.6-1). The south and southeast sides of the dome have some tree cover, but most of the dome is in pasture land; no clearing would be required in the site area. The land overlying the dome is used primarily for cattle grazing, but there are some oil and gas fields in the vicinity (largely centered on the southwestern slopes), and a limestone quarry adjacent to the proposed storage site.

State Highway 36 runs within a half-mile of the site on the east and there are several paved and surfaced roads over the dome itself. The only new roads required would be those on the site itself.

2.6.2 On-Site Facilities

On-site facilities required for operation of the Damon Mound site would consist of: ten to twelve storage caverns with diked wellheads; crude oil, raw water and brine pipelines to wellheads (buried alongside the access roads); central pumping and control facilities; a crude oil distribution system; a raw water supply system; a brine disposal system including a brine pit and three backup injection wells; and an on-site power generation system.

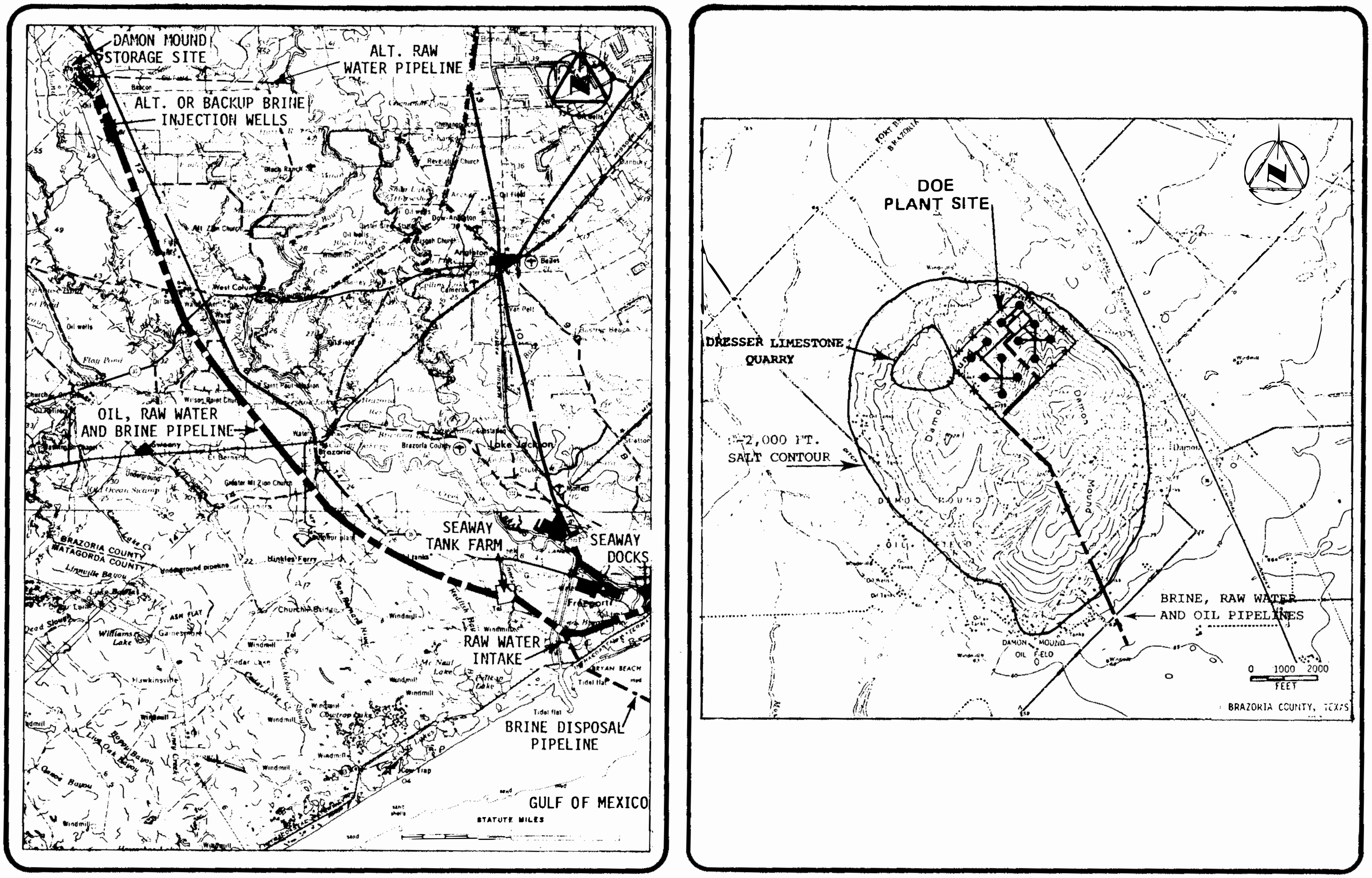


FIGURE 2.6-1 Vicinity and site map - Damon Mound candidate SPR storage site (alternative site).

FIGURE 2.6-2 Air photo of Damon Mound candidate SPR storage site (alternative site).

The area dedicated to the alternative SPR facility at Damon Mound would be about 232 acres. About 13 percent of this area, or 30 acres, would be regraded for road and pipeline alleys, drill pads and the plant area (Figure 2.6-1).

The plant area would accommodate equipment and facilities for leaching and operating the storage caverns. Included here would be the main pump and control buildings, the warehouse and office complex, diked blanket oil and raw water tanks and a lined brine pit. An on-site power generator, a fuel tank large enough to hold a four day supply, and a 100 foot exhaust stack would also be located in the plant area. All plant facilities and wellheads would be appropriately fenced.

Land requirements for both SPR and early storage facilities are summarized in Table 2.6-1.

2.6.3 Off-Site Facilities

Operation of the alternative SPR site at Damon Mound would require increased use of the raw water intake and crude oil distribution systems constructed at Bryan Mound for the early storage phase development (Figure 2.2-3). The two new DOE tanker docks at Freeport Harbor and their associated pipelines and pumping equipment would be constructed as part of the SPR program for the Damon Mound site development.

Off-site facilities related to the storage of crude oil at Damon Mound (Figure 2.6-1) would encompass: raw water intake and brine disposal pipelines connecting Bryan Mound and Damon Mound; brine disposal pipeline to the 5.8 mile offshore Gulf diffuser and bidirectional crude oil pipelines between the SEAWAY Tank Farm and the site.

2.6.4 Alternative Facilities

In designing the Damon Mound alternative site for the SPR program, a number of alternative facilities and systems were considered. Acreages affected by these alternatives are summarized in Table 2.6-1.

2.6.4.1 Crude Oil Distribution System

Alternatives to the proposed crude oil distribution system are the same as those described in paragraph 2.3.4.1.

TABLE 2.6-1 Land requirements - Damon Mound candidate SPR storage site (alternative site).

	Total Miles Pipeline Row	Excavation (c.y.)	Fill (c.y.)	Required Right-of-Way and Affected Habitat (Acres): Cleared Land Constr/Maint[a]	Fluvial and Oak Woodlands Constr/Maint[a]	Coastal Prairies Constr/Maint[a]	Brackish to Freshwater Marsh Constr/Maint[a]	Shell Ramp Barrier Flat Constr/Maint[a]	Coastal and Inland Waters Constr/Maint[a]	Number of Water Crossings	Total Acreage Impacted Constr/Maint[a]
A. SPR Facilities											
1) Storage Site											
a) Central Plant Area	---	---	Minimal	---	---	10/10	---	---	---	---	10/10
b) Brine Surge Pond	---	---	Minimal	---	---	3/3	---	---	---	---	3/3
c) Plant Access Road	---	---	Minimal	---	---	5/5	---	---	---	---	5/5
d) Onsite Roads and Pipe Alleys	6.0	31,680	Minimal	---	---	---	---	---	---	---	---
e) Cavern Wellhead Pads	---	---	---	---	---	12/12	---	---	---	---	12/12
f) Containment Dikes at Cavern Wellheads	---	---	840	---	---	---	---	---	---	---	---
2) Offsite											
a) Backup Brine Injection Wells	Follows Proposed DOE Right-of-Way										
1) Pipeline Excavation	2.9	15,280	---	---	---	---	---	---	---	---	---
2) Roadways to Wellheads	---	---	min. fill	---	---	---	---	---	---	---	---
3) Wellhead Pads	---	---	Minimal	---	---	3/3	---	---	---	13	3/3
b) Oil, Brine and Raw Water Pipelines to Seaway Tank Farm	32.3	511,632	---	5/4	182/136	210/158	---	---	---	---	397/298
c) Brine and Raw Water Pipelines to Bryan Mound	4.1	94,800	---	Follows Proposed DOE Right-of-Way							
d) Brine Disposal to 5.8 mi diffuser	7.5	177,300	---	---	---	20/14	.2/.1	1/.5	142/0	2	163/15
e) Pipeline Connection to Brazos Harbor	0.6	6,000	---	4/3	---	---	4/3	---	---	---	8/6
f) New Tanker Docks	---	1,050,000	---	14/14	---	---	---	---	---	---	14/14
Sub-Total SPR Facilities - - Damon Mound -	53.4	1,846,692	840	23/21	182/136	263/205	4/3	1/1	142/0	15	615/366
B. Early Storage Facilities at Bryan Mound	10.4	94,600	665,000	74/69	---	43/33	33/26	---	---	1	150/128
Total Land Requirements Early Storage plus SPR at Damon Mound	63.8	1,941,292	665,840	97/90	182/136	306/238	27/29	1/1	142/0	16	765/494
C. Alternatives to Proposed Systems											
1) Brine Disposal (Wells)	Follows Proposed DOE Right-of-Way										
a) Pipeline Excavation	3.2	17,000	---	---	---	---	---	---	---	---	---
b) Roadways to Wellheads	---	---	Minimal	---	---	---	---	---	---	---	---
c) Wellhead Pads	---	---	Minimal	---	---	19/19	---	---	---	---	19/19
2) Brine Disposal to 12.5 mi diffuser	14.2	274,600	---	---	---	20/14	.2/.1	1/.6	305/0		326/15
3) Raw Water (Brazos River)	10.0	52,940	---	---	4/3	115/86	---	---	3/3	4	122/92
4) Raw Water (Groundwater Supply Wells)	Follows Proposed DOE Right-of-Way										
a) Pipeline Excavation	6.1	32,280	---	---	---	---	---	---	---	---	---
b) Roadways to Wellheads	---	---	Minimal	---	---	---	---	---	---	---	---
c) Wellhead Pads	---	---	---	---	---	22/22	---	---	---	---	22/22

[a] Construction Right-of-Way/Maintenance Right-of-Way

2.6.4.2 Raw Water System

An alternative raw water source would be ground water from the saline Evangeline aquifer. If large quantities were obtained from this source, however, such action might aggravate an already severe ground subsidence problem.

A second alternative might be to withdraw surface water from the Brazos River east of the site, using an intake structure and desander similar to that constructed at Bryan Mound for the early storage phase of the SPR development. The water would have to be purchased from the Lower Brazos River Authority, and previous riparian commitments could limit water availability during periods of low river flow.

2.6.4.3 Brine Disposal System

Alternatives to the proposed brine disposal system are the same as those described in paragraph 2.5.4.3.

2.6.4.4 Power System

An alternative to the on-site generation of power would be the purchase of commercial power from the nearest HL&P substation. Standby charges would be substantial because of the large loads that would be required during the projected fill-withdrawal cycles.

2.7 ALTERNATIVE SITE - NASH DOME

The alternate SPR facility at Nash dome could store 100 MMB of crude oil for the Seaway group. Initial fill would be completed approximately five years after start of construction. Crude oil would be delivered to Nash dome via the surge tanks at Bryan Mound.

2.7.1 Site Location and Characteristics

Nash dome is located in southern Fort Bend County, Texas, just touching the northern end of Brazoria County. Houston lies about 35 miles northeast of the site (Figures 2.7-1 and 2.7-2). The Brazos River passes approximately 6 miles east of the dome, the Gulf of Mexico is 36 miles to the south, and Cow Creek borders the dome on the south. The site is located 33 miles northwest of the SEAWAY Tank Farm.

Nash dome encompasses 600 surface acres within the -2000-foot salt contour (Figure 2.7-1). There is no surface expression of the dome. There are trees on the southern reaches of the dome, along Cow Creek, while the northern portion has been cultivated; three farmsteads are within the proposed site boundaries and would be displaced. Oil wells generally surround the dome and sulfur production has been centered in the southwest quadrant.

Since existing roads provide suitable access to the site, the only new road construction would be for access to the plant area and wellheads.

2.7.2 On-Site Facilities

On-site facilities required for operation of the Nash dome site would consist of: ten to twelve storage caverns with diked wellheads; crude oil, raw water and brine pipelines to wellheads (buried alongside the access roads); central pumping and control facilities; a crude oil distribution system; a raw water supply system; a brine disposal system including a brine pit and three backup injection wells; and an on-site power generation system.

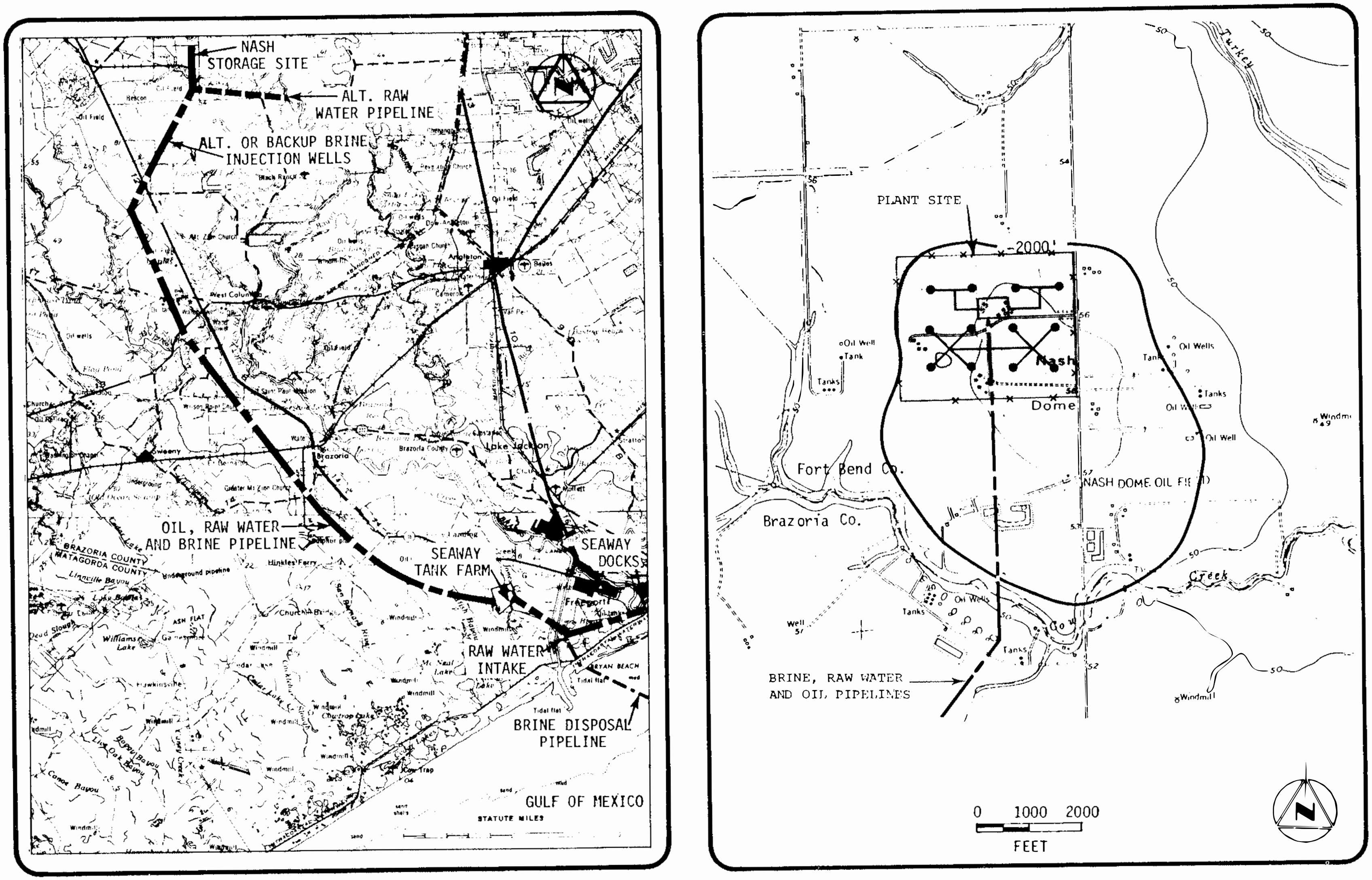


FIGURE 2.7-1 Vicinity and site map - Nash dome candidate SPR storage site (alternative site).

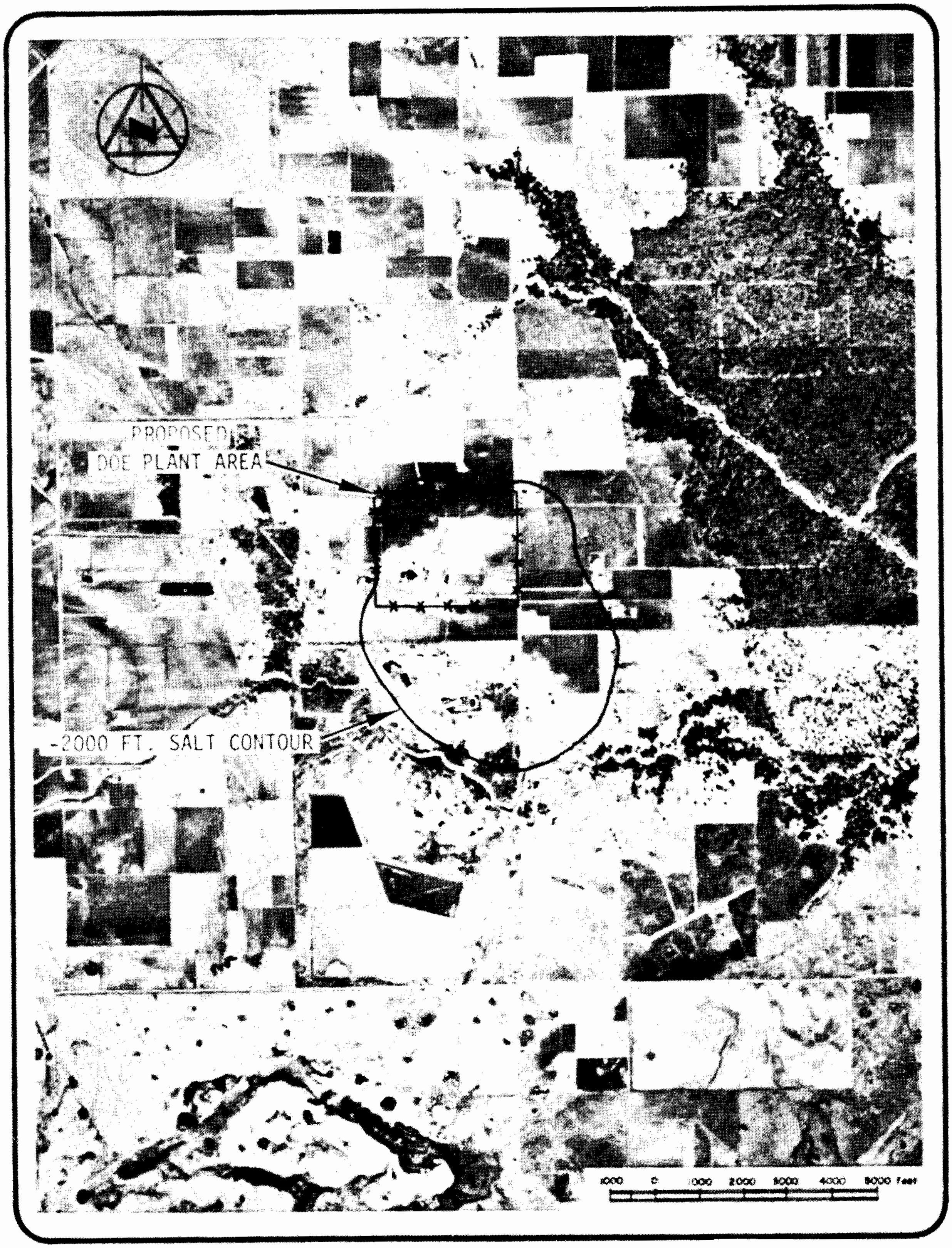


FIGURE 2.7-2 Air photo of Nash dome candidate SPR storage site (alternative site).

The area dedicated to the alternative SPR facility at Nash dome would be about 206 acres. About 15 percent of this area, or 30 acres, would be regraded for road and pipeline alleys, drill pads and the plant area (Figure 2.7-1).

The plant area would accommodate equipment and facilities for leaching and operating the storage caverns. Included here would be the main pump and control buildings, the warehouse and office complex, diked blanket oil and raw water tanks, and a lined brine pit. An onsite power generator, a fuel tank large enough to hold a four-day supply, and a 100 foot exhaust stack would also be located in the plant area. A 10 acre material and equipment yard would adjoin the plant area. All plant facilities and wellheads would be appropriately fenced.

Land requirements for both SPR and early storage facilities are summarized in Table 2.7-1.

2.7.3 Off-Site Facilities

Operation of the alternative SPR site at Nash dome would require increased use of the raw water intake and crude oil distribution systems constructed at Bryan Mound for the early storage phase development (Figure 2.2-3). The two new DOE tanker terminals at Brazosport and their associated pipelines and pumping equipment (Figure 2.1-1) would be constructed as part of the SPR program for Nash dome site development.

Offsite facilities related to the storage of crude oil at Nash dome (Figure 2.7-1) would encompass: raw water intake and brine disposal pipelines connecting Bryan Mound and Nash dome; a brine diffuser 5.8 miles offshore in the Gulf of Mexico; and bi-directional crude oil pipelines between the SEAWAY Tank Farm and the site.

2.7.4 Alternative Facilities

In designing the Nash dome alternative site for the SPR program, a number of alternative facilities and systems were considered. Acreages affected by these alternatives are summarized in Table 2.7-1.

2.7.4.1 Crude Oil Distribution System

Alternatives to the proposed crude oil distribution system are described in paragraph 2.3.4.1.

TABLE 2.7-1 Land requirements - Nash dome candidate SPR storage site (alternative site).

	Total Miles Pipeline Row	Excavation (c.y.)	Fill (c.y.)	Required Right-of-Way and Affected Habitat (Acres): Cleared Land Constr/Maint[a]	Fluvial and Oak Woodlands Constr/Maint[a]	Coastal Prairies Constr/Maint[a]	Brackish to Freshwater Marsh Constr/Maint[a]	Shell Ramp Barrier Flat Constr/Maint[a]	Coastal and Inland Waters Constr/Maint[a]	Number of Water Crossings	Total Acreage Impacted Constr/Maint[a]
A. SPR Facilities											
1) Storage Site											
a) Central Plant Area	---	---	Minimal	10/10	---	---	---	---	---	---	10/10
b) Brine Surge Pond	---	---	Minimal	3/3	---	---	---	---	---	---	3/3
c) Plant Access Road	---	Minimal	---	---	---	---	---	---	---	---	---
d) Onsite Roads and Pipe Alleys	5.7	30,100	---	5/5	---	---	---	---	---	---	5/5
e) Cavern Wellhead Pads	---	---	---	12/12	---	---	---	---	---	---	12/12
f) Containment Dikes at Cavern Wellheads	---	---	840	---	---	---	---	---	---	---	---
2) Offsite											
a) Backup Brine Injection Wells	Follows Proposed DOE Right-of-Way										
1) Pipeline Excavation	2.5	13,200	---	---	---	---	---	---	---	---	---
2) Roadways to Wellheads	---	Minimal	---	---	---	---	---	---	---	---	---
3) Wellhead Pads	---	---	---	---	---	3/3	---	---	---	14	3/3
b) Oil, Brine and Raw Water Pipelines to Seaway Tank Farm	32.6	517,180	---	---	210/158	219/165	---	---	---	---	429/323
c) Brine and Raw Water Pipelines to Bryan Mound	4.1	54,800	---	Follows Proposed DOE Right-of-Way							
d) Brine Disposal to 5.8 mi diffuser	7.5	177,300	---	---	---	20/14	.2/.1	1/.5	142/0	2	163/15
e) Pipeline Connections to Brazos Harbor	0.6	6,000	---	4/3	---	---	4/3	---	---	---	8/6
f) New Tanker Docks	---	1,050,000	---	14/14	---	---	---	---	---	---	14/14
Sub-Total SPR Facilities - Nash Dome -	53.0	1,848,580	840	48/47	210/158	242/182	4/3	1/1	142/0	16	647/391
B. Early Storage Facilities at Bryan Mound	10.4	94,600	665,000	74/69	---	43/33	33/26	---	---	1	150/128
Total Land Requirements- Early Storage plus SPR at Nash Dome	63.4	1,943,180	665,840	122/116	210/158	285/215	37/29	1/1	142/0	17	797/519
C. Alternatives to Proposed Systems											
1) Brine Disposal (Wells)	Follows Proposed DOE Right-of-Way										
a) Pipeline Excavation	3.2	17,000	---	---	---	---	---	---	---	---	---
b) Roadways to Wellheads	---	---	Minimal	---	---	---	---	---	---	---	---
c) Wellhead Pads	---	---	Minimal	---	---	19/19	---	---	---	---	19/19
2) Brine Disposal to 12.5 mi diffuser	14.2	274,600	---	---	---	20/14	.2/.1	1/.5	305/0		326/0
3) Raw Water (Brazos River)	6.1	31,820	---	---	4/3	69/52	---	---	---	2	73/55
4) Raw Water (Groundwater Supply Wells)	Follows Proposed DOE Right-of-Way										
a) Pipeline Excavation	6.1	32,200	---	---	---	---	---	---	---	---	---
b) Roadways to Wellheads	---	---	Minimal	---	---	---	---	---	---	---	---
c) Wellhead Pads	---	---	---	---	---	22/22	---	---	---	---	22/22

[a] Construction Right-of-Way/Maintenance Right-of-Way

2.7.4.2 Raw Water System

Alternatives to the proposed raw water system are the same as those described in paragraph 2.6.4.2.

2.7.4.3 Brine Disposal System

Alternatives to the proposed brine disposal system are the same as those described in paragraph 2.5.4.3.

2.7.4.4 Power System

Alternatives to the proposed power system are the same as those described in paragraph 2.6.4.4.

2.8 SUMMARY

The Seaway Group of SPR storage sites has been designed to provide a storage capacity of 163 MMB of crude oil in leached salt dome caverns in southeastern Texas. An early storage capacity of 63 MMB in existing cavities is being developed at Bryan Mound, near Freeport. The expansion of Bryan Mound by an additional 100 MMB capacity is the proposed action. This additional capacity would be created by solution mining ten to twelve new cavities. Early storage facilities for crude oil distribution, raw water supply, and brine disposal to five deep wells (backup) would continue to be used for the expanded storage.

In place of the proposed action, one of the four alternative sites (Allen dome, West Columbia dome, Damon Mound, or Nash dome) could be used to attain the total storage capacity of 163 MMB. Development of any of these sites would involve not only solution mining of the 100-MMB capacity but also construction of pipelines connecting the Bryan Mound crude oil, raw water and brine systems to the selected site.

Alternatives to the expanded use of Bryan Mound early storage systems are addressed for each of the sites as appropriate. These alternatives include local raw water supplies and brine disposal systems, and alternative power supplies for each site.

Current plans call for the development of only one site -- either the proposed site or one of the alternatives -- in addition to the early storage capacity. Development of more than one site is not unreasonable, and the impacts of developing multiple sites would be substantially similar to those discussed here.

As referenced in Section 1.1, the President has proposed to the Congress that the SPR be expanded to a total of one billion barrels. An amendment to the SPR Plan addressing the expansion is currently in preparation. If the amendment becomes effective, DOE projects that an increase in the capacity of the Seaway Group may be required. Current planning for expansion of the Seaway Group indicates that the ultimate capacity may be limited to approximatley 200 million barrels because of the limitation on withdrawal rates imposed by the capacity of Freeport

Harbor. Nevertheless, for purposes of analysis the environmental impacts of developing multiple sites in the Seaway Group are presented in terms of developing two complete storage facilities of 100 million barrels each. It is assumed that Bryan Mound, the proposed site for expansion in the Seaway Group would be developed in addition to one other site. The major facility which would be unique to the increased group capacity would be two additional 200,000 barrel surge tanks at Bryan Mouns in order to permit isolation of different crude oil types. The other facilities required for a combination of sites would be identical to those described for the indiviudal candidate sites; however, the time required for site development, fill and withdrawals, would be extended. For example, the crude oil withdrawal rate for the system would remain one million barrels per day and would take about nine months to complete. Similarly, the time required to fill a Seaway Group with a 264 MMB capacity would be over one and one-half times as long, assuming the same fill rate. The raw water, brine and oil distribution system would not need to be significantly modified since the fill and withdrawal rates would be the same, however, the additional site or sites would have to be connected to these systems via pipelines.

CHAPTER 3.0

DESCRIPTION OF THE ENVIRONMENT

3.1 INTRODUCTION

This chapter describes the environment, both natural and man-made, in the region of the proposed project and in the immediate vicinity of the five sites of the Seaway Group of SPR sites.

The regional environment, discussed in Section 3.2, presents information on the region as it pertains to the specific disciplines discussed. For land features, the region can be considered to include the Gulf Coast of southeast Texas; for surface water, the region encompasses the Brazos and San Bernard River basins; and for socioeconomics, the region is the four-county area including Brazoria, Ford Bend, Harris, and Galveston Counties.

In Sections 3.3 through 3.7 the specific environment of each of the five candidate sites--Bryan Mound, Allen dome, West Columbia dome, Damon Mound, and Nash dome--is presented. Because many environmental characteristics are similar at two or more sites, the regional description is most complete. Descriptions for the proposed and alternative sites are cross-referenced to previous sections as appropriate. Section 3.8 briefly presents the environmental aspects of multiple site development.

Aspects of the region and the five sites of greatest significance with regard to impacts of the project (discussed in Chapter 4) are summarized in Section 3.9. A more detailed description of the existing environment in the Seaway Group region is presented in Appendix B of this document. References used have been deleted for this chapter, but appear in Appendix B.

3.2 REGIONAL ENVIRONMENT

3.2.1 Land Features

3.2.1.1 Physiography and Topography

The Seaway Group of SPR sites is situated in the gulfward margin of the Gulf Coastal Plain physiographic province which is characterized as a relatively flat, featureless prairie terrace. Marshes, swamps, and low gradient streams are common (Figure 3.2-1), and natural levees are often found along the streams.

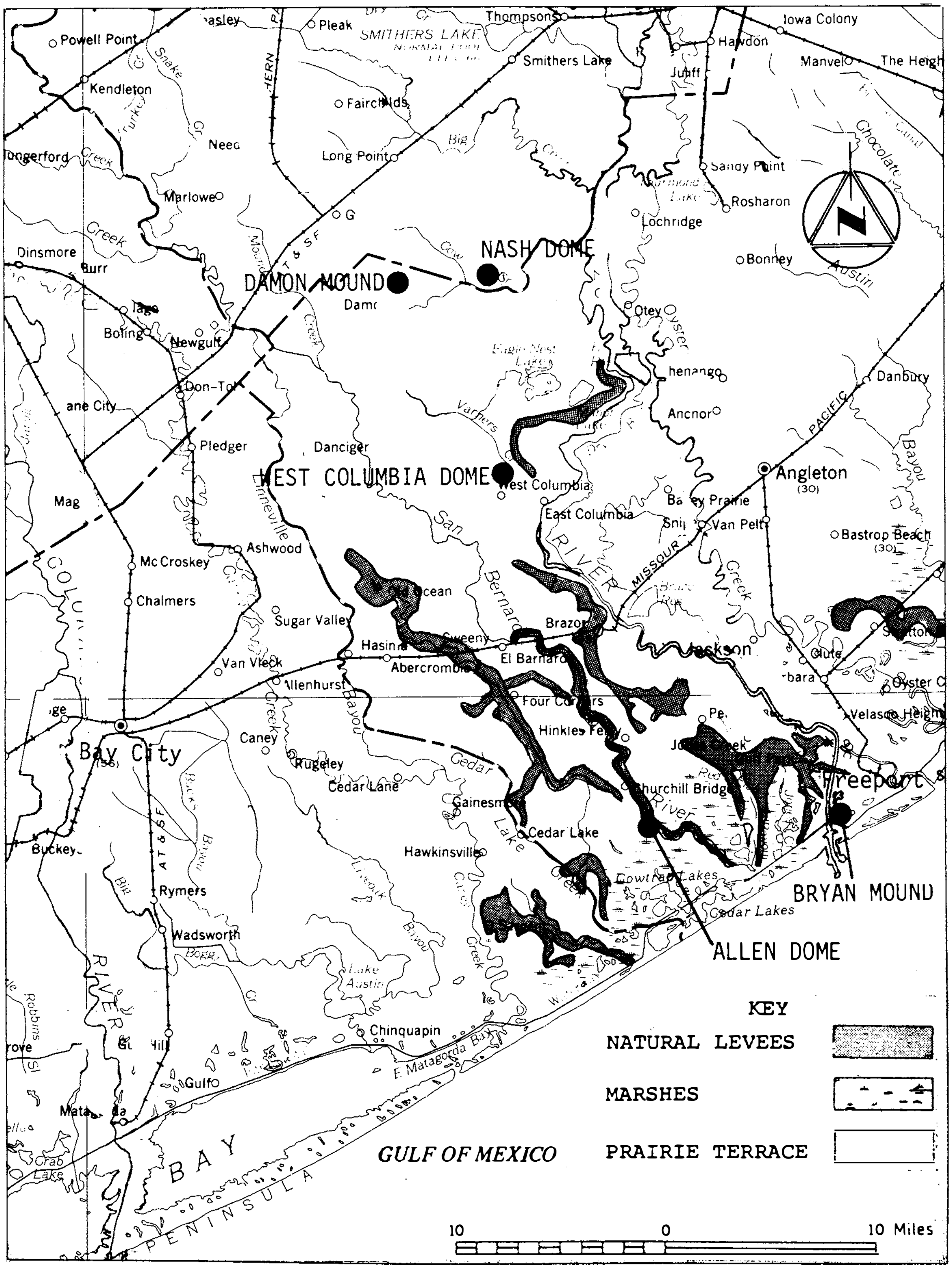
The Gulf Coastal Plain slopes almost imperceptibly (about 5 feet per mile) toward the Gulf of Mexico. The region's major topographic relief is associated with salt dome structures that have risen through younger sediments. Relief at Bryan Mound salt dome, for example, is about 15 feet above the surrounding terrain, while at Damon Mound salt dome the relief is about 80 feet above the surrounding terrain, to a maximum elevation of 146 feet above sea level.

The region in the vicinity of the Seaway Group sites is bounded on the coast by Christmas Bay and East Matagorda Bay. This area is unique for the Texas coast, because the barrier island chain is separated from the mainland only by narrow, restricted bays which are almost filled by marshes; the broad, shallow bays characteristic of the rest of the Texas coast are absent here.

The offshore region is in the Gulf Continental Shelf physiographic province. The bathymetry is virtually featureless with a bottom sloping gently offshore at 6 to 10 feet per mile. The bottom is broken by dredged channels and occasional coral heads. Significant bottom movements have occurred in the area with some contours changing as much as 10 feet within the last 40 years. The shoreline has moved Gulfward over the same period.

3.2.1.2 Regional Geology

The dominant geologic feature of coastal Texas is the Gulf Coast geosyncline, whose axis generally corresponds with the present Gulf coastline. The stratigraphic record of shallow marine sediments indicates that the geosyncline has been slowly subsiding since Cretaceous



SOURCE: Base Map from Hydrologic Unit Map, 1974: USGS.

FIGURE 3.2-1 Physiographic map of region, including Seaway Group of SPR sites.

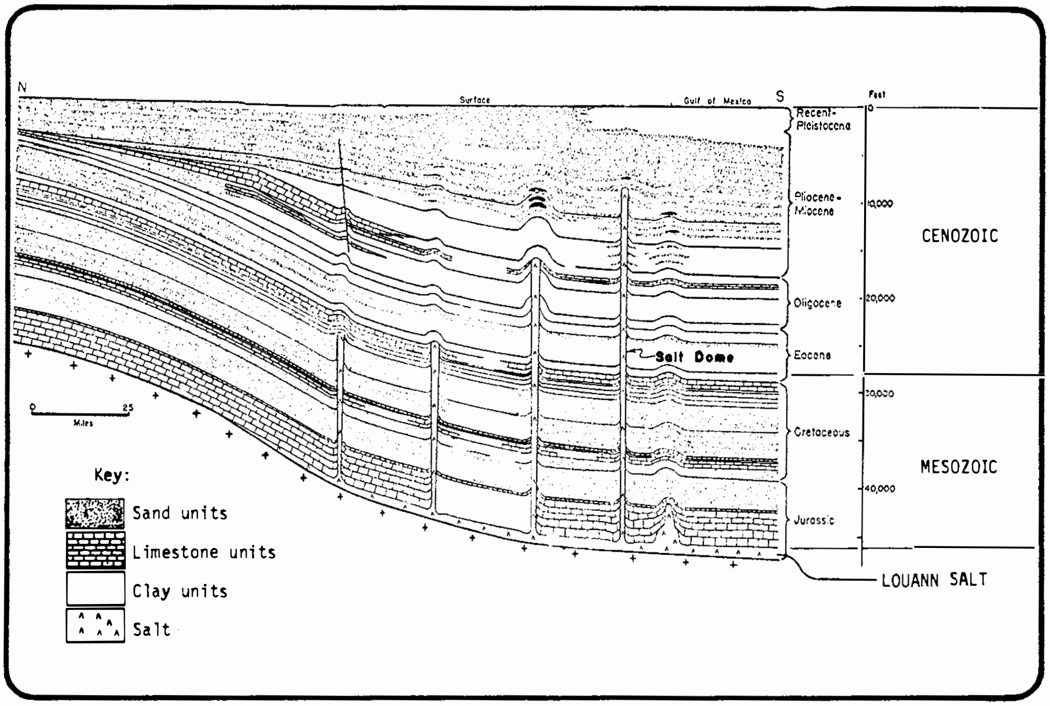
times. The area of geosynclinal subsidence received voluminous accumulations of deltaic and shallow marine sediments derived from central North America.

The sediments of the Gulf Coast are principally Eocene to Miocene, although rocks as old as Cretaceous are encountered in wells along the inland margin of the area and Pliocene to Recent deposits mantle the coastal belt. These sediments represent a complex of deltaic deposits interfingering gulfward with marine deposits which carry a sequence of well known fossil zones. The deltaic and marine deposits form a large wedge of Mesozoic and Cenozoic sediments that progressively thickens toward the south. In the vicinity of the coast, the wedge is reported to be about 40,000 feet thick. Individual stratigraphic units also thicken and dip southward. These depositional processes are still active. A generalized cross-section of the Gulf Coast geosyncline is presented in Figure 3.2-2.

Most of the shallow surficial sediments of the Texas gulf coast are composed of recently derived modern (Holocene) sediments which lie on top of the older (Pleistocene) sediments. Pleistocene sediments crop out in the Freeport area. There, they include clays, fine sands, shells and limey concretions indicative of their marine origins.

Several minor structures are superimposed on the Gulf Coast geosyncline. The relatively simple homoclinal regional structure often referred to as the north limb of the Gulf Coast geosyncline is interrupted coastward by a series of faults and a number of salt domes. The most noticeable fault system approximately parallels the geosynclinal axis. Faults making up the system are typically normal and downthrown to the south. This faulting is believed to have occurred gradually but concurrently with the geosynclinal development. Many other, smaller faults are locally associated with individual salt domes. Reportedly, they have resulted from salt plug emplacement.

The many salt domes scattered along the gulf coast are another dominant structural feature of the region. Typically, they are roughly cylindrical in shape, one to five miles in diameter, and are encountered



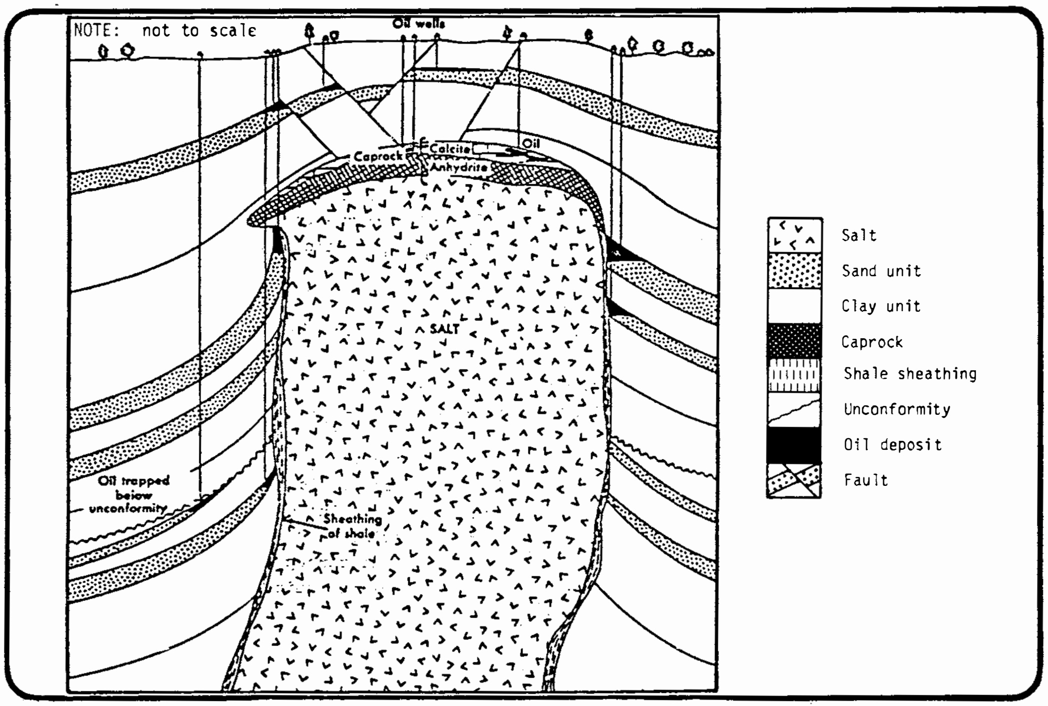


FIGURE 3.2-2 Regional geologic cross-section (top); typical salt dome structure (bottom)

from less than a hundred feet to several thousand feet below the surface (Figure 3.2-2). The domes are believed to be derived from the thick Louann Salt Formation, of probable Jurassic age, which rests near the base of the sediments. Aided by buoyancy provided by the relatively low specific gravity of salt, local portions of the deep salt layer have moved upward through the overlying strata. In response to this upward flow, the strata are locally upturned and create excellent structural traps for accumulations of oil and gas.

It should be recognized that at least some salt domes, particularly those offshore or along the coast, are considered dynamic features, viscoplastically rising at small but finite rates (on the order of 1 millimeter per year). The domes are concomitantly consumed at the upper surface through dissolution by ground water.

Most investigators now agree that salt dome caprock represents an accumulation of insoluble material originally transported within the salt. As the salt rose through overlying strata, its upper surface was apparently leached by unsaturated water from above. As the salt dissolved, anhydrite was concentrated as an insoluble residue. Gypsum, native sulfur and other minerals may have evolved as products of altered anhydrite.

The Texas Gulf Coast is one of the least seismically active regions in the United States. The National Oceanic and Atmospheric Administration has classified the U.S. into four zones with differing degrees of expected seismic risk based on the recorded history of past seismic activity. Zone 0 is assigned to those areas having no reasonable expectancy of surface earthquake damage. Although the Seaway Group region is within a Zone 0 seismic risk zone, a computer-aided search of recorded seismic events within a 200-mile radius of Freeport identified four such events which occurred in this century. The nearest was centered about 180 miles distant.

3.2.1.3 Economic Geology

Oil and gas are certainly chief among the mineral and energy sources of the Texas coastal zone. The Gulf Coast region is also an important source of: sulfur; salt, chlorine and magnesium bases for chemical products; shell, clay, and sand for construction aggregate; and industrial sand.

The region's main petroleum producing horizon is the Oligocene Frio Formation. Oil and gas are extracted from natural traps in disturbed strata commonly associated with salt domes. Oil production occurs in both onshore and offshore areas.

Sulfur and salt are also associated with salt domes. Salt is produced by solution and conventional mining of the dome itself. Most is used as salt brine, a feedstock in the manufacture of chlorine, soda, and soda ash. Sulfur is produced by the Frasch process, in which super-heated water is pumped into sulfur-bearing caprock material to melt the sulfur which is then forced to the surface by compressed air.

Chlorine and magnesium for chemical processes are derived from seawater from the Gulf of Mexico. Dow Chemical Co. in Freeport produces 93 percent of the total United States production of magnesium.

Since gravel for construction aggregate is scarce in the gulfward edge of the Gulf Coastal Plain, much of the local fine sand and shell resources are used for this purpose. About half of the area's shell production is used for construction aggregate. The remainder goes into the production of cement, lime and chemicals. Fine grained sand is used extensively for fill.

3.2.1.4 Soils

The surface and near-surface Pleistocene and Holocene sediments are the parent materials for soil development in the Gulf Coast region. These are fluvial and deltaic sediments deposited by the San Bernard and Brazos Rivers. Surficial soils in the region consist of sandy to clayey loam, with minor concentrations of organics and salt.

Soil associations are defined for the purposes of mapping soils. A soil association is a landscape that has a distinctive proportional distribution of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soil. The soils in one association may occur in another, but in a different proportion. The major soil associations found in the region of the Seaway Group include the Lake Charles-Edna-Bernard, the Harris-Veston-Galveston and the Moreland-Pledger-Norwood associations.

The Lake Charles-Edna-Bernard association consists of poorly drained clayey and loamy deltaic soils. These soils contain a significant portion of montmorillonite clay and are strongly acid to moderately alkaline at the surface; alkalinity increases with depth. These soils have a high shrink-swell potential and very low permeability. They are highly corrosive and present severe residential foundation problems.

The Harris-Veston-Galveston association varies from the clayey Harris series in old tidal flats, through a loamy Veston series to the sandy Galveston soils. Harris soils are largely montmorillonite clay, while the Veston are loamy in texture. Both are derived from marine and deltaic sediments which are nearly neutral to alkaline (calcareous) in the surface layer. Many soils of this association are classified as saline-sodic and have an extremely high salinity which limits plant growth. Many areas covered by these soils are subjected to frequent inundation by seawater.

The Moreland-Pledger-Norwood association is characteristically calcareous, clayey and loamy, having developed on recent flood plain alluvium. These soils are mixed with a considerable amount of montmorillonite clay which imparts a high shrink-swell potential. Permeability is low. They are moderately alkaline and calcareous to neutral in the surface layer (presenting a moderate surface salinity hazard to plants), while subsoils are much higher in salinity.

Studies indicate that surficial sediments in the offshore area vary from loose, fine sand and silt near shore to soft mud farther offshore. These sediments generally vary in thickness from 50 feet to a few feet along the coast between deltaic areas. Pleistocene sediments vary from sand to clay and are normally more dense than the overlying sediments. Areas of shelly sand and silt attributable to reworked glacial period shorelines also occur, as do near shore sediments consisting of barrier island sands overlying interbedded sand and silt-clay layers. Geophysical studies have shown a wide distribution of calcium carbonate-cemented Pleistocene beach ridges both onshore and offshore.

3.2.2 Water Environment

3.2.2.1 Surface Water Systems

The major surface water systems in the Texas Gulf Coastal Plain include the Brazos River and its tributaries, the San Bernard River and its tributaries, the coastal wetlands, Freeport Harbor and the Intracoastal Waterway, and the Gulf of Mexico (Figure 3.2-3).

The Brazos River

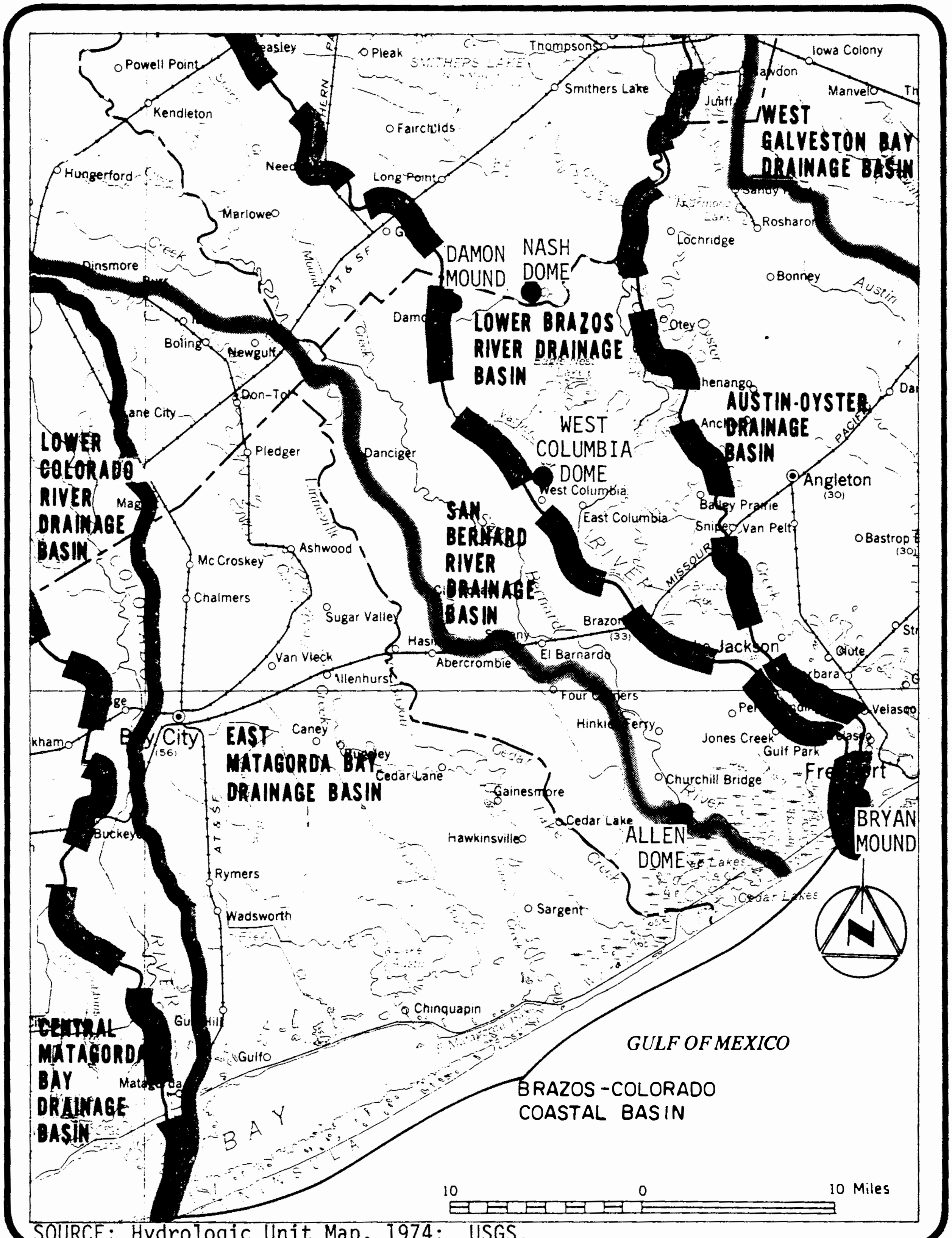
The Brazos River Drainage Basin is the largest in Texas. Its area, 44,340 square miles, encompasses about 15 percent of the state. The tidal portion extends from the Gulf of Mexico to Brazoria. Estuarine conditions are present in its lower reaches.

The lower Brazos River was diverted in the early 1940s to provide a harbor in the old riverbed for the Freeport area. This diverted channel, the Brazos River Diversion Channel, is about 6 miles long from the point of diversion to the Gulf of Mexico. Ten-foot depths are reported between the Intracoastal Waterway and Brazoria. Controlling depth at the mouth of the river is approximately 3 to 4 feet.

The water of the lower 50 to 100 miles of the Brazos River is often too saline for municipal and industrial use. This salinity comes from the salt domes, springs, and seeps in the upper river basin. Several reservoirs have been built in the basin, but use of the water has been limited because of the salinity.

Dow Chemical Co. is the major industrial user of the lower Brazos River, both as a source of water and as a wastewater receiving stream. During high water stages, Dow purchases fresh water from the Lower Brazos River Authority and stores it in the Brazoria and Harris Reservoirs.

The annual volume of fresh water transferred to Dow ranges from 42 billion to 84 billion gallons. The city of Freeport obtains approximately 550 million gallons of fresh water annually from Dow.



SOURCE: Hydrologic Unit Map, 1974: USGS.

FIGURE 3.2-3 Regional surface water features.

Texas Water Quality Board (TWQB) standards for water quality, approved by the Federal government, classify the tidal portion of the lower Brazos River as suitable for both contact and noncontact recreation and for propagation of fish and wildlife. From the head of the tide to Whitney Dam, the Brazos River is also classified for domestic water supply.

The primary source of leaching and displacement water for Seaway Group SPR sites would be the Brazos River Diversion Channel. The intake on the Diversion Channel would be located approximately at mile 2 of the river, which is adjacent to Bryan Mound. Recent data shows the region to have a generally normal estuarine environment. Seasonal variations in flow rates range from about 400 cfs (6 MMB/D) to nearly 20,000 cfs (300 MMB/D).

A natural saltwater wedge, which generally has very little dissolved oxygen (DO), is found in the bottom water of the upper portion of the estuary. This "dead saltwater wedge" is subject to frequent changes in position.

The lower Brazos River is subject to wide variations in water quality, primarily as a result of changing river flow rates, although tidal interaction is another important factor in the lower reaches of the river.

Coastal Wetlands in the Brazos-Colorado Coastal Basin

The Brazos-Colorado Coastal Basin lies between the Brazos River basin and the Colorado River basin to the southwest, and has a drainage area of 1850 square miles. The low-lying coastal wetlands between the Brazos and San Bernard Rivers (Figure 3.2-3) drain an area of approximately 46 square miles and constitute a major wetlands resource. The major drainage path is Jones Creek, which flows in a southerly direction, interconnecting many small ponds and lakes, and finally discharging into the Intracoastal Waterway. Jones Creek shows tidal influence with saltwater intrusion as far upstream as State Highway 36.

Recent data indicate that Jones Creek is an organically polluted stream, probably as a result of inadequate sewage treatment. The community of Jones Creek is not serviced by public sewage treatment facilities, and individually owned septic tanks could be a cause of the high biological oxygen demand (BOD) levels and fecal coliform counts observed. Decaying vegetation from surrounding marshes probably also contributes to the observed high BOD.

The San Bernard River

The San Bernard River, with a drainage area of 1005 square miles, is the major watercourse within the Brazos-Colorado Coastal Basin (Figure 3.2-3). In its lower reaches (up to Brazoria) the San Bernard River is an estuary. Runoff throughout the basin is generally of good to excellent quality. Irrigation-return flows and oil-field brines are probably the major sources degrading the chemical quality of the river throughout its reach.

Freeport Harbor and Intracoastal Waterway

Freeport Harbor is a federally maintained deep draft navigation facility that extends from deep water in the Gulf of Mexico through a jettied entrance to Freeport, Texas, a distance of about 7 miles. The present harbor components are shown in Figure 3.2-4. A number of improvements, including widening of the entrance to Brazos Harbor Channel and dredging of certain other channels, are currently underway.

The Intracoastal Waterway connects with Freeport Harbor, the Brazos River Diversion Channel and the San Bernard River about 1 mile inland from the Gulf. The U.S. Army Corps of Engineers operates a set of locks on the waterway on each side of the Brazos River Diversion Channel, to keep detritus and silt from entering the waterway during periods of high river flows.

The Intracoastal Waterway drains to the Gulf of Mexico through the San Bernard and Brazos estuary mouths and the entrance to Freeport Harbor. The waterway is used extensively by bulk cargo barges and pleasure craft. The entrances to the San Bernard and Brazos Rivers are shallow (3 to 4 feet, MLW), so most barge traffic exits into Freeport Harbor or the Gulf of Mexico through the Freeport Harbor Entrance Channel.

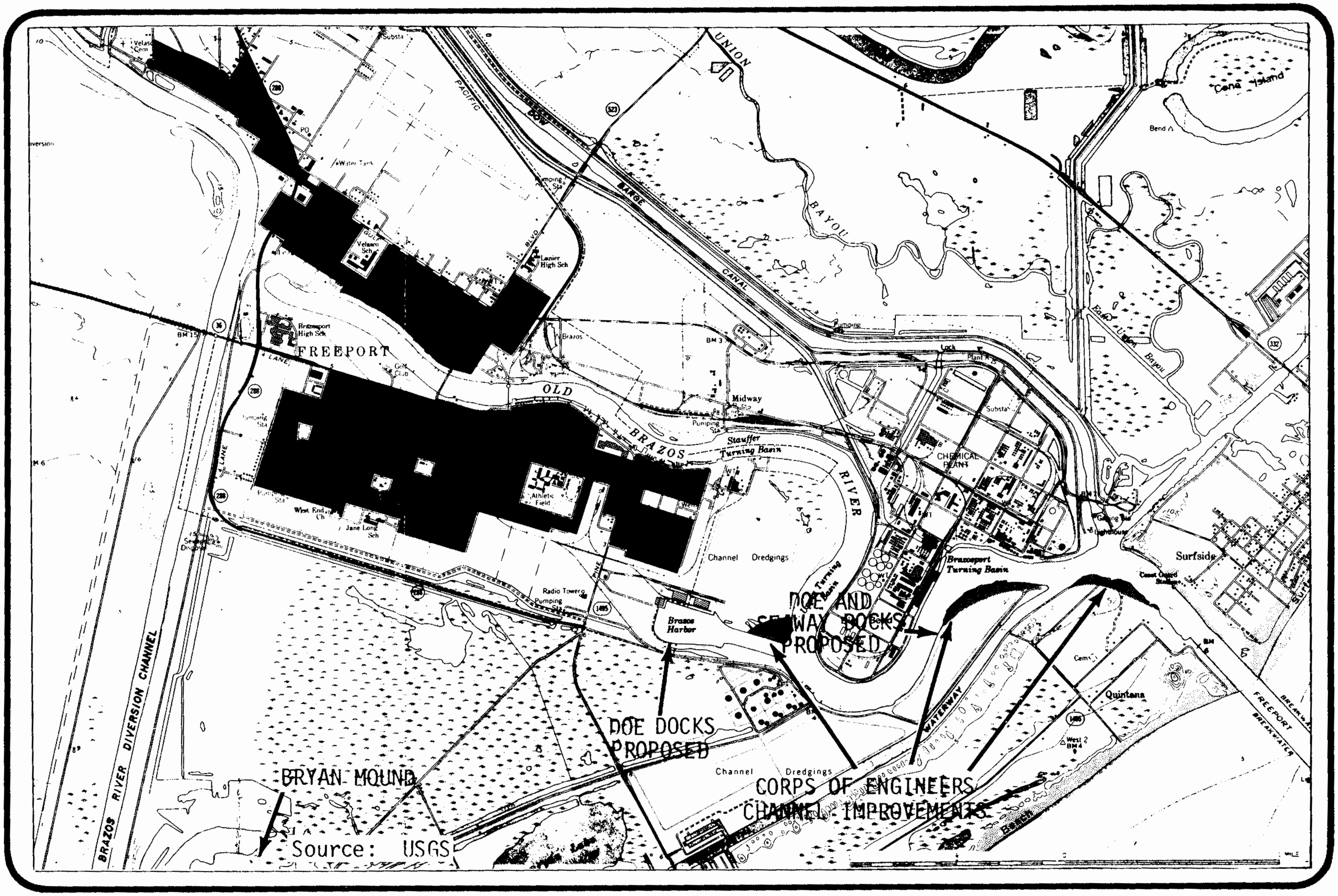


FIGURE 3.2-4 Freeport Harbor.

Freeport Harbor and the Intracoastal Waterway are tidal bodies. The diurnal tide in Freeport Harbor has a mean range of about two feet, and the mean high water is about one foot above sea level. During prolonged periods of strong north winds in the winter, the water surface may be depressed as much as 3.5 feet below mean sea level. Sustained south and southeast winds during the summer may raise the water level. Extreme fluctuations in water levels are caused by tropical storms and hurricanes.

Nearshore Gulf of Mexico

The shallow coastal waters of the Gulf of Mexico southeast of Bryan Mound constitute the primary brine disposal location for all sites. To attain the necessary 50 foot depth for disposal, the diffuser site would be approximately 5 nautical miles offshore.

Prevailing water currents in the region are generally toward the south and east except during the summer when they shift toward the north and east. The currents are primarily wind driven but are also influenced by tides and large scale circulation patterns. Salinities and temperatures in the region are typical of Gulf Coast waters, and characteristically have isohalines and isotherms paralleling the coast except in summer when they become alligned perpendicular to the coast. Density, a function of temperature and salinity, generally occurs in similar patterns. Vertical profiles of the water column over the shelf show that thermal stratification occurs during the months of October through May, but the waters are nearly isothermal during the summer. Salinity and density are homogeneous in the water column most of the year.

The chemical composition of the region's waters is within the range of typical coastal values. At certain times during the year nutrient salt levels (NH_3, NO_2, PO_4) and dissolved oxygen are low which could limit biological productivity. Oil and grease concentrations increase with distance offshore toward the shipping lanes. Suspended matter varies seasonally with river input and biological productivity.

3.2.2.2 Subsurface Water Systems

Occurrence of Ground Water

The subsurface materials of the region are characterized by more than 9000 feet of poorly consolidated sediments, primarily sands and shales. Sand units make up about 40 percent of the total thickness and generally qualify as aquifers, in that they contain enough saturated permeable material to yield significant quantities of water to wells, although fresh to slightly saline water is found only in the uppermost units. Usually only those formations containing fresh water are studied in detail by hydrologists. Therefore, information regarding the characteristics of deeper formations or those containing saline water is lacking--except in areas where petroleum exploration has taken place.

In the region of the Seaway Group of SPR sites, fresh to slightly saline water is found only in the Chicot and the Evangeline aquifers. Each is composed of parts of several geologic formations that are regionally grouped into the Gulf Coast Aquifer. The following summary of regional ground water conditions is based on the work of Sandeen and Wesselman and Hammond.

The Evangeline aquifer consists of alternating sands and clays ranging from about 2000 feet thick near the inland margin of the region to more than 3500 feet thick at the coast. Beds containing fresh and slightly saline water reach a total thickness of about 1100 feet. Most units vary considerably in thickness from location to location, generally ranging from a few feet to about 100 feet. In general, there is more sand than clay in the aquifer.

The Evangeline aquifer is present in the subsurface everywhere in the region except where it has been penetrated by salt domes. Only the upper beds of the Evangeline in Brazoria County contain fresh water, the rest are saline. The average dip of the fresh water bearing beds is approximately 30 feet per mile to the southeast except over salt domes, where the dip approaches zero and may even be reversed. Local dips away from salt domes are more than 30 feet per mile.

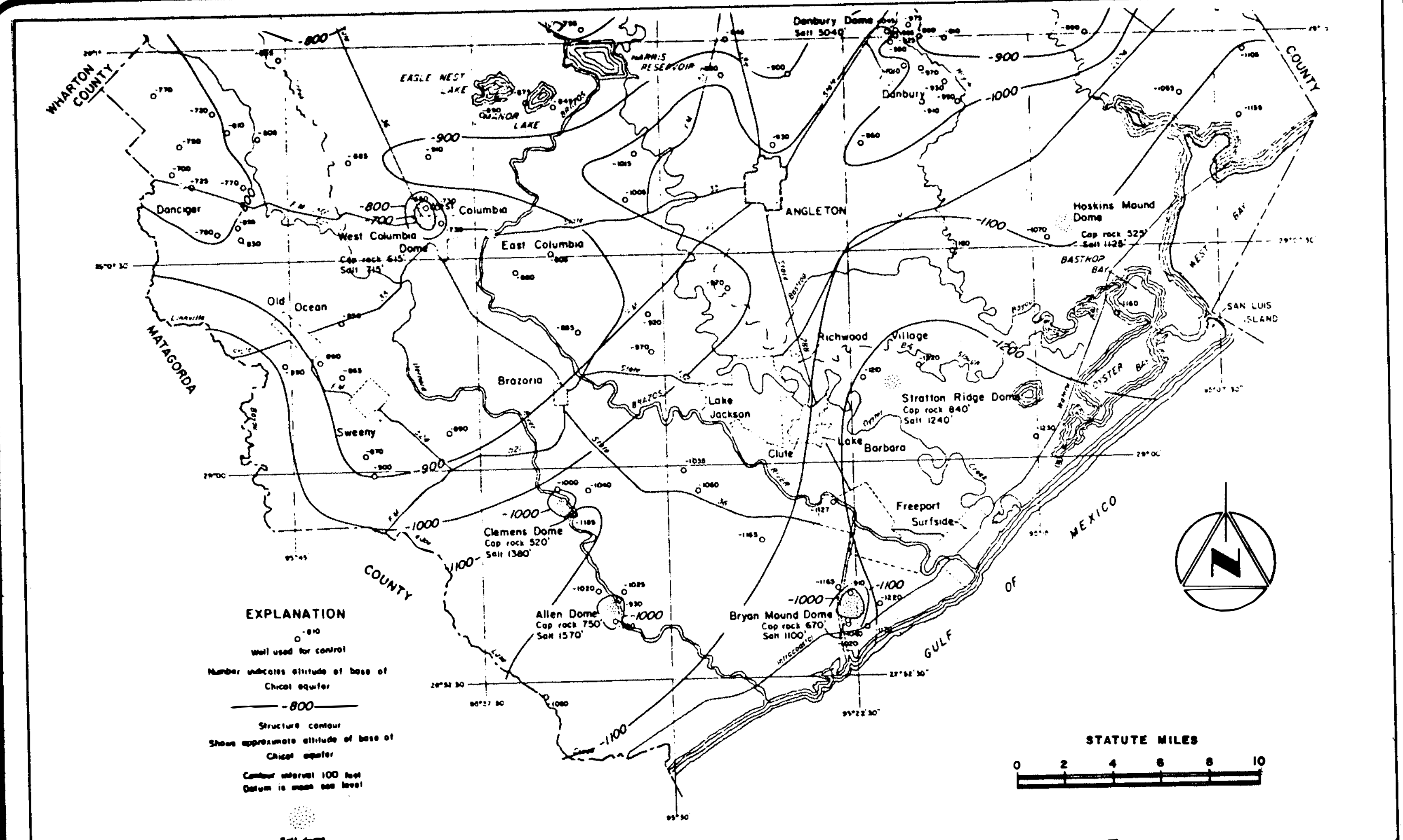
Separation of the Chicot aquifer (Figure 3.2-5) from the underlying Evangeline aquifer is based on differences in lithology, permeability, water level, and stratigraphic position. The Chicot is subdivided into upper and lower units which in most places are separated by clay. In Brazoria County, the upper unit is either a water table or an artesian aquifer; the lower unit is an artesian or a leaky artesian aquifer.

The upper unit of the Chicot aquifer is the most widespread fresh water aquifer in Brazoria County, and the only fresh water aquifer in much of the southern part of the county. Water from this aquifer is used for public and domestic supplies and for part of the water supply for Freeport area industries. Because of the large drawdown in the area, the thin section of freshwater sand, and the close proximity of water of poorer quality, the aquifer is thought to be fully developed, and may even be overdeveloped in the area. Except at Freeport, the Chicot aquifer contains little or no fresh water in a band several miles wide which parallels the coast.

The lower unit of the Chicot aquifer contains a large amount of slightly saline water. Through the central part of Brazoria County, sand thicknesses of between 100 and 300 feet are reported.

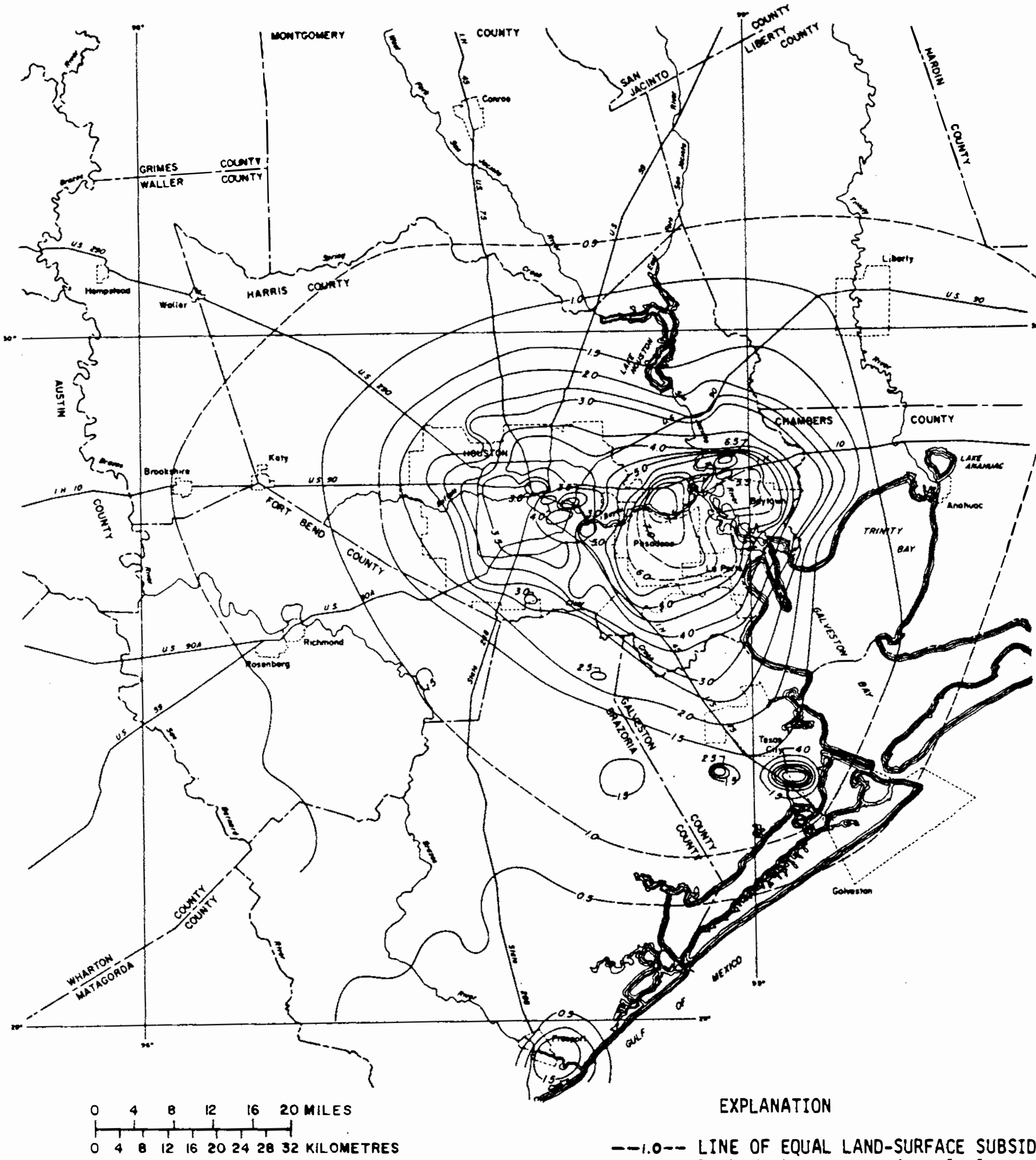
In areas not affected by pumping, the regional ground water movement is southeast toward the Gulf of Mexico. In areas of large ground water withdrawals, however, the direction of movement may be modified or reversed (toward the areas of pumpage). Withdrawal of large quantities of water may also cause land subsidence or saltwater intrusion, depending on such factors as pumping rate, well spacing and completion, and aquifer thickness. Data indicate that in the Texas coastal area, about one foot of subsidence has historically resulted per 100 feet of drawdown.

Subsidence on the order of 1.6 feet in Freeport and 4 feet in Texas City has already occurred (Figure 3.2-6). Most of the pumping has been restricted to the fresh water zones of the upper Chicot aquifer, about 150 feet thick. The lower unit of that aquifer and the Evangeline aquifer, on the other hand, provide a total of over 1000 feet of sand with moderately saline water and could thus provide more water with the



Source: W.M. Sandeen and J.B. Wesselman, "Groundwater Resources of Brazoria County, Texas, Texas Water Development Board, Report No. 163, 1973.

FIGURE 3.2-5 Approximate elevation of the base of the Chicot Aquifer.



EXPLANATION

—1.0— LINE OF EQUAL LAND-SURFACE SUBSIDENCE
Dashed where approximately located
Interval 0.5 foot (0.15 metres)

SOURCE: R.K. Gabrysch, "Ground Water Development and Land Surface Subsidence, Houston-Galveston Region, Texas", <u>1974 Water for Texas Conference</u>, Texas Water Resources Institute, Texas A&M University, September 20, 1974.

FIGURE 3.2-6 Subsidence of the land surface, 1943-73 same magnitude of drawdown. In addition, these deeper formations may already be consolidated to a greater extent than shallower ones, and this might result in less subsidence per foot of drawdown.

The Pliocene and Miocene sandstones, which underlie the Chicot and Evangeline aquifers to depths of 9000 feet or more, contain moderately saline to very saline water; but the permeability of these deep formations is less than that of the overlying aquifers. Even these low permeabilities are sufficient for successful development of saline water supplies or for subsurface brine emplacement via injection wells.

Uses of Ground Water

As might be expected, water use in the region has increased steadily with increased population and industrialization. The primary use of ground water in Brazoria county is for irrigation; the second largest use is industrial. From 1913 to 1940, the extraction of sulfur from salt domes by the Frasch process constituted the largest use of ground water. By 1958, however, all of the sulfur mines were closed. As late as 1962, industry in Brazoria County was obtaining more than 95 percent of its fresh water needs from surface sources. Most drinking water in the Freeport area is obtained exclusively from ground water sources.

3.2.3 Climatology and Air Quality

3.2.3.1 Climatology

The general classification of the climate of the Texas Gulf Coast region is humid subtropical. The summers are long and hot, the winters are short and mild. The proximity of the warm Gulf of Mexico and the prevailing south to southeasterly winds result in a marine climate. The annual average wind speed is 11.5 mph at Galveston and 10.0 mph at Hobby Field (Houston). Slack winds occur frequently but are usually of brief duration.

Precipitation is distributed rather evenly throughout the year; heavy downpours may occur during any month, but are most likely in summer, associated with tropical disturbances. High relative humidity is characteristic throughout the year. The annual average relative humidity is approximately 78 percent at Galveston and 74 percent at Hobby Field.

Heavy fog (visibility reduced to one-quarter mile or less) occurs an average of 42 days each year, based on a 30-year period of record at Hobby Field. The number of days with heavy fog is highest in winter, with few summertime occurrences.

Annual precipitation is normally 45-46 inches. Monthly average rainfall is highest in summer (particularly along the coast) and lowest in spring. Daily rainfall amounts of one-half inch or more can be expected approximately 27 days each year. Thunderstorms occur 59 days a year in the region, based on Hobby Field data. Thunderstorm frequency reaches a peak during July and August (10 and 9 occurrences, respectively) with only 2 or 3 thunderstorm days per month from October through March. Severe thunderstorms accompanied by high winds, hail, or tornadoes are infrequent, however.

Based on data from Galveston and Hobby Field, the annual mean temperature over the region is almost 70^{o}F. In summer, the highest average daily maximums range from the upper 80s (^{o}F) along the coast to the lower 90s (^{o}F) inland. The lowest average daily minimums range from near 50^{o}F along the coast to the middle 40s (^{o}F) further inland.

During the period 1955 through 1967, 46 tornadoes occurred within the one-degree latitude-longitude square encompassing the region. This is a mean annual frequency of 3.5 occurrences, but the probability of a tornado hitting a point in a given year is only .00238.

Tropical storm statistics indicate that a hurricane can be expected about every 7-10 years, while a great hurricane (winds greater than 124 mph) occurs only about every 28 years.

Atmospheric stability in conjunction with the general ventilation (winds) indicates the ability of the atmosphere to disperse air pollutants. Meteorological conditions which lead to high air pollution potential are light winds accompanied by surface inversions and above-surface stable layers (limited mixing).

The number of forecast days of high meteorological potential for air pollution in the contiguous United States has been compiled; this value is near zero for the Seaway Group area.

3.2.3.2 Air Quality

The Federal Clean Air Act provides for the prevention and control of air pollution. Several categories of air quality standards (i.e., the National Ambient Air Quality Standards (NAAQS), the air quality regulations of the State of Texas, and Federal prevention of significant deterioration regulations) were reviewed to note all provisions applicable to the Seaway Group region.

The NAAQS issued by the U.S. Enviornmental Protection Agency (EPA) in April 1971 include primary standards intended to protect public health and secondary standards to protect public welfare. In addition, Texas regulations specify single source standards for sulfur dioxide (SO_2), hydrogen sulfide (H_2S), and total suspended particulates (TSP).

In November 1974, the EPA issued a regulation to prevent significant deterioration (PSD) of air quality in areas with air cleaner than the standards at the time the regulation was issued. The Clean Air Act Amendments of August 1977 contain significant changes in PSD requirements. Major changes affecting this project include the expansion of PSD designated source categories from 19 to 28, one of which is petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels, and the extension of the regulations to all criteria pollutants and not just SO_2 and TSP. However, except for SO_2 and TSP where allowable incremental increases in baseline concentrations are specified, other criteria pollutants are to be controlled using Best Available Control Technology (BACT) at present. Therefore, hydrocarbon emissions from crude oil storage tanks would probably have to be controlled using floating roofs equipped with double seals.

The Clean Air Act requires that each state institute an air quality control program and issue a State Implementation Plan (SIP) defining measures to achieve the NAAQS within the state.

Current Texas regulations require that crude-oil storage tanks larger than 10 MB in the Seaway Group region be equipped with a floating roof or vapor recovery system. Vapor emissions from ship loading and unloading activities are not regulated at this time; an interim strategy to meet the NAAQS for photochemical oxidants, however, by controlling reactive hydrocarbon emissions, has recently been proposed by the EPA for the Texas SIP. Proposed additional controls for the Houston/Galveston area interim plan include crude-oil storage controls (floating roof or vapor recovery system) and ship and barge vapor recovery (for gasoline only).

SIPs must also consider "new source review". The most recent ruling from EPA regarding new source review has established an emission offset system whereby new sources are required to show that their emissions plus SIP-required reductions from existing sources equal a net decrease in emissions. That is, the new source should not delay progress in achieving the NAAQS. However, this regulation applies only to permanent onshore facilities and is expected to exclude new sources with "potential" emissions totaling less than 100 tons/year. EPA has determined that because of the temporary and intermittent nature of emissions associated with the Bayou Choctaw SPR site, the emission offset policy does not apply to this particular activity. EPA has informally confirmed that this determination applies to other similar SPR sites. In any event since double-seal floating roof storage tanks are planned for the Seaway SPR program, "potential" emissions are expected to be less than 100 tons/year. DOE has been further advised by EPA that the offset policy is under review and that a clarification will be forthcoming in the near future. DOE will take any necessary actions consistent with this clarification.

Existing Air Quality Levels

Air quality in the Seaway Group region is very good with the exception of high non-methane hydrocarbon and oxidant concentrations near Freeport, Texas. Concentrations of carbon monoxide (CO), sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) are minimal, and, in some cases, below the minimum detectable limits. Particulate levels are low, as would be expected in rural areas subject to reasonably consistent winds due to the flat terrain and influence of the Gulf of Mexico.

Measurements by the Texas Air Control Board have shown that oxidant levels in air of rural origin (background concentrations) occasionally exceed national ambient air quality standards. Additional measurements have also shown that non-methane hydrocarbon levels in excess of the federal guidelines may occur in the Gulf of Mexico over 100 miles from shore.

The largest regional source of pollutants are petroleum refineries and petrochemical industries. Transportation and combustion of industrial fuels are also important pollution sources in the Seaway Group region.

3.2.4 Background Ambient Sound Levels

Background ambient sound levels are expected to be diverse in the Seaway Group region due to the varied land uses. No in situ noise measurements were made in the area for this study, but principal land uses have been categorized and the major expected sound sources identified.

Brining activities, oil wells, and petrochemical plants near several of the salt domes produce sound levels typical of industrial areas. Similarly, the region's few population centers exhibit sound levels typical for small urban communities. Outside these areas, in regions where the oil and brine pipelines would pass, sound levels are typical of secluded, undeveloped, moderately wooded areas: dominated by wind in the trees and marshland vegetation, and insect, bird and wildlife activity.

Table 3.2-1 presents a summary of the estimated prefacility background ambient sound levels in the Seaway Group region.

3.2.5 Ecosystems and Species

The Seaway Group of SPR sites is located in the southeastern Coastal Zone of Texas, which extends from the Inner Continental Shelf inland about 45 linear miles, essentially encompassing Brazoria County (Figure 3.2-7). This region includes a number of estuaries and tidally influenced streams, rivers and their associated wetlands (marshlands). It is also characterized by low to moderate fresh-water inflow and a low tidal range. The subtropical climate of the Texas Coastal Zone strongly influences the relative abundance and distribution of many of the terrestrial plants and animals in the region. Interspersed among this natural environment are bayside and intrabay oil fields, bayside refineries, petrochemical plants, dredged intracoastal canals and channels and other urban or industrial facilities.

The numerous marine, estuarine, and freshwater marshes in the project area provide habitat, food, and cover for a large variety of valuable resident and migratory biological resources. One of the important biological resource areas in the region is the San Bernard National Wildlife Refuge, located about 15 miles west of Bryan Mound and about 5

TABLE 3.2-1 Summary of prefacility sound level(dB) estimates for Bryan Mound Site

Area	L_d	L_n	L_{dn}
Along Intracoastal Waterway and near Industrial Activities	59	54	61
Noise Sensitive Land Use[a] (Freeport)	58	39	56
Undeveloped Area[b]	51	45	54
Noise Sensitive Land Use[b] (Small communities)	52	45	54

[a] FES 76-8.

[b] Ambient survey at Jones Creek, SEADOCK Inc., March, 1974.

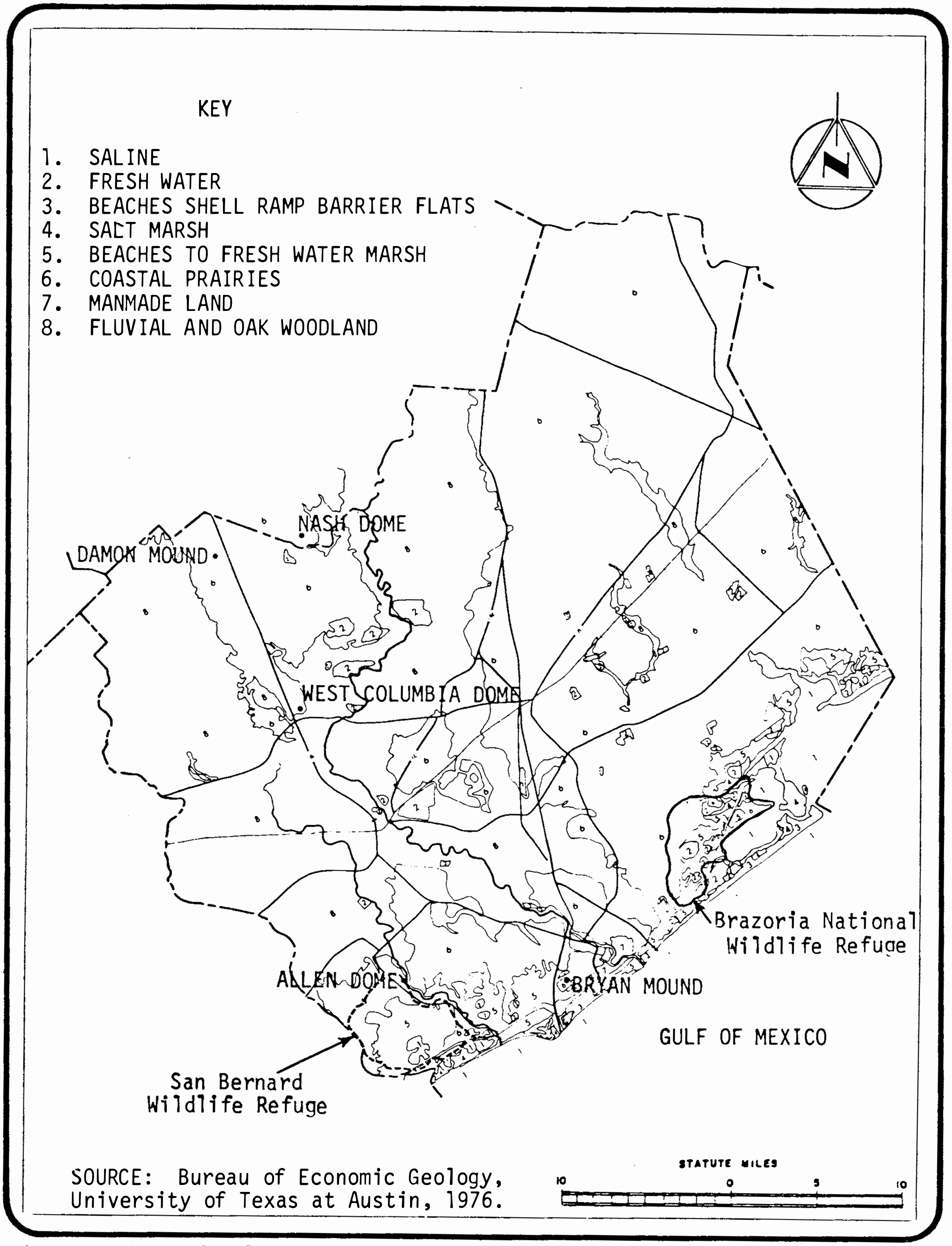


FIGURE 3.2-7 Regional ecosystems.

miles south of the Allen dome (Figure 3.2-7). A summary of the important flora and fauna typical of the project region is presented in Table 3.2-2.

3.2.5.1 Ecosystems

The main ecological components (based principally on floral assemblages) of the Texas Coastal Zone are: coastal and inland waters; beach and shell ramp-barrier flats; coastal marshlands; spoil areas; coastal prairies; cleared lands; and fluvial and oak woodlands. These ecosystems generally trend in successive north-south bands which parallel the local fluvial environment.

Coastal and Inland Waters

The greatest diversity of environments and biological assemblages in the region occur in the coastal and inland waters--the Gulf of Mexico, bays, estuaries, rivers, streams, lakes and ponds. Texas bays and estuaries are relatively low-energy environments which are protected by barrier islands and peninsulas. Water exchange between the Gulf and the estuaries is largely governed by proximity to tidal passes. During storms, Gulf waters also enter low-lying inland areas through storm channels or washovers. Fresh water is furnished to the bays and lagoons by the Brazos and San Bernard Rivers, and several smaller streams which drain local areas. Because of these contributions, the range of salinities in the water bodies is quite variable, and this largely governs the abundance, diversity, and distribution of biological assemblages found in these ecosystems.

Coastal waters, river mouths and passes along the Texas Gulf Coast provide excellent nursery habitats for juvenile shrimp and fish. Fish and shellfish off the Texas coast are generally abundant and diverse. Estuarine waters within Brazoria County are primarily limited to the extreme lower and extreme upper coastlines of the county. Circulation in the semi-enclosed lakes and bays along the coastline is generally poor except near open water. Species diversity tends to be low but population densities are high. Major habitat uses of coastal and inland waters include feed and resting by waterfowl.

TABLE 3.2-2 Major ecosystems and typical organisms in the region of the Seaway Group of SPR sites.

	Ecosystem: Marshlands			Coastal Prairies	Fluvial and Oak Woodlands	Cleared Lands		Coastal and Inland Waters		Beaches, Shell Ramp-Barrier Flats
	Freshwater Marsh	Brackish Marsh	Salt Marsh			Urban and Suburban	Crops and Future Lands	Freshwater	Saline	
Key to Fig. 3.2-7	5	5	4	6	8	7	6	2	1	3
TYPICAL OR IMPORTANT ORGANISMS										
Plants, herbs, grasses and trees	Maiden cane cordgrass sedges water hyacinth pennywort	cordgrass soilbind morning glory fiddle leaf morning glory sea purslane coastal sacahuista bulrush cattail rushes	smooth cordgrass salt grass lazy daisy shortgrass glasswort salt matrimonyvine batis sea myrtle Carolina wolfberry bulrush Harstem bulrush	Gulf cordgrass bunchgrass Indian grass switchgrass bluestem live oak huisache ragweed prairie pleatleaf	live oak pecan sugar berry pignut hickory bluestem cordgrass Bermuda grass green birer yaupon seamyrtle blackjack oak hybrid oak water oak	Various residential species	rice soybeans prairie grass	diatoms bluegreen algae green algae	diatoms dinoflagellates sea lettuce other attached algae sargasso weed	sea oats cordgrass mesquite morning glory seacoat bluestem
Mollusks and crustaceans	snails mussels clams crayfish	snails crabs crayfish clams shrimp oysters	fiddler crabs mud crabs clams oysters snails shrimp	snails	NA	NA	NA	clams snails oysters	clams oysters shrimp crabs snails	snails clams ghost crabs
Water snakes, amphibians, and reptiles	turtles western cottonmouth toads frogs	Western cottonmouth Gulf salt marsh snake Western diamondback rattlesnake	Gulf salt marsh snake Western cottonmouth	ornate box turtle leopard frogs Western diamondback rattlesnake Eastern garter-snake Gulf Coast toad spotted chorus toad	ornate box turtle five-lined skink Eastern garter-snake Hurter's spadefoot gray tree frog	NA	NA	turtles frogs water snakes	Ridley turtle Leatherback turtle	sea turtles
Fish	minnows crappie sunfish catfish gar	killifish	killifish cyprinids immature mullet spot	NA	NA	NA	NA	crappie catfish black bass gar shad buffalo-fish	mullet anchovy silver-sides cyprinids menhaden red drum sea trout tarpon flounder sea catfish croaker spat	NA
Mammals	muskrat raccoon nutria	muskrat rabbits rice rat Canid sp.	Canid sp. raccoon rice rat cattle	Canid sp. cattle hispid cotton rat rice rat rabbits striped skunk	gray and fox squirrel opossum armadillo raccoon cottontail rabbit white-footed mouse bobcat coyote bats fox skunk	opossum domesticated animals bats rabbits striped skunk	cattle rabbits hispid cotton rat	muskrat nutria	whales porpoises	small rodents mice
Birds	gulls terns black skimmer red-winged blackbird willet black duck mottled duck blue-winged teal Great Blue heron Snowy egret	American coot yellowlegs terns Seaside sparrow yellow-crowned night heron mottled duck blue-winged teal Great Blue heron Great egret Green heron Louisiana heron snow goose	plovers geese Great Blue heron Little Blue heron egrets Least bittern ibis Roseate spoonbill ducks clapper rail sandpipers	sparrows marsh hawk Eastern meadow-lark egrets vultures kites upland plover killdeer bobwhite quail sandhill crane	turkey vulture Coopers hawk great horned owl red-bellied woodpecker gray catbird tufted titmouse prothonotary warbler brown thrasher chestnut-sided warbler scarlet tanager cardinal Indigo bunting Northern oriole white-eyed vireo	blackbirds robins starlings	blackbirds hawks killdeer Eastern meadowlark mourning dove sparrows	ducks gulls coots geese	frigate bird gulls terns ducks	waterfowl terns seagull geese ducks

[a] Site specific biological species are presented in Section 8.3.

The region contains numerous creeks, bayous and sloughs characterized by low gradients and flow rates; many are intermittent. The largest standing water bodies in Brazoria County include Harris and Brazoria Reservoirs and Eagle Nest, Manor and Mallard Lakes, all of which are located in the northern portion of the county.

Beaches and Shell Ramp-Barrier Flats

These areas consist mostly of bare sand and shell, some of which are stabilized by vegetation. Maximum elevations in this area reach 18 feet. The typical biological assemblage associated with this component consists of salt-tolerant plants, varieties of crabs, small rodents, snakes and several species of birds and waterfowl.

Coastal Marshlands

The coastal marshlands ecosystem is well developed in Brazoria County at elevations of less than 5 feet above mean sea level. These marshlands occur throughout much of the near-shore coastal region, covering about 84,000 acres. Saline, brackish, and freshwater marshes are found within the study area; salinities in the marine and estuarine marshes decrease toward the north.

Saline marshes occur primarily on the plains of bayhead deltas, along bay margins and on tidal flats. Brackish marshlands receive water from both the Gulf of Mexico and from the streams of the region. Both saltwater and brackish marshes provide excellent habitat for mammals, reptiles, and wintering migratory waterfowl. Freshwater marshlands in the region are mainly found along the flood plains of the Brazos and Colorado Rivers. They are utilized by waterfowl as feeding sites. Marshlands constitute complex valuable natural habitats sensitive to minor changes in environment.

Coastal Prairies

The coastal prairie ecosystem covers 413,000 acres within the project region. Surface soils ranging in color from light brown to light gray, have poor to moderate drainage. The areas most subject to inundation by saline waters during high tidal flows or floods are dominated by gulf cordgrass. The coastal uplands originally supported an extensive prairie grassland, but much of the grassland has been converted into agricultural and urban uses.

Cleared Lands

Approximately 45,000 acres of cleared lands are located within the region. These were cleared for agricultural cultivation (including farming for high-nutrient pasture grasses), and urbanization.

The typical wildlife species which frequent cleared lands are quite varied and are strongly influenced by the pressures of specific land uses. Residential and especially farm, or ranch areas, contain domesticated animals while more isolated areas provide habitat for furbearers and predators. Rice fields are favorite feeding grounds for geese and other waterfowl in the winter months.

Heavily urbanized sections of Brazoria County, on the other hand, and especially those devoted to industrial uses such as Freeport Harbor, offer rather poor habitat. Natural vegetation is often sparse or present only in scattered areas.

Fluvial and Oak Woodlands

The region's fluvial and oak woodlands provide habitat for a variety of resident and migratory avifauna.

The largest ecosystem in the project region consists of the fluvial woodlands, most of which trend in a northwest to southeast direction following the dominant drainage patterns. Fluvial woodlands, in the strictest sense, are woodlands adjacent to riparian or estuarine areas, but some of the areas included here occur in depressional basins with impeded drainage characteristics. The vegetation in these low areas is predominantly of the fluvial hardwood type. The fluvial woodlands are generally the most heterogeneous of the floral assemblages. Due to their mesophytic-hydrophytic moisture regime, they support vegetation from the surrounding ecosystems in addition to several species not found elsewhere.

The oak woodlands in the region possess elements common to both fluvial woodlands and post-oak savannahs.

3.2.5.2 Commercially and Recreationally Important Species

Agriculture

Commercially important crops in Brazoria County are limited generally to rice, grain and sorghum, with rice being the most important. Brazoria County is one of 13 coastal Texas counties which account for 30 percent of the nation's rice harvest. Some hay and grain are produced for local beef and dairy cattle. An extensive irrigation and drainage canal system and tank ponds are utilized in agricultural production. Locally, small areas have been cleared for range and cultivation, but use of wooded lands in the project region for commercial timbering is rare.

Terrestrial Species

The major commercially valuable wildlife species within the region include the opossum, skunk, nutria and raccoon, which are trapped for fur.

Hunting is a locally popular recreational activity. The predominant recreationally important species in the region include waterfowl and furbearers, as well as dove, quail, squirrels, cottontail rabbits and whitetailed deer. Local coastal marshes provide winter habitat for about a quarter of the ducks and a third of the geese that migrate to the Gulf Coast region. Waterfowl are hunted in the marshes and fields where they feed, while other birds are generally hunted in agricultural areas. In general, all birds can be considered recreationally important to the large number of bird watchers in the region. Squirrels are important game animals in areas where suitable habitat is present. Some furbearing species are also hunted for sport, including raccoon, fox, and coyote.

Aquatic Species

Commercial fishing is a multimillion dollar business along the Texas coast. The major commercial species are shrimp, blue crab, oyster, menhaden and several common sport fish. Shrimp are the single most valuable marine product in Texas. Brown shrimp, the most abundant species, are concentrated in the zone from Galveston to Brownsville. White shrimp are also commercially important in the region offshore central Texas.

Many species of crab are collected in Texas coastal waters, but the blue crab is the only one extensively exploited by man. Adult blue crab populations are fished in nearshore bays and the inner shelf of open Gulf waters. The American oyster occurs in estuaries, bays and lagoons of Brazoria County. Most oyster production in the last few years, however, has centered in bays in neighboring counties, especially Matagorda County.

Black bass, sunfish, catfish and crappie are the region's most important fresh water sport fish. Larger lakes and the San Bernard and Brazos Rivers are the major sport fishing areas, but many small ponds and creeks also have sport fish. The local marshes provide a recreational crab fishery. In coastal waters, red drum (red fish), sea trout, tarpon, and flounder are the primary sport fish.

3.2.5.3 Threatened and Endangered Species

Plants

Of the plant species proposed for endangered status by the U.S. Fish and Wildlife Service whose range would extend into Texas, none of the specific taxa are known to occur in Brazoria and Fort Bend Counties. However, the botany of these areas is not well known.

Some plant species named by the Texas Organization for Endangered Species are found within the general area of Freeport. Sea-oats were recorded in the area southeast of Bryan Mound, smooth cordgrass (oyster-grass) grows along the old Intracoastal Waterway; and black walnut was reported approximately 8 miles northwest of Bryan Mound.

Birds

The Texas Organization for Endangered Species and the U.S. Fish and Wildlife Service list four bird endangered species which may be found near the gulf coast: southern bald eagle, peregrine falcon, whooping crane, and brown pelican.

The reddish egret and roseate spoonbill are on the list of peripheral birds (those whose occurrence in the United States is on the edge of its natural range and which are threatened with extinction in that portion of their range). Relatively few of these species are expected to nest or breed near the candidate sites or along the pipeline rights-of-way, however, because of their proximity to human habitation.

Terrestrial Wildlife

The red wolf is the only mammal species on the Federal and State lists that may occur in the region. The red wolf formerly ranged over much of the southeastern United States, but now its range is restricted to a few southeastern counties of Texas and to Cameron Parish, Louisiana. Observation of a red wolf has not been confirmed west of the Brazos River for at least five years.

Aquatic Wildlife

The American alligator and Houston toad are the only species of aquatic wildlife on the Federal list of threatened or endangered species that have been reported in Brazoria County, but they should not be affected by the project. Three additional species, the Atlantic Ridley turtle, the Hawksbill turtle and the leather back turtle, presently on the Federal list of endangered species, occur in the Gulf of Mexico and could occur in the project region.

3.2.5.4 Critical Areas of Concern

The Texas Coastal Management Program Briefing Paper for Federal Reviewers, issued by the Land Office in March of 1978 designated four site specific areas of particular concern along the Gulf coast. None of these is located in the vicinity of the Seaway group. Sand dunes are another area of particular concern and the General Land Office is preparing criteria by which the commissioner in the future will designate dunes critical to the protection of public lands.

3.2.6 Natural and Scenic Resources

3.2.6.1 Natural Resources

The region surrounding the Seaway Group SPR sites in Brazoria and Fort Bend Counties contains several fresh water lakes and two major rivers, the Brazos and the San Bernard, which flow into the Gulf of Mexico; the coastal shoreline consists of many miles of bay shore and Gulf frontage. The lakes and rivers, beaches, saltwater marshes, bays and the Gulf of Mexico itself provide the region with an abundance of natural resources which support a variety of outdoor recreational activities.

The Brazos and the San Bernard Rivers provide excellent wildlife habitat along most of their length in Brazoria County. The numerous fresh water lakes and saltwater marshes and bays provide scenic resources for passive recreation as well as good fishing and hunting sites.

Most of the region's park and recreational land is under public management, including two national wildlife refuges in Brazoria County administered by the United States Fish and Wildlife Service. Both these refuges, the San Bernard (15,414 acres) and Brazoria (9525 acres), are located near the coast. The San Bernard National Wildlife Refuge, is adjacent to the San Bernard River near the Allen dome site. The Brazoria National Wildlife Refuge is near Christmas Bay, northeast of Freeport. Both offer public hunting and fishing in limited areas, sightseeing, birdwatching, and nature photography.

The Texas Parks and Wildlife Department administers three state parks in Brazoria County: Bryan Beach, Mud Island, and the Varner-Hogg Plantation. Other developed recreation areas in the vicinity of Freeport include Quintana, Surfside, and San Luis Pass beaches. Bryan Beach State Park is located approximately one mile south of Bryan Mound; it consists of 877 acres, and recreational facilities are being planned for future public use.

There are 67 public and private recreational areas in Brazoria County, including marinas, parks, camps, beaches and other areas. The county contains 27 historic sites, including the Varner-Hogg Plantation State Park near West Columbia. There are 31 city and county parks and playgrounds in the Brazosport area and a natural recreation area comprising approximately 25 miles of open beaches.

Fort Bend County has 19 designated recreational sites. Among these are the six municipal parks operated by the cities of Richmond and Rosenburg. There are also 14 designated historical sites within Fort Bend County. None of these recreational sites would be directly affected by the project.

3.2.6.2 Scenic Resources

Scenic resources in Brazoria and Fort Bend Counties are primarily related to the area's abundant coastal resources: sandy beaches make up over half of Brazoria County's coastline; many miles of bay and coastal shorelines are coastal marshlands.

Inland, the two-county area is essentially flat, with only a few areas of topographic variation. Low-lying zones tend to be marshy due to the region's poor drainage. These wetlands and the areas along the Brazos River, San Bernard River, and Jones Creek are surrounded by woodlands of natural scenic beauty. Such areas are most prevalent in western Brazoria County and in the southwest and southeast portions of Fort Bend County. The remainder of the two counties consists primarily of cleared land in agricultural use, whose chief aesthetic appeal comes from the broad open vistas provided.

3.2.7 Archaeological, Historical and Cultural Resources

The Texas Coastal Zone contains a number of archaeological sites which provide evidence that humans have inhabited the region for as long as 15,000 years. Brazoria County contains 37 known archaeological sites. These sites are similar to many found in the coastal zone, in that they contain middens of ostrea and rangia shells, and most are located on or near the beach.

One historic site in Brazoria County, the John McCroskey Cabin, two miles northeast of Cedar Lake on Stringfellow Ranch, is listed in the National Register. Two additional sites have been chosen by the Texas State Board of Review for submission to the National Register: the Levi Jordan Plantation, located approximately 10 miles north of Bryan Mound; and the Varner-Hogg Plantation, near West Columbia.

3.2.8 Socioeconomic Environment

Although the proposed and alternative SPR storage sites themselves are located in Brazoria and Fort Bend Counties, the general socioeconomic region also includes Harris and Galveston Counties. The physical development will be limited to Brazoria, and possibly Fort Bend Counties, but the economic and employment effects will involve all four counties.

3.2.8.1. History

Brazoria County was one of the earliest centers of development in what is now Texas. The original inhabitants of this section of the central Texas coast, a tribe of seven-foot tall cannibals called the

Karankawas, were recorded in the Freeport area as late as the early 1900s. They are now extinct.

The first European explorers of Texas landed there in the 16th century. Later, the early Texas immigrants sailed to the Freeport area to establish Stephen F. Austin's first colony. Brazosport, the current name for a group of communities in the Freeport area, was the site of the first armed conflict between Texans and Mexicans--at the Battle of Velasco in 1832, four years before the Alamo.

Most of the people now living in the Brazosport area moved there as adults. According to the Brazosport Chamber of Commerce, persons of Spanish descent and American Negroes are the only significant ethnic and minority groups in the Freeport area.

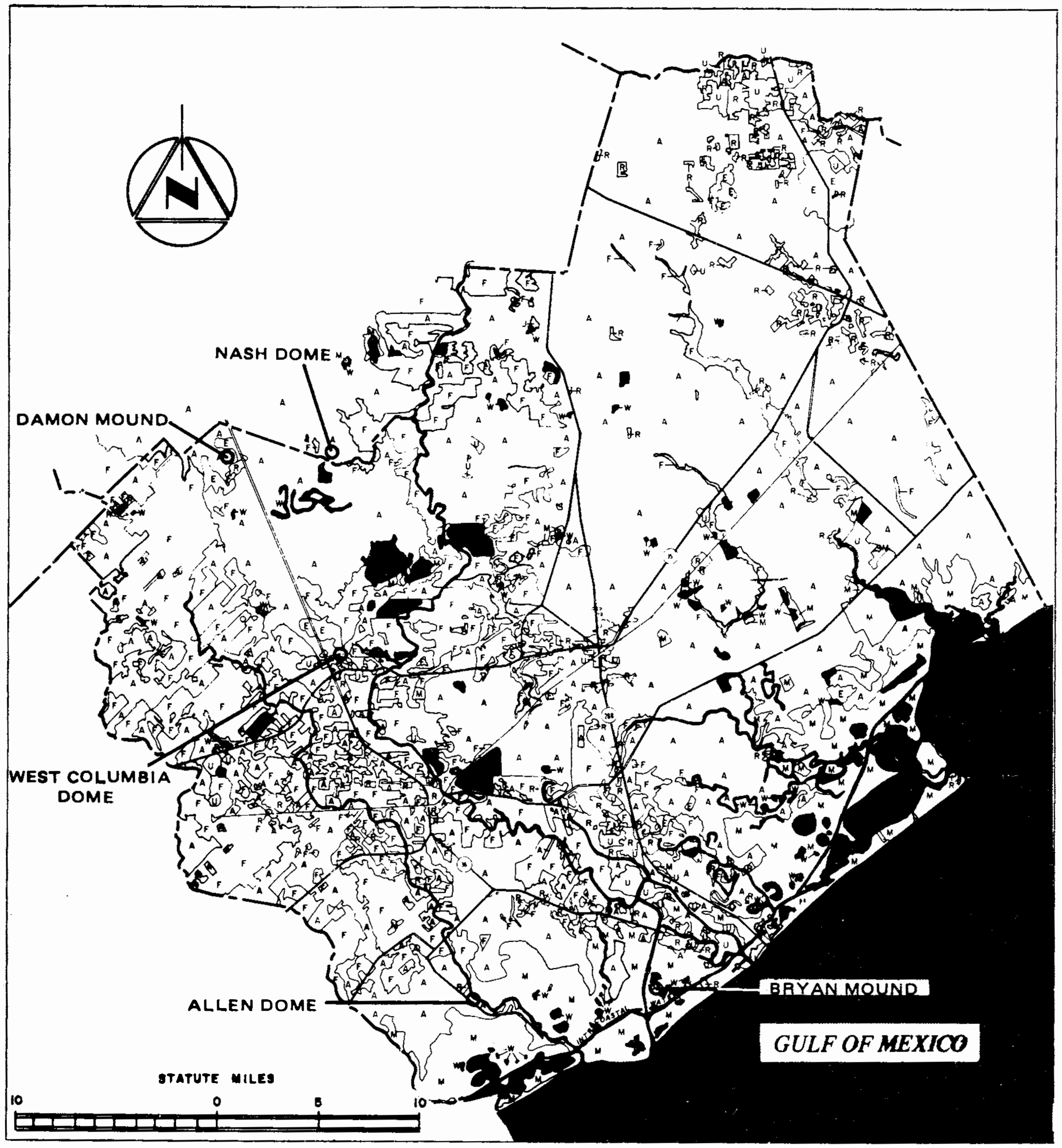
3.2.8.2 Land-Use Patterns and Planning

Existing Land Uses

The general land-use characteristics of Brazoria County are shown in Figure 3.2-8. Although the county has undergone very rapid industrialization and urbanization since World War II, only a small portion of its total land area is currently in urban use. Most of the industrialization and/or urban development in the four-county region is concentrated in Houston, Galveston, Texas City, and the Brazosport area. Thus, the rural agricultural economy remains significant in the four counties.

Urbanization in the region is strongly concentrated in and about the various cities. The primary exceptions to this pattern in Brazoria County are the linear residential and commercial developments following State Highway 288 between Angleton and Lake Jackson, and the residential development along county roads in the triangular area formed by Sweeney, West Columbia, and Brazoria.

Petrochemical activities in Brazoria County are concentrated in a few large operations, principally: Dow Chemical north and south of Freeport; Monsanto Chemical and Amoco Chemical on Chocolate Bayou north of Farm to Market Road 2004; and Phillips and Allied Chemical Refineries near Old Ocean, on the western boundary of Brazoria County.



KEY

A - AGRICULTURAL
R - RESIDENTIAL
F - FOREST
U - URBAN
E - EXTRACTIVE
M - MARSH
■ - WATER

SOURCE: NASA, 1970.

FIGURE 3.2-8 Prominent land uses.

The Gulf of Mexico is used for multiple purposes including waterborne commerce, pleasure boating, fishing and offshore mineral production.

The Houston-Galveston Area Council of Governments projections for the year 2000 indicate the rapid spread of residential development outward from Houston, particularly along radial highways; along Interstate 45 north, U.S. 90A west and I-10 east. Substantial growth is also expected to occur southward along I-45 toward Galveston. In the northern part of Brazoria County growth is expected between Alvin and Houston (Harris County), and in the southern part northward from Freeport to Lake Jackson, Clute, Richmond (the county seat of Fort Bend County) and Angleton (the county seat of Brazoria County).

Major industrial development in the region is expected to occur along the Houston Ship Channel. Additional smaller industrial areas are expected throughout the region, particularly in the vicinity of Galveston Bay. In Brazoria County, substantial expansion of industry is foreseen in the Freeport area and spreading eastward. At Chocolate Bayou, a major industrial complex is anticipated; it is projected to be the largest in the region other than that along the Houston Ship Channel. The U.S. Army Corps of Engineers is currently planning a substantial harbor maintenance and improvement project in the Freeport area.

3.2.8.3 Transportation Systems

The region is well served by highways, railroad lines, navigable waterways, and airports, with Houston as the hub. Interstate 45 links Galveston and Houston, State Highways 288 and 35 connect Southern Brazoria County with Houston, and State Highway 36 links Freeport with U.S. 59 west of Houston. A new two-lane highway along Galveston Island, which crosses the San Luis Pass Bridge, provides good access between the Galveston-Texas City and Brazosport areas.

Future plans call for upgrading Routes 35 and 288 to expressway status for their entire length through Brazoria County. The completion of these projects will constitute an important segment of the planned radial-circumferential expressway system for the greater Houston-Galveston area.

Railroads serving Brazoria County include: the Atchison, Topeka and Santa Fe, which serves Freeport and Houston, and links the region with the west and north; and the Missouri-Pacific, which serves Brazoria County and Houston, and links these areas with Baton Rouge and northern cities.

The Intracoastal Waterway links Freeport and Galveston with other Texas ports. Waterborne transportation on the Waterway and the Gulf is an important form of transportation within the region, and connects the region with the major east coast ports.

3.2.8.4 Population Characteristics

Population Centers

There are only nine cities and towns in the region (Brazoria, Fort Bend, Harris, and Galveston Counties) with a population of 10,000 or more, and only four of these have populations of 25,000 or more.

Historical Growth and Trends

The regional population is growing rapidly in comparison with the State and nation. Brazoria and Harris Counties showed significant growth rates, 42.1 and 40.1 percent, respectively, between 1960 and 1970. Fort Bend and Galveston Counties are growing more slowly although at relatively rapid rates. The region is expected to continue to grow rapidly as Houston expands.

3.2.8.5 Housing

The overwhelming majority of the region's housing stock is in Harris County, but Brazoria County has the greatest proportion of owner-occupied units in the four-county area.

The median value of single family houses in the region is well above the State average, and is highest in the Houston area.

3.2.8.6 Economy

The basic economy of the region is dominated by manufacturing and the petroleum and chemical industries. Brazoria County has an extensive mineral extraction industry, including oil and gas, with an income of over $260 million annually. Petroleum and chemical industries, fishing, tourism and agriculture are also important to the county's economy.

Fort Bend County relies heavily on the mineral extraction and the petrochemical industry but also has an active agricultural industry. Many residents of this county are employed in the Houston area.

Port activities dominate the Galveston-Texas City economies, with the surrounding areas of Galveston County active in agribusiness, tourism, and mineral extraction.

The regional center of business activity is in Houston (Harris County), a highly industrialized area with over 2500 manufacturing plants. Port activities, tourism, and service industries are also important to the economy of the county and the surrounding region.

Large employers in Brazoria County that are not dependent on the petroleum and chemical industries include the Texas Department of Corrections, the shrimp industry, and various recreational activities.

Employment

The region is subdivided into two areas: Brazoria and Fort Bend Counties, where the project will be located, and the Houston-Galveston area, where most of the workers are expected to live. Both areas are expected to experience substantial growth in refining and petrochemical manufacture independent of the SPR program. Refining and petrochemicals, currently the two largest industries in Brazoria County, account for nearly a third of all available jobs.

The employment structure of Houston reflects its role as a regional center. It has large shares of its employment in manufacturing, service, retail trade, construction, wholesale trade, transportation, and public utilities. Overall, Houston has the largest labor pool and the most diversified economic base in the region. Galveston and Fort Bend Counties have the greatest proportion of their employment in the manufacturing and wholesale and retail trades.

Income

Median family income in the region is well above the average for Texas as a whole. Brazoria County has the highest median family income of any of the four counties and it also stands among the highest in value of single-family homes. This wealth is largely attributable to the high wages paid by the chemical industry.

3.2.8.7 Public Services

Since public services such as police and fire protection, health and local roads are primarily provided by local agencies (counties, cites, and special districts), these topics as related to each specific SPR site are discussed in the appropriate following sections of this EIS.

3.3 BRYAN MOUND (PROPOSED SITE)

3.3.1 Land Features

3.3.1.1 Physiography and Topography

Bryan Mound is a topographically high area surrounded by coastal marshes. Maximum elevation on the dome is 16 feet. The dome is bounded by a man-made flood and hurricane levee system. The bathymetry of the offshore area is relatively flat with a small shell ridge and rock formation near the proposed diffuser site.

3.3.1.2 Local Geology

Bryan Mound salt dome is the principal structural element of local geology. It is roughly circular in plan view, with a diameter of about 6000 feet. The top of the dome lies about 1100 feet below sea level. Oil drilling on the flanks of the dome has defined the salt core to have a volume of about 1.5 cubic miles above a depth of 10,560 feet. Deformation caused by the upward movement of the salt and the settling and compaction of overlying sediments has produced a system of subsurface faults and flexures over the flanks of the dome.

The salt (halite) is coarsely crystalline. About 3 percent of the dome's mass consists of anhydrite, with traces of other minerals including calcite, dolomite, barite, pyrite, quartz, celestite, iron minerals and sulfur.

The caprock is a maximum of 480 feet thick and is composed primarily of anhydrite and limestone although hot sulfur water and hydrogen sulfide are also present. The upper portion has a zone of very porous and cavernous limestone and gypsum mixed with sulfur.

Unconsolidated and partially consolidated muds, sands, and shales of Holocene, Pleistocene, and Pliocene age overlie the central portion of Bryan Mound. Unconsolidated and partially consolidated sands and shales of Tertiary age extend to a depth of at least 15,000 feet on its flanks. Surface sediments are of the Pleistocene Beaumont foundation, which consists of fine sand and mud. Bottom sediments offshore Bryan Mound are similar in composition and slope gently Gulfward.

3.3.1.3 Economic Geology

Oil production began at Bryan Mound in 1949, but has always been low. Less than 11,000 barrels of crude were produced in 1965, and no active oil production is presently underway. Production was from the Miocene, at about 3400-foot depths. The deepest well reported was 7530 feet; it bottomed in Oligocene strata.

More than five million tons of sulfur were extracted from the caprock between 1912 and 1935, and a small amount was extracted by a pilot plant in 1967-68. (Since the sulfur wells were drilled only into the caprock, they will not affect the integrity of the proposed and existing caverns below.)

Dow Chemical Co. has over the years leached five solution cavities in the salt mass of Bryan Mound. The brine was used as a petrochemical process feedstock. The DOE is presently converting four of these caverns for petroleum storage as part of the early storage phase of the SPR.

3.3.1.4 Soils

Soil associations in the vicinity of the Bryan Mound site include the Harris-Veston-Galveston and the Moreland-Pledger-Norwood associations. The Harris-Veston-Galveston association occupies the area from the Gulf of Mexico shoreline to the Intracoastal Waterway. The area north of the Intracoastal Waterway, including the Bryan Mound dome, contains the Moreland-Pledger-Norwood association. At the dome site,, vegetation in some areas has been stunted as a result of sulfur and brine spills. Recent bottom sediments offshore from Bryan Mound are marine deposited and derive from Brazos River discharges.

3.3.2 Water Environment

3.3.2.1 Surface Water Systems

Bryan Mound is bordered by four major surface water bodies: the Brazos River Diversion Channel; Freeport Harbor; the Intracoastal Waterway; and the Gulf of Mexico. Several lakes and reservoirs exist within the triangular area protected by the levee system, and others, including Mud Lake and Bryan Lake, are outside the levees.

The Brazos River Diversion Channel passes just west of the proposed SPR storage site. This channel, a straight "channelized" reach of the river, is bordered on both sides by flood levees. Its major commercial traffic, besides barge traffic on the river, consists of petroleum industry support vessels which dock along the east bank, just south of Freeport.

The offshore Gulf waters near the proposed site have characteristics generally similar to regional values. Baseline environmental studies conducted recently in the area have shown that within the average yearly and monthly patterns, a great deal of temporary and minor variations occur. Such a deviation from the norm occurred in December 1977 when observed current directions and the intensity of vertical stratification of the water column varied from the expected range.

3.3.2.2 Subsurface Water Systems

Bryan Mound is one of seven salt domes in Brazoria County that penetrate through the Evangeline aquifer and into the Chicot aquifer (Figure 3.2-5). The base of the Chicot aquifer is about 1100 feet below sea level in the vicinity of the dome. Fresh water occurs in the upper 80 feet of the aquifer over the dome, and slightly saline water from 80 to about 225 feet. At a radius of about 1.5 miles from the perimeter of Bryan Mound, the base of the slightly saline water extends to a depth of 500 feet. The water in the formations adjacent to the dome and the caprock is probably highly saline.

Deeper aquifers in the vicinity of Bryan Mound are capable of delivering large quantities of slightly to moderately saline water. Beneath the Evangeline aquifer, Miocene sands continue to a depth of 6500 feet. Although little data are available concerning these sands, analysis of a single well, located 15 miles to the northeast of Bryan Mound, indicates that these sands occur in 70 to 120 foot thick layers interspersed with layers of clay. These sands probably contain saline water. The Miocene formations below 6500 feet are mostly silt and clay.

3.3.3 Climatology and Air Quality

3.3.3.1 Climatology

Bryan Mound is a typical coastal industrial site along the Texas Gulf Coast. It can be expected to experience generally higher wind speeds and more frequent east to southeasterly winds, smaller diurnal ranges of temperature, slightly higher humidity, and significantly fewer stable periods than the sites further inland. These conditions are characteristic of the offshore vicinity. Bryan Mound's rainfall peak is in September.

Wind and storm activity off the coast have a strong effect on variations in water heights. As reported by the U.S. Army Corps of Engineers, during strong northwesterly winds, water levels can drop to as low as -4.0 feet and during hurricanes the high levels could be +15.0 feet.

3.3.3.2 Air Quality

Existing air quality levels at Bryan Mound are very good with the exception that non-methane hydrocarbon and oxidant concentrations sometimes exceed the NAAQS.

3.3.4 Background Ambient Sound Levels

Activities influencing sound levels in the Bryan Mound area include brining operations at the dome, traffic on the Intracoastal Waterway and Brazos River, petrochemical activity at Freeport and vehicular traffic. In addition, construction and operational noise associated with the early storage phase of the SPR at Bryan Mound and channel dredging in Freeport Harbor also affect local sound levels in these areas. To the west of the site, in essentially unpopulated areas more distant from industrial activity, sound levels are dominated by animals and insects and wind rustling foliage. To the south is Bryan Beach Recreation Area. an undeveloped recreational site.

The principal noise-sensitive land use areas are residential areas in Freeport, two to three miles from the Bryan Mound storage site. The unpopulated areas of the Gulf coastline and the marshes west of Bryan Mound are also somewhat noise sensitive.

3.3.5 Ecosystems and Species

3.3.5.1 Ecosystems

Most of the immediate vicinity of the Bryan Mound site could be classified as a disturbed or built-up area. Surrounding areas are made up of coastal prairie and brackish marshland ecosystems. The coastal marshlands have been identified by the State as important natural habitat.

The brackish marshland ecosystem dominates all of the low-lying environs of the site except for the northern flank of the mound, where the coastal prairie ecosystem extends along the levees paralleling the Brazos River Diversion Channel. This ecosystem is composed of medium to very tall grasses (Table 3.3-1) which form a moderate to a very dense cover for wildlife. These grasses are usually found in the site area where soil moisture extends to great depth. Gulf Coast Prairie is the climax vegetation and is greatly influenced by the low elevations. Those areas periodically inundated by seawater are dominated by Gulf cordgrass.

Bryan Mound is nearly surrounded by large and small bodies of water which provide a diverse range of aquatic habitats--from the Brazos River on the west and the Intracoastal Waterway on the south to the many nearby tidal and marsh lakes and drainage canals. The largest of these small lakes are Unnamed Lake (150 acres), Mud Lake (87 acres) and Old Reservoir (35 acres). Salinities in these lakes vary from freshwater up to 15 parts per thousand, depending on the location of the pond, the season of the year, and the flood stage of the Brazos River.

Circulation is generally poor in these semi-enclosed lakes and ponds. Species diversity tends to be low, but population densities are relatively high. This diversity-density relationship indicates an unstable and poorly balanced biological system. In fresh and slightly brackish waters, pennate and centrate diatoms are generally the most common phytoplankton; however, in the Bryan Mound area, green algae are the most abundant of the plankton flora. In the more eutrophic water bodies, the filamentous blue-green algae are both recurring and abundant.

3.3.5.2 Species

The Bryan Mound site is located approximately equidistant between the San Bernard and Brazoria National Wildlife Refuges. Both refuges are an important part of the ecology of the Texas coast because of their large areas of wildlife habitat and the great diversity and abundance of resident wildlife. Both are located in coastal marshlands which constitute extremely vulnerable habitat.

Marshes and tidal ponds, such as Mud Lake and Bryan Lake, which connect with the Gulf of Mexico by way of the Intracoastal Waterway or the Brazos River, are very productive in terms of the numbers of animals and plants present when all species are combined. Benthic communities in the more freely flowing water bodies around Bryan Mound are greatly influenced by the position of the saltwater wedge in these bodies.

Cattle are the second most abundant quadruped at the Bryan Mound site. Their ability to consume large amounts of vegetation puts them in direct competition with the numerous small rodents (the most abundant quadrupeds) and rabbits for the available food resources.

Marine communities found in the vicinity of the proposed diffuser site are typical of the communities discussed in Section 3.2.5.2. White shrimp are known to spawn in the vicinity of the site, and the area is used as a commercial fishing ground.

None of the commercial, recreational, threatened and endangered species discussed in Section 3.2.5.3 are known to inhabit the onshore Bryan Mound site.

3.3.6 Natural and Scenic Resources

The marsh and prairie areas surrounding Bryan Mound are typical of those found throughout this region of the Texas Gulf Coast and have no unique natural or scenic features. Due to prior industrial development, the area in the immediate vicinity of the project site has a relatively low aesthetic value. Although the site itself is not easily accessible from major public roads, it is visible from the road on the levee along the Brazos River Diversion Channel west of the site. Parts of the project area may be visible to the southern areas of Freeport.

Bryan Beach State Park lies about one mile southeast of the site, effectively separated from it by the Intracoastal Waterway.

3.3.7 Archaeological, Historical and Cultural Resources

The candidate site does not contain any known sites of archaeological, historical, or cultural significance. If this site is selected for SPR development, a qualified archaeologist will survey those portions of the site not previously surveyed for DOE, and coordinate with the State Historical Preservation Officer.

3.3.8 Socioeconomic Environment

Land Use Patterns

The proposed Bryan Mound SPR site is located within the group of communities known collectively as Brazosport, which includes the city of Freeport. The area is highly industrialized, with petroleum related facilities representing a significant share of the economy.

To the east of the site is an area classified as made-land, an area graded and filled with spoil or other material. It has been utilized for urban-residential and industrial expansion. This type of area is commonly developed over marsh and reclaimed land. Approximately one-half mile east are facilities of Phillips Petroleum and Houston Natural Gas. Farther to the east are the Brazosport (Freeport) Harbor facilities.

Land uses on the southern perimeter of the Bryan Mound site include marsh and spoil areas. Immediately adjacent to the site is a mud pit (Mud Lake), which was used previously for the disposal of drilling mud. South of Bryan Mound is the Bryan Beach recreational area and the Gulf of Mexico.

The proposed industrial use of the Bryan Mound SPR site is compatible with the general land use patterns in the Freeport harbor area.

Transportation Systems

Access to the site is by Route 288 connecting with a road along the east side of the Brazos River Diversion Channel, or by a gravel county road connecting with Route 1495. Freeport is located about 2 miles from the Bryan Mound site by County Road 242.

Waterborne transportation in the site vicinity occurs primarily along the Intracoastal Waterway immediately south of the site and in shipping lanes 14 miles offshore in the Gulf.

Population Characteristics

Freeport is the port city of Brazoria County. It had an estimated 1976 population of 19,500. The age distribution can be characterized as fairly youthful. Approximately half the local population is between 20 and 55 years of age, while about 40 percent are 19 years or younger.

Housing

The vacancy rate for rental units in Brazoria County in 1970 was very high, but very low for sale units. In contrast, all types of housing are in short supply in the Brazosport area, the county's major urban complex. A large percentage of the work force is forced to commute from other areas, some from as far as Houston (40 miles). This situation will probably continue for some time due to the rapid growth of the area.

Economy

The largest chemical manufacturing complex in the world is located in Brazosport, centered around the Texas Division of the Dow Chemical Co. Other large local manufacturers include Shell Oil Buccaneer Plant, Dow Badische, and Davis Oyster Creek Division. The Brazosport area is also a seasonal home to one of the world's largest shrimp fishing fleets, producing as much as 15 million pounds of shrimp annually from coastal waters.

Public Services

In addition to the Community Hospital, five small clinics serve the Freeport area. There is a shortage of medical personnel in the area, but an established system exists for emergency evacuation of seriously injured persons by helicopters or fixed wing aircraft.

Police and fire protection for the project would be provided by the Brazoria County Sheriff's Office and the City of Freeport. Deputies from the Sheriff's Department regularly patrol areas outside the municipalities. Freeport has a paid full-time fire department equipped with modern pumper trucks and a foam trailer for chemical fires. Additional fire-fighting units and personnel are available from adjacent communities under an established and tested system for mutual assistance. A large number of trained volunteer firemen are also available if needed.

3.4 ALLEN DOME ALTERNATIVE SITE

3.4.1 Land Features

3.4.1.1 Physiography and Topography

The Allen dome site is a flat floodplain, sloping gently away from the natural levees of the San Bernard River. Maximum elevation on the levees is about 5 feet, while the site elevation is about 4 feet.

3.4.1.2 Local Geology

Allen dome is a shallow salt dome, almost circular in plan. Its broad, nearly flat top lies about 1380 feet below sea level. All sides of the dome dip steeply but a reentrant feature on the south edge of the dome has a significant salt embayment and overhang within the proposed storage cavern interval.

A detailed composition or quality of the salt mass is not known at this time, but experience with other domes in the area suggests that the composition should be similar to that found at Bryan Mound (Section 3.3.1.2).

The average caprock thickness is about 490 feet and it appears to completely overlie the salt dome. The caprock is composed of calcite, gypsum, and anhydrite, with sand and shale sediments. Lenses of sandy clay are reported throughout most of the limey portion of the caprock. Sulfur is a minor constituent.

Unconsolidated sediments of muds, shales and sands of Pleistocene and Recent age overlie the caprock. Unconsolidated and partially consolidated sands and shales of Pliocene and Miocene age extend downward along the dome to depths between 4500 and 7000 feet and below. The thickness of the Miocene section in the vicinity of the dome is approximately 6500 feet. Faulting within the Miocene and overlying Pliocene formations immediately adjacent to the dome is probably extensive and complex.

The bathymetry in the vicinity offshore is described in Section 3.3.1.2.

3.4.1.3 Economic Geology

The earliest oil production at Allen dome was in 1927 and the area's most recent drilling activity was in 1962. Oil and gas occur primarily in Miocene sediments on the southeast and east flanks of the dome. No known oil or gas production is located over the top of the dome in the area proposed for the storage facility. Sulfur is a minor constituent of the caprock, but has never been a commercial resource.

3.4.1.4 Soils

Soils of the Moreland-Pledger-Norwood association occur along the San Bernard River. Marine sediments are described in Section 3.3.1.4.

3.4.2 Water Environment

3.4.2.1 Surface Water Systems

The San Bernard River passes east of the Allen dome site. The reach of the San Bernard from the Gulf of Mexico to Brazoria is an estuary. A dredged channel at Bernard Acres, south of the site, is 50 feet wide by 9 feet deep and can accommodate pleasure boats.

South of the Allen dome site, the coastal marshes of the San Bernard Wildlife Refuge drain into the Intracoastal Waterway. Some of the marshlands east of the San Bernard River drain into the river via small tributaries such as Redfish Bayou. The rest of the marsh east of the San Bernard drains into the waterway.

The site is subject to periodic flooding. The Corps of Engineers computes that the 100-year backwater flood from the San Bernard River would rise to elevation +9.5 feet. The 100-year hurricane flood at the site has been estimated at 14 to 18 feet (including surges of the Gulf).

The marine conditions in the area of the proposed brine diffuser are discussed in Section 3.3.2.1.

3.4.2.2 Subsurface Water Systems

Ground water use in the vicinity of the Allen dome does not appear to be extensive. The hydraulic gradient is essentially flat in the upper unit of the Chicot aquifer at the site. Local use of ground water is probably limited to rural domestic pumpage and stock watering.

Shallow fresh aquifers in the area are in common usage as a supply source for individual domestic water requirements. The town of Brazoria, about 10 miles north of the site, pumps water from the lower unit of the Chicot aquifer. The cone of drawdown in the surface aquifer from the pumping extends to the site, but the hydraulic gradient is relatively flat, at about 1.5 feet per mile.

3.4.3 Climatology and Air Quality

3.4.3.1 Climatology

Ambient conditions at the Allen dome site are expected to be similar to those at Bryan Mound. Like Bryan Mound, the Allen site experiences a predominantly marine climate characterized in Section 3.3.3.1 with prevailing south to southeasterly winds.

3.4.3.2 Air Quality

Air quality levels at Allen dome site are generally consistent with those of Bryan Mound. Existing air quality levels are very good, with the exception that non-methane hydrocarbon and oxidant concentrations sometimes exceed the NAAQS.

3.4.4 Background Ambient Sound Levels

A wildlife refuge is located to the southwest of the Allen dome site and grazing lands lie on the northeast and south. A small residential development, about 35 single-family dwellings approximately 1000 feet south of the site, is the principal noise-sensitive land use area. Streets have been laid out in an area 1/2 mile north of the site, but at present few houses have been built.

The Allen dome site is an appreciable distance from the Intracoastal Waterway and other industrial or drilling activities that could contribute to sound levels. Principal sound sources anticipated include insect and animal activity, recreational activity on the San Bernard River, and wind. Average day/night sound levels of up to 54 dB are estimated for the area.

3.4.5 Ecosystems and Species

3.4.5.1 Ecosystems

Within the proposed Allen dome site area, the ecosystems are characterized mainly as coastal prairie, fluvial woodland, and estuary.

The San Bernard National Wildlife Refuge, located two miles southwest of the site, is important to the regional ecology because of its large wildlife habitat and the diversity and abundance of its wildlife communities. The refuge is located in coastal marshland and dotted with numerous lakes and ponds. Coastal marshlands may also be found interfingering with coastal prairies east of the Allen Dome site.

The coastal prairie ecosystem around Allen dome is used predominantly for grazing. The predominant vegetation consists of medium tall to tall grasses (Table 3.2-2).

The fluvial woodlands ecosystem is located on the eastern portion of the site, along the banks of the San Bernard River.

The river itself provides the major aquatic habitat in the site vicinity. A small intermittent creek drains the center of the site and a number of drainage ditches are located along the access roads, but these are not expected to provide significant aquatic habitat. A manmade canal opening on the San Bernard River has been constructed south of Allen dome, in the San Bernard Acres subdivision. In this reach, the estuary is usually stratified.

The biologic environment in the Gulf of Mexico surrounding the proposed diffuser site is described in Section 3.3.5.2.

3.4.5.2 Species

The Allen dome site is located in an area dominated by the coastal prairie ecosystem. This ecosystem provides suitable habitat for a large number of avian species and at least 12 species of mammals. Species commonly associated with coastal prairies are presented in Table 3.2-2.

The hispid cotton rat and rice rat are two small rodent species most likely to occur on the site. Rice rats, however, favor wet areas, so they are probably restricted in abundance and distribution at the site.

At least 60 species of birds are likely to occur throughout the year in the site's fluvial woodlands ecosystem. Bird species commonly encountered at the Allen dome are presented in Table 3.2-2. The woodlands at the site are grazed by cattle and, consequently, growth of the understory is reduced; this may preclude the occurrence of some species which would normally inhabit similar (but undisturbed) forest layers.

It is not uncommon to collect blue catfish near the mouth of the San Bernard River during periods of high river flow. On the other hand, during low river flow, blue crabs, Atlantic croakers, and gulf menhaden have been taken more than 8 miles upstream from the site. The lower San Bernard River provides an important nursery for many species of fish and some of the more important invertebrates such as blue crab and shrimp. The most abundant fish collected in the river near the proposed site are seatrout and Atlantic croaker.

3.4.6 Natural and Scenic Resources

Although the natural resources and recreational opportunities in the vicinity of the Allen dome site are similar to those near the Bryan Mound site, Allen dome is closer to the San Bernard National Wildlife Refuge, located southwest of the site, and is adjacent to the San Bernard River. The river has been dredged to a navigable depth of nine feet and affords recreational boating and fishing opportunities.

The Allen dome site contains no aesthetic characteristics unique to the area.

3.4.7 Archaeological, Historical, and Cultural Resources

The candidate site does not contain any known sites of archaeological, historical, or cultural significance. If this site is selected for SPR development, a qualified archaeologist will survey it for DOE, and coordinate with the State Historical Preservation Officer.

3.4.8 Socioeconomic Environment

Land Use Patterns

Most of the land surrounding the Allen dome site is pastureland, with a few marshy areas along the San Bernard River. The San Bernard National Wildlife Refuge is southwest of the site.

A small subdivision and marina has been built southeast of the site, near the San Bernard River, and land to the north has been partitioned for future residential development.

Transportation Systems

The site can be reached by Texas State Highway 36, a northwesterly trending road between Freeport and Brazoria, which runs about six miles east of the site. F.M. 2918, a paved state highway, passes within 3500 feet of the western edge of the -2,000-foot salt contour. Improved gravel roads serve the northern and southern portions of Allen dome.

Population Characteristics

The area immediately surrounding Allen dome is predominantly undeveloped. The population centers nearest the site include the small subdivision, Bernard Acres, south of the site and the small community of Churchill Bridge to the north. The partitioned acreage immediately north of the site is essentially undeveloped at this time, but will in the future probably provide homesites for a moderate number of families.

Housing

There are a number of small communities and developed subdivisions within four to five miles of Allen dome, the largest of which are Churchill Bridge and Jones Creek. Southern Brazoria County is currently experiencing a housing shortage as population growth continues.

Economy

There are few employment opportunities in the immediate vicinity of Allen dome and most residents of this area work in the Brazosport area, or farther away. There are few retail facilities in either Jones Creek or Churchill Bridge and most residents shop in the Brazosport area.

Public Services

Allen dome is served by the Brazosport area hospitals and the Brazoria County Sheriff's Department provides local police protection, in conjunction with the Texas Department of Public Safety, which patrols state highways. Fire protection services come from the River's End Fire Department and the Brazoria Fire Department.

3.5 WEST COLUMBIA DOME ALTERNATIVE SITE

3.5.1 Land Features

3.5.1.1 Physiography and Topography

The West Columbia dome is located on the prairie terrace of the Gulf Coastal Plain. A freshwater swamp occupies the center of the site. General surface elevation of the area is 35 feet, but there is a slight topographic depression over the center of the dome with elevations below 25 feet. The highest elevation near the site is a small hill to the west, which crests slightly above 45 feet.

3.5.1.2 Local Geology

West Columbia salt dome is an elliptical structure in plan, with steep sides and a fairly flat top. The highest point at which salt has been encountered is about -700 feet.

Local faulting around the dome exhibits a very strong east-west pattern, possibly controlling or a result of the east-west trend of the long axis of the dome. A series of radial faults is also known along the dome's north and south sides.

Quality of the salt mass is unknown at this time; it is, however, probably similar to that found at Bryan Mound (Section 3.3.1.2).

The caprock at West Columbia dome ranges in thickness from 100 to 150 feet over the northern portion of the dome. It thins out to the south, and is missing altogether on the south side of the dome. Its composition is reported to be a mixture of gypsum and anhydrite.

Up to 600 feet of unconsolidated and partially consolidated muds and clays, sands, gravels and shales of Recent and Pleistocene age overlie the central portion of the dome. Unconsolidated and partially consolidated sands and shales of Pliocene, Miocene and Oligocene age extend downward along the flanks to depths below 8000 feet.

3.5.1.3 Economic Geology

Initial petroleum-related production from the West Columbia dome was in 1904 when gas was produced, but commerical production did not begin until 1917. Most drilling centered on the southeastern and northern flanks of the dome. Oil and gas occur in Oligocene and Miocene sediments that are faulted or pinched out against the sides of the dome.

No oil or gas production is located over the top of the dome in the area proposed for the storage facility.

3.5.1.4 Soils

Soils in the West Columbia site area are assigned to the Moreland-Pledger-Norwood association. Marine sediments offshore Bryan Mound are described in Section 3.3.1.4.

3.5.2 Water Environment

3.5.2.1 Surface Water Systems

The West Columbia dome is situated between two major river channels, the Brazos and the San Bernard. The town of East Columbia lies on the Brazos River about 3 miles east of the site. The river is about 250 to 300 feet wide in the reach through East Columbia. Varner Creek is located about one-half mile to the east of the dome, and joins the Brazos River approximately three miles southeast of the site. No streamflow measurements are available for Varner Creek, but it is indicated as an intermittent stream in this area on USGS topographic maps.

The San Bernard passes nearest about 3 miles to the southwest of the dome; there it is about 100 feet wide. Bell Creek, a small stream passing about one mile west of the site, flows southerly into the San Bernard River. The confluence of Bell Creek and the San Bernard River is approximately 3 miles south-southwest of the site.

According to preliminary U.S. Army Corps of Engineers' studies, flooding of the Brazos River may reach elevation +33.0 feet. This 100-year flood could inundate the proposed site.

The marine conditions in the area of the proposed brine diffuser are described in Section 3.3.2.1.

3.5.2.2 Subsurface Water Systems

West Columbia dome is one of seven salt domes that penetrate through the Evangeline aquifer and into the Chicot aquifer in Brazoria County. The base of the Chicot aquifer is about 900 feet below sea level in the vicinity. Fresh water occurs in about the upper 70 feet of material over the dome and slightly saline water in about the upper 600 feet. The base of the slightly saline water extends to a depth of 800 feet about one mile from the center of the dome. The water in the formations adjacent to the dome and the caprock is highly mineralized.

Aquifers in the vicinity of West Columbia dome are capable of delivering large quantities of slightly to moderately saline water. Ground water use in the vicinity of West Columbia dome does not appear to be extensive. The hydraulic gradient is essentially flat in the upper unit of the Chicot aquifer at the site. The town of West Columbia pumps water from the lower unit of the Chicot aquifer. The site is within the cone of drawdown from that pumping.

3.5.3 Climatology and Air Quality

3.5.3.1 Climatology

Coastal effects are generally less pronounced at West Columbia dome, since the site is 25 miles inland. Compared with the coastal sites (as described in Section 3.3.3.1 and 3.4.3.1), this storage site is expected to experience lighter winds and more frequent south and south-southeast winds, larger diurnal ranges of temperature, slightly lower humidity, and a higher frequency of stable conditions.

Tropical storm effects, while more pronounced than further inland, will be significantly less at this site than along the coast.

3.5.3.2 Air Quality

Air quality at this site is generally equivalent to that at Bryan Mound (i.e. low levels with the exception of hydrocarbon and oxidant concentrations). Quantitatively, only slight differences are expected due to local influences and the occasional influx of air from heavily industrialized areas northeast of the site.

3.5.4 Background Ambient Sound Levels

An oil field is located approximately one mile north of the West Columbia site. A number of drill rigs are active at the field and are principal sound sources in this area.

The principal noise-sensitive land use areas are the residential and educational areas in and around West Columbia. Sound levels of 56 dB are estimated for these areas, with the principal sound sources being the normal activities of West Columbia residents.

3.5.5 Ecosystems and Species

3.5.5.1 Ecosystems

Ecological habitat types found in the vicinity of the West Columbia dome site (Table 3.2-2) include coastal prairie, fresh water marsh, fluvial woodlands and cleared land (a developed oil field). The West Columbia dome site is located on land which consists mostly of grassland used primarily for grazing. Scattered woodland groves and a marshland area are also located directly over the dome.

The dominant vegetation at the site consists of coastal prairie grasses, but cattle grazing areas contain introduced cultivated grass species. Fluvial woodlands around the site are generally isolated, scattered overstory species of which live oak and other oak are dominant. Industrial development and widespread cultivation of the area have almost removed the forest cover from the site. Marshlands in the vicinity of the site consist primarily of the biologically productive fresh water marsh ecosystem, which is characterized by stumps and snags in the shallow depressional area directly over the dome.

The proposed pipeline right-of-way to the alternative West Columbia dome SPR site crosses nearly the whole range of ecosystems present in the Seaway Group region: coastal prairies, fluvial and oak woodlands, brackish and fresh water marshlands, croplands and other cleared lands and a number of inland waterways.

3.5.5.2 Species

Coastal prairie and cleared lands normally provide habitat for a diverse fauna, but because of the extensive development and the amount of human activity near the West Columbia dome site, presence of many animal species is unlikely. The cottontail rabbit is the only game species likely to occur at the site, but because of the site's overgrazed condition the prairie cannot support abundant cottontail populations.

Woodland habitat, too, is very limited at the dome site and this also affects species density.

The only significant aquatic habitat at the site is a small intermittent creek which drains the marsh at the center of the site and joins Varner Creek about one-half mile northeast of the site. The shallow water, snag and stump infested area in the center of the site provides habitat for birds and wildlife, although low water conditions and the numerous oil wells in the area may discourage a number of species that would normally be expected.

The biologic environment in the Gulf of Mexico surrounding the proposed brine diffuser location is described in Section 3.3.5.2.

3.5.6 Natural and Scenic Resources

There are no recreational facilities on the West Columbia dome site, but the Varner-Hogg Plantation State Park is located about one-half mile east of the site's eastern boundary. This park is an important historic area preserving buildings and artifacts dating from the early settlement of Texas. There are several urban recreation facilities in the town of West Columbia, approximately one mile southeast of the site. East of the Varner-Hogg State Park, a golf course straddles Varner Creek.

The project site itself contains no unique scenic resources, being typical of coastal prairies and rangelands found throughout the county. Surrounding areas have been extensively developed for oil and gas production. The area along Varner Creek east of the site is partially wooded and has greater aesthetic appeal than West Columbia dome.

3.5.7 Archaeological, Historical, and Cultural Resources

The candidate site does not contain any known sites of archaeological, historical, or cultural significance. If this site is selected for SPR development, a qualified archaeologist will survey it for DOE, and coordinate with the State Historical Preservation Officer.

3.5.8 Socioeconomic Environment

Land Use Patterns

The West Columbia dome alternative SPR site is located approximately one mile north of the town of West Columbia, just south of the West Columbia Oil Field. The lands surrounding the site are used predominantly for range and pasture, and for oil and gas production. In West Columbia, land uses are essentially urban-residential-commercial.

The Varner-Hogg State Park, a wildlife refuge, is located one-half mile east of the site. An area of freshwater marsh is also reported, to the east of the site.

Transportation Systems

The site is located approximately one mile north of West Columbia just east of State Route 36. A well-maintained shell road connects the site with Route 36. There are few roads within the boundaries of the site itself, but lightly traveled roads, used for the existing oil development, nearly encircle the site just outside its perimeter.

Population Characteristics

Although there are a few residences along the gravel road just south of the site and along Rouge 36 about a quarter of a mile southeast of the site, the closest urbanized area is the town of West Columbia.

Housing

West Columbia has a severe shortage of housing, and many wishing to move into the area must wait for units to be constructed to accommodate them. This area is expected to double its population within the next decade.

Economy

Most West Columbia residents are dependent on the county's petro-chemical industry either locally or in the Freeport area. There is an active retail center in the city to serve area residents. Agriculture in the surrounding prairies also provides some local income.

Public Services

Major health-care services for West Columbia are provided primarily by facilities in the Brazosport area, but hospital facilities are also available in Sweeny and Angleton. The West Columbia dome site will be served by the West Columbia volunteer fire department, which has mutual assistance agreements with other volunteer brigades in the county. Police services would be provided by the Brazoria County Sheriff's Office, in conjunction with the Texas Department of Public Safety, which patrols state highways and handles traffic-related calls.

3.6 DAMON MOUND ALTERNATIVE SITE

3.6.1 Land Features

3.6.1.1 Physiography and Topography

Damon Mound is one of the most conspicuous topographic features of the Gulf Coastal Plain in Texas. It rises some 80 feet above the surrounding countryside to a maximum elevation of 146 feet. The dome is broad and its flanking slopes are consequently gentle.

3.6.1.2 Local Geology

Damon Mound salt dome is elliptical in plan view, with a broad, fairly flat top. The highest elevation of the top of the salt mass ranges from 527 to 600 feet below sea level.

A pattern of faulting associated with the dome has a major northwesterly trend which parallels the dome's major axis. In addition, at least eight radial faults have been interpreted along the southern perimeter of the dome.

The quality of the salt dome is unknown at this time, but it is probable that it is similar in composition to that found at Bryan Mound (Section 3.3.1.2).

The caprock at Damon Mound is about 380 feet thick. The major constituents include gypsum and limestone. A thin, discontinuous horizon of anhydrite-rich gypsum often is found between the limestone and gypsum. Sulfur is found scattered in thin horizons through the gypsum and anhydrite-rich gypsum horizons.

Well records show that the caprock reaches to within 68 feet of the surface, but it may actually extend to the surface on the northwest and east sides of the dome, where limestone and gypsum similar to caprock materials have been mined and quarried.

Although it is unclear whether the caprock extends to the surface at Damon Mound, it is known that the sedimentary rock sequence over the dome is very thin. Sedimentary rocks extend to great depths all around the dome. Local disturbance around the dome includes tilting and faulting of the sedimentary strata.

3.6.1.3 Economic Geology

Oil was first produced at Damon Mound in 1915. Production has been largely confined to the dome's eastern and western rims. Oil and gas are thought to occur in Oligocene and Miocene sediments which are faulted or pinched out against the sides of the dome. No known oil or gas production is located over the top of the dome in the area proposed for the storage facility.

Dresser Minerals, Inc., has opened a limestone quarry on Damon Mound adjacent to the proposed crude oil storage site. The limestone, used for road fill, is of poor quality.

3.6.1.4 Soils

Soils at the Damon Mound site are assigned to the Lake Charles-Edna-Bernard association. Marine sediments offshore Bryan Mound are described in Section 3.3.1.4.

3.6.2 Water Environment

3.6.2.1 Surface Water Systems

The Damon Mound alternative SPR site is located between the Brazos and San Bernard Rivers, in the San Bernard River drainage basin. Site drainage is to Mound Creek, one mile to the north. This creek flows south-southeasterly to join the San Bernard River about four miles west of the town of West Columbia. No streamflow measurements are available for Mound Creek.

Approximately 7 miles north of the town of West Columbia lies the source of Varner Creek, intermittent in this area. It joins the Brazos River approximately 1.5 miles east of West Columbia. Bell Creek lies approximately 1.5 miles south-southwest of the town of West Columbia. Bell Creek flows generally westerly at this location, and merges with the San Bernard River about one mile further downstream. No streamflow measurement or water quality data are available for Bell Creek or Varner Creek. The proposed pipeline route also crosses the Brazos River Diversion Channel and Jones Creek.

The marine conditions in the area of the proposed brine diffuser are discussed in Section 3.3.2.1.

3.6.2.2 Subsurface Water Systems

The base of the Chicot aquifer is about 800 feet below sea level in the vicinity of the dome. Fresh water does not occur in the material over the dome, and slightly saline water occurs to an elevation about 100 feet below sea level. The base of the slightly saline water extends to a depth of 900 feet about one mile from the dome. The water in the formations adjacent to the dome and the caprock is highly mineralized. Aquifers in the vicinity of Damon Mound are capable of delivering large quantities of slightly to moderately saline water.

Ground water use in the vicinity of Damon Mound does not appear to be extensive. The hydraulic gradient is essentially flat in both the upper and lower units of the Chicot aquifer near the site. Local use of ground water is probably currently limited to rural domestic pumpage and stock watering.

3.6.3 Climatology and Air Quality

3.6.3.1 Climatology

Damon Mound is one of the two most inland sites of the Seaway Group, and the one with the highest average elevation. Like the West Columbia area, the Damon Mound area experiences light south to southeast winds, large diurnal temperature ranges and lower humidity, a higher frequency of stable conditions, and less tropical storm effects than the coastal areas described in Section 3.3.3.1.

3.6.3.2 Air Quality

Damon Mound site is situated near the small, primarily residential town of Damon. Oil production activity around the dome is the primary local source of pollutants, while the occasional influx of air from heavily industrialized areas northeast of the site may occasionally contribute to high concentrations of pollutants. The existing air quality conditions are considered to be equivalent to those at Freeport (i.e., generally low levels with the exception of hydrocarbon and oxidant concentrations).

3.6.4 Background Ambient Sound Levels

The small town of Damon overlies a portion of Damon Mound on the east. A limestone quarry, active since 1975, lies on the western portion of the mound. Blasting and digging activities are associated with the quarry, plus truck movements on an access road skirting the north portion of the site. These activities strongly influence sound levels in the area. Background ambient sound levels of 54-56 dB are estimated for the town of Damon, which contains the principal noise-sensitive land use areas.

3.6.5 Ecosystems and Species

3.6.5.1 Ecosystems

The area surrounding the Damon Mound alternative SPR site includes pastureland as well as industrial and residential developments. The coastal prairie ecosystem makes up a major portion of the site itself (Table 3.2-2), but scattered oak woodlands (consisting of scrubby, immature hardwood species) are also found there. Significant industrial and residential development on and near the site have affected the area's natural ecosystems, and the available surface habitat is largely urban (the town of Damon).

The only aquatic habitat on Damon Mound are a few very small ponds and several intermittent creeks. During the spring these creeks drain into Mound Creek, about one mile north of the site.

The biologic environment in the Gulf of Mexico surrounding the proposed brine diffuser site is described in Section 3.3.5.2.

3.6.5.2 Species

The coastal prairie habitat at the site is heavily grazed. The general urban and industrial setting has affected the number and diversity of birds and other species found there. The few wooded areas on the site are not large enough to support large wildlife populations.

3.6.6 Natural and Scenic Resources

The area surrounding the Damon Mound site has few natural or scenic resources. Most of the Mound itself is used as pastureland or for petroleum production, neither of which provides unique or valuable scenic resources. The southern and southeastern areas near the town of Damon have greater aesthetic appeal due to gentle, wooded slopes of the dome. The surrounding countryside is very flat, but contains wooded areas interspersed with pasture and croplands. The San Bernard River is located approximately one mile west of Damon Mound.

The area on the southwestern edge of the site was stripped during previous mining operations, and a limestone quarry is presently operating adjacent to the site.

There are no major recreation areas located near the project site.

3.6.7 Archaeological, Historical, and Cultural Resources

The candidate site does not contain any known sites of archaeological, historical, or cultural significance. If this site is selected for SPR development, a qualified archaeologist will survey it for DOE, and coordinate with the State Historical Preservation Officer.

3.6.8 Socioeconomic Environment

Land Use Patterns

Land uses in the vicinity of the Damon Mound alternative SPR storage site include mineral extraction, agriculture and pasture, residential and forest. The land overlying Damon Mound itself is used primarily for cattle grazing; land adjoining to the north is predominantly cultivated. The land immediately west of the site is presently being used for quarrying operations.

Transportation Systems

The Damon Mound site is easily accessible from State Route 36 just east of Damon. Direct access to the proposed site is provided by gravel roads servicing the Damon Mound Oil Field west of the site.

Population Characteristics

The small town of Damon is the nearest population center to the site.

Housing

Damon is the residential area closest to the site. Other nearby residential areas include Needville, in Fort Bend County, and West

Columbia. Although housing in Brazoria County is generally limited, the northern portion of the county, around Damon, has a higher vacancy rate than the southern portion.

Economy

There are very few employment opportunities within the area immediately surrounding the site. Nearby industries are related to agricultural production, mineral extraction and retail sales. The Damon area is not expected to experience significant economic growth within the foreseeable future.

Public Services

There are four hospitals located within 20 miles of Damon Mound: the Polly Ryan Hospital in Richmond; the Texas Gulf Sulphur Company Hospital in Wharton County; the Angleton-Danbury General Hospital; and the Sweeny Community Hospital. The Damon area is dependent on these facilities for its major medical services.

Supplementary police services for the Damon Mound site can be provided by the Brazoria County Sheriff's Office, since deputies from this department regularly patrol the area. Calls for police services involving traffic or accidents on state highways are handled by the Texas Department of Public Safety. Fire protection can be provided by the volunteer Damon Fire Department, which handles all fires within a 10-mile radius. Mutual assistance agreements are in effect with surrounding volunteer fire departments.

3.7 NASH DOME ALTERNATIVE SITE

3.7.1 Land Features

3.7.1.1 Physiography and Topography

Nash dome is in the prairie terrace of the Gulf Coastal Plain. Average elevation in the area is about 50 feet, but a slight mound over the dome itself rises to a maximum elevation of 58 feet.

3.7.1.2 Local Geology

Nash salt dome is an elliptical, shallow-lying structure with a relatively flat top and steep sides. The broad, almost flat top lies at about 950 feet below sea level and an estimated 600 to 900 feet of Pleistocene and Recent age sediments overlie the dome.

Major faulting associated with the dome exhibits a typical radial pattern.

The quality and composition of the salt mass is probably similar to that at Bryan Mound (Section 3.3.1.2). Composition of caprock overlying the Nash dome is unknown; studies of other domes suggest that gypsum and anhydrite comprise most of the caprock, but sulphur is present in commercial quantities.

3.7.1.3 Economic Geology

The petroleum deposits around Nash dome were the first discovered in the United States by geophysical methods. Oil was first produced there in 1926. Interpretation of the salt structure indicates that the oil occurs primarily on the southern flank of the dome. Deposits are concentrated in Miocene age sands and limestones which are faulted or pinched out against the sides of the dome. No known oil or gas production is located over the top of the dome in the area proposed for the storage facility.

Freeport Sulphur Co., using the Frasch process, has recovered sulphur from some 50 acres on the southwest rim of the caprock.

3.7.1.4 Soils

Soils in the vicinity of the Nash dome belong to the Lake Charles-Edna-Bernard association. Sediments offshore Bryan Mound are described in Section 3.3.1.4.

3.7.2 Water Environment

3.7.2.1 Surface Water Systems

Surface water runoff from the Nash dome alternative SPR site is to Cow Creek (one mile to the south) and Turkey Creek (one mile to the north). No streamflow data are available for either stream, but they are both classified as intermittent by the U.S. Geological Survey. The two creeks merge about one mile east of the site, and the combined flow reaches the Brazos River about 3-1/2 miles east of the site. The marine conditions in the area of the proposed brine diffuser are discussed in Section 3.3.2.1.

3.7.2.2 Subsurface Water Systems

Nash dome penetrates through the Evangeline aquifer and into the Chicot aquifer. The base of the Chicot aquifer is about 700 feet below sea level in the vicinity of the dome. Fresh water occurs in about the upper 600 feet of material over the dome. Slightly saline water occurs from about 600 to 1000 feet.

About one mile from the dome, the base of the slightly saline water extends to a depth of 1200 feet. The water in the formations adjacent to the dome and the caprock is highly mineralized. Aquifers in the vicinity of Nash dome are capable of supplying large quantities of slightly to moderately saline water.

Ground water use in the vicinity of the Nash dome is apparently not extensive. Local use of ground water is probably limited to rural domestic pumpage and stock watering.

3.7.3 Climatology and Air Quality

3.7.3.1 Climatology

Nash dome is one of the two most inland sites of the Seaway Group, about 36 miles from the Gulf of Mexico. This area should experience lighter and more frequent south and southeast winds than the coastal areas described in Section 3.3.3.1. Humidity is expected to be slightly lower and diurnal temperature ranges greater than along the coast. Tropical storm effects are significantly less than along the coast.

3.7.3.2 Air Quality

Oil production activity around Nash dome is the primary local source of pollutants, while the occasional influx of air from heavily industrialized areas northeast of the site may occasionally contribute to high concentrations of pollutants. The existing air quality conditions are considered to be equivalent to those at Freeport (i.e., generally low levels with the exception of hydrocarbon and oxidant concentrations).

3.7.4 Background Ambient Sound Levels

The Nash dome site is virtually unpopulated. Aside from a small number of oil wells, the principal noise sources are insects and animals and the wind. Average day/night sound levels of less than 50 dB are estimated for the area.

3.7.5 Ecosystems and Species

3.7.5.1 Ecosystems

The Nash dome alternative SPR site generally consists of croplands and pastures, but a number of active oil fields surround the site. Coastal prairie and fluvial woodland ecosystems are also present (Table 3.7-1), but water impoundments and industrial developments on and in the immediate vicinity of the dome (especially to the south) have markedly affected large areas.

The proposed pipeline right-of-way to the Nash dome site will cross coastal prairies, fluvial woodlands, inland waterways and cleared lands.

The biologic environment surrounding the proposed brine diffuser location is described in Section 3.3.5.2.

3.7.5.2 Species

The local croplands and pastures provide only limited habitat for birds and wildlife. Few mammal species are likely to inhabit the cleared agricultural areas found on Nash dome since little food or cover is available.

The small onsite ponds are steep-banked and have no emergent aquatic vegetation, but some of the ponds and Cow Creek to the south may support small fish populations.

3.7.6 Natural and Scenic Resources

There are few natural and scenic resources in the area surrounding Nash dome. The area south of the site, along Cow Creek contains some wooded areas. The site itself and much of the surrounding countryside is used for agricultural production and pastureland. The site is very flat and contains few trees.

3.7.7 Archaeological, Historical, and Cultural Resources

The candidate site does not contain any known sites of archaeological, historical, or cultural significance. If this site is selected for SPR development, a qualified archaeologist will survey it for DOE, and co-ordinate with the State Historical Preservation Officer.

3.7.8 Socioeconomic Environment

Land Use Patterns

The Nash dome alternative SPR site is perhaps the most rural of the Seaway Group sites. Land uses in the vicinity include pastureland, agricultural cropland, limited residential development, forests, and petroleum production. Areas north and east of the site are classified as agricultural but significant acreages are presently out of cultivation. The area south of Nash dome is primarily used for oil and gas production.

Transportation Systems

Access to the site from State Highway 36 is provided via lightly traveled county roads.

Population Characteristics

The closest area of concentrated population is the town of Damon, and there are a few widely spaced residences in the vicinity of Nash dome.

Housing

The nearest available housing to Nash dome is in Damon, in Brazoria County, and Needville in Fort Bend County.

Economy

Economic activities near Nash dome are essentially the same as those discussed for Damon Mound (Section 3.6.8).

Public Services

Medical services for the Nash dome site would be available in Richmond, or from the facilities listed for Damon Mound (Section 3.6.8). Supplementary police services could be provided by the Fort Bend Sheriff's Department, headquartered in Richmond. Fire protection services could be provided by the Damon Fire Department (Section 3.6.8).

3.8 SUMMARY

Proposed and alternative sites for the Seaway Group SPR include five shallow salt domes where existing cavities and/or new solution-mined caverns could feasibly be used to store crude oil. All are within a 35-mile radius of the port facilities at Freeport Harbor and the oil distribution facilities associated with the port and the SEAWAY Pipeline.

The Seaway Group sites are located on the seaward margin of the Texas Gulf Coastal Plain. Surface relief is subtle, with a general slope toward the Gulf of Mexico. Elevations within the region range from sea level to 146 feet. The origin of the salt domes is in the Louann (Gulf Coast) Salt formation, a large evaporite deposit which extends throughout the Gulf coastal region from western Florida to Texas. At least 500 salt domes are known to occur in the Louann Basin. Oil, gas, salt and sulphur are the main economic minerals associated with these salt domes.

Surface water in Brazoria County comes from the major rivers, the Brazos and the San Bernard, and inundated coastal areas. Water for this project could be supplied by surface sources. Circulation in the nearshore Gulf of Mexico is predominantly wind-driven; there is a significant probability of stagnation during all seasons.

Ground water is heavily exploited by the major metropolitan centers in southeast Texas, and surface subsidence resulting from the large withdrawals extends into the vicinity of some of the proposed storage sites. Sufficient water is available in deep saline aquifers to meet the requirements of this project. Brine disposal to deep saline water bearing sands is possible in this region since available data suggest that there is an extensive thickness of suitable sands at depths below 5000 feet.

Air quality in Brazoria County is generally good, with the exception that non-methane hydrocarbon and photochemical oxidant concentrations sometimes exceed national and State standards. The intense local development of petroleum production and petrochemical industries is probably the chief cause of these occasional concentrations. At times, wind conditions will introduce pollutants from the heavily industrialized areas to the north and northwest.

Noise sources in the area vary from site to site and range from the industrialized sources near Bryan Mound to the rural, agricultural sources near Nash dome.

Local ecosystems at the sites are typical of the Texas coastal plain and include coastal prairies and marshlands, fluvial and oak woodlands, agricultural and cleared lands, beaches and shell ramp-barrier flats. Inland and coastal waters and all terrestrial ecosystems are productive.

Natural and scenic resources in the area include major wildlife management areas and extensive public beaches. The San Bernard and Brazoria Wilflife Refuges are major natural preserves in the area.

The Brazosport, Houston and Texas City-Galveston areas are the major socioeconomic units directly affected by the project. All these areas are experiencing relatively low unemployment and recent economic growth, especially in the petrochemical industries.

CHAPTER 4.0

ENVIRONMENTAL IMPACTS OF THE PROPOSED AND ALTERNATIVE ACTIONS

4.1 INTRODUCTION

The purpose of this section is to describe the impacts the proposed action or the alternatives could have on the local or regional environment. Impacts have been addressed on the basis that the facilities would be built, and that five cycles of storage would occur during the 20-25 year life of the program. As discussed before, the existence of the strategic reserve should reduce the likelihood of severe petroleum supply interruptions. The assessment is thus based on a "worst case" assumption.

Risks related to the storage and transportation of oil and brine for the proposed and alternative SPR storage sites are summarized in Section 4.2. Impacts associated with construction and operation at the proposed site (Bryan Mound) are presented in Section 4.3; impacts associated with the four alternate sites are described in Sections 4.4 through 4.7. Circumstances which offset, wholly or in part, any negative environmental impacts of the project development are presented in Section 4.8. A summary of the most significant negative and beneficial impacts of developing any of the five site alternatives is contained in Section 4.9.

A detailed description of environmental impacts of the Seaway Group SPR program appears in Appendix C of this report. Reference citations are included in Appendix C.

4.2 SPR OIL AND BRINE SPILLS FOR THE CANDIDATE STORAGE SITES

Oil spills that might accompany development of SPR storage facilities could occur during marine transport between the open Gulf of Mexico and the DOE docks at Freeport, during pipeline transport between the docks and the storage sites, and during terminal operations at the storage sites or the SEAWAY Tank Farm. The risk of cavern collapse is considered remote. Estimates of spill frequencies and the total spill volumes projected for five ("worst case") cavern fill and cavern withdrawal operations are provided in Tables 4.2-1 and 4.2-2, respectively, for the Bryan Mound early storage development and for the SPR expansion at each candidate site. Because exposures are similar, projected oil spill frequencies and volumes are basically functions of storage capacity. Thus, a 163 MMB storage capacity at any combination of sites would produce roughly 2.6 times as much oil spillage as the Bryan Mound early storage site alone (163 MMB/63 MMB). Some additional exposure would result were Allen dome, West Columbia dome, Damon Mound or Nash dome developed rather than Bryan Mound expansion, because of greater pipeline lengths and the additional terminal facility risks, but the difference is not great.

A summary of brine and raw water* spill risk expectation for the Bryan Mound early storage development and SPR expansion at each candidate site is provided in Table 4.2-3 for leaching, oil fill, oil withdrawal, and standby storage. Brine spill exposures occur from pipelines during leaching and oil fill and are greatest during cavern fill. Raw water spill exposures occur from pipelines during leaching, oil withdrawal, and standby storage, and are greatest during standby storage because of the assumed continuous exposure. Total projected spillages of brine and raw water are primarily dependent on site selection, since pipeline length is the principal exposure parameter.

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*The term "raw water" is used to denote that drawn from the Brazos River Diversion Channel for cavern leaching and oil withdrawal operations. It normally is fresh water but, during periods of low river flows, it could become slightly to moderately brackish as a higher proportion of water from the Gulf enters the raw water intake structure.

TABLE 4.2-1 Oil spill expectation model projections - cavern fill operations.

Oil Handling Mode/Location	Average Spill Size (bbl)	Bryan Mound Early Storage		Bryan Mound SPR Expansion		Allen Dome SPR Expansion		West Columbia SPR Expansion		Nash Dome SPR Expansion		Damon Mound SPR Expansion		Total Program[a] Spill Risk		Maximum Credible Spill Size (bbl)
		No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	
Gulf																
-Transfers	12.9	14.6	189	23.2	300	23.2	300	23.2	300	23.2	300	23.2	300	37.8	489	1,000
-Vessel Casualty	1111	0.018	20	0.029	32.2	0.029	32.2	0.029	32.2	0.029	32.2	0.029	32.2	0.047	52.2	60,000
Freeport Harbor																
-Transfers	21.7	2.9	63	4.6	100	4.6	100	4.6	100	4.6	100	4.6	100	7.5	163	500
Terminals																
-Bryan Mound	500	0.0315	15.8	0.05	25	0.05	25	0.05	25	0.05	25	0.05	25	0.0815	40.8	5,000
-SEAWAY	1100	---	---	---	---	0.05	55	0.05	55	0.05	55	0.05	55	0.05	55	5,000
-Alternative Storage Site	500	---	---	---	---	0.05	25	0.05	25	0.05	25	0.05	25	0.05	25	5,000
Pipelines																
-Pumping[b]	1100	0.0005	0.6	---	---	0.0063	6.9	0.0158	17.3	0.0252	27.7	0.0252	27.7	0.0257	28.3	10,000
Total - Single Fill	---	17.6	288.4	27.9	457.2	28.0	544.1	28.0	554.5	28.0	564.9	28.0	564.9	45.6	853.3	
Total - 5 Fills	---	87.8	1442.0	139.5	2286.0	140.0	2720.5	140.0	2772.5	140.0	2824.5	140.0	2824.5	228.0	4266.5	

[a] Totals are for worst case combination of sites having 163 MMB storage capacity, i.e., Bryan Mound early storage and Nash or Damon Mound SPR expansion.

[b] No pipeline spills are allocated to Bryan Mound SPR expansion as oil would be exposed to spillage due to standby storage with early storage facility. For other SPR sites, pipeline spill exposures occur between site and Seaway Terminal.

TABLE 4.2-2 Oil spill expectation model projections - cavern withdrawal operations[a] and project totals.

Oil Handling Mode/Location	Average Spill Size (bbl)	Bryan Mound Early Storage		Bryan Mound SPR Expansion		Allen Dome SPR Expansion		West Columbia SPR Expansion		Nash Dome SPR Expansion		Damon Mound SPR Expansion		Total Program[b] Spill Size		Maximum Credible Spill Risk (bbl)
		No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	
Gulf																
-Transfers	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
-Vessel Casualty	1111	0.0028	3.1	0.0045	5	0.0045	5	0.0045	5	0.0045	5	0.0045	5	0.0073	8.1	60,000
Freeport Harbor																
-Transfers	42	1.2	50.4	1.9	80	1.9	80	1.9	80	1.9	80	1.9	80	3.1	130.4	500
Terminals																
-Bryan Mound	500	0.0315	15.8	0.05	25	0.02	10	0.02	10	0.02	10	0.02	10	0.0515	25.8	5,000
-SEAWAY[c]	1100	0.0189	20.8	0.03	33	0.05	55	0.05	55	0.05	55	0.05	55	0.0689	75.8	5,000
-Alternative Storage Site	---	---	---	---	---	0.05	25	0.05	25	0.05	25	0.05	25	0.05	25.0	5,000
Pipelines																
-Pumping[d]	1100	0.0008	0.9	---	---	0.0016	1.8	0.0041	4.5	0.0066	7.2	0.0066	7.2	0.0074	8.1	10,000
Total - Single Withdrawal	---	1.2	91.0	1.7	124.3	2.03	176.8	2.03	179.5	2.03	182.2	2.03	182.2	3.29	273.2	
Total - 5 Withdrawals	---	6.3	455.0	8.4	621.5	10.1	884.0	10.1	897.5	10.1	911.0	10.1	911.0	16.4	1366.0	
Project Total - 5 Cycles	---	94.1	1897.0	147.9	3001.0	150.1	3604.5	150.1	3670.0	150.1	3735.5	150.1	3735.5	244.2	5632.5	
Project Total with Oil Stored in Pipeline	---	94.1	1930	147.9	3001.0	150.2	3657.7	150.2	3803.0	150.3	3948.5	150.3	3948.5	244.4	5878.5	

[a] During withdrawal it is assumed that about 40 percent of the oil is shipped by tanker to the Gulf and about 60 percent is delivered to the SEAWAY Pipeline.

[b] Totals are for worst case combination of sites having 163 MMB storage capacity, i.e., Bryan Mound early storage and Nash or Damon SPR expansion.

[c] For worst case exposure calculations, it is assumed that all oil pumped from Allen, West Columbia, Nash, and Damon Mound sites is subject to SEAWAY Terminal spill risks.

[d] No pipeline spills are allocated to Bryan Mound SPR expansion as oil would be exposed to spillage due to standby storage with early storage facility. For other SPR sites, pipeline spill exposures occur between site and SEAWAY Terminal.

TABLE 4.2-3 Brine and raw water spill[a] expectation model projections during project lifetime.

TABLE 4.2-3 Expected brine spills[a] during project lifetime.

Storage Facility		Leaching				Cavern Fill				Standby Storage			
		Brine		Raw Water		Brine		Raw Water		Brine		Raw Water	
		Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore
Bryan Mound	No. Spills	-	-	-	-	0.0125	0.0025	-	-	0.0035	0.0016	0.0078	.0035
Early Storage	Barrels	-	-	-	-	62.5	12.5	-	-	18	8	39	17
Bryan Mound	No. Spills	0.01	0.002	-	0.001	0.0195	0.0040	-	-	0.0043	0.0019	b	b
SPR Expansion	Barrels	50	10	-	5	97.5	20.1	-	-	21	9	b	b
Allen Dome	No. Spills	0.01	0.024	-	0.023	0.0195	0.047	-	-	b	0.0717	b	0.0707
SPR Expansion	Barrels	50	120	-	120	97.5	235	-	-	b	359	b	359
West Columbia	No. Spills	0.01	0.048	-	0.047	0.0195	0.091	-	-	b	0.15	b	0.15
SPR Expansion	Barrels	50	240	-	235	97.5	455	-	-	b	750	b	750
Nash Dome	No. Spills	0.01	0.072	-	0.071	0.0195	0.142	-	-	b	0.237	b	0.237
SPR Expansion	Barrels	50	360	-	355	97.5	710	-	-	b	1142	b	1142
Damon Mound	No. Spills	0.01	0.072	-	0.071	0.0195	0.142	-	-	b	0.237	b	0.237
SPR Expansion	Barrels	50	360	-	355	97.5	710	-	-	b	1142	b	1142
Total Program	No. Spills	0.01	0.072	-	0.071	0.032	0.1445	-	-	0.0078	0.2410	0.0078	0.2410
Spill Risk[c]	Barrels	50	360	-	355	160	723	-	-	39	1160	39	1160

Storage Facility		Oil Withdrawal				Project Lifetime			
		Brine		Raw Water		Brine		Raw Water	
		Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore
Bryan Mound	No. Spills	-	-	-	0.0005	0.0160	0.0041	0.0155	0.0076
Early Storage	Barrels	-	-	-	2.5	80.5	20.5	78	37.5
Bryan Mound	No. Spills	-	-	-	b	0.0338	0.0079	b	0.001
SPR Expansion	Barrels	-	-	-	b	160.5	39.1	b	5
Allen Dome	No. Spills	-	-	-	0.0115	0.0295	0.143	b	0.178
SPR Expansion	Barrels	-	-	-	57.5	147.5	714	b	895
West Columbia	No. Spills	-	-	-	0.0235	0.0295	0.289	b	0.371
SPR Expansion	Barrels	-	-	-	117.5	147.5	1445	b	1853
Nash Dome	No. Spills	-	-	-	0.036	0.0295	0.451	b	0.582
SPR Expansion	Barrels	-	-	-	180	147.5	2212	b	2910
Damon Mound	No. Spills	-	-	-	0.036	0.0295	0.451	b	0.582
SPR Expansion	Barrels	-	-	-	180	147.5	2212	b	2910
Total Program	No. Spills	-	-	-	0.0365	0.0498	0.458	0.0155	0.5896
Spill Risk[c]	Barrels	-	-	-	183	249	2243	78	2948

[a]Average spill from brine pipelines taken to be 5000 barrels; maximum credible spill taken to be 30,000 barrels; computed for five cavern fill/withdrawal operations.

[b]Losses from these SPR operations would occur in any case as a result of Bryan Mound early storage and are attributed to these facilities.

[c]Program totals are for worst case combination of sites having 163 MMB storage capacity, i.e., Bryan Mound early storage and Nash or Damon Mound SPR expansion.

4.3 PROPOSED SITE FOR SPR EXPANSION - BRYAN MOUND

The site proposed for expansion of 100 MMB SPR storage capacity in the Seaway Group is Bryan Mound, which was previously selected for early storage phase development of 63 MMB of existing cavern space. The environmental impacts of construction and operation of early storage phase facilities, including storage of 63 MMB of oil in four existing salt dome cavities, were addressed in FES 76/77-6 and its July 1977 Draft Supplement.

4.3.1 Impact of Site Preparation and Construction

4.3.1.1 Land Features

Proposed Facilities

Grading and excavation at the expanded Bryan Mound SPR storage site would be confined to about 36 acres (Table 2.3-1); most of it in areas already disturbed. Early storage phase facilities will be used when possible.

Construction of the new DOE tanker docks in Freeport Harbor would require an estimated 1,050,000 cubic yards (cy) of dredging from the harbors and about 14 acres of dock-site grading. As these facilities would be constructed on disturbed land, the impacts would not be significant. Suitable approved locations for spoil disposal are available nearby.

Construction of the brine diffuser 5.8 miles offshore from Bryan Mound would affect 21 acres of coastal prairie, marshland and beaches, and 142 acres of Gulf bottom. About 38,000 cy of soil onshore and 139,000 cy of soil offshore would be disturbed.

About 6000 cy of material would be temporarily displaced during installation of a pipeline between the DOE early storage phase oil distribution pipeline and Brazos Harbor (Figure 2.1-1). This activity would temporarily disrupt about four acres of marshland.

Leaching of up to 12 storage cavities in the Bryan Mound salt dome would involve removal of 100 MMB (20.8×10^6 cy) of salt. Sufficient space would be left between cavities to preserve structural integrity.

Alternative Facilities

The alternative brine disposal system calling for injection into deep salt water bearing sands would require the disturbance of 61 acres off-site to construct the drill pads and pipelines for 19 additional brine injection wells. About 57,000 cy of material would temporarily be excavated for pipeline installation and about 61,000 cy of fill would be placed for the access roadways and wellhead pads. The alternative disposal plan calling for sale of the brine to Dow Chemical Co. would require no new pipelines or excavation, as existing pipelines could be utilized.

Another disposal plan would call for a brine diffuser 12.5 miles offshore from Bryan Mound. Construction would temporarily disrupt 326 acres, all but 21 of which would be offshore, and require 97,300 cy of excavation over that required for the 5.8 mile diffuser.

The alternative raw water supply from Dow's Harris and Brazoria Reservoirs would require temporary excavation of about 32,000 cy of material in a 37-acre right-of-way (along existing pipeline rights-of-way) to install an additional pipeline from Dow's plant "B." Development of raw water wells to tap the Evangeline aquifer would disturb 69 acres and require 57,000 cy of excavation for pipelines.

On-site power generation would require minimal additional land disturbance. This disturbance would be restricted to the plant area.

Use of the Phillips docks for oil distribution would require installation of a short pipeline segment, requiring excavation of an estimated 2500 cy of material on 6 acres of land. Conversion of the SEAWAY Docks for loading tankers would require minimal amounts of site grading. Construction of an SPM monobuoy for VLCC tanker offloading in the Gulf of Mexico would require a 30-mile pipeline to 100-foot water depths. An estimated 369,000 cy of material would be excavated along a 727-acre right-of-way. Monobuoy installation would affect a negligible area.

4.3.1.2 Water

Site preparation and construction of the proposed facilities at Bryan Mound may impact several water bodies, including the onsite lakes, the Intracoastal Waterway, the Brazos River Diversion Channel, Freeport Harbor, the Gulf of Mexico, and various ground water aquifers.

Raw Water Withdrawal

Water for leaching the caverns would be obtained from the intake on the Brazos River Diversion Channel constructed for the early storage phase of SPR development. Withdrawal of a maximum of 534,000 B/D (36 cfs) would be required. Normal river flows range from about 400 cfs to 20,000 cfs. Under extreme low flow conditions (40 cfs), tidal dynamics in the Brazos Estuary promote the inshore flow of Gulf water, increasing the salinity of the lower Brazos River. Even under these conditions, however, the additional impact of raw water withdrawals on water quality is expected to be negligible.

Brine Disposal

Construction of the pipeline to the brine diffuser would locally increase turbidity and resuspend nutrients and trace metals in the sediments. The effects are expected to be minor due to their short duration and limited areal extent. During cavern leaching, a maximum discharge of approximately 684,000 B/D of brine would be released to the Gulf of Mexico (leaching new caverns while simultaneously filling the existing early storage phase caverns). Brine would be discharged through a diffuser in 50 feet of water, five miles south of Bryan Beach. Possible impacts on water quality in the Gulf of Mexico were determined by computer simulation analyses coordinated by NOAA (Appendix G) and summarized in the draft Supplement to FES 76/77-6 (July, 1977). Results showed that current velocities have only a moderate effect on maximum predicted salinity levels in the far field, but greatly influence the shape of the salinity plumes. Strong currents produce long, narrow plumes; salinity concentrations near the diffuser are relatively low. During stagnant conditions, the plume remains close to the diffuser and concentrations are generally higher due to salinity build-ups (to a maximum of about 4 ppt excess salinity in the immediate vicinity of the diffuser).

In addition to increasing salinity the discharged brine would also locally alter ambient ion concentrations and ratios. Oil concentrations are expected to average 6 ppm over the life of the diffuser, slightly above ambient. For a discussion of the oil in brine analysis see Appendix D. These effects would have a minor impact beyond the 25 acres most intensely affected by the brine.

The back-up brine disposal system would inject brine into deep, salt water bearing sands, where it is expected that the dense brine would flow downward and not mix extensively with water in the receiving formation. Because of the intended depth of injection, the possibility that fresh water aquifers would be affected by upward migration or leakage of the brine is considered remote. No impacts on water supplies are anticipated.

Construction of DOE Docks

Dredging at the two DOE tanker docks sites in Freeport Harbor (total of 1,050,000 cy) would cause a temporary increase in turbidity and a possible release of toxic sulfides, heavy metals, arsenic, pesticides or other pollutants in the bottom sediments. Most researchers have concluded that modern hydraulic dredging techniques have little effect on the water column directly overlying the sediments. Significant increases in any parameter have been reported only within 200 feet of the dredge.

The amount of dredging required for the new DOE docks is comparable to ongoing maintenance dredging in Freeport Harbor (over 1 million cy annually) and the proposed improvement of the Harbor channel (100 million cy). The impact of construction dredging for the DOE docks should therefore be negligible.

Construction of Surface Facilities at Bryan Mound

Site preparation and construction activities at Bryan Mound would require displacement of approximately 30,300 cy of soil on 36 acres of land. These soils are highly erodable and could affect the onsite lakes and the Intracoastal Waterway by increasing sedimentation and introducing chemicals from the soil or from construction activities. Standard engineering control techniques (interceptor ditches, dikes, and sedimentation ponds) would be utilized to prevent significant degradation of water quality from site runoff.

Accidental Brine Release

The estimated quantity of brine that could spill during leaching of Bryan Mound expansion cavities is up to 50 barrels into Gulf waters and up to 10 barrels on land or in water bodies between Bryan Beach and the storage site. In addition, an estimated 5 barrels of raw water could be lost from the raw water supply system. A maximum credible spill of up to 30,000 barrels of brine is considered possible, though very unlikely.

Local recharge of near-surface aquifers has been found to be minimal, so potential seepage from the membrane-lined brine pit or minor pipeline spills are likely to have negligible impact on water quality. A brine spill at the site or along the disposal pipeline could, however, locally impact shallow aquifers.

Hurricane surge studies indicate that the 100-year flood elevation at Bryan Mound is +12.0 feet MSL, excluding wave runup. As the brine pond would be protected by an existing levee of elevation +19 feet MSL, there is little likelihood of a storm-induced failure resulting in a release of brine. Should a storm surge of sufficient magnitude breach the levee, however, impacts caused by loss of the brine would be small compared to the attendant storm wave and salt water damage.

Alternative Facilities

Alternative systems to provide raw water for cavern leaching and oil displacement include: 1) supply from Dow Chemical Co.'s existing reservoirs; and 2) withdrawal of saline ground water from the Evangeline aquifer. Use of Dow's reservoirs would be feasible, since sufficient storage capacity is available, but an additional pipeline would have to be constructed between Dow's plant "B" and the Bryan Mound site. Development of a suitable well field would be feasible were it not for the problem of surface subsidence. Impacts that might result from withdrawal of such large quantities of water include lowering of the piezometric level in the pumped zone, land subsidence, and salt water intrusion.

Alternative brine disposal systems include: 1) using the brine to provide all or part of Dow's feedstock demand; 2) deep well injection into Miocene sands; and 3) a brine disposal pipeline to a 12.5 mile diffuser site in the Gulf of Mexico. Delivery of brine to Dow would have no environmental impacts from pipeline construction since the pipeline is presently in place. Brine spillage on the order of tens of barrels could be expected, however, during the life of the project. This alternative appears impractical at this time since Dow has been unwilling to accept brine at the rates and volumes necessary. The impacts of the 12.5 mile diffuser system on water quality would be similar to that experienced at the proposed site. Deep well injection of brine into salt water bearing sands would not affect potable water supplies unless confining aquifer beds should be fractured (resulting in upward displacement of saline water), or unless the brine migrates up improperly plugged wells. The proposed receiving formations range in depth from 3000 to 8000 feet, well below any aquifer containing fresh or slightly saline water; generally, the only wells extending to the depth of the injection zones are oil wells concentrated near the dome. No adverse impact on water supplies would be foreseen should injection be selected for brine disposal, but all deep wells in the disposal area would be investigated for potential migration of brine. Also, aquifer pressures would be monitored prior to and during brine injection.

Alternative crude oil distribution methods include: 1) use of Phillips or SEAWAY Docks in place of new DOE docks; and 2) construction of a marine pipeline and monobuoy. As no dredging would be required to use the industry docks, water quality impacts would be limited to minor quantities of erosion and release of construction wastes at the dock sites. Construction of the offshore SPM terminal facilities would produce significant local, but temporary, suspension of bottom sediments and trapped chemicals along the 30-mile pipeline right-of-way.

Onsite power generation would have relatively minor impacts on water resources. Minor quantities of cooling water would be taken from the Brazos River raw water supply system and could be discharged through the brine disposal pipeline to the Gulf.

4.3.1.3 Air Quality

The quality of the air in the vicinity of Bryan Mound would be only slightly affected during site preparation and construction. The sources of emissions would be short-lived and transient in nature.

Sources of Emission

The pollution sources which would affect air quality at the Bryan Mound site during construction include general construction vehicles, drilling rigs, and fugitive dust.

During a seven-month site preparation phase, there would be clearing operations, well drilling, landfill, pipeline laying and road construction. The diesel and gasoline engines used would emit hydrocarbons (HC), SO_2, CO, NO_2 and particulates. Accurate prediction of the drill rig and vehicular emissions during construction is difficult because these emissions depend upon many factors, including type, number, and model year of vehicles, duty cycle, average speeds, cold operation fractions and ambient temperatures.

Dust emissions from site construction activities would be associated with land clearing, excavation and cut and fill operations. Amounts would vary from day to day, depending on the activity and the weather. A large portion would be caused by equipment traffic over temporary roads.

Impacts on Air Quality

Downwind concentrations resulting from drill rig and vehicular emissions during construction would be small when compared to Federal or State standards. Even though the 3-hour hydrocarbon standard is often exceeded in this area, the addition of the low hydrocarbon concentrations due to construction activities would have very little impact on ambient air quality beyond about 1 km. In addition, impacts due to construction activities would be short term in nature and confined to a relatively small area.

The amount of dust produced would be relatively small because most of the on-site and access roads are surfaced. Most of the dust would settle within the site boundaries; fugitive dust escaping the site would not seriously impact the environment.

Alternative Facilities

Alternative sources of raw water would have some effect on construction emissions, since development of a ground water well field would increase drill rig emissions significantly (perhaps as much as a factor of two). Pipeline construction activities would cause some additional emissions. Since these emissions would occur away from the site, little interaction is expected, and air quality impacts would be essentially as described above.

Development of the alternative brine disposal systems with the exception of the 12.5 mile diffuser would increase construction emissions, but they would be relatively small, short term, and confined to a small area with little impact on ambient air quality.

Of the alternative methods of crude oil distribution, only construction of a marine terminal would significantly alter anticipated air quality impacts. Most construction would be several miles offshore, however, and associated emission levels should be no higher than for the storage site; effects on air quality in the Freeport area should be negligible.

4.3.1.4 Noise

Site preparation and construction activities at Bryan Mound would adversely impact ambient sound levels in the vicinity of the site. The source of the increased sound levels would be the conventional construction equipment - trucks, bulldozers, oil well drilling rigs, etc. - used to complete the SPR project.

Since typical noise levels associated with operation of the various types of equipment are known, it is possible to calculate a noise impact zone for each major construction activity associated with project development. The radius of this impact zone is the distance within which the assumed baseline day/night prefacility sound level (54 dB) would be raised at least 3 dB, a discernable amount, by the associated activity.

For the Bryan Mound site, these radii are:

Construction Activity	Noise Impact Zone Radius (ft)
Drilling new wells	4500
Laying of pipe	1800
Access road construction	1400
DOE dock construction	2200

All construction activity would be conducted during normal construction hours (early morning to mid-afternoon) except drilling, which is assumed to be continuous throughout a 24-hour day. The area impacted by construction noise at this site consists mostly of uninhabitated marshlands.

Dock construction would raise noise levels at areas along the uninhabited Intracoastal Waterway and at the Dow Chemical Co. plant. These are commercial and industrial zones, however, where prefacility day/night sound levels are expected to be higher than 54 dB. Some residences in the city of Freeport may be affected during construction of the docks, but the present industrial uses in the area and the short duration of construction would reduce this impact. Therefore, impacts due to dock construction would be negligible. Pipe laying and access road construction would impact areas for only a short duration, and since most of the pipeline runs through uninhabited marshlands, impacts would be negligible.

Construction of alternative brine disposal wells for the Bryan Mound site might temporarily impact some residences in the city of Freeport. Conversion of SEAWAY or Phillips docks would cause less noise generation than construction of the new DOE docks.

4.3.1.5 Ecosystems and Species

Site preparation and construction of the proposed SPR expansion at Bryan Mound would affect both terrestrial and aquatic biotic resources in the area. Terrestrial habitats potentially affected include cleared industrial land, coastal prairie, brackish marsh, and beach/shell ramp/barrier flat communities. Aquatic habitats include the Brazos River Diversion Channel, the Intracoastal Waterway, the lakes and ponds adjacent to the storage site, Freeport Harbor and the near-shore Gulf of Mexico.

Most affected land areas have already been cleared for previous industrial use. Also, the early storage phase development at Bryan Mound would be either in progress or recently completed when the SPR expansion got underway. In most cases, SPR expansion at Bryan Mound would not create new impacts but would add small additional impacts to those of the early storage phase development.

In the following subsections, potential impacts on ecosystems and species are treated according to specific operational aspects of facility development.

Raw Water Withdrawal

Withdrawal of raw water at a rate of 534,000 B/D for leaching the storage cavities would affect plankton, nekton and some small fish in the Brazos River Diversion Channel, since it could be assumed that all the organisms taken into the raw water pipeline would be destroyed. Larger fish would be able to avoid entrainment since the intake system would be designed for a low maximum velocity (0.5 ft/sec). Water quality of the lower Brazos River has been reported as extremely variable and ichthyoplankton would be expected to be scarce (these forms are very sensitive to changes in water quality). Thus, the potential impact on ichthyoplankton would be minimal. The numbers of organisms entrained in the raw water intake would vary according to the season. Generally, the numbers of organisms present during the spring is high; populations decrease with the approach of warm summer temperatures and reach a minimum during the winter.

The quantity of water to be withdrawn is a very small percentage (<0.5 percent) of normal river flow; even under low-flow conditions, it would still be a small percentage of normal daily tidal flux. The quantity of organisms which would thus be destroyed by raw water entrainment would not have a significant impact on local resources. Phytoplankton populations would be quickly replenished by upstream communities, and there are no known species of fish or shellfish which are particularly dependent on the Brazos that might be sensitive to small seasonal depletions of juvenile populations.

Brine Disposal

Dredging used for offshore pipeline construction would destroy some benthic habitat and smother some benthic organisms along the right-of-way. These effects would be brief and localized.

Since brine would be discharged into the Gulf of Mexico, it could impact marine biota around the immediate point of discharge. The distribution of the brine plume is described in Appendix G, and Section 3.2.5 of the Draft Supplement to FES 76/77-6.

The formation of a 25 acre, elevated temperature and salinity area around the diffuser could cause a local disruption in the biotic communities. Within this area plankton and benthic organisms would be stressed or killed. Mature nekton would avoid the diffuser area minimizing adverse effects. These impacts would be minor. It is not anticipated that the nearby white shrimp spawning grounds will be significently effected and no major impact on commercial fishing in the region is expected. Beyond the highest temperature-salinity area, minor effects to some sensitive marine organisms may include physiological stress, reduced productivity and altered physical development. This would occur over a limited area of the bottom and would not affect regional productivity.

Computations of brine diffusion in mid-depth and surface waters indicate that salinity excesses would be less than 0.5 ppt and that this small increase would extend to the surface only after extended periods of stagnation currents. Planktonic organisms in the upper water column are unlikely to detect these small changes (about 1 percent) in ambient salinity gradients.

Adult fish should not be significantly affected by the brine plume except as it impacts a local benthic food source near the diffuser. The immediate vicinity of the diffuser would be avoided by some fish species but there would be no shortage of additional suitable habitat nearby.

<u>Construction of DOE Docks</u>

Construction of two DOE docks and pier facilities in Freeport Harbor would each affect approximately 14 acres of manmade land. Vegetation is limited to a few sparsely distributed grass and weed species. A small number of birds and mammals would also be temporarily affected. The increased dredging activity is not expected to have a significant impact on the harbor biota. Any increased turbidity and sedimentation of harbor waters would be of short duration.

Construction of Surface Facilities at Bryan Mound

Grading and filling of the site for well pads, pipelines and dikes would affect about 36 acres of cleared land. An additional 8 acres of marsh and prairie land would be affected by construction of a pipeline to Brazos Harbor. This would cause a temporary erosion problem which would, in turn, increase the turbidity and concentration of suspended solids in the nearby small lakes and ponds. Grading and filling would destroy many small invertebrates. In addition, valuable marshland and wildlife habitat for small birds and mammals would be removed from the ecosystem. The most common wildlife to be directly affected would include small rodents, amphibians, reptiles and birds.

Indirect effects of site preparation and construction include forced migration of wildlife due to loss of habitat or increased noise. The total impact of this migration would depend on the extent and availability of space, cover, food and other resources in nearby habitats. Because of the extensive prairie and marshland areas available adjacent to Bryan Mound, the potential for relocation is considered good. However, reduction of the total regional supply of marshland would result. Forced migration could be of local importance should construction occur during late winter and early spring when the carrying capacity of the land was at its highest. Indirect impacts would also be important during the winter period when large migratory bird populations inhabit the area.

It is not expected that surface construction would greatly affect either the Brazos River or the Intracoastal Waterway. Also, there are no known important breeding or nesting areas on Bryan Mound that would be impacted by construction activities. No threatened, endangered or otherwise unique or important terrestrial or aquatic species are expected to inhabit the site. Marshland loss would be minimal and limited to areas already affected by human development.

Accidental Brine Release

The estimated quantities of brine that could be accidentally spilled from the retention pond on-site or from the brine disposal line to the Gulf are very small. These spills would not be anticipated to have adverse impacts on more than an acre or two of terrestrial or aquatic habitat. Although a maximum credible spill of up to 30,000 barrels of brine could have significant local impacts on vegetation and wildlife, the probability of its occurring is extremely small.

The most likely location for a large brine spill would be in offshore Gulf waters along the pipeline (excluding the possibility of a hurricane-induced brine reservoir failure). A release of up to 30,000 barrels of brine in nearshore waters would primarily destroy bottom organisms, though organisms in the water column could also be affected. Such a spill would be locally significant, but recolonization would begin almost immediately after the brine had mixed with coastal water.

Should a maximum credible brine spill occur at the site, or between the site and the beach area, the brine could affect the beach/shell ramp-barrier flats, the brackish marsh, the on-site lakes or the Intracoastal Waterway. Impacts on local vegetation and wildlife that could not avoid the brine would be devastating, particularly in the terrestrial habitat or in Mud Lake. Tens of acres of habitat could be destroyed; resulting saline concentrations in the soil could remain above levels tolerated by new vegetation for several years.

Alternative Facilities

Alternative systems to provide raw water for cavern leaching and oil displacement include: 1) supply from Dow Chemical Co.'s existing reservoirs; and 2) withdrawal of saline ground water from the Evangeline aquifer. Use of Dow's reservoirs would impact up to 37 acres of coastal prairie and marshland habitat for a new pipeline. Construction of water supply wells would disrupt nearly 70 acres of coastal prairies for wellhead pads and pipelines.

Alternative brine disposal systems include: 1) using the brine to provide all or part of Dow's feedstock demand; 2) deep-well disposal, and 3) a brine disposal pipeline to a diffuser 12.5 miles offshore in the Gulf of Mexico. The first alternative would have no impact on ecosystems or species, since the pipeline is already in place. The second would require construction of 19 additional injection wells and connecting pipelines. Construction of the injection wells would have a long-term impact on marshland biota, since the well pads would be filled to higher elevation, thus converting 19 acres of marshland to (eventually) a coastal prairie habitat. The third would have construction and operational effects similar to those expected with the proposed diffuser. Popular commercial fishing areas would be impacted to a lesser extent at this site.

Alternative crude-oil distribution methods include: 1) use of SEAWAY or Phillips docks; and 2) construction of a marine pipeline and offshore SPM monobuoy. The first alternative would have essentially no impacts on ecosystems as no new land would be cleared. Construction of a marine pipeline and SPM monobuoy would require temporary disturbance of nearshore and offshore bottom material over a 30-mile pipeline corridor. Benthic organisms would be directly destroyed by jetting of the pipeline trench and by siltation, but the effects are generally expected to be of minor, local significance and of short-term duration. It is expected that the oil line would be placed in a corridor paralleling the planned brine disposal line, which would minimize onshore impacts.

4.3.1.6 Natural and Scenic Resources

There would be no significant impact on recreational activities or natural and scenic resources as a result of project construction. All major recreational facilities are at a sufficient distance so they would not be affected. Impacts on waterfowl habitats near the site are expected to be minor, as the site is adjacent to industrial areas; any increase in noise, dust, and traffic would be temporary. Construction of pipeline and well fields for alternative brine disposal or raw water supply would impact waterfowl areas in the marsh to the north of Bryan Mound. Other alternatives should have no aesthetic or recreational impacts.

4.3.1.7 Archaeological, Historical, and Cultural Resources

There are expected to be no significant impacts on archaeological, historical or cultural resources resulting from construction of the project or its alternatives. A cultural resources survey was conducted on the Bryan Mound early storage site. If SPR expansion at Bryan Mound is selected, additional previously unsurveyed areas would be surveyed for their potential archaeological, historical, or cultural resources.

In compliance with Section 2(a) of Executive Order 11593, "Protection and Enhancement of the Cultural Environment" (May 13, 1971), a survey will be carried out to locate, inventory and nominate eligible historic, architectural and archaeological properties to the National Register of Historic Places that may occur on lands affected by the chosen development alternative. The results of this survey will insure that the proposed undertaking will not result in the transfer, sale, demolition or substantial alteration of eligible National Register Properties.

In compliance with Section 1(3) of Executive Order 11593, it will be assured that the project will not result in the destruction or deterioration of non-federally owned districts, sites, buildings, structures or objects of historical, architectural or archaeological significance.

4.3.1.8 Socioeconomic Environment

Land Use

Land use impacts resulting from the development of 100 MMB of newly leached storage capacity at Bryan Mound are not significant because all development would be on or adjacent to previously developed industrial land.

Development of the brine diffuser system to the Gulf would have temporary minor impact on the use of a small area required for construction vessels.

Alternative development plans would have some additional land use impacts in that additional undeveloped land would be utilized.

Proposed and alternative development plans would comply with local land use regulations.

Transportation

The two roads connecting the Bryan Mound site to the Freeport area would be sufficient to handle the increase in traffic resulting from on-site construction activities. The major highways to which these roads connect already experience some congestion during peak commuting hours, and additional traffic resulting from peak employment (253 workers) could cause additional congestion. This worst-case condition is thought to be unlikely because: first, the project would employ some of the workers on night shifts, since leaching operations would continue over a full 24-hour workday; second, some work shifts would be staggered to avoid commuting hours; third, some carpooling is expected; and finally, construction would be heaviest only during a brief three-month period - from the second through the fourth month. After the fourth month, total employment on all shifts would fall to about 132 workers or less.

The SPR project would have a minimal impact on waterborne transportation in Freeport Harbor due to an increase in tanker traffic. The worst-case increase in tanker traffic during the initial fill (assuming a tanker capacity of only 32,000 DWT, or 254,000 bbl of oil) would average about one tanker every day, compared to the 1976 total of 436 vessels (Brazos River Navigation District). The brine diffuser pipeline would cross the Intracoastal Waterway and a portion of the Gulf of Mexico, having temporary minor impacts on waterborne traffic.

Alternative project facilities, particularly development of a ground water supply system, a brine injection field, a 12.5 mile offshore diffuser or an offshore terminal, could affect traffic conditions because of the additional workers and material that would be required. Impacts should not be significant, however.

Population and Housing

Construction of the SPR facilities at Bryan Mound is unlikely to have a significant impact on local population levels. Many workers would be expected to commute from the region's urban areas. The major construction effort would be of relatively short duration, making relocation of entire families less likely. Those workers who do relocate near the project area should cause little incremental stress on the community, especially when existing stresses from rapid population growth are considered. Some contractors, however, might set up temporary mobile home communities near Freeport.

No significant impact on housing or population is expected to occur should any of the alternative facilities be developed.

Economy

Construction of SPR facilities would have a significant impact on construction employment in the region. The first six months would be the most labor-intensive, with employment levels declining over the following months: construction income would further decline during the last three years of the project.

Brazoria and Fort Bend Counties have relatively low rates of unemployment, so much of the labor force would likely commute from the Galveston-Texas City area, or even from Houston. Most of the disposable (after-tax) income would be spent where the workers reside, so economic benefits to Brazoria and Fort Bend Counties would depend in large measure on the percentage of local workers employed by the project.

Wherever possible, the project would rely on the extensive local petrochemical, fabricating, repair and maintenance industries for goods and services.

It is impossible at this time to determine what proportion of employment or goods and services would come from any part of the region, but the project is not expected to generate much additional long-term economic growth.

Development of alternative facilities would have some additional economic impact, depending on the labor and materials required. Development of groundwater supply or brine injection well fields and construction of an offshore terminal would have the greatest additional impact.

Government and Public Services

Construction of the SPR facility at the Bryan Mound site would involve the removal of 240 acres from the tax rolls of Brazoria County. Assuming a fair market valuation of $1000 per acre at the Bryan Mound site, the tax loss to the county would be about $690 per year, for the life of the project.

Basic security and fire protection services required to protect project personnel, equipment and supplies would be provided by the project. Additional police surveillance and local traffic control may be required, however, especially during the peak construction period.

Adequate levels of health services are available in the area, and project construction would not significantly impact local health facilities.

Similarly, the impact on local schools would be minimal, since few workers would be likely to relocate into the area.

4.3.2 Impact from Operation and Standby Storage

Should an oil supply interruption occur while oil is stored at Bryan Mound, a total of 163 MMB would be available for distribution, either by tanker or via the SEAWAY Pipeline. Oil would be pumped from both the early storage phase and expansion SPR caverns, using virtually the same facilities and operating procedures. When the supply interruption is over, oil would also be re-injected into the storage cavities with the same facilities. Until an oil supply interruption occurred, these facilities would be maintained in a condition of standby readiness: storage cavern systems would be monitored; pipelines checked for leaks; valves actuated; and other standard procedures carried out to assure proper system operation.

Thus, operation of the expanded SPR facilities at Bryan Mound would not introduce any new or unique operational impacts but would only require the extended use of systems to accommodate a capacity increased from 63 MMB to 163 MMB. Principal impacts would be those associated with hydrocarbon emissions and oil or brine spills. This section addresses the "worst case" assumption of five cycles (fills/withdrawals) of petroleum storage.

4.3.2.1 Land Features

Effects of normal operation and standby storage on land features are expected to be minimal. Soils would stabilize after revegetation.

It is extremely unlikely that the caprock and salt roof over a cavern could collapse. Should such an event occur, however, a lake might form over the dome; significant quantities of oil or brine could be released to the surface or to shallow ground water aquifers; impacts on surface facilities could be severe. The entire concept of underground oil storage depends on maintaining the structural integrity of the storage caverns. The concept of cavern stability is treated in detail in Appendix F.

Use of alternative raw water, brine, or crude oil distribution systems would have no impact on land features during project operation and standby storage.

4.3.2.2 Water

Impacts on water resources during operation of the Bryan Mound facility could result from raw water withdrawal, brine disposal, maintenance dredging at the dock sites, and possible spills of oil or brine.

Raw Water Withdrawal

Raw water for displacing the stored oil during an oil supply interruption would be obtained from the intake on the Brazos River Diversion Channel. Since the amount of oil to be withdrawn from Bryan Mound would total 163 MMB (100 MMB from expanded SPR storage and 63 MMB from early storage), the water withdrawal rate would be 1 MMB per day (65 cfs) for the 163-day withdrawal period. This is a 87 percent greater rate than during cavern leaching, but is still less than 1 percent of the normal daily discharge of the Brazos. Even during low-flow periods, this withdrawal rate should not induce any measurable increase in Gulf water flow up the river. Water quality and quantity in the lower Brazos River should thus not be measurably affected by raw water withdrawal.

Brine Disposal

When oil is pumped into the storage caverns during refill operations, brine would be displaced intermittently to the Gulf of Mexico through the diffuser at an average rate of 240 MB/D. During operations, brine would temporarily be stored in on-site brine pits, and discharged intermittently through the brine diffuser. This would ensure design exit velocities are achieved, to provide adequate mixing of the brine with the Gulf water. The expected average concentration of oil in the displaced brine during cavern refills is 6 ppm (see Appendix D). Disposal would occur for a 2.3-year period during each refill operation.

DOE is currently developing a monitoring plan to be implemented during disposal which will be designed to verify the MIT transient plume dispersion model, and to detect impacts to biologic populations and degradation of water and sediment quality attributable to the brine discharge. Predisposal laboratory and field studies are currently under way to investigate brine tolerance of selected sensitive species and to characterize existing sediments, biologic populations, water quality, and coastal dynamics in the immediate area of the proposed diffuser site. A preliminary report on the results of the predisposal studies is presented in Appendix G.

Disposal of brine into deep, salt water bearing sands through the 5-well backup system would, similarly, have little adverse impact.

Maintenance Dredging

The impact of dredging on water quality in Freeport Harbor during construction of the DOE docks is described in paragraph 4.3.1.2. Similar impacts would occur during maintenance dredging, but to a lesser extent. In comparison with the present maintenance dredging currently required in the harbor (over 1 million cy every two years), the incremental impact of maintenance dredging at the DOE facilities would be insignificant.

Accidental Oil Release

During project operation, oil spills could occur in the Gulf of Mexico, in Freeport Harbor, along pipelines connecting the storage site with the DOE tanker docks and with SEAWAY Tank Farm, or from the wellheads and oil surge tanks at the storage site itself. A summary of the oil spill expectation model projections is provided in Section 4.2.

In the watershed east of the Brazos River Diversion Channel, spills at the Bryan Mound site or from connecting pipelines to the SEAWAY Tank Farm would enter a low area of swampy land and shallow lakes. Drainage from accidental ruptures near the SEAWAY Tank Farm would be into the Jones Creek and Brazos River watersheds, but the terminal area itself is expected to be well protected by dikes. Spills from transfer at the docks would enter Freeport Harbor waters. The flushing of this channel is by sluggish tidal action, thus containing the floating oil would be facilitated.

Movement of spilled oil from the south face of the Bryan Mound site would be impeded by dikes and berms. Flows not contained by the diking would generally be contained between the storm wave levee and the irregular ridges of spoil alongside the Intracoastal Waterway.

Oil spills are most likely to reach the Gulf of Mexico only from tanker spills.

An "average" crude oil contains 30 percent paraffin hydrocarbons, 50 percent napthene hydrocarbons, 15 percent aromatic hydrocarbons, and 5 percent nitrogen, sulfur and oxygen-containing compounds. As soon as oil is released to the water environment, weathering begins. The major weathering processes are evaporation, dissolution, emulsification, sedimentation, biological degradation, and chemical oxidation.

Evaporation tends to reduce concentrations of the most toxic portions of the crude oil. A surface residue forms, which may develop a specific gravity greater than water, especially if salt, clay, or organic particles are suspended in the water and can attach to the oil. As a result, this residue would sink and might affect bottom organisms.

Dissolution in the water column is selective. Most of the soluble materials go into solution quickly, but additional soluble material can be produced later from biological and chemical oxidation.

Emulsifications of crude oil globules in the water column, would be dispersed easily by currents and, it is believed, eventually dissolve or sink after contact with suspended solids.

Sedimentation of oil is enhanced by evaporation and dissolution of the lighter weight fractions and by contact with suspended sediments and organic material. Close to shore, contact with suspended solids is likely during periods of high runoff or in stormy weather. Sedimentation also can occur from bacterial action in the oil slick.

Biological degradation occurs in almost all crude oil fractions, but normal alkanes are attacked preferentially, and aromatics are least preferred. A supply of nitrogen, phosphorus and oxygen is needed for biodegradation; in areas where oxygen concentrations are low, it is a slow, long term process.

Oil spilled on the water's surface would initially spread under gravitational, viscosity and surface-tension forces at a rate dependent on the initial chemical characteristics of the oil and the physical characteristics of the slick. The rate would also vary with time as weathering or degradational processes act on the spilled oil.

A near-shore spill could affect large areas of beach or marshland on a rising tide making containment and cleanup difficult. The relatively confined locations of most potential spill sites, however, makes for a fairly narrow range of credible oil spill situations, most of which could be mitigated by oil spill response efforts.

Two potentially significant impacts of oil spills on water resources would be the potential for buildup of toxic fractions and the depletion of oxygen levels in shallow, poorly flushed water bodies as found in the coastal bays and marshes southwest and northeast of Freeport (including the vicinity of San Bernard National Wildlife Refuge) and, to a lesser extent, in Mud Lake or Unnamed Lake on Bryan Mound. Although the potential impacts cannot be accurately predicted, small changes in marsh environments could have severe and widespread consequences.

Oil spills reaching the Brazos River, Freeport Harbor, the Intracoastal Waterway, or the open Gulf would not have significant impacts on water quality because of the potentials for dilution and oil recovery. Oil which sinks to the bottom or is deposited on the shoreline, however, could affect the water column for several weeks or even months. There should be no impact on domestic surface water supplies, as all surface waters in the vicinity of the project are too saline for consumption.

The surface of the ground water aquifer is about 40 feet below sea level at the site, with a steep gradient toward the Brazosport area. There is little or no recharge to the upper unit of the Chicot aquifer from the Brazos River Diversion Channel; this suggests that near-surface materials are relatively impermeable and would tend to prevent surface oil spills from reaching potable water supplies.

Should a subsurface spill occur, oil would tend to collect at the water table and migrate laterally along the water surface. Crude oil tends to migrate very slowly through subsurface formations, and then only under pressure; some components of the oil, particularly the lighter aromatic hydrocarbons, might be sufficiently soluble to impart an objectionable taste and odor to the water that might be noticeable in the Brazosport area.

Accidental Brine or Saline Raw Water Release

During project operation, brine spills could occur from the brine disposal pipeline or the on-site brine pit; raw water could be spilled from the raw water supply line or, during standby storage, from the brine disposal line. A summary of the brine spill expectation model projections is provided in Section 4.2.

In the watershed east of the Brazos River Diversion Channel, spills from the Bryan Mound site would enter a low area of swampy land and shallow lakes.

Spills of brine or saline raw water would have less adverse impact on water quality at the Bryan Mound site than would oil spills. Except for a very large brine spill, the normal flushing of most local water bodies would quickly dilute salt concentrations to normal levels, resulting in only a temporary degradation of water quality. Flushing is not as effective in Mud Lake, Unnamed Lake, the marshlands and other water bodies at the Bryan Mound site, however; salinity excesses might be present for several days or weeks, and saline soil conditions could slow vegetative and fauna recovery in the area.

Flood Hazards

Surface facilities at Bryan Mound would be subject to potential flooding caused by hurricanes or tropical storms. Surface elevations over the dome vary from 5 to 16 feet, MSL. The height of the storm levee south of the dome is +17 feet MSL. Levees along the Brazos Diversion Channel and the Old Brazos River are about +19 feet MSL. Most planned SPR facilities at Bryan Mound would be located behind the protective levees (Figure 2.4-2). The calculated 100-year flood level at

Bryan Mound is only +12 feet MSL, excluding wave runup, so there is little likelihood of storm-induced failures.

Storm floods greater than the 100-year event could occur and could damage surface facilities. In the presence of oncoming storms, oil would be removed from the surface tanks, thus eliminating the largest spill potential. If surface piping were ruptured, a few barrels of oil might escape but would be retained within the storage area. Damage to wellhead piping could result in loss of a few barrels from the cavern. Brine from the settling pond would be quickly diluted by sea water.

As only limited quantities of oil or brine would be released in the event of a damaging storm flood, environmental effects due to the flood waters and winds themselves would be much greater than those from spilled oil or brine.

Alternative Facilities

Raw water supplied from the Dow Reservoirs would have minimal environmental impact. Withdrawal of up to 1,000,000 B/D of saline ground water could lower fluid pressure in the pumped zones and possibly result in additional land subsidence (see paragraph 4.3.1.2).

Providing brine to Dow Chemical Company would result in approximately the same exposure to pipeline spills as disposal to the Gulf; no other adverse impacts are expected. The rate of deep-well brine injection during oil fill operations would be about 22 percent of the leaching rate; the potential for aquifer fracturing or migration of oil and gas resources would thus be much lower than during leaching. Operation of a diffuser 12.5 miles offshore would have impacts similar to the proposed system.

Use of Phillips or SEAWAY docks would not affect projected oil spill volumes. Use of an offshore SPM terminal would reduce projected oil spill volumes by about 60 percent and would particularly limit volumes of oil spilled in nearshore and harbor waters.

4.3.2.3 Air Quality

The largest potential effects on air quality from operation of the SPR storage system would come from hydrocarbon emissions during the fill and withdrawal cycles (Table 4.3-1). Hydrogen sulfide emissions are

TABLE 4.3-1 Estimated hydrocarbon emissions[a] (tons) during life of the project.

Location	Fills (5)	Withdrawals (5)	Brine Pond	100 MMB Expansion Total	Early Storage Total[b]
25 miles offshore (Transfer to 45 MDWT tankers)	7,560	0	0	7,560	(4,763)
Gulf of Mexico (Tanker transit)	245	140	0	385	(242)
SEAWAY and Brazos Harbor (Load and offload 45 MDWT tankers)	4,410	3,067	0	7,477	(4,760)
Storage Site	0	0	251	251	(732)[b]
Total	12,215	3,207	251	15,673	(10,497)

Note: The emissions presented in this table are for 100 MMB expansion at any site; the early storage emissions at Bryan Mound are given in brackets for comparison.

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[a] Average conditions assuming Reid vapor pressure of 4 psia.

[b] Includes 574 tons due to storage tank emissions and 158 tons due to brine pond emissions. All storage tank emissions were attributed to Early Storage operation.

expected to be minimal, since most of the crude would have weathered sufficiently during overseas transit to essentially eliminate the H_2S component.

Sources of Emissions

The quality of air during operation would be affected by the following sources of hydrocarbon emissions:

- Valves, Seals, and Gauges
- Crude Oil Storage Tanks
- Tankers and Tanker Operations
- Brine Ponds

There would be a large number of valves, seals, and gauges associated with pumping crude oil between the dock facility and the storage cavities where some slight leakage could occur.

As discussed in Section C.3.2.3, vapor losses from the four 200-MB floating roof double seal storage tanks at Bryan Mound were conservatively estimated to be 75 percent less than the standing storage losses predicted using API 2517 methodology. The average annual emission rate would be approximately 23 tons/year during standby and fill years but would increase to approximately 36 tons/year during withdrawal years (due to elevated crude oil temperature).

Hydrocarbon emissions from marine transport would take place during: 1) transfer of oil 25 miles offshore from VLCCs to smaller tankers; 2) "breathing" losses in transit from the smaller tankers; 3) offloading the tankers at the DOE docks; and 4) loading the smaller tankers at the DOE docks (during an oil supply interruption). Emissions would be substantially larger during oil fill operations than during withdrawal: the emissions accompanying VLCC tanker transfer operations are expected to occur only during fill; and delivery of 600,000 B/D to the SEAWAY Pipeline substantially reduces emissions from tanker loading and transit.

The final source of hydrocarbon emissions would be the dissolved oil passed through the brine pond during each cavity refill. The hydrocarbon emissions from the brine pond presented in Table 4.3-1 have been based on evaporation of 50 percent of the oil dissolved in the brine. If 100 percent of the dissolved oil evaporated, the contribution of brine pond emissions would be doubled, and the estimated maximum downwind concentrations (beyond the site) would still be below the three hour hydrocarbon standard. The impacts on air quality would thus be similar to those presented, assuming 50 percent evaporation.

Impacts on Air Quality

Annual hydrocarbon emissions during withdrawal operations and during fill operations are estimated to increase current annual hydrocarbon emissions in Brazoria County only about 0.7 percent and 0.5 percent, respectively. Of the individual emission sources, only tanker transfer operations would result in off-site concentrations that would exceed the three hour hydrocarbon standard. Under unfavorable conditions, exceedances may occur as far as 13 km downwind of the docks. Since the three hour hydrocarbon standard is often exceeded in the Brazosport area, "worst-case" storage tank emission concentrations may cause infrequent additional exceedances of the standard. Pipeline and brine pond emissions are estimated to have a relatively minor impact on air quality.

Alternative Facilities

The only alternative facilities that would alter air quality impacts of SPR storage would be the use of an offshore SPM terminal such as SEADOCK for oil transport and generation of electric power onsite.

Use of an offshore terminal during oil fill operations would substantially reduce hydrocarbon emissions: 1) emissions would be reduced at the VLCC transfer point; 2) tanker transit emissions would be eliminated; and 3) transfer emissions at the docks would be eliminated.

Downwind concentrations resulting from onsite power generation, based on oil-fired gas turbines at 45,000 HP (approximately 34 megawatt) that vent through a 100 foot stack, would not exceed National or State standards. Since the hydrocarbon standards are sometimes exceeded in the Brazosport area, emissions from the power plant (especially when combined with tank and brine pond emissions) might result in infrequent additional exceedances of the standards.

4.3.2.4 Noise

Material handling equipment, especially the electric pumps for filling and emptying the storage caverns, would be the principal sound sources during facility operation.

During fill and withdrawal cycles, oil would be transferred from or loaded onto tankers at the DOE docks in Freeport Harbor. Noise associated with these activities would not impact the surrounding heavily industrialized areas. Noise associated with tanker movement into and out of the harbor would have no adverse impact.

Selection of the onsite power generation alternative would have only a slight noise impact. Since gas turbine generators are specifically designed to meet stringent noise criteria, however, the contribution to offsite noise levels would be negligible.

4.3.2.5 Ecosystems and Species

Raw Water Withdrawal

During a severe oil supply interruption, raw water would be withdrawn from the Brazos River Diversion Channel to displace the stored oil (Draft Supplement to FES 76/77-6). The withdrawal rate would be 1 MMB per day for the 163-day withdrawal period - a 87 percent greater rate than during cavern leaching. As described in paragraph 4.3.1.5, entrainment of small aquatic organisms in the intake system would result in their destruction. Even at the rate of 1 MMB per day, water withdrawal is less than 1 percent of the normal river flow, and a much lower percent of the normal daily tidal flow. Therefore, if the entrained organisms are evenly distributed in the water column, less than one percent would be killed. No significant impacts to marine resources are expected.

Brine Disposal

The brine disposal rate required during oil fill operations would average 150 MB/D, with an expected maximum of 240 MB/D (Section 4.3.2.2).

This is about 22 percent of the maximum average discharge rate during leaching (section 4.3.1.2). Disposal would continue for approximately 2.3 years following each oil withdrawal. Potential adverse impacts related to brine disposal during operations would be the result of increased salinities and discharge of oil dissolved in the brine displaced during cavern refill. Concentrations of oil in the brine effluents are expected to range from 5 to 10 ppm (Appendix D).

Discharge of oil contaminated brine from the diffuser is expected to provide dilution of the effluent by a factor of 50 to 100 almost immediately, so concentrations of hydrocarbons should not be distinguishable from ambient conditions beyond a few hundred feet from the diffuser, even under stagnant current conditions. Chronic pollution problems which could cause low productivity and low species diversity may occur at the point of discharge. The effects, however, should not be significant, even locally, to the Gulf's marine resources.

Tanker Transport

Marine transport operations could affect the marine life in Freeport Harbor, since ship passage could cause increased turbidity and shoreline erosion. High turbidity might clog or abrade gills of fish and macrobenthos, or suffocate mollusks. It could also reduce plankton productivity, thus reducing the amount of food available to filter-feeding fishs and mollusks. The State of Texas classified Freeport Harbor as suitable only for non-contact recreation because the harbor has poor water quality. Therefore, impacts directly attributable to the tankers for the expanded SPR oil storage capacity would be minor in comparison with the total impact from all ship traffic and dredging within the harbor.

Accidental Oil Release

Because of the expected very low frequency or severity of oil spills (Section 4.2), chronic oil pollution of Bryan Mound should not occur.

In the watershed east of the Brazos River Diversion Channel, spills at the Bryan Mound site or from connecting pipelines to the SEAWAY Tank Farm would enter a low area of swampy land and shallow lakes. Drainage from accidental ruptures near the SEAWAY Tank Farm would be into the Jones Creek and Brazos River watersheds, but the terminal area itself is expected to be well protected by dikes. Spills from transfer at the docks would enter Freeport Harbor waters. The flushing of this channel is by sluggish tidal action which is well suited for containing the floating oil.

Ecological effects of oil spills are quantified on the basis of acres that could be severely impacted. It is assumed that 25 barrels per acre of fresh crude would cause a 100-percent loss of vegetation for a period of at least two years in wetlands or coastal prairie. In open water bodies, it has been estimated that a contamination of 6 barrels per acre could cause total loss of productivity in shallow waters (2 to 4 feet deep) for periods of two weeks up to several months.

Using these damage parameters as indicators, the following impacts may be estimated. For a large tanker spill and maximum spreading, up to 1680 acres of marshland could be impacted, or up to 7000 acres of benthic habitat in shallow coastal waters. Vulnerable areas include the Brazos River Diversion Channel, the lower San Bernard River and associated lakes, bays and marshes west of Freeport; and Christina, Drum and Bastrop Bays to the east. For an oil transfer accident at the tanker docks, a possible marsh impact of up to 14 acres or a shallow-water impact of up to 60 acres might result. For a large pipeline spill, a possible wetland impact of up to 320 acres or a shallow-water impact of up to 1340 acres might result. The lower Brazos River Diversion Channel and lakes and marshes on Bryan Mound are potentially vulnerable.

Accidental Brine or Saline Raw Water Release

The potential impacts of accidental brine releases on ecosystems are discussed in paragraph 4.3.1.5.

Alternative Facilities

Alternative raw water supply options include: 1) delivery from Dow Chemical Company's existing reservoirs; and 2) withdrawal of saline groundwater from the Evangeline aquifer. The first alternative would impose no significant risk exposure, since fresh water would be flowing through the pipeline. The second option would expose additional portions of brackish marsh to possible saline raw water spills.

The alternative brine disposal systems with the exception of the 12.5 mile Gulf diffuser would similarly expose additional areas to the risk of brine spills.

Use of a marine pipeline and an offshore SPM terminal would substantially reduce (by about 60 percent) the spill risks associated with crude oil movement through Freeport Harbor.

4.3.2.6 Natural and Scenic Resources

Operations and standby storage at Bryan Mound would have no significant impact on natural or scenic resources or recreation during normal procedures. Potential impacts from an accidental spill are addressed below.

If an oil spill at sea reached shore, beaches used for recreation, such as Bryan or Quintana Beach, could be significantly impacted. This may impact some of the estimated 3 million annual beach visitors. Though the oil itself could be fairly rapidly cleared from the beaches, residues deposited on offshore substrate could drift to shore for many months afterwards.

The project would emit few fumes or vibrations, and noise sources would be consistent with existing industrial development in the surrounding area. Burial of all pipelines on the site would help minimize visual impacts.

4.3.2.7 Archaeological, Historical and Cultural Resources

There are expected to be no significant impacts on archaeological, historical or cultural resources resulting from operation of the project or its alternatives at the Bryan Mound site. If this site were selected for development, a cultural resources survey would be conducted of previously unsurveyed areas prior to construction (Section 4.3.1.7).

4.3.2.8 Socioeconomic Environment

Land Use

The addition of the 100 MMB SPR storage reserve at Bryan Mound would have little additional impact on land use during operation. The land at the site and along pipeline routes would already be dedicated to these uses. Of the 425 acres required for construction offsite and within the fenced area, 275 acres would be required for maintenance. The new DOE docks would be consistent with existing land uses and restrictions and would require a relatively small land area. The area containing the Gulf brine diffuser would be unavailable for other uses for the duration of the project.

Transportation

Very little additional traffic would result from project operation. A small crew (estimated at 10 employees during standby operation and 55 during oil fill or withdrawal) would be necessary to carry out fill and storage activities, so commuting traffic would be insignificant in comparison to current traffic volumes on county roads.

There would be a small increase in tanker traffic during filling and withdrawal operations, but this is not expected to significantly affect port operations. During oil withdrawal, approximately 1.5 tankers (32 DWT) per day for 163 days would constitute the expected increase in tanker traffic in Freeport Harbor. This would be offset by an expected decrease in normal oil import traffic in the harbor. Refill of the storage capacity would occur over a 2.4-year period, increasing traffic in Freeport Harbor by about one vessel every two days.

Population and Housing

Operation of the SPR project site would have very little effect on population in the surrounding area. The project would have a total of 55 employees on-site in three shifts during fill and withdrawal operations. During standby operations, only about ten employees would work at the site. Even if all the employees were to migrate to the Brazosport area with their families, the impact on the local population and housing would be negligible. Brazosport has grown rapidly since 1970 and the population associated with this project would constitute only a minor increment compared with this increase.

Economy

Operation of the Bryan Mound SPR storage site would have an insignificant effect on the economy of the area. Supplies for some operations may be purchased from existing petrochemical and service industries. Since operation of the project would require a relatively small work force, this would cause an insignificant impact on the local labor pool.

Employment income from the project would average 96,000 per month during the filling and withdrawal phases. Most of this income is expected to stay in the local area for the three years of filling and withdrawal associated with each oil supply interruption. During standby operations, income would average approximately $17,500 a month for the 10 employees required. This income alone is not expected to be sufficient to stimulate the local economy. The indirect and induced incomes derived from these activities are not expected to be significant.

Government and Public Services

The operational phase of the SPR project would have less impact on police and fire protection services than during the construction phase, as fewer workers would be required. The project would supply its own basic security and fire protection services, thus lessening the need for these public services. No adverse impacts on health services are expected during normal operations. The small number of workers and their families with children that may permanently relocate in the area would have no significant impact on schools in Brazosport.

4.3.3 Impact Due to Termination and Abandonment

Although no specific plan for termination and abandonment of the Bryan Mound SPR storage site has yet been established, the DOE will be required to develop such a plan near termination of the project. To date, no specific experience with the abandonment of an oil storage cavern facility exists in the United States, but various feasible plans are available.

Potential environmental hazards that must be considered include surface subsidence and the release of residual oils squeezed from the workings by possible long-term plastic closures.

At present, it is intended to put the facility to some beneficial use rather than simply abandon it. Such potential uses might include: 1) disposal of wastes (dredge spoil, slurried fly ash, radioactive waste or other polluted or toxic materials); or 2) development of a compressed-air storage facility for peak power use. The final selection of an abandonment plan will likely depend on the current economic and environmental trade-offs and regulations in effect at the time of termination.

Use of the facility in the manner described above would assure continued surveillance of the caverns. The inherent integrity of the caverns would prevent any leakage of material into the environment. Certain activities associated with the specific selected use - waste transport, etc. - would create some potential for environmental impact, such as that resulting from traffic, spillage and noise.

Should no beneficial use be found for the facility, the wells could be sealed and the caverns left filled with brine. No adverse environmental effects are likely to result from such action.

4.3.4 Relationship of the Proposed Action to Land Use Plans, Policies, and Controls

The Brazosport Planning Board, a part of the Brazosport Chamber of Commerce, maintains a master plan for Brazosport and coordinates planning for the Brazosport area. Current plans are considered flexible and appear to be designed to accommodate the needs of expanding industrialization along the Brazoria County Gulf coast area.

A projected land use plan has been formulated to guide future development in Brazoria County. Land use goals for guiding growth within Brazoria County include: establishment of a program for the optimum use of resources (natural and human); ensuring orderly economic growth; enhancing and preserving unique regional advantages or assets; providing for quality in the total environment and compatibility among the various land use components that make up the regional community; and ensuring public health and safety. Guided by these goals, the county's alternative land activity pattern considers the following development concepts:

- o Concentrate community urbanization in areas not prone to floods.
- o Emphasize expansion of existing urban centers.
- o For health and aesthetic reasons, physically separate residential areas from industrial centers.

- Encourage creation of definable centers for future urbanization.
- Balance urban and private/public open-space developments.
- Retain large tracts of land for agricultural use.
- Discourage urbanization abutting the new freeway to maximize free traffic flow.
- Concentrate heavy industrial development in the southern part of the county near the Intracoastal Waterway and in the vicinity of Chocolate Bayou.

In light of these goals, development concepts, and future land-use plans - and considering existing land use patterns - it is not anticipated that the proposed Bryan Mound SPR facility would be in conflict with any land use policies or plans.

Several Texas and Federal agencies have regulatory power over activities occurring in coastal areas or wetlands. These regulations are not expected to limit the proposed construction of the project.

4.3.5 Summary of Adverse and Beneficial Impacts

Development of the Bryan Mound salt dome as an SPR oil storage facility is not likely to generate significant regional environmental impacts except for the remote possibility of a major oil spill, or the uncontrolled release of hydrocarbon vapors during oil transfer operations. Construction and use of an offshore SPM terminal would reduce hydrocarbon emissions by more than 50 percent and would minimize the chance of a nearshore oil spill.

The fact that the Bryan Mound site has long been used for industrial purposes such as brine production minimizes the scope of changes resulting from construction activities. Although portions of the immediate area have a relatively high primary biological productivity, the amount of land affected by the project would be small in relation to the amount of similar land nearby.

Noise is not expected to cause adverse affects, either during construction or operation.

Although the project would require large quantities of water for solution mining and oil displacement, the total raw water demand of the project constitutes less than one percent of the average flow from the Brazos River Diversion Channel.

Disposal of brine in the Gulf of Mexico is expected to moderately increase the salinity of waters adjacent to the brine diffuser; this could have an adverse impact on local marine organisms and might interfere with migration of some estuarine species. Construction of brine disposal wells as a backup system would temporarily disrupt marshland northeast of the site.

Construction and operation of dock facilities in Freeport Harbor is not likely to have a significant impact on either the ecology of the area or the water quality of the harbor, as the harbor is frequently dredged.

During construction of SPR facilities at Bryan Mound, increases in income and employment in the region are expected. These increases will be of short duration and are not expected to significantly affect the area's economy. Operation of the Bryan Mound facility would provide minor additional income to the local area during standby storage and oil fill and withdrawal phases. Temporary increases in traffic congestion in the Freeport area could be expected during construction.

The indirect economic benefits of the Strategic Petroleum Reserve program are of considerable importance to the regional economy, as the area is highly dependent on the petroleum-petrochemical industry for employment. Assurance of a continued oil supply in the event of a national emergency would provide a measure of security for that industry and for local residents.

Table 4.3-2 provides a summary tabulation of the adverse and beneficial impacts associated with development and operation of this candidate site. The data are in both qualitative and quantitative form, as appropriate.

TABLE 4.3-2a Summary of environmental impacts caused by development of Bryan Mound SPR facilities.

		ACTIVITY AND EXPECTED IMPACT	
DISCIPLINE	ENVIRONMENT OR SYSTEM	PROPOSED FACILITY	ALTERNATIVE FACILITY
Geology and Land Features	Bryan Mound and immediate vicinity	Site Preparation Excavation of 30,300 cy at the storage site on 36 acres of industrial land. Cavern Leaching Removal of 20.8 x 10^6 cy of salt for cavern development.	
	Brine Diffuser Pipeline Corridor	Pipeline Construction Excavation of 177,300 cy for 7.5 mi pipeline on 21 acres of coastal prairie and 142 acres of Gulf bottom.	Pipeline Construction Excavation of 274,600 cy for 14.2 mi pipeline on 21 acres of coastal prairie and 305 acres of Gulf bottom.
	Brine Disposal Well Field		Brine Disposal 61 acres and 57,000 cy excavation.
	DOE Tanker Docks in Freeport Harbor	Site Preparation Dredging of 1,050,300 cy and grading of 14 acres for the tanker docks.	
	Pipeline Corridor to Brazos Harbor	Pipeline Construction Excavation of 6,000 cy for pipeline to Brazos Harbor on 4 acres of marsh and 4 acres of cleared land.	
	Phillips dock		Site Preparation 6 acres and 2,500 cy excavation.
	Offshore SPM Terminal		Terminal Preparation 62 acres and 46,205 cy.
	Ground Water		Raw Water Supply Well field for raw water supply: 69 acres and 57,000 cy excavation.
Water Resources	Brazos River Diversion Channel and ICW	Site Preparation Small quantities of sediment and construction pollutants carried into river by rainfall runoff. Raw Water Supply 334,000 BPD withdrawn for leaching over a two-year period expected to have minimal effects on water quality. Brine Spills Very small possibility of brine release reaching water bodies.	
	Gulf of Mexico	Brine Disposal Construction of pipeline would cause temporary disruption of 142 acres of Gulf bottom. 684,000 BPD brine disposal could increase bottom salinity by 1 ppt over 3 square miles; approximately 25 acres would have excess salinities of 5 ppt or more. Brine Spills Expected brine spills would have no significant impact; possible maximum credible spill could have significant local impact.	Brine Disposal Pipeline construction would cause temporary disruption of 305 acres of Gulf bottom. Salinity concentrations near the diffuser should be similar to the proposed diffuser location.
	Freeport and Brazos Harbors	Site Preparation Dredging and dock construction impacts considered comparable to annual maintenance dredging in Freeport Harbor.	

TABLE 4.3-2a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITY	 ALTERNATIVE FACILITY
	Site Lakes and Ponds	Site Preparation Sediment and miscellaneous construction pollutants could degrade water quality. Brine Spills Expected brine spills insignificant; possible maximum credible spill could have significant impact.	
			Brine Disposal Delivery of brine to Dow plant would have insignificant expectation of brine spill.
	Ground Water		Raw Water Supply Possible local subsidence caused by ground water withdrawal for leaching. Brine Disposal Deep well injection of brine is not expected to affect ground water supplies; potential for adverse impact limited to migration up old unplugged wells.
Air Quality	Bryan Mound and Dock Sites	Site Preparation Minor quantities of particulates, SO_2, CO, HC and NO_2 released from construction equipment.	
	Marine Terminal in Gulf of Mexico		Marine Terminal Construction Construction of a marine terminal would increase emissions offshore but have little effect on concentration at Freeport.
	Pipeline Corridor		Raw Water Supply and Brine Disposal Development of well fields for raw water supply or brine injection may double site emissions. Pollutant concentration should remain within standards in the absence of background pollutants.
Noise Level	Storage Site	Site Preparation Maximum zone of noise impact (defined as 3 dB increase over ambient), 4,500 feet; no residences or noise sensitive areas affected.	
	Freeport and Brazos Harbors	Site Preparation Maximum zone of noise impact, 2,200 feet; no residences or noise sensitive areas affected.	
	Well Fields		Raw Water Supply and Brine Disposal Slightly increased zone of noise impact due to drilling of brine disposal or raw water supply wells; no residences or noise sensitive areas affected.

TABLE 4.3-2a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT: PROPOSED FACILITY	ACTIVITY AND EXPECTED IMPACT: ALTERNATIVE FACILITY
Species and Ecosystems	Aquatic		
	Brazos River Diversion Channel and ICW	Site Preparation: Destruction of phytoplankton and zooplankton due to entrainment at water intake during the two-year leaching periods. Impact on regional biotic resources considered insignificant.	
		Brine Spill: Possible major spill of brine into ICW from brine diffuser pipeline considered remote. Locally significant aquatic impacts could occur.	
	Gulf of Mexico	Brine Disposal: Pipeline construction would cause temporary loss of 142 acres of benthic communities. Brine effluent could affect benthos communities over several hundred to several thousand acres. Some loss of benthos and plankton in the immediate diffuser area. Some impact on local white shrimp.	Brine Disposal: Pipeline construction would cause temporary loss of 305 acres of benthic communities. The impact of brine effluent would be similar to the proposed diffuser site.
		Oil and Brine Spills: Possible maximum credible oil or brine spill could destroy several acres of benthos and some biota in water column.	
			Marine Terminal: Construction of marine terminal facilities expected to have minimal local, short-term effect on benthos in offshore waters.
	Site Lakes and Ponds	Site Preparation: Minimal local impacts due to erosion and runoff from site construction.	
		Brine Spill: Major brine spill remotely possible; significant loss of biota would follow.	
	Freeport and Brazos Harbors	Site Preparation: Very local, short-term impacts due to dredging activities.	
	Terrestrial		
	Cleared Land	Site Preparation: Loss of 34 acres due to facility construction. Revegetation of 7 acres likely. Minimal impact importance.	
		Brine Spill: Large brine spill could destroy several acres.	
	Wetlands	Site Preparation: Loss of 4 acres brackish marsh due to facility construction. Revegetation of 1 acre likely. Minimal impact importance.	
		Brine Spill: Large brine spill could destroy several acres.	
			Brine Disposal and Raw Water Supply: Loss of 61 acres of marshland due to construction of deep well injection system; 11 acres could be returned to wetland habitat. Similar impact due to well field development for raw water supply. Locally significant impact on wetland productivity and habitat.

TABLE 4.3-2a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITY	ALTERNATIVE FACILITY
Natural and Scenic Resources	Bryan Beach	Site Preparation Minor impact on facility use due to nearby construction.	
	Pipeline Construction	ROW Clearing Minor impact due to displacement of birdlife from nearby marshes.	
Socioeconomic Conditions	Land Use	All Environments 79 acres of cleared land and marsh developed adjacent to existing industrial land.	
	Transportation	Potential for traffic congestion in Freeport area, especially if SEADOCK is constructed simultaneously. Temporary minor impediment to transportation in the Gulf where construction takes place.	
	Population and Housing	No significant impacts expected unless SEADOCK is constructed simultaneously.	
	Economy	Total construction wages of $7.3 million, only part of which would remain in the Freeport area.	
	Government	Tax revenues due to increased local purchasers expected to exceed cost of new services. Loss of Tax revenues of $69,000/year for life of project.	Brine Disposal and Raw Water Supply Should deep well brine injection or ground water withdrawal for leaching be selected, impacts listed above would be increased by perhaps as much as a factor of two. Marine Terminal Similar effects would accompany development of a marine terminal, except land use would be little changed.

TABLE 4.3-2b Summary of environmental impacts caused by operation of Bryan Mound SPR facilities.

DISCIPLINE	SUBJECT AREA	PROPOSED PHYSICAL FACILITY	ALTERNATIVE PHYSICAL FACILITY
Geology and Land Features	Bryan Mound and immediate vicinity	Cavern Collapse Remote possibility of roof collapse causing surface subsidence and formation of a large lake.	
Water Resources	Brazos River Diversion Channel	Raw Water Supply 1,000,000 BPD withdrawn for oil displacement for 163 days; expected to have minimal effects on water quality.	
	Brazos Channel and ICW	Oil and Brine Spills Very small possibility of oil or brine release.	
	Gulf of Mexico	Brine Disposal 240,000 BPD brine disposal should have minimal water quality impacts during refill.	
		Oil and Brine Spills Oil spills may total 2,500 barrels, brine spills 200 barrels during project life-time; effects not expected to be significant unless oil or brine reaches shallow coastal bays.	Oil Spills Use of marine terminal could reduce total oil spill volume by more than 50 percent.
	Site Lakes and Ponds	Oil and Brine Spills Impacts from expected oil and brine spills negligible. Possible very large spill could seriously degrade water quality for several weeks or months.	
	Freeport and Brazos Harbors	Maintenance Dredging Maintenance dredging impacts insignificant.	
		Oil Spills Oil spills may be relatively frequent though of small average size (1,350 bbl in 50 spills during project lifetime).	
	Ground Water	Oil and Brine Spills Very slight chance of local ground water pollution due to surface or brine oil spill; collapse of cavern could seriously degrade ground water supplies for Brazosport area but such an occurrence is highly unlikely.	
			Brine Disposal Deep well injection and brine delivery to Dow should not have significant impacts.
			Subsidence Subsidence potential greater than during leaching because of 1,000,000 BPD withdrawal rate.
Air Quality	Oil Handling and Storage Areas	Total Emissions Total emissions from 163 MMB oil storage facility for 5 fill and withdrawal cycles equal 25,170 tons, 60 percent due to SPR site expansion. Distribution of emissions as follows: 47 percent in Gulf of Mexico, 25 miles from Freeport; 2 percent in transit between open Gulf and dock site; 47 percent from docks at Freeport; 4 percent from Bryan Mound storage site. (All for project life-time).	

TABLE 4.3-2b continued.

DISCIPLINE	SUBJECT AREA	EXPECTED IMPACT: PROPOSED PHYSICAL FACILITY	EXPECTED IMPACT: ALTERNATIVE PHYSICAL FACILITY
Air Quality (cont'd)	Oil Handling and Storage (cont'd)	Storage in Surge Tanks: Average annual emissions from floating roof tanks at Bryan Mound equals 23 tons; if withdrawal occurs, value is 36 tons.	
		Dock Transfer: Hydrocarbon standards exceeded up to 13 kilometers from DOE docks; interaction from other DOE sources not considered significant.	
			Marine Terminal: Significant reduction (69 percent) in total emissions with marine terminal; standards exceedance onshore virtually eliminated.
			Bryan Mound: Onsite power generation adds a locally significant source of hydrocarbons (2,500 tons over project lifetime).
Noise Level		Storage Site Operation: No significant increase in ambient sound levels on or adjacent to the site.	
Species and Ecosystems	Aquatic		
	Brazos River Diversion Channel and ICW	Raw Water Supply: Destruction of less than 1 percent of phytoplankton and zooplankton population in Brazos River during each 150 day withdrawal period.	
		Oil and Brine Spills: Possibility of major spill of brine into ICW or of oil into Brazos from pipeline considered remote. Would cause locally significant impacts on aquatic life.	
	Gulf of Mexico	Brine Disposal: Effluent could affect plankton and benthos over several hundred to perhaps one thousand acres during oil fill. Should be significant only immediately adjacent to diffuser.	Brine Disposal: The alternative would have impacts similar to the proposed system.
		Oil and Brine Spills: Expected brine and oil spill volumes should not significantly affect marine biota. Estimated total of 2,530 barrels of oil and 275 barrels of salt water and brine during project lifetime. Possible very large or maximum credible oil or brine spill could have significant impacts to several thousand acres of shallow water or marsh if spill reaches shore before cleanup.	
			Marine Terminal: Reduce coastal exposure to oil spills if marine terminal developed.
	Site Lakes and Ponds	Oil and Brine Spills: Very little impact expected based on probability of spills. Potential for significant loss of biota, should a large spill of brine or oil occur.	

TABLE 4.3-2b continued.

DISCIPLINE	SUBJECT AREA	EXPECTED IMPACT PROPOSED PHYSICAL FACILITY	ALTERNATIVE PHYSICAL FACILITY
Species and Ecosystems (cont'd)	Aquatic (cont'd)		
	Freeport or Brazos Harbors	Maintenance Dredging Local, short-term maintenance dredging impacts. Oil Spills Local contamination of water with oil possible.	
	Terrestrial		
	Coastal Prairie and Marsh	Oil and Brine Spills Impacts primarily limited to possible oil or brine spills. Likelihood small but possible impact locally significant, especially if during spring season.	Brine Disposal and Raw Water Supply Additional marsh exposure to brine spill if well supply or ground water injection developed.
Natural and Scenic Resources	Bryan Beach and Coastal Marshes	Oil Spills Adverse impacts limited primarily to possible large oil spill which could foul beaches, coat marshes and contaminate water with oil.	
Socioeconomic Environment	Economy	Storage Site Employment Total wages expected to be approximately $92,000 during each month of oil fill and withdrawal, $17,500 during standby storage.	

4.4 ALTERNATIVE SITE - ALLEN DOME

4.4.1 Impact of Site Preparation and Construction

4.4.1.1 Land Features

Proposed Facilities

Grading at the 184-acre Allen dome alternative SPR site would disturb about 31 acres (Table 2.4-1). On-site fill would total about 410,200 cy, most of which would be required to elevate the plant area to elevation 22 feet to provide freeboard for the 100 year flood. Of this total, fill for roads, drill pads, and other facilities on-site would be about 29,640 cy.

Construction impacts of the two DOE tanker terminals in Freeport Harbor and the 5.8 mile offshore brine diffuser are described in paragraph 4.3.1.1.

Construction of raw water and brine disposal pipelines from Bryan Mound to the Allen dome site and the three back-up brine disposal wells would temporarily affect 125 acres in a 100 foot right-of-way. Excavation volume is estimated at 149,060 cy.

Construction of the bi-directional crude oil pipelines between SEAWAY Tank Farm and the site require an additional excavation of 42,240 cy.

Leaching of up to twelve storage cavities at the Allen dome site would involve removal of 100 MMB (20.8×10^6 cy) of salt. Sufficient space would be left between cavities to preserve structural integrity.

A high-voltage transmission line linking the site with Community Service Electric & Gas Company's substation in West Columbia would require a utility corridor.

Alternative Facilities

Four alternative raw-water supply systems were considered: (1) development of a well field would require 22 acres and 28,800 cy of excavation; (2) use of San Bernard River water would require construction of an intake system, a desander, a several acre spoil area and a short pipeline (less than 1/2 mile); (3) water from the Gulf of Mexico via a pipeline along the east bank of the San Bernard River would require approximately 141 acres of off-shore and 93 acres of onshore rights-of-way, in addition to a desander and spoil area; (4) withdrawal of water from the Brazos River above Freeport would also require construction of an intake system, a desander, a several acre spoil area and a 5 mile pipeline.

Brine disposal alternatives would have the following impacts: (1) injection into deep salt water bearing sands would require disturbance of 19 acres off-site and about 19,000 cy of excavation to construct the drill pads and for pipeline installation; (2) brine disposal directly to the Gulf would utilize the same pipeline right-of-way along the San Bernard River as the Gulf water supply alternative; and (3) brine disposal to a diffuser 12.5 miles offshore from Bryan Mound would have impacts as discussed in Section 4.3.1.7.

On-site power generation would require no additional land disturbance outside the plant area.

Alternatives to the crude oil distribution system are discussed in paragraph 4.3.1.1.

4.4.1.2 Water

Site preparation and construction of the proposed facilities at Allen dome may impact several water bodies, including the San Bernard River, Jones Creek, the Intracoastal Waterway, the Brazos River Diversion Channel, Freeport Harbor, the lakes and ponds at Bryan Mound, the Gulf of Mexico, and various ground water aquifers.

Raw Water Withdrawal

The potential impacts on water quality in the Brazos River Diversion Channel due to raw water withdrawal are described in paragraph 4.3.1.2.

Brine Disposal

The potential impacts on water quality in the Gulf of Mexico and in the deep aquifers are described in paragraph 4.3.1.2.

Construction of DOE Docks

The potential impacts on water quality in Freeport Harbor are described in paragraph 4.3.1.2.

Construction of Surface Facilities at Allen Dome

Site preparation and construction activities at Allen dome would require displacement of approximately 38,000 cy of earth. Natural site drainage is toward the San Bernard River. Standard engineering control techniques (interceptor ditches, dikes, and sedimentation ponds) would be utilized to prevent significant degradation of water quality from site runoff.

Construction of Oil, Brine and Water Supply Pipelines

The proposed water supply, brine disposal, and crude oil pipelines would cross the San Bernard River, east of the site. The water supply and brine pipelines would also cross Jones Creek and the Brazos River Diversion Channel between the SEAWAY Tank Farm and Bryan Mound.

Trench excavation across the water courses would create increased turbidity and release soluble substances from the substrate to the water column. Impacts would be temporary and local in extent.

There should be no impact on ground water supply or quality due to pipeline installation.

Accidental Brine Release

A possible brine (or raw water) spill could affect the San Bernard River, Jones Creek, the Brazos River Diversion Channel, lakes and ponds on Bryan Mound, the Intracoastal Waterway, or the Gulf of Mexico.

The estimated quantity of brine that could be spilled during leaching of Allen dome expansion cavities is up to 50 barrels into Gulf waters and up to 120 barrels on land or in water bodies between Bryan Beach and Allen dome. In addition, an estimated 120 barrels of raw water could be spilled from the raw water supply system. Maximum credible spills of up to 30,000 barrels are considered possible, though very unlikely.

Local recharge of near surface aquifers has been found to be minimal, so potential seepage from the membrane lined brine pit or minor pipeline spills are likely to have negligible impact of water quality. A brine spill at the site or along the disposal pipeline could locally impact shallow aquifers.

Hurricane surge studies indicate that the 100 year flood elevation at Allen dome is +14.0 feet MSL, excluding wave runup. As the brine pond would be elevated to elevation +22 feet MSL, there is little likelihood of a storm induced failure resulting in a release of brine. Should a storm surge of sufficient magnitude breach the pond, however, impacts caused by loss of the brine would be small compared with the attendant storm wave and salt water damage.

Alternative Facilities

Alternative raw water systems for cavity leaching include: (1) withdrawal of saline ground water; (2) withdrawal of water from the San Bernard River adjacent to the site; (3) withdrawal of water from the Gulf of Mexico; and (4) withdrawal of water from the Brazos River above Freeport. Withdrawal of ground water is feasible but has the potential of lowering the piezometric head, thus allowing saline water intrusion and land subsidence. The San Bernard River in the vicinity of the site is a tidal estuary. Withdrawal of water for leaching would induce a somewhat greater inflow of Gulf waters and would probably increase average salinities during withdrawals. Construction of a pipeline along the east bank of the San Bernard River to the Gulf of Mexico for withdrawal of ocean water would create sedimentation and other normal construction impacts on the San Bernard River and near shore Gulf waters during and immediately following pipeline installation. Use of a separate raw water intake on the Brazos River would be feasible, except that previous water supply commitments may limit water availabilities during low flow periods.

Alternative brine disposal systems include: (1) deep well injection; (2) disposal directly to the Gulf through a pipeline along the east bank of the San Bernard River; and (3) disposal through a diffuser 12.5 miles offshore from Bryan Mound. The impacts of brine injection to saline water bearing sands are discussed in paragraph 4.3.1.2. Brine disposal to the Gulf would use the same pipeline right-of-way as indicated above for water withdrawal. Impacts of this alternative and the 12.5 mile diffuser offshore of Bryan Mound would be similiar to those described in paragraph 4.3.1.2 for the proposed brine disposal system.

Alternative crude oil distribution methods are described in paragraph 4.3.1.2.

4.4.1.3 Air Quality

Air quality impacts resulting from site preparation and construction of the proposed facilities at the Allen dome alternative SPR site would be similar to those discussed in paragraph 4.3.1.3, where it was concluded that air quality impacts would be minor.

Additional emissions from construction of a 10 mile raw water pipeline to the Gulf of Mexico would be a relatively insignificant source of pollutants.

4.4.1.4 Noise

Site preparation and construction at Allen dome would adversely impact ambient sound levels in the vicinity. The increase in noise resulting from these activities, with the exception of plant facility construction, would be similar to those discussed in paragraph 4.3.1.4.

For construction of facilities connected with the Allen dome site, the noise impact zone radii are:

Area	Construction Activity	Impact Zone Radius (ft)
Allen dome site	Drilling new wells	4500
	Construction of support facilities	2000
Pipeline routes	Laying of pipe	1800
	Access road construction	1400
Freeport Harbor	DOE dock construction	2200

Approximately 16 residences south of Allen dome might be exposed to increased sound levels. As the construction activities would occur over an estimated 15 month period, this impact would be only of short term significance.

Construction of an alternative raw water or brine disposal well field in the vicinity of Allen dome would contribute noise levels of a magnitude similar to the onsite activities. The zone of impact would then be extended further to the east in a sparsely inhabited area of marshland and coastal prairie. Construction of the alternative pipelines to the Gulf would increase noise levels at Bernard Acres very briefly (2 to 3 days). Construction of an offshore terminal would have no measurable effect on onshore noise levels.

4.4.1.5 Ecosystems and Species

Site preparation and construction of the alternative SPR facilities at Allen dome would affect both terrestrial and aquatic resources in the area. Terrestrial habitats potentially affected include undeveloped coastal prairie grassland, fluvial woodland, and brackish marsh. Aquatic habitats include the San Bernard River, Jones Creek, the Brazos River Diversion Channel, the Intracoastal Waterway, the lakes and ponds at Bryan Mound, Freeport Harbor, and the near shore Gulf of Mexico.

Development of the Allen dome site would affect relatively undeveloped lands of moderate to high natural productivity.

In the following subsections, potential impacts on ecosystems and species are treated according to specific aspects of facility development.

Raw Water Withdrawal

The potential impacts on species in the Brazos River Diversion Channel are described in paragraph 4.3.1.5.

Brine Disposal

The potential impacts on species in the Gulf of Mexico are described in paragraph 4.3.1.5.

Construction of DOE Docks

The potential impacts are described in paragraph 4.3.1.5.

Construction of Surface Facilities at Allen Dome

Facilities constructed at Allen dome that would have a potential impact on the site ecology include the pump house and control buildings, the cavern wellheads and brine disposal wells, access roadways, the brine pond, and a utility power corridor.

The Allen dome storage facilities would be located on a 184-acre tract consisting mostly of coastal prairie and fluvial woodlands. The plant area, equipment yard, and 12 new entry wells would reduce the coastal prairie habitat by 28 acres. The loss of this habitat is not significant when compared with the total acreage of similar coastal prairie habitat in Brazoria County. In addition to habitat loss, the direct effects of construction activities would include forced migration and the loss of food, cover, and breeding areas for many smaller animals. Following construction, some wildlife species would return to the site.

Site clearing could also result in increased erosion but this impact should be of a minor and temporary nature.

Clearing the land for the utility corridor would cause minimal losses of habitat, as little ground disruption would occur. The most significant and longest lasting impacts would be to wooded areas should they be cleared.

Construction of Pipelines

A total of 99 acres would be required for construction of the proposed raw water, brine, and crude oil pipelines between the Allen dome site and the SEAWAY Tank Farm. Between SEAWAY and Bryan Mound, the raw-water and brine pipelines would be constructed within an existing right-of-way. Construction activities along the right-of-way would impact coastal prairie, fluvial and oak woodlands, and brackish marsh habitats. There are six water crossings along the right-of-way.

Construction activities would temporarily displace wildlife from the immediate vicinity of the right-of-way and would eliminate most useful habitat until regrowth of vegetation.

Significant alterations of drainage patterns could result in long-term habitat alterations within and beyond the confines of the project site. However, except for elimination of woody vegetation, much of the right-of-way, especially in the coastal prairie, would revert to nearly pre-existing conditions. This would be particularly true if maintenance clearing were minimized to allow growth of natural shrubs, tall grasses, and other vegetation easily cleared in case of need for pipeline access.

Brush and trees removed from the right-of-way in woodland areas would result in a permanent loss of this habitat to woodland species, especially arboreal wildlife.

Construction in marshlands and across creeks and rivers would result in the temporary loss of bottom habitat and resuspension of any heavy metals, pesticides, or other pollutants in bottom sediments. Sedimentation from land runoff would have a variety of effects, including loss of productivity, burying of the benthos, and interference with respiration of fish and amphibians. These impacts would permanently alter some small valuable wetlands in the vicinity, reducing the regional supply.

Accidental Brine Release

The most likely location for a large brine spill would be onshore between Allen dome and Bryan Beach. In such an event, the brine could affect coastal prairie or brackish marsh habitats, the San Bernard River, Jones Creek, the Brazos River Diversion Channel, the lakes on Bryan Mound, or the Intracoastal Waterway.

The potential impacts of such an occurrence are described in paragraph 4.3.1.5.

Alternative Facilities

Four alternative raw water supply systems were considered: (1) withdrawal of saline ground water; (2) withdrawal of water from the San Bernard River adjacent to the site; (3) withdrawal of water from the Gulf of Mexico; and (4) withdrawal of water from the Brazos River above Freeport. Withdrawal of ground water would require construction of a well field and disrupt 22 acres of coastal prairie habitat. The San Bernard alternative would disrupt 5 acres of on-site coastal prairie habitat and one acre of fluvial woodlands. The pipeline to the Gulf would increase sedimentation and result in other construction impacts along the east bank of the San Bernard River in an area totaling 234 acres. The Brazos River alternative would impact a total of 106 acres of fluvial and oak woodland and coastal prairie habitat along a 5-mile pipeline.

Alternative brine disposal methods include deep well injection, diffusion in the Gulf south of Allen dome, and use of the 12.5 mile diffuser south of Bryan Mound. Deep well injection would cause the loss of an additional 19 acres of coastal prairie habitat. Brine disposal directly to the Gulf would use the same pipeline right-of-way as indicated above for water withdrawal. Impact of this alternative would be the same as those described in paragraph 4.3.1.5 for the proposed brine disposal system. The impact of the 12.5 mile diffuser is also described in paragraph 4.3.1.5 for alternative facilities, and in Appendix G.

Alternative crude oil distribution methods are described in paragraph 4.3.1.5.

4.4.1.6 Natural and Scenic Resources

Construction at the Allen dome site and along the pipeline route would have a noticeable temporary effect on some local natural resource and recreational areas in Brazoria County. Construction activities would temporarily disrupt hunting and fishing activities adjacent to the site and along the pipeline route.

Construction activity would also have a negative but temporary effect on local ambience. Residents in the small subdivision nearby would be subjected to construction noise, dust, vibration and fumes. Construction along the pipeline right-of-way would disturb the undeveloped quality of the coastal prairie and marsh environments crossed. There may be some temporary disruption of wildlife in portions of the San Bernard National Wildlife Refuge from onsite construction noise.

Development of an alternative raw water supply or brine injection field east of Allen dome would not significantly affect natural or scenic resources. Construction of pipelines to the Gulf would temporarily disturb residents of Bernard Acres and might disrupt wildlife population in the nearby San Bernard Wildlife Refuge.

4.4.1.7 Archaeological, Historical and Cultural Resources

No significant impacts on archaeological, historical or cultural resources are expected from construction of the project or its alternatives. If SPR expansion at Allen dome were selected, the site and pipeline routes would be surveyed for their potential archaeological, historical, or cultural resources prior to construction. Compliance would be made with the provisions of Executive Order 11593.

4.4.1.8 Socioeconomic Environment

Land Use

Developing the Allen dome site would change the primary land use of the site, the pipeline routes to SEAWAY Tank Farm, and the pipeline routes to the Gulf diffuser from a non-cultivated grazing area to an industrial area. Other pipeline routes required follow established rights-of-way and would not alter present land uses.

Alternative development plans would impact land use to the extent that additional undeveloped land would be converted to industrial use.

Transportation

During the construction period, traffic would increase on the major highways and roads servicing Allen dome. Impacts would be most noticeable during the first year of construction, when the largest number of workers would be commuting. Construction crews would be working long shifts, however, and their commuting hours would not be expected to conflict with other commuters. During the peak construction month over 500 workers would commute to the site daily; additional traffic would be generated by truck traffic to the site. While the capacities of existing roads are unlikely to be exceeded in the project area, some congestion may occur at shift changes. It is anticipated that in non-peak hours, traffic in the project area would be only minimally impacted.

The project would have a small impact on waterborne transportation in Freeport Harbor, caused by an increase in tanker traffic. The worst case increase in tanker traffic during the initial fill (assuming a tanker capacity of only 32,000 DWT, or 254,000 bbl of oil) would average about one tanker every day.

Waterborne traffic in the area may be temporarily disrupted during pipeline construction across navigable waterways. Barges may be used to transport construction materials to the site on the San Bernard River.

Construction of alternative water supply, brine disposal and oil distribution facilities could affect the area's transportation conditions because of the additional workers and material that would be required. Impacts should not be significant.

Population and Housing

The potential impacts on population and housing would be similar to those described in paragraph 4.3.1.8.

Economy

Potential economic impacts are described in paragraph 4.3.1.8.

Government and Public Services

Construction of the SPR facilities at Allen dome would involve the removal of 184 acres from the property tax rolls of Brazoria County. Assuming that the land at Allen dome has a fair market value of $1000 per acre, the tax loss to the county would be $530 per year, for the life of the project.

Potential project impacts on local public services are the same as those described in paragraph 4.3.1.8.

4.4.2 Impact from Operation and Standby Storage

Development of a 100 MMB storage capacity at Allen dome would ensure that, in the event of an oil supply interruption, a total 163 MMB of oil would be available from the Seaway Group SPR facilities for delivery to the SEAWAY Pipeline or to tankers via Freeport Harbor. Oil would probably be pumped preferentially from Allen dome to SEAWAY Tank Farm for pipeline transport north; oil in excess of SEAWAY capacity (600 MB per day) would then be pumped to the tanker dock along with oil from the Bryan Mound early storage phase facilities. Until an oil supply interruption occurred, the facilities at Allen dome would be maintained in a condition of standby readiness.

Principal environmental impacts would be those associated with oil or brine spills and with hydrocarbon emissions.

4.4.2.1 Land Features

Effects of normal operation and standby storage on land features are expected to be minimal. Soils would stabilize soon after revegetation.

The possible impacts of the improbable occurence of a cavern collapse are described in paragraph 4.3.2.1.

Use of alternative facilities would have no impact on land features during project operation or standby storage.

4.4.2.2 Water

Impacts on water resources during operation of the Allen dome facility could result from raw water withdrawal, brine disposal, maintenance dredging at dock sites, and possible spills of oil or brine.

Raw Water Withdrawal

Raw water for displacing the stored oil during an oil supply interruption would be obtained from the intake on the Brazos River Diversion Channel. Since the amount of oil to be withdrawn from the alternative SPR site and the Bryan Mound early storage phase cavities would total 163 MMB (100 MMB from expanded SPR storage and 63 MMB from early storage), the water withdrawal rate would be 1 MMB per day (65 cfs) for the 163 day withdrawal period. This is a 87 percent greater rate than during leaching, but it is still less than 1 percent of the normal daily discharge of the Brazos. Even during low flow periods, this withdrawal rate should not induce any measurable increase in Gulf water flow up the river. Water quality and quantity in the lower Brazos River should thus not be measurably affected by raw water withdrawal.

Brine Disposal

The potential impacts on water quality in the Gulf of Mexico and in the deep salt water bearing sands are described in paragraph 4.3.2.2.

Maintenance Dredging

The potential impacts on water quality in Freeport Harbor are described in paragraph 4.3.2.2.

Accidental Oil Release

During project operation, oil spills could occur in the Gulf of Mexico, in Freeport Harbor, along the pipelines connecting the storage site with the DOE tanker docks and with SEAWAY Tank Farm, from the wells at Allen dome, or from oil surge tanks at Bryan Mound. A summary of the oil spill expectation model projections is given in Section 4.2.

The probable movement of spills occurring east of the SEAWAY Tank Farm is described in paragraph 4.3.2.2.

Spills at the Allen dome site not contained within the diking would enter the San Bernard River watershed; the most likely drainage path is an existing swale which passes through a subdivision (Bernard Acres) and enters the river near a marina. Spills from the pipeline route west of the community of Jones Creek could either enter the San Bernard River watershed or diffuse southward into marshlands between the river and the proposed SEADOCK terminal site.

Oil spills are most likely to reach the Gulf of Mexico only from tanker spills.

Oil weathering processes and dispersal characteristics, and the potential impact of oil spills are described in paragraph 4.3.2.2.

Accidental Brine or Saline Raw Water Release

During project operation, brine spills could occur from the brine disposal pipeline or the on-site brine pit; raw water could be spilled from the raw water supply line or, during standby storage, from the brine disposal line. A summary of brine spill expectation model projections is provided in Section 4.2.

The probable movement of spills occuring east of the SEAWAY Tank Farm is described in paragraph 4.3.2.2.

Spills at the Allen dome site not contained within the diking would enter the San Bernard River watershed; the most likely drainage path is an existing swale which passes through Bernard Acres subdivision and enters the river near a marina. Spills from the pipeline route west of the community of Jones Creek could either enter the San Bernard River watershed or diffuse southward into marshlands between the river and the proposed SEADOCK terminal site.

The potential impacts of brine and raw water spills are described in paragraph 4.3.2.2.

Flood Hazards

Surface facilities at Allen dome would be subject to potential flooding caused by hurricanes or tropical storms. Surface elevations over the dome vary from 0 to 6 feet MSL. A storm levee would be constructed around facilities at Allen dome to a height of +22 feet MSL. All planned SPR facilities at Allen dome would be located behind the protective storm levee (Figure 2.5-5). The calculated 100-year flood level at Allen dome is +14 feet MSL, excluding wave runup, so there is little likelihood of storm-induced failures.

Potential impacts of a greater than 100-year flood are considered in paragraph 4.3.2.2.

Pipelines and storage tanks at Bryan Mound would be subject to flood hazards as described in paragraph 4.3.2.2.

Alternative Facilities

Use of the San Bernard River for raw water supply should have no significant adverse impacts on water quality in that estuary although average salinities would be increased. Use of saline ground water to displace the stored oil would have about the same potential adverse impact, especially surface subsidence, as described in paragraph 4.3.2.2. Withdrawal of water from the Gulf of Mexico should have no measurable impact on water quality.

Since average brine disposal rates would be less than 45 percent of the rates needed for cavern leaching, the potential adverse impacts of deep well injection would be less than those noted for construction. Brine would be disposed of intermittently, at a rate to insure that design exit velocities at the diffuser are met (Section 4.3.2.2). DOE is also developing a monitoring plan, to be implemented during disposal (loc. cit.). The impact on water quality from each, however, would be much less than during cavern leaching.

The potential impacts of alternative crude oil distribution methods are described in paragraph 4.3.2.2.

4.4.2.3 Air Quality

Air quality impacts resulting from operation of the proposed facilities at the Allen dome alternative SPR site would be similar to those discussed in paragraph 4.3.2.3. The inventory of total HC emissions given in Table 4.3-1 for 100 MMB expansion at Bryan Mound expected over a 22 year period of operation (5 cycles) would apply for Allen dome development.

Air quality impacts from alternative crude oil distribution and power generation systems would also be similar to those discussed in paragraph 4.3.2.3.

4.4.2.4 Noise

Noise impacts of operating SPR facilities at Allen dome would be similar to those described in paragraph 4.3.2.4. Though the community of Bernard Acres is less than one-half mile from the site, noise impacts from pumping and other operations would not be noticeable there.

4.4.2.5 Ecosystems and Species

Raw Water Withdrawal

The potential impacts on ecosystems and species in the Brazos River Diversion Channel are described in paragraph 4.3.2.5.

Brine Disposal

The potential impacts on ecosystems and species in the Gulf of Mexico are described in paragraph 4.3.2.5.

Tanker Transport

The potential impacts on ecosystems and species in Freeport Harbor are described in paragraph 4.3.2.5.

Maintenance of Project Lands

The chief impact of normal maintenance of the proposed pipeline right-of-way and other project lands on terrestrial ecology would result from the periodic clearing required for access, surveillance, and monitoring. During operations, right-of-way maintenance could disturb soil and vegetation through vehicle movement and weed control measures.

Maintenance of the pipeline and the elimination of cover could have adverse effects upon some wildlife species, preventing small rodents and other wildlife from becoming established on the pipeline corridor. Brush clearing would maintain the "edge" effect, however, and encourage new growth of established plant species, thus providing a continued food source for herbivorous wildlife.

Day to day operation of project lands would have only limited impact on wildlife, mostly those in noise impacted areas. Noise levels would not be noticeable on most portions of project lands, however.

Accidental Oil Release

Because of the expected very low frequency of spills (Section 4.2), chronic oil pollution should not occur at Allen dome, Bryan Mound, or along the proposed pipeline routes.

A large spill of oil in the vicinity of Allen dome could reach the San Bernard River, the adjoining National Wildlife Refuge, some of the dome, or the coastal bays and marshes. Severe impacts to vegetation, aquatic life, terrestrial mammals and, particularly, bird life could result. Other potentially sensitive areas exposed to oil or brine spills are Jones Creek and the adjacent prairie land along the pipeline right-of-way, shallow lakes and ponds on Bryan Mound, and nearshore Gulf waters and shorelines.

The damage parameters discussed in paragraph 4.3.2.5 apply to the Allen dome site alternative except that a large pipeline spill could impact up to 380 acres of wetlands (or prairie). The most sensitive areas would probably be the pipeline right-of-way between Allen dome and the SEAWAY Tank Farm, and the lakes and ponds on Bryan Mound.

Except in the case of a very large oil spill (or a moderately sized spill in a sensitive area), biological impacts are not expected to be of regional significance.

Accidental Brine or Raw Water Release

The potential impacts of accidental brine releases on ecosystems are discussed in paragraph 4.3.1.5.

Alternative Facilities

Use of a ground water supply system or a deep well brine injection system would expose additional portions of coastal prairie to brine spills.

Use of a marine pipeline and an offshore SPM terminal would substantially reduce (by about 60 percent) the spill risks associated with crude oil movement through Freeport Harbor.

Withdrawal of raw water from the San Bernard River would substantially reduce the exposure to saline raw water (not brine) spills, but would represent a more significant potential for loss of large numbers of phytoplankton, zooplankton and small fish in the river, and would affect the salinity regime of the tidal estuary.

Use of pipelines to withdraw water from, and dispose brine into, the Gulf of Mexico should not significantly affect the ecology in the open Gulf. Maintenance of pipeline rights-of-way along the east bank of the San Bernard River would displace certain wildlife species temporarily and could result in some sedimentation. More significantly, there would be a greater exposure to brine spills in the lower San Bernard, in the adjacent wildlife refuge, and in the coastal bays and marshes.

4.4.2.6 Natural and Scenic Resources

Operation and maintenance of project facilities would have no significant impacts on recreation or natural resources in the local area. However, should an oil or brine spill affect wildlife habitat, recreation activities could be significantly impacted because of the potential for affecting the San Bernard Wildlife Refuge.

Project facilities would have an adverse aesthetic impact on the nearby residential development. The degree of impact would depend on flood control measures used to protect on-site facilities. If the area were protected by vegetated levees or by grading, many of the facilities would be masked.

Burial of pipelines would minimize the visual impact of project facilities; maintenance of right-of-way and the aboveground facilities at Allen dome, however, would detract from the largely undisturbed local setting of the nearby housing areas.

4.4.2.7 Archaeological, Historical and Cultural Resources

There are expected to be no significant impacts on archaeological, historical or cultural resources resulting from operation of the project or its alternatives at the Allen dome site. If this site were selected for development, however, a cultural resources survey would be conducted prior to construction.

4.4.2.8 Socioeconomic Environment

Land Use

Operation of the project would constitute a major long term change in the existing local land use at Allen dome. The 184-acre site would be fenced off for the life of the project. Of the 494 acres required for construction offsite and within the fenced area, 313 acres would be needed for pipeline and surface facility maintenance, and some of the excess land would be revegetated and returned to present uses. No structures could be erected within the pipeline rights-of-way.

Transportation

Operation and maintenance activities would have a minimal effect on local transportation facilities since the labor force would be limited to a few maintenance people (10) plus a relatively small crew (approximately 30 at Allen dome and 25 at Bryan Mound) for filling and withdrawal operations.

During oil withdrawal operations, the tanker traffic in Freeport Harbor would increase by about 1.5 tankers (32,000 DWT) per day for 163 days. Refill of the storage capacity would occur over a 2.4 year period, increasing traffic in Freeport Harbor by about one vessel (32 MDWT) every two days.

Population and Housing

During the normal operation period, only a small number of personnel would be involved (approximately 10 persons). The impact on population and housing would be slight in the local area and insignificant in the region. During emergency withdrawal and ensuing refilling activities, some additional personnel may be required (bringing the total force to about 55). Most of these additional workers would probably commute to the site, as housing is in relatively short supply and employment would be temporary.

Economy

Economic impacts of the project are described in paragraph 4.3.2.8.

Government and Public Service

Impacts of project operation are described in paragraph 4.3.2.8.

4.4.3 Impact Due to Termination and Abandonment

Impacts caused by termination and/or abandonment of the Allen dome SPR storage site would be similar to those described in paragraph 4.3.3.

4.4.4 Relationship of Proposed Action to Land Use Plans, Policies and Controls

The proposed project is anticipated to be generally consistent with the flexible land use planning practiced in Brazoria County (Section 4.3.4). It is not anticipated that the Allen dome alternative site would be in conflict with any State land use plans or policies.

4.4.5 Summary of Adverse and Beneficial Impacts

Development of the Allen salt dome as an SPR oil storage facility is not likely to generate significant regional environmental impacts except for the remote possibility of a major oil or brine spill, or the uncontrolled release of hydrocarbon vapors during oil transfer operations. Construction and use of an offshore SPM terminal would reduce hydrocarbon emissions by more than 50 percent and would minimize the chance of a near shore oil spill.

The Allen dome site has not been extensively used for industrial purposes and thus construction of storage facilities and associated pipelines would cause potentially significant local disruption. Although much of the area has a high primary biological productivity, the amount of land permanently affected by the project would be small in relation to the amount of similar land in the area. However, the project would contribute to the loss of valuable wetlands regionally.

Although the project would require large quantities of water for solution mining and oil displacement, the total raw water demand of the project constitutes less than one percent of the average flow from the Brazos River Diversion Channel.

Disposal of brine in the Gulf of Mexico is expected to moderately increase the salinity of waters adjacent to the brine diffuser; this could have an adverse impact on local marine organisms and might interfere with migration of some estuarine species. Construction of brine disposal wells as a back-up system would temporarily disrupt coastal prairie habitat east of the site. Construction of either alternative brine diffuser system to the Gulf would temporarily disrupt some coastal lands.

Construction and operation of dock facilities in Freeport Harbor is not likely to have a significant impact on either the ecology of the area or the water quality of the harbor, as the harbor is frequently dredged.

During construction of SPR facilities at Allen dome, increases in income and employment in the Freeport region are expected. These increases would be of short duration and are not expected to significantly affect the area's economy. Operation of the Allen dome and Bryan Mound SPR facilities would provide minor additional income to the local area during standby storage and oil fill and withdrawal phases. Temporary increases in traffic congestion in the Freeport and Allen dome area could be expected during construction.

The indirect economic benefits of the Strategic Petroleum Reserve program are of considerable importance to the regional economy, as the area is highly dependent on the petroleum-petrochemical industry for employment. Assurance of a continued oil supply in the event of a national emergency would provide a measure of security for that industry and thus for local residents.

Table 4.4-1 provides a summary tabulation of the adverse and beneficial impacts associated with development of this candidate site. The data are in both qualitative and quantitative form, as appropriate.

TABLE 4.4-1a Summary of environmental impacts caused by development of Allen dome SPR facilities.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITY	ALTERNATIVE FACILITY
Geology	Allen dome and immediate vicinity	Site Preparation Excavation of 27,720 cy at the storage site on 31 acres of pasture land and fill of 410,200 cy. Cavern Leaching Removal of 20.8×10^6 cy of salt for cavern development.	
	Pipeline Corridors-between Allen dome and Bryan Mound	Pipeline Construction Excavation of 191,300 cy along the oil, brine and raw water pipeline routes on 125 acres of primarily prairie grassland.	Brine Disposal Brine disposal to aquifers: 19 acres and 19,000 cy excavation.
	DOE Tanker Docks in Freeport Harbor	Site Preparation Dredging of 1,050,000 cy and grading of 14 acres for the tanker docks.	
	Pipeline Corridor to Brazos Harbor	Pipeline Construction Excavation of 5000 cy for pipeline to Brazos Harbor on 4 acres of marsh, and 4 acres of cleared land.	
	Phillips Dock		Site Preparation 6 acres and 2500 cy excavation.
	Offshore SPM Terminal		Terminal Preparations 62 acres and 46,205 cy excavation.
	Pipeline Corridor to Gulf of Mexico	Pipeline Construction Excavation of 1[illegible],300 cy for 7.5 mile pipeline on 21 acres of coastal prairie and 142 acres of Gulf bottom.	Pipeline Construction Excavation of 274,600 cy for 14.2 mile pipeline on 21 acres of prairie and 305 acres of Gulf bottom. Raw Water Supply and Brine Disposal Approximately 234 acres of cleared and excavated ROW offshore for pipeline directly to Gulf for raw water supply or brine disposal.
	Ground Water		Raw Water Supply Well field for raw water supply: 22 acres and 28,900 cy excavation.
Water Resources	Brazos River Diversion Channel and ICW	Site Preparation Small quantities of sediment and construction pollutants carried into river by rainfall runoff. Raw Water Supply 534,000 BPD withdrawn for leaching over a two-year period expected to have minimal effects on water quality. Brine Spills Very small possibility of brine release reaching water bodies.	
	Gulf of Mexico	Brine Disposal Pipeline construction would cause temporary disruption of 142 acres of Gulf bottom. 584,000 BPD brine disposal could increase bottom salinity by 1 ppt over 3 square miles; approximately 25 acres would have excess salinities of 5 ppt or more. Brine Spills Expected brine spills would have no significant impact; possible maximum credible spill could have significant local impact.	Brine Disposal Disposal of brine in Gulf south of Allen dome or 5.7 miles south of the proposed diffuser should leave same impact as primary proposal. Pipeline construction would cause temporary disruption of 141 acres and 305 acres of Gulf bottom, respectively.

TABLE 4.4-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITY	ALTERNATIVE FACILITY
Water Resources (cont'd)			Marine Terminal Construction Construction of marine terminal would temporarily increase turbidity levels in nearshore Gulf waters.
	San Bernard River, Jones Creek and Lakes and Ponds on Bryan Mound	Site Preparation Sediment and miscellaneous construction pollutants could degrade water quality. Brine Spills Expected brine spills insignificant; possible maximum credible spill could have significant impact.	Raw Water Supply Withdrawal of water from San Bernard River could increase average salinities in tidal estuary. Brine Disposal and Raw Water Supply Construction of brine disposal or raw water pipeline to Gulf would produce sedimentation in San Bernard River.
	Freeport and Brazos Harbors	Site Preparation Dredging and dock construction impacts considered comparable to annual maintenance dredging in Freeport Harbor.	
	Ground Water		Raw Water Supply Possible local subsidence caused by ground water withdrawal for leaching. Brine Disposal Deep well injection of brine is not expected to affect ground water supplies; potential for adverse impact limited to migration up old unplugged wells.
Air Quality	Allen Dome Dock Sites	Site Preparation Minor quantities of particulates, SO_2, CO, HC, and NO_2 released from construction equipment at Allen dome.	
	Marine Terminal		Marine Terminal Construction Construction of a marine terminal would increase emissions offshore but have little effect on concentrations at Freeport.
	Pipeline Corridor		Raw Water Supply and Brine Disposal Development of well fields for raw water supply or brine injection may double site emissions. Pollutant concentrations should remain within standards in the absence of background pollutants. Brine Disposal Construction of pipelines directly to Gulf would have local minor, short-term effects on local air quality.
Noise Level	Storage Site	Site Preparation Maximum zone of noise impact (defined as 3 dB increase over ambient), 4500 feet for Allen dome; 16 residences affected south of Allen dome for a period of 15 months.	

TABLE 4.4-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT: PROPOSED FACILITY	ACTIVITY AND EXPECTED IMPACT: ALTERNATIVE FACILITY
Noise Level (cont'd)	Docks	Site Preparation Maximum zone of noise impact, 2200 feet; no residences or noise sensitive areas affected.	
	Pipeline Routes	Pipeline Construction Zone of noise impact equal to 1800 feet; very few residences affected for periods of less than a week.	
			Brine Disposal Slightly increased zone of noise impact due to drilling of brine disposal or raw water supply wells; no residences or noise sensitive areas affected. Noise impact to Bernard Acres increased for less than one week due to pipeline construction to Gulf.
Species and Ecosystems	Aquatic:		
	Brazos River Diversion Channel and ICW	Brine Spill Possible major spill of brine from pipeline considered remote. Locally significant aquatic impacts could occur.	
	Gulf of Mexico	Brine Disposal Pipeline construction would cause temporary loss of 142 acres of benthic communities. Brine effluent could affect benthos communities over several hundred to several thousand acres. Some loss of benthos and plankton in the immediate diffuser area. Some impact on local white shrimp.	Brine Disposal Pipeline construction of 12.5 mile diffuser would cause temporary loss of 305 acres of benthic community. The impact of brine effluent should lie similar to the proposed diffuser location.
		Brine Spill Possible maximum credible brine spill could destroy several acres of benthos and some biota in water column.	
			Marine Terminal Construction of marine terminal facilities expected to have minimal local, short-term effect on benthos in offshore waters. Raw Water Supply and Brine Disposal Pipeline Also loss of up to 140 acres of benthos temporarily in offshore Gulf. Regionally significant impact on wetland productivity.
	San Bernard River and Lakes and Ponds on Bryan Mound	Site Preparation Minimal local impacts due to erosion and runoff from site construction. Brine Spill Major brine spill remotely possible; significant loss of biota would follow.	
	Freeport and Brazos Harbors	Site Preparation Very local, short-term dredging impacts.	

TABLE 4.4-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITY	ACTIVITY AND EXPECTED IMPACT ALTERNATIVE FACILITY
Species and Ecosystems (cont'd)	Terrestrial		
	Coastal Prairie	Site Preparation Loss of 158 acres due to facility construction. Revegetation of 33 acres likely. Minimal impact importance. Brine Spill Large brine spill could destroy several acres.	
			Brine Disposal Loss of 19 acres of Coastal Prairies due to construction of deep well injection system
			Raw Water Supply Similar impact due to well field development for raw water supply. Locally significant impact on productivity and habitat.
	Wetlands	Site Preparation Loss of 16 acres due to facility construction. Revegetation of 4 acres likely. Minimal impact importance. Brine Spill Large brine spill could destroy several acres.	
			Raw Water Supply Loss of 76 acres of wetland habitat (mostly brackish marsh) due to construction of raw water supply or brine disposal pipeline to Gulf.
	Fluvial Woodland	Site Preparation Loss of 2 acres due to facility construction. Minimal impact importance. Brine Spill Large brine spill could destroy several acres.	
Natural and Scenic Resources	Pipeline Construction	ROW Clearing Significant impact on aesthetics due to nearby construction. Minor impact due to short-term displacement of birdlife from nearby marshes and wildlife refuge.	
Socioeconomic Conditions		All Environments	
	Land Use	Approximately 198 acres of Coastal Prairie, marsh, fluvial woodland and cleared land developed.	
	Transportation	Potential for traffic congestion on local roads near Allen dome. Temporary minor impediment to navigation in Gulf during diffuser construction.	
	Population and Housing	No significant impacts expected.	
	Economy	Total construction wages of $8.3 million, only part of which would remain in the Brazosport area.	

TABLE 4.4-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITY	ALTERNATIVE FACILITY
Socioeconomic Conditions (cont'd)	Government	Tax revenues due to increased local purchases expected to exceed cost of new services. Loss of tax revenues of $53,000 per year for life of the project.	Brine Disposal and Raw Water Supply Should deep well brine injection or ground water withdrawal for leaching be selected, impacts listed above could be increased significantly. Similar effects would accompany development of a marine terminal, except land use would be little changed.

TABLE 4.4-1b Summary of environmental impacts caused by operation of Allen dome SPR facilities.

DISCIPLINE	SUBJECT AREA	EXPECTED IMPACT PROPOSED PHYSICAL FACILITY	 ALTERNATIVE PHYSICAL FACILITY
Geology and Land Features	Allen dome and immediate vicinity	Cavern Collapse Remote possibility of roof collapse causing surface subsidence and formation of a lake over the dome.	
Water Resources	Brazos River Diversion Channel	Raw Water Supply 1,000,000 BPD withdrawn for oil displacement for 163 days; expected to have minimal effects on water quality.	
	Brazos Channel, ICW, and San Bernard River	Oil and Brine Spills Very small possibility of oil or brine release.	Raw Water Supply Withdrawal of water from San Bernard River would raise average salinity.
	Gulf of Mexico	Brine Disposal 240,000 BPD brine disposal should have minimal water quality impacts. Oil and Brine Spills Oil spills may total 2,750 barrels, and brine spills 210 barrels during project lifetime; effects not expected to be significant unless oil or brine reaches shallow coastal bays.	Brine Disposal Disposal of brine to Gulf south of Allen dome would spread salinity excess over two locations. Oil Spills Use of marine terminal could reduce total oil spill volume by more than 50 percent. Raw Water Supply Withdrawal of water from Gulf should not affect water quality.
	Jones Creek and Lakes and Ponds on Bryan Mound	Oil and Brine Spills Expected impacts from oil and brine spills negligible. Possible very large spill could seriously degrade water quality for several weeks or months.	
	Freeport and Brazos Harbors	Maintenance Dredging Maintenance dredging impacts insignificant. Oil Spills Oil spills may be relatively frequent though of small average size (1,470 barrels in 53 spills during project lifetime).	
	Ground Water	Oil and Brine Spills Very slight chance of local ground water pollution due to surface oil or brine spill; collapse of cavern could seriously degrade groundwater supplies for Allen dome area but such an occurrence is highly unlikely.	Brine Disposal Deep well injection should not have significant impacts. Subsidence Subsidence potential greater than during leaching because of 1,000,000 BPD well withdrawal rate.

TABLE 4.4-1b continued.

DISCIPLINE	SUBJECT AREA	EXPECTED IMPACT PROPOSED PHYSICAL FACILITY	 ALTERNATIVE PHYSICAL FACILITY
Air Quality	Oil Handling and Storage Areas	Total Emission Total emissions from 163 MMB oil storage facilities for 5 fill and withdrawal cycles equal 26,170 tons, 60 percent due to SPR site expansion. Distribution of emissions as follows: 47 percent in Gulf of Mexico, 25 miles from Freeport; 2 percent in transit between open Gulf and dock site; 47 percent from docks at Freeport; and 4 percent from Bryan Mound storage site.	
		Storage in Surge Tanks Annual emissions from floating roof tanks at Bryan Mound equal 23 tons. If withdrawal occurs during year, value is 36 tons.	
		Dock Transfers Hydrocarbon standards exceeded up to 13 kilometers from DOE docks; interaction from other DOE sources not considered significant.	
			Marine Terminal Significant reduction (59 percent) in total emissions with marine terminal; standards exceedance onshore virtually eliminated.
			Allen Dome Onsite power generation adds a locally significant source of hydrocarbons at Allen dome (1,275 tons over project lifetime).
Noise Levels		Storage Site Operation No significant increase in ambient sound levels on or adjacent to the sites.	
Species and Ecosystems	Aquatic:		
	Brazos River Diversion Channel	Raw Water Supply Destruction of less than 1 percent of phytoplankton and zooplankton population in Brazos River during each 163 day withdrawal period.	
	Brazos River Diversion Channel, ICW, San Bernard River, and Jones Creek	Oil and Brine Spills Possibility of major spill of brine or oil into ICW or Brazos from pipeline considered remote. Would cause locally significant impacts on aquatic life.	Brine Spills Additional exposure to brine spills along San Bernard River and Wildlife Refuge if pipeline constructed to Gulf.
			Raw Water Supply Potential for impacts on biota in San Bernard River if used for water supply.
	Gulf of Mexico	Brine Disposal Effluent could affect plankton & benthos community over several hundred to perhaps one thousand acres during oilfill. Should be significant only immediately adjacent to diffuser.	Brine Disposal The alternatives would have impacts similar to the proposed system.

TABLE 4.4-1b continued.

DISCIPLINE	SUBJECT AREA	EXPECTED IMPACT: PROPOSED PHYSICAL FACILITY	EXPECTED IMPACT: ALTERNATIVE PHYSICAL FACILITY
Species and Ecosystems (cont'd)		Oil and Brine Spills Expected brine and oil spill volumes should not significantly affect marine biota. Estimated total of 2,750 barrels of oil and 288 barrels of salt water and brine during project life-time. Possible very large or maximum credible oil or brine spill could have significant impacts to several thousand acres of shallow water or marsh if spill reaches shore before cleanup.	
			Marine Terminal Reduced coastal exposure to oil spills if marine terminal de-veloped.
	Site Lakes and Ponds	Oil and Brine Spills Very little impact expected based on probability of spills. Potential for significant loss of biota, should a large quan-tity brine or oil spill occur.	
	Freeport and Brazos Harbors	Maintenance Dredging Local, short-term maintenance dredging impacts. Oil Spills Local contamination of water with oil possible.	
	Terrestrial:		
	Coastal Prairie, Marsh and Fluvial Woodlands	Oil and Brine Spills Impacts primarily limited to possible oil or brine spills. Likelihood small, but possible impact locally significant, especially if during spring nesting season.	
			Raw Water Supply and Brine Disposal Additional prairie exposure to brine spill if groundwater injection developed.
Natural and Scenic Resources	Bryan Beach, Coastal Marshes, San Bernard River, and Wildlife Refuge	Oil Spills Adverse impacts limited pri-marily to possible large oil spill which could foul beaches and coat marsh and shallow water area with oil.	
Socioeconomic Environment	Economy	Storage Site Employment Total wages expected to be ap-proximately $92,000 during each month of oil fill and withdrawal; $17,500 during standby storage.	

4.5 ALTERNATE SITE - WEST COLUMBIA DOME

4.5.1 Impact of Site Preparation and Construction

4.5.1.1 Land Features

Proposed Facilities

Grading and construction at the 232-acre West Columbia alternative SPR site would disturb about 30 acres (Table 2.5-1). About 62,640 cy of fill would be placed in the freshwater marsh at the site.

Construction impacts of the two DOE tanker terminals in Freeport Harbor are described in paragraph 4.3.1.1.

Construction of raw water intake and brine disposal pipelines from Bryan Mound to the West Columbia site would require excavation of 297,680 cy of material and disruption of 279 acres. An additional 3 acres and 12,150 cy of fill would be required for the three back-up brine injection wells. Construction of the proposed brine diffuser to the Gulf of Mexico from Bryan Mound would create impacts as described in Section C.3.1.1.

Construction of the bi-directional crude oil pipelines between SEAWAY Tank Farm and the site would require the excavation of an additional 121,440 cy.

Soils would stabilize soon after revegetation but filled marsh areas would become coastal prairie rather than marsh. Adequate drainage would be included to prevent stagnation of impounded freshwater marsh.

A high-voltage transmission line linking the site with Community Public Service Co.'s West Columbia substation would be required.

Leaching of up to twelve storage cavities at the West Columbia dome site would involve removal of 100 MMB (20.8×10^6 cy) of salt. Sufficient space would be left between cavities to preserve structural integrity.

Alternative Facilities

Two alternative raw water supply systems were considered: (1) development of a well field would require about 22 acres and 31,200 cy of fill for drill pads and pipeline rights-of-way; (2) withdrawal of water from the Brazos River near East Columbia would require construction of an intake system, a desander, a several acre spoil area and a 3 mile pipeline.

Disposal of brine in deep salt water bearing sands would require 19 acres and 19,000 cy of fill for drill pads. Disposal of brine through a diffuser 12.5 miles offshore in the Gulf would require an additional 163 acres for pipeline construction.

On-site power generation would require very little additional land disturbance.

Alternatives to the crude oil distribution system are discussed in paragraph 4.3.1.1.

4.5.1.2 Water

Site preparation and construction of proposed facilities at West Columbia dome may impact several water bodies, including Varner Creek, Bell Creek, the Intracoastal Waterway, the Brazos River Diversion Channel, Freeport Harbor, the lakes and ponds at Bryan Mound, the Gulf of Mexico, and various ground water aquifers.

Raw Water Withdrawal

The potential impacts on water quality in the Brazos Diversion Channel are described in paragraph 4.3.1.2

Brine Disposal

The potential impacts on water quality in the Gulf of Mexico and in the deep sands are described in paragraph 4.3.1.2.

Construction of DOE Docks

The potential impacts on water quality in Freeport Harbor are described in paragraph 4.3.1.2.

Construction of Surface Facilities at West Columbia Dome

Site preparation and construction activities at West Columbia dome would require displacement of approximately 34,000 cy of material. Natural site drainage is to the south and east, toward Varner Creek and West Columbia. Standard engineering control techniques (interceptor ditches, dikes, and sedimentation ponds) would be utilized to prevent significant degradation of water quality from site runoff.

Construction of Oil, Brine and Water Supply Pipelines

The proposed water supply, brine disposal and crude oil pipelines would cross Bell Creek and several intermittent streams in the 23 mile segment between the storage site and SEAWAY Tank Farm. East of SEAWAY Tank Farm, the water supply and brine disposal pipelines would also cross Jones Creek, the Brazos River Diversion Channel, and Unnamed Lake on Bryan Mound.

Trench excavation across the water courses would create increased turbidity and release soluble substances from the substrate to the water column. Impacts would be temporary and local in extent.

There should be no impact on ground water supply or quality due to pipeline installation.

Accidental Brine Release

A possible brine (or raw water) spill could affect Varner, Bell, or Jones Creeks, the Brazos River Diversion Channel, lakes and ponds on Bryan Mound, the Intracoastal Waterway, or the Gulf of Mexico.

The estimated quantity of brine that could be spilled during leaching of West Columbia storage cavities is up to 50 barrels into Gulf waters and up to 240 barrels on land or in water bodies between Bryan Beach and West Columbia dome. In addition, an estimated 235 barrels of raw water could be spilled from the raw water supply system. Maximum credible spills of up to 30,000 barrels are considered possible, though very unlikely.

Local recharge of near surface aquifers has been found to be minimal, so potential seepage from the membrane lined brine pit or minor pipeline spills are likely to have negligible impact on water quality. A brine spill at the site or along the disposal pipeline could, however, locally impact shallow aquifers.

The Brazos River backwater flood studies indicate that the 100 year flood elevation at West Columbia is +33 feet MSL. Elevations in the vicinity of plant facilities range from +25 to +35 feet MSL. The brine pond, thus, would have to be protected from backwater floods by a dike.

As no strong currents or waves would be generated, there is no reason to expect a possible brine pond failure.

Alternative Facilities

Alternative raw water systems for cavern leaching include: (1) withdrawal of saline ground water; and (2) withdrawal of water from the Brazos River near the site. Withdrawal of ground water is potentially feasible but has the potential of lowering the piezometric head, thus allowing saline water intrusion and land subsidence. Use of a separate raw water intake on the Brazos River would be feasible, except that previous water supply commitments may limit water availabilities during low flow periods.

Impacts of the alternative brine disposal systems, deep well injection and the 12.5 mile diffuser, are the same as those described in paragraph 4.3.1.2.

Impacts associated with alternative crude oil distribution systems are described in paragraph 4.3.1.2.

4.5.1.3 Air Quality

Air quality impacts resulting from site preparation and construction of the proposed facilities at the West Columbia dome alternative SPR site would be similar to those discussed in paragraph 4.3.1.3, where it was concluded that air quality impacts would be minor.

4.5.1.4 Noise

Site preparation and construction at West Columbia dome would adversely impact ambient sound levels in the vicinity. The increase in noise resulting from these activities, with the exception of plant facility construction, would be similar to those discussed in paragraph 4.3.1.4.

For construction of facilities connected with the West Columbia dome site, the noise impact zone radii are:

Area	Construction Activity	Impact Zone Radius (ft)
West Columbia dome site	Drilling new wells	3600
	Construction of support facilities	1580
Pipeline routes	Laying of pipe	1430 to 1800
	Access road construction	1100
Freeport Harbor	DOE dock construction	2200

Approximately five residences might experience a noticeable increase in noise levels from construction activity at West Columbia dome. Along the pipeline route from West Columbia dome to SEAWAY Terminal, residences and public lands within 1800 feet of the pipeline route would be exposed to sound level increases of at least 3 dB. Since the route follows existing pipeline right-of-way for most of its length, and construction activities would be completed within 2 or 3 days at any given location, noise impacts should not be severe.

Construction of an alternative raw water or brine disposal well field along the proposed pipeline route would contribute noise levels of a magnitude similar to the on site drilling activities. The zone of noise impact would thus be extended further to the west in a sparsely populated area of fluvial woodland and coastal prairie. Construction of an offshore terminal or the 12.5 mile offshore diffuser would have no measurable effect on onshore noise levels.

4.5.1.5 Ecosystems and Species

Site preparation and construction of the alternative SPR facilities at West Columbia dome would affect both terrestrial and aquatic resources in the area. Terrestrial habitats potentially affected include coastal prairie grassland, fluvial woodland, and freshwater marsh. Aquatic habitats include Varner Creek, Bell Creek, Jones Creek, the Brazos River Diversion Channel, the Intracoastal Waterway, the lakes and ponds at Bryan Mound, Freeport Harbor, and the near shore Gulf of Mexico.

In the following subsections, potential impacts on ecosystems and species are treated according to specific aspects of facility development.

Raw Water Withdrawal

The potential impacts on ecosystems and species in the Brazos River Diversion Channel are described in paragraph 4.3.1.5.

Brine Disposal

The potential impacts on ecosystems and species in the Gulf of Mexico are described in paragraph 4.3.1.5.

Construction of DOE Docks

The potential impacts are described in paragraph 4.3.1.5.

Construction of Surface Facilities at West Columbia Dome

Facilities constructed at West Columbia dome that would have a potential impact on the site ecology include the pump house and control buildings, the cavern wellheads and brine disposal wells, access roadways, the brine settling pond, and a utility power corridor.

The West Columbia dome storage facilities would be located on a 232 acre tract consisting of mostly coastal prairie and freshwater marsh. Site construction activities would reduce the marsh habitat by about 30 acres. This loss would also reduce the amount of food, cover, and nesting area available for wildlife. The marsh is not considered highly productive but it does provide habitat for egrets and other wading birds. Following construction, some wildlife would return to the site.

Site clearing could also result in increased erosion but this impact should be of a minor and temporary nature.

Construction of Pipelines

A total of 279 acres would be required for construction of the proposed raw water, brine and crude-oil pipelines between the West Columbia dome site and the SEAWAY Tank Farm. Between SEAWAY Tank Farm and Bryan Mound, the raw water and brine pipelines would be constructed within an existing right-of-way. Construction activities along the right-of-way would impact coastal prairie and fluvial and oak woodland habitats. As most of the proposed route parallels the SEAWAY Pipeline right-of-way, these habitat disturbances would be minimal.

The potential impacts on ecosystems are described in paragraph 4.4.1.5.

Accidental Brine Release

The most likely location for a large brine spill onshore would be between West Columbia dome and Bryan Beach. In such an event, the brine could affect fluvial woodland, coastal prairie or brackish marsh habitats, or Varner, Bell or Jones Creeks, the Brazos River Diversion Channel, the lakes on Bryan Mound, or the Intracoastal Waterway.

The potential impacts of such an occurrence are described in 4.3.1.5.

Alternative Facilities

Construction of a ground water supply or a brine injection well field along the proposed pipeline corridor would eliminate the need for multiple pipelines to Bryan Mound but would not greatly reduce the amount of right-of-way which would have to be cleared. The 12.5 mile diffuser alternative would require a 14.2 mile pipeline passing through 20 acres of coastal prairie. It is estimated that a water supply well field would require 22 wells and about 22 acres of land. Similarly, a brine injection field would require 19 acres for 19 well pads.

Impacts of constructing alternate crude oil distribution systems and the brine diffuser are described in paragraph 4.3.1.5.

4.5.1.6 Natural and Scenic Resources

Project construction would have only a minor adverse effect on the natural and scenic resources in the area. The storage site itself has no unique scenic characteristics and currently offers a flat, largely featureless view. Some of the proposed onsite facilities would perhaps be visible from the roads leading to the entrance of Varner-Hogg State Park east of the site. It is unlikely, however, that the facilities would be visible from the park itself. The project construction would be visible from the houses southwest of the site. The pipeline routes would follow existing rights-of-way and would have only a temporary impact on the natural and scenic resources of the areas crossed.

Development of an alternative water supply, a brine injection field along the proposed DOE and existing SEAWAY Pipeline corridor southwest of the site, or a brine diffuser 12.5 miles offshore would not significantly affect natural or scenic resources.

4.5.1.7 Archaeological, Historical and Cultural Resources

No significant impacts on archaeological, historical or cultural resources are expected from construction of the project or its alternatives. If SPR expansion at West Columbia dome is selected, the site and pipeline routes would be surveyed for their potential archaeological, historical, or cultural resources prior to construction. The development would be made to comply with provisions of Executive Order 11593.

4.5.1.8 Socioeconomic Environment

Land Use

Developing the site at West Columbia dome would change the primary land use of the site and along the pipeline route to SEAWAY Tank Farm from an undeveloped grazing area to an industrial area. Other pipeline routes required follow established rights-of-way and would not alter present land uses.

Alternative development plan would impact land use to the extent that additional undeveloped land would be converted to industrial use.

Transportation

Project construction activity could significantly increase the traffic volume of Route 36, which would carry the over 500 workers to the site. Truck traffic related to the construction would also increase along this highway. Connecting routes would also be impacted. The amount of increased congestion would depend on the time of day workers commuted to the site and the number who drove their own vehicles. Traffic impacts would be temporary, however, as most construction activity would occur between the second and sixth months of the project.

The project would have a small impact on waterborne transportation in Freeport Harbor, caused by an increase in tanker traffic. The worst-case increase in tanker traffic during the initial fill (assuming a tanker capacity of only 32,000 DWT, or 254,000 bbl of oil) would average about one tanker every day.

Construction of alternative water supply, brine disposal and oil distribution facilities could affect the area's transportation conditions because of the additional workers and material that would be required. Impacts should not be significant, however.

Population and Housing

The impacts on population and housing near the West Columbia site would be similar to those discussed in paragraph 4.3.1.8. The lack of available housing in West Columbia should further discourage migration to the area.

Economy

Potential economic impacts are similar to those described in paragraph 4.3.1.8.

Government and Public Services

Construction of the SPR facilities at the West Columbia dome site would involve the removal of 232 acres from the tax rolls of Brazoria County. Assuming a fair market value of $1000 per acre for the West Columbia site, the tax loss would be $668 per year for the life of the project.

Potential project impacts on local public services are similar to those described in paragraph 4.3.1.8.

4.5.2 Impact from Operation and Standby Storage

Development of a 100-MMB storage capacity at the West Columbia dome site would ensure that, in the event of a severe oil supply interruption, a total of 163 MMB of oil would be available from the Seaway Group SPR facilities for delivery to the SEAWAY Pipeline or to tankers via Freeport Harbor. Oil would probably be pumped preferentially from West Columbia dome to SEAWAY Tank Farm for pipeline transport north; oil in excess of SEAWAY capacity (600 MB per day) would then be pumped to the tanker dock along with oil from the Bryan Mound early storage phase facilities. Until an oil-supply interruption occurred, the facilities at West Columbia dome would be maintained in a condition of standby readiness.

4.5.2.1 Land Features

Effects of operation and standby storage on land features are expected to be minimal. Soils would soon stabilize after revegetation.

The possible impacts of the improbable occurrence of a cavern collapse are described in paragraph 4.3.2.1.

Use of alternative facilities would not affect land features.

4.5.2.2 Water

Impacts on water resources during operation of the West Columbia dome facility could result from raw water withdrawal, brine disposal, maintenance dredging at dock sites, and possible spills of oil or brine.

Raw Water Withdrawal

Impacts of raw water withdrawal for oil displacement are described in paragraph 4.4.2.2.

Brine Disposal

The potential impacts of brine disposal on water quality in the Gulf Mexico and in the deep sands are described in paragraph 4.3.2.2.

Maintenance Dredging

The potential impacts on water quality in Freeport Harbor are described in paragraph 4.3.2.2.

Accidental Oil Release

During project operation, oil spills could occur in the Gulf of Mexico, in Freeport Harbor, along the pipelines connecting the storage site with the DOE tanker docks and with SEAWAY Tank Farm, from the wells at West Columbia dome, or from oil surge tanks at Bryan Mound. A summary of oil spill expectation model projections is given in Section 4.2.

The probable movement of spills occurring east of the SEAWAY Tank Farm is described in paragraph 4.3.2.2.

Spills at the West Columbia dome site not contained within the diking would flow toward Varner Creek, which discharges to the Brazos River; the most likely drainage path is the intermittent stream draining the freshwater marsh and entering the river northeast of the site. Spills from the pipelines west of the storage site would flow toward

Bell Creek, which empties into the San Bernard River. Between the Bell Creek watershed divide and a State penal farm, drainage is generally: (1) into the San Bernard River through a number of intermittent drainageways; (2) into the Brazos River south of Dow Chemical Company plant; or (3) into the Jones Creek watershed which flows through marshland to the Intracoastal Waterway.

Oil spills are most likely to reach the Gulf of Mexico only from tanker spills.

Oil weathering processes and dispersal characteristics, and the potential impact of oil spills are described in paragraph 4.3.2.2.

<u>Accidental Brine or Saline Raw Water Release</u>

During project operation, brine spills could occur from the brine disposal pipeline or the on-site brine pit; raw water could be spilled from the raw water supply line or, during standby storage, from the brine disposal line. A summary of brine spill expectation model projections is provided in Section 4.2.

The probable movement of spills occuring east of the SEAWAY Tank Farm is described in paragraph 4.3.2.2.

Spills at the West Columbia dome site not contained within the diking would flow toward Varner Creek, which discharges to the Brazos River; the most likely drainage path is the intermittent stream draining the freshwater marsh and entering the river northeast of the site. Spills from the pipelines west of the storage site would flow toward Bell Creek, which empties into the San Bernard River. Between the Bell Creek watershed divide and a State penal farm, drainage is generally: (1) into the San Bernard River through a number of intermittent drainageways; (2) into the Brazos River south of a Dow Chemical Company plant; or (3) into the Jones Creek watershed which flows through marshland to the Intracoastal Waterway.

The potential impacts of brine and raw water spills are described in paragraph 4.3.2.2.

Flood Hazards

Flood hazards at West Columbia dome are significantly less serious than at sites nearer the coast. Surface elevation in the freshwater marsh at the site is about +25 feet MSL. The calculated 100 year flood level of the Brazos River is +33 feet MSL, so high water could reach the site from Varner Creek through the stream which drains the marsh. However, no strong currents or other damaging conditions would accompany high waters. The brine reservoir and other surface facilities could be protected by a suitable levee or by filling.

Potential impacts of a greater than 100 year flood are considered in paragraph 4.3.2.2.

Pipelines and storage tanks at Bryan Mound would be subject to flood hazards as described in paragraph 4.3.2.2.

Alternative Facilities

Use of saline ground water to displace the stored oil and the injection of brine into deep subsurface salt water bearing sands and the brine diffuser would have the same potential adverse impacts as described in paragraph 4.3.2.2.

The potential impacts of the alternative crude oil distribution methods are described in paragraph 4.3.2.2.

4.5.2.3 Air Quality

Air quality impacts resulting from operation of the proposed facilities at the West Columbia dome alternative SPR site would be similar to those described in paragraph 4.3.2.3. The inventory of total HC emissions given in Table 4.3-6 for 100 MMB expansion at Bryan Mound expected over a 22 year period of operation (5 cylces) would apply for West Columbia development.

Air quality impacts from alternative crude oil distribution and power generation systems would also be similar to those discussed in paragraph 4.3.2.3.

4.5.2.4 Noise

Noise impacts of operating SPR facilities at West Columbia dome would be similar to those described in paragraph 4.3.2.4. Though the town of West Columbia is about one mile from the site, noise impacts from pumping and other operations would not be noticeable there.

4.5.2.5 Ecosystems and Species

Raw Water Withdrawal

The potential impacts on ecosystems and species in the Brazos River Diversion Channel are described in paragraph 4.3.2.5.

Brine Disposal

The potential impacts on ecosystems and species in the Gulf of Mexico are described in paragraph 4.3.2.5.

Tanker Transport

The potential impacts on ecosystems and species in Freeport Harbor are described in paragraph 4.3.2.5.

Maintenance of Project Lands

The potential impacts on wildlife are described in paragraph 4.4.2.5.

Accidental Oil Release

Because of the expected very low frequency of spills (Section 4.2), chronic pollution of oil or brine should not occur at West Columbia dome, Bryan Mound, or along the proposed pipeline routes.

A large spill of oil in the vicinity of West Columbia dome could reach Varner Creek and, thus, the San Bernard River, resulting in pollution of water resources and loss of aquatic and stream bank vegetation, benthos, fish and some birds. Other sensitive areas potentially exposed to oil or brine spills are Jones Creek and adjacent prairie land near the SEAWAY Tank Farm, shallow lakes and ponds on Bryan Mound and nearshore Gulf waters and shorelines.

The damage parameters discussed in paragraph 4.3.2.5 apply to the West Columbia dome site alternative. The most sensitive areas would probably be the pipeline right-of-way near the SEAWAY Tank Farm and the lakes and ponds on Bryan Mound.

Except in the case of a very large oil or brine spill (or a moderately sized spill in a sensitive area), biological impacts are not expected to be of regional significance.

Accidental Brine or Raw Water Release

The potential impacts of accidental brine releases on ecosystems and species are discussed in paragraph 4.3.1.5.

Alternative Facilities

Use of a ground water supply system or a deep well brine injection system would expose additional portions of prairie grassland and fluvial woodland to brine spills.

Use of a marine pipeline and an offshore SPM terminal would substantially reduce (by about 60 percent) the spill risks associated with crude oil movement through Freeport Harbor.

4.5.2.6 Natural and Scenic Resources

Normal project operations would have fewer impacts on scenic and natural resources than construction. After pipeline construction most rights-of-way would be allowed to return to the native prairie vegetation. Some areas, including the storage site, would be permanently altered, however.

After construction, the noise, dust, fumes and vibrations would be significantly reduced. Above ground storage facilities at the site would be visible from several residences near the town of West Columbia south of the dome, although it might be possible to screen facilities from view by landscaping.

4.5.2.7 Archaeological, Historical and Cultural Resources

There are expected to be no significant impacts on archaeological, historical or cultural resources resulting from operation of the project or its alternatives at the West Columbia dome site. If this site were selected for development, however, a cultural resources survey would be conducted prior to construction.

4.5.2.8 Socioeconomic Environment

Land Use

Operation and maintenance of the West Columbia SPR site would have a modest impact on land use. The 232 acre site would be fenced and its present use as grazing land would be terminated for the life of the project. Of the 699 acres required for construction offsite and within the fenced area, 479 acres would be needed for pipeline and surface facility maintenance, and some of the excess land would be revegetated and returned to present uses. No structures could be erected within the pipeline right-of-way.

Transportation

The operational impacts on transportation would be similar to those described in paragraph 4.4.2.8.

Population and Housing

The operational impacts on population and housing would be similar to those described in paragraph 4.4.2.8.

Economy

Economic impacts of the project are similar to those described in paragraph 4.3.2.8.

Government and Public Services

Impacts of project operation are similar to those described in paragraph 4.3.2.8.

4.5.3 Impact Due to Termination and Abandonment

The impacts due to termination and/or abandonment of the West Columbia dome SPR storage site would be similar to those described in paragraph 4.3.3.

4.5.4 Relationship of the Proposed Action to Land Use Plans, Policies and Controls

It is not anticipated that the proposed West Columbia dome SPR facility would conflict with State or county land use plans or policies. For a further discussion of the land use plans, policies and controls in the area, refer to paragraph 4.3.4.

4.5.5 Summary of Adverse and Beneficial Impacts

Development of the West Columbia salt dome as an SPR oil storage facility is not likely to generate significant regional environmental impacts except for the remote possibility of a major oil or brine spill, or the uncontrolled release of hydrocarbon vapors during oil transfer operations.

The longtime use of the surrounding area for oil and gas production would tend to minimize the scope of impacts resulting from construction activities.

Although large quantities of water would be required to leach storage caverns, the withdrawal of this water from the Brazos River Diversion Channel would constitute less than one percent of its average flow.

Disposal of brine in the Gulf of Mexico is expected to moderately increase salinity in water near the diffuser, but this increase is not expected to be significant though there may be some adverse effect on local marine organisms.

Pipeline construction could temporarily affect the water quality of Varner Creek, Bell Creek and Jones Creek by increasing turbidity and release of pollutants from bottom sediments. Varner Creek and Bell Creek could also receive sediments from surface runoff and erosion during site preparation and construction.

Dock construction in Freeport Harbor is not expected to have significant effects on either the ecology of the area or its water quality, as the harbor is frequently dredged.

The reduction of available wildlife habitat in the vicinity of the site and along the pipeline routes is the most significant ecological impact associated with development of this site.

During construction of SPR facilities at West Columbia dome, increases in income and employment in the Brazoria County region are expected. These increases would be of short duration and are not expected to provide major stimulus to the area's economy. Operation of the facility would provide minor additional income during standby storage and fill and withdrawal phases. Temporary increases in traffic congestion in the West Columbia area are expected during construction.

The indirect economic benefits of the Strategic Petroleum Reserve are of considerable importance to the regional economy, as the area has a well developed petroleum-petrochemical industry. Assurance of a continued oil supply in the event of a national emergency would provide a measure of security for that industry and thus for local residents.

Table 4.5-1 provides a summary tabulation of the adverse and beneficial impacts associated with development of this candidate site. The data are in both qualitative and quantitative form, as appropriate.

TABLE 4.5-1a Summary of environmental impacts caused by development of West Columbia dome SPR facilities.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT: PROPOSED FACILITY	ACTIVITY AND EXPECTED IMPACT: ALTERNATIVE FACILITY
Geology	West Columbia dome and immediate vicinity	Site Preparation Excavation of 34,000 cy at the storage site on 30 acres of marsh and fill of 62,000 cy. Cavern Leaching Removal of 20.3×10^6 cy of salt for cavern development.	
	Pipeline Corridors - between West Columbia dome and Bryan Mound	Pipeline Construction Excavation of 431,270 cy along the oil, brine and raw water pipeline routes on 282 acres of fluvial woodland and prairie grassland.	Brine Disposal Brine disposal by deep well injection; 19 acres and fill of 19,000 cy.
	Brine Diffuser Pipeline Corridor	Pipeline Construction Excavation of 177,300 cy for a 7.5 mile pipeline on 21 acres of coastal prairie and 142 acres of Gulf bottom.	Pipeline Construction Additional excavation of 97,300 cy and 163 acres of Gulf bottom for a 14.2 mile pipeline.
	DOE Tanker Dock in Freeport Harbor	Site Preparation Dredging of [illegible],050,000 grading of 14 acres for the tanker docks.	
	Pipeline Corridor to Brazos Harbor	Pipeline Construction Excavation of 6,000 cy for pipeline to Brazos Harbor on 4 acres of marshland and 4 acres of cleared land.	
	Phillips Dock		Site Preparation 6 acres and 2,500 cy excavation.
	Offshore SPM Terminal		Terminal Preparation 52 acres and 46,205 cy excavation.
	Ground Water		Raw Water Supply Well field for raw water supply: 22 acres and 31,200 cy excavation.
Water Resources	Brazos River Diversion Channel and ICW	Site Preparation Small quantities of sediment and construction pollutants carried into river by rainfall runoff. Raw Water Supply 534,000 BPD withdrawn for leaching over a two-year period expected to have minimal effects on water quality. Brine Spills Very small possibility of brine release reaching water bodies.	
	Gulf of Mexico	Brine Disposal Pipeline construction would cause temporary disruption of 142 acres of Gulf bottom. 684,000 BPD brine disposal could increase bottom salinity by 1 ppt over 3 square miles; approximately 25 acres would have excess salinities of 5 ppt or more. Brine Spills Expected brine spills would have no significant impact; possible maximum credible spill could have significant local impact.	Brine Disposal Pipeline construction would cause temporary disruption of 305 acres of Gulf bottom. Salinity concentrations should be similar to that of the proposed diffuser. Marine Terminal Construction Construction of marine terminal would temporarily increase turbidity levels in nearshore Gulf waters.

TABLE 4.5-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITY	ALTERNATIVE FACILITY
Water Resources Cont'd.	Varner Creek, Bell Creek, Jones Creek and Lakes and Ponds on Bryan Mound	Site Preparation Sediment and miscellaneous construction pollutants could degrade water quality. Brine Spills Expected brine spills insignificant; possible maximum credible spill could have significant impact.	
	Freeport and Brazos Harbors	Site Preparation Dredging and dock construction impacts considered comparable relative to annual maintenance dredging in Freeport Harbor.	
	Ground Water		Raw Water Supply Possible local subsidence caused by ground water withdrawal for leaching. Brine Disposal Deep well injection of brine is not expected to affect ground water supplies; potential for adverse impact limited to migration up old unplugged wells.
Air Quality	West Columbia, Bryan Mound and Dock Sites	Site Preparation Minor quantities of particulates, SO_2, CO, HC, and NO_2 released from construction equipment at West Columbia dome and at Bryan Mound.	
	Marine Terminal		Marine Terminal Construction Construction of a marine terminal would increase emissions offshore but have little effect on concentrations at Freeport.
	Pipeline Corridor		Raw Water Supply and Brine Disposal Development of well fields for raw water supply or brine injection may double site emissions. Pollutant concentrations should remain within standards in the absence of background pollutants.
Noise Level	Storage Site	Site Preparation Maximum zone of noise impact (defined as 3 dB increase over ambient), 4,500 feet for West Columbia dome and 2,000 feet for Bryan Mound; 16 residences affected south of Allen dome for period of 15 months.	
	Docks	Site Preparation Maximum zone of noise impact, 2,200 feet; no residences or noise sensitive areas affected.	
	Pipeline Routes	Pipeline Construction Zone of noise impact equal to 1,800 feet; very few residences affected, all for periods of less than a week.	
			Raw Water Supply and Brine Disposal Slightly increased zone of noise impact due to drilling of brine disposal or raw water supply wells; few residences or noise sensitive areas affected.
Species and Ecosystems - Aquatic	Brazos River Diversion Channel and ICW	Site Preparation Destruction of phytoplankton and zooplankton during the two year leaching period. Impact on regional biotic resources considered insignificant.	

TABLE 4.5-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITY	 ALTERNATIVE FACILITY
Species and Eco-systems Cont'd.		Brine Spills Possible major spill of brine from pipeline considered remote. Locally significant aquatic impacts could occur.	
	Gulf of Mexico	Brine Disposal Pipeline construction would cause temporary loss of 142 acres of benthic communities. Brine effluent could affect benthos communities over several hundred to several thousand acres. Some loss of benthos and plankton in the immediate diffuser area. Some impact on local white shrimp.	Brine Disposal Pipeline construction would cause temporary loss of 305 acres of benthic communities. The impacts of brine effluent should be similar to that of the proposed diffuser.
		Oil and Brine Spills Possible maximum credible oil or brine spill could destroy several acres of benthos and some biota in water column.	
			Marine Terminal Construction of marine terminal facilities expected to have minimal local, short-term effect on benthos in offshore waters.
	Varner, Bell and Jones Creeks, Lakes and Ponds on Bryan Mound	Site Preparation Minimal local impacts due to erosion and runoff from site construction. Brine Spill Major brine spill remotely possible; significant loss of biota would follow.	
	Freeport and Brazos Harbors	Site Preparation Very local, short-term dredging impacts.	
	Ground Water		Raw Water Supply Similar impact due to well field development for raw water supply. Locally significant impact on productivity and habitat.
Terrestrial	Coastal Prairie	Site Preparation Loss of 153 acres due to facility construction. Revegetation of 38 acres likely. Minimal impact. Brine Spill Large brine spill could destroy several acres.	
			Brine Disposal Loss of 19 acres of coastal prairies or fluvial woodland due to construction of deep well injection system.
	Brackish Marsh	Site Preparation Loss of 30 acres due to facility construction. Moderate local impact importance. Brine Spill Large brine spill could destroy several acres.	
	Fluvial Woodland	Site Preparation Loss of 149 acres. Significant local importance. Brine Spill Large brine spill could destroy several acres.	

TABLE 4.5-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITY	ALTERNATIVE FACILITY
Natural and Scenic Resources	West Columbia	Site Preparation Minor impact on aesthetics due to nearby construction.	
	Pipeline Route	ROW Clearing Minor impact due to short-term displacement of birdlife from nearby marshes at Bryan Mound.	
Socioeconomic Conditions		All Environments	
	Land Use	Approximately 355 acres of fluvial woodland, coastal prairie, and marsh developed.	
	Transportation	Potential for traffic congestion on Highways 35 and 36, particularly near West Columbia. Temporary minor impediment to navigation in Gulf during diffuser construction.	
	Population and Housing	No significant impacts expected.	
	Economy	Total construction wages of $9.3 million, only part of which would remain in the Brazosport area,	
	Government	Tax revenues due to increased local purchases expected to exceed cost of new services. Loss of Tax Revenue of $66,800 per year for life of the project.	Brine Disposal and Raw Water Supply Should deep well brine injection or ground water withdrawal for leaching be selected, impacts listed above would not be increased significantly. Marine Terminal Similar effects would accompany development of a marine terminal, except land use would be little changed.

TABLE 4.5-1b Summary of environmental impacts caused by operation of West Columbia dome SPR facilities.

DISCIPLINE	SUBJECT AREAS	EXPECTED IMPACT PROPOSED PHYSICAL FACILITY	EXPECTED IMPACT ALTERNATIVE PHYSICAL FACILITY
Geology and Land Features	West Columbia Dome and immediate vicinity	Cavern Collapse Remote possibility of roof collapse causing surface subsidence and formation of a lake over the dome.	
Water Resources	Brazos River Diversion Channel	Raw Water Supply 1,000,000 BPD withdrawn for oil displacement for 163 days; expected to have minimal effects on water quality.	
	Brazos Channel and ICW	Oil and Brine Spills Very small possibility of oil or brine release.	
	Gulf of Mexico	Brine Disposal 240,000 BPD brine disposal should have minimal water quality impacts.	
		Oil and Brine Spills Oil spills may total 2,750 barrels, and brine spills 210 barrels during project lifetime; effects not expected to be significant unless oil or brine reaches shallow coastal bays.	Oil Spills Use of marine terminal could reduce total oil spill volume by more than 50 percent.
	Varner, Bell and Jones Creeks, and Lakes and Ponds on Bryan Mound	Oil and Brine Spills Expected impacts from oil and brine spills negligible. Possible very large spill could seriously degrade water quality for several weeks or months.	
	Freeport and Brazos Harbors	Maintenance Dredging Maintenance dredging impacts insignificant.	
		Oil Spills Oil spills may be relatively frequent though of small average size (1,470 barrels in 53 spills during project lifetime).	
	Ground Water	Oil and Brine Spills Very slight chance of local ground water pollution due to surface oil or brine spill; collapse of cavern could seriously degrade groundwater supplies for West Columbia area but such an occurence is highly unlikely.	
			Brine Disposal Deep well injection should not have significant impacts.
			Subsidence Subsidence potential from ground water withdrawal greater than during leaching because of 1,000,000 BPD well withdrawal rate.
Air Quality	Oil Handling and Storage Areas	Total Emissions Total emissions from 163 MMB oil storage facilities for 5 fill and withdrawal cycles equal 26,170 tons, 50 percent due to SPR site expansion. Distribution of emissions as follows: 47 percent in Gulf of Mexico, 25 miles from Freeport; 2 percent in transit between open Gulf and dock site; 47 percent from docks at Freeport; and 4 percent from Bryan Mound storage site.	

TABLE 4.5-1b continued.

DISCIPLINE	SUBJECT AREAS	EXPECTED IMPACT PROPOSED PHYSICAL FACILITY	EXPECTED IMPACT ALTERNATIVE PHYSICAL FACILITY
Air Quality		Storage in Surge Tanks Annual emissions from floating roof tanks at Bryan Mound equal 23 tons. If withdrawal occurs during year, value is 36 tons. Dock Transfer Hydrocarbon standards exceeded up to 13 kilometers from DOE docks; interaction from other DOE sources not considered significant.	
			Marine Terminal Significant reduction (63 percent) in total emissions with marine terminal; standards exceedance on-shore virtually eliminated. West Columbia Dome Onsite power generation adds a locally significant source of hydrocarbons at West Columbia dome (1,275 tons over project lifetime).
Noise Levels		Storage Site Operation No significant increase in ambient sound levels on or adjacent to the sites.	
Species and Eco-Systems - Aquatic	Brazos River Diversion Channel	Raw Water Supply Destruction of less than 1 percent of phytoplankton and zooplankton population in Brazos River during each 150-day withdrawal period.	
	Brazos River Diversion Channel, ICW, Varner, Bell and Jones Creek	Oil and Brine Spills Possibility of major spill of brine or oil from pipeline considered remote. Would cause locally significant impacts on aquatic life.	
	Gulf of Mexico	Brine Disposal Effluent could affect plankton and benthos over several hundred to perhaps one thousand acres during oilfill. Should be significant only immediately adjacent to diffuser.	Brine Disposal The alternative would have impacts similar to the proposed system.
		Oil and Brine Spills Expected brine and oil spill volumes should not significantly affect marine biota. Estimated total of 2,750 barrels of oil and 288 barrels of salt water and brine during project lifetime. Possible very large or maximum credible oil or brine spill could have significant impacts to several thousand acres of shallow water or marsh if spill reaches shore before cleanup.	
			Marine Terminal Reduced coastal exposure to oil spills if marine terminal developed.
	Bryan Mound Lakes and Ponds	Oil and Brine Spills Very little impact expected based on probability of spills. Potential for significant loss of biota, should a large brine or oil spill occur.	
	Freeport and Brazos Harbors	Maintenance Dredging Local, short-term maintenance dredging impacts. Oil Spills Local contamination of water with oil possible.	

TABLE 4.5-1b continued.

DISCIPLINE	SUBJECT AREAS	EXPECTED IMPACT PROPOSED PHYSICAL FACILITY	ALTERNATIVE PHYSICAL FACILITY
Species and Ecosystems - Terrestrial	Coastal Prairie, Marsh and Fluvial Woodlands	Oil and Brine Spills Impacts primarily limited to possible oil or brine spills. Likelihood small, but possible impact locally significant, especially if during spring nesting season.	Raw Water Supply and Brine Disposal Additional exposure to brine spill if well supply or groundwater injection developed.
Natural and Scenic Resources	Bryan Beach, Coastal Marshes, San Bernard River, and Wildlife Refuge	Oil Spills Adverse impacts limited primarily to possible large oil spill which could foul beaches and coat marsh and shallow water area with oil.	
Socioeconomic Environment	Economy	Storage Site Employment Total wages expected to be approximately $96,000 during each month of oil fill and withdrawal; $17,500 during standby storage.	

4.6 ALTERNATIVE SITE - DAMON MOUND

4.6.1 Impact of Site Preparation and Construction

4.6.1.1 Land Features

Proposed Facilities

Grading and construction at the 232-acre Damon Mound alternative SPR site would disturb about 30 acres (Table 2.6-1).

Construction impacts of the two DOE tanker terminals in Freeport Harbor and the brine diffuser are described in paragraph 4.3.1.1.

Construction of raw water intake and brine disposal pipelines from Bryan Mound to the Damon Mound site would require excavation of 395,888 cy of material and disruption of 397 acres. An additional 3 acres would be required for the three backup brine injection wells.

Construction of the bi-directional crude oil pipelines between SEAWAY Tank Farm and the site would require excavation of an additional 170,544 cy of material.

Leaching of up to 12 storage cavities at the Damon Mound site would involve removal of 100 MMB (20.8×10^6 cy) of salt. Sufficient space would be left between cavities to preserve structural integrity.

Alternative Facilities

Two alternative raw water supply systems were considered: 1) development of a well field would require about 22 acres for drill pads; 2) withdrawal of water from the Brazos River east of the site would require construction of an intake system, a desander, a several-acre spoil area, and a 10-mile pipeline.

Disposal of brine in deep salt water bearing sands would require about 19 acres for drill pads, and disposal via the 12.5 mile offshore diffuser would require an additional 163 acres for construction rights-of-way.

Purchase of commercial power would require construction of a transmission corridor to the site.

Alternatives to the crude oil distribution system are discussed in paragraph 4.3.1.1.

4.6.1.2 Water

Site preparation and construction of proposed facilities at Damon Mound may impact several water bodies, including Bell Creek, Jones Creek, Varner Creek, Mound Creek, the Intracoastal Waterway, the Brazos River Diversion Channel, Freeport Harbor, the lakes and ponds at Bryan Mound, the Gulf of Mexico, and various ground water aquifers.

Raw Water Withdrawal

The potential impacts on water quality in the Brazos River Diversion Channel are described in paragraph 4.3.1.2.

Brine Disposal

The potential impacts on water quality in the Gulf of Mexico and in the deep salt water bearing sand are described in paragraph 4.3.1.2.

Construction of DOE Docks

The potential impacts on water quality in Freeport Harbor are described in paragraph 4.3.1.2.

Construction of Surface Facilities at Damon Mound

Site preparation and construction activities at Damon Mound would require displacement of approximately 31,680 cy of earth. Natural site drainage is toward the north, down the slope of the mound; there are no significant water bodies in this area. Standard engineering control techniques (interceptor ditches, dikes and sedimentation ponds) would be utilized to prevent significant degradation of water quality in small ponds and intermittent streams from site runoff.

Construction of Oil, Brine and Water Supply Pipelines

The proposed water supply, brine disposal, and crude oil pipelines would cross Varner and Bell Creeks and several intermittent streams in the 32.3-mile segment between the storage site and SEAWAY Tank Farm. East of SEAWAY Tank Farm, the water supply and brine pipelines would also cross Jones Creek, the Brazos River Diversion Channel, and Unnamed Lake on Bryan Mound.

Trench excavation across the water courses would create increased turbidity and release soluble substances from the substrate to the water column. Impacts would be temporary and local in extent, however.

There should be no impact on ground water supply or quality due to pipeline installation.

Accidental Brine Release

A possible brine (or raw water) spill could affect Mound, Varner, Bell or Jones Creeks, the Brazos River Diversion Channel, lakes and ponds on Bryan Mound, the Intracoastal Waterway or the Gulf of Mexico.

The estimated quantity of brine that could be spilled during leaching of Damon Mound storage cavities is up to 50 barrels into Gulf waters and up to 360 barrels on land or in water bodies between Bryan Beach and Damon Mound (Figure 2.6-1). In addition, an estimated 355 barrels of raw water could be spilled from the raw water supply system. Maximum credible spills of up to 30,000 barrels are considered possible, though very unlikely.

Local recharge of near-surface aquifers has been found to be minimal, so potential seepage from the membrane-lined brine pit or minor pipeline spills are likely to have negligible impact on water quality. A brine spill at the site or along the disposal pipeline could, however, locally impact shallow aquifers.

The location of proposed SPR oil storage facilities on the elevated surface of Damon Mound precludes any dangers of possible flood-induced brine spills at the site.

Alternative Facilities

Impacts of the alternative raw water intake systems are similar to those described in paragraph 4.3.1.2.

Impacts of the alternative brine disposal system, deep well injection, are described in paragraph 4.3.1.2.

Impacts associated with alternative crude oil distribution systems are described in paragraph 4.3.1.2.

4.6.1.3 Air Quality

Air quality impacts resulting from site preparation and construction of the proposed facilities at the Damon Mound alternative SPR site would be similar to those discussed in paragraph 4.3.1.3, where it was concluded that air quality impacts would be minor.

Additional paint emissions from construction of an 8500 bbl fuel tank for onsite power generation would have no significant impact on air quality.

4.6.1.4 Noise

Site preparation and construction at Damon Mound would adversely impact ambient sound levels in the vicinity. The increase in noise resulting from these activities, with the exception of plant facility construction, would be similar to those discussed in paragraph 4.3.1.4. One major difference is that onsite generation is the primary alternative for power at this site, which could increase the duration of construction activity.

For construction of facilities connected with the Damon Mound site, the noise impact zone radii are:

Area	Construction Activity	Impact Zone Radius (ft)
Damon Mound site	Drilling new wells	4500
	Construction of support facilities	2000
Pipeline routes	Laying of pipe	1800
	Access road construction	1400
Freeport Harbor	DOE dock construction	2200

Approximately 57 residences in Damon may be exposed to significantly increased noise levels during construction.

Construction of an alternative raw water or brine disposal well field along the proposed pipeline route would contribute noise levels of a magnitude similar to the onsite drilling activities. The zone of noise impact would thus be extended further to the southwest in a sparsely populated area of coastal prairie. Construction of an offshore terminal would not have a measurable effect on onshore noise levels.

4.6.1.5 Ecosystems and Species

Site preparation and construction of the alternative SPR facilities at Damon Mound would affect both terrestrial and aquatic resources in the area. Terrestrial habitats potentially affected include coastal prairie grassland and fluvial woodlands. Aquatic habitats include Varner Creek, Bell Creek, Jones Creek, the Brazos River Diversion Channel, the Intra-coastal Waterway, the lakes and ponds at Bryan Mound, Freeport Harbor, and the near-shore Gulf of Mexico.

In the following subsections, potential impacts on ecosystems and species are treated according to specific operational aspects of facility development.

Raw Water Withdrawal

The potential impacts on escosystems and species in the Brazos River Diversion Channel are described in paragraph 4.3.1.5.

Brine Disposal

The potential impacts on ecosystems and species in the Gulf of Mexico are described in paragraph 4.3.1.5.

Construction of DOE Docks

The potential impacts are described in paragraph 4.3.1.5.

Construction of Surface Facilities at Damon Mound

Facilities constructed at Damon Mound that would have a potential impact on the site ecology include the pump house and control buildings, the cavern wellheads and brine disposal wells, access roadways, the brine settling pond, and a 45,000 kilowatt gas turbine power generator.

The Damon Mound storage facilities would be located on an approximately 232 acre tract consisting of mostly coastal prairie and oak woodlands. Construction at the site would impact about 30 acres of coastal prairie habitat used for grazing. Permanent loss of this habitat would result in the loss of food, cover, nesting and breeding areas for wildlife. The loss of this habitat is not significant when compared with the total acreage of similar coastal prairie habitat in Brazoria County.

Small populations of invertebrates, mammals, and birds at the site may be forced to migrate to other areas during construction, but because of the large amount of coastal prairie available adjacent to Damon Mound, the potential for relocation is good.

Construction of Pipelines

A total of 397 acres would be required for construction of the proposed raw water, brine and crude oil pipelines between the Damon Mound site and the SEAWAY Tank Farm. The entire route, except for a short spur leading to Damon Mound, follows existing pipeline corridors. Between SEAWAY Tank Farm and Bryan Mound, the raw water and brine pipelines would also be constructed within an existing right-of-way.

The potential impact on ecosystems are described in paragraph 4.4.1.5.

Accidental Brine Release

The most likely location for a large spill would be onshore between Damon Mound and Bryan Beach. In such an event, the brine could affect coastal prairie or fluvial woodland habitats, or Mound, Varner, Bell or Jones Creeks, the Brazos River Diversion Channel, the lakes on Bryan Mound, or the Intracoastal Waterway.

The potential impacts of such an occurrence are described in paragraph 4.3.1.5.

Alternative Facilities

Construction of a ground water supply well field or a brine injection field along the proposed pipeline corridor would eliminate the need for multiple pipelines to Bryan Mound but would not greatly reduce the amount of right-of-way which would have to be cleared. It is estimated that a water well supply field would require 22 wells and about 22 acres of land. Similarly, a brine injection field would require 19 acres for 19 well pads. Use of the 12.5 mile Gulf of Mexico diffuser would require 20 acres of coastal prairie and 1 acre of marsh.

Impacts of constructing alternate crude oil distribution systems are described in paragraph 4.3.1.5.

4.6.1.6 Natural and Scenic Resources

Site preparation and construction activities at Damon Mound would have some adverse impacts on surrounding natural and scenic resources. On-site construction and pipe laying activities would be visible from some areas of Damon. The negative impacts from noise, vibration, and dust would be temporary in nature and affect only a limited area. No major recreational facilities would be affected.

Alternative brine disposal, raw water supply, and oil distribution systems would have minimal additional impact on scenic and natural resources.

4.6.1.7 Archaeological, Historical and Cultural Resources

No significant impacts on archaeological, historical, or cultural resources are expected from construction of the project or its alternatives. If SPR expansion at Damon Mound is selected, the site and pipeline routes would be surveyed for their potential archaeological, historical, or cultural resources prior to construction. The development would be made to comply with the provisions of Executive Order 11593.

4.6.1.8 Socioeconomic Environment

Land Use

Developing the site at Damon Mound would not significantly alter the primary land use of the area. Although development would put present pastureland to industrial use, much of the surrounding area is already heavily used for quarrying and petroleum production.

Alternative development plans would not significantly impact present land use.

Transportation

Most construction workers (about 550 at peak employment) are expected to commute from local or regional urban centers. This commuting traffic, along with trucks transporting materials, would have a significant impact on traffic volumes along Route 36 and within the town of Damon. The amount of increased congestion would depend on the time of day workers commuted and the number who drove their own vehicles. Traffic impacts would be temporary, however, as most construction activity would occur between the second and sixth months of the project.

The project would have a small impact on waterborne transportation in Freeport Harbor, caused by an increase in tanker traffic. The worst-case increase in tanker traffic during initial fill (assuming a tanker capacity of only 32,000 DWT, or about 254,000 bbl of oil) would average about one tanker every day.

Construction of alternative water supply, brine disposal, and oil distribution facilities could affect the area's transportation conditions because of the additional workers and material that would be required. Impacts should not be significant.

Population and Housing

The potential impacts on population and housing would be similar to those described in paragraph 4.3.1.8. The limited stock of housing available in Damon would also discourage workers from relocating in the area.

Economy

Potential economic impacts are described in paragraph 4.3.1.8.

Government and Public Services

Construction of the SPR facilities at the Damon Mound site would involve the removal of about 232 acres from the property tax rolls of Brazoria County. Assuming a fair market value of $1000 per acre for the Damon Mound site, the tax loss would be about $668 per year for the life of the project.

Potential project impacts on local public services are described in paragraph 4.3.1.8.

4.6.2 Impact from Operation and Standby Storage

Development of a 100 MMB storage capacity at the Damon Mound site would ensure that, in the event of an oil supply interruption, a total of 163 MMB of oil would be available from the Seaway Group SPR facilities for delivery to the SEAWAY Pipeline or to tankers via Freeport Harbor. Oil would probably be pumped preferentially from Damon Mound to SEAWAY Tank Farm for pipeline transport north; oil in excess of SEAWAY capacity (600 MB per day) would then be pumped to the tanker dock along with oil from the Bryan Mound early storage phase facilities. Until an oil supply interruption occurred, the facilities at Damon Mound would be maintained in a condition of standby readiness.

4.6.2.1 Land Features

Effects of operational and standby storage on land features are expected to be minimal. Soils would soon stabilize after revegetation.

The possible impacts of the improbable occurrence of a cavern collapse are described in paragraph 4.3.2.1.

Use of alternative facilities would not affect land features.

4.6.2.2 Water

Impacts on water resources during operation of the Damon Mound facility could result from raw water withdrawal, brine disposal, maintenance dredging at dock sites, and possible spills of oil or brine.

Raw Water Withdrawal

Impacts of raw water withdrawal for oil displacement are described in paragraph 4.4.2.2.

Brine Disposal

The potential impacts on water quality in the Gulf of Mexico and in the deep salt water bearing sands are described in paragraph 4.3.2.2.

Maintenance Dredging

The potential impacts on water quality in Freeport Harbor are described in paragraph 4.3.2.2.

Accidental Oil Release

During project operation, oil spills could occur in the Gulf of Mexico, in Freeport Harbor, along the pipelines connecting the storage site with the DOE tanker docks and with the SEAWAY Tank Farm from the wellheads at Damon Mound or oil surge tanks at Bryan Mound. A summary of oil spill expectation model projections is given in Section 4.2.

The probable movement of spills occurring east of the SEAWAY Tank Farm is described in paragraph 4.3.2.2.

Spills at the Damon Mound site not contained within the diking would flow northward downslope to level ground. No significant water bodies are located in this area or on the dome. Spills from the pipeline just south of the dome would flow through the intermittent stream beds toward Mound Creek, which drains into the San Bernard River. Further south, pipeline spills would enter Varner Creek, which drains into the Brazos River; still farther south, the spills would enter Bell Creek, which flows to the San Bernard. Between the Bell Creek watershed divide and a State penal farm, drainage is generally: 1) into the San Bernard River through a number of intermittent drainageways; 2) into the Brazos south of a Dow Chemical Company plant; or 3) into the Jones Creek watershed which flows through marshland to the Intracoastal Waterway.

Oil spills are most likely to reach the Gulf of Mexico only from tanker spills.

Oil weathering processes and dispersal characteristics, and the potential impact of oil spills are described in paragraph 4.3.2.2.

Accidental Brine or Saline Raw Water Release

During project operation, brine spills could occur from the brine disposal pipeline or the on-site brine pit; raw water could be spilled from the raw water supply line or, during standby storage, from the brine disposal line. A summary of brine spill expectation model projections is provided in Section 4.2.

The probable movement of spills occurring east of the SEAWAY Tank Farm is described in paragraph 4.3.2.2.

Spills at the Damon Mound site not contained within the diking would flow northward downslope to level ground. No significant water bodies are located in this area or on the dome. Spills from the pipeline just south of the dome would flow through intermittent stream beds toward Mound Creek, which drains into the San Bernard River. Further south, pipeline spills would enter Varner Creek, which drains into the Brazos River; still farther south, the spills would enter Bell Creek, which flows to the San Bernard. Between the Bell Creek watershed divide and a State penal farm, drainage is generally: 1) into the San Bernard River through a number of intermittent drainageways; 2) into the Brazos south of a Dow Chemical Company plant; or 3) into the Jones Creek watershed which flows through marshland to the Intracoastal Waterway.

The potential impacts of brine and raw water spills are described in paragraph 4.3.2.2.

Flood Hazards

The elevated location of the Damon Mound site precludes the potential for serious flood hazards. Pipeline and storage tanks at Bryan Mound would be subject to flood hazards as described in paragraph 4.3.2.2.

Alternative Facilities

Use of saline ground water to displace the stored oil and the injection of brine into deep subsurface salt water bearing sands would have the same potential adverse impacts as described in paragraph 4.3.2.2.

The potential impacts of the alternative crude oil distribution methods are described in paragraph 4.3.2.2.

4.6.2.3 Air Quality

Air quality impacts resulting from operation of the proposed facilities at the Damon Mound alternative SPR site would be similar to those discussed in paragraph 4.3.2.3, except that on site power generation would be an additional source of emissions (see Appendix C, Section C.3.2.3).

Air quality impacts from alternative crude oil distribution systems would also be similar to those discussed in paragraph 4.3.2.3. The alternative power supply method, purchase of commercial off site power, would eliminate a potential source of hydrocarbon emissions.

4.6.2.4 Noise

Noise impacts of operating SPR facilities at Damon Mound would be similar to those described in paragraph 4.3.2.4, except that selection of the commercial power alternative would further reduce noise impacts. Though the town of Damon is about one-half mile from the site, noise impacts from pumping and other operations would not be noticeable there.

4.6.2.5 Ecosystems and Species

Raw Water Withdrawal

The potential impacts on ecosystems and species in the Brazos River Diversion Channel are described in paragraph 4.3.2.5.

Brine Disposal

The potential impacts on ecosystems and species in the Gulf of Mexico are described in paragraph 4.3.2.5.

Tanker Transport

The potential impacts on ecosystems and species in Freeport Harbor are described in paragraph 4.3.2.5.

Maintenance of Project Lands

The potential impacts on wildlife are described in paragraph 4.4.2.5.

Accidental Oil Release

Because of the expected low frequency of spills (Section 4.2), chronic oil pollution should not occur at Damon Mound, Bryan Mound or along the proposed pipeline routes.

Areas potentially sensitive to damage from a large oil spill include Mound, Varner, Bell and Jones Creeks, wetlands near the SEAWAY Tank Farm, shallow lakes and ponds on Bryan Mound, and near-shore Gulf waters and shorelines.

The damage parameters discussed in paragraph 4.3.2.5 apply to the Damon Mound site alternative. The most sensitive areas would probably be the pipeline right-of-way near the SEAWAY Tank Farm and the lakes and ponds on Bryan Mound.

Except in the case of a very large oil spill (or a moderately sized spill in a sensitive area), biological impacts are not expected to be of regional significance.

Accidental Brine or Raw Water Release

The potential impacts of accidental brine releases on ecosystems are discussed in paragraph 4.3.1.5.

Alternative Facilities

Use of a ground water supply system or a deep well brine injection system would reduce the exposure to brine or saltwater spills because long pipelines to the coast would not be needed.

Use of a marine pipeline and an offshore SPM terminal would substantially reduce (by about 60 percent) the spill risks associated with crude oil movement through Freeport Harbor.

4.6.2.6 Natural and Scenic Resources

Operation and maintenance activities at the project site would be visible from houses in the northwest corner of Damon. There are no significant adverse impacts anticipated to the natural resources at the site.

Along the pipeline route there would be minimal impacts of natural and scenic resources as much of the land would be revegetated to its previous state.

4.6.2.7 Archaeological, Historical and Cultural Resources

There are expected to be no significant impacts on archaeological, historical, or cultural resources resulting from operation of the project or its alternatives at the Damon Mound site. If this site were selected for development, however, a cultural resources survey would be conducted prior to construction.

4.6.2.8 Socioeconomic Environment

Land Use

Operation and maintenance of the Damon Mound SPR site would have little additional impact on land use. The 232 acre site would be fenced and its present use as grazing land would be terminated for the life of the project. Of the 817 acres required for construction offsite and within the fenced area, 568 acres would be needed for maintenance. The excess land would be revegetated and returned to present uses. No impact on land uses in the town of Damon is expected.

Transportation

The operational impacts on transportation at Damon would be similar to those described in paragraph 4.4.2.8.

Population and Housing

The operational impacts on population and housing at Damon would be similar to those described in paragraph 4.4.2.8.

Economy

Economic impacts of the project are described in paragraph 4.3.2.8.

Government and Public Services

Impacts of project operation are described in paragraph 4.3.2.8.

4.6.3 Impact Due to Termination and Abandonment

The impacts due to termination and/or abandonment of the Damon Mound SPR storage site would be similar to those described in paragraph 4.3.3.

4.6.4 Relationships of the Proposed Action to Land Use Plans, Policies, and Controls

It is not anticipated that the proposed Damon Mound SPR facility would conflict with State or county land use plans or policies. For a further discussion of the land use plans, policies and controls in the area, refer to paragraph 4.3.4.

4.6.5 Summary of Adverse and Beneficial Impacts

Development of the Damon Mound salt dome as an SPR storage facility is not likely to generate significant regional environmental impacts except for the remote possibility of a major oil or brine spill, or the uncontrolled release of hydrocarbon vapors during oil transfer operations.

The long term use of the area surrounding the site for oil and gas production, for limestone mining and for cattle grazing would tend to reduce the apparent impacts resulting from construction activities.

Erosion of disturbed material on the site and along the pipeline would increase the potential for siltation of Mound Creek and several other tributaries of the San Bernard and Brazos Rivers. Other construction activity that would impact water quality would include dredging and construction at the two dock sites in Freeport Harbor and installation of pipelines to SEAWAY Tank Farm and Bryan Mound.

Increased salinity in the Gulf of Mexico would result from brine disposal. Contamination of ground water supplies is unlikely.

No significant noise impact is expected during operation of the project, but some portions of Damon may experience increased noise levels during on-site drilling. The duration of this impact would be short, however.

The reduction of available wildlife habitat in the vicinity of the site and along the pipeline routes is the most significant ecological impact associated with development of this site.

Although large quantities of water would be required to leach storage caverns, the withdrawal of this water from the Brazos River Diversion Channel would constitute less than one percent of its average flow.

Disposal of brine in the Gulf of Mexico is expected to moderately increase salinity in water near the diffuser, but this increase is not expected to be significant though there may be some adverse effect on local marine organisms.

Pipeline construction could temporarily affect the water quality of Mound, Varner, Bell and Jones Creeks by increasing turbidity and release of pollutants from bottom sediments.

Dock construction in Freeport Harbor is not expected to have significant effects on either the ecology of the area or its water quality, as the harbor is frequently dredged.

During construction of SPR facilities at Damon Mound, increases in income and employment in the Brazoria County region are expected. These would be of short duration and are not expected to provide major stimulus to the area's economy. Operation of the facility would provide minor additional income during standby storage and fill and withdrawal phases. Temporary increases in traffic congestion in the Damon Mound area are expected during construction.

Table 4.6-1 provides a summary tabulation of the adverse and beneficial impacts associated with development of this candidate site. The data are in both qualitative and quantitative form, as appropriate.

TABLE 4.6-1a Summary of environmental impacts caused by development of Damon Mound SPR facilities.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT: PROPOSED FACILITY	ACTIVITY AND EXPECTED IMPACT: ALTERNATIVE FACILITY
Geology and Land Features	Damon Mound dome and immediate vicinity	Site Preparation Excavation of 31,680 cy at the storage site on 30 acres of pasture land. Cavern Leaching Removal of 20.3 x 10^6 cy of salt for cavern development.	
	Dock Area	Dock Construction Dredging of 1,050,000 cy, grading of 14 acres for the tanker docks.	
	Offshore SPM Terminal		Marine Terminal 62 acres and 46,205 cy excavation.
	Phillips Dock		Dock Construction 6 acres and 2,300 cy excavation.
	Pipeline Corridors Between Damon Mound and Bryan Mound	Pipeline Construction Excavation of 381,712 cy for the oil, brine and raw water pipeline routes on 400 acres of primarily prairie grassland. Excavation of 6,000 cy for pipeline to Brazos Harbor on 4 acres of marsh, and 4 acres of cleared land.	Raw Water Supply Well field for raw water supply: 22 acres. Possible local subsidence caused by ground water withdrawal for leaching. Brine Disposal Brine disposal to deep wells; 19 acres.
	Brine Diffuser Pipeline Corridor	Pipeline Construction Excavation of 177,300 cy for 7.5 mi pipeline on 21 acres of Coastal prairie and 142 acres of Gulf bottom.	Pipeline Construction Additional excavation of 97,300 cy and 163 acres of Gulf bottom for 14.2 mi pipeline.
Water Resources	Brazos River Diversion Channel and ICW	Site Preparation Small quantities of sediment and construction pollutants carried into river by rainfall runoff. Raw Water Supply 534,000 BPD withdrawn for leaching over a two-year period expected to have minimal effects on water quality. Brine Spills Very small possibility of brine release reaching water bodies.	
	Gulf of Mexico	Brine Disposal Pipeline construction would cause temporary disruption of 142 acres of Gulf bottom. 684,000 BPD brine disposal could increase bottom salinity by 1 ppt over 3 square miles; approximately 25 acres would have excess salinities of 5 ppt or more. Expected brine spills would have no significant impact; possible maximum credible spill could have significant local impact.	Brine Disposal Pipeline construction would cause temporary disruption of 305 acres of Gulf bottom. Salinity concentrations and brine spill risks would be similar to that of proposed diffuser location. Terminal Construction Construction of marine terminal would temporarily increase turbidity levels in nearshore Gulf waters.

TABLE 4.6-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT: PROPOSED FACILITY	ACTIVITY AND EXPECTED IMPACT: ALTERNATIVE FACILITY
Water Resources (cont'd)	Mound Creek, Varner Creek, Bell Creek, Jones Creek, and Lakes and Ponds on Bryan Mound	Site Preparation Sediment and miscellaneous construction pollutants could degrade water quality. Brine Spills Expected brine spills insignificant; possible maximum credible spill could have significant impact.	
	Freeport and Brazos Harbors	Dock Construction Dredging and dock construction impacts considered comparable relative to annual maintenance dredging in Freeport Harbor.	
	Ground Water		Brine Disposal Deep well injection of brine is not expected to affect ground water supplies; potential for adverse impact limited to migration up old unplugged wells.
Air Quality	Damon Mound, Bryan Mound and Dock Sites	Site Preparation and Painting Minor quantities of particulates, SO_2, CO, HC, and NO_2 released from construction equipment at Damon Mound and at Bryan Mound.	Raw Water Supply and Brine Disposal Development of well fields for raw water supply or brine injection may double site emissions. Pollutant concentrations should remain within standards in the absence of background pollutants. Terminal Construction Construction of a marine terminal would increase emissions offshore but have little effect on concentrations at Freeport.
Noise Level	Storage Site	Site Preparation and Construction Maximum zone of noise impact (defined as 3 dB increase over ambient), 4,500 feet for Damon Mound and 2,000 feet for Bryan Mound for a period of 15 months.	
	Terminal Area	Dock Construction Maximum zone of noise impact, 2,200 feet; no residences or noise sensitive areas affected.	
	Pipeline Corridors	Pipeline Construction Zone of noise impact equal to 1,800 feet; very few residences affected for periods of less than a week.	Wellfield Construction Slightly increased zone of noise impact due to drilling of brine disposal or raw water supply wells; no residences or noise sensitive areas affected.

TABLE 4.6-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT: PROPOSED FACILITY	ALTERNATIVE FACILITY
Species and Ecosystems	Aquatic:		
	Brazos River Diversion Channel and ICW	Cavern Leaching: Destruction of less than 1% of phytoplankton and zooplankton during the two-year leaching period. Impact on regional biotic resources considered insignificant.	
		Brine Spills: Possible major spill of brine from pipeline considered remote. Locally significant aquatic impacts could occur.	
	Gulf of Mexico	Brine Disposal: Pipeline construction would cause temporary loss of 142 acres of benthic communities. Brine effluent could affect benthos communities over several hundred to several thousand acres. Some loss of benthos and plankton in the immediate diffuser area. Some impact on local white shrimp.	Brine Disposal: Pipeline construction would cause temporary loss of 305 acres of benthic communities. The impacts of brine effluent would be similar to that of proposed diffuser location.
		Oil and Brine Spills: Possible maximum credible oil or brine spill could destroy several acres of benthos and some biota in water column.	
			Terminal Construction: Construction of marine terminal facilities expected to have minimal local, short-term effect on benthos in offshore waters.
	Mound, Varner, Bell, and Jones Creeks, and Lakes and Ponds on Bryan Mound	Site Preparation and Construction: Minimal local impacts due to erosion and runoff from site construction.	
		Brine Spills: Major brine spill remotely possible; significant loss of biota would follow.	
	Freeport and Brazos Harbors	Dredging: Very local, short-term dredging impacts.	
	Terrestrial:		
	Coastal Prairie	Facility Construction: Loss of 253 acres due to facility construction. Revegetation of 58 acres likely. Minimal impact.	
		Brine Spills: Large brine spill could destroy several acres.	
			Raw Water Supply or Brine Disposal Wellfield: Loss of 19 acres of Coastal Prairies due to construction of deep well injection system. Similar impact due to well field development for raw water supply. Locally significant impact on productivity and habitat.
	Brackish Marsh	Facility Construction: Loss of 4 acres due to facility construction. Revegetation of 1 acre likely. Minimal impact importance.	
		Brine Spills: Large brine spill could destroy several acres.	

TABLE 4.6-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITY	ALTERNATIVE FACILITY
Species and Ecosystems (cont'd)	Terrestrial (cont'd) Fluvial Woodland	Facility Construction Loss of 182 acres due to facility construction. Revegetation of 46 acres likely. Significant local importance. Brine Spills Large brine spill could destroy several acres.	
Natural and Scenic Resources	Damon Mound dome and immediate vicinity	Site Preparation and Construction Significant impact on aesthetics due to nearby construction.	Raw Water Supply or Brine Disposal Wellfield; Terminal Construction Should deep well brine injection or ground water withdrawal for leaching be selected, impacts listed above could be reduced slightly. Similar effects would accompany development of a marine terminal, except land use would be little changed.
Socioeconomic Conditions	Land Use	All Environments Approximately 473 acres of Coastal Prairie, marsh, fluvial woodlands, and cleared land developed.	
	Transportation	Potential for traffic congestion on local roads near Damon Mound. Temporary minor impediment to navigation in Gulf during diffuser construction.	
	Population and Housing	No significant impacts expected.	
	Economy	Total construction wages of $9.3 million, only part of which would remain in the Brazosport area.	
	Government	Tax revenues due to increased local purchases expected to exceed cost of new services. Loss of tax revenue of $66,300 per year for the life of the project.	

TABLE 4.6-1b Summary of environmental impacts caused by operation of Damon Mound SPR facilities.

DISCIPLINE	SUBJECT AREAS	EXPECTED IMPACT: PROPOSED PHYSICAL FACILITY	EXPECTED IMPACT: ALTERNATIVE PHYSICAL FACILITY
Geology and Land Features	Damon Mound dome and immediate vicinity	Leached Caverns Remote possibility of roof collapse causing surface subsidence and formation of a lake over the cavern.	
Water Resources	Brazos River Diversion Channel	Raw Water Supply 1,000,000 BPD withdrawn for oil displacement for 163 days; expected to have minimal effects of water quality.	Raw Water Supply Subsidence potential from ground water withdrawal during leaching because of 1,000,000 BPD well withdrawal rate.
	Brazos Channel and ICW	Oil or Brine Spills Very small possibility of oil or brine release.	
	Gulf of Mexico	Brine Disposal 240,000 BPD brine disposal should have minimal water quality impacts. Oil or Brine Spills Oil spills may total 2,750 barrels, and brine spills 210 barrels during project lifetime; effects not expected to be significant unless oil or brine reaches shallow coastal bays.	Terminal Construction Use of marine terminal could reduce total oil spill volume by more than 50 percent.
	Mound, Varner, Bell and Jones Creeks, and Lakes and Ponds on Bryan Mound	Oil or Brine Spills Expected impacts from oil and brine spills negligible. Possible very large spill could seriously degrade water quality for several weeks or months.	
	Freeport and Bryan Harbors	Terminal Construction Maintenance dredging impacts insignificant. Oil Spills Oil spills may be relatively frequent though of small average size (1,470 barrels in 53 spills during project lifetime).	
	Ground Water	Oil or Brine Spills Very slight chance of local ground water pollution due to surface oil or brine spill; collapse of cavern could seriously degrade groundwater supplies for Damon Mound area but such an occurrence is highly unlikely.	Brine Disposal Deep well injection should not have significant impacts.

TABLE 4.6-1b continued.

DISCIPLINE	SUBJECT AREAS	EXPECTED IMPACT PROPOSED PHYSICAL FACILITY	ALTERNATIVE PHYSICAL FACILITY
Air Quality	Oil Handling and Storage Locations	Total Emissions Total emissions from 163 MMB oil storage facilities for 5 fill and withdrawal cycles equal 26,170 tons, 60 percent due to SPR site expansion. Distribution of emissions as follows: 47 percent in Gulf of Mexico, 25 miles from Freeport; 2 percent in transit between open Gulf and dock site; 47 percent from docks at Freeport; and 4 percent from Bryan Mound storage site.	
		Storage Tank Emissions Annual emissions from floating roof tanks at Bryan Mound equal 23 tons. If withdrawal occurs during the year, value is 36 tons.	
		Dock Transfers Hydrocarbon standards exceeded up to 13 kilometers from DOE docks; interaction with other DOE sources not considered significant.	
			Marine Terminal Significant reduction (69 percent) in total emissions with marine terminal; standards exceedance on-shore virtually eliminated.
	Damon Mound dome and vicinity	Power Generation Onsite Onsite power generation adds a locally significant source of hydrocarbons at Damon Mound (2,600 tons over project lifetime).	Commercial Power Purchase of commercial power would eliminate onsite emissions from power plant.
Noise Levels	Terminal and Storage Sites	Site Operations No significant increase in ambient sound levels on or adjacent to the sites.	
Species and Ecosystems	Aquatic		
	Brazos River Diversion Channel	Raw Water Supply Destruction of less than 1 percent of phytoplankton and zooplankton population in Brazos River during each 5-month withdrawal period.	
	Brazos River Diversion Channel, ICW, Mound, Varner, Bell and Jones Creeks	Oil or Brine Spills Possibility of major spill of brine or oil from pipeline considered remote. Would cause locally significant impacts on aquatic life.	
	Gulf of Mexico	Brine Disposal Effluent could affect plankton and benthos over several hundred to perhaps one thousand acres during oilfill. Should be significant only immediately adjacent to diffuser.	Brine Disposal The alternative would have impacts similar to the proposed system.
		Oil and Brine Spills Expected brine and oil spill volumes should not significantly affect marine biota. Estimated total of 2,750 barrels of oil and 288 [illegible] barrels of salt water and brine during project lifetime.	
		Possible very large or maximum brine spill could have significant impacts to several thousand acres of shallow water or marsh.	Oil Spills Reduced coastal exposure to oil spills if marine terminal developed.

TABLE 4.6-1b continued.

DISCIPLINE	SUBJECT AREAS	EXPECTED IMPACT: PROPOSED PHYSICAL FACILITY	EXPECTED IMPACT: ALTERNATIVE PHYSICAL FACILITY
Species and Ecosystems (cont'd)	Aquatic (cont'd)		
	Site Lakes and Ponds	Oil or Brine Spills: Very little impact expected based on probability of spills. Potential for significant loss of biota, should a large quantity brine or oil spill occur.	
	Freeport or Brazos Harbors	Dredging: Local, short-term maintenance dredging impacts. Oil Spills: Local contamination of water with oil possible.	
	Terrestrial		
	Coastal Prairie, Marsh and Fluvial Woodlands	Oil or Brine Spills: Impacts primarily limited to possible oil or brine spills. Likelihood small, but possible impact locally significant, especially if during spring nesting season.	Brine Spills: Additional prairie exposure to brine spill if ground water injection developed.
Natural and Scenic Resources	Bryan Beach, Coastal Marshes, San Bernard River, and Wildlife Refuge	Oil Spills: Adverse impacts limited primarily to possible large oil spill which could foul beaches and coat marsh and shallow water area with oil.	
Socioeconomic Environment	Economy	Facility Operations: Total wages expected to be approximately $96,000 during each month of oil fill and withdrawal; $18,000 during standby storage.	

4.7 ALTERNATIVE SITE - NASH DOME

4.7.1 Impact of Site Preparation and Construction

4.7.1.1 Land Features

Proposed Facilities

Grading and construction at the 206-acre Nash dome alternative SPR site would disturb about 30 acres (Table 2.7-1).

Construction impacts of the two DOE tanker terminals in Freeport Harbor and the brine diffuser pipeline to the Gulf are described in paragraph 4.3.1.1.

Construction of raw water intake and brine disposal pipelines from Bryan Mound to the Nash dome site would require excavation of 412,787 cy of material and disruption of 429 acres. An additional 3 acres would be required for the three back up brine injection wells.

Construction of the bi-directional crude oil pipelines between SEAWAY Tank Farm and the site would require displacement of 172,393 cy of material.

Leaching of up to twelve storage caverns at the Nash dome site would involve removal of 100 MMB (20.8 X 10^6 cy) of salt. Sufficient space would be left between cavities to preserve structural integrity.

Alternative Facilities

Two alternative raw-water supply systems were considered: (1) development of a well field would require about 22 acres for drill pads; (2) withdrawal of water from the Brazos River east of the site would require construction of an intake system, a desander, a several acre spoil area and a 6-mile pipeline.

Disposal of brine in deep saline water bearing sands would require about 19 acres for drill pads, and brine disposal to the diffuser 12.5 miles offshore would require 163 additional acres over the proposed system.

Purchase of commercial power would require construction of a 10-mile transmission corridor to the site.

Alternatives to the crude oil distribution system are discussed in paragraph 4.3.1.1.

4.7.1.2 Water

Site preparation and construction of proposed facilities at Nash dome may impact several water bodies, including Cow Creek, Turkey Creek, Varner Creek, Bell Creek, Jones Creek, the Intracoastal Waterway, the Brazos River Diversion Channel, the Gulf of Mexico, and various ground water aquifers.

Raw Water Withdrawal

The potential impacts on water quality in the Brazos River Diversion Channel are described in paragraph 4.3.1.2.

Brine Disposal

The potential impacts on water quality in the Gulf of Mexico and in the deep aquifers are described in paragraph 4.3.1.2.

Construction of DOE Docks

The potential impacts on water quality in Freeport Harbor are described in paragraph 4.3.1.2.

Construction of Surface Facilities at Nash Dome

Site preparation and construction activities at Nash Dome would require displacement of approximately 30,100 cy of earth. Natural site drainage is toward Turkey Creek to the north and Cow Creek to the south-east. Standard engineering control techniques (interceptor ditches, dikes, and sedimentation ponds) would be utilized to prevent significant degradation of water quality from site runoff.

Construction of Oil, Brine and Water Supply Pipelines

The proposed water supply, brine disposal, and crude oil pipelines would cross Cow, Varner, and Bell Creeks and several other intermittent streams in the 32.6 mile segment between the storage site and SEAWAY Tank Farm. East of SEAWAY Tank Farm, the water supply and brine disposal pipelines would also cross Jones Creek, the Brazos River Diversion Channel and Unnamed Lake on Bryan Mound.

Trench excavation across the water courses would create increased turbidity and release soluble substances from the substrate to the water column. Impacts would be temporary and local in extent, however.

There should be no impact on ground water supply or quality due to pipeline installation.

Accidental Brine Release

A possible brine (or raw water) spill could affect Cow, Varner, Bell or Jones Creeks, the Brazos River Diversion Channel, lakes and ponds on Bryan Mound, the Intracoastal Waterway, or the Gulf of Mexico.

The estimated quantity of brine that could be spilled during leaching of Nash dome storage cavities is up to 50 barrels into Gulf waters and up to 360 barrels on land or in water bodies between Bryan Beach and Nash dome. In addition, an estimated 355 barrels of raw water could be spilled from the raw water supply system. Maximum credible spills of up to 30,000 barrels are considered possible, though very unlikely.

Local recharge of near surface aquifers has been found to be minimal, so potential seepage from the brine pit or minimal pipeline spills are likely to have negligible impact on water quality. A brine spill at the site or along the disposal pipeline could, however, locally impact shallow aquifers.

Elevations at the Nash dome site are approximately +55 feet MSL. Brazos River backwater flood studies indicate a 100 year flood elevation of +47.5 feet at Nash dome. Thus storage facilities at the site are not subject to significant flood hazards.

Alternative Facilities

Impacts of the alternative raw water intake systems are described in paragraph 4.5.1.2.

Impacts of the alternative brine disposal systems, deep well injection, and 12.5 mile diffuser are described in paragraph 4.3.1.2.

Impacts associated with alternative crude oil distribution systems are described in paragraph 4.3.1.2.

4.7.1.3 Air Quality

Air quality impacts resulting from site preparation and construction of the proposed facilities at the Nash dome alternative SPR site would be similar to those discussed in paragraph 4.3.1.3, where it was concluded that air quality impacts would be minor.

Additional emissions from construction of an 8500 bbl fuel tank for on-site power generation would have no significant impact on air quality.

4.7.1.4 Noise

Site preparation and construction at Nash dome would adversely impact ambient sound levels in the vicinity. The increase in noise resulting from these activities, with the exception of plant facility construction, would be similar to those discussed in paragraph 4.3.1.4. One major difference is that on-site generation is the primary alternative for power at this site, which could increase the duration of construction activity.

For construction of facilities connected with the Nash dome site, the noise impact zone radii are:

Area	Construction Activity	Impact Zone Radius (ft)
Nash dome site	Drilling new wells	7100
	Construction of support facilities	3160
Pipeline routes	Laying of pipe	2844
	Access road construction	2200
Freeport Harbor	DOE dock construction	2200

The zones of noise impact are larger than those at other candidate sites because background noise levels are estimated at only about 50 dB. There are no private residences in the immediate Nash dome area that would be affected by construction noise (three farm residences exist which would have to be relocated off site).

Construction of an alternative raw water supply or brine disposal well field along the proposed pipeline route would contribute noise levels of a magnitude similar to the on-site drilling activities. The zone of noise impact would thus be extended further to the southwest in a sparsely populated area of coastal prairie. Construction of a marine terminal would have little effect on onshore noise levels.

4.7.1.5 Ecosystems and Species

Site preparation and construction of the SPR facilities at Nash dome would affect both terrestrial and aquatic resources in the area. Terrestrial habitats potentially affected include coastal prairie grassland and fluvial woodlands. Aquatic habitats include Turkey, Cow, Varner, Bell and Jones Creeks, the Brazos River Diversion Channel, the Intracoastal Waterway, the lakes and ponds at Bryan Mound, Freeport Harbor and the near shore Gulf of Mexico.

In the following subsections, potential impacts on ecosystems and species are treated according to specific operational aspects of facility development.

Raw Water Withdrawal

The potential impacts on ecosystems and species in the Brazos River Diversion Channel are described in paragraph 4.3.1.5.

Brine Disposal

The potential impacts on ecosystems and species in the Gulf of Mexico are described in paragraph 4.3.1.5.

Construction of DOE Docks

The potential impacts are described in paragraph 4.3.1.5.

Construction of Surface Facilities at Nash Dome

Facilities constructed at Nash dome that would have a potential impact on the site ecology include the pump house and control buildings, the cavern wellheads and brine disposal wells, access roadways, the brine settling pond and a 34,000 kilowatt gas-turbine power generator.

The Nash dome storage facilities would be located on a 206 acre tract in a generally agricultural area. Construction at the site would impact about 30 acres of cleared pastureland. Permanent loss of this habitat would result in the loss of food, cover, and nesting and breeding areas for wildlife. The loss of this habitat is not significant when compared with the total acreage of similar habitat in Fort Bend and Brazoria Counties.

Small populations of invertebrates, mammals, and birds at the site may be forced to migrate to other areas during construction, but because of the large amount of coastal prairie habitat available adjacent to Nash dome, the potential for relocation is good.

Construction of Pipelines

A total of 429 acres would be required for construction of the proposed raw water, brine and crude oil pipelines between the Nash dome site and the SEAWAY Tank Farm. Much of the pipeline route, except a 6-mile spur leading to Nash dome, follows existing pipeline corridors. Between SEAWAY and Bryan Mound, the raw water and brine pipelines would also be constructed within an existing right-of-way.

The potential impacts on ecosystems are similar to those described in paragraph 4.4.1.5.

Accidental Brine Release

The most likely location for a large brine spill would be onshore between Nash dome and Bryan Beach. In such an event, the brine could affect coastal prairie or fluvial woodland habitats, or Cow, Varner, Bell or Jones Creek, the Brazos River Diversion Channel, the lakes on Bryan Mound or the Intracoastal Waterway.

The potential impacts of such an occurrence are described in paragraph 4.3.1.5.

Alternative Facilities

Construction of a ground water well supply field or a brine injection field along the proposed pipeline corridor would eliminate the need for multiple pipelines to Bryan Mound but would not greatly reduce the amount of right-of-way which would have to be cleared. It is estimated that a water supply well field would require 22 wells and about 22 acres of land. Similarly, a brine injection field would require an additional 19 acres and 19 well pads. Use of the 12.5 mile diffuser would require 20 acres of coastal prairie and 1 acre of marsh.

Impacts of constructing alternate crude oil distribution systems are described in paragraph 4.3.1.5.

4.7.1.6 Natural and Scenic Resources

Construction activities at Nash dome would have a minor impact on natural and scenic resources. Most of the area that would be disrupted has been previously developed for pipeline routes or agricultural production. The site is visible from public roads, but these are infrequently travelled.

The alternative brine disposal, water supply, and oil distribution systems would not significantly alter the impacts anticipated.

4.7.1.7 Archaeological, Historical and Cultural Resources

No significant impacts on archaeological, historical or cultural resources are expected from construction of the project or its alternatives. If SPR expansion at Nash dome is selected, the site and pipeline routes would be surveyed for their potential archaeological, historical, or cultural resources prior to construction. The development would be made to comply with the provisions of Executive Order 11593.

4.7.1.8 Socioeconomic Environment

Land Use

Developing the site at Nash dome would change the primary land use of the site from an agricultural and grazing area to an industrial area. Pipeline routes would not alter present land uses.

Alternative development plans would impact land use to the extent that additional agricultural or grazing land would be converted to industrial use.

Transportation

Most construction workers (about 555 at peak employment) are expected to commute from local or regional urban centers in Brazoria or Fort Bend Counties. This commuting traffic, along with project related truck traffic, would have a significant impact on traffic volumes along Route 36 past the towns of Damon and Needville.

The potential impacts on transportation would be similar to those described in paragraph 4.6.1.8.

Population and Housing

The potential impacts on population and housing would be similar to those described in paragraph 4.3.1.8.

Economy

Potential economic benefits are described in paragraph 4.3.1.8.

Government and Public Services

Construction of SPR facilities at the Nash dome site would involve the removal of 206 acres from the tax rolls of Fort Bend County. Assuming that land at this site is valued at $1000 per acre, the property tax loss would amount to about $593 per year for the life of the project.

Potential project impacts on local public services are described in paragraph 4.3.1.8.

4.7.2 Impact From Operation and Standby Storage

Development of a 100 MMB storage capacity at the Nash dome site would ensure that, in the event of an oil supply interruption, a total of 163 MMB of oil would be available from the Seaway Group SPR facilities for delivery to the SEAWAY Pipeline or to tankers via Freeport Harbor. Oil would probably be pumped preferentially from Nash dome to SEAWAY Tank Farm for pipeline transport north; oil in excess of SEAWAY capacity (600 MB per day) would then be pumped to the tanker dock along with oil from the Bryan Mound early storage phase facilities. Until an oil supply interruption occurred, the facilities at Nash dome would be maintained in a condition of standby readiness.

4.7.2.1 Land Features

Effects of operation and standby storage on land features are expected to be minimal. Soil would soon stabilize after revegetation.

The possible impacts of the improbable occurrence of a cavern collapse are described in paragraph 4.3.2.1.

Use of alternative facilities would not affect land features.

4.7.2.2 Water

Impacts on water resources during operation of the Nash dome facilities could result from raw water withdrawal, brine disposal, maintenance dredging at dock sites, and possible spills of oil or brine.

Raw Water Withdrawal

Impacts of raw water withdrawal for oil displacement are described in paragraph 4.4.2.2.

Brine Disposal

The potential impacts on water quality in the Gulf of Mexico and in the deep aquifers are described in paragraph 4.3.2.2.

Maintenance Dredging

The potential impacts on water quality in Freeport Harbor are described in paragraph 4.3.2.2.

Accidental Oil Release

During project operation, oil spills could occur in the Gulf of Mexico, in Freeport Harbor, along the pipelines connecting the storage site with the DOE tanker docks and with the SEAWAY Tank Farm, from the wellheads at Nash dome, or oil surge tanks at Bryan Mound. A summary of oil spill expectation model projections is given in Section 4.2.

The probable movement of spills occurring east of the SEAWAY Tank Farm is described in paragraph 4.3.2.2.

Spills at the Nash dome site not contained within the diking would drain into Turkey or Cow Creeks which flow into the Brazos River. The proposed water storage project south of Eagle Nest Lake would be protected by containment dikes, and therefore would not be directly affected should a spill reach the lake. Likewise, the Harris Reservoir would not be directly affected as long as the intakes from the Brazos River were closed during a spill episode. Near the junction point between the Nash dome and Damon Mound pipelines, spills would enter Varner Creek, which drains into the Brazos River; further south, the spills would enter Bell Creek, which flows to the San Bernard. Between the Bell Creek watershed divide and a State penal farm, drainage is generally: (1) into the San

Bernard River through a number of intermittent drainageways; (2) into the Brazos River south of a Dow Chemical Company plant; or (3) into the Jones Creek watershed which flows through marshland to the Intracoastal Waterway.

Oil spills are most likely to reach the Gulf of Mexico only from tanker spills.

Oil weathering processes and dispersal characteristics, and the potential impact of oil spills are described in paragraph 4.3.2.2.

Accidental Brine or Raw Water Release

During project operation, brine spills could occur from the brine disposal pipeline or the on-site brine pit; raw water could be spilled from the raw water supply line or, during standby storage, from the brine disposal line. A summary of brine spill expectation model projections is provided in Section 4.2.

The probable movement of spills occurring east of the SEAWAY Tank Farm is described in paragraph 4.3.2.2.

Spills at the Nash dome site not contained within the diking would drain into Turkey or Cow Creeks which flow into the Brazos River. The proposed water storage project south of Eagle Nest Lake would be protected by containment dikes, and therefore would not be directly affected should a spill reach the lake. Likewise, the Harris Reservoir would not be directly affected as long as the intakes from the Brazos River were closed during a spill episode. Near the junction point between the Nash dome and Damon Mound pipelines, spills would enter Varner Creek, which drains into the Brazos River; farther south, the spills would enter Bell Creek, which flows to the San Bernard. Between the Bell Creek watershed divide and a State penal farm, drainage is generally: (1) into the San Bernard River through a number of intermittent drainageways; (2) into the Brazos river south of a Dow Chemical Company plant; or (3) into the Jones Creek watershed which flows through marshland to the Intracoastal Waterway.

The potential impacts of brine and raw water spills are described in paragraph 4.3.2.2.

Flood Hazards

The elevation of the Nash dome site precludes the potential for serious flood hazard. Pipelines and storage tanks at Bryan Mound would be subject to flood hazards as described in paragraph 4.3.2.2.

Alternative Facilities

Use of saline ground water to displace the stored oil, the injection of brine into deep subsurface salt water bearing sands, and 12.5 mile diffuser would have the same potential adverse impacts as described in paragraph 4.3.2.2.

The potential impacts of the alternative crude oil distribution methods are described in paragraph 4.3.2.2.

4.7.2.3 Air Quality

Air quality impacts resulting from operation of the proposed facilities at the Nash dome alternative SPR site would be similar to those discussed in paragraph 4.3.2.3, except that on-site power generation would be an additional but minor source of emissions.

Air quality impacts from alternative crude oil distribution systems would also be similar to those discussed in paragraph 4.3.2.3. The alternative power supply method, purchase of commercial off-site power, would eliminate a potential source of hydrocarbon emissions.

4.7.2.4 Noise

Noise impacts of operating SPR facilities at Nash dome would be similar to those described in paragraph 4.3.2.4, except that selection of the commercial power alternative would further reduce noise impacts. As there are no residences near the site, impacts would be insignificant.

4.7.2.5 Ecosystems and Species

Raw Water Withdrawal

The potential impacts on ecosystems and species in the Brazos River Diversion Channel are described in paragraph 4.3.2.5.

Brine Disposal

The potential impacts on ecosystems and species in the Gulf of Mexico are described in paragraph 4.3.2.5.

Tanker Transport

The potential impacts on ecosystems and species in Freeport Harbor are described in paragraph 4.3.2.5.

Maintenance of Project Lands

The potential impacts on wildlife are described in paragraph 4.4.2.5.

Accidental Oil Release

Because of the expected low frequency of spills (Section 4.2), chronic oil pollution should not occur at Nash dome, Bryan Mound or along the proposed pipeline routes.

Areas potentially sensitive to drainage from a large oil spill include Turkey, Cow, Varner, Bell and Jones Creeks, wetlands near the SEAWAY Tank Farm, shallow lakes and ponds on Bryan Mound and near shore Gulf waters and shorelines. Also, should a large oil spill reach the eagles' nesting area along the Brazos River southeast of the site, a broad range of vegetation and wildlife, including the endangered southern bald eagle, could be impacted.

The damage parameters discussed in paragraph 4.3.2.5 apply to the Nash dome site alternative. The most sensitive areas would probably be the pipeline right-of-way near the SEAWAY Tank Farm, and the lakes and ponds on Bryan Mound.

Except in the case of a very large oil or brine spill (or a moderately sized spill in a sensitive area), biological impacts are not expected to be of regional significance.

Accidental Brine or Raw Water Release

The potential impacts of accidental brine releases on ecosystems are discussed in paragraph 4.3.1.5.

Alternative Facilities

Use of a ground water supply system or a deep-well brine injection system would reduce the exposure to brine or saltwater spills because long pipelines to the coast would not be needed.

Use of a marine pipeline and an offshore SPM terminal would substantially reduce (by about 60 percent) the spill risks associated with crude oil movement through Freeport Harbor.

4.7.2.6 Natural and Scenic Resources

Operation and maintenance activities at the project site would have little effect on the scenic values in the area unless future development occurs along county roads. The project facilities would not be visible from any residences in the area. There are no significant adverse impacts anticipated to the natural resources at the site.

Along the pipeline route there would be minimal impacts on natural and scenic resources since much of the land would be revegetated to its previous state.

4.7.2.7 Archaeological, Historical and Cultural Resources

There are expected to be no significant impacts on archaeological, historical, or cultural resources resulting from operation of the project or its alternatives at the Nash dome site. If this site were selected for development, however, a cultural resources survey would be conducted prior to construction.

4.7.2.8 Socioeconomic Environment

Land Use

Operation and maintenance of the Nash dome SPR site would have little additional impact on land use. The 206 acre site would be fenced and its present use for cultivation and cattle grazing would be terminated for the life of the project. Of the 823 acres required for construction offsite and within the fenced area, only 567 acres would be needed for maintenance and some of the excess land would be revegetated and returned to present uses.

Transportation

The operational impacts on transportation would be similar to those described in paragraph 4.4.2.8.

Population and Housing

The operational impacts on population and housing near Nash dome would be similar to those described in paragraph 4.4.2.8 for Allen dome.

Economy

Economic impacts of the project are described in paragraph 4.3.2.8.

Government and Public Services

Impacts of project operation are described in paragraph 4.3.2.8.

4.7.3 Impact Due to Termination and Abandonment

The impact due to termination and/or abandonment of the Nash dome SPR storage site would be similar to those described in paragraph 4.3.3.

4.7.4 Relationship of the Proposed Action to Land Use Plans, Policies and Controls

It is not anticipated that the proposed Nash dome SPR facility would conflict with State or county land use plans or policies. For a further discussion of the land use plans, policies and controls in the area, refer to paragraph 4.3.4.

4.7.5 Summary of Adverse and Beneficial Impacts

Development of the Nash salt dome as an SPR oil storage facility is not likely to generate significant regional environmental impact except for the remote possibility of a major oil or brine spill, or the uncontrolled release of hydrocarbon vapors during oil transfer operations.

The longtime use of the area surrounding the site for oil and gas production and for agriculture would tend to minimize the scope of impacts resulting from construction activities.

Erosion of disturbed material on the site and along the pipeline route would increase the potential for siltation of the several intermittent streams crossed. Other construction activity that would impact water quality would include dredging and construction at the two dock sites in Freeport Harbor and installation of pipelines to SEAWAY Tank Farm, Bryan Mound and the offshore diffuser system.

No significant noise impact is expected during construction or operation of the project.

The reduction of available wildlife habitat in the vicinity of the site and along the pipeline routes is the most significant ecological impact associated with development of this site.

Although large quantities of water would be required to leach storage caverns, the withdrawal of this water from the Brazos River Diversion Channel would constitute less than one percent of its average flow.

Disposal of brine in the Gulf of Mexico is expected to moderately increase salinity in water near the diffuser, but this increase is not expected to be significant though there may be some adverse effect on local marine organisms.

Pipeline construction could temporarily affect the water quality of Cow, Varner, Bell, and Jones Creeks by increasing turbidity and release of pollutants from bottom sediments.

Dock construction in Freeport Harbor is not expected to have significant effects on either the ecology of the area or its water quality, as the harbor is already frequently dredged.

During construction of SPR facilities at Nash dome, increases in income and employment in the Brazoria County region are expected. These increases would be of short duration and are not expected to provide major stimulus to the area's economy. Operation of the facility would produce minor additional income during standby storage and fill and withdrawal phases. Minor increases in traffic congestion in the Nash dome area are expected during construction.

Table 4.7-1 provides a summary tabulation of the adverse and beneficial impacts associated with the development of this candidate site. The data are in both qualitative and quantitative form, as appropriate.

TABLE 4.7-1a Summary of environmental impacts caused by development of Nash dome SPR facilities.

DISCIPLINE	ENVIRONMENT OR SYSTEM	ACTIVITY AND EXPECTED IMPACT PROPOSED FACILITIES	 ALTERNATIVE FACILITIES
Geology and Land Features	Nash dome and immediate vicinity	*Site preparation* excavation of 30,100 cy at the storage site on 30 acres of agricultural land.	
		Cavern Leaching Removal of 20.8 x 10^6 cy of salt for cavern development.	
	DOE Dock Area (Freeport Harbor)	*Dock Construction* Dredging of 1,050,000 grading of 14 acres for the tanker docks.	
	Offshore SPM Terminal		*Marine Terminal Construction* 62 acres and 46,205 cy excavation.
	Phillips Dock Area		*Site Preparation* 5 acres and 2,500 cy excavation.
	Pipeline Corridors Between Nash Dome and Bryan Mound	*Pipeline Construction* Excavation of 585,130 cy along the oil, brine and raw water pipeline routes on 432 acres of primarily prairie grassland. Excavation of 6,000 cy for pipeline to Brazos Harbor on 4 acres of marsh, and 4 acres of cleared land.	
			Raw Water Supply Well field for raw water supply: 22 acres.
			Brine Disposal Brine disposal to deep wells; 19 acres.
	Brine Diffuser Pipeline Corridor	*Pipeline Construction* Excavation of 177,300 cy for 7.5 mile pipeline on 21 acres of coastal prairie and 142 acres of Gulf bottom.	*Pipeline Construction* Excavation of additional 97,300 cy for 14.2 mile pipeline on additional 163 acres for 12.5 mile diffuser site.
Water Resources	Brazos River Diversion Channel and ICW	*Site Preparation* Small quantities of sediment and construction pollutants carried into river by rainfall runoff.	
		Raw Water Supply 534,000 BPD withdrawn for leaching over a two-year period expected to have minimal effects on water quality.	
		Brine Spills Very small possibility of brine release reaching water bodies.	
	Gulf of Mexico	*Brine Disposal* Pipeline construction would cause temporary disruption of 142 acres of Gulf bottom. 684,000 BPD brine disposal could increase bottom salinity by 1 ppt over 3 square miles; approximately 25 acres would have excess salinities of 5 ppt or more. Expected brine spills would have no significant impact; possible maximum credible spill could have significant local impact.	*Brine Disposal* Pipeline construction would cause temporary disruption of 305 acres of Gulf bottom; salinity concentrations and brine spill risks would be similar to that of the proposed diffuser location.
			Terminal Construction Construction of marine terminal would temporarily increase turbidity levels in nearshore Gulf waters.

TABLE 4.7-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	EXPECTED IMPACT PROPOSED FACILITIES	 ALTERNATIVE FACILITIES
	Turkey, Cow, Varner, Bell and Jones Creeks and Lakes and Ponds on Bryan Mound	Site Preparation Sediment and miscellaneous construction pollutants could degrade water quality. Brine Spills Expected brine spills insignificant; possible maximum credible spill could have significant impact.	
Water Resources (cont'd)	Freeport and Brazos Harbors	Dredging Dredging and dock construction impacts considered comparable to annual maintenance dredging of Freeport Harbor.	
	Ground Water		Raw Water Supply Possible local subsidence caused by ground water withdrawal for leaching. Brine Disposal Deep well injection of brine is not expected to affect ground water supplies; potential for adverse impact limited to migration up old unplugged wells.
Air Quality	Nash dome, Bryan Mound and Dock Sites	Site Preparation and Painting Minor quantities of particulates, SO_2, CO, HC, and NO_2 released from construction equipment at Nash dome and at Bryan Mound.	Raw Water Supply or Brine Disposal Development of well fields for raw water supply or brine injection may double site emissions. Pollutant concentrations should remain within standards in the absence of background pollutants. Terminal Construction Construction of a marine terminal would increase emissions offshore but have little affect on concentrations at Freeport.
Noise Level	Storage Site	Site Preparation and Construction Maximum zone of noise impact (defined as 3 dB increase over ambient), 7,100 feet for Nash dome and 2,000 feet for Bryan Mound; no residences affected.	
	Dock Area	Dock Construction Maximum zone of noise impact, 2,200 feet; no residences or noise sensitive areas affected.	
	Pipeline Corridors	Pipeline Construction Zone of noise impact equal to 1,800 feet; very few residences affected for periods of less than a week.	Raw Water Supply or Brine Disposal Wellfields Slightly increased zone of noise impact due to drilling of brine disposal or raw water supply wells; few residences or noise sensitive areas affected.

TABLE 4.7-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	EXPECTED IMPACT: PROPOSED FACILITIES	EXPECTED IMPACT: ALTERNATIVE FACILITIES
Species and Ecosystems	Aquatic Brazos River Diversion Channel and ICW	Raw Water Supply Destruction of less than 1% of phytoplankton and zooplankton during the two year leaching period. Impact on regional biotic resources considered insignificant. Brine Spills Possible major spill of brine from pipeline considered remote. Locally significant aquatic impacts would occur.	
Species and Ecosystems	Gulf of Mexico	Brine Disposal Pipeline construction would cause temporary loss of 142 acres of benthic communities. Brine effluent could affect benthos communities over several hundred to several thousand acres. Some loss of benthos and plankton in the immediate diffuser area. Some impact on local white shrimp. Oil and Brine Spills Possible maximum credible oil or brine spill could destroy several acres of benthos and some biota in water column.	Brine Disposal Pipeline construction would cause temporary loss of 305 acres of benthic communities. The impacts of brine effluent would be similar to proposed diffuser location. Terminal Construction Construction of marine terminal facilities expected to have minimal local, short-term effect on benthos in offshore waters.
	Turkey, Cow, Varner, Bell, Jones Creeks and Lakes and Ponds on Bryan Mound	Site Preparation and Construction Minimal local impacts due to erosion and runoff from site construction. Brine Spills Major brine spill remotely possible; significant loss of biota would follow.	
	Freeport and Brazos Harbors	Dredging Very local, short-term dredging impacts.	
	Terrestrial Coastal Prairie	Facility Construction Loss of 242 acres due to facility construction. Revegetation of 60 acres likely. Minimal impact importance. Brine Spill Large brine spill could destroy several acres.	Raw Water Supply or Brine Disposal Wellfield Loss of 19 acres of Coastal Prairies due to construction of deep well injection system. Similar impact due to well field development for raw water supply. Locally significant impact on productivity and habitat.

TABLE 4.7-1a continued.

DISCIPLINE	ENVIRONMENT OR SYSTEM	EXPECTED IMPACT: PROPOSED FACILITIES	EXPECTED IMPACT: ALTERNATIVE FACILITIES
	Brackish Marsh	Facility Construction Loss of 4 acres due to facility construction. Revegetation of 1 acre likely. Minimal impact importance. Brine Spills Large brine spill could destroy several acres.	
	Fluvial Woodland	Facility Construction Loss of 210 acres. Revegetation of 52 acres likely. Significant local importance. Brine Spills Large brine spill could destroy several acres.	
Natural and Scenic Resources	Pipeline Route to Seaway Terminal	Pipeline Construction Significant impact on aesthetics due to nearby construction. Minor impact on hunting and bird watching due to short-term displacement of birdlife from nearby marshes and wildlife refuge.	Raw Water Supply or Brine Disposal Wellfields; Marine Terminal Construction Should deep well brine injection or ground water withdrawal for leaching be selected, impacts could be reduced slightly. Similar effects would accompany development of a marine terminal, except land use would be little changed.
Socioeconomic Environment	Land Use	All Environments Approximately 505 acres of Coastal Prairie, marsh, fluvial woodlands and cleared land developed.	
	Transportation	Potential for minor traffic congestion on local roads near Nash dome. Temporary minor impediment to navigation in Gulf during diffuser construction.	
	Population and Housing	No significant impacts expected.	
	Economy	Total construction wages of $9.4 million, only part of which would remain in the Brazosport area.	
	Government	Tax revenues due to increased local purchases expected to exceed cost of new services. Loss of property tax revenues of $68,400 per year for life of the project.	

TABLE 4.7-1b Summary of environmental impacts caused bv ooeration of Nash dome SPR facilities.

DISCIPLINE	SUBJECT AREAS	EXPECTED IMPACT PROPOSED PHYSICAL FACILITY	ALTERNATIVE PHYSICAL FACILITY
Geology and Land Features	Nash dome and immediate vicinity	Leacned Caverns: Remote possibility of roof collapse causing surface subsidence and formation of a lake over the dome.	
Water Resources	Brazos River Diversion Channel	Raw Water Supply: 1,000,000 BPD withdrawn for oil displacement for 163 days; expected to have minimal effects on water quality.	
	Brazos Channel and ICW	Oil or Brine Spills: Very small possibility of oil or brine release.	
	Gulf of Mexico	Brine Disposal: 240,000 BPD brine disposal should have minimal water quality impacts.	
		Oil or Brine Spills: Oil spills may total 2,750 barrels, and brine spills 210 barrels during project lifetime; effects not expected to be significant unless oil or brine reaches shallow coastal bays.	
			Marine Terminal: Use of marine terminal could reduce total oil spill volume by more than 50 percent.
	Turkey, Cow, Varner, Bell and Jones Creeks and Lakes and Ponds on Bryan Mound	Oil or Brine Spills: Expected impacts from oil and brine spills negligible. Possible very large spill could seriously degrade water quality for several weeks or months.	
	Freeport and Bryan Harbors	Dredging: Maintenance dredging impacts insignificant.	
		Oil Spills: Oil spills may be relatively frequent though of small average size (1,470 barrels in 53 spills during project lifetime).	
	Ground Water	Oil or Brine Spills: Very slight chance of local ground water pollution due to surface oil or brine spill; collapse of cavern could seriously degrade ground water supplies for Nash dome area but such an occurrence is highly unlikely.	
			Raw Water Supply: Subsidence potential from ground water withdrawal greater than during leaching because of 1,000,000 BPD well withdrawal rate.
			Brine Disposal: Deep well injection should not have significant impacts.

TABLE 4.7-1b continued.

DISCIPLINE	SUBJECT AREAS	EXPECTED IMPACT PROPOSED PHYSICAL FACILITY	EXPECTED IMPACT ALTERNATIVE PHYSICAL FACILITY
Air Quality	Oil handling and storage locations	Total Emissions. Total emissions from 163 MMB oil storage facilities for 5 fill and withdrawal cycles equal 26,170 tons, 60 percent due to SPR site expansion. Distribution of emissions as follows: 47 percent in Gulf of Mexico, 25 miles from Freeport; 2 percent in transit between open Gulf and dock site; 47 percent from docks at Freeport; and 4 percent from Bryan Mound storage site.	
		Storage Tank Emissions. Annual emissions from floating roof tanks at Bryan Mound equal 23 tons. If withdrawal occurs during year, value is 36 tons.	
		Dock Transfer Emissions. Hydrocarbon standards exceeded up to 13 kilometers from DOE docks; interaction from other DOE sources not considered significant.	
			Marine Terminal. Significant reduction (69 percent) in total emissions with marine terminal; standards exceedance onshore virtually eliminated.
	Nash dome and vicinity	Power Generation Onsite. Onsite power generation adds a locally significant source of hydrocarbons at Nash dome (2600 tons over project lifetime).	Commercial Power. Purchase of commercial power would eliminate onsite emissions from power plant.
Noise Levels	Terminal and storage sites	Site Operations. No significant increase in ambient sound levels adjacent to the sites.	
Species and Ecosystems	Aquatic:		
	Brazos River Diversion Channel	Raw Water Supply. Destruction of less than 1 percent of phytoplankton and zooplankton population in Brazos River during each 163-day withdrawal period.	
	Brazos River Diversion Channel, ICW, Cow, Varner, Bell, and Jones Creeks	Oil or Brine Spill. Possibility of major spill of brine or oil from pipeline considered remote. Would cause locally significant impacts on aquatic life.	
	Gulf of Mexico	Brine Disposal. Effluent could affect plankton & benthos community over several hundred to perhaps one thousand acres during oilfill. Should be significant only immediately adjacent to diffuser.	Brine Disposal. The alternative would have impacts similar to the proposed system.
		Oil or Brine Spills. Expected brine and oil spill volumes should not significantly affect marine biota. Estimated total of 2750 barrels of oil and 288 barrels of salt water and brine during project lifetime.	
		Possible very large or maximum credible oil or brine spill could have significant impacts to several thousand acres of shallow water or marsh if spill reaches shore before cleanup.	

TABLE 4.7-1b continued.

DISCIPLINE	SUBJECT AREAS	EXPECTED IMPACT PROPOSED PHYSICAL FACILITY	EXPECTED IMPACT ALTERNATIVE PHYSICAL FACILITY
			Marine Terminal Reduced coastal exposure to oil spills if marine terminal developed.
	Bryan Mound Lakes and Ponds	Oil or Brine Spills Very little impact expected based on probability of spills. Potential for significant loss of biota, should a large quantity brine or oil spill occur.	
	Freeport or Brazos Harbors	Dredging Local, short-term maintenance dredging impacts. Oil Spills Local contamination of water with oil possible.	
	Terrestrial:		
	Coastal Prairie, Marsh and Fluvial Woodlands	Oil or Brine Spills Impacts primarily limited to possible oil or brine spills. Likelihood small, but possible impact locally significant, especially if during spring nesting season. Additional prairie exposure to brine spill if well supply or groundwater injection developed.	
Natural and Scenic Resources	Bryan Beach, Coastal Marshes, San Bernard River, and Wildlife Refuge	Oil Spills Adverse impacts limited primarily to possible large oil spill which could foul beaches and coat marsh and shallow water area with oil.	
Socioeconomic Environment	Economy	Facility Operations Total wages expected to be approximately $96,000 during each month of oil fill and withdrawal; $17,500 during standby storage.	

4.8 CONSIDERATIONS OFFSETTING ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED AND ALTERNATIVE ACTIVITIES

The United States possesses abundant natural resources and yet is dependent upon the importation of large quantities of fuels, especially petroleum. Imported crude oil now constitutes about 50 percent of the nation's oil supply and accounts for 20 percent of the total domestic energy usage. In 1974 the annual cost of these imports was over $25 billion.

In the past twenty-five years, the United States has experienced four sudden denials of oil imports by oil-exporting countries. Not until the oil embargo of 1973-74, however, did the nation find itself without the capacity and resources to offset the interruption of oil imports. This embargo reduced the quantities of petroleum imported by the United States by approximately 2 million barrels per day for 19 weeks and caused world prices for crude oil to skyrocket.

Although the full impacts of supply denial and simultaneous price increases on the United States economy are still under study and debate, most macroeconomic estimates of these events tend to indicate a Gross National Product (GNP) loss of approximately $35-45 billion. Although not all this GNP loss can be ascribed to the embargo, it contributed significantly to increases in both consumer and wholesale price indices. In addition, the GNP loss was reflected in higher unemployment and economic stagnation in several sectors, including automobile sales and housing starts, which exacerbated the economic downturn believed to have started in late 1973. During this period, the embargo prevented real growth that might have stabilized unemployment and provided a stronger base for eventual economic recovery.

The United States is now more vulnerable to a petroleum supply interruption than it was in the fall of 1973. In responding to that interruption, many relatively easy steps to conserve energy were taken, and significant improvements in energy efficiency have been achieved. Higher energy prices, natural gas shortfalls, and continued uncertainty about the availability and price of alternative forms of energy have induced many energy users to restrict their energy consumption and emphasize more effective energy management practices. Additional improvements, however, will require substantial capital investment, longer lead times, and even more intensive energy management. Moreover, the current program to convert oil- and gas-fired utilities and industrial plants to coal will be completed in the next few years; this success will largely preclude further conversion to coal during a future oil-supply interruption. Some estimates have shown that a future supply interruption of the magnitude of that in 1973-74 could cause a reduction in the GNP equivalent to the loss of 2 million jobs. Economic effects would not be limited to a few geographical areas or industries but would affect the entire nation.

Standby supplies of petroleum have been proposed repeatedly as a way to buffer the impact of future supply interruptions. The National Petroleum Council, the Ford Foundation and the Energy Laboratory at the Massachusetts Institute of Technology have all recommended this action. In addition, the International Energy Program (IEP) agreement, which the United States has entered into with 17 other energy-importing countries, provides for the establishment of this type of reserve. Although the western European nations and Japan have developed stockpiles, the only appreciable stocks in the United States are working inventories.

The concern voiced by these organizations and the public, in addition to the nation's formal commitments to the IEP, provided strong impetus for passage of the Energy Policy and Conservation Act of 1975 (P.L. 94-163), which provides for the creation of the Strategic Petroleum Reserve. An SPR storage facility, if developed at one of the candidate sites (Bryan Mound, Allen, West Columbia, Damon Mound or Nash salt domes), would provide 100 million barrels of petroleum reserves in addition to the 63 MMB already being developed at Bryan Mound.

4.9 SUMMARY COMPARISON OF RELATIVE ENVIRONMENTAL IMPACTS

Sections 4.2 through 4.7 contain a summary of expected and potential environmental impacts which might be caused by the proposed and alternative project systems at the five candidate oil storage sites. The "worst case" of 5 storage cycles is assumed. In this section, a summary is provided of the most significant impacts associated with the development of the proposed systems at each site.

The summary of site impacts is presented in Table 4.9-1. Eight categories of potential impacts (Geology/Land Features, Water Resources, etc.) are subdivided into specific types of impacts (e.g., "excavation/dredging" under Geology/Land Features).

4.9.1 Summary Comparison of Impacts on Geology/Land Features

Impacts on geology and land resources would result in part from construction of on-site facilities (roads, work pads for wellheads, dikes and levees, etc.) and in part from construction of pipelines for the raw water supply, brine disposal and crude oil distribution systems.

These impacts would be least disruptive (on both counts) at the Bryan Mound site. On-site construction impacts would be essentially the same for the four alternative sites, but pipelines to the Damon Mound and Nash dome sites would be considerably longer than required for the others.

4.9.2 Summary Comparison of Impacts on Water Resources

Withdrawal of raw water from the Brazos River Diversion Channel and the disposal of brine into the Gulf of Mexico could result in small impacts on water resources. The magnitude of these impacts would be essentially the same for any of the sites since the same intake and disposal facilities would be used.

The maximum raw-water requirement of the SPR program (1 MMB per day) occurs during the oil withdrawal phase. This amount is less than one percent of the normal flow of the Brazos River Diversion Channel at the raw water intake structure.

TABLE 4.9-1a Comparison of specific environmental impacts caused by development of proposed SPR facilities at proposed and alternative SPR sites.

Category of Impact Potential	Proposed Site 500 MMB SPR: Bryan Mound	Alternative Sites-- 1 billion bbl SPR: Allen	West Columbia	Damon Mound	Nash
Geology and Land Features					
Storage Site Preparation	Excavation of 30,300 cy at the storage site on 36 acres of industrial land.	Excavation of 27,720 cy at the storage site on 31 acres of pasture land, 410,200 cy of fill.	Excavation of 34,000 cy at the storage site on 30 acres of marsh and pasture land, 62,640 cy of fill.	Excavation of 31,680 cy at the storage site on 30 acres of pasture land.	Excavation of 30,100 cy at the storage site on 30 acres of agricultural land.
Pipeline Corridors	Excavation of 6,000 cy for pipeline to Brazos Harbor on 4 acres of marsh, and 4 acres of cleared land. Excavation of 177,300 cy for 7.5 mile pipeline to Gulf brine diffuser on 21 acres of primarily prairie grassland and 142 acres of Gulf bottom.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
		Excavation of 191,300 cy for injection wells and oil, brine and raw water pipeline routes on 125 acres of primarily prairie grassland.	Excavation of 431,270 cy for injection wells and oil, brine and raw water pipeline routes on 282 acres of fluvial woodland and prairie grassland.	Excavation of 581,700 cy for injection wells and oil, brine and raw water pipeline routes on 400 acres of primarily prairie grassland and woodland.	Excavation of 585,180 cy for injection wells and oil, brine and raw water pipeline routes on 432 acres of primarily prairie grassland.
Tanker Docks	Dredging of 1,050,000 cy and grading of 14 acres for the tanker docks.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Water Resources					
Site Preparation and Construction	Small quantities of sediment and construction pollutants carried into Brazos River or site lakes and ponds by rainfall runoff.	Sediment and miscellaneous construction pollutants could degrade water quality in San Bernard River, Jones Creek, or lakes and ponds on Bryan Mound.	Sediment and miscellaneous construction pollutants could degrade water quality in Varner, Bell, or Jones Creeks, Brazos River and lakes and ponds on Bryan Mound.	Sediment and miscellaneous construction pollutants could degrade water quality in Mound, Varner, Bell and Jones Creeks, lakes and ponds on Bryan Mound or the Brazos River.	Sediment and miscellaneous construction pollutants could degrade water quality in Turkey, Cow and Jones Creeks, Brazos River, and lakes and ponds on Bryan Mound.
Brine Spills	Very small possibility of brine release reaching Brazos River Diversion Channel or ICW.	Very small possibility of brine release reaching Brazos River Diversion Channel or ICW.	Very small possibility of brine release reaching Brazos River Diversion Channel or ICW.	Very small possibility of brine release reaching Brazos River Diversion Channel or ICW.	Very small possibility of brine release reaching Brazos River Diversion Channel or ICW.
	Expected brine spills in Gulf of Mexico would have no significant impact; possible maximum credible spill could have significant local impact.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
	Expected brine spills into site lakes and ponds insignificant; possible maximum credible spill could have significant impact.	Expected brine spills into San Bernard River, Jones Creek and lakes and ponds on Bryan Mound insignificant; possible maximum credible spill could have significant impact.	Expected brine spills into Varner Creek, Bell Creek, Jones Creek and lakes and ponds on Bryan Mound insignificant; possible maximum credible spill could have significant impact.	Expected brine spills into Mound Creek, Varner Creek, Bell Creek, Jones Creek, and lakes and ponds on Bryan Mound insignificant; possible maximum credible spill could have significant impact.	Expected brine spills into Turkey, Cow and Jones Creeks, and lakes and ponds on Bryan Mound insignificant; possible maximum credible spill could have significant impact.
Raw Water Supply	534,000 BPD withdrawn for leaching over a five-year period expected to have minimal effects on water quality in Brazos River and ICW.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)

TABLE 4.9-1a continued.

Category of Impact Potential	Proposed Site 500 MMB SPR	Alternative Sites -- 1 billion bbl SPR			
	Bryan Mound	Allen	West Columbia	Damon Mound	Nash
<u>Water Resources</u> (cont'd)					
Brine Disposal	684,000 BPD brine disposal could increase bottom salinity by 1 ppt over 3 square miles; Approximately 25 acres-increase of 5 ppt or more.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Dock Construction	Dredging and dock construction impacts considered comparable to annual maintenance dredging in Freeport and Brazos Harbors.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
<u>Air Quality</u>					
Bryan Mound and Storage Sites	Minor quantities of particulates, SO_2, CO, HC and NO_2 released from construction equipment at Bryan Mound.	Minor quantities of particulates, SO_2, CO, HC and NO_2 released from construction equipment at Allen dome. and Bryan Mound.	Minor quantities of particulates, SO_2, CO, HC and NO_2 released from construction equipment at West Columbia dome and at Bryan Mound.	Minor quantities of particulates, SO_2, CO, HC and NO_2 released from construction equipment at Damon Mound and at Bryan Mound. Additional emissions from construction of fuel tanks in use in onsite electrical generation would have no significant impacts.	Minor quantities of particulates, SO_2, CO, HC and NO_2 released from construction equipment at Nash dome and at Bryan Mound. Additional emissions from construction of fuel tanks in use in onsite electrical generation would have no significant impacts.
<u>Noise Level</u>					
Storage Site Construction	Maximum zone of noise impact (defined as 3 dB increase over ambient), 4,500 feet; no residences or noise sensitive areas affected.	Maximum zone of noise impact (defined as 3 dB increase over ambient), 4,500 feet for Allen dome; 16 residences affected south of Allen dome for a period of 15 months.	Maximum zone of noise impact (defined as 3 dB increase over ambient), 4,500 feet for West Columbia dome and 2,000 feet for Bryan Mound; 16 residences affected south of Allen dome for a period of 15 months.	Maximum zone of noise impact (defined as 3 dB increase over ambient), 4,500 feet for Damon Mound and 2,000 feet for Bryan Mound; 57 residences affected south of Damon Mound for a period of 15 months.	Maximum zone of noise impact (defined as 3 dB increase over ambient), 7,100 feet for Nash dome and 2,000 feet for Bryan Mound; no residences affected.
Dock Construction	Maximum zone of noise impact, 2,200 feet; no residences or noise sensitive areas affected.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Pipeline Construction	Zone of noise impact equal to 1,800 feet; very few residences affected, all for periods of less than a week.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
<u>Species and Ecosystems</u>					
<u>Aquatic</u>					
Site Preparation	Minimal local impacts on Site lakes and ponds due to erosion and runoff from site construction.	Minimal local impacts on San Bernard River and lakes and ponds on Bryan Mound due to erosion and runoff from site construction.	Minimal local impacts on Varner, Bell and Jones Creeks, lakes and ponds on Bryan Mound due to erosion and runoff from site construction.	Minimal local impacts on Mound, Varner, Bell, and Jones Creeks, and lakes and ponds on Bryan Mound due to erosion and runoff from site construction.	Minimal local impacts on Turkey, Cow, Varner, Bell, Jones Creeks, and lakes and ponds on Bryan Mound due to erosion and runoff from site construction.

TABLE 4.9-1a continued.

	Proposed Site 500 MMB SPR	Alternative Sites -- 1 billion bbl SPR			
Category of Impact Potential	Bryan Mound	Allen	West Columbia	Damon Mound	Nash
Species and Ecosystems					
Aquatic (cont'd)					
Brine Spills at Site	Major brine spill into site lakes and ponds and ICW remotely possible; significant loss of biota would follow.	Major brine spill into San Bernard River and lakes and ponds on Bryan Mound or Brazos River Diversion Channel and ICW remotely possible; significant loss of biota would follow.	Major brine spill into Varner, Bell and Jones Creeks or lakes and ponds on Bryan Mound or Brazos River Diversion Channel and ICW remotely possible; significant loss of biota would follow.	Major brine spill into Mound, Varner, Bell and Jones Creeks, or lakes and ponds on Bryan Mound or Brazos River Diversion Channel and ICW remotely possible; significant loss of biota would follow.	Major brine spill into Turkey, Cow, Varner, Bell or Jones Creeks and lakes and ponds on Bryan Mound or Brazos River Diversion Channel and ICW remotely possible; significant loss of biota would follow.
Brine Spills in Gulf	Possible maximum credible brine spill into Gulf of Mexico could destroy several acres of benthos and some biota in water column.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Raw Water Supply	Destruction of phytoplankton and zooplankton in Brazos River Diversion Channel and ICW during the two-year leaching period. Impact on regional biotic resources considered insignificant.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Brine Disposal	Brine effluent could affect plankton and benthos community over several hundred to several thousand acres in Gulf of Mexico. Significant adjacent to brine diffuser.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Dock Construction	Very local, short-term dredging impacts in Freeport and Brazos Harbors.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Terrestrial					
Coastal Prairie					
Facility Construction	Loss of 20 acres due to facility construction. Revegetation of 6 acres likely. Minimal impact importance.	Loss of 158 acres due to facility construction. Revegetation of 33 acres likely. Minimal impact importance.	Loss of 153 acres due to facility construction. Revegetation of 38 acres likely. Minimal impact.	Loss of 263 acres due to facility construction. Revegetation of 58 acres likely. Minimal impact.	Loss of 242 acres due to facility construction. Revegetation of 60 acres likely. Minimal impact.
Brine Spills	Large brine spill could destroy several acres.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Brackish Marsh and Wetlands					
Facility Construction	Loss of 4 acres due to facility construction. Revegetation of 1 acres likely. Minimal impact importance.	Loss of 16 acres due to facility construction. Revegetation of 4 acres likely. Minimal impact importance.	Loss of 30 acres due to facility construction. Moderate local impact importance.	Loss of 4 acres due to facility construction. Revegetation of 1 acre likely. Minimal impact importance.	Loss of 4 acres due to facility construction. Revegetation of 1 acre likely. Minimal impact importance.
Brine Spills	Large brine spill could destroy several acres.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)

TABLE 4.9-1a continued.

Category of Impact Potential	Proposed Site 500 MMB SPR: Bryan Mound	Alternative Sites -- 1 billion bbl SPR: Allen	West Columbia	Damon Mound	Nash
Species and Ecosystems					
Terrestrial (cont'd)					
Fluvial Woodlands					
Facility Construction	-----	Loss of 2 acres due to facility construction. Minimal impact importance.	Loss of 149 acres. Significant local importance. Revegetation of 37 acres likely.	Loss of 182 acres due to facility construction. Revegetation of 46 acres likely. Significant local importance.	Loss of 210 acres. Revegetation of 52 acres likely. Significant local importance.
Brine Spills	Large brine spill could destroy several acres.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Natural and Scenic Resources					
Facility Construction	Minor impact on Bryan Beach use due to nearby construction. Minor impact on hunting and bird watching due to displacement of birdlife from nearby marshes.	Significant impact on aesthetics due to nearby construction. Minor impact on hunting and bird watching due to short-term displacement of birdlife from nearby marshes and wildlife refuge.	Minor impact on aesthetics due to nearby construction. Minor impact on hunting and bird watching due to short-term displacement of birdlife from nearby marshes at Bryan Mound.	Significant impact on aesthetics due to nearby construction. Minor impact on hunting and bird watching due to short-term displacement of birdlife from nearby marshes at Bryan Mound.	Significant impact on aesthetics due to nearby construction. Minor impact on hunting and bird watching due to short-term displacement of birdlife from nearby marshes and wildlife refuge.
Socioeconomic Conditions					
Land Use	25 acres of Coastal Prairie, flat, and marsh developed adjacent to 54 acres of cleared land.	Approximately 198 acres of Coastal Prairie, marsh, flat, fluvial woodland, and cleared land developed.	Approximately 355 acres of fluvial woodland, Coastal Prairie, cleared land, flat, and marsh developed.	Approximately 473 acres of Coastal Prairie, marsh, fluvial woodlands, cleared land and flat developed.	Approximately 505 acres of Coastal Prairie, marsh, fluvial woodlands, flat, and cleared land developed.
Transportation	Potential for traffic congestion in Freeport area, especially if SEADOCK is constructed.	Potential for traffic congestion on local roads near Allen Dome.	Potential for traffic congestion on highways 35 and 36, particularly near West Columbia.	Potential for traffic congestion on local roads near Damon Mound.	Potential for minor traffic congestion on local roads near Nash dome.
Population and Housing	No significant impacts expected unless SEADOCK is constructed simultaneously.	No significant impacts expected.	No significant impacts expected.	No significant impacts expected.	No significant impacts expected.
Economy	Total construction wages of $7.35 million, only part of which would remain in the Freeport area.	Total construction wages of $8.3 million, only part of which would remain in the Brazosport area.	Total construction wages of $9.3 million, only part of which would remain in the Brazosport area.	Total construction wages of $9.3 million, only part of which would remain in the Brazosport area.	Total construction wages of $9.4 million, only part of which would remain in the Brazosport area.
Government	Tax revenues due to increased local purchases expected to exceed cost of new services. Loss of tax revenue $69,000 per year for project lifetime.	Tax revenues due to increased local purchases expected to exceed cost of new services. Loss of tax revenue $53,000 per year for project lifetime.	Tax revenues due to increased local purchases expected to exceed cost of new services. Loss of tax revenue $66,800 per year for project lifetime.	Tax revenues due to increased local purchases expected to exceed cost of new services. Loss of tax revenue $66,500 per year for project lifetime.	Tax revenues due to increased local purchases expected to exceed cost of new services. Loss of tax revenue $68,400 per year for project lifetime.

TABLE 4.9-1b Comparison of specific environmental impacts caused by operation of proposed SPR facilities at proposed and alternative SPR sites.

	Proposed Site 500 MMB SPR	Alternative Sites -- 1 billion bbl SPR			
Category of Impact Potential	Bryan Mound	Allen	West Columbia	Damon Mound	Nash
Geology and Land Features					
Storage Site and Immediate Vicinity	Remote possibility of roof collapse causing surface subsidence and formation of a large lake.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Water Resources					
Oil and Brine Spills	Very small possibility of oil or brine release into Brazos Channel or ICW.	Very small possibility of oil or brine release into Brazos Channel, ICW, and San Bernard River.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Oil and Brine Spills in Gulf	Oil spills in Gulf of Mexico may total 2,500 barrels, brine spills 200 barrels during project lifetime; effects not expected to be significant unless oil or brine reaches shallow coastal bays.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Oil and Brine Spills along Pipelines	Impacts from expected oil and brine spills into site lakes and ponds negligible. Possible very large spill could seriously degrade water quality for several weeks or months.	Expected impacts from oil and brine spills into Jones Creek, and Lakes and Ponds on Bryan Mound negligible. Possible very large spill could seriously degrade water quality for several weeks or months.	Expected impacts from oil and brine spills into Varner, Bell and Jones Creeks, and Lakes and Ponds on Bryan Mound negligible. Possible very large spill could seriously degrade water quality for several weeks or months.	Expected impacts from oil and brine spills into Mound, Varner, Bell and Jones Creeks, and Lakes and Ponds on Bryan Mound negligible. Possible very large spill could seriously degrade water quality for several weeks or months.	Expected impacts from oil and brine spills into Turkey, Cow, Varner, Bell and Jones Creeks, and Lakes and Ponds on Bryan Mound negligible. Possible very large spill could seriously degrade water quality for several weeks or months.
Oil and Brine Spills in Freeport and Brazos Harbors	Oil spills in Freeport and Brazos Harbors may be relatively frequent though of small average size (1470 barrels in 53 spills during project lifetime).	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
	Very slight chance of local ground water pollution due to surface oil or brine spill; collapse of cavern could seriously degrade ground water supplies for Brazosport area but such an occurrence is highly unlikely.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Raw Water Supply	1,000,000 BPD withdrawn from Brazos Channel and ICW for oil displacement for 163 days; expected to have minimal effects on water quality.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)

TABLE 4.9-1b continued.

Category of Impact Potential	Proposed Site 500 MMB SPR Bryan Mound	Alternative Sites -- 1 billion bbl SPR Allen	West Columbia	Damon Mound	Nash
Brine Disposal	240,000 BPD brine disposal into Gulf of Mexico should have minimal water quality impacts during refill.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Dredging	Maintenance dredging impacts on Freeport and Brazos Harbors insignificant.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Air Quality					
Oil Handling and Storage	Total emissions from 163 MMB oil storage facility for 5 fill and withdrawal cycles equal 27,820 tons, 56 percent due to SPR site expansion. Distribution of emissions as follows: 44 percent in Gulf of Mexico, 25 miles from Freeport; 2 percent in transit between open Gulf and dock site; 44 percent from docks at Freeport; 10 percent from Bryan Mound storage site.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Storage in Surge Tanks	Annual emissions from floating roof tanks at Bryan Mound equal 93 tons; 165 tons with withdrawal.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Dock Transfers	Hydrocarbon standards exceeded up to 13 kilometers from DOE docks; interaction from other DOE sources not considered significant.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Power Generation (Onsite)	-----	-----	-----	Onsite power generation adds a locally significant source of hydrocarbons at Damon Mound (2,600 tons over project lifetime).	(Same as Damon Mound)
Noise Levels					
Facility Operation	No significant increase in ambient sound levels on or adjacent to the sites.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)

TABLE 4.9-1b continued.

Category of Impact Potential	Proposed Site 500 MMB SPR: Bryan Mound	Alternative Sites -- 1 billion bbl SPR: Allen	West Columbia	Damon Mound	Nash
Species and Ecosystems					
Aquatic:					
Oil and Brine Spills	Possibility of major spill of brine into ICW or of oil into Brazos from pipeline considered remote. Would cause locally significant impacts on aquatic life.	Possibility of major spill of brine or oil into ICW, Brazos, San Bernard River or Jones Creek from pipeline considered remote. Would cause locally significant impacts on aquatic life.	Possibility of major spill of brine or oil into Brazos River Diversion Channel, ICW, Varner, Bell and Jones Creeks from pipeline considered remote. Would cause locally significant impacts on aquatic life.	Possibility of major spill of brine or oil into Brazos River Diversion Channel, ICW, Mound, Varner, Bell and Jones Creeks from pipeline considered remote. Would cause locally significant impacts on aquatic life.	Possibility of major spill of brine or oil into Brazos River Diversion Channel, ICW, Cow, Varner, Bell and Jones Creeks from pipeline considered remote. Would cause locally significant impacts on aquatic life.
	Expected brine and oil spill volumes in Gulf of Mexico should not significantly affect marine biota. Estimated total of 2750 barrels of oil and 288 barrels of salt water and brine during project lifetime.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
	Possible very large or maximum credible oil or brine spill could have significant impacts to several thousand acres of shallow water or marsh.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
	Very little impact on site lakes and ponds expected based on probability of spills. Potential for significant loss of biota, should a large spill of brine or oil occur.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
	Local contamination of water with oil possible in Freeport and Brazos Harbors.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Raw Water Supply	Destruction of less than 1 percent of phytoplankton and zooplankton population in Brazos River during each 163 day withdrawal period.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Brine Disposal	Brine effluent could affect benthos community over several hundred to perhaps one thousand acres in Gulf of Mexico during oil fill. Should be significant only immediately adjacent to diffuser	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
Dredging	Local, short-term maintenance dredging impacts in Freeport and Brazos Harbors.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)

TABLE 4.9-1b continued.

	Proposed Site 500 MMB SPR	Alternative Sites -- 1 billion bbl SPR			
Category of Impact Potential	Bryan Mound	Allen	West Columbia	Damon Mound	Nash
<u>Species and Ecosystems</u> (Cont'd.)					
Terrestrial:					
Coastal Prairie, Marsh, and/or Fluvial Woodlands					
Oil and Brine Spills	Impacts primarily limited to possible oil or brine spills. Likelihood small but possible impact locally significant, especially if during spring season.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
<u>Natural and Scenic Resources</u>	Adverse impacts limited primarily to possible large oil spill which could foul beaches and coat marsh and shallow water area with oil.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)
<u>Socioeconomic Environment</u>	Total wages at storage site expected to be approximately $92,000 during each month of oil fill and withdrawal; $17,500 during standby storage.	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)	(Same as Bryan Mound)

The maximum brine disposal rate (684 MB per day) occurs during the cavern leaching phase. This rate could have significant benthic effects in the vicinity of the diffuser during periods of current stagnation; during periods of normal current flow in the Gulf, plumes of increased salinity could alter local migration patterns of estuarine species.

Potential erosional impacts on water resources are expected to be temporary and are generally proportional to pipeline routing. Development of any of the alternative sites would result in some impact. Pipelines to West Columbia dome, Damon Mound and Nash dome all cross a number of small creeks or streams. Pipelines to Allen dome would cross the San Bernard River near the San Bernard National Wildlife Refuge. Development of Bryan Mound would have minimal erosional impacts on water quality.

Oil and brine spills are a function of the throughput, lengths of pipeline and type of handling facility. Since each of the Seaway Group sites would have similar capacities and facilities, the controlling factor would be pipeline length, making Damon Mound and Nash dome the two sites with the greatest potential spill risks.

4.9.3 Summary Comparison of Impacts on Air Quality

One of the most significant potential impacts of the SPR program would be the effects on air quality. The pollutant of particular concern would be hydrocarbon emissions, most of which would be released during crude-oil transfer operations. Chief emission sources would be the two DOE docks at Freeport Harbor and the four early storage phase surge tanks at Bryan Mound; miscellaneous valve losses would account for minimal emissions. The magnitude of potential hydrocarbon emissions from these principal sources would be essentially the same for any of the Seaway Group sites. The Damon Mound and Nash dome sites, however, because of their proposed on-site power generation capabilities, would have the greatest potential impact on regional air quality.

4.9.4 Summary Comparison of Impacts of Noise

Noise impacts resulting from construction activities would be of relatively short duration and should not have regional significance. Three of the alternative sites, however--Allen dome, West Columbia dome and Damon Mound--are located near rural communities which might be impacted slightly. Of these, Damon Mound would have the greatest potential impact since it lies closest to a noise-sensitive area (the town of Damon).

4.9.5 Summary Comparison of Impacts on Ecosystems and Species

Impacts of development on ecosystems and species would result from disruption of habitat, direct and indirect physical impairment of species, and reduction in habitat quality. Of the five Seaway Group candidate sites, Allen dome is the only one that could potentially affect valuable habitat since it is located adjacent to both the San Bernard National Wildlife Refuge and the San Bernard River. Development of Bryan Mound would have the least impact on ecosystems and species since the site has already been developed for oil storage as part of the early storage phase of the SPR development.

4.9.6 Summary of Comparison of Impacts on Natural and Scenic Resources

The principal impacts of development in these areas would result from site development and pipeline right-of-way clearance and maintenance. Development of Allen dome would have the greatest potential impact on natural resources since it lies adjacent to the San Bernard National Wildlife Refuge and the San Bernard River. It would also have the greatest impact on scenic resources, as the site is in direct view of Bernard Acres, a small residential development directly to the south. Development of Bryan Mound, Damon Mound, or West Columbia dome would have the least impact on natural and scenic resources; these sites are located in areas with extensive existing petroleum-related activity.

4.9.7 Summary Comparison of Impacts on Socioeconomic Environment

Most socioeconomic impacts are beneficial in that employment/income would result from site development. The magnitude of the beneficial impact is a function of the construction that would be required to develop the site. From this standpoint, Nash dome or Damon Mound would have the greatest benefit because of the greater construction required for the longer pipeline right-of-way. Bryan Mound, on the other hand, would place the least stress on community services; it is the closest site to Freeport, Brazoria County's industrial center and the community with the largest and best-trained police and fire departments.

4.10 MULTIPLE SITE DEVELOPMENT ALTERNATIVE

4.10.1 Introduction

The Strategic Petroleum Reserve program oil storage capacity may be expanded as discussed in Section 2.8, thus requiring the allocation of 263 MMB of storage capacity to the Seaway Group of sites. This capacity may be achieved by using a combination of sites. While any combination of candidate SPR sites would fulfill this goal, the surface and onsite facilities associated with the sites and the oil distribution, raw water, and brine disposal pipelines described for each of the sites would remain the same under this multiple site development alternative. The principal differences between this alternative and those previously discussed are: the additional site(s) required to provide the increased capacity, two additional 200,000 BBL surge tanks required at Bryan Mound tank farm, and extended crude oil fill and withdrawal schedules.

The schedule for crude oil withdrawal would be extended for a 263 MMB Seaway Group capacity to approximately nine months. The rate of withdrawal would therefore be the same as for a 163 MMB capacity (1 MMB per day). Since there would be no change in the rate at which crude oil would be removed from storage, no expansion of dock or pipeline systems would be required. Similarly, the fill schedule would be extended to allow use of the same facilities as are proposed for the 163 MMB capacity. Other systems and facilities such as the raw water system, brine disposal system, crude oil pipelines, and on-site facilities might be used for a longer period of time but would not require expansion.

Should the increased storage capacity be required in the Seaway Group, most impacts would be additive. An example of an additive impact would be the impacts of raw water withdrawal on the aquatic ecology of the Brazos River Diversion Channel. If more than one Seaway SPR site were developed, the maximum withdrawal of 1 MMB per day would occur for 263 rather than 163 days. The impacts of developing the second site could be added to those at the first. Most impacts are site related and geographically separated so that the impacts can be considered additive.

Certain impacts resulting from multiple site development in the Seaway Group would achieve economies of scale. This is because multiple site development may cause less impact than the apparent impact of adding those impacts attributed to each site. An example of this type of impact would be construction of pipelines if Nash dome and Damon Mound are developed. One set of pipelines would be constructed to the end of their common right-of-way, where they would split off to the two sites. Another impact which would moderate the individual impacts of developing two sites independently would be on the loss of employment opportunities after completion of the construction phase. The availability of jobs would continue as the construction would be scheduled within the constraints of the raw water and brine disposal system capacities.

4.10.2 Construction Impacts

The principal impacts of constructing the increased capacity alternative would be raw water withdrawal, brine disposal, construction of additional surge tankage, and socioeconomic effects of developing several sites. The degree of impact within these areas is, for the most part, dependent upon which of the sites are included in the new combination. Economy of scale impacts may result from socioeconomic effects.

The effects of raw water withdrawal or brine disposal would not constitute a significant impact because the project would not increase the rates of withdrawal or disposal. Only the duration of the impacts would increase.

Construction of two additional 200,000 barrel surge tanks at Bryan Mound is anticipated if the Seaway Group capacity is increased to 263 MMB. These additional tanks would be used to permit segregation of different crude oil types. Paint solvent emissions from these tanks would impact air quality at Bryan Mound for a short time.

The synergistic socioeconomic impacts of the increased capacity alternative development could include both beneficial and adverse effects. A beneficial effect of developing multiple sites would be seen in the construction related employment and payrolls, as construction crews would be needed at each of the sites and at the terminals. This increase would be between \$15 and \$20 million, which would be distributed over the construction period. Adverse effects could be realized if the sites included in the combination were close to one another. These impacts would occur to the towns near the sites and would include increased traffic and demands on services.

The most significant synergistic effect of increasing the storage capacity to 263 MMB is that proportional impacts of terminal construction would not occur since no additional new docks would be required.

4.10.3 Operation and Maintenance

The potential synergistic impacts of operating and maintaining the increased capacity alternative are principally the increased hydrocarbon emissions resulting from increased throughput, socioeconomic impacts and, for specific sites, the raw water system.

Additional hydrocarbon emissions would result from the increased crude oil throughput. Storage tank losses would also increase since the number of tanks would be increased. Estimated hydrocarbon losses over an assumed 22-year period of operation for five fill/withdrawal cycles, including continuous storage tank emissions during standby storage, are presented in Table 4.10-1 based on average crude oil properties (Reid vapor pressure of 4 psia and molecular weight of 70 for fugitive losses).

The hydrocarbon emissions for 263 MMB of storage would be slightly more than 42,000 tons during the life of the project (200 MMB expansion emissions plus early storage emissions in Table 4.10-1). Comparing only the expansion totals, the increase in HC emissions from the proposed 100 MMB expansion to a 200 MMB expansion would be slightly more than 100 percent, due to the two additional surge tanks which would contribute 308 additional tons of hydrocarbon emissions over the life of the project. The expansion of the Seaway Group capacity from 63 MMB (early storage capacity) to 163 MMB would require no additional surge tanks. Tanker transfer, tanker transit, and brine pond emissions would all double for 200 MMB expansion compared to 100 MMB expansion.

When examined on the basis of average daily emission rates during operations, hydrocarbon emissions would be approximately the same since

TABLE 4.10-1 Estimated hydrocarbon emissions[a] (tons) during life of the project for expansion to 263 MMB.

Location	Fills (5)	Withdrawals (5)	Storage Tanks[b]	Brine Pond	200 MMB Expansion Total	Early Storage Total[c]
25 miles offshore (Transfer to 45 MDWT tankers)	15,120	0	0	0	15,120	(4,763)
Gulf of Mexico (Tanker transit)	490	280	0	0	770	(242)
SEAWAY and Brazos Harbor (Load and Offload 45 MDWT tankers)	8,820	6,134	0	0	14,954	(4,760)
Storage Site	0	0	308	502	810	732[c]
Total	24,430	6,414	308	502	31,654	10,497

Note: The emissions presented in this table are for 200 MMB expansion at the Seaway group of sites; the early storage emissions at Bryan Mound (63 MMB) are given in brackets.

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[a]Average conditions assuming Reid vapor pressure of 4 psia.

[b]Two additional 200,000 BBL storage tanks required at Bryan Mound required for expansion to 263 MMB.

[c]Includes 574 tons due to standing storage tank emissions (four original tanks) and 158 tons due to brine pond emissions.

the withdrawal and fill rates would be about the same, but extended over a longer period of time. However, annual hydrocarbon emissions when 263 MMB is completely withdrawn during a calendar year would be about 1680 tons/year, an increase of 62 percent from the 163 MMB case. Annualized fill losses would only increase two percent to about 690 tons/year.

A major consideration in assessing the air quality impacts of any size Seaway Group system is that the majority of emissions would be temporary and intermittant, occurring during the period of initial fill, and then potentially during any subsequent periods of fill and withdrawal. The only potential emission source attributable to the SPR Program would be the storage tanks constructed for use only in conjunction with the program. This assumes that some oil will remain in the tanks at all times.

The expectation of oil and brine spills would increase in approximate proportion to the size of the program expansion; spills are generally additive for additional sites. Tables 4.10-2 and 4.10-3 detail the crude oil spill expectation for an expansion to 263 MMB by adding either Nash Dome or Damon Mound to the 163 MMB capacity for the proposed development at Bryan Mound. Oil spill expectation over the project lifetime for 263 MMB of storage capacity would total approximately 8900 barrels, of which 3950 barrels would be attributable to expansion. Increased exposure at terminals and in pipelines contribute most of the increase compared to the Bryan Mound expansion spill expectation of 3000 barrels over the project lifetime.

Brine and raw water spill expectation is summarized in Table 4.10-4. A 163 MMB storage capacity at Bryan Mound would have expected brine and water spills totalling 309 and 120 barrels, respectively, during the project lifetime. Expansion to a 263 MMB capacity would increase expected spills to 2711 and 3030 barrels, respectively, due to the longer pipeline connections to an expansion site.

The socioeconomic impacts of additional operational employment and payrolls would be less than a proportional addition on the basis of storage capacity. The effect on regional income would be small.

TABLE 4.10-2 Oil spill expectation - multiple site development alternative - cavern fill operations.

Oil Handling Mode/Location	Average Spill Size (bbl)	Bryan Mound Early Storage [a]		Bryan Mound SPR Expansion [a]		Additional 100 MMB Site [b]		Total Program Spill Risk		Maximum Credible Spill Size (bbl)
		No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	
Gulf										
-Transfers	12.9	14.6	189	23.2	300	23.2	300	61.0	789	1,000
-Vessel Casualty	1111	0.018	20	0.029	32.2	0.029	32.2	0.076	84.4	60,000
Freeport Harbor										
-Transfers	21.7	2.9	63	4.6	100	4.6	100	12.1	263	500
Terminals										
-Bryan Mound	500	0.0315	15.8	0.05	25	0.05	25	0.1315	65.8	5,000
-SEAWAY	1100	---	---	---	---	0.05	55	0.05	55	5,000
-Additional Storage Site	500	---	---	---	---	0.05	25	0.05	25	5,000
Pipelines										
-Pumping	1100	0.0005	0.6	(c)	(c)	0.0252	27.7	0.0257	28.3	10,000
Total - Single Fill	---	17.6	288.4	27.9	457.2	28.0	564.9	73.4	1310.5	
Total - 5 Fills	---	87.8	1442.0	139.5	2286.0	140.0	2824.5	367.2	6552.5	

a) Seaway Group 163 MMB storage capacity assumed at Bryan Mound.

b) Seaway Group 263 MMB storage capacity - for analysis purposes, additional site assumed to be either Nash Dome or Damon Mound.

c) Pipeline spills are attributed to early storage at Bryan Mound.

TABLE 4.10-3 Oil spill expectation - multiple site development alternative - cavern withdrawal operations and project totals.

Oil Handling Mode/Location[a]	Average Spill Size (bbl)	Bryan Mound[b] Early Storage		Bryan Mound[b] SPR Expansion		Additional 100 MMB Site[c]		Total Program Spill Size		Maximum Credible Spill Size (bbl)
		No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	No. Spills	Barrels	
Gulf										
-Transfers	---	---	---	---	---	---	---	---	---	---
-Vessel Casualty	1111	0.0028	3.1	0.0045	5	0.0045	5	0.0118	13.1	60,000
Freeport Harbor										
-Transfers	42	1.2	50.4	1.9	80	1.9	80	5.0	210.4	500
Terminals										
-Bryan Mound	500	0.0315	15.8	0.05	25	0.02	10	0.1015	50.8	5,000
-SEAWAY[d]	1100	0.0189	20.8	0.03	33	0.05	55	0.0989	108.8	5,000
-Additional Storage Site	---	---	---	---	---	0.05	25	0.05	25	5,000
Pipelines										
-Pumping	1100	0.0008	0.9	(e)	(e)	0.0044	4.8	0.0052	5.7	10,000
Total - Single Withdrawal	---	1.2	91.0	1.7	143.0	2.03	179.8	5.3	413.8	
Total - 5 Withdrawals	---	6.3	455.0	8.4	715	10.1	899.0	26.3	2069.0	
Project Total - 5 cycles	---	94.1	1897.0	147.9	3001.0	150.1	3723.5	393.5	8621.5	
Project Total with Oil Stored in Pipeline	---	94.1	1930	147.9	3001.0	150.3	3948.5	374.2	8879.5	

a) During withdrawal it is assumed that about 40 percent of the oil is shipped by tanker to the Gulf and about 60 percent is delivered to the SEAWAY Pipeline.

b) Seaway Group 163 MMB storage capacity assumed at Bryan Mound.

c) Seaway Group 263 MMB storage capacity - for analysis purposes, additional site assumed to be either Nash Dome or Damon Mound.

d) For worst case exposure calculations, it is assumed that all oil pumped from Nash Dome or Damon Mound site is subject to SEAWAY Terminal spill risks.

e) Pipeline spills are attributed to early storage at Bryan Mound.

TABLE 4.10-4 Brine and raw water spill expectation[a] during project lifetime - multiple site development alternative.

Storage Facility		Leaching				Cavern Fill				Standby Storage				Oil Withdrawal				Project Lifetime			
		Brine		Raw Water		Brine		Raw Water		Brine		Raw Water		Brine		Raw Water		Brine		Raw Water	
		Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore	Gulf	Onshore
Bryan Mound	No. Spills	--	--	--	--	0.0125	0.0025	--	--	0.0035	0.0016	0.0078	0.0035	--	--	--	0.0005	0.0160	0.0041	0.0155	0.0076
Early Storage	Barrels	--	--	--	--	62.5	12.5	--	--	18	8	39	17	--	--	--	2.5	80.5	20.5	78	37.5
Bryan Mound	No. Spills	0.01	0.002	--	0.001	0.0195	0.0040	--	--	0.0043	0.0019	b	b	--	--	--	b	0.0338	0.0079	b	0.001
SPR Expansion	Barrels	50	10	--	5	97.5	20.1	--	--	21	9	b	b	--	--	--	b	168.5	39.1	b	5
Additional	No. Spills	0.01	0.072	--	0.071	0.0195	0.142	--	--	b	0.237	b	0.237	--	--	--	0.036	0.0295	0.451	b	0.582
100 MMB Site[c]	Barrels	50	360	--	355	97.5	710	--	--	b	1185	b	1185	--	--	--	180	147.5	2255	b	2910
Total Program	No. Spills	0.02	0.074	--	0.072	0.0515	0.1485	--	--	0.0073	0.2405	0.0078	0.2405	--	--	--	0.0365	0.0793	0.4630	0.0155	0.5906
Spill Risk	Barrels	100	370	--	360	258	743	--	--	39	1202	39	1202	--	--	--	182	396	2315	78	2952

[a]Average spill from brine pipelines taken to be 5000 barrels; maximum credible spill taken to be 30,000 barrels; computed for five cavern fill/withdrawal operations.

[b]Losses from these SPR operations would occur in any case as a result of Bryan Mound early storage and are attributed to these facilities.

[c]Seaway Group 263 MMB storage capacity - for analysis purposes, additional site assumed to be either Nash Dome or Damon Mound.

4.10.4 Conclusions

As indicated in the preceding sections, there would be some synergistic impacts of expanding the storage capacity of the Seaway Group from 163 MMB to 263 MMB. Some of these impacts are less than direct addition of site related impacts while others are more. Most of these synergistic impacts are nearly equal to the sum of the impact for each of the alternative groups described in Section 4.3 through 4.7. Therefore, the impacts of different combinations of sites to provide a capacity of 263 MMB can be closely approximated by combining the site related impacts.

CHAPTER 5.0

MITIGATIVE MEASURES AND UNAVOIDABLE ADVERSE IMPACTS

5.1 INTRODUCTION

In Section 5.2, several mitigative measures are described that could moderate adverse impacts of the proposed project on both the natural and man-made environment. These potential mitigative measures apply to all sites. Unavoidable adverse impacts which cannot be avoided, despite application of mitigative measures, are summarized on a site-specific basis in Sections 5.3 through 5.7.

5.2 MITIGATIVE MEASURES AND CONTROLS AVAILABLE TO LIMIT ADVERSE EFFECTS DURING CONSTRUCTION AND OPERATION

The following measures are available to minimize the extent and significance of potential adverse impacts of the proposed project.

5.2.1 Site Preparation, Construction and Design

5.2.1.1 Erosion Control

1. Soil erosion during grading may be reduced by diverting surface runoff away from the construction and spoil areas and by providing sedimentation traps.

2. After grading, measures taken to control surface erosion include installation of temporary vegetative or gravel cover, mulching and rip-rapping.

3. During all construction activities, the speed and movement of vehicles can be controlled to protect natural vegetation, seeded areas and erosion control structures. Vehicles should cross drainageways only where culverts are provided.

4. To check the effectiveness of erosion control measures, water quality may be monitored at appropriate locations as part of the construction program.

5.2.1.2 Air Quality

1. Waste timber, brush and other waste materials would normally be burned. Whenever practicable, other methods of disposal (shredding or mulching) could be used.

2. Internal combustion engines could be maintained in good mechanical condition to reduce emissions.

3. Areas traversed by heavy equipment may be gravel surfaced and sprinkled when necessary to control dust. Main roadways could be paved and maintained.

5.2.1.3 Water Quality

1. Erosion control measures would also help maintain surface water quality.

2. Use of modern hydraulic dredging techniques would minimize the impacts resulting from dredging at the DOE dock sites in Freeport Harbor.

3. Rapid and effective clean-up of oil spills would help minimize impacts on surface water quality.

5.2.1.4 Habitat Quality

1. In clearing the pipeline rights-of-way, only small trees and shrubs should be removed. Pipelines could be rerouted to avoid wetlands. No growth retardants, chemical or herbicides should be used during construction.

2. Buffer strips of natural vegetation could be preserved along the pipeline rights-of-way wherever possible to provide wildlife habitat and minimize erosion.

3. Original topsoil during excavation could be stockpiled and later replaced and reseeded with native grasses.

4. After completion of construction, all disturbed areas not required for permanent facilities can be landscaped and reseeded with native grasses.

5. Dredged material removed during construction of the new DOE dock facilities would be disposed of in compliance with all regulations, not only in "approved" areas but ones not environmentally sensitive.

6. Care should be taken during construction to minimize dredge and fill to avoid altering the natural drainage/flow patterns.

7. Multiple brine injection wells could be drilled from a single (larger) wellpad by using the technique of directional drilling in order to minimize filling of wetlands.

5.2.1.5 Socioeconomic Conditions

1. Construction work shifts can be scheduled to avoid or reduce adverse effects on local highway traffic. The encouragement of carpools or some other shared transportation would help lessen the number of private vehicles at the site and further reduce adverse impacts on the local transportation facilities.

2. Provision of on-site security and fire protection services would lessen the need for onsite services.

3. Rapid and efficient clean-up of any oil spills would minimize adverse impacts on recreational facilities.

4. Use of approved navigational markers to avoid hazards to nearby vessels during brine diffuser construction.

5.2.2 Operations and Standby

5.2.2.1 Water Quality

1. During standby operations, observation wells may be monitored regularly to detect changes in water table elevation or contamination of the aquifer.

2. Continued monitoring of surface water quality would assist in detecting low level oil or brine pipeline leaks.

3. Skimmers may be installed in the brine pond to remove any floating oil prior to brine disposal.

5.2.2.2 Habitat Quality

1. The area permanently fenced can be limited to only that necessary to maintain security of plant structures. This would significantly reduce the area required for permanent facilities.

2. The use of herbicides could be restricted.

5.2.2.3 Air Quality

1. Filling the surge tanks with water when not in use would minimize the impact of hydrocarbon vapor releases.

2. Vapor control and recovery systems could be installed on tanks to prevent or minimize hydrocarbon emissions.

3. Vapor recovery systems for tankers to prevent or minimize hydrocarbon emissions during oil transfer operations are technically feasible. DOE is currently assessing the practicability of applying these systems to the SPR transfer facilities.

4. All tankers can be required to be permanently ballasted. This would reduce the anticipated air quality impacts from ballast disposal.

5.2.2.4 Socioeconomic Conditions

Installation of approved permanent navigational markers at the brine diffuser site to avoid hazards to water borne traffic or trawling operations.

5.2.3 Control of Hydrocarbon Emissions

The release of hydrocarbons to the atmosphere affects the project in two ways. First, hydrocarbon emissions represent an irretreivable loss of petroleum resources from the SPR system (paragraph 7.2.6). Second, uncontrolled vapor releases would contribute a significant amount of hydrocarbons to the atmosphere in southeastern Texas, an area where hydrocarbon concentrations are already high.

It is technologically possible to significantly reduce hydrocarbon emissions from the storage and transportation systems. For example, the surge tanks could be filled with water during periods when there is no oil movement. The calculated emission summaries are based on the assumption that the four 200,000 barrel surge tanks at Bryan Mound are kept partially filled during static storage (no oil movement). Filling the surge tanks with water during periods when there is no oil movement would reduce surge tank emissions by about one-third.

Another possible system of vapor control is a vapor condensation unit. This unit compresses the gases to 3 or 4 atmospheres, sufficient to liquefy most of the petroleum vapors which are then recovered and reinjected into the storage cavern under pressure. The compressed air used in the unit must eventually be returned to the atmosphere, and some petroleum is flashed off. The system's efficiency may range from 60 to 85 percent petroleum recovery. This system could be most easily implemented at the DOE docks in Freeport Harbor. A vapor condensation unit requires a considerable capital investment, the specific amount depending on the size of the unit required. At present, most crude oil facilities do not handle sufficient quantities of oil to justify extensive vapor control systems. Also, existing state air quality regulations in Texas (the location of many major crude oil facilities) specifically exclude such facilities from control. Adaptation of existing technology would be feasible for the SPR oil storage system and may be economically advantageous.

5.2.4 Oil Spill Containment and Recovery Plan

The oil spill containment and recovery plan is presented and discussed in Appendix E.

5.3 BRYAN MOUND (PROPOSED SITE)

5.3.1 Land Impacts

Approximately 240 acres in the immediate vicinity of the Bryan Mound site would be removed from its present utilization (brine production and some cattle grazing) during operation of the Strategic Petroleum Reserve Program, or about twenty-five years. Site access will be controlled by the DOE for reasons of safety and security of the stored oil.

On-site activities during the construction phase of the project would include the grading and excavation of 36 acres. This acreage would be occupied by roadways and drill pads.

Leaching of 100 MMB of storage capacity in the Bryan Mound salt dome would involve the removal of 20.8×10^6 cubic yards of salt. Construction and operation of the DOE dock facilities would commit the use of 14 acres. Construction of the pipelines associated with the Bryan Mound candidate SPR site would disrupt 4 acres of coastal marshland in addition to four acres of cleared land and involve about 6000 cy of material to be temporarily displaced. Use of the brine disposal pipeline to the Gulf of Mexico 5.8 mile diffuser would commit 21 acres of land and 177,300 cy excavation, and operation of the diffuser would constitute a minor obstacle to navigation in the area.

For the life of the project, however, 30 acres onsite and 35 acres offsite for maintenance of permanent surface facilities and pipeline right-of-way would be unavoidably adversely impacted.

5.3.2 Water Impacts

During construction, some siltation of the onsite lakes would be expected despite use of erosion control techniques. A minor reduction in water quality would occur temporarily in Freeport Harbor during dredging activities for the new DOE docks. The amount of material to be dredged, (approximately 1,050,000 cy), is comparable to ongoing dredging operations in the harbor, which are approximately 1 million cy annually.

Consumptive use of water at the Bryan Mound site will be small in relation to available surface water supply. The maximum rate of water withdrawal (65 cfs) during the oil withdrawal phase should not exceed one percent of the average daily flow of the Brazos River Diversion Channel. Disposal of brine into the Gulf of Mexico should have no significant effect on water quality except in the immediate vicinity of the diffuser; salinity concentrations near the diffuser would generally be higher during periods of current stagnation than during periods of strong currents. A brine or oil spill could impact either ground water or surface water quality, particularly if such a spill was of a relatively low level and went undetected. Such an event, however, is unlikely to occur. If a massive brine spill were to occur at the site or along the disposal pipeline, water quality in the upper unit of the Chicot aquifer could be affected.

5.3.3 Air and Noise Impacts

Air quality in the vicinity of Bryan Mound would be slightly affected from site preparation and construction activities; impacts would be short-term and confined to a relatively small area. Emission sources include general construction vehicles, drilling rig engines, and fugitive dust.

During facility operations, significant hydrocarbon emissions could result from the transportation and transfer of oil. Under unfavorable conditions, hydrocarbon emissions may exceed the NAAQS as far as 13 kilometers downwind of the DOE docks.

The area affected by noise increases from site construction activity is mostly uninhabited marshlands. Dock construction would raise noise levels in Freeport Harbor, where the impact is expected to be minor.

Principal noise sources during the operation and standby storage phases of the project would be material handling equipment (pumps). No significant increases in noise levels would be experienced on public thoroughfares or in residential areas.

5.3.4 Ecosystem Impacts

Development of the Bryan Mound site would have a minimal impact on the biological resources of the site since most of the land has previously undergone industrial development, i.e., brining operations. Approximately 3 acres of coastal marshland habitat would be permanently lost, as well as 14 acres of coastal prairie and 47 acres of cleared land.

There are no known rare or endangered species resident in the immediate area of Bryan Mound.

At the DOE dock sites, a small amount of benthos would be lost during dredging, and phytoplankton productivity in the harbor may be reduced.

The impact of brine disposal in the Gulf of Mexico is expected to be minimal outside the immediate vicinity of the diffuser; the estuarine migration of some larval shrimp could be locally disturbed.

5.4 ALTERNATIVE SITE - ALLEN DOME

5.4.1 Land Impacts

Approximately 184 acres at the Allen dome candidate SPR site would be enclosed by a security fence and removed from its present use as a cattle grazing area during operation of the Strategic Petroleum Reserve program.

Access to the site would be controlled by the DOE for reasons of safety and security of the stored oil.

On-site activities during the construction phase would involve the grading of about 31 acres. This area would be occupied by surface facilities, such as an office building, a brine pond, a pump house, roadways, drill pads and equipment yards. About 413,200 cubic yards of fill material would be required to provide protection against flooding.

Solution mining at Allen dome to create 100 MMB of oil storage capacity would require the removal of 20.8 X 10^6 cy of salt. Construction and operation of the DOE dock facilities in Freeport Harbor would commit 14 acres. Pipeline and wellhead pad construction associated with the development of Allen dome would require another 296 acres to be disturbed during construction. Much of this acreage (115 acres) would be revegetated during the operation phase; access to the pipelines would still be required. Operation of the brine diffuser in the Gulf would constitute a minor obstacle to navigation in the area.

For the life of the project, however, 31 acres onsite and 129 acres offsite for maintenance of permanent surface facilities and pipeline right-of-way would be unavoidably adversely impacted.

5.4.2 Water Impacts

During construction, some siltation of the San Bernard River would be expected despite use of erosion control techniques. The San Bernard River, Jones Creek, and the Brazos River Diversion Channel would also experience some localized water quality degradation as a result of pipeline installation and burial. The impacts of water consumption and brine disposal would be similar to those described in paragraph 5.3.2.

The impacts of dock construction and operation would be the same as those described in paragraph 5.3.2.

A large brine or oil spill, although unlikely, could affect the water quality of the San Bernard River, Jones Creek, the Brazos Diversion Channel, the lakes and ponds at Bryan Mound, the Intracoastal Waterway or the Gulf of Mexico.

5.4.3 Air and Noise Impacts

Air quality at the Allen dome site would be slightly affected during site preparation and construction; impacts would be short-term and confined to a relatively small area. Emission sources include general construction vehicles, drilling equipment and fugitive dust.

During facility operations, significant hydrocarbon emissions could result from the transportation and transfer of oil. Under unfavorable conditions, hydrocarbon concentrations may exceed NAAQS as far as 13 kilometers downwind of the DOE docks.

Noise from site preparation and construction could adversely impact approximately 16 residences south of the site; the impact would be short-term and transitory in nature, however. Noise impacts from operation are not expected to be significant.

5.4.4 Ecosystem Impacts

Development of the Allen dome site would include the permanent disruption of 125 acres of coastal prairie, two acres of fluvial woodlands, 20 acres of cleared land, and 12 acres of marsh.

Raw-water withdrawal from the Brazos River Diversion Channel would result in a loss of phytoplankton, zooplankton, and other small aquatic biota unable to avoid the 0.5 ft/sec intake stream.

The effects of dock construction and brine disposal are described in paragraph 5.3.4.

Construction at river crossings would affect the local aquatic environment.

5.5 ALTERNATIVE SITE - WEST COLUMBIA DOME

5.5.1 Land Impacts

Approximately 232 acres in the immediate vicinity of the West Columbia dome candidate SPR site would be removed from its present use as a grazing area for cattle during operation of the Strategic Petroleum Reserve program.

Access to the site would be controlled by the DOE for reasons of safety and security of the stored oil.

Grading for surface facilities would involve about 30 acres. These surface facilities include an office building, a brine pit, a pump house, roadways, drill pads and an equipment yard. The fresh water marsh at the site would be filled with about 63,000 cy of material. Pipeline construction would require excavation of 602,420 cy and would disrupt about 450 acres. An additional 3 acres and 12,150 cy of fill would be required for pipelines and drill pads for the backup brine injection wells. Operation of the brine diffuser would create a minor obstacle to navigation in the area.

For the life of the project, however, 30 acres onsite and 247 acres offsite for permanent surface facilities and pipeline right-of-way would be unavoidably adversely impacted.

Solution mining at West Columbia dome to create 100 MMB of oil storage capacity would require the removal of 20.8×10^6 cy of salt. Construction and operation effects of the dock facilities in Freeport Harbor would commit 14 acres.

5.5.2 Water Impacts

During pipeline construction, some siltation might occur in Varner Creek, Bell Creek, Jones Creek and the Brazos River Diversion Channel. Site preparation and construction would also affect Varner Creek despite use of erosion control techniques.

The effects of water consumption, construction of the DOE docks in Freeport Harbor and brine disposal in the Gulf of Mexico would be similar to those discussed in paragraph 5.3.2.

A large brine or oil spill, although unlikely, could affect the water quality of Varner, Bell or Jones Creeks, the Brazos River Diversion Channel, the lakes and ponds at Bryan Mound, the Intracoastal Waterway or the Gulf of Mexico.

5.5.3 Air and Noise Impacts

The unavoidable adverse impacts on air quality in the vicinity of West Columbia dome from site preparation and construction activities, and from operation and standby of the candidate facilities, would be similar to those discussed in paragraph 5.4.3. The chief differences would be the relocated brine pond emissions and some additional fugitive dust. Approximately five residences would experience a short-term increase in noise during site preparation and construction.

5.5.4 Ecosystem Impacts

Development of the West Columbia dome site would require the maintenance of about 30 acres of marsh habitat for the life of the Strategic Petroleum Reserve; this is a small fraction of this type of habitat in the vicinity. Approximately 115 acres of coastal prairie, 112 acres of woodlands and 17 acres of cleared land would be removed for the life of the project.

A total of 210 acres would be required for pipeline right-of-way from West Columbia dome to the SEAWAY Tank Farm, eliminating the vegetative cover within the right-of-way, increasing erosion, and decreasing primary productivity.

The effects of brine disposal and dock construction are described in paragraph 5.3.4.

5.6 ALTERNATIVE SITE - DAMON MOUND

5.6.1 Land Impacts

Approximately 232 acres in the immediate vicinity of the Damon Mound candidate SPR site would be removed from its present use (cattle grazing) during operation of the Strategic Petroleum Reserve.

Access to the site would be controlled by the DOE for reasons of safety and security of the stored oil.

Approximately 30 acres of the site would be graded for surface facilities, such as the office building, a brine pond, a pump house, drill pads, pipelines, roadways and an equipment yard. The site would be located approximately 3/4 mile from the town of Damon. An additional 471 acres would be required for the pipeline and wellhead pad construction. Much of this land would be returned to its present use following construction although operational activities would require continued access to the pipelines. Operation of the brine diffuser would constitute a minor obstacle to navigation in the immediate area.

Leaching of 100 MMB of storage capacity in the Damon Mound salt dome would require the removal of 20.8 X 10^6 cubic yards of salt. Construction and operation effects of the dock facilities in Freeport Harbor would commit 14 acres.

For the life of the project, however, 30 acres onsite and 336 acres offsite for permanent surface facilities and pipeline right-of-way would be unavoidably adversely impacted.

5.6.2 Water Impacts

Site preparation and construction activities associated with the development of the Damon Mound site could adversely affect the quality of Mound Creek despite the use of erosion control techniques. The proposed water supply, brine disposal and oil pipelines would cross Varner and Bell Creeks and several intermittent streams between the site and the SEAWAY Tank Fram. The water supply and brine disposal pipelines would cross Jones Creek, the Brazos River Diversion Channel and Unnamed Lake. Impacts to Freeport Harbor from DOE dock construction are identical to those discussed in paragraph 5.3.2.

A large brine or oil spill, although unlikely, could affect the water quality of Mound, Varner, Bell or Jones Creeks, the San Bernard or Brazos Rivers, lakes and ponds at Bryan Mound, the Intracoastal Waterway or the Gulf of Mexico.

5.6.3 Air and Noise Impacts

Air quality in the vicinity of the Damon Mound site would be slightly affected by site preparation and construction activities; impacts would be short-term and confined to a relatively small area. Emission sources include general construction equipment, drilling rig engines and fugitive dust. During operations, significant hydrocarbon emissions could result from the transportation and transfer of oil. Under unfavorable conditions, hydrocarbon concentrations may exceed NAAQS as far as 13 kilometers downwind of the DOE docks. Additional emissions from construction of an 8500-barrel fuel tank for use in on-site power generation would have no significant impact on air quality.

Increased noise from site preparation and construction could temporarily impact approximately 57 residences in Damon.

5.6.4 Ecosystem Impacts

Development of the Damon Mound site would require the maintenance of about 205 acres of coastal prairie habitat which is presently used for cattle grazing; approximately 136 acres of woodlands, three acres of marsh, one acre of barrier flat, and 21 acres of cleared land for the life of the project. Pipeline right-of-way from Damon Mound to the SEAWAY tank farm would require 158 acres of prairie grassland and 136 acres of fluvial woodland.

No known significant breeding or nesting sites exist on Damon Mound, nor are any threatened or endangered species known to exist at the site.

5.7 ALTERNATIVE SITE - NASH DOME

5.7.1 Land Impacts

Approximately 206 acres in the immediate vicinity of the Nash dome candidate SPR site would be converted from its present use (crop production) during operation of the Strategic Petroleum Reserve program.

Access to the site would be controlled by the DOE for reasons of safety and security of the stored oil.

Approximately 30 acres of the site would be graded for surface facilities, such as the office building, a brine pond, a pump house and an equipment yard. An additional 603 acres would be required for the pipeline and wellhead pad construction. Much of this land would be returned to its present uses following construction although operational activities would require continued access to the pipelines. Operation of the brine diffuser would create a minor obstacle to navigation on in the area.

Leaching of 100 MMB of stored capacity in the Nash salt dome would require the removal 20.8 X 10^6 cubic yards of salt. Construction and operation effects of the dock facilities in Freeport Harbor would commit 14 acres.

For the life of the project, however, 30 acres onsite and 361 acres offsite for permanent surface facilities and pipeline right-of-way would be unavoidably adversely impacted.

5.7.2 Water Impacts

Site preparation and construction activities associated with the development of the Nash dome site could adversely affect the quality of Turkey and Cow Creeks despite the use of erosion control techniques. The proposed water supply, brine disposal and oil pipelines would cross Cow, Varner, and Bell Creeks and several intermittent streams between the storage site and the SEAWAY Tank Farm. The water supply and brine disposal pipelines would cross Jones Creek, the Brazos River Diversion Channel and Unnamed Lake. Impacts to Freeport Harbor from DOE dock construction are identical to those discussed in paragraph 5.3.2.

A large brine or oil spill, although unlikely, could affect water resources in Cow, Varner, Bell or Jones Creeks, the Brazos River Diversion Channel, lakes and ponds at Bryan Mound, the Intracoastal Waterway or the Gulf of Mexico.

5.7.3 Air and Noise Impacts

Air quality in the vicinity of the Nash dome site would be slightly affected by site preparation and construction activities; impacts would be short-term and confined to a relatively small area. Emission sources include general construction equipment, drilling rig engines and fugitive dust. During operations, significant hydrocarbon emissions could result from the transportation and transfer of oil. Under unfavorable conditions, hydrocarbon concentrations may exceed NAAQS as far as 13 kilometers downwind of the DOE Docks. Additional emissions from the construction of an 8500-barrel fuel tank for use in on-site power generation would have no significant impact on air quality.

Increased noise from site preparation and construction would have no significant impact as there are no private residences in the immediate vicinity of the site.

5.7.4 Ecosystem Impacts

Site activities at the Nash dome site would require the maintenance of about 182 acres of coastal prairie which is presently used for crop production; approximately 158 acres of woodlands, three acres of marsh, one acre of barrier flat and 47 acres of cleared land. Pipeline right-of-way from Nash dome to the SEAWAY Tank farm would require 165 acres of prairie grassland and 158 acres of fluvial woodland.

No known significant breeding or nesting sites exist on Nash dome, nor are any threatened or endangered species known to exist at the site.

Chapter 6.0

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

This chapter describes the relatively short-term uses of the local environment that are implicit in the construction and operation of the proposed SPR oil storage facilities at the Bryan Mound, Allen dome, West Columbia dome, Damon Mound or Nash dome (Seaway Group) candidate sites and the expected effects on maintenance and enhancement of long-term productivity. Based on the analyses in the previous chapter of this EIS, it is concluded that the proposed uses of the proposed site and its environs would not significantly affect the long-term productivity of the environment under normal conditions.

The principal short-term use of the selected Seaway Group site would be for the underground storage of petroleum. This storage will enhance the short-term availability of petroleum resources should the nation's foreign supplies be reduced or interrupted, and would provide a measure of stability and security to our economy and to our national well-being.

The expansion of Bryan Mound or development of an alternative site for underground oil storage would add 100 MMB to the Strategic Petroleum Reserve System. With the addition of this oil storage capacity to the existing capacity of 63 MMB presently in use at Bryan Mound, the Seaway Group of candidate sites would account for approximately 33 percent of the storage requirements detailed in the Energy Policy and Conservation Act of 1975.

There is no evidence from current experience in the United States to indicate that any environmental stresses would result from underground oil storage. Long-term studies and experiences in European countries indicate that no harmful effects can be expected using current technology.

With adequate safety precautions to prevent accidental spills, and on-going monitoring programs to detect the leakage of oil, no long-term harmful effects are expected.

It is recognized, however, that chronic or high-level pollution from accidental spills could have adverse impacts in certain areas. It is difficult to quantify these impacts or to estimate the short- or long-term effects of a major oil spill since these effects would depend on the location and rate of the spill. Data on average spill rates and maximum credible spill impacts indicate that any significant environmental damage should be localized and not affect regional environmental resources.

6.1 EFFECT ON NATIONAL AND REGIONAL ECONOMIC PRODUCTIVITY

Development and use of one of the candidate SPR storage sites would provide an increased potential of 100 million barrels of petroleum for the 20-25 year operating life of the facilities. This oil would provide a measure of certainty in meeting projected national energy needs for a limited time in the event of an oil import reduction or interruption.

The storage of petroleum would thus increase available standby energy. The beneficial effects on economic productivity would be large compared with the loss of salt resources from solution mining or the loss of site land for other potential uses, primarily agriculture.

The most noticeable short-term effect would be an increased demand on supplies (such as drilling rigs, pipe and sheet metal needed for construction, and increased payrolls). The only short-term economic effect attributable to the development of Bryan Mound would be the loss of brining operations by Dow Chemical Company. The short-term economic effects for Allen dome, West Columbia dome and Damon Mound would be the loss of pasture for cattle. (An additional economic loss at Allen dome would include the potential for development of housing along the San Bernard River.) The short-term economic loss for Nash dome would be the loss of farm production. Brine disposal would impact shrimp fisheries in the vicinity of the proposed diffuser.

6.2 ADVERSE IMPACTS ON PRODUCTIVITY

6.2.1 Impacts on Land Use

The construction and operations associated with development of petroleum storage at the candidate sites would commit a loss of 100 MMB of salt resources. The Bryan Mound site has been used extensively for brine production by Dow Chemical Company for many years. At present, however, most of these operations have been reduced or halted at Bryan Mound. The large number of commercially exploitable salt domes in or near the Gulf of Mexico and the quantity of salt at these sources make it unlikely that use of Bryan Mound for oil storage would curtail future salt or brine production. Salt is not being produced at Allen, West Columbia, Damon Mound or Nash salt domes.

The surface area that would be disrupted by development of the Bryan Mound, Allen dome, West Columbia dome or Damon Mound SPR facilities is currently used as grazing and pastureland. This use would be ended for the life of the project but could be resumed following the termination and abandonment of the facility. The surface area that would be disrupted by the development of Nash dome SPR facilities is used as farmland. No unique, threatened, or endangered species of plants or animals should be affected by the project.

6.2.2 Impacts on Water Use

Construction and operation of the project is not expected to be detrimental to commercial or recreational uses of any of the water resources in the vicinity of Bryan Mound, Allen, West Columbia, Damon Mound or Nash domes.

6.2.3 Impacts on Air Resource Uses

Uncontrolled hydrocarbon emissions from tankers during oil transfer and transportation, would produce a significant increase in atmospheric hydrocarbon loading in the vicinity of the transfer terminals. Since ambient concentrations of non-methane hydrocarbons in the vicinity of Freeport occasionally exceed the 3 hour National Ambient Air Quality Standard, the additional hydrocarbon loading could affect the selection of future industrial sites in the area.

CHAPTER 7.0

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

7.1 INTRODUCTION

Resources that are irreversibly committed by the proposed action are those that cannot be altered at some later time to restore their original value. Such resources are consumed and are not recoverable for subsequent use.

The types of resources affected by the underground storage of crude oil can be described as: 1) material resources (for example, renewable and nonrenewable materials consumed in construction and operation); and 2) natural resources, including any recognized beneficial uses of the environment.

Resources that may be irreversibly committed are: 1) plants and animals destroyed on and around the site; 2) construction materials and energy that cannot be recovered or recycled; 3) materials consumed or reduced to waste products; and 4) land areas removed from present uses.

The following paragraphs detail resource commitments required for the expansion of the Seaway Group SPR from its early storage capacity of 63 MMB. Table 7.2-1 compares the resource commitments for the proposed and alternative sites.

7.2 SUMMARY OF IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

7.2.1 Land

Proposed development of the Bryan Mound site would require 425 acres to be restricted from present use, 221 of which would be graded and excavated for site facilities both within the 240 acre fenced area and for offsite brine disposal, raw water and crude oil pipeline systems. During operation, the fenced area and pipeline rights-of-way would require 275 acres, but, for the life of the project, only 65 acres would be unavoidably impacted due to permanent surface facility structures and pipeline rights-of-way. Pipeline rights-of-way could possibly be converted to other uses, leaving only 26 acres of land irretrievably lost to permanent structures.

Development of alternative sites in the Seaway Group would involve land commitments as follows, compared to the proposed expansion at Bryan Mound:

	Bryan Mound	Allen Dome	West Columbia Dome	Damon Mound	Nash Dome
Land restricted from present use, acres	425	494	699	817	823
Area graded and excavated for site facilities, acres	221	341	497	615	647
(Site fenced area, acres)	(240)	(184)	(232)	(232)	(206)
Area required for operation, acres					
-Total fenced area or restricted R.O.W.	275	313	479	568	567
-Site facilities or restricted R.O.W.	65	160	277	366	391
Land irretrievably committed, acres	26	43	42	47	42

7.2.2 Air

The expected short-term effects of construction and operation on air resources are described in Sections 4.3 through 4.7. Uncontrolled venting during the transfer of oil to and from the storage caverns would result in releases of hydrocarbon vapors. Other atmospheric releases are of relatively minor significance. No irreversible commitments of air resources in the region could occur for the proposed expansion of the Seaway Group SPR.

7.2.3 Water

Expansion of the Bryan Mound SPR site as the proposed development would require the leaching of 100 MMB of new capacity for the site design total of 163 MMB. Leaching the new cavern space would require 700 MMB of raw water. Assuming that five fill-and-withdrawal cycles are required during the life of the project, an additional 500 MMB of raw water would be used for oil displacement, for a total of 1200 MMB (5.04×10^{10} gallons). This water would be irretrievable in its original low-salinity form, as brine would be formed in the caverns by salt solution.

Water for Bryan Mound would be obtained from the Brazos River Diversion Channel, which has a mean daily flow of 8357 cubic feet per second. Over the project lifetime of approximately 25 years, the Bryan Mound expansion would use 0.13 percent of the river flow of 3.94×10^{13} gallons. The loss of this volume of water over the life of the project is insignificant.

Construction of any of the alternative sites would also require leaching of 100 MMB of new capacity; water would be required from the Brazos River Diversion Channel in the same quantities as for Bryan Mound.

7.2.4 Ecosystems and Species

Construction of the proposed crude-oil storage facility and the associated docks and pipelines would result in habitat alterations. During construction, there would be a temporary displacement and/or loss of plants and animals from both on-shore and off-shore pipeline rights-of-way. Oil-fill operations and resulting brine disposal would also have temporary effects on marine biota. Effects during standby operation, however, would be minimal.

The cumulative effects of facility construction and operation on the biotic community would be minimal to insignificant when the total population and productivity of the area is evaluated. No endangered, threatened, or unique wildlife or vegetation species would be affected by the proposed action.

At Bryan Mound, 26 acres of cleared land would be continuously cleared of obstructive vegetation for the duration of the project due to permanent surface facilities and must be considered irretrievable.

At the alternative sites, the land considered irretrievable for other uses for the duration of the project would amount to the following totals: 17 acres of cleared land, and 26 acres of coastal prairie for Allen dome; 14 acres of cleared land, 3 acres of coastal prairie, and 25 acres of marsh for West Columbia dome; 14 acres of cleared land, and 33 acres of coastal prairie for Damon Mound; and 39 acres of cleared land and 3 acres of coastal prairie for Nash dome.

7.2.5 Material

7.2.5.1 Construction Materials

Most of the concrete, steel and other materials used for construction of the sites, pipelines and docks may be physically (though often not economically) retrievable. These materials must, however, be considered as an irretrievable commitment of resources since valid estimates of their salvage cannot be made at this time. Estimates of construction material irretrievably committed total about 20,000 tons of steel and 30,000 tons of concrete for the Bryan Mound site. At Allen dome, the estimates are 35,000 tons of steel and 32,000 tons of concrete. Estimates for the other sites are: West Columbia dome, 59,000 tons of steel and 33,000 tons of concrete; Damon Mound, 73,000 tons of steel and 35,000 tons of concrete; and Nash dome, 74,500 tons of steel and 35,000 tons of concrete.

7.2.5.2 Salt

Disposal of brine from solution mining irreversibly commits the solid salt resource. However, many other salt domes, beds, and deposits are present throughout the country, and the 38 million tons of salt committed at Bryan Mound or the alternative sites would not have a significant impact on total availability.

7.2.5.3 Oil

For the five fill-withdrawal cycles planned for the proposed system, the total potentially stored oil is 500 MMB of crude oil at Bryan Mound or the alternative sites. Assuming that oil losses through incomplete recovery, evaporation, and spills could total about 0.03 percent of the potential storage capacity, a total of 150 MB of crude oil might be irretrievable from storage at Bryan Mound or an alternative site.

7.2.6 Energy

The energy consumed during site construction and operation includes that required to supply materials, prepare and operate the site, transport the crude oil; it also includes losses of crude oil during transport and storage. Tabulated gross energy commitments include:

Activity	Millions of BTU (includes energy lost in conversion)
Construction	
Labor	100,000
Equipment	400,000
Steel (20,000 tons)[1]	800,000
Concrete (30,000 tons)[2]	180,000
	1,480,000
Oil Handling	
Tanker Transport (4.6×10^8 ton-miles)[3]	1,710,000
Loading, Unloading, Water Supply and Brine Disposal	2,210,000
	3,920,000

[1]Requires 40 MMBTU per ton for manufacture.

[2]Required 6 MMBTU per ton for manufacture.

[3]Calculated at 750 BTU per ton-mile.

The tabulations indicate that about 1,480,000 MMBTU would be consumed in constructing the proposed system at Bryan Mound and 3,920,000 MMBTU would be expended in handling the oil through five storage cycles. In terms of crude oil equivalence content (5.5 MMBTU/barrel), the potential oil resource use is:

Construction - 0.062% of potential cavern storage capacity	(270,000 bbl)
Handling (5 cycles) - 0.16% of potential cavern storage capacity	(710,000 bbl)
Oil not recovered from caverns - 0.0046% of potential cavern storage capacity	(20,000 bbl)
Oil released by evaporation during transportation - 0.023% of potential cavern storage capacity	(100,000 bbl)
Spill expectation during project lifetime - 0.00060% of potential cavern storage capacity	(2,600 bbl)
Total - 0.22% of potential storage capacity of 500 MMB	(1,102,600 bbl)

The energy used is irretrievable. It represents an investment of approximately 0.22 percent of the storage capacity to help prevent future drastic reductions in energy availability as a result of arbitrary decisions by foreign suppliers.

The energy expended for construction and operation at any of the alternative sites is summarized in Table 7.2-1. The differences in energy requirements depend on the distances over which the oil is handled and the volumes handled.

7.2.7 Labor

To construct and operate the Bryan Mound candidate site for 20 years, approximately 347 man-years of effort would be required. This involves approximately 327 man-years of effort for construction and initial fill and approximately 20 man-years of operational effort. This utilization of manpower would not be available for other uses and would be irretrievable.

TABLE 7.2-1 Resource commitments for Seaway Group candidate sites.

RESOURCE		UNITS	BRYAN MOUND	ALLEN DOME	WEST COLUMBIA DOME	DAMON MOUND	NASH DOME
Land	-Land Removed from Present Use	Acres	425	494	699	817	823
	-Land Irretrievably Committed	Acres	26	43	42	47	42
Water	-Water Used During Project Lifetime	MMB (%)[1]	1,200 (0.13)	1,200 (0.13)	1,200 (0.13)	1,200 (0.13)	1,200 (0.13)
Material	-Construction Materials - Steel	Tons	21,000	35,000	59,500	73,000	74,500
	- Concrete	Tons	30,000	32,000	33,000	35,000	35,000
	-Salt	MM Tons	38	38	38	38	38
Energy	-Labor and Equipment for Construction	MMBTU	500,000	600,000	700,000	700,000	700,000
	-Oil Handling by Tanker	MMBTU	1,965,000	1,965,000	1,965,000	1,965,000	1,965,000
	-Oil Transfers, Raw Water Supply and Brine Disposal	MMBTU	2,540,000	3,905,000	6,620,000	8,175,000	8,355,000
Energy Equivalence	-Construction	bbl (%)[2]	275,000 (0.055)	400,000 (0.080)	600,000 (0.12)	700,000 (0.14)	710,000 (0.14)
	-Oil Handling	bbl (%)	817,000 (0.16)	1,070,000 (0.21)	1,560,000 (0.31)	1,875,000 (0.37)	1,875,000 (0.38)
	-Oil Not Recovered	bbl (%)	23,000 (0.0046)	23,000 (0.0046)	23,000 (0.0046)	23,000 (0.0046)	23,000 (0.0046)
	-Oil Released by Evaporation	bbl (%)	113,000 (0.023)	113,000 (0.023)	113,000 (0.023)	113,000 (0.023)	113,000 (0.023)
	-Spill Expectation (Table 4.2-2)	bbl (%)	3,000 (0.00060)	3,700 (0.00074)	3,800 (0.00076)	3,900 (0.00078)	3,900 (0.00078)
	Total	bbl	1,231,000	1,609,700	2,299,800	2,684,900	2,724,900
	-Percent of Potential Storage Capacity	(%)	(0.25)	(0.32)	(0.46)	(0.54)	(0.54)
	-Potential Storage Capacity	MMbbl	500	500	500	500	500
Labor	-Manpower Required for Construction	man-years	327	378	427	440	435
	-Manpower Required for Operation	man-years	20	463	614	614	614
	-Total Manpower	man-years	347	841	1,041	1,054	1,049

[1]Raw water source for all sites - Brazos River Diversion Channel

[2]Percent of potential storage capacity

7.2.8 Capital

The cost of constructing and operating the facility over the project lifespan would represent money for equipment and manpower which is essentially irretrievable. These costs are weighted against the possible severe economic loss which the country would incur if no provisions were made against oil embargos.

7.2.9 Summary

Table 7.2-1 is a comparative summary of the commitment of resources required to develop any of the Seaway Group SPR sites.

CHAPTER 8.0

SUMMARY OF PROPOSED AND ALTERNATIVE ACTIVITIES

8.1 INTRODUCTION

This section summarizes the proposed and alternative facilities at the 5 candidate sites of the Seaway Group SPR. The major structural requirements of each site are summarized in Table 8.1-1.

TABLE 8.1-1 Summary of major structural requirements of each SPR candidate site.

	Bryan Mound	Allen Dome	West Columbia	Damon Mound	Nash Dome
Expansion Capacity	100 MMB	100	100	100	100
Number of New Cavity Wells	12	12	12	12	12
New Water Pipelines to site	0 mi	12.1	27.1	36.4	36.7
New Water Pipelines on site	3.3 mi	3.3	3.3	3.3	3.3
New Oil Pipelines to to site	0.6 mi	12.7	27.7	37.0	37.3
New Oil Pipelines on site	3.3 mi	3.3	3.3	3.3	3.3
New Docks	2	2	2	2	2
New Brine disposal line to Gulf	7.5 mi	19.6	34.6	43.9	44.2
New Partial Backup Brine injection wells	0	3	3	3	3
Brine pipeline to injection wells	0 mi	1.9	2.3	2.9	2.5
Plant Control Facilities	exists	new	new	new	new
Brine Pit	exists	100,000 BBL	100,000 BBL	100,000 BBL	100,000 BBL
Oil Surge Tanks	4 exist	4 (exist at Bryan Mound)	4 (exist at Bryan Mound)	4 (exist at Bryan Mound)	4 (exist at Bryan Mound)
Blanket Oil Tank	0	1	1	1	1
Prime Water Tank	0	1	1	1	1
Power Generator Fuel Tank	0	0	0	1	1

8.2 NO-ACTION

A description of the no-action alternative and its impacts, as it applies to the entire program, is provided in the Programmatic EIS (FES-76-2). Within the SPR program, a decision not to expand the Bryan Mound facilities would result in the development of one of the other candidate sites to take its place. In that case, the impacts described in Section 3.0 of the Bryan Mound EIS (FES 76/77-6) and its July, 1977 Supplement would be maintained. However, a decision not to develop Bryan Mound would result in other impacts: those associated with the alternate facility. Since all the candidate sites are also located in the Gulf Coast region, many of the impacts resulting from development of a replacement site would be substantially the same as those for Bryan Mound. Detailed impacts of any particular facility are very site-specific, however, and are discussed in the section for that site.

8.3 SUMMARY OF ACTIVITIES AT BRYAN MOUND - PROPOSED SITE

Proposed Activities

To create 100 MMBof additional storage space at Bryan Mound up to 12 new cavern wells would be drilled on the site. Each well would require grading approximately 1 acre of cleared land for a drill pad and road access. After completion of the well, leaching of the salt to create a storage cavern would begin. Raw water would be withdrawn from the Brazos River Diversion Channel at the early storage phase intake structure, located about 2 miles from the Gulf of Mexico. The raw water would be injected into the wells, where it would dissolve salt from the cavern walls (thus forming brine) and displace brine already produced in the cavity. Brine displaced from the cavities would go first to the brine pit, where solids would settle out, and then be dispersed 5.8 miles offshore in the Gulf of Mexico via the brine diffuser, or injected into deep saline aquifers through five back-up injection wells. Brine injection pumps would be part of the early storage phase pumping capacity and are housed in a central pumphouse. Pipelines between the central pumphouse and storage cavity wells would cross 2.3 miles of coastal prairies.

Completed storage caverns would be filled with oil brought into Freeport Harbor in tankers. Two new tanker docks would be constructed, which would require a total of about 14 acres of "made land" and about 1,050,000 cy of dredging for construction. New crude oil pipelines would be required to connect these new dock facilities to the early storage phase pipeline between SEAWAY, Inc. docks and the Bryan Mound site. One pipeline would cross only a few hundred feet of "made land" while the second would cross approximately four acres of "made land" and four acres of coastal marsh.

At the storage site, the crude oil may be temporarily stored in one of four 200,000 bbl surge tanks, constructed as part of the early storage development. The crude oil would then be injected into the completed caverns, displacing brine which would be disposed of through the brine pit and diffuser in the Gulf of Mexico or through the injection wells.

During an emergency withdrawal of crude oil from the storage caverns, raw water would be withdrawn from the Brazos River Diversion Channel to displace the stored oil. Maximum water withdrawal rates of approximately 1 MMB per day occur at this time. This represents less than 1 percent of the average flow of the Brazos River Diversion Channel. The oil would be distributed: 1) to the SEAWAY, Inc. Pipeline through an early storage phase pipeline from the storage site to the SEAWAY, Inc. Tank Farm at Jones Creek; or 2) to tankers at the new DOE docks in Freeport Harbor via the early storage pipeline and the new connector pipelines.

Expansion of the Bryan Mound early storage phase site to the total proposed Seaway Group SPR capacity of 163 MMB would achieve the maximum economy of use of early storage facilities. These include the crude oil distribution pipelines, injection pumps, raw water supply facilities, and the four surge tanks. The major new facilities required for execution of the expansion activities at the Bryan Mound storage site include construction of new docks, new caverns and brine disposal facilities.

Alternative Activities

Alternatives to the proposed crude oil distribution activities described above include use of Phillips Petroleum Co.'s dock and construction of an offshore SPM terminal. Phillips' docks could be utilized on a "space-available" basis and could be relied upon only for "topping off" the crude oil storage; use of the Phillips' docks would require construction of a 0.6 mile pipeline to the early storage phase pipeline connecting the SEAWAY, Inc. docks and the Bryan Mound site; it would not reduce the requirements for the new DOE Freeport Harbor docks. Construction of an SPM deep-water terminal would eliminate the need for the two proposed DOE docks, but would require a 30 mile offshore pipeline, increased surge tankage, and conversion of existing SEAWAY Docks in Freeport Harbor to handle tanker on-loading operations.

Raw water supply alternatives include acquisition of raw water from Dow Chemical Co.'s reservoirs or from ground water aquifers. Dow Chemical's Harris and Brazoria reservoirs have sufficient storage to satisfy the SPR requirements; a new 6 mile pipeline would have to be constructed, which would cross coastal prairie along the Brazos River Diversion Channel and at Bryan Mound. The ground water supply alternative would require construction of at least 10 wells and about 8.7 miles of pipeline; the location of these wells is not finalized at this time, but most of the activity would probably take place in the coastal marsh on the west side of the Brazos River Diversion Channel.

Brine disposal alternatives include a 12.5 mile brine diffuser in the Gulf of Mexico, injection of all brine into deep, salt water bearing sands or supply to Dow for use in their petrochemical processing operations. The brine diffuser would require a 14.2 mile pipeline passing through 20 acres of coastal prairie on land. Deep injection would require construction of 19 additional disposal wells (1 acre each) and 3.6 miles of additional brine pipeline, most of which would be in coastal marshlands; additional brine injection pumps would be required at the storage site. Supply of brine to Dow would require no additional pipelines, but the maximum rate of brine production may exceed Dow's requirements.

On-site power generation is an alternative to the purchase of commercial power. Large generators would not require much additional land, but would locally increase air pollutant emissions.

8.4 SUMMARY OF ACTIVITIES AT ALLEN DOME ALTERNATIVE SITE

Proposed Activities

Development of 100 MMB capacity at the Allen dome SPR site would require development of up to 12 new solution mined cavities. Each well would require grading approximately 1 acre of coastal prairie for a drill pad and road access. After completion of the well, leaching of the storage cavern would begin. Raw water would be withdrawn from the Brazos River Diversion Channel at the intake structure built for the Bryan Mound early storage phase of the SPR program. This intake is located approximately 2 miles from the Gulf of Mexico. The raw water would be piped to the Allen dome site via a 12.1 mile pipeline crossing 123 acres of prairie grassland, 2 acres of fluvial woodland and 20 acres of marsh. At the site it would be injected into the wells where it would dissolve salt from the cavern walls (thus forming brine). Injection of raw water would also displace the brine previously produced in the cavern.

Brine displaced from the cavities would be allowed to settle in an on-site brine pit to permit removal of insoluble materials. Clarified brine would then be pumped from the pit and piped back to a brine diffuser in the Gulf of Mexico. This 19.6 mile pipeline would cross 143 acres of prairie grassland, 2 acres of fluvial woodland, and 20 acres of marsh, paralleling the route of the leaching water pipeline. As a partial backup system, a series of 3 brine disposal wells would be built. Each would occupy about 1 acre of prairie grassland and the pipelines would cross 1.9 miles of prairie grassland. Brine injection pumps would be situated in the pumphouse on the storage site.

Completed storage caverns would be filled with oil brought into Freeport Harbor in tankers. Two new tanker docks would be constructed, which would require about 14 acres of "made land" and about 1,050,000 cy of dredging for construction. New crude oil pipelines would be required to connect these new dock facilities to the early storage phase pipeline between SEAWAY, Inc. Docks and the Bryan Mound site. One pipeline would cross only a few hundred feet of "made land", while the second would cross approximately four acres of "made land" and four acres of coastal marsh.

At the Bryan Mound early storage site, the crude oil may be temporarily stored in one of four 200,000 bbl surge tanks, constructed as part of the early storage development. From the early storage site, the oil would be transferredto the expansion SPR storage site at Allen dome. The 12.7 pipeline would parallel the raw water and brine pipelines used in the preparation of the storage site, crossing 123 acres of prairie grassland, two acres of fluvial woodland, 24 acres of marsh, and four acres of made-land. At the site, the crude oil would be injected into the completed caverns, displacing brine, which would be disposed of through the brine pit and diffuser in the Gulf of Mexico or through the injection wells.

During an emergency withdrawal of crude oil from the storage caverns, raw water would be withdrawn from the Brazos River Diversion Channel, and piped to the Allen dome storage site to displace the stored oil. Maximum water withdrawal rates of approximately 1 MMB per day occur at this time. This represents less than 1 percent of the average flow of the Brazos River Diversion Channel. The oil would be distributed: 1) to the SEAWAY, Inc. Pipeline at the SEAWAY, Inc. Tank Farm at Jones Creek; or 2) to tankers at the new DOE docks in Freeport Harbor via the early storage pipeline and the new connector pipelines.

Plant facilities required at the Allen dome alternative SPR storage site would include access roads and pipe alleys to the wellheads, crossing 1.8 miles of prairie grassland, a central plant area housing pumps, meters, offices, shops and warehouse and also containing a transformer area, a raw water tank (to prime water pumps), a blanket oil tank and the brine pit. Grading for these facilities would cover 31 acres of prairie grassland.

Development of the Allen dome alternative SPR site would achieve economies due to the use of previously developed facilities at the Bryan Mound early storage site. These include the crude oil distribution pipelines, the raw water supply facilities, and the four surge tanks. New facilities to be developed for the SPR expansion include construction of new docks in Freeport Harbor and their connecting pipelines, brine disposal facilities and the facilities at the Allen dome alternative SPR storage site described above.

Alternative Activities

Alternatives to the proposed crude oil distribution activities described above include use of Phillips Petroleum Co.'s docks and construction of an offshore SPM terminal. Phillips' docks could be utilized on a "space-available" basis and could be relied upon only for "topping off" the crude oil storage; use of the Phillips' docks would require construction of a 0.5 mile pipeline to the early storage phase pipeline connecting the SEAWAY, Inc. docks and the Bryan Mound site; it would not reduce the requirements for the new DOE Freeport Harbor docks. Construction of an SPM deep water terminal would eliminate the need for the two proposed docks, but would require a 30 mile offshore pipeline, increased surge tankage, and conversion of existing SEAWAY Docks in Freeport Harbor to handle tanker on-loading operations.

Raw water supply alternatives include acquisition of water from ground water aquifers, from the Brazos River, from the San Bernard River or from the Gulf of Mexico. Development of the ground-water supply alternative would require construction of at least 10 wells and approximately 8.7 miles of pipeline; the location of these wells is not finalized at this time. Withdrawal of water from the Brazos River would require construction of a water-intake and pumping structure in the river, and an 5 mile pipeline crossing fluvial woodlands and prairie grasslands. Use of the San Bernard River alternative would require construction of a water intake and pumping structure in the river; the pipeline would be entirely on the site. The Gulf of Mexico diffuser alternative would dispose of brine directon to a five mile diffuse4 and would require an intake structure and 13.4 miles of pipeline, 5.8 miles offshore and 7.6 miles onshore, distributed between 17 acres of prairie grassland, and 76 acres of marsh.

Brine disposal alternatives include injection of all brine into deep salt water bearing sands or dispersal via either a 5.8 mile brine diffuser offshore of the site or a 12.5 mile diffuser from Bryan Mound. Deep injection of the brine would require construction of 19 additional disposal wells (covering 1 acre each for the drill pad) and approximately

3.2 miles of additional brine disposal pipeline crossing prairie grassland; additional brine injection pumps would be required at the storage site. Disposal of the brine through a diffuser 12.5 miles in the Gulf would require a 13.4 mile pipeline crossing 17 acres of prairie grassland, 76 acres of marsh, and 140 acres offshore. The 12.5 mile diffuser in the Gulf of Mexico would require a 26.3 mile pipeline passing through 143 acres prairie, 20 acres of marsh, two acres of woodlands and 306 acres offshore.

An alternative to the purchase of commercially available power and the transmission line right-of-way is on-site power generation. This would require construction of the generators, fuel storage tanks and an exhaust stack 100 feet high.

8.5 SUMMARY OF ACTIVITIES AT WEST COLUMBIA DOME ALTERNATIVE SITE

Proposed Activities

Development of 100 MMB capacity at the West Columbia dome SPR site would require development of up to 12 new solution mined cavities. Each well would require grading approximately 1 acre of coastal prairie for a drill pad and road access. After completion of the well, leaching of the storage cavern would begin. Raw water would be withdrawn from the Brazos River Diversion Channel at the intake structure built for the Bryan Mound early storage phase of the SPR program. This intake is located approximately 2 miles from the Gulf of Mexico. The raw water would be piped to the West Columbia dome storage site via a 27.1 mile pipeline crossing 149 acres of fluvial woodland, 169 acres of prairie grassland and 8 acres of marsh. At the site it would be injected into the wells where it would dissolve salt from the cavern walls (thus forming brine). Injection of raw water would also displace the brine previously produced in the cavern.

Brine displaced from the cavities would be allowed to settle in an on-site brine pit to permit removal of insoluble materials. Clarified brine would then be pumped from the pit and piped back to the brine diffuser in the Gulf of Mexico. This 34.6 mile pipeline would cross 149 acres of fluvial woodland, 189 acres of prairie grassland and 8 acres of marsh, paralleling the route of the leaching water pipeline. As a partial backup system, a series of 3 brine disposal wells would be built. Each would occupy about 1 acre of coastal prarie and the pipelines would cross 2.3 miles of coastal prarie. Brine injection pumps would be situated in the pumphouse on the storage site.

Completed storage caverns would be filled with oil brought into Freeport Harbor in tankers. Two new tanker docks would be constructed, which would require a total of about 14 acres of "made land" and about 1,050,000 cy of dredging for construction. New crude oil pipelines would be required to connect these new dock facilities to the early storage phase pipeline between SEAWAY, Inc. Docks and the Bryan Mound site. One pipeline would cross only a few hundred feet of "made land" while the second would cross approximately 4 acres of "made land" and 4 acres of coastal marsh.

At the Bryan Mound early storage site, the crude oil may be temporarily stored in one of four 200,000 bbl surge tanks, constructed as part of the early storage phase development. From the early storage site, the oil would be transferred to the expansion SPR storage site at West Columbia dome. The 27.7 mile pipeline would parallel the raw water and brine pipelines used in the preparation of the storage site, crossing 149 acres of fluvial woodland, 169 acres miles of prairie grassland, 12 acres of marsh, and 4 acres of made-land. At the site, the crude oil would be injected into the completed caverns, displacing brine, which would be disposed of through the brine pit and diffuser in the Gulf of Mexico or through the injection wells.

During an emergency withdrawal of crude oil from the storage caverns, raw water would berwithdrawn from the Brazos River Diversion Channel and piped to the West Columbia dome storage site to displace the stored oil. Maximum water withdrawal rates of approximately 1 MMB per day occur at this time. This represents less than 1 percent of the average flow of the Brazos River Diversion Channel. The oil would be distributed: 1) to the SEAWAY, Inc. Pipeline at the SEAWAY, Inc. Tank Farm at Jones Creek; or 2) to tankers at the new DOE docks in Freeport Harbor via the early storage pipeline and the new connector pipelines.

Plant facilities required at the West Columbia dome alternative SPR storage site would include access roads and pipe alleys to the well-heads, crossing 2.2 miles of freshwater marsh, a central plant area housing pumps, meters, offices, shops and warehouse and also containing a transformer area, a raw water tank (to prime water pumps), a blanket oil tank and the brine pit. Grading for these facilities would cover 30 acres of freshwater marsh.

Development of the West Columbia dome alternative SPR site would achieve economies due to the use of previously developed facilities at the Bryan Mound early storage site. These include the crude oil distribution pipelines, the raw water supply facilities, and the four surge tanks. New facilities to be developed for the SPR expansion include construction of new docks in Freeport Harbor and their connecting pipelines, brine disposal facilities and the facilities at the West Columbia dome alternative SPR storage site described above.

Alternative Activities

Alternatives to the proposed crude-oil distribution activities described above include use of Phillips Petroleum Co.'s docks and construction of an offshore SPM terminal. Phillips' docks could be utilized on a "space-available" basis and could be relied upon only for "topping off" the crude-oil storage; use of the Phillips' docks would require construction of a 0.5 mile pipeline to the early storage phase pipeline connecting the SEAWAY, Inc. docks and the Bryan Mound site; it would not reduce the requirements for the new DOE Freeport Harbor docks. Construction of an SPM deep-water terminal would eliminate the need for the two proposed DOE docks, but would require a 30 mile offshore pipeline, increased surge tankage, and conversion of existing SEAWAY Docks in Freeport Harbor to handle tanker on-loading operations.

Raw-water supply alternatives include acquisition of raw water from ground water aquifers or from the Brazos Rive near East Columbia. Development of the ground-water supply alternative would require construction of at least 10 wells whose locations are not finalized at this time. Withdrawal water from the Brazos River would require construction of a raw-water intake and pumping structure in the river and a 3.2 mile pipeline crossing 34 acres fluvial woodlands and 4 acres prairie grassland.

The brine disposal alternative is injection of all brine into deep salt water bearing snads. Deep injection would require construction of 19 additional disposal wells (1 acre each) and approximately 3.2 miles of additional brine disposal pipeline crossing prairie grasslands; additional brine injection pumps would be required at the storage site. The 12.5 mile brine diffuser in the Gulf of Mexico would require 41.3 miles of pipeline passing through 149 acres of woodlands, 189 acres of prairies, and eight acres of marsh.

An on-site power generation capacity is an alternative to purchase of commercial power. Implementation of this alternative would require construction of the generators, a fuel storage tank and an exhaust stack on the plant site; no additional acreage is required.

8.6 SUMMARY OF ACTIVITIES AT DAMON MOUND ALTERNATIVE SITE

Proposed Activities

Development of 100 MMB capacity at the Damon Mound SPR site would require development of up to 12 new solution mined cavities. Each well would require grading approximately 1 acre of coastal prairie for a drill pad and road access. After completion of the well, leaching of the storage cavern would begin. Raw water would be withdrawn from the Brazos River Diversion Channel at the intake structure built for the Bryan Mound early storage phase of the SPR program. This intake is located approximately 2 miles from the Gulf of Mexico. The raw water would be piped to the Damon Mound storage site via a 36.4 mile pipeline crossing 182 acres of fluvial woodland, 249 acres of prairie grassland, 8 acres of marsh, and 5 acres of made-land. At the site it would be injected into the wells where it would dissolve salt from the cavern walls (thus forming brine). Injection of raw water would also displace the brine previously produced in the cavern.

Brine displaced from the cavities would be allowed to settle in an on-site brine pit built to permit removal of insoluble materials. Clarified brine would them be pumped from the pit and piped back to the brine diffuser in the Gulf of Mexico. This 43.9 mile pipeline would cross 182 acres of fluvial woodland, 269 acres of prairie grassland, 8 acres of marsh, and 5 acres of cleared land paralleling the route of the leaching water pipeline. As a partial backup system, a series of 3 brine disposal wells would be built. Each would occupy about 1 acre of prairie grassland and the pipelines would cross 2.9 miles of prairie grassland. Brine injection pumps would be situated in the pumphouse on the storage site.

Completed storage caverns would be filled with oil brought into Freeport Harbor in tankers. Two new tanker docks would be constructed, which would require a total of about 14 acres of "made land" and about 1,050,000 cy of dredging for construction. New crude oil pipelines would be required to connect these new dock facilities to the early storage phase pipeline between SEAWAY, Inc. Docks and the Bryan Mound site. One pipeline would cross only a few hundred feet of "made land," while the second would cross approximately 4 acres of "made land" and 4 acres of coastal marsh.

At the Bryan Mound early storage site, the crude oil may be temporarily stored in one of four 200,000 bbl surge tanks, constructed as part of the early storage phase development. From the early storage site, the oil would be transferred to the expansion SPR storage site at Damon Mound. The 37 mile pipeline would parallel the raw water and brine pipelines used in the preparation of the storage site, crossing 182 acres of fluvial woodland, 249 acres of prairie grassland, 12 acres of marsh, and 9 acres of made-land. At the site, the crude oil would be injected into the completed caverns, displacing brine, which would be disposed of through the brine pit and diffuser in the Gulf of Mexico or through the injection wells.

During an emergency withdrawal of crude oil from the storage caverns, raw water would be withdrawn from the Brazos River Diversion Channel, and piped to the Damon Mound storage site to displace the stored oil. Maximum water withdrawal rates of approximately 1 MMB per day occur at this time. This represents less than 1 percent of the average flow of the Brazos River Diversion Channel. The oil would be distributed: 1) to the SEAWAY, Inc. Pipeline at the SEAWAY, Inc. Tank Farm at Jones Creek; or 2) to tankers at the new DOE docks in Freeport Harbor via the early storage pipeline and the new connector pipelines.

Plant facilities required at the Damon Mound alternative SPR storage site to operate the facility would include access roads and pipe alleys to the wellheads, crossing 6 miles of prairie grassland, a central plant area housing pumps, meters, offices, shops and warehouse and also containing a transformer area, onsite power generators, a raw water tank (to prime water pumps), a blanket oil tank and the brine pit. Grading for these facilities would cover 30 acres of prairie grassland.

Development of the Damon Mound alternative SPR site would achieve economies due to the use of previously developed facilities at the Bryan Mound early storage site. These include the crude oil distribution pipelines, the raw water supply facilities, and the four surge tanks. New facilities to be developed for the SPR expansion include construction of new docks in Freeport Harbor and their connecting pipelines, brine disposal facilities and the facilities at the Damon Mound alternative SPR storage site described above.

Alternative Activities

Alternatives to the proposed crude oil distribution activities described above include use of Phillips Petroleum Co.'s docks and construction of an offshore SPM terminal. Phillips' docks could be utilized on a "space-available" basis and could be relied upon only for "topping off" the crude oil storage; use of the Phillips' docks would require construction of a 0.5-mile pipeline to the early storage phase pipeline connecting the SEAWAY, Inc. Docks and the Bryan Mound site; it would not reduce the requirements for the new DOE Freeport Harbor docks. Construction of an SPM deep-water terminal would eliminate the need for the two proposed DOE docks, but would require a 30-mile offshore pipeline, increased surge tankage and conversion of existing SEAWAY Docks in Freeport Harbor to handle tanker on-loading operations.

Raw-water supply alternatives include acquisition of raw water from ground water aquifers and from the Braozos River east of Damon Mound. Development of the ground-water supply alternative would require construction of at least 10 wells and approximately 6.1 miles of pipeline; the location of these wells is not finalized at this time. Withdrawal of water from the Brazos River would require construction of a water intake and pumping structure in the river, and a 10-mile pipeline crossing 115 acres of prairie grasslands, 4 acres of fluvial woodlands and 3 acres of water bodies.

A brine disposal alternative is injection of all brine into deep salt water bearing snads. Deep injection would require construction of 19 additional disposal wells (1 acre each) and approximately 3.2 miles of additional brine disposal pipeline crossing prairie grasslands; additional brine injection pumps would be required at the storage site. The 12.5 mile brine diffuser in the Gulf of Mexico would require 50.6 miles of pipeline passing through 182 acres of woodlands, 269 acres of prairies, 8 acres of marsh and 5 acres of made-land.

Purchase of commercial power is an alternative to on-site power generation. Construction of a utility corridor would be required.

8.7 SUMMARY OF ACTIVITIES AT NASH DOME ALTERNATIVE SITE

Proposed Activities

Development of 100 MMB capacity at the Nash dome SPR site would require development of up to 12 new solution mined cavities. Each well would require grading approximately 1 acre of coastal prairie for a drill pad and road access. After completion of the well, leaching of the storage cavern would begin. Raw water would be withdrawn from the Brazos River Diversion Channel at the intake structure built for the Bryan Mound early storage phase of the SPR program. This intake is located approximately 2 miles from the Gulf of Mexico. The raw water would be piped to the Nash dome storage site via a 36.7 mile pipeline crossing 210 acres of fluvial woodland, 258 acres of prairie grassland and 8 acres of marsh. At the site it would be injected into the wells where it would dissolve salt from the cavern walls (thus forming brine). Injection of raw water would also displace the brine previously produced in the cavern.

Brine displaced from the cavities would be allowed to settle in an on-site brine pit to permit removal of insoluble materials. Clarified brine would then be pumped from the pit and piped back to a brine diffuser in the Gulf of Mexico. This 44.2 mile pipeline would cross 210 acres of fluvial woodland, 278 acres of prairie grassland and 8 acres of marsh, paralleling the route of the leaching water pipeline. As a partial backup system, a series of 3 brine injection wells would be built. Each would occupy about 1 acre of prairie grassland and the pipelines would cross 2.5 miles of prairie grassland. Brine injection pumps would be situated in the pumphouse on the storage site.

Completed storage caverns would be filled wih oil brought into Freeport Harbor in tankers. Two new tanker docks would be constructed, which would require a total of about 14 acres of "made land" and about 1,050,000 cy of dredging for construction. New crude oil pipelines would be required to connect these new dock facilities to the early storage phase pipeline between SEAWAY, Inc. Docks and the Bryan Mound site. One pipeline would cross only a few hundred feet of "made land," while the second would cross approximately 4 acres of "made land" and 4 acres of coastal marsh.

At the Bryan Mound early storage site, the crude oil may be temporarily stored in one of four 200,000 bbl surge tanks, constructed as part of the early storage phase development. From the early storage site, the oil would be transferred to the expansion SPR storage site at Nash dome. The 37.3 mile pipeline would parallel the raw water and brine pipelines used in the preparation of the storage site, crossing 210 acres of fluvial woodland, 258 acres of prairie grassland, 12 acres of marsh, and 4 acres of made-land. At the site, the crude oil would be injected into the completed caverns, displacing brine, which would be disposed of through the brine pit and diffuser in the Gulf of Mexico or through the injection wells.

During an emergency withdrawal of crude oil from the storage caverns, raw water would be withdrawn from the Brazos River Diversion Channel and piped to the Nash dome storage site to displace the stored oil. Maximum water withdrawal rates of approximately 1 MMB per day occur at this time. This represents less than 1 percent of the average flow of the Brazos River Diversion Channel. The oil would be distributed: 1) to the SEAWAY, Inc. Pipeline at the SEAWAY, Inc. Tank Farm at Jones Creek; or 2) to tankers at the new DOE docks in Freeport Harbor via the early storage pipeline and the new connector pipelines.

Plant facilities required at the Nash dome alternative SPR storage site would include access roads and pipe alleys to the wellheads, crossing 5.7 miles of cleared land, a central plant area housing pumps, meters, offices, shops and warehouse and also containing a transformer area, on-site power generators, a raw-water tank (to prime water pumps), a blanket oil tank and the brine pit. Grading for these facilities would cover 30 acres of prairie grassland.

Development of the Nash dome alternative SPR site would achieve economies due to the use of previously developed facilities at the Bryan Mound early storage site. These include the crude oil distribution pipelines, the raw water supply facilities, and the four surge tanks. New facilities to be developed for the SPR expansion include construction of new docks in Freeport Harbor and their connecting pipelines, brine disposal facilities and the facilities at the Nash dome alternative SPR storage site described above.

Alternative Activities

Alternatives to the proposed crude-oil distribution activities described above include use of Phillips Petroleum Co.'s docks and construction of an offshore SPM terminal. Phillips' docks could be utilized on a "space-available" basis and could be relied upon only for "topping off" the crude oil storage; use of the Phillips' docks would require construction of a 0.5 mile pipeline to the early storage phase pipeline connecting the SEAWAY, Inc. docks and the Bryan Mound site; it would not reduce the requirements for the new DOE Freeport Harbor docks. Construction of an SPM deep-water terminal would eliminate the need for the two proposed DOE docks, but would require a 30 mile offshore pipeline, increased surge tankage, and conversion of existing SEAWAY Docks in Freeport Harbor to handle tanker on-loading operations.

Raw-water supply alternative sinclude acquisition of raw water from ground water aquifers or from the Brazos River east of the Nash dome site. Development of the ground-water supply alternative would require construction of at least 10 wells and approximately 6.1 miles of pipeline; the location of these wells is not finalized at this time. Withdrawal of water from the Brazos River would require construction of a water intake and pumping structure in the river, and a 6.1 mile pipeline crossing prairie grassland.

A brine disposal alternative is injection of all brine into deep salt water bearing sands. Deep injection of the brine would require construction of 19 additional disposal wells (1 acre each) and approximately 3.2 miles of additional brine disposal pipeline crossing prairie grasslands; additional brine injection pumps would be required at the storage site. The 12.5 mile brine diffuser in the Gulf of Mexico would require 50.9 miles of pipeline passing through 210 acres of fluvial woodlands, 278 acres of prairie grassland and 8 acres of marsh.

An alternative to on-site generation of power is the purchase of commercial power. A utility corridor would have to be established.

CHAPTER 9.0

CONSULTATION AND COORDINATION WITH OTHERS

Various local and regional agencies contributed information and assistance for the preparation of this Environmental Impact Statement. Further advice and coordination will be sought from agencies having regulatory jurisdiction over those segments of the environment which would or could be potentially affected by the proposed project. Procedures are currently underway to prepare applications for those permits and licenses which would be required to proceed with the implementation of the early storage phase of the project.

9.1 COORDINATION AND CONTACTS WITH OTHERS

In preparation for the Bryan Mound early storage phase Environmental Impact Statement (FES 76/77-6), the July 1977 Supplement, and this Environmental Impact Statement, numerous agencies, governmental units and other groups were consulted for information and technical expertise pertaining to the proposed project. These groups are listed alphabetically below.

Federal

United States Army Corps of Engineers, Galveston, Texas
United States Coast Guard, Port Arthur, Texas
Environmental Protection Agency, Dallas, Texas, Region VI
Federal Insurance Administration
United States Geological Survey, National Center, Reston, Virginia
Department of the Interior
National Marine Fisheries Service
National Oceanic and Atmospheric Administration, New Orleans, Louisiana
Occupational Safety and Health Administration, New Orleans, Louisiana

State

General Land Office, Austin, Texas
Texas Park and Wildlife Commission, Austin, Texas
Railroad Commission, Austin, Texas
Tax Assessors Office, Freeport, Texas
Texas Water and Light Commission, Austin, Texas
Texas Water Quality Board, Austin, Texas

Local

Brazos River Authority, Wade, Texas

County Engineer, Brazoria, Texas

Port of Houston Authority, Houston, Texas

Other

Dow Chemical Company, Freeport, Texas

Gulf Oil Corporation, Houston, Texas

Lockheed Aircraft Company, Clean Lake City, Texas

LOOP, Inc., New Orleans, Louisiana

Rice University, Houston, Texas

Seadock, Inc., Houston, Texas

Texas A&M University

Texas Eco, Bryan, Texas

University of Houston, Houston, Texas

9.2 ENVIRONMENTALLY ORIENTED PERMITS AND LICENSES

Regulatory Bodies and Their Jurisdictional Concerns:

The Federal and State regulations which must be complied with during project development are listed in Table 9.2-1. DOE will consult with the State agencies in charge of implementing these regulations pursuant to the Intergovernmental Coordination Act of 1968.

TABLE 9.2-1 Regulatory bodies and their jurisdictional concerns.

AGENCY	REGULATORY JURISDICTIONAL CONCERNS	REFERENCE	REMARKS
1. U.S. Army Corps of Engineers, Galveston, District Engineer	A. "General Regulatory Policies"	33 CFR 320	
	1. Prohibits the unauthorized obstruction or alteration of any navigable waters.		
	2. Discharge of dredged materials into navigable waters.		
	3. Structures or activities affecting the navigability of navigable waters; includes structures under a navigable waterway.		
	4. Discharge of refuse into navigable waters.		
	5. Temporary occupation with use of any seawall, bulkhead, etc.		
	6. Declares a national policy to encourage a productive and enjoyable harmony between man and his environment.		
	7. Preservation of the quality of the aquatic environment as it affects the conservation, improvement and enjoyment of fish and resources.		
	8. License needed which will reflect upon properties listed in the National Register of Historic Places.		
	B. "Permits for Structures or Work in or Affecting Navigable Waters of the United States"	33 CFR 322	
	1. Structures or activities affecting the navigability of navigable waters; includes structures under a navigable waterway.		
	2. Work connecting canals to navigable waters.		
	3. Fixed structures on the outer continental shelf.		
	4. Piers or bulkheads at the coastline.		
	C. "Permits for Discharges of Dredged or Fill Material into Waters of the United States"	33 CFR 323	

TABLE 9.2-1 continued.

AGENCY	REGULATORY JURISDICTIONAL CONCERNS	REFERENCE	REMARKS
2. U.S. Coast Guard, District Commander of 8th Coast Guard District (New Orleans)	Coast Guard Regulations on Oil Spills	33 CFR 154	Letters of intent must be submitted and approved 60 days prior to date the operation is intended to begin.
	Letter of intent to operate oil transfer facility.	33 CFR 154 110	
3. U.S. Environmental Protection Agency, Region VI	Regulations on Policies and Procedures for the National Pollutant Discharge Elimination System (NPDES)	40 CFR 125	
	1. These Regulations proscribe the policy and procedures to be followed by the Administrator of the U.S.E.P.A. pursuant to Sections 402 and 403 of the Federal Water Pollution Control Act.	33 USC 1251 nt	
	2. Requires permits . . . for any industrial discharges into navigable waters including the "contiguous zone" territorial sea. Such a permit would probably be necessary for discharge of effluents from the offshore and onshore terminal waste treatment facilities. In addition, should the NPDES permit system requirements not apply to a particular from the EPA administrator (or from appropriate designated State or Interstate agencies) whenever a Federal license or permit is being sought for activities which may result in discharge into the navigable waters.		
	Regulations on Oil Pollution Prevention	40 CFR 112	
	A Spill Prevention, Control, and Countermeasures Plan (SPCC) must be prepared for each oil handling facility, within six months of the commencement of facility operations.	40 CFR 112.3	
	Regulations on Transportation for Dumping, and Dumping of Materials into Ocean Waters	40 CFR 220	
	Permit for ocean dumping required for brine disposal.	40 CFR 220.1 (b) (2)	

TABLE 9.2-1 continued.

AGENCY	REGULATORY JURISDICTIONAL CONCERNS	REFERENCE	REMARKS
4. Texas Department of Water Resources	(a) Permit for discharge of waste into public waters.	Texas Water Quality Act, Chapter 21, Vernon's Texas Water Code, Section 21.079	
	(b) Permit required prior to construction of a treatment facility.		
	(c) A waste discharge from any industrial, public or private project or development which constitutes a new source of pollution is required to have the highest and best degree of treatment available under existing technology.	Texas Water Quality Rule 635.6	If treatment facilities are built in a flood area, the design report shall describe precautions taken to prevent waste from entering floodwaters.
	(d) Notification must be given within 24 hours of any spill or accidental discharge.	Texas Water Quality Rule 635.4	
	(e) Activities which are inherently capable of causing spillage or accidental discharge of polluting substances are subject to regulations or preventive measures adopted by the Board.	Texas Water Quality Rule 635.6	
	(f) Certification of NPDES permits.	Texas Water Quality Rules, Section 645	
	(g) Permits required for storm water runoff.		
	(h) Appropriate permit required for use of surface waters and leaching and displacement.	Texas Water Code, Chapters 5 and 6	Annual Report of water taken from streams and reservoirs may be requested.
	(i) Appropriate permit required for use of surface waters for water supply system for human use.		
5. Texas Air Control Board	(a) Construction permit required for any facility that may emit air contaminants.	Texas Clean Air Act (Article 4477-5) Section 3.27; Texas Regulation VI, Rule 601	Plans and specifications are to be submitted for determining compliance with air control standards.
	(b) Operating permits are issued for any facility that emits air contaminants.	Texas Clean Air Act (Article 4477-5), Section 3.28	Application must be made within 60 days after operation commences; monitoring data may be required.

TABLE 9.2-1 continued.

AGENCY	REGULATORY JURISDICTIONAL CONCERNS	REFERENCE	REMARKS
6. Texas Water Development Board	Certification that well casings are sufficiently sealed and that use of wells will not contaminate fresh water supplies.	Texas Water Conservation Rules and Regulations (Rules 8 and 13)	
7. Texas Railroad Commission	(a) Notification of drilling operations relating to oil activities.	Texas Railroad Commission Rules and Regulations	
	(b) Permit for oil pipelines.	Rule 70	
	(c) Submission of monthly storage reports and annual pipeline operation reports.		
	(d) Permit required to dispose of brine.		If all brine is transferred to Dow, no permit is required.
8. Texas General Land Office	Right-of-way of pipelines crossing public lands.		Office will submit letter of objection or no objection to Corps.
9. Texas State Department of Highways	Right-of-way for pipelines crossing highways.		
10. Texas Historical Commission	(a) Notification of findings of survey conducted to determine whether National Register of Historic Places property would be affected by the project.	16 U.S.C. 470(f) "National Historical Preservation Act of 1966"	
	(b) Notification of findings of survey conducted to determine whether properties which would be eligible for nomination to the National Register of Historic Places would be affected by the project.	Executive Order #11593 "Protection and Enhancement of the Cultural Environment," May 1971	

TABLE 9.2-1 continued.

AGENCY	REGULATORY JURISDICTIONAL CONCERNS	REFERENCE	REMARKS
11. Texas Parks and Wildlife Department	(a) No permit required if all dredged spoil will be used to backfill pipeline trench, and stream banks will be returned to original condition after pipeline construction. (b) As above, and, if beaches will be returned to original condition after use of Gulf water for leaching and displacement.		Office will submit letter of objection or no objection to Corps.
12. Texas Department of Health Resources	(a) Approval of plans and specifications required before construction of water supply system, for human use, is commenced. (b) Permit required for collection, handling, storage, and disposal of municipal or industrial solid waste.		
13. Velasco Drainage District	Permits required for laying pipelines through to levees and through wave barrier.		District will submit letter of objection or no objection to Corps.
14. Brazoria County Commissioners Court	Approval required for laying pipelines across county roads.		
15. Brazoria County Health Department	Permit required for septic tank.		

9.3 REQUEST FOR COMMENTS

Comments on the Draft EIS for Seaway Group Salt Domes were requested from the following agencies, companies, and organizations. Copies of the document were also made available to the Council on Environmental Quality and to the public in September 1977.

Federal

Department of Agriculture
Department of the Army
Department of Commerce
Department of Defense
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of Labor
Department of State
Department of Transportation
Department of the Treasury
Advisory Council on Historic Preservation
Appalachian Regional Commission
Council on Environmental Quality
Energy Research and Development Administration
Environmental Protection Agency
Federal Energy Administration (10 Regional Offices)
Federal Power Commission
Interstate Commerce Commission
National Science Foundation
Nuclear Regulatory Commission
Tennessee Valley Authority
Water Resources Council
National Oceanic and Atmospheric Administration
U.S. Fish & Wildlife Service

State

Texas State Clearinghouse
Texas Soil and Water Conservation Board
Texas Railroad Commission
Texas Parks and Wildlife Department
Texas Department of Water Resources
Texas Department of Agriculture
Texas Industrial Commission
Texas Air Control Board
State Department of Highways and Public Transportation
Bureau of Economic Geology
General Land Office
Texas Forest Service
Texas Department of Health Resources
Texas Energy Advisory Commission
Office of the Governor

Texas Coastal and Marine Council
Texas Historical Commission
Division of Natural Resources and the Environment
Office of State-Federal Relations
Brazos River Authority

Local

Brazoria County
Fort Bend County
Velasco Drainage District
City of Freeport
Houston-Galveston Area Council of Governments
Franklin County
East Texas Council of Governments
Hopkins County
Orange County
Smith County

Other

American Petroleum Institute
Center for Law and Social Policy
Electric Power Research Institute
Environmental Defense Fund, Inc.
Environmental Policy Center
Friends of the Earth
Fund for Animals, Inc.
Institute of Gas Technology
Interstate Natural Gas Association
Izaak Walton League of America
Energy Conservation Committee--Keys to Education for Environmental Protection
National Association of Counties
National Audubon Society
National Parks and Conservation Association
National League of Cities
National Resource Defense Council, Inc.
National Wildlife Federation
New York State--Office of Energy Analysis
U.S. Conference of Mayors
American Littoral Society
Edison Electric Institute
Kaiser Engineers
Florida Audubon Society
Galveston Audubon Society
Council of the Environment
League of Women Voters
Houston Power & Light
Nature Conservancy
South Jetty
Sierra Club--Gulf Coast Regional Conservation Committee
Sierra Club--Southern Plains Regional Conservation Committee
Sierra Club, Houston

LOOP, Inc.
Seadock, Inc.
Gulf States Marine Fisheries Commission
Dow Chemical
Spradlin, Hoker, Best and Spradlin
Mobil Oil Corporation
The Houston Post
Texas Conservation Council, Inc.
Houston Sportsmen's Club
Texas Environmental Coalition
Houston Audubon Society
Seaway Pipeline, Inc.
Morton Salt
Texasgulf, Inc.
Texas Coastal and Marine Council
Rice University
Sabine River Authority
Southern Methodist University
Southwestern Electric Power Company
Texas A&M University
University of Texas
American Fisheries Society

9.4 DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

The list of agencies and groups included with the Summary in the front of this statement indicates those who furnished written comments on the draft environmental impact statement to the Department of Energy within the allotted comment period. Copies of the comment letters are included in Appendix K.

All of the review comments received by DOE have been considered in the preparation of this final EIS. Although only timely comments are formally addressed here, all comments were considered to the extent practicable in the preparation of the document. The EIS has been expanded and modified where appropriate as a result of comments received. In other cases, either no substantive issues were raised or no change to the EIS was considered appropriate. The following listing presents a summary of the disposition of substantive issues raised in the comments.

9.4.1 Comments Received from Federal Agencies

9.4.1.1 U.S. Environmental Protection Agency, November 30, 1977

Comment 1:

The statement would be strengthened if it included dimensional drawings of the proposed intake structures for raw water withdrawal. In addition, the statement should address intake flow velocity and screen designs that will be used. This information would allow for an effective evaluation of these structures to determine whether best technology in their design has been used to minimize environmental impacts.

Response:

The proposed raw water intake structure will be constructed as part of the early storage phase development of the Bryan Mount Salt Dome, and is discussed in detail in Section 1.2.1 of the Final Supplement to FEA FES 76/77-6. Intake flow velocity would be limited to less than 0.5 feet per second under maximum intake volumes at low tidal elevations. A traveling screen with a 3/16" mesh opening will be used.

Comment 2:

The draft EIS needs to be strengthened with regard to draft regulations of the Underground Injection Control (UIC) Program of the Safe Drinking Water Act (PL 93-523). Sufficient data should be presented to EPA when it becomes available from the on-going testing and analysis program before initiation of the emplacement, mining or disposal operations. This information provided should be consistent with the requirements proposed in EPA Administrator's Decision Statement #5 (39 CFR:69) or the superseding UIC regulations when final, and the permit regulations of the Oil and Gas Division of the Texas Railroad Commission. The intentions of the applicant with regard to these recommendations should be addressed in the Final EIS.

Response:

The EIS reflects preliminary designs and an appraisal of available information on the environment which potentially may be affected. This material is considered to be of sufficient detail to enable an assessment of the environmental feasibility of the project. In several instances, flexible designs and close monitoring of construction and operation would be required to support an effective evaluation of the resulting environmental impacts. Data would be provided to EPA and to the Texas Railroad Commission as it becomes available and DOE would closely coordinate the appropriate activities with EPA and the Texas Railroad Commission. At the public hearing conducted by the Texas Railroad Commission on September 15, 1977, information was provided on the planned brine injection system. Additional information is provided in the Final Supplement to the Bryan Mound FES.

Comment 3:

The method of brine disposal strongly recommended involves using the displaced brine as a chemical feed stock wherever practicable. The applicant's intention on this recommendation should be addressed in the Final.

Response:

In the event that brine produced by SPR activities can be economically used by local industry, DOE would attempt to make it available. There are, however, several technological and economic barriers reducing the likelihood that the SPR brine would be put to such uses. First, the quality of brine for industrial use, such as feedstock for chlorine and soda ash plants, must be extremely high. This quality is a function of several characteristics, the most important being 1) the purity of the salt in the formation, 2) the quality of the dissolving water, 3) the salt concentration in the brine, and 4) the soluble impurities in the brine, primarily potassium, magnesium and sodium sulfate.

The dissolving water to be used for leaching new caverns at Bryan Mound or any of the alternative sites in the Seaway Group would come from the Brazos River, having an unacceptably high level of impurities to be useable in sensitive chemical processes. Pretreatment of the raw water would be required at a much higher cost if the brine were to be sold. Further, the quality and salt concentration required varies between industries and processes and the quantity of brine produced during SPR leaching would exceed the demand of any single receiving facility. Therefore, if more than one plant were to be served it would be difficult to define a common brine quality acceptable to all receivers. Pipelines would need to be built at considerable cost to the plants using the brine. Given the relatively short duration of leaching activities and the uncertainty of brine supply during later fill cycles, in addition to the problems cited above, the economic feasibility of selling SPR displaced brine is uncertain.

Brine in the existing caverns at Bryan Mound is presentely being delivered to Dow Chemical Company as the initial fill for the early storage phase proceeds. However, this arrangement is temporary only, and involves relatively low rates and volumes. Dow has not expressed a willingness to accept brine (or provide the water necessary) at the rates and volumes required for leaching.

Comment 4:

It appears that impacts regarding utilization and loss of wetlands could be minimized if appropriate measures were taken. In light of Executive Order 11990 on Protection of Wetlands the applicant should substantively evaluate proposed and alternative actions regarding their potential to adversely impact wetlands, practicability, and possible mitigative measures. Efforts should be made to avoid wetland utilization for any rights-of-way. Planning for future storage and expansion should consider offshore domes and other sites inland from wetland areas.

Response:

The issue of wetlands preservation has been addressed in numerous sections of the draft EIS. Initial alignments of the pipeline rights-of-way and other facilities were made with sensitivity to this issue. Where possible the SPR pipeline rights-of-way were located along existing rights-of-way or adjacent to other previously developed areas to minimize the impacts on wetlands. This approach will be confirmed by DOE in later detailed design and engineering studies. Some rewording in sections dealing with wetlands in the draft EIS has occurred to better reflect DOE's concern for wetlands.

Comment 5:

The statement should address any discharges as a result of domestic wastewater treatment at the selected SPR expansion sites. The statement should address the location of the discharge point, the type of treatment, and the possible impacts this discharge could have on the receiving stream. In addition, the statement should address whether application for a National Pollutant Discharge Elimination System (NPDES) permit has been made.

Response:

Sanitary wastes generated at the proposed storage sites or along the construction rights-of-way would be handled through portable facilities provided consistent with Occupational Safety and Health Administration regulations. Current plans for operation of early storage capacity at Bryan Mound include the construction of an underground holding tank for domestic wastewater which will be periodically pumped out and transferred to the Freeport wastewater treatment facility for disposal.

No additional facilities would be necessary for SPR operations at Bryan Mound. Similar wastewater handling procedures are anticipated for use at the alternative sites. An application for an NPDES permit has been submitted to EPA for the discharges which would occur at Bryan Mound.

Comment 6:

On page B.2-82, in the discussion of the interpretative ruling of December 21, 1976, regarding the Federal Clean Air Act, the name "Emission Trade-Offs" is incorrectly used since it is more commonly referred to as "Emission Offset." This discrepancy in terminology should be corrected in the final statement. Furthermore, based on the extrapolation from regional air quality data, the statement indicates that levels of non-methane hydrocarbons and photochemical oxidants are predicted to be high and are expected to continue to exceed standards occasionally in the Freeport, Texas area. Therefore, the emission offset policy may apply for the proposed project. In addition, the final statement should note that the exclusion of new sources, which emit less than 100 tons per year, as required under the emission offset policy, is based on "potential" instead of "actual" emissions. These matters and their effect upon this project should be adequately considered and addressed in the final statement.

Response:

These changes have been incorporated on pages B.2-80, B.2-83, 3.2-20 and 3.2-21. The text has also been modified to reflect the EPA determination that the offset policy does not apply to SPR facilities due to the temporary and intermittent nature of the emissions. DOE is aware that the EPA policy regarding emission offsetts is currently undergoing review and that a clarification will be issued in the near future. DOE will take any steps necessary as a result of this clarification.

Comment 7:

In addressing the ambient air quality standards, the final statement should recognize that the Clean Air Act, amended on August 7, 1977, has changed past Prevention of Significant Deterioration (PSD) Regulations. Those changes that are significant to this project are that PSD designated source categories have been expanded from 19 to 28 sources, one of which is petroleum storage and transfer facilities. Also, PSD regulations no longer apply only to particulate and sulphur dioxide emissions but to all criteria pollutants, (i.e., Sulfur Dioxide (SO_2), Total Suspended Particulate (TSP), Non-Methane Hydrocarbon (NMHC), Nitrous Oxides (NO_x), Carbon Monoxide (CO), and Photochemical Oxidants (O_3)). These changes and their effect upon this project should be considered and adequately addressed in the final statement.

Response:

These changes have been incorporated on pages B.2-80 and 3.2-20.

Comment 8:

The levels of environmental noise tabulated on page B.2-88 of the Draft EIS have been labeled as "established guidelines," from EPA. This phrase, "established guidelines," is incorrect. Rather, this table reflects "identified levels" which are requisites to protect public health and welfare with an adequate margin of safety for both activity interference and hearing loss. Furthermore, the noise levels cited in this table do not constitute a regulation, specification, or standard. This discrepancy should be corrected in the final statement.

Response:

Section B.2.4, Background Ambient Sound Levels, has been revised accordingly.

Comment 9:

The Draft EIS needs to be strengthened in the section addressing the Spill Prevention Control and Countermeasure (SPCC) Plan. The Final EIS should contain a statement that a SPCC Plan, which will meet the requirements of Coded Federal Regulations 40 CFR 112, will be prepared within six months after the facilities begin operation and shall be fully implemented no later than one year after operations begin.

Response:

Section E.2.1.5 has been revised to include a statement defining implementation of the SPCC Plan.

9.4.1.2 National Oceanic & Atmospheric Administration, National Ocean Survey, November 2, 1977

Comment 1:

Appendix B - Description of the Environment - Historical mean surface current data are for a position 30 miles SW of diffuser location. Topographic, wind shear, and other effects may cause significant differences. Site specific data are missing.

Response:

Site specific data have been obtained since publication of the Draft EIS. These data have been included in the description of the Environment in Chapter 3 and Appendix B and in the discussion of impacts in Chapter 4 and Appendix C. Complete data are presented in Appendix G.

Comment 2:

Appendix E - Oil and Brine Spill Risk Analysis - The present state-of-the-art for oil spill analysis includes models which provide contours of probabilistic impact and probabilistic time to impact. This information, missing in the subject DEIS, would improve the plan for containment and removal of spilled oil.

Response:

Oil movement, as addressed in the EIS, includes tanker transport in coastal waters from the 12-mile limit to the SEAWAY docks. Spills occurring in these waters would be principally influenced by nearshore currents and tides, harbor dimensions and man-made features. Models which provide contours of probabilistic impact and probabilistic time to impact are more appropriate for assessing effects of spills in open waters, with no nearshore influences, and would not provide a meaningful approximation of actual conditions.

Comment 3:

Appendix G - Brine Dispersion Modeling - The two modeling approaches used to characterize the dispersion of brine into surrounding waters may suffer from assumptive mathematical simplifications. The limitation of steady state and constant current field of the Radian Corporation model has been recognized in the DEIS. The assumptions of constant depth and vertically constant current are weaknesses in the MIT model.

Response:

The approach used by the MIT investigators assumes a constant depth and a vertically constant current in order to closely approximate ambient conditions while yielding a manageable mathematical model. Future developments in modeling capability will likely enable the removal of these potential limitations.

For the Gulf Coast area which exhibits a low bottom gradient, the assumption of a uniform water depth is reasonable in both the near and far field. A constant vertical current, while not accurately depicting conditions in the very near field becomes less significant in the intermediate and far field. Additionally, for the high velocity diffusers analyzed, jet velocity is greatly in excess of current velocity (by about two orders of magnitude) and the near field plume would be little influenced by current variations with depth.

9.4.1.3 National Oceanic & Atmospheric Administration, National Marine Fisheries Service, November 2, 1977

Comment 1:

In the numerous sections of the DEIS dealing with the primary brine disposal location for all sites being considered, it appears that the locations in the Gulf of Mexico five nautical miles southeast of Bryan Mound were selected solely to obtain a 50-ft. depth for disposal of the brine. Apparently, no considerations are given to alternative sites in the Gulf which would be less damaging to marine fishery resources.

Response:

Criteria for the evaluation of brine disposal locations included technical feasibility, navigational restraints and cost, together with an assessment of potential impacts to the physical, chemical and biological environments. Based on these criteria, the proposed diffuser site 5.0 nautical miles southeast of Bryan Mound was selected. A complete discussion of the criteria and potential impacts is presented in Appendix G for both the proposed location and an alternative site 10.9 nautical miles from shore.

Comment 2:

Additional information on the abundance and productivity of marine species in the vicinity of the proposed and alternative sites should be incorporated and discussed in the appropriate sections of the Final EIS. Additional alternative disposal sites in other nearby parts of the Gulf of Mexico that are not known to be sensitive habitats for marine species that are major components of the recreational and commercial fisheries should be discussed.

Response:

Shrimp fishery statistics for the Galveston District have been included in Appendix G. This appendix also contains a discussion of the diversity and abundance of zooplankton, phytoplankton and benthic fauna in the same area. Additional information on the location and productivity of species of commercial or recreational value provided by the Texas Agricultural Extension Service has also been included and discussed in Appendix G relative to the proposed and alternative sites. The location of spawning sites relative to the proposed diffuser operations has been assessed using information on brine dispersion from the NOAA Analysis of Brine Disposal in the Gulf of Mexico. The impacts of brine diffusion are summarized in Sections 4.3.1.5 and 4.3.2.5.

Comment 3:

In the presentation of deep well injection of brine into deep saline aquifers as an alternative to discharge of brine into the Gulf of Mexico, for each of the five Seaway candidate sites, the alternative of directional drilling from non-wetland locations should also be discussed for those candidate sites wherein wetlands are presently being considered as possible injection wellpad locations.

Response:

The alternative method of brine disposal through use of deep well injection assumes the more conventional arrangement of a separate wellpad for each well and the drilling of vertical holes. This method is typically used for both oil production wells and for injection wells. Acreages affected and fill quantities required are therefore presented for the methods commonly used. Final designs would be coordinated to minimize disruption of wetlands. Use of directional drilling is considered as a mitigative measure in Chapter 5.

9.4.1.4 <u>Department of the Army, Galveston District Corps of Engineers, November 17, 1977</u>

<u>Comment 1</u>:

The dredging work and most of the facilities to be constructed in connection with the proposed Strategic Petroleum Reserve storage site will require Section 10 and 404 permits under the regulatory program of the Corps of Engineers. In view of this requirement as part of the overall Federal action and the apparent concerns of environmental groups and organizations with the impact of certain aspects of the project on shrimp and other marine life, the EIS should be expanded sufficiently so as to adequately cover the effects of these permit activities as well as the primary activity of petroleum storage. This might obviate the necessity for preparation of a separate EIS when the Corps of Engineers takes action on the Section 10 and 404 permit application.

<u>Response</u>:

The need for Corps of Engineers Section 10 and 404 permits has been recognized in the EIS and is so stated in Chapter 9, Table 9.2-1. Details of those activities requiring Corps permits, as available through the preliminary design phase, are outlined in Chapter 2 and Appendix A. The environments which would be affected by permit activities are described in Chapter 3 and Appendix B. Chapter 4 and Appendix C define the impacts on those environments. All sections have been upgraded to include previously unavailable information on the effects of brine discharge in the Gulf of Mexico.

<u>Comment 2</u>:

The discussion under paragraph 4.3.1, Volume I on the impacts of brine disposal, dock construction and dredging shows little quantification of the total impact of these activities on the ecosystems and the biota of the area, both marine and terrestrial. These discussions should be expanded to more adequately quantify these impacts.

Response:

The need for quantifying the impacts to the marine biota as a result of brine disposal in the Gulf of Mexico has been recognized and details have been presented in Appendix G of this report. Given the limitations in data availability, the level of quantification presented is adequate for the purpose of characterizing the potential impacts of the proposed action. Additional efforts have been made to quantify impacts in Appendix G of this report using data collected specifically for the SPR program and representing the best available data for the area. These data collection efforts will be continued prior to and during program operations.

Comment 3:

The referenced Corps of Engineers Regulations as listed in Table 9.2-1 in Volume I are not current. The regulations on "Permits for Activities in Naviagble Waters or Ocean Waters," 33 CFR 209.120 and "Permits for Discharges of Deposits into Navigable Waters," 33 CFR 209.131 were rescinded by regulations entitled "Regulatory Program of the Corps of Engineers" published in the Federal Register, Part II, Tuesday, 19 July 1977. Applicable regulations for activities addressed in paragraph B in Table 9.2-1 ("Piers, Dredging, etc. in waterways") are now covered by 33 CFR Part 322 of the above referenced 19 July 1977 regulations.

Response:

Table 9.2-1 has been revised according to these new regulations.

Comment 4:

Discussions of brine disposal in the Gulf of Mexico occur in several parts of Section 4 of the Environmental Impact Statement and in Appendix C. The discussions center around the findings of two models showing the extent and magnitude of salinity increase above ambient around the diffuser. However, no information on the salinity tolerance of various biological elements found in the area is presented to aid in assessing the significance of the described changes. Also, some life history information, on at least commercial species, should be presented along with describing critical growth stages, spawning habits, migrations, etc. which may be affected by the brine discharge. The results of the pre-disposal studies briefly described on page 4.3-18 along with a review of existing literature, much of which is available through Federal agencies and State universities associated with mariculture, should be presented in the final Environmental Statement.

Response:

In Section G of this report, salinity tolerances and life histories of several of the marine organisms characteristic of these waters are presented.

9.4.1.5 Advisory Council on Historic Preservation, October 26, 1978

Comment:

Additional cultural resource studies are necessary before a final determination can be made that no properties included in or known to be eligible for inclusion in the National Register of Historic Places will be affected by this project. If these studies identify such resources, the project should be delayed pending review by the Advisory Council on Historic Preservation.

Response:

As stated in the draft EIS, those project areas not previously surveyed for cultural resources will be surveyed prior to construction. If cultural resources in or eligible for inclusion in the National Register of Historic Places are found to be potentially impacted by the project, the Advisory Council on Historic Preservation will be afforded the opportunity for comment as required under the "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800).

9.4.2 Comments Received from State Agencies

No substantive comments were received from state agencies.

9.4.3 Comments Received from Local Agencies

No substantive comments were received from local agencies.

9.4.4 Comments Received from Companies, Groups and the Public

No substantive comments were received from companies, groups and the public.

9.5 DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT SUPPLEMENT TO THE FINAL ENVIRONMENTAL STATEMENT, BRYAN MOUND (FES 76/77-6)

The following comments were received on the draft supplement for the Bryan Mound final EIS concerning the subject of offshore brine disposal in the Gulf of Mexico. Comments regarding other areas treated in the draft supplement to FES 76/77-6 were discussed in the final supplement, dated December, 1977.

9.5.1 Comments Received from Federal Agencies

9.5.1.1 National Oceanic and Atmospheric Administration National Marine Fisheries Service, August 12, 1977

Comment 1:

Page 2-68. The various descriptions of salinity tolerances found in subsections under Marine Ecology should, where appropriate, include a discussion of the work done by Copeland and Bechtel (1974) and Gunter, Ballard and Venkataramiah (1974).

Response:

Discussion of the work done by Copeland and Bechtel (1974) and Gunter, Ballard and Venkataramiah (1974) was included in the biological and physical studies of Seaway Group Brine Diffuser Report included in its entirety in Appendix G. The Copeland study is cited in Section G.3.3.1, while the Gunter study is in G.3.3.2.

Comment 2:

Page 2-86, Figure 22. This figure was apparently developed primarily from information contained in Figure 2.7, Migration of Gulf of Mexico Penaeid Shrimp in the Atlas of the Living Resources of the Seas published by FAO, Department of Fisheries, Rome, in 1972. However, the boundaries of the major white and brown shrimp fishing grounds shown in Figure 22 are considerably different than those in Figure 2.7 of the FAO publication. Also, the migration routes were illustrated as examples only by FAO.

Realizing some errors even in their publication, FAO is in the process of revising it. The figures on pages 7 and 11 of the Bureau of Commercial Fisheries Circular 312 (Osborn, Magham and Drummond, 1969) should be used to portray the brown and white shrimp fisheries.

In addition, Figure 23 (page 2-87) sufficiently portrays the migration of larval and juvenile penaeid shrimps, so that the incomplete and inaccurate portrayal can be deleted from Figure 22.

Response:

Figure 22 has been deleted from this report. Figure 23 (Seaway Figure G.2-3) has been retained. The location of white and brown shrimp grounds as well as their life histories and migration patterns are described in Appendix G.

Comment 3:

Page 2-88, paragraph 1. Since the peak migration of brown shrimp to the Gulf occurs during May and June (Trent, 1966), it appears that brown shrimp migration from the estuaries is unrelated to temperature reduction.

Response:

This has been corrected in Appendix G. Factors such as increasing water temperature and salinity, storms and approaching sexual maturity may contribute to initiating shrimp migration.

Comment 4:

Page 2-88, paragraph 2. The statement that white shrimp post-larvae, which come into the estuary later in the year, "overwinter in the estuaries," should be modified to state that they may overwinter in the estuaries. It is also stated in this paragraph that "some recent information indicates that a white shrimp spawning stock occurs 5-7 miles off Bryan Beach." The Texas Agricultural Extension Service documented spawning populations of white shrimp inside of the proposed diffuser site vicinity. The shrimp and fisheries resources at the alternative diffuser site 12.5 nautical miles offshore, and into 10 nautical miles should be compared with the resources in the vicinity of the proposed site in view of this additional information.

Response:

The text has been modified to state that white shrimp may overwinter in the estuaries. The impact assessment for the proposed diffuser location considers the potential impacts on spawning grounds from normal operations assuming their presence as a worst-case scenario.

Copies of the letters from the Texas Agricultural Extension Service are provided in Appendix K. The material contained therin has been included in Section 3.3.5 and Appendices B and G. Reference to a 12.5 nautical mile alternative diffuser site in the draft supplement to the Bryan Mound environmental impact statement was in error. The alternative site is planned for 10.9 nautical miles (12.5 statute miles) off Bryan Mound. The material in the letters referenced above are applicable to this site also.

Comment 5:

Page 3-37. The supplemental final environmental impact statement should include and discuss the results of bioassays recommended in the Summary and Conclusions section of the Proceedings of the Strategic Petroleum Reserve Workshop - Environmental Considerations of Brine Disposal Near Freeport, Texas, held in Houston, Texas, on February 17 and 18, 1977. It was concluded that at least three candidate organisms be selected for tolerance studies under laboratory conditions. These include: white shrimp (all life stages), red drum (adult and juvenile), and polychaete worms. It was further recommended that brine from the Bryan Mound Dome be used for these tolerance studies and that the water used to form the brine for the bioassays be from the same source as the water that will be used during the drawdown phase and when enlarging the dome by leaching. This is extremely important since, as the EIS notes, the Brazos River Diversion Channel (from which the water will be drawn) is often extremely polluted. The results of the bioassays should also be included and discussed in the final supplement.

Response:

Results from bioassays on representative species have been included in this EIS (Appendix G). Tests were run subjecting the polychaets *Neanthes arenaceodentata*, the eggs and larvae of the spotted seatrout *Cynoscion nebulosus*, blue crab zoea (*Collinectes sapidus*), eggs and postlarvae of white shrimp (*Penaeus setiferus*) and three phytoplankton *Skeletonema costatum*, *Hymenomonas carterae* and *Tetiaselmis chui* to various dilutions, using seawater, of Bryan Mound brine.

Comment 6:

Page 7-7. Since locating the diffuser 10 N miles offshore would apparently locate it beyond the white shrimp spawning grounds and the sportfishing bank, this location should also be discussed as an alternative because it should involve less construction costs and less disruption of Gulf bottom than the 12.5 N mile alternative. Any additional information available concerning the fisheries in the vicinity of these sites should be discussed.

Response:

Due to an editorial error in the draft report, the alternative brine disposal pipeline was described as being 12.5 N miles offshore. In fact, it is 12.5 statue miles, or 10.9 nautical miles offshore. The impacts discussed in the text apply to the 12.5 statute mile pipeline length.

9.5.2 Comments Received from State Agencies

9.5.2.1 Texas Parks and Wildlife Department, August 8, 1977

Comment 1:

The plans for operation of the Bryan Mound Salt Dome Strategic Petroleum Reserve include three methods of disposing of brine from the facility - use as feedstock by Dow Chemical Company, use of injection wells, and disposal by diffuser in the Gulf of Mexico. It is recommended that disposal in the Gulf of Mexico be kept as low as possible in order to avoid adverse impacts to the offshore fisheries, particularly with respect to the white shrimp fishery.

Response:

Current plans for Bryan Mound development call for the use of a brine diffuser to the Gulf to dispose of the large quantities of brine resulting from cavern leaching. Ratio of economic costs to environmental benefits of disposal of this brine through deep wells would be considerably more than for the proposed system. During fill operations, the use of the diffuser is also planned. The five backup wells to be constructed as part of the SPR facilities would have the capacity to dispose of this brine, but also at a considerably higher operating cost. The use of these wells for disposal of brine during fill will be evaluated in the context of ongoing facilities planning and development to achieve programmatic objectives. Dow has not expressed a willingness to enter into a long-term arrangement to accept the brine (and provide the necessary high quality raw water) at the substantially higher rates and volumes involved.

Comment 2;

Section 3.1.8 of the draft should be expanded to discuss possible interference with navigation and trawling operations which may result from the installation of a Gulf brine diffuser system. Section 4.6 should also be expanded to discuss this subject.

Response:

Construction of the Gulf brine diffuser system would occur in a very small area of the navigational space available in this section of the nearshore area. The pipe-laying vessels would temporarily occupy small areas along the proposed route. The pipeline would be lain 3 to 10 feet below the surrounding terrain to avoid interference with navigation or trawling operations. The 2006 foot long diffuser would have ports rising 5 feet above the bottom, however this area would be carefully marked with approved navigational devices such as lights and radar reflectors and would constitute only a minor obstacle to navigation. The diffuser ports would also be equipped with "anti-snag" devices to avoid damage to trawling nets. The diffuser, therefore, is not expected to constitute major adverse impact. This is discussed in Sections 4.3.1.8, 4.3.2.8, 5.2.1.5, 5.2.2.4, 5.3.1, 5.4.1, 5.5.1, 5.6.1, 5.7.1, C.3.1.8, and C.3.2.8.

9.5.3 Comments Received from Local Agencies

9.5.3.1 Brownsville-Port Isabel Shrimp Producers Association, August 24, 1977

Comment:

Fleets from the Brownsville-Port Isabel area depend on the entire Texas Coast for shrimp production and over the years the fishing grounds just offshore from Freeport have become recognized as prime white shrimp areas.

The proposed location of the brine diffuser system would directly conflict with major white shrimping efforts and hamper production. There is a distinct possibility that high salinity waters found in the area could affect reproduction of gravid white shrimp, which congregate near shore for mating and spawning, and could also effect the migration patterns of larval and juvenile shrimp.

An alternative diffuser site at 12.5 N. miles offshore, would not significantly conflict with the interest of most shrimpers. Whichever site is chosen should be properly marked for night and day observation.

Response:

The use of the proposed 5.0 nautical mile site may have a greater potential for impact upon shrimp in its vicinity than the alternative site, but neither is expected to have a significant effect on the overall shrimp fishery. The effects on other biota may differ, however. These issues are discussed in brief in Section 4.3.1.5 and 4.3.2.5 and in detail in Appendices C and G. The diffuser site when chosen would be marked with appropriate navigational devices to accommodate day or night observation.

9.5.3.2 Port Isabel Shrimp Association, August 24, 1977

The proposed location of a Bryan Mound diffuser system - only 5N. miles from shore, would definitely conflict with production, and possibly reproduction of white shrimp in that area. White shrimp production decreases would certainly result from the direct trawl hindrance of diffuser pipes in the area. It is not inconceivable that high saline (314 parts per thousand) brines could affect mating behavior of white shrimp, and the survival of newly fertilized eggs and developing larvae exposed to abnormally high salinities. High saline brines might also disrupt normal emigration patterns of juvenile white and brown shrimp leaving bays and estuaries, and interfere with longshore migrations of adult shrimp.

A diffusion site located 11.5 to 12.5 miles offshore, would be less harmful to both shrimp biology and commercial shrimping activity.

Response:

With the knowledge that alternative brine disposal sites must be considered, DOE has embarked on a chemical-geological-biological-physical sampling survey of a proposed alternative offshore area, located 10.9 nautical miles offshore of Bryan Mound. Historic and preliminary field data as well as potential impacts upon this alternative site are discussed in Section G.4.

The diffuser ports have been designed with an anti-snag feature which would prevent the fouling of trawl nets on diffuser pipe structures.

9.5.3.3 Texas Environmental Coalition, August 27, 1977

Comment:

The predisposal laboratory and field studies are inadequately discussed in the draft supplement. The brine tolerance of various indigenous species and their lifecycle forms is not currently known relative to the brines under consideration. It is assumed that mobile species would move away from the highly impacted brine diffusion area. This conclusion discounts the possibility of damage to a known nearby white shrimp spawning area. The importance of the white shrimp fishery to the Texas shrimp fishery is not represented as a significant potential impact. The potential adverse impact on redfish spawning in the diffuser area is assumed to be minimal with the suggestion that these fish will spawn elsewhere. Data should be provided to support this assessment. Data on the existing recreational fishery in the area, and the potential effects of construction, should be presented.

Qualitative data on the displacement water and the Gulf waters in the diffuser area is insufficient. Additional data is necessary to assure the validity of the monitoring program and the predictions of the effects of brine on water quality.

Biologic populations in the immediate area of impact are not described. Of special importance are potential benthos losses. Benthos, in combination with bottom sediments, may be responsible for the success of this spawning area for shrimp and redfish.

Coastal dynamics in the immediate vicinity of the proposed site are not adequately addressed. Data used in preparing the diffusion models were not taken from the immediate area, and do not reflect the magnitude of day-to-day and hour-to-hour changes that could take place in the local current regime. In addition, local experience indicates that the 16-day stagnation period, chosen as an extreme in the model projections, may, in fact, fall short of the extreme condition.

Any final environmental statement on this project should contain sufficient biological, chemical and physical data to approach the proposed brine and displacement water disposal in the Gulf of Mexico.

All possible restoration techniques should be employed after trench backfill. Monitoring and necessary additional work should be undertaken during the restoration period to assure total restoration in the delicate areas of wetlands and dunes. The work should be undertaken at a time when the increased turbidity and bottom sedimentation will have the least adverse environmental impact to migratory and spawning species in the vicinity.

Response:

Since the adoption of offshore diffuser system as the proposed brine disposal system for the Seaway Group, DOE has engaged in ongoing research, monitoring, and analysis of physical and biological data related to this system. Since the preparation of the Draft Supplement to the Bryan Mound Final Environmental Impact Statement (FEA 76/77-6) further investigation of available literature and data sources has been completed and detailed baseline studies of the physical, chemical and biological oceanography have been embarked upon. Appendix G of this report presents the preliminary results of the first four months those studies. As indicated in the Appendix this pre-operational research will continue until June 1978, after which operational monitoring studies would be commenced when the brine diffuser is in use.

The concerns expressed by the Texas Environmental Coalition have been discussed in detail in Appendix G. The DOE is well aware of, and concerned with the preservation of the productivity of the Texas Gulf fisheries. New site-specific data and previous research on aquatic species, species specific salinity tolerances, water quality, and brine characteristics have been carefully analyzed. Brine dispersion modeling using current patterns known to exist in the vicinity of the brine diffuser have been included. From these investigations more precise assessments of the potential impacts have been made in appropriate sections of this EIS. The impacts associated with brine disposal pipeline construction are addressed in Section 4.3.1 of this EIS.

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