U.S. Army Corps
of Engineers
Galveston District

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

for
Calhoun County Navigation District's
Proposed Matagorda Ship Channel
Improvement Project
Calhoun and Matagorda Counties, Texas

VOLUME I

Sections 1-15 and Appendices A and B

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ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT CALHOUN AND MATAGORDA COUNTIES, TEXAS

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ABSTRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT CALHOUN AND MATAGORDA COUNTIES, TEXAS

The responsible lead agency for this permit action is the U.S. Army Corps of Engineers, Galveston District (USACE), under the authority of Section 404 (33 U.S.C. 1344) of the Clean Water Act, Section 10 (33 U.S.C. 403) of the Rivers and Harbors Act, and Section 103 (33 U.S.C. 1413) of the Marine Protection, Research, and Sanctuaries Act.

This Draft Environmental Impact Statement (DEIS) was prepared as required by the National Environmental Policy Act (NEPA) to present an evaluation of potential impacts of Calhoun County Navigation District's (CCND) proposed Matagorda Ship Channel Improvement Project (MSCIP). The proposed MSCIP includes widening and deepening the Matagorda Ship Channel from the Port of Port Lavaca – Point Comfort marine slips and existing Point Comfort Turning Basin in Lavaca Bay through Matagorda Bay and offshore into the Gulf of Mexico and dredging of a new turning basin in Lavaca Bay. This DEIS addresses the potential impacts of the proposed MSCIP on the human environment, as identified during the public interest review, including placement of dredged material. Factors relevant to the proposed project were considered. Among those factors are: dredged material management, ecological impact, salinity changes, protected species, historic resources, water and sediment quality, hazardous materials, shoreline erosion, economics, navigation, recreation, energy needs, safety, and, in general, the welfare of the people. This DEIS provides relevant information to the public and the USACE on the potential impacts of the proposed project. Included in this DEIS are reports presenting the results of studies done specifically for this project such as the Shoreline Erosion Report, Habitat Equivalency Analysis Report, Hydrodynamic Salinity Model Results Report, Oyster Evaluation Report, and a Construction Material Contaminants Assessment. The public response to the findings of this DEIS will be addressed in the Final EIS. The Final EIS will be an informational document used by the USACE in its decision to grant, grant with conditions, or deny the permit, which will be described in the Record of Decision (ROD).

Comments on this DEIS must be postmarked by: July 2, 2007

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Acronyms and Abbreviations

ac	acres
ACHP	Advisory Council on Historic Preservation
AEP	American Electric Power
AIRS	Aerometric Information Retrieval System
ASCS	Agricultural Stabilization Conservation Service
AST	Aboveground Storage Tank Database
AWOIS	Automated Wreck and Observation System
BA	Biological Assessment
BO	Biological Opinion
CA	Corrective Action
CAPA	Chlor-Alkali Process Area
CAS	Corrective Action Strategy
CAS	Corrective Action Strategy
CCC	Coastal Coordination Council
CCND	Calhoun County Navigation District
CEI	Coastal Environments, Inc.
CEQ	Council on Environmental Quality
CERCLIS	Comprehensive Environmental Response Compensation and Liability Information System Database
CFR	*Code of Federal Regulations*
cfu/dL	colony forming units per deciliter or 100 mL
cm	centimeters
CO	carbon monoxide
COC	contaminant of concern
COPC	constituents of potential concern
CORRACT	Resource Conservation and Recovery Act Corrective Actions List
CP&L	Central Power & Light
CPUE	catch per unit effort
CTC	Central Texas Coast
cy	cubic yards
CZM	Coastal Zone Management Program
DA	Department of the Army
dB	decibels
dBA	A-weighted sound level
DDT	dichloro-diphenyl-trichloroethane
°F	degrees Fahrenheit
DHHS	Department of Health and Human Services
DMMP	Dredged Material Management Plan
DNAPL	dense nonaqueous phase liquid
DO	dissolved oxygen

DOD	Department of Defense
DOT	Department of Transportation
EDR	Environmental Data Resources
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EMS	emergency management services
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ERDC	Engineering Research and Development Center
ERL	Effects Range Low
ERNS	Emergency Response Notification System
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FC	fecal coliform
FCC	Federal Communications Commission
FDA	Federal Food and Drug Administration
FERC	Federal Energy Regulatory Commission
FINDS	Facility Index System
FM	Farm to Market Road
FONSI	Finding of No Significant Impact
FPC	Formosa Plastics Company
FPPA	Farmland Protection Policy Act of 1981
FS	feasibility study
ft	feet/foot
FTZ	Foreign Trade Zone
FWS	U.S. Fish and Wildlife Service
GBRA	Guadalupe-Blanco River Authority
GIWW	Gulf Intracoastal Waterway
GLO	General Land Office
GMFMC	Gulf of Mexico Fisheries Management Council
Gulf	Gulf of Mexico
HEA	Habitat Equivalency Analysis
HTRW	hazardous, toxic, and radioactive waste
HUD	Department of Housing and Urban Development
Hz	Hertz
IMO	International Maritime Organization
ISD	independent school district
ITM	*Inland Testing Manual*
JEC	Jackson Electric Cooperative, Inc.
LCRA	Lower Colorado River Authority

L_{dn}	Day-Night Sound Level
LEP	Limited English Proficiency
LEPC	Local Emergency Planning Committee
L_{eq}	equivalent sound level
LNG	Liquefied Natural Gas
LNGC	LNG carrier
LOA	length overall
LPC	Limiting Permissible Concentration
LUST	Leaking Underground Storage Tank Listing
m	meters
m^3	cubic meters
MCND#1	Matagorda County Navigation District #1
mcy	million cubic yards
mg/L	milligram per liter
MICU	Mobile Intensive Care Unit
MLT	mean low tide
MPRSA	Marine Protection and Sanctuaries Act
MSC	Matagorda Ship Channel
MSCIP	Matagorda Ship Channel Improvement Project
MSI	MarineSafety International
MUD	Municipal Utility District
NAAQS	National Ambient Air Quality Standards
NCDC	National Climatic Data Center
NDD	Natural Diversity Database
NED	National Economic Development
NEPA	National Environmental Policy Act
NFWL	National Fish and Wildlife Laboratory
ng/l	nanogram/liter
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priority List
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
NYSDEC	New York State Department of Environmental Conservation
ODMDS	Ocean Dredged Material Disposal Site
O_3	ozone
PA	placement area (for dredged material)
PADS	PCB Activity Database

PAH	polycyclic aromatic hydrocarbon
Pb	lead
PCBs	polychlorinated biphenyls
PCE	primary constituent element
PCMC	Palacios Community Medical Center
PCN	Point Comfort and Northern Railway
PCO	Point Comfort Operation
PCTB	Point Comfort Turning Basin
PM_{10}	particulate matter with particle diameters of 10 micrometers or less
$PM_{2.5}$	particle diameters of 2.5 micrometers or less
Port	Port of Port Lavaca-Point Comfort
ppm	parts per million
ppt	parts per thousand
RAATS	Resource Conservation and Recovery Act Administrative Action Tracking System database
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act Information System Database
RCRA Gen/TSDF	Resource Conservation and Recovery Act Generator/Treatment, Storage, Disposal
RCRA-G	Resource Conservation and Recovery Act Generators and Violators List
RCRA-TSD	Resource Conservation and Recovery Act Treatment, Storage, or Disposal List
RCRIS	Resource Conservation and Recovery Information System
RI	Remedial Investigation
RIA	Regional Implementation Agreement
RI/FS	remedial investigation, risk assessment, and feasibility study
ROD	Record of Decision
RRC	Railroad Commission of Texas
RSPA	Research and Special Programs Administration
RV	recreational vehicle
SAL	State Archeological Landmarks
SAL	State Archeological Landmark
SAV	submerged aquatic vegetation
SAWS	San Antonio Water Service
SCS	Soil Conservation Service
SH	State Highway
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SPILL	Spills Incident Information System database
SPP	Suspended Particulate Phase
SRU	Special Response Unit
SSA	sole source aquifers
SSF	State Superfund List
STSSN	Sea Turtle Stranding and Salvage Network

SWMU	solid waste management unit
TAC	Texas Administrative Code
TAMUG	Texas A&M University at Galveston
TARL	Texas Archeological Research Laboratory
TCEQ	Texas Commission on Environmental Quality
TCWC	Texas Colonial Waterbird Census
TDH	Texas Department of Health
TEA	Texas Education Agency
THC	Texas Historical Commission
TOC	total organic carbon
TOS	Texas Ornithological Society
TPH	total petroleum hydrocarbons
TPWD	Texas Parks and Wildlife Department
tpy	tons per year
TRIS	Toxic Release Inventory System
TSDC	Texas State Data Center
TSHA	Texas State Historical Association
TWC	Texas Workforce Commission
TWDB	Texas Water Development Board
TWQS	Texas Surface Water Quality Standards
TxDOT	Texas Department of Transportation
TXLF	City/County Solid Waste Landfill listings
TXSPILL	TCEQ Spills database
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USBOC	U.S. Census Bureau
USDA	U.S. Department of Agriculture's
USGS	U.S. Geological Survey
UST	Underground Storage Tank Database
VEC	Victoria Electric Cooperative
VFD	volunteer fire departments
WES	Waterways Experiment Station
WMA	Wildlife Management Area
WPA	Works Progress Administration
WQC	water quality discrete criteria
WRDA	Water Resources Development Act
WVA	Wetland Value Assessment

EXECUTIVE SUMMARY

ES.1 INTRODUCTION AND AUTHORITY

The Calhoun County Navigation District (CCND) of Calhoun County, Texas, proposes to improve approximately 26 miles of the existing Matagorda Ship Channel (MSC) for the purpose of reducing maritime transportation costs, to increase operational efficiencies of commodities moving through the Port of Port Lavaca – Point Comfort (Port), and to improve navigation safety. The present configuration of the MSC constrains the movement of deep-draft liquid and dry bulk carriers by requiring light loading and delivery routing, which generate increased channel traffic and prohibits efficient use of terminal capacity.

The U.S. Army Corps of Engineers, Galveston District (USACE), under the authority of Section 404 (33 U.S.C. 1344) of the Clean Water Act, Section 10 (33 U.S.C. 403) of the Rivers and Harbors Act, and Section 103 of the Marine Protection Research and Sanctuary Act (33 U.S.C 1413), is the lead agency for the permit action. This Draft Environmental Impact Statement (DEIS) was prepared as required by the National Environmental Policy Act (NEPA) to present an evaluation of potential impacts associated with CCND's proposed Matagorda Ship Channel Improvement Project (MSCIP).

ES.2 PURPOSE AND NEED

The purpose of the proposed project is to widen and deepen the MSC to improve deep-draft transport of commerce to the Port. Up to 90% of vessels calling at the Port are currently reported to be light-loaded due to draft limitations of the present channel configuration. Proposed channel improvements could reduce or eliminate light-loading measures and allow larger cargo vessels to call on the Port. Recent economic evaluations indicate that annual tanker calls and dry bulk calls will increase at Gulf Coast ports (Hackett, 2003) and that larger ships will likely be added to the existing fleet in pursuit of economic efficiency (Waters et al., 2000).

The project need is the elimination of existing operational constraints to avoid vessel delays, thereby reducing shipping costs and logistical problems and increasing the safety of the channel. Restrictive drafts associated with the current configuration of the MSC force deep-draft vessels to light-load and constraints increase the cost of raw materials and products delivered to the Port and adjacent users. Proposed channel improvements would reduce transportation costs for existing commodities, which are crucial to the regional economy.

ES.3 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

Various improvement plans for the MSC, which included alternatives for different channel widths and depths, and alternatives for dredged material placement, were evaluated to meet the needs of the proposed

project. The USACE is currently authorized to maintain the MSC's In-Bay Channel to an existing depth of –36 feet (ft) mean low tide (MLT) at a width of 200 ft and the Entrance channel to a depth of –38 ft MLT at a width of 300 ft. The CCND evaluated five alternatives to modify the In-Bay Channel of the MSC to depths ranging from –36 ft to –51 ft MLT and at widths ranging from 200 ft to 400 ft, and alternatives to modify the Entrance Channel to depths ranging from –38 ft to –53 ft MLT and at widths ranging from 300 ft to 600 ft. Ship simulation runs on various MSC configurations were accomplished under multiple meteorological and hydrographic variables to screen for critical channel conditions and to develop the optimal channel geometry.

Based on the ship simulation results, along with outputs from a transportation cost analysis, the CCND concluded benefits of the project could be optimized by: 1) improving the MSC's In-Bay Channel to a proposed depth and width of –44 ft MLT and 400 ft, respectively; 2) improving the MSC's Entrance Channel to a proposed depth and width of –46 ft MLT and 600 ft, respectively; and, 3) constructing a new turning basin to allow for a ship turning circle of 1,650 ft at a depth of –44 ft MLT. Since this geometry for the MSC's In-Bay and Entrance Channels would maximize navigation benefits and meet the purpose and need of the project, it was identified as the Proposed alternative for the MSCIP.

The Proposed alternative for the MSCIP would generate approximately 46.5 million cubic yards (mcy) of new work dredged material and approximately 257.5 mcy of future maintenance dredged material over the 50-year life of the project. Three general dredged material placement plans, along with the No-Action Plan, were identified and evaluated to assess costs and ecological impacts and benefits of each placement alternative. These placement plan alternatives included Upland Confined Placement, Gulf Unconfined Placement, and Multi-Use Placement. The Upland Confined Placement alternative entails placing all of the MSCIP's dredged material within upland confined sites. The Upland Confined Placement alternative does not provide for the beneficial use of dredged material. In addition, this alternative requires the acquisition of substantial acreage of land and has a high cost. Therefore the Upland Confined Placement alternative was eliminated from further consideration. The Gulf Unconfined Placement alternative involves the placement of the MSCIP's dredged material within Ocean Dredged Material Disposal Sites (ODMDS) located offshore of the Matagorda Peninsula. As with the Upland Confined Placement alternative, the Gulf Unconfined Placement alternative does not provide for the beneficial use of the dredged material, and the cost of transporting all of the dredged material to ODMDSs for offshore placement was determined to be cost prohibitive. Therefore, the Gulf Unconfined Placement alternative was removed from further consideration.

The third general dredged material placement plan that was evaluated is the Multi-Use Placement alternative. The Multi-Use Placement alternative entails placing both new work and future maintenance dredged material within a mix of upland, in-bay and offshore placement areas. An array of mixed placement scenarios was analyzed to identify the alternative that optimized environmental benefit outputs at least cost. A multi-agency Dredged Material Management Plan (DMMP) Workgroup served to guide the project proponent in developing placement plans to meet the project purpose while minimizing and mitigating for environmental impacts. Four mixed placement alternatives under the Multi-Use Placement

alternative were developed based on guidance from the DMMP workgroup and the public. Each of the four Multi-Use Placement alternative options (labeled in the DEIS as 1A, 1B, 2A and 2B) had a mix of different placement features with which to compare environmental benefits and costs. All four alternatives include placement features to receive new work and future maintenance dredged material to create in-bay upland sites; create in-bay marshes; provide for beach nourishment and shoreline protection; cap mercury laden bottom sediments; create oyster reefs; and place the material in ODMDSs. Environmental outputs for each of the four Multi-Use Placement alternative options were determined primarily by the Habitat Equivalency Analysis (HEA), as coordinated with the multi-agency DMMP Workgroup. The HEA outputs allowed the DMMP Workgroup to compare habitat functional values of impacted versus created areas for the various Multi-Use Placement alternative options. Multi-Use Placement alternative 2A was determined to have the maximum HEA value of the four alternatives at +4789.5 and is the option that is the least costly to implement. Therefore, the Multi-Use Placement alternative 2A is proposed as the plan to manage the MSCIP's new work and future maintenance dredged material.

The features of the Multi-Use Placement alternative 2A are:

1. create an in-bay upland site (PA A1) located south of the Port at the existing USACE in-bay dredged material PAs 18 and 19 with 3.3 mcy of new work material and 45.1 mcy of future maintenance material;
2. create a combination upland and marsh site (PA A2) along the northern shore of Cox Bay to eliminate future erosion in this area with 6.3 mcy of new work material;
3. create a clay core oyster reef (PAs OR1 and OR2) within Lavaca Bay with approximately 1.0 mcy of new work material;
4. provide nourishment (PAs BN1, BN2, and BN3) on public beaches along the Magnolia-Indianola shoreline with 1.9 mcy of new work material;
5. create an in-bay upland site (PA D) adjacent to the southwest side of the existing Dredge Island with 1.6 mcy of new work material and 14.8 mcy of maintenance material;
6. place submerged cap and create oyster reefs on (PA ER1) bottom sediments contaminated with elevated levels of mercury within Lavaca Bay southwest of Dredge Island with 0.4 mcy of new work stiff clay material, creating oyster reefs on the mounded caps;
7. cap in situ bottom sediments contaminated with elevated levels of mercury located in shallow waters along SH 35 and then create an upland site (PA ER2) with 2.1 mcy of new work material and 6.9 mcy of future maintenance material;
8. cap in situ bottom sediments contaminated with elevated levels of mercury located on the northern edge of Dredge Island and then create a transitional marsh and upland site (PA ER3) with 2.3 mcy of new work material and 13.2 mcy of future maintenance material;
9. protect the eroding shoreline at Sand Point by constructing armored earthen levees and in-bay marshes (PA G) with 4.7 mcy of new work material, and 0.4 mcy of in situ material;

10. create a terrestrial upland placement site (PA P1) located immediately south of Alamo Beach on agriculture lands with 1.0 mcy of new work material and 55 mcy of future maintenance;
11. place 108.9 mcy of future maintenance material in existing in-bay unconfined placement areas (PAs 5 to PA 12) located northeast of the MSC;
12. create a multi-use habitat site (PA H4) located north of Port O'Conner along the MSC to include marshes, submerged aquatic platforms, and bird island with 10.0 mcy of new work material;
13. place 13.6 mcy of future maintenance material from the MSC Entrance Channel at the existing Matagorda ODMDS (PA 1) located 2 miles offshore from the Matagorda Peninsula and 1,000 ft south of the MSC Entrance Channel centerline; and
14. place 8.8 mcy of new work soft clay material from the MSC In-Bay Channel and 3.2 mcy of new work mixed material from the MSC Entrance Channel at a proposed ODMDS site (PA O5) located approximately 3 miles offshore from the Matagorda Peninsula and 1,000 ft south of the MSC Entrance Channel centerline.

The DEIS carried forward the evaluation and impact analysis of the Proposed alternative to improve the MSC by deepening and widening the In-Bay Channel to –44 ft MLT and 400 ft, respectively, by deepening and widening the Entrance Channel to –46 ft MLT and 600 ft, respectively, and manage the placement of the dredged material as described above. Additionally, CCND proposes to construct a new turning basin at the intersection of the MSC and Alcoa Channel to accommodate larger vessels.

The No-Action alternative was also carried forward for evaluation. This alternative assumes the USACE denial of the permit, in which case the MSC would not be improved and navigation restrictions would continue. The No-Action alternative provides a baseline for a future-without-project conditions scenario to which the Proposed alternative can be compared.

ES.4 POTENTIAL ENVIRONMENTAL IMPACTS

The DEIS addresses the potential impacts of the proposed project on human and environmental issues identified during the public interest review, including placement of dredged material. All factors that may be relevant to the proposed project were considered. Among those factors are: dredged material management, air quality, shoreline erosion, economics, general environmental concerns, historic resources, protected species, navigation, recreation, water and sediment quality, energy needs, safety, hazardous materials, and, in general, the welfare of the people. The following provides a brief description of potential impacts that were identified.

Air Quality

The combustion of diesel fuel in internal combustion engines during the dredging operations of the proposed project would result in air emissions of CO, NO_x, PM, SO_2, and VOC. This includes marine vessels, onshore construction equipment (cranes, trucks, dozers, backhoes, etc.), and employee commuter vehicles. Routine maintenance dredging of the channel would also result in air emissions. The

maintenance emissions were conservatively estimated based on the ratio of volume of dredged material displaced from maintenance activities to the total volume of new work dredging. Emissions from construction and maintenance of the proposed channel improvement project were estimated using EPA-approved software and modeling tools. It is expected that air contaminant emissions from construction dredging activities would result in minor short-term impacts on air quality in the immediate vicinity of the dredging site. Due to the phased, one-time construction dredging process proposed, it is expected there would be no long-term impacts (beyond the project duration) to air quality in the area. Maintenance dredging activities are also expected to result in minor short-term impacts on air quality in the immediate vicinity of the dredging site. Emissions from maintenance dredging are not expected to result in a serious impact to the regional air quality or differ significantly from present maintenance dredging activities. All emissions are expected to be within the NAAQS and the rules and regulations of the EPA and the TCEQ.

Noise

Dredging and placement activities would generate noise from a variety of equipment, including pumps and generators, dredge tender barges, and tugboats. Noise levels associated with dredging activities would be less than existing ambient conditions at sensitive receivers beyond 4,100 ft from the channel. Therefore, short-term impacts related to these operations would be nearly identical to those that occur during current maintenance dredging. Onshore noise levels during placement activities are not expected to increase substantially and would be short-term. No permanent noise sources would be installed as part of the proposed project, thus no long-term noise impacts are expected.

Physiography, Topography, and Bathymetry

Local changes to bathymetry and topography are expected to occur as a result of the proposed project. Placement of dredged material would nourish approximately 3 miles of shoreline, provide protection from a breach along the peninsula separating Keller Bay from Matagorda Bay, and create marsh habitat in open bay areas. Deepening and widening the channel would result in a reduction in drawdown and wake heights for existing vessels. However, these changes are expected to have negligible impacts on the regional physiography, topography and bathymetry in the project area.

Geology, Mineral Resources, and Soils

No impacts are expected to occur to geology in the project area as a result of the proposed project.

A review of mineral resources, including oil and gas wells and pipelines, indicated that four plugged wells, five dry holes, two well-permitted locations, eight natural gas pipelines, and one ammonia pipeline occur in the footprint of proposed dredged material placement areas. Placement area boundaries may be reconfigured to avoid impacts and pipeline relocations will be assessed by the owners with lines being relocated if conditions warrant. No mitigation is expected for well sites, plugged wells, or dry holes.

Potential surface soil impacts could occur from the release of petroleum products during construction. Use of best management practices (BMPs) during construction would minimize this potential. No impacts to prime farmlands are expected.

Groundwater Hydrology

Potential impacts to groundwater could occur from accidental spill of petroleum products during construction. Use of BMPs during construction would minimize this potential.

Hazardous Material

The potential to encounter hazardous material during construction in the channel is limited. However, the industrial nature of the Point Comfort area increases the risk of encountering hazardous material during dredging and placement activities. Because portions of the area have been used for military training, there is some potential for encountering unexploded ordinance.

Water and Sediment Quality

Proposed channel improvements could result in a small (<1%) increase in tidal range and changes in salinity, especially during times of higher inflow. No significant impacts are expected to result from DO or turbidity changes, and no significant change in ambient or sediment mercury concentrations are expected. Mud waves from the placement of dredged material are not expected to result in the release of mercury impacted sediment. Routine tests of maintenance material dredged from the channel have not indicated cause for concern regarding use of the material. Proposed capping of mercury impacted sediment in Lavaca Bay would assist in the prevention of resuspending sediment with higher mercury concentrations during future actions. Construction of barge access channels through areas in Cox Bay with known at-depth mercury-impacted sediments may be unavoidable. If such sediments are encountered, they will be placed in an upland confined placement area. No increase in channel bottom velocities are expected to occur.

Commercial and Recreational Navigation

Minor delays to commercial navigation may occur during construction of the proposed channel improvements. The wider and deeper channel would allow larger vessels to call on the Port. This could reduce the number of vessel trips allowing greater shipping efficiencies. The larger channel dimensions would also improve navigation safety for existing commercial traffic. Recreational vessels would also experience delays during construction. However, no significant effects on recreational navigation uses of the channel are expected.

Vegetation and Wetlands

No significant impacts to upland vegetation are expected. Approximately 250 acres (ac) of submerged aquatic vegetation (SAV) would be protected by placement of dredged material. Additionally, about

325 ac of SAV-suitable sand platforms would be created by placement of dredged material. Anticipated salinity changes are not expected to be substantial enough to negatively affect SAV, and a reduction in wave energy may result in minor benefits to SAV beds along the shoreline north of Port O'Connor. Placement of dredged material may also result in the development of estuarine tidal flats. Predicted increases in tidal amplitude are not expected to significantly impact estuarine tidal flats.

Approximately 432 ac of estuarine marsh would be protected by placement of dredged material, and the DMMP would result in a net increase of about 587 ac of marsh in the bays. Changes in salinity likely to occur within the bay are well within the salinity tolerance and optimal ranges for the wetland communities in the study area. No loss or reduction in marsh function is anticipated. Changes in tidal amplitude may result in minor shifts in distribution of high salt/brackish marshes and low marsh. No negative impacts to existing shrub-scrub wetlands or fresh-intermediate wetlands are anticipated.

Terrestrial and Aquatic Wildlife (Including EFH)

Temporary, local impacts to terrestrial communities and habitats may occur during construction activities. However, the proposed DMMP would result in a net gain of upland and marsh habitat, beach nourishment, and a bird island, which would provide additional habitat in the study area. Conversion of a rice field to an upland placement area is not expected to have a significant impact on local wildlife resources.

Placement of dredged material and dredging activities would affect the benthic community where bay bottom is disturbed. Aquatic communities in the benthos are likely to shift from current composition to that of more opportunistic species. Repeated dredging may prevent the benthic community from fully developing to pre-construction communities. However, these species would still provide a food source to other organisms. Similar shifts in community composition can be expected at the maintenance material ODMDS. The benthic community at the new work material ODMDS is expected to recover fairly quickly following placement of the new work material.

No adverse impacts are expected to occur to finfish or shellfish populations as a result of anticipated salinity changes in the bays. The Proposed alternative is expected to increase the annual and cumulative habitat functional value in the bays, resulting in a significant benefit on the Matagorda Bay system as a whole, despite the loss of approximately 4,060 ac of open-bay bottom. Thus, recreational and commercial fisheries are not expected to be negatively impacted. Additionally, no significant impacts to essential fish habitat (EFH) are expected.

Construction of the Proposed alternative is expected to result in the loss of approximately 148 ac of oyster reefs and habitat. Additionally, salinity changes anticipated in the bays are estimated to result in a loss of about 106 ac of oyster reef production. However, approximately 298 ac of oyster reef would be created by placement of new-work dredged material from construction of the Proposed alternative.

Protected Species

Potential changes in salinity and tidal amplitude are not expected to significantly impact protected species. Increases and protection of marsh habitat and SAV, as well as beach nourishment, may provide some benefit to protected species in the area.

Dredging activities could result in the incidental take of sea turtles in the project area. However, restriction of hopper dredging activities to between December 1 and March 31, if possible, and the use of relocation trawlers working in front of the dredges, if required, would reduce the potential for these impacts. A Biological Assessment has been prepared and submitted with this DEIS as Appendix N. Coordination with U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) is ongoing.

Cultural Resources

Records review and remote-sensing surveys have been conducted along the MSC and at proposed in-bay placement areas. Five anomalies or known recorded sites were identified in placement area footprints and 20 anomalies were identified along the MSC. A cultural resources report will be submitted to the Texas Historical Commission (THC). Avoidance of all recorded anomalies is recommended and if unavoidable, close-order surveys will be recommended. THC has requested additional investigation of areas with a high potential for association with historic elements, such as the Indianola townsite. Efforts are ongoing to initiate surveys for all or portions of PAs A2, BN1, BN2, BN3, OR1, OR2, O5 (new-work ODMDS), and P1. Additional close-order surveys will be conducted for three anomalies identified within the channel improvement footprint and at PA G. Coordination with the THC and investigations will continue, as necessary.

Land Use, Recreation, Aesthetics, and Socioeconomics

No significant impacts to land use, recreation, aesthetics or socioeconomics are expected to result from the proposed project. Beach nourishment of public beaches and construction of marshes and bird islands in the area would result in benefits to recreation in the area. New upland areas created from placement of dredged material are not expected to negatively impact the visual quality of the area because they would be adjacent to existing upland and/or consistent with the bay setting. Reduced navigation restrictions and increased efficiency at the Port is likely to have a positive economic benefit in the local community, which could result in increased development in the area.

ES.5 COORDINATION AND PUBLIC INVOLVEMENT

Public involvement in the proposed project has occurred through public meetings and other outreach throughout the history of the project. The public, resource agencies, industry, local government, and other interested parties have been proactively informed about the project.

Public and agency concerns were identified at the public scoping meeting held April 25, 2006, at the Bauer Community Center, Port Lavaca, Texas. At this meeting the project was introduced and comments on the proposed project were solicited from attendees. Oral and written comments were collected at the meeting and written comments were collected throughout the scoping period, which ended May 25, 2006. In addition to the scoping meeting, the Calhoun Port Authority presented the proposed DMMP alternatives to the public on July 20, 2006.

A total of seven meetings of the DMMP Workgroup, comprising Federal and State resource agency representatives, the applicant, and consultants were held to discuss placement of dredged material from the project. Two additional agency workgroups were formed; the Aquatic Species Impact Workgroup and the Hydrodynamic/Salinity Modeling Workgroup. These workgroups met to develop a method to analyze potential project impacts and to oversee the modeling efforts that provided information on changes in hydrology and salinity.

This DEIS is being made available to all known Federal, State and local agencies as well as interested organizations and individuals. A list of document recipients is included in the DEIS in Section 9.0.

1.0 INTRODUCTION, PURPOSE, AND NEED

1.1 INTRODUCTION

The Calhoun County Navigation District of Calhoun County, Texas (CCND) applied to the U.S. Army Corps of Engineers (USACE), Galveston District, for a Department of the Army (DA) permit, under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act for dredge and fill activities related to improving the Matagorda Ship Channel (MSC) on January 10, 2006 (Appendix A). Activities subject to the jurisdiction of the USACE would include dredging in navigable waters to deepen and widen portions of the MSC and placement of fill in waters of the U.S. Based on the DA permit application submitted by CCND, the USACE determined that the permitting action for the proposed dredge and fill activities constitutes a major Federal action. In accordance with the National Environmental Policy Act (NEPA), this Environmental Impact Statement (EIS) has been prepared to analyze and disclose the potential impacts of the proposed project and reasonable alternatives on the natural and human environment. The permit application reflecting the applicant's plans for the proposed project is included in this document as Appendix A.

The existing MSC is approximately 26 miles long extending from the Port of Port Lavaca – Point Comfort (Port) turning basin in Lavaca Bay through the southwest section of Matagorda Bay and offshore into the Gulf of Mexico (Gulf) through Matagorda Peninsula (Figure 1.1-1a–c). The in-bay channel is authorized to a project depth of –36 feet (ft) mean low tide (MLT), plus 2 ft of advanced maintenance depth and an additional 2 ft of over depth to compensate for physical conditions and inaccuracies in the dredging process. The channel has a 200-ft bottom width with 3 horizontal to 1 vertical sideslope ratios. The entrance channel in the Gulf is maintained at –38 ft MLT plus 3 ft of advanced maintenance depth and 2 ft of over depth and 10 to 1 sideslopes. The USACE is responsible for the continued maintenance dredging of both the entrance and in-bay channels of the MSC.

CCND's MSC Improvement Project (MSCIP) would entail widening and deepening the MSC from the Port marine slips and existing Point Comfort Turning Basin in Lavaca Bay (USACE Station 118+502) through Matagorda Bay and offshore into the Gulf (USACE Station –23+000). The overall channel length would be increased by approximately 1 mile to 27 miles total length. In addition to the specific design depth, all of the proposed alternative design depths will also feature an advance maintenance depth and paid allowable over depth, similar to the existing channel configuration. CCND would also deepen its existing facilities to match the proposed channel improvement and construct a new turning basin at the intersection of the MSC and Alcoa Channel. The channel improvements proposed by the CCND will require the permanent placement of dredged material in several areas within the Matagorda Bay region and offshore in the Gulf. Details of the dredged material placement areas (PAs) and methodology are provided in the Dredged Material Management Plan (DMMP) developed for the project (Appendix B). Additional information regarding the proposed project is presented in Section 2.0.

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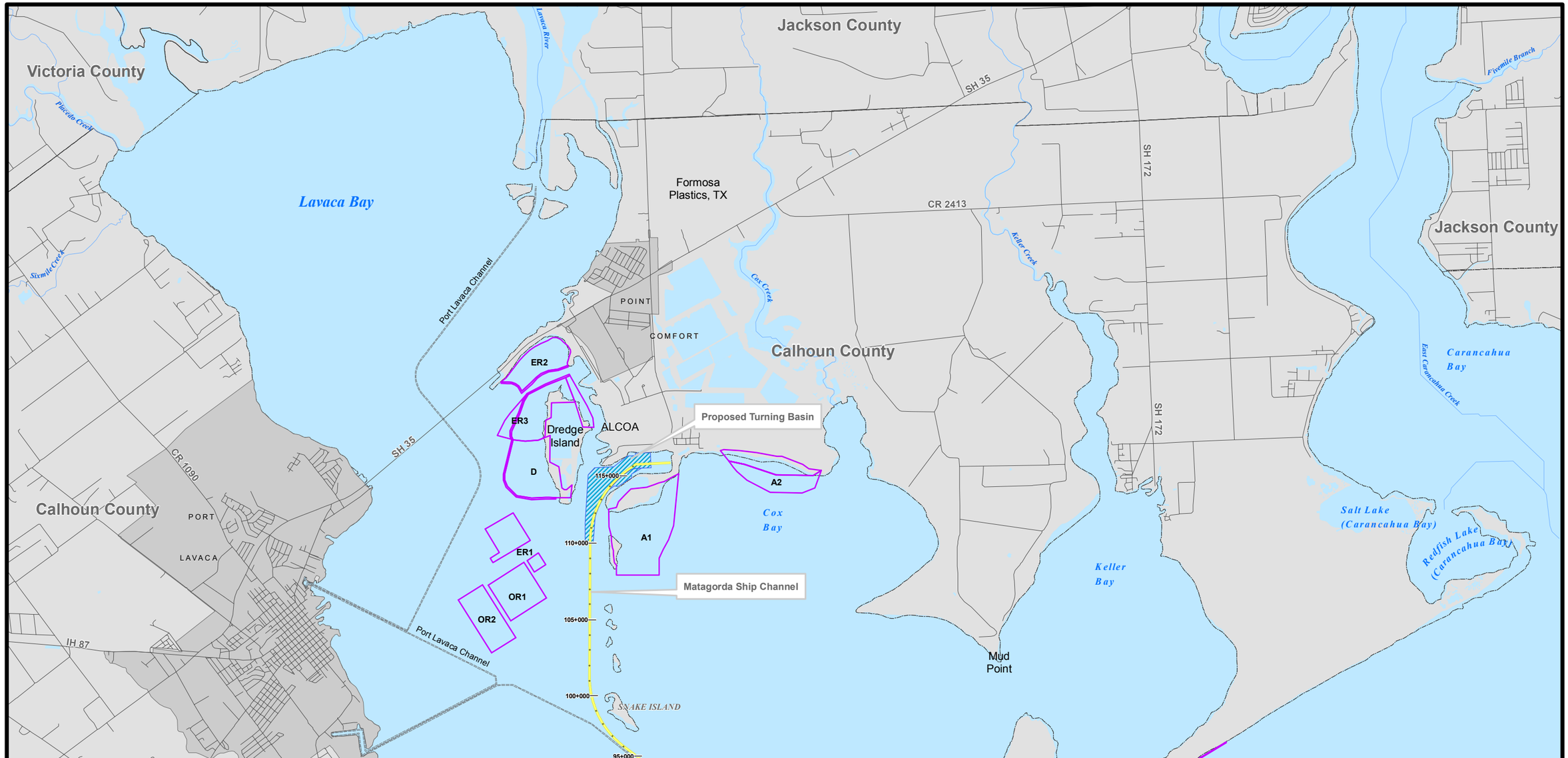

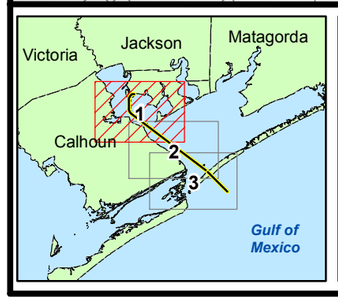

N
W E
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5,280 2,640 0 5,280
Feet

Legend

- Proposed Placement Areas
- Proposed Turning Basin
- Navigable Waterway
- Proposed Channel Improvement
- County Line

PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
Phone: (512) 329-8342 Fax: (512) 327-2453

Figure 1.1-1A

Proposed Matagorda Ship Channel Improvement Project Components and Channel Station Map

Job No.: 441652.00	Scale: 1:79,200
Prepared by: EMons/DRohrer	Date: 20070125
File: N:/44165200/projects/BaseMaps/Fig1_1_1A_vr2.mxd	

Lavaca Bay

Matagorda Bay

Chocolate Bay

Port Lavaca Channel

Gallinipper Point

ALAMO BEACH

MAGNOLIA BEACH

INDIANOLA

Calhoun County

Indian Point

Sand Point

Powderhorn Lake

Coloma Creek

East Coloma Creek

CR 2717

CR 2760

CR 1289

P1 dredge pipeline and drainage corridor

Matagorda Ship Channel

100+000

95+000

90+000

85+000

80+000

75+000

70+000

65+000

60+000

55+000

50+000

45+000

40+000

35+000

30+000

25+000

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BN3

P1

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PA 11

PA 10

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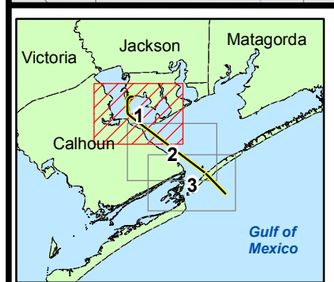
PA 8

PA 7

PA 6

PA 5

H4



N
W E
S

5,280 2,640 0 5,280 Feet

Legend

- Proposed Placement Areas
- Proposed Channel Improvement
- Navigable Waterway
- Existing USACE Maintenance material Placement Areas that will continue to be used
- County Line

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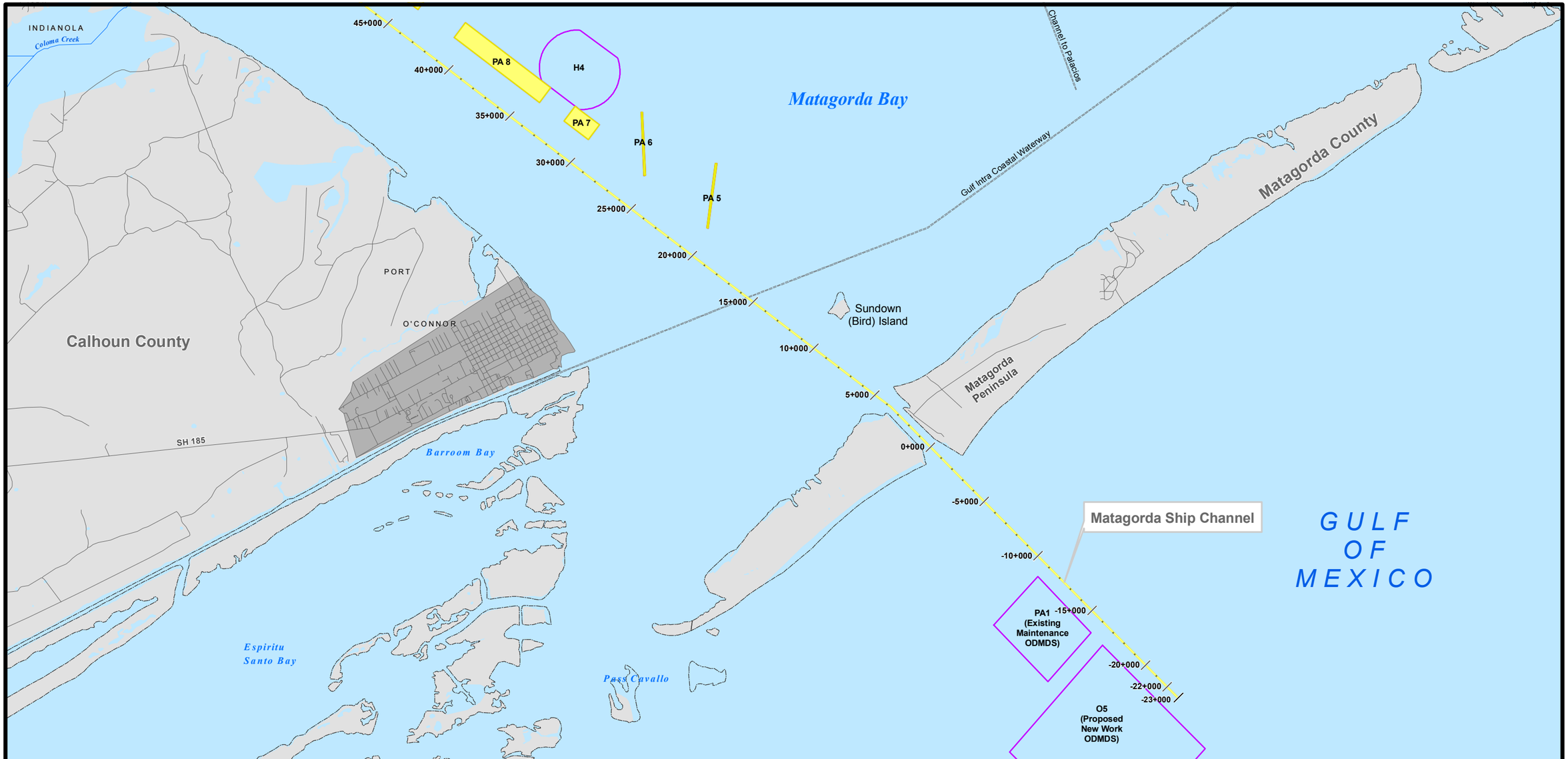
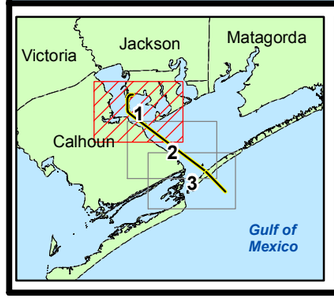
Figure 1.1-1B

Proposed Matagorda Ship Channel Improvement Project Components and Channel Station Map

Job No.: 441652.00	Scale: 1:79,200
Prepared by: EMonshaugen	Date: 20060530
File: N:/44165200/projects/BaseMaps/Fig1_1_1B_vr2.mxd	





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5,280 2,640 0 5,280
Feet

Legend

- Proposed Placement Areas
- Proposed Channel Improvement
- Navigable Waterway
- Existing USACE Maintenance material Placement Areas that will continue to be used
- County Line

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Figure 1.1-1C

Proposed Matagorda Ship Channel Improvement Project Components and Channel Station Map

Job No.: 441652.00	Scale: 1:79,200
Prepared by: EMonshaugen	Date: 20060530
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In November 2005, the CCND notified USACE of their plans to improve the MSC. Since that time, CCND has conducted numerous studies, with non-Federal funds, in support of their Section 404/10 permit application for construction of navigation improvements to the MSC. CCND has requested that the USACE maintain the improved channel in accordance with Section 204(f), Operations and Maintenance of Water Resources Development Act (WRDA) of 1986, as amended in WRDA 1990.

The following authorities are described in USACE Engineering Regulations 1165-2-124 Construction of Harbor and Inland Harbor Projects by non-Federal Interests, which allow navigation districts or similar entities to undertake navigation improvement projects. Under Section 204(a) of WRDA 1986, any non-Federal interest is authorized to undertake navigational improvements in harbors or inland harbors of the United States, subject to obtaining any permits required pursuant to Federal and State Laws in advance of the actual construction of such improvements. Section 204(f), as amended in WRDA 1990, requires USACE to be responsible for the maintenance of improvements made by the non-Federal interest if the following conditions are met:

- The Secretary of the Army (Secretary) determines, before construction, that the improvements, or separable elements thereof, are economically justified, environmentally acceptable, and consistent with the purposes of this title.
- The Secretary certifies that the project is constructed in accordance with applicable permits and the appropriate engineering and design standards; and
- The Secretary does not find that the project, or separable element thereof, is no longer economically justified or environmentally acceptable.

The CCND has applied for a permit to improve the Matagorda Ship Channel and is conducting studies needed in conjunction with the permit application. In addition, the CCND intends to submit a request to the Office of the Assistant Secretary of the Army for Civil Works (OASA [CW]) to have the USACE assume future maintenance of the proposed improvements to the navigation channel. If the USACE issues a permit for the improvements, then the CCND intends to go forward with constructing the navigation improvement project with non-Federal funds. The CCND is actively coordinating with the USACE to plan and design the MSCIP to meet Federal requirements necessary for the USACE to assume operations and maintenance of the improved channel in accordance with Section 204(f) (Operations and Maintenance) of the Water Resources Development Act (WRDA) 1986 as amended in WRDA 1990.

1.2 PURPOSE

The purpose of the project is to improve the deep-draft transport of commerce on the MSC for the existing and planned users of the channel. Currently, up to 90% of vessels calling at the Port are reported to be light-loaded due to draft limitations of the present channel configuration. By expanding the MSC dimensions and associated turning basin and marine slips, cargo vessels could reduce or eliminate light-loading measures and larger cargo vessels unable to transit the current channel configuration could call on the Port. The channel improvements would reduce transportation costs for existing commodities, which

are crucial to the regional economy. Because the existing turning basin at 1,000 ft by 1,000 ft may be deepened but cannot be expanded to accommodate the larger vessels, CCND proposes to construct a new turning basin at the intersection of the MSC and Alcoa Channel to accommodate larger vessels.

1.3 NEED

The concept of public and private need for the proposed project is important to the balancing process of the USACE public interest review (33 *Code of Federal Regulations* [CFR] 320.4(a)(2)(i)). A private applicant's proposal frequently satisfies a public as well as a private need (e.g., providing the public with needed goods and services). A public sector applicant's project is presumed to address some public need, such as public recreation. With regards to private projects, Department of the Army regulations (33 CFR 320.4 (q)) state that the USACE will generally not concern itself with the question of whether a proposed project will earn a profit or become economically viable, or whether it is needed in the market place. In regards to public projects, the USACE can defer to a state or other government entity decision to spend public money. However, regulations indicate that the USACE should make an independent review of the public need for a project from the perspective of the overall public interest. This independent review is relevant to the USACE permit decision. The USACE will question the public need for a project if the proposed project appears to be unduly speculative. In the public interest review, the USACE has the responsibility to balance public interest need or benefits against public interest detriments. The decision of whether to authorize a proposed project and the conditions under which it will be allowed are determined by the outcome of this general balancing process.

The MSC has undergone incremental improvements since its original construction in 1910. Through Congressional authorization, the construction of the current 36-ft deep-draft configuration was completed in 1966. Concurrent with the channel improvements, terminal facilities (both bulk and general cargo) at the Port have been expanded to provide capacity for terminal operators. Since 1966, the USACE has conducted at least two reconnaissance reports (USACE 1989, 2004) that have identified the present configuration as a constraint to a more efficient maritime commerce and have recommended improvements that would contribute to the National Economic Development (NED). Specifically, according to the reports, the current draft and width of the MSC limit modern deep-draft cargo vessels, which affects terminal capacity and economic efficiency of seaborne trade. These limitations are confirmed by current light loading practices and one-way vessel access on the channel.

The need for this project is derived from an analysis of current and projected vessel transits, cargo tonnage, and capacity at existing and proposed terminal facilities. The Port handles a variety of products, including petroleum, aluminum ore, chemicals, and allied products. In addition, a proposed Liquefied Natural Gas (LNG) re-gasification terminal is currently under review by the Federal Energy Regulatory Commission (FERC), as well as plans to modify an existing power plant (Joslin Unit) to utilize petroleum coke as fuel. The facility would supply gas and LNG products to local industries, which may include Alcoa and Formosa, and would tie into existing pipelines to supply energy throughout the region. The

LNG terminal would generate an additional 120 estimated transits annually on the MSC from LNG carrier vessels.

Port records indicate that liquid bulk (tankers) and dry bulk cargo vessels are the dominant deep-draft vessels operating in the MSC. According to Hackett (2003), the average draft for tankers calling at U.S. ports in 2001 was 39.1 ft with a minimum draft of 17.5 ft and a maximum draft of 74.9 ft. Dry bulk carriers had an average draft of 37.3 ft with a minimum draft of 22.7 ft and a maximum of 60.7 ft. Estimates by Hackett (2003) for Gulf Coast ports indicate an expected annual increase in tanker calls of 1.9% and dry bulk calls of 2.0%. These average ship dimensions exceed the capacity of the MSC and affect the delivery of supplies and commodities to the Port. For example, ships calling at Alcoa facility are loaded to 70% of capacity, and a portion of the Formosa Gulf Coast tanker fleet exceeds the maximum MSC depth. The proposed LNG re-gasification terminal at the Port will also contribute to increases in vessel traffic.

The configuration of the MSC is the controlling factor in safe vessel transits to and from the Port. With restrictive drafts, deep-draft vessels will continue to experience constrained calls by light loading and delivery routing, which generate increased channel traffic and do not maximize terminal capacity. These constraints increase the cost of raw materials and products delivered to the Port and adjacent users. The reductions in allowable maximum cargo load are significant. For example, a 42-ft design draft vessel is required to reduce its maximum dry bulk cargo by 17,311 short tons to navigate the 36-ft depth MSC, reducing its total cargo carried from a design maximum of 65,920 to 48,609 short tons, or approximately 26% (Matagorda Ship Channel Reconnaissance Report, 1989).

Deepening and widening the channel would also enhance navigation safety. The proposed bay channel bottom width of 400 ft would allow safe two-way traffic, providing an increased factor of safety for most vessels, and in the process would contribute to reduced delays and operational cost savings. Increased safety would also reduce the potential for accidents and spills and further protect the area's coastal and estuarine resources.

The current configuration of the channel will limit the LNG carrier size to the smaller class vessels of 75,000 cubic meters (m^3) to 88,000 m^3 capacity. Increases in the channel dimensions would increase the maximum quantity of LNG delivered per vessel transit by allowing the use of 165,000 m^3 to 225,000 m^3-class carriers. The use of the larger class of carriers would reduce the number of transits required to deliver a given volume of LNG and achieve an associated reduction in the cost of delivered gas. In addition, the potential reduction in transportation costs could allow greater flexibility in obtaining LNG from different foreign sources at competitive cost.

The Port maintains records of both vessel and barge transits on the MSC and cargo volume throughput. A review of this information for the period starting in 2000 indicates a general increase in transit and tonnage (Figures 1.3-1 and 1.3-2). Records of vessel and barge transits and cargo throughput are also

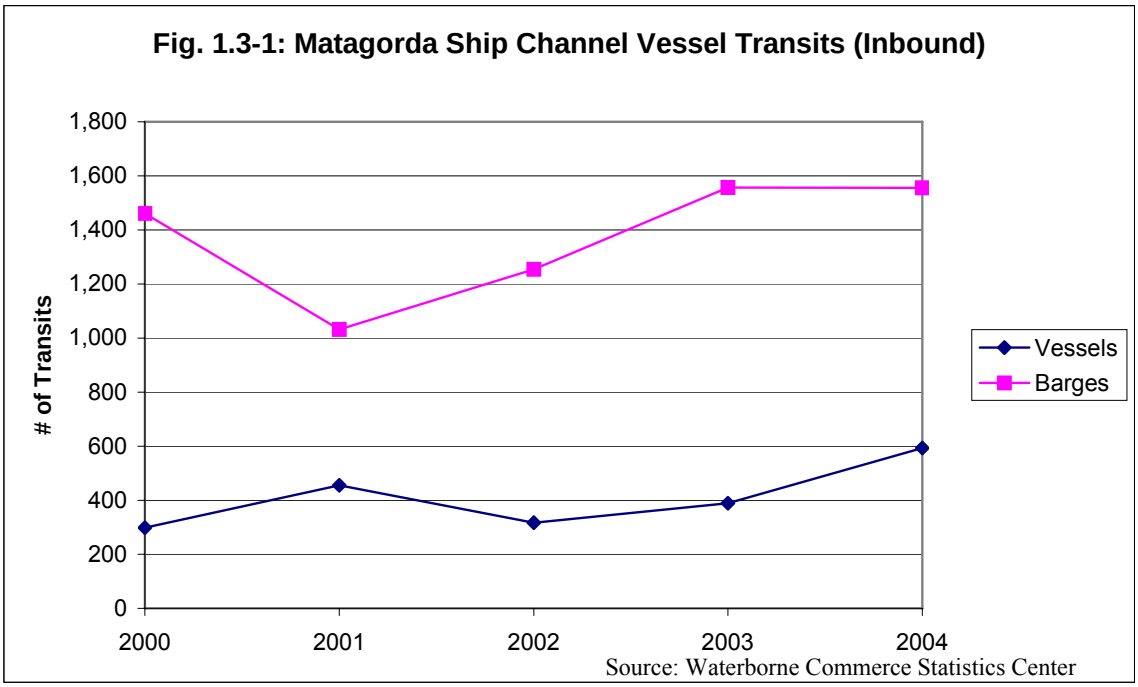
Fig. 1.3-1: Matagorda Ship Channel Vessel Transits (Inbound)
# of Transits
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
2000
2001
2002
2003
2004
Vessels
Barges
Source: Waterborne Commerce Statistics Center

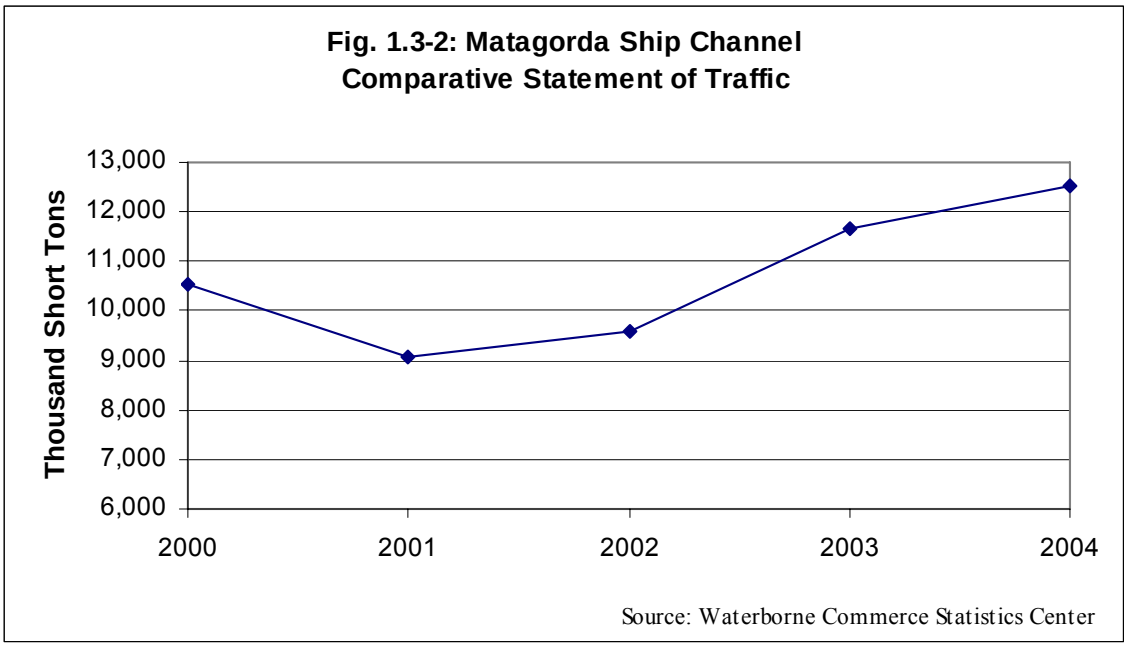
Fig. 1.3-2: Matagorda Ship Channel
Comparative Statement of Traffic
Thousand Short Tons
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
2000
2001
2002
2003
2004
Source: Waterborne Commerce Statistics Center

maintained by the USACE's Waterborne Commerce Statistics Center in New Orleans, Louisiana. This trend is expected to continue as the Port increases terminal capacity through its capital improvement program. In general, economic pressure and technological advances have influenced the trend toward larger ships, which as a result have increased channel improvement needs. It is projected that there will be a significant overall increase in demand for shipping, due to globalization and large increases in commodity trade (Hackett, 2003). The existing fleet will grow and it is likely that larger ships will be built in pursuit of economic efficiency (Waters et al., 2000). The regional economy in the study area is heavily dependent on the heavy industry and shipping supported by the Port. Marine cargo and vessel activity generate 5,300 direct jobs in the region, with an additional 4,590 induced jobs. The majority of the direct jobs are created by the movement of petroleum and petroleum products, primarily liquid chemicals, at the Port complex (Martin Associates, 2005). The widening and deepening of the MSC is consistent with other regional navigation channel improvements in response to these trends maintaining competitiveness in the market place while contributing to NED goals.

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2.0 DESCRIPTION AND EVALUATION OF ALTERNATIVES

2.1 INTRODUCTION

This section discusses the alternatives considered during the preparation of the EIS, including those that were eliminated from further study, those considered in detail, and the No-Action alternative. Although it fails to meet the Purpose and Need of the proposed project, the No-Action alternative always remains as an alternative to the applicant's Proposed alternative.

This discussion is intended to form the basis for the USACE's permit decision. As a result of the decision process, the USACE may issue the permit, deny the permit, or issue the permit with modifications or conditions. As discussed in Section 2.4.1, the No-Action alternative is considered to be equivalent to denial of the permit by the USACE.

While alternate sites might be considered alternatives for some projects that address a national or statewide-need, such is not the case for the present Permit Application. The vast majority of deep draft commodity movement in the MSC is for the import of raw material for use by the chemical and alumina processing plants located at or near Point Comfort. The processing facilities are connected to the docks by pipelines or conveyor systems. Processed chemicals, plastics, and alumina are then distributed from the port area on ships, barges and rail. These major industrial processing facilities are critical to the local economy and are dependant on efficient and reliable port operations. There are not reasonable cost-effective options for diverting commodities or production to other facilities in the United States. Therefore, the types of alternatives addressed were combinations of widening and deepening alternatives and dredged material placement alternatives at the project location.

2.2 ALTERNATIVES SCREENING

Identification of reasonable alternatives for channel improvements began with identifying actions that would meet the stated need for the project and comparing them to each other by assessing the positive and negative impacts of each alternative to the human and natural environment. Thus, a set of basic criteria are formulated against which potential project impacts were evaluated. An evaluation framework was developed to measure, quantify, and report impacts from each alternative using the established criteria. These criteria are generally derived from water resource planning guidance of the USACE and are described in terms of technical and environmental perspectives.

Technical criteria developed for alternative formulation and evaluation were based on maximizing the navigational attributes of the waterway for commercial vessel transportation in a manner that would achieve the stated purpose and need of the project and is determined as the least environmentally damaging practicable alternative. These criteria require alternatives to be compatible with navigation needs and consistent with the requirements of the navigational equipment using this portion of the waterway and to provide a long-term plan for the placement of dredged materials. Technical information,

both historical data and specific information prepared for this project, used during this study included, but was not limited to, salinity model data, ship simulation results, aerial photography, historical dredging records, and previously published scientific reports related to this area. Nonstructural alternatives to channel improvements, such as transshipment, use of tides, split deliveries, light loading, pilot regulations, tug assistance, vessel modification and traffic management, were not considered viable for evaluation because the channel depth is the predominant limitation or constraint on deeper-draft vessel transits and the unique characteristics of the commodities imported/exported through the channel.

The general environmental criteria for navigation projects are identified in Federal environmental statutes, executive orders, and planning guidelines. It is the national policy that fish and wildlife resource conservation be given equal consideration with other study purposes in the formulation and evaluation of alternatives. Thus, the basic guidance in project development was to assure that care be taken to preserve and protect significant ecological, aesthetic, and cultural values, and to conserve natural resources. In developing and considering alternatives, particular emphasis was placed on the following:

- Protection and preservation of the existing fish and wildlife resources along with the protection and preservation of estuaries, wetland habitats, and water quality – and improvement of these resources through using dredged material beneficially to create and/or protect habitat;
- Consideration in the project design of the least disruptive construction techniques and methods;
- Mitigation for project-related unavoidable impacts by minimizing, rectifying, reducing or eliminating, compensating, replacing, or substituting resources; and
- Preservation of significant historical and archeological resources through avoidance of effects. This is the preferable action to any other form of mitigation since these are finite, nonrenewable resources.

As stated in Section 1.1, the MSC is currently maintained between –36 and –38 ft MLT. In order to identify appropriate channel dimensions for consideration, the fleet of vessels that either have, or would potentially call at the Port was reviewed. The largest vessels commonly using the channel are Panamax class vessels, which must be light loaded 5.5 to 6 ft to transit the 36-ft depth of the Matagorda Ship Channel. The ore deliveries to the Alcoa facility are predominantly from the Port of Kamsar in west Africa. Recent Kamsarmax vessels have a full loaded draft of 47.2 ft and would be light loaded by over 13 ft to reach the Alcoa terminal. The largest chemical carriers currently calling at the Port have been less than fully loaded, and it is considered likely that larger vessels would use an expanded channel. Based on recent ship simulations, the existing channel can accommodate a 71,000 cubic meters (m^3) class LNG carrier. Larger LNG carriers require both a deeper and wider channel. The vessel dimensions considered are presented in Table 2.2-1.

Based on the dimensions of both the existing and potential vessels using the Port, a series of Channel Improvement Alternatives (channel alternatives) were developed. The channel alternatives were selected to safely accommodate a range of vessels. In addition to the No-Action alternative, the channel alternatives considered ranged from improving the MSC to 42 ft by 200 ft, as presented in the 1989

Table 2.2-1
Vessel Dimensions

Vessel Type/Class	Length Overall (ft)	Beam (ft)	Draft (Loaded) (ft)
Current Ore Carrier	774	107	46.3
Kamsarmax Ore Carrier	751	106	47.2
Current Chemical Carrier	643	96	38.1
Potential Chemical Carrier	740.7	119.4	41.1
LNG 88k m^3	819	131	34.8
LNG 135k m^3	915	140	37.7
LNG 220k m^3	1,020	158	41

Reconnaissance Report prepared by USACE, Galveston District, to a 51-ft-deep by 400-ft-wide channel that would allow fully loading the largest ore carriers currently using the Alcoa terminal, plus the largest class of LNG carrier. The 51-ft depth channel alternative (channel alternative 4) has since been eliminated from consideration because of the high cost of initial construction and small incremental transportation benefits over the channel dimensions for channel alternative 3.

Five structural channel improvement alternatives were developed and evaluated (Table 2.2-2) using the technical and environmental criteria previously described. The typical dredging prism for each channel alternative includes 3 horizontal to 1 vertical sideslopes and an additional 2-ft depth for advanced maintenance and 2 ft for allowable over depth on the main channel and turning basin. For the entrance channel, 10 horizontal to 1 vertical sideslopes with 3 ft advanced maintenance and 2 ft allowable over depth are in addition to the project depth.

Table 2.2-2
Structural Channel Improvement Alternatives Evaluated for the MSCIP

Channel Alternative No.	Turning Basin/Main/ Bay Channel		Entrance Channel		Dredged Volume
	Depth (MLT) (ft)	Width (ft)	Depth (MLT) (ft*)	Width (ft)	Total (mcy**)
No Action	36	200	38	300	0
1989 Recon	42	200	44	300	12.5
1	40	350	42	450	28.14
2	42	350	44	450	33.27
3	44	400	46	600	46.50
4	51	400	53	500	60.81

*Project depth without 3 ft of advance maintenance and 2 ft of allowable over depth.
**mcy = million cubic yards.

Screening efforts were guided by results from maneuvering simulations under the existing channel configuration, completed using a post-Panamax class vessel with a length overall (LOA) of 1,115 ft, a beam of 168 ft, and a 39.4-ft draft. Simulation runs on the MSC were completed under multiple

meteorological and hydrographic variables to screen for critical channel conditions and to develop optimal channel geometry.

Real-time, "man-in-loop" vessel simulations that accounted for ship dynamics, area weather, and bay hydrodynamics were conducted at MarineSafety International (MSI) in Newport, Rhode Island. These simulations were conducted for both the existing channel configuration conditions and the proposed improvements to the MSC. A full visual model of the channel and port facilities was created for use in the simulation along with a radar database. MSI's vessel database includes numerous LNG carriers (LNGCs), tankers, bulk carriers, and container ships. Matagorda Bay Pilots were involved in the setup and validation of the geographic and hydrographic models and with the execution of simulations for the proposed improvements. All simulations were done in accordance with US Army Corps' Engineer Research and Design Center (ERDC) testing protocols.

For all channel alternatives considered, avoidance and minimization of impacts was the preferred form of mitigation. However, unavoidable project-related impacts, primarily from removal of bay-bottom and placement of dredged material, will occur with any channel configuration and may be mitigated through a variety of means. Because these impacts are related to the quantity and composition of dredged material, they are proportional to the size of the channel.

Through the evaluation of the project area and discussions with Federal and state resource agencies, it became apparent that the majority of potential impacts associated with the proposed project would affect aquatic resources, specifically oyster reefs and unvegetated bay bottom.

As indicated, the impacts are proportional to the size of the channel. A wider channel affects more oyster reefs and bay bottom. However, the offsetting mitigation is also scalable because more dredged material is available to create oyster reefs and to create/protect habitat (marsh or seagrass) that has a higher functional value than the impacted bay bottom.

These economic and environmental effects were the main criteria used to identify the applicant's Preferred alternative. Thus, Alternative No. 3 (see Table 2.2-2) was selected to compare against the No-Action alternative because it provides navigation benefits to the broadest base of channel users, while also improving the habitat function value of the bay system.

2.2.1 Design Channel

CCND, as the applicant, has proposed to deepen the MSC main channel to –44 ft MLT, widen the channel to 400 ft with 3 horizontal to 1 vertical sideslopes, deepen the MSC entrance channel to –46 ft MLT, and widen the entrance channel to 600 ft with 10 horizontal to 1 vertical sideslopes (channel alternative 3 in the ship simulation analysis, see Table 2.2-2). This channel design was selected on the basis of an economic benefit analysis as the channel alternative that will provide navigation benefits to the

broadest base of channel users, and because of the improvement to the habitat function value of the bay system, which results from the proposed DMMP.

Under the proposed plan, the existing 200 ft wide MSC would be widened as follows (see plan sheets 3 to 10 in Appendix A):

- Channel Station -23+000 to 4+655.99 – both sides of the channel widened to 600 ft (flaring out to approximately 761 ft at station 4+655.99)
- 4+655.99 to 8+774.78 – both sides of the channel widened to taper form 761 to 400 ft with the northeast side of the channel tapering down to 0 ft wider at channel station 8+774.78
- 8+774.78 to approximately 95+000 – widened on southwest side of the channel to 400 ft
- Approximately 95+000 to proposed turning basin at 110+000 – widened to between 400 and 802.5 ft primarily on the west side of the channel with portions widened on the east around the curves to the turning basin

Increasing the depth of the main channel to –44 ft MLT will benefit existing facilities that use the channel and or the Port, such as Alcoa, Formosa, Texas Liquid Fertilizer, and Ineos Nitriles (formerly BP Chemical) by allowing greater loading of ships delivering supplies. Transportation savings will accrue from shipments of the major commodities delivered to the Port and Alcoa, including aluminum ore and naphtha. In addition to improving access for existing vessels, the proposed channel alternative would allow for the safe transit of the larger 250,000 m^3 class carriers now being constructed. While deepening the channel beyond the proposed channel alternative would provide additional transportation cost savings for some bulk liquids and for aluminum ore, it would not provide transportation cost savings for all the primary commodities and certain port users. This impact is most evident in the lack of cost savings for future LNG transport, where the largest carrier vessel under development would not require a depth greater than –44 ft MLT.

Channel alternatives less than –44 ft MLT limit the potential for navigation cost savings. Preliminary results indicate that, with the exception of cargoes from Mexico or Central America, the shallower depths in the 1989 Reconnaissance Report alternative and channel alternatives 1 and 2 would increase bulk liquid and aluminum ore transportation costs by $.30/ton to $.70/ton per foot of channel depth. In addition, reducing the channel size from channel alternative 3 to channel alternative 2 would result in a 33% reduction in LNG vessel capacity. This reduced capacity would require a 50% increase in the number of LNG vessel calls to provide the same amount of gas, at a significantly increased economic cost.

The proposed channel alternative would generate approximately 46.5 mcy of new construction dredged material. This alternative was selected based on several considerations including: historical trends in commodity tonnage, previous incidents of light loading, future landside throughput capacity availability, fleet trends, and maneuvering limitations.

The proposed channel alternative would result in an 8-ft increase in available draft on the MSC. The widening would increase maneuvering tolerances for vessels in transit and provide additional separation distance between barge and deep draft vessels. The proposed channel improvements would reduce vessel light loading requirements and allow the use of larger vessels, resulting in transportation cost savings. Using the dredged material beneficially would provide habitat and shoreline restoration opportunities as part of the DMMP.

2.3 ALTERNATIVE DESCRIPTIONS FOR DREDGED MATERIAL PLACEMENT

The project alternatives considered include coupling improvements to the MSC with the placement of new work and future maintenance dredged material. As evaluated in Section 2.2 of this EIS, the proposed channel design for the MSCIP was determined based upon the economic benefits and safety provided to navigation interests for a broad base of channel users. In summary, the economic analysis concluded improvements to the MSC should provide for deepening and widening of the In-Bay Channel to a depth of –44 ft MLT and a width of 400 ft, and deepening and widening the Entrance Channel to a depth of –46 ft MLT and a width of 600 ft. The volume of new work material required to be dredged and managed for improving the MSC is estimated at 46.5 mcy, with a total of 257.5 mcy of material to be dredged over a period of 50 years to maintain the MSCIP.

The proposed channel improvement action requires the placement of new work and maintenance dredged material in an economically feasible and environmentally acceptable manner. A range of dredged material placement alternatives was considered, including confined upland placement, use of the dredged material beneficially, unconfined in-water placement, ocean placement, and a combination of these placement features. In the interest of meeting the project purpose and need while minimizing and mitigating for environmental impacts, the project applicant and USACE met with representatives of several State and Federal resources agencies to develop a DMMP. This DMMP Workgroup served to guide the applicant in developing viable disposal management alternatives for the proposed MSCIP dredged material. The DMMP Workgroup included representatives from:

- Texas Commission on Environmental Quality (TCEQ);
- Texas General Land Office (GLO);
- Texas Parks and Wildlife Department (TPWD);
- National Marine Fisheries Service (NMFS); and
- U.S. Fish and Wildlife Service (FWS).

Three major placement alternatives were identified and evaluated to assess costs and positive and negative ecological effects of managing and placing the MSCIP's new work and future maintenance dredged material over a period of 50 years. In general, these alternatives include Upland Confined Placement, Gulf Confined Placement, and Multi-use Placement. Along with the No-Action alternative,

the evaluation of these three dredged material placement alternatives are described in the following subsections.

2.3.1 Alternative 1: No-Action Alternative

The No-Action alternative for this project is one which would result in no construction requiring a USACE permit. Since the proposed project requires dredging activities within navigable waters, it could not be constructed without a permit from the USACE. Thus, the No-Action alternative is equivalent to the USACE denial of the permit for proposed improvements to the MSC. In the event of permit denial, the channel would not be improved and future benefits would not be captured. Under the No-Action alternative, the existing project would continue to be maintained at its current dimensions and dredged material would be placed in compliance with the applicable DMMP. Foregoing navigation improvements to the MSC would have the following impacts: (1) long-term increase in transportation costs to navigation relative to those that would result from project implementation; (2) loss of potential for increased channel usage, since a widened and deepened channel would permit two-way traffic and allow for larger vessel classes to transit; and (3) failure to improve vessel traffic safety that would result from a widened MSC. Therefore, the No-Action alternative is not considered viable.

2.3.2 Alternative 2: Upland Confined Placement

Under the Upland Confined Placement alternative all the material dredged from the MSC's Entrance and In-Bay navigation channels as part of the improvements project would be placed within upland confined sites. There are two existing upland placement areas currently in use to receive maintenance dredged material. These upland placement areas are located at Dredge Island and at PA19. PA19 resides in Lavaca Bay on property owned by the CCND. However the two upland placement areas lack sufficient capacity to receive all of the new work and maintenance dredged material anticipated to be generated by the MSCIP. Several other upland placement areas were identified (see Appendix B) that cumulatively could accommodate both the MSCIP's new work and future maintenance dredged material.

These additional potential sites would require multiple land acquisition, estimated at approximately $3,000 per acre (ac), and would entail addressing any potential mitigation impacts. Approximately 3,888 ac of upland placement areas would need to be identified to manage the material generated by both new work and subsequent maintenance dredging operations. Dredged material from MSC reaches within Lavaca Bay, Matagorda Bay, and the Gulf would need to be pumped from a distance of up to 9 miles in order to avoid discharge of the material on high quality wetlands, marshes, oysters and/or seagrass habitats.

It is estimated the new work construction cost with the Upland Confined Placement Alternative would be $308,108,000. This does not include the cost for additional mitigation required for impacts to the bay bottom and oyster reef from widening the channel. Cost of future maintenance for the project over a period of 50 years is $749,310,000. Total cost for the MSCIP with the Upland Confined Placement Alternative, excluding mitigation costs, is estimated to be $1,057,418,000.

The Upland Confined Placement Alternative has the least conversion of open bay bottom and offshore habitats, since all of the dredged material would be placed at onshore sites. However, this alternative does not provide for opportunities to apply the MSCIP's dredged material to construct mitigation sites or use the material beneficially to increase the total habitat functional value of aquatic habitats. In addition, the Upland Confined Placement Alternative would require acquisition of extensive acreage of land, resulting in significant cost increases, along with the potential requirement to mitigate impacts to wetlands and other terrestrial habitats.

The Upland Confined Placement Alternative was removed from further consideration due to the substantial costs and complexities of acquiring significant amounts of land to place the dredged material.

2.3.3 Alternative 3: Gulf Unconfined Placement

The Gulf Unconfined Placement Alternative involves the placement of materials dredged from the MSC's Entrance and In-Bay navigation channels within Ocean Dredged Material Disposal Sites (ODMDS), located offshore of the Matagorda Peninsula and adjacent to the down drift side of the Entrance Channel. An existing maintenance ODMDS (PA1) designated by EPA to receive maintenance dredged material (sediments that accumulate in the channel and can hamper navigation traffic) from the MSC is located approximately two miles offshore of the Matagorda Peninsula and 1,000 ft southwest (or down drift) of the MSC Entrance Channel centerline.

A potential new work material ODMDS (PA O5) has been considered immediately downstream of the PA1 for the one-time placement of the MSCIP's new work dredged material. Both PA1 and PA O5 are dispersive sites, therefore their capacities are considered to be unlimited. Under the Gulf Unconfined Placement Alternative, all of the new work and future maintenance material generated by constructing and maintaining the MSCIP would be placed in PA1 and PA O5.

It is estimated the new work construction with the Gulf Unconfined Placement Alternative would cost $313,472,000. The cost for this alternative is driven by the distance to transport the dredged material using hopper dredges or dump scows of up to 27 miles. This cost does not include additional mitigation that would be required for impacts to bay bottom and oyster reefs resulting from widening the MSC. The project maintenance cost over the 50-year project life is $1,073,104,000, excluding costs for mitigation sites. The total project cost for Gulf Unconfined Placement is $1,386,576,000.

The Gulf Unconfined Placement Alternative minimizes the conversion of Bay habitats by avoiding the placement of dredged material at in-bay sites. Instead, all of the material dredged to construct and maintain the MSCIP would be placed in unconfined offshore placement areas. This alternative does not provide for opportunities to apply the MSCIP's dredged material to construct mitigation sites or use the material beneficially to increase the total habitat functional value of aquatic habitats. In addition, the cost to transport all of the new work and future maintenance dredged material to offshore sites is substantial and economically prohibitive.

The Gulf Unconfined Placement Alternative was removed from further consideration due to the added costs of transporting all of the new work and future maintenance material to offshore placement areas.

2.3.4 Alternative 4: Multi-use Placement

The fourth placement alternative entails placing both new work and future maintenance dredged material within a mix of upland, in-bay and offshore placement areas. An array of scenarios under the Multi-use Placement Alternative was analyzed to identify the least-cost scenario that provides net positive ecological impacts. Appendix B provides a complete description of each Multi-use Placement alternative along with the placement features associated with the Multi-use Placement Alternative.

Essentially, four alternatives evolved as being feasible for implementation under the Multi-use Placement Alternative. Each of the four alternatives had a mix of different placement features in which to compare costs and environmental outputs. All four alternatives include placement features to receive new work and future maintenance material to create in-bay upland sites; create in-bay marshes; provide for beach nourishment and shoreline protection; cap in situ mercury laden bottom sediments; create oyster reefs on top of mercury impacted sediments; and, disperse the material at offshore placement sites. With the exception of the offshore placement sites, two of the alternatives (1A and 1B) have full confinement of the new work and future maintenance dredged material. The other two alternatives (2A and 2B) are similar to Alternatives 1A and 1B, except that in 2A and 2B the Matagorda Channel reach maintenance dredged material will continue to be placed in the existing unconfined open bay placement areas. Other differences include Alternatives 1A and 2A placing dredged material within an onshore site, and Alternatives 1B and 2B placing dredged material within an in-bay area to create an upland site in lieu of having the dredged material placed within an onshore site. Section 2.4 describes each placement feature for the Multi-use Placement Alternative, with additional details provided in the MSCIP DMMP (see Appendix B).

Environmental outputs for each of the four alternatives were determined primarily by the Habitat Equivalency Analysis (HEA), as coordinated with the multi-agency DMMP Workgroup. In general, the HEA outputs allowed the DMMP Workgroup to compare habitat functional values of impacted versus created areas over the 50-year performance period for the four Multi-use Placement Alternatives. A complete description of the HEA's computational methodology can be found in Appendix J.

For Alternative 1A it is estimated the MSCIP new work construction will cost $269,542,000 and maintenance of the MSCIP will cost $590,190,000, for a total MSCIP cost of $859,732,000 and an equivalent annual cost of $26,580,000. The HEA value for this alternative is computed as +862.6 (Table 2.4-1).

Table 2.4-1
Alternative Costs and HEA Values

Alternative	Placement Type	Cost ($ million) and Value				
		New Work Cost	Maintenance Cost	Total Cost	Equivalent Annual Cost	HEA[1] Value
Alt 1	No-Action	0	228	228	na	0
Alt 2	Upland Confined	308	749	1,057	na	–2,217.6
Alt 3	Gulf Unconfined	313	1,073	1,387	na	–5,525.0
Alt 4 (1A)	Multi-use (Alternative 1A)	270	590	860	26.6	862.6
Alt 4 (1B)	Multi-use (Alternative 1B)	301	562	864	27.8	–2,043.3
Alt 4 (2A)	**Multi-use (Alternative 2A)**	**248**	**525**	**773**	**24.1**	**4,789.9**
Alt 4 (2B)	Multi-use (Alternative 2B)	280	497	777	26.5	1,883.9

[1]As compared with the No-Action alternative.

For Alternative 1B it is estimated the MSCIP new work construction will cost $301,469,000 and maintenance of the MSCIP will cost $562,241,000, for a total MSCIP cost of $863,710 000 and an equivalent annual cost of $27,829,000. The HEA value for this alternative is computed as –2,043.3.

For Alternative 2A it is estimated the MSCIP new work construction will cost $248,050,000 and maintenance of the MSCIP will cost $524,521,000, for a total MSCIP cost of $772,571,000 and an equivalent annual cost of $24,106,000. The HEA value for this alternative is computed as +4,789.5.

For Alternative 2B it is estimated the MSCIP new work construction will cost $279,977,000 and maintenance of the MSCIP will cost $496,572,000, for a total MSCIP cost of $776,549,000 and an equivalent annual cost of $26,482,000. The HEA value for this alternative is computed as +1,883.9.

Based upon comparing HEA outputs and cost to construct among the four alternatives, it is concluded Alternative 2A of the Multi-use Placement Alternatives provides the greatest environmental output at the lowest cost.

2.4 MULTI-USE DREDGED MATERIAL PLACEMENT FEATURES

A description of each dredged material placement feature for the Multi-use Placement Alternatives are provided in this section and further described in Appendix B. Table 2.4-2 displays in a tabular form the placement features for each of the four Multi-use Placement Alternatives.

2.4.1 Placement Area A1 – In-Bay Upland

Proposed PA A1 is a 530-ac, rectangular site located south of the Port of Port Lavaca-Point Comfort facilities on existing USACE PAs 18 and 19. The area is planned to be an upland site with part of the placement area on land and the majority of the site located in open water. Approximately 530 ac of bay

bottom are expected to be covered during the filling of the placement area. PA A1 will be used to contain approximately 2.0 mcy stiff clay and 1.3 mcy soft clay of new work material and 45.1 mcy of future maintenance material.

Table 2.4-2
Multi-Use Placement Alternatives and Features

		Multi-use Alternatives			
Placement Area	Feature Description	1A	1B	2A	2B
A1	In-Bay Upland	X	X	X	X
A2	In-Bay Upland/Marsh	X	X	X	X
BN1, BN2, BN3	Beach Nourishment	X	X	X	X
C2	In-Bay Upland		X		X
D	In-Bay Upland	X	X	X	X
ER1	Oyster Reef on Mercury Impacted Sediment	X	X	X	X
ER2	In-Bay Upland on Mercury Impacted Sediment	X	X	X	X
ER3	In-Bay Upland/Marsh on Mercury Impacted Sediment	X	X	X	X
G	Marsh/Shoreline Protection	X	X	X	X
H2	In-Bay Upland	X	X		
H4	In-Bay Upland	X	X		
H4 Habitat Area	Marsh/Sand Platform/Bird Island			X	X
O5	Offshore Dispersive Site	X	X	X	X
OR1 and OR2	Oyster Reef	X		X	
P1	Onshore Upland	X		X	
PA1	Existing Offshore Dispersive Site	X	X	X	X
PA5 to PA12	Existing Unconfined Area in Matagorda Bay			X	X

2.4.2 Placement Area A2 – Combined Upland/Marsh

Proposed PA A2 is a 260-ac, rectangular site located along the northern shore of Cox Bay, which is an eroding clay bluff. The area is planned to include uplands as well as marsh in the open bay adjacent to the bluff, which should eliminate future erosion in this area. The upland part of the site is planned to extend from the bluffs to an interior levee. The site will have a marsh along the bay. PA A2 will contain 140 ac of uplands and 120 ac of marsh constructed from new work material. This area will be used to contain approximately 0.8 mcy stiff clay and 5.4 mcy soft clay of new work material. A small amount of oyster reef will be impacted by construction of the site (0.75 ac) (BESI, 2006a).

2.4.3 Placement Areas BN1, BN2, and BN3 – Beach Nourishment

Proposed PAs BN1, BN2, and BN3 are located along the public beaches of the Magnolia-Indianola shoreline. These proposed PAs would nourish the beaches in areas that have been eroding at an average rate of 3 to 4 ft per year. Confining structures of stone or a comparable system will be used at the end of the fills near the LaSalle monument to the south as well as along the beach fill and at the public boat ramp

to the north to stabilize the sand. Additional structures would be provided at the Crabbing Bridge to protect the inlet to Old Towne Lake and at Indian Point to protect the fill. Depending on the composition of the sand, the beach may be built out between 150 to 300 ft for a total of 125 ac after the initial construction. This area will be used to contain approximately 1.9 mcy of new work material. Since these beach nourishment areas will be restoring similar habitats to what has been lost to erosion, they would not be considered significant impacts to bay bottom habitat.

2.4.4 Placement Area C2 – In-Bay Upland

PA C2 is a rectangular 886-ac in-bay upland placement area located to the north of the ship channel, north of Magnolia Beach in Lavaca Bay. Levees will be raised around the site during the initial construction of the channel and openings will be provided to allow circulation until the maintenance material is placed inside. Half of the area will be filled with new work material, the other half of the area will remain open until 25 years later, when maintenance material will be placed there over the remaining project life. PA C2 will be used to contain approximately 2.2 mcy of new work material and 55.0 mcy of future maintenance material.

2.4.5 Placement Area D – In-Bay Upland

PA D is a 274.2-ac, rectangular site located adjacent to the southwest side of the existing "Dredge Island." The area is planned to be an upland site with part of the placement area on land and the majority of the site located in open water. Both marsh and high marsh will be created in a 100-ft-wide area along the perimeter of the upland; 7.1 ac marsh and 7.1 ac of high marsh will be created. PA D and ER3 join together, PA ER3 is the part of the placement area that is on mercury-impacted sediments. The amount of existing oyster reef in the proposed placement area was estimated at 0.66 ac (BESI, 2006a). A marsh delineation done by BESI (2006b) found 3.4 ac of marsh and 18.6 ac of high marsh along the edge of Dredge Island. The remainder of the existing habitat of the site is non-marsh Dredge Island shoreline and open bay bottom. PA D will be used to contain approximately 0.5 mcy stiff clay and 1.1 mcy soft clay of new work material and 14.8 mcy of future maintenance material.

2.4.6 Placement Area ER1 – Enhanced Recovery Area Oyster Reef

Proposed PA ER1 is located on sediments that are impacted by mercury, which was analyzed for the Lavaca Bay Superfund Site. The extent of the area is approximately 126 ac and will consist of alternating 50-ft-wide rows approximately 2 ft thick for oyster reef creation and 50-ft-wide channels for access. The effective area for oyster reef creation is 63 ac. Creation of PA ER1 would also temporarily affect approximately 63 ac of unvegetated benthic habitat. However, the positive effect of covering impacted sediments is believed to outweigh any negative effects to existing benthic habitats. Crushed limestone or other suitable media may be placed on the clay to serve as a base for the recruitment of oysters. These may serve as mitigation for the project impacts. The thickness of material of 2 ft provides substantial separation between impacted sediments and the created oyster reefs. Thus, there is not a concern for the

potential methylation of mercury within this created oyster reef. PA ER1 will utilize approximately 0.4 mcy of very stiff to hard new work clay material.

2.4.7 Placement Area ER2 – Enhanced Recovery Area In-Bay Upland and Marsh

PA ER2 is a 178-ac in-bay upland area that will cover mercury-impacted sediments. PA ER2 is located northwest of Dredge Island, along State Highway (SH) 35. An analysis of aerial photos indicated that approximately 3.4 ac of marsh are present at the site, these impacts would be mitigated by creation of a 10.2-ac fringe marsh. In a similar manner oyster reef were estimated to be 0.6 ac. PA ER2 will be used to contain approximately 1.1 mcy stiff clay and 1.0 mcy soft clay of new work material and 6.9 mcy of future maintenance material.

2.4.8 Placement Area ER3 – Enhanced Recovery Area In-Bay Upland and Marsh

Sediments on the northern edge of Dredge Island are impacted by mercury with concentrations above the Lavaca Bay Superfund Record of Decision sediment Remedial Action Objective. PA ER3 is a 252.5-ac confined placement area to contain soft new work and maintenance dredged material. Dredged sediments will be placed over the area to cover impacted sediment. A 100-ft-wide marsh will be created along the perimeter to serve as both shoreline protection as well as mitigation for project impacts. In addition to PA ER3 upland and fringe marsh, a marsh will be connected to the east side of Dredge Island. Along the shoreline and within the water, the thickness of the clay cover will be a minimum of 2.0 ft thick. In the deeper water areas, the thickness will be greater in order to reach the target intertidal level. Thick material provides adequate separation between impacted sediments and the created marsh. Thus, there is not a concern for the potential methylation of mercury within this created marsh. PA ER3 will result in the loss of approximately 11 ac of coastal marsh (1.6 ac of fringe marsh and 9.4 ac of high marsh), 17 ac of oyster reefs, and 184.5 ac of mercury-impacted bay bottom.

2.4.9 Placement Area G – Marsh with Sand Point and Keller Bay Protection

Erosion at Sand Point and the peninsula separating Keller Bay from Matagorda Bay threatens the adjacent marsh systems and seagrass habitat in Keller Bay. A breach of this peninsula would cause Keller Bay to be connected to Matagorda Bay and result in a loss of seagrass habitat and acceleration of the loss of marsh due to erosion. PA G and associated shoreline protection is proposed to prevent a breach from occurring. PA G is a 332-ac (including 12 ac of levee) rectangular marsh located 300 ft offshore of Sand Point Marsh and continues as shoreline protection to the end of Keller Bay. The shoreline protection proposed consists of an armored earthen levee to approximately elevation 6.0 ft above MLT with an area of 12.6 ac. The marsh area has a capacity of 2.6 mcy of stiff clay and 2.1 mcy of soft clay material, and will be constructed entirely from new work material. The levee will be constructed using 0.4 mcy of materials mechanically excavated from along the shoreline.

2.4.10 Placement Area H2 – In-Bay Upland

PA H2 is a 564-ac rectangular upland located north of Port O'Connor in Matagorda Bay northeast of the ship channel. Half of the area will be filled with new work material, and the other half will not begin to be filled until 25 years later. The site has a capacity of 9.2 mcy new work material and 42.4 mcy of maintenance material.

2.4.11 Placement Area H4 (Habitat Area) –Marsh, Sand Platform, and Bird Island

PA H4 is located north of Port O'Connor in Matagorda Bay along the northeast side of the ship channel. The area will be a mosaic of habitat including 325 ac of sandy shallow-water habitat at a depth of –2 to –3 MLT, 100 ac of marsh islands/terraces, a 25-ac bird island, and 20 ac of levee, for a total of 470 ac. Seagrass beds at the shoreline between Powderhorn Lake and Port O'Connor are expected to provide propagules to establish seagrass in the calm, shallow, sandy areas. A perimeter levee with gaps for water circulation will be installed and armored to an elevation of 8.0 MLT and silty/sandy material will be placed inside to create the variety of habitats. The site will be used to contain approximately 1.5 mcy stiff clay and 8.5 mcy silty sand of new work material.

2.4.12 Placement Area H4 (Full Containment) –Sand Platform and Bird Island

In alternatives that feature full containment of dredged material in Matagorda Bay, the PA H4 habitat area will be replaced by a PA H4 upland area. As a upland PA, PA H4 has a capacity to hold 10.7 mcy of new work material and 42.5 mcy of maintenance material in a 675-acre footprint. The PA H4 (Full Containment) feature does not contain a mosaic of habitats, but has 131 ac of shallow sandy areas that are conducive to seagrass colonization.

2.4.13 Placement Area O5 – New ODMDS

PA O5 is a 1,600-ac rectangular open-water placement area located approximately 3 miles offshore and 1,000 ft south of the channel centerline. It is proposed to use this site only once for the placement of 12.0 mcy of new work material generated by the dredging of the MSC's Entrance Channel and portions of the In-Bay channel.

2.4.14 Placement Areas OR1 and OR2 – Clay Core Oyster Reefs

Proposed PAs OR1 and OR2 together have 235 ac of clay core oyster reefs located in upper Lavaca Bay. Sites were selected to maximize their potential to become productive oyster reef habitat, which is based on a number of factors, including appropriate salinity, orientation to currents, and temperature. The proposed reefs would be constructed from stiff clay from new work channel material to provide an elevation of a minimum of 1 ft above surrounding bay bottom. The stiff clay serves as a base for the

proposed oyster reefs. After the clay is placed the area will be covered with 3 inches of crushed limestone or similar media conducive to recruitment of oyster. This area will be used for the placement of approximately 1.0 mcy of new work material.

2.4.15 Placement Area P1 – Terrestrial Upland

Proposed PA P1 is a 700-ac site located south of Alamo Beach on existing agricultural land. The area is planned to be an upland site and would be built out over the 50-year project life. Levees will be raised around the site during the initial construction of the channel and provide capacity for 1.0 mcy of new work and 55.0 mcy of future maintenance material.

2.4.16 Placement Area PA1 – Existing ODMDS

PA1 is a 453-ac rectangular open-water placement area located approximately 2 miles offshore and 1,000 ft south of the channel centerline. PA1 will be used for the continued placement of approximately 13.6 mcy of maintenance material from the Entrance Channel over a 50-year period.

2.4.17 Existing Unconfined Open-Water Placement Areas 5, 6, 7, 8, 9, 10, 11, and 12

The MSC is currently maintained by placing dredged material in unconfined placement areas along the length of the channel, both in the bay and offshore.

PAs PA 5–12 are located northeast of the ship channel in Matagorda Bay. The areas are separated from the channel by a ridge that is most likely a remnant of the initial construction of the channel. The tidal currents in this area are relatively small and are oriented parallel to the channel and placement areas. The shoaling rates in this portion of Matagorda Bay have not changed significantly since the construction of the channel in the 1960's. This constant shoaling rate provides good evidence that the ridge acts as a barrier between the channel and placement areas, and that the currents do not recycle material into the channel. The areas will be used for the placement of 109 mcy of future maintenance material in Matagorda Bay. Modeling has indicated that the material is dispersed through wave action within a year of placement (URS 2006a).

2.4.18 Placement Areas 01 and 02 – Sundown Island and Port O'Conner Beach

Although not presented as placement areas for the 50-year DMMP, both Sundown Island and Port O'Conner Beach may potentially receive new work and/or maintenance dredged material. Both sites have been used in the past as placement areas for Gulf Intracoastal Waterway (GIWW) maintenance dredged material.

2.4.19 Dredged Material Placement Alternative Selection

Alternative 2A of the Multi-use Placement Alternatives is the most economically viable alternative and provides the greatest increase in habitat function compared to other Multi-Use Placement Alternatives, the Upland Confined Placement Alternative, and the Gulf Unconfined Placement Alternative. In addition, Alternative 2A provides the greatest environmental outputs at the least cost among the other three Multi-use Placement Alternatives (1A, 1B, and 2B). Therefore, the Multi-use Placement Alternative 2A is the Preferred alternative to manage the placement of material dredged to modify the MSC for the purpose of improving the deep draft transport of commerce through the MSC. Shown in Table 2.5-1 is a cost comparison of each placement alternative.

2.5 PROPOSED ALTERNATIVE (APPLICANT'S PREFERRED ALTERNATIVE)

Following the alternatives screening process, CCND identified their preferred alternative for channel improvements and dredged material placement. The applicant's preferred alternative, as described in the following sections, is referred to throughout this document as the Proposed alternative.

2.5.1 Proposed Channel Dimensions

Improvements to the MSC would entail deepening the In-Bay Channel from –36 ft MLT to –44 ft MLT, with 2 ft of advance maintenance and 2 ft of allowable overdepth. The In-Bay Channel would be widened from its existing width of 200 ft to a proposed width of 400 ft. The Entrance Channel would deepened from –38 ft MLT to –46 ft MLT, with 3 ft of advance maintenance and 2 ft of allowable overdepth. The Entrance Channel width is proposed to be modified from 300 to 600 ft. In addition, a new turning basin would be constructed to allow for a ship turning circle of 1,650 ft, at a depth of –44 ft MLT, with 2 ft of advance maintenance and 2 ft of allowable overdepth. Approximately 46.5 mcy of new work material would be generated upon initial construction and 257.5 mcy of maintenance material would be generated over a period of 50 years after construction of the improvement project.

The MSC through Matagorda Peninsula and Jetties already exceeds the proposed project dimensions because of scouring within the channel. Thus, new work dredging is not required because the existing grade is below the project depth as well as advanced maintenance and allowable dredge overdepth. It is also anticipated that no maintenance dredging will be required through this area because high channel velocities scour the channel and are expected to continue to do so after the improvements are made to the MSC.

2.5.2 Proposed Dredged Material Placement Plan

Alternative 2A of the Multi-use Placement Alternatives is the preferred placement alternative to manage placement of MSCIP's dredged material. Alternative 2A is described in detail in the DMMP (see

Table 2.5-1
Acreage Impacted/Acreage Created of Habitats for Placement Areas in the Proposed Alternative

Proposed Alternative		Open Bay Bottom	Mercury Impacted Bottom	Offshore Bottom	Upland	Estuarine Low Marsh	Oyster Reef	Sand Platform	Beach	Bird Island	Unconfined Placement	Ship Channel Bottom	Estuarine High Marsh[2]	Agricultural Land	Onshore Placement Area	Total Area (acres)
Proposed Ship Channel	Acreage Impacted	574.78		213			129.22									917
	Acreage Created											917				
A1[3]	Acreage Impacted	530														530
	Acreage Created				530											
A2	Acreage Impacted	259.25					0.75									260
	Acreage Created				140	120										
BN1, BN2, and BN3	Acreage Impacted	125														125
	Acreage Created								125							
D[4]	Acreage Impacted	251.54				3.4	0.66						18.6			274.2
	Acreage Created				260	7.1							7.1			
ER1	Acreage Impacted		126													126
	Acreage Created	63					63									
ER2[4]	Acreage Impacted		174			3.4	0.6									178
	Acreage Created				167.8	10.2										
ER3	Acreage Impacted		184.5		40	1.6	17						9.4			252.5
	Acreage Created	5.2			201	30.25							16.05			
G	Acreage Impacted	332														332
	Acreage Created				12	320										
G Shoreline Protection	Acreage Impacted	21.8														21.8
	Acreage Created	9.2			12.6											
H4 Habitat Area	Acreage Impacted	470														470
	Acreage Created				20	100		325		25						
O5	Acreage Impacted			1,600												1,600
	Acreage Created										1,600					
OR1 and OR2	Acreage Impacted	235														235
	Acreage Created						235									
P1[5]	Acreage Impacted													700		700
	Acreage Created														700	
PA1	Acreage Impacted			453												453
	Acreage Created										453					
PA5-12	Acreage Impacted	1,350														1,350
	Acreage Created										1,350					
Total	Acreage Impacted	4,149.4	484.5	2,266.0	40.0	8.4	148.2	0.0	0.0	0.0	0.0	0.0	28.0	700.0	0.0	7,824.5
	Acreage Created	77.4	0.0	0.0	1,343.4	587.6	298.0	325.0	125.0	25.0	3,403.0	917.0	23.2	0.0	700.0	

[1]Marsh habitat acreage created will be *Spartina alterniflora* near mean sea level.

[2]High marsh areas have infrequent tidal flooding, acreage created they will be dominated by *Spartina patens* .

[3]Includes active placement areas PA18 and PA19.

[4]Area D oyster reef area and Area ER2 marsh and oyster reef areas estimated using aerial photos.

[5]NRCS has performed a wetland delineation on part of the P1 area, identifying 1.5 acre of farmed wetlands (under CWA, Section 404 regulation). A wetland delineation will need to be performed to accurately assess all wetlands impacted.

Appendix B) and is the proposed DMMP for the Proposed alternative. Alternative 2A entails features that will utilize new work and maintenance dredged material to:

1. create an in-bay upland site (PA A1) located south of the Port at the existing USACE in-bay dredged material PAs 18 and 19 with 3.3 mcy of new work material and 45.1 mcy of future maintenance material;
2. create a combination upland and marsh site (PA A2) along the northern shore of Cox Bay to eliminate future erosion in this area with 6.3 mcy of new work material;
3. create a clay core oyster reef (PAs OR1 and OR2) within Lavaca Bay with approximately 1.0 mcy of new work material;
4. provide nourishment (PAs BN1, BN2, and BN3) on public beaches along the Magnolia-Indianola shoreline with 1.9 mcy of new work material;
5. create an in-bay upland site (PA D) adjacent to the southwest side of the existing Dredge Island with 1.6 mcy of new work material and 14.8 mcy of maintenance material;
6. place submerged cap and create oyster reefs on (PA ER1) bottom sediments contaminated with elevated levels of mercury within Lavaca Bay southwest of Dredge Island with 0.4 mcy of new work stiff clay material, creating oyster reefs on the mounded caps;
7. cap in situ bottom sediments contaminated with elevated levels of mercury located in shallow waters along SH 35 and then create an upland site (PA ER2) with 2.1 mcy of new work material and 6.9 mcy of future maintenance material;
8. cap in situ bottom sediments contaminated with elevated levels of mercury located on the northern edge of Dredge Island and then create a transitional marsh and upland site (PA ER3) with 2.3 mcy of new work material and 13.2 mcy of future maintenance material;
9. protect the eroding shoreline at Sand Point by constructing armored earthen levees and in-bay marshes (PA G) with 4.7 mcy of new work material, and 0.4 mcy of in situ material;
10. create a terrestrial upland placement site (PA P1) located immediately south of Alamo Beach on agriculture lands with 1.0 mcy of new work material and 55 mcy of future maintenance;
11. place 108.9 mcy of future maintenance material in existing in-bay unconfined placement areas (PAs 5 to PA 12) located northeast of the MSC;
12. create a multi-use habitat site (PA H4) located north of Port O'Conner along the MSC to include marshes, submerged aquatic platforms, and bird island with 10.0 mcy of new work material;
13. place 13.6 mcy of future maintenance material from the MSC Entrance Channel at the existing Matagorda ODMDS (PA 1) located 2 miles offshore from the Matagorda Peninsula and 1,000 ft south of the MSC Entrance Channel centerline; and
14. place 8.8 mcy of new work soft clay material from the MSC In-Bay Channel and 3.2 mcy of new work mixed material from the MSC Entrance Channel at a proposed ODMDS site (PA O5) located approximately 3 miles offshore from the Matagorda Peninsula and 1,000 ft south of the MSC Entrance Channel centerline.

A complete description of Alternative 2A's placement features can be found in the DMMP (see Appendix B). Acreages of habitat impacted and created from implementation of the plan are provided in Table 2.5-1. Table 2.5-2 provides a list of Alternative 2A's placement features and the corresponding volume of dredged material to be placed in each feature. Placement areas can be seen on Figure 1.1-1.

Table 2.5-2
Multi-Use Placement Features (Alternative 2A)

		Alternative 2A	
Feature Identity	Feature Description	New Work (mcy)	Maintenance (mcy)
A1	In-Bay Upland	3.3	45.1
A2	In-Bay Upland/Marsh	6.2	0.0
BN1, BN2, BN3	Beach Nourishment	1.9	0.0
C2	In-Bay Upland	0.0	0.0
D	In-Bay Upland	1.6	14.8
ER1	Oyster Reef on Mercury Impacted Sediment	0.4	0.0
ER2	In-Bay Upland on Mercury Impacted Sediment	2.1	6.9
ER3	In-Bay Upland/Marsh on Mercury Impacted Sediment	2.3	13.2
G	Marsh/Shoreline Protection	4.7	0.0
H2	In-Bay Upland	0.0	0.0
H4	In-Bay Upland	0.0	0.0
H4 Habitat Area	Marsh/Sand Platform/Bird Island	10.0	0.0
O5	Offshore Dispersive Site	12.0	0.0
OR1 and OR2	Oyster Reef	1.0	0.0
P1	Onshore Upland	1.0	55.0
PA1	Existing Offshore Dispersive Site	0.0	13.6
PA5 to PA12	Existing Unconfined Area in Matagorda Bay	0.0	108.9
TOTAL	New Work and Maintenance Material	46.5	257.5

2.5.3 Location of Proposed Access Channels

Access channels would be used primarily for the placement of stone on the perimeter of some placement areas and for providing access for the spill barges and support equipment for dredged material placement. For these uses, a draft of at least –6 ft MLT is needed. The following PAs may require an access channel: A1, A2, D, ER2, ER3, G, and G Levee. Plan sheets submitted with the permit application show the approximate location of potential access channels for each of these PAs (Appendix A). Any barge channel needed would be approximately 80 ft wide with 6 ft of draft. Material dredged from access corridors will be placed along the channel alignment and pulled back into the channel upon completion of construction. If material is impacted by mercury above the Lavaca Bay Superfund Remedial Action Objective for open water, it will be managed in a manner consistent with the Lavaca Bay Superfund Site requirements. The

following describes the need for an access channel at each of the areas and notes whether or not the area has been surveyed to identify cultural resources or oysters that may be directly impacted by construction.

PA A1. Water depth around the perimeter of PA A1 is between –1 and –5 ft MLT. Therefore an access channel will be needed around the circumference of the site (see Figure 15 of 46, Appendix A). Most of the perimeter of this PA has been surveyed for cultural resources and oysters.

PA A2. Water depth around the perimeter of PA A2 is between –2 and –4 ft MLT. Therefore an access channel will be needed around the bay side of the site (see Figure 16 of 46, Appendix A). Only a small portion of the western side of the perimeter of this PA has not been surveyed for cultural resources and oysters because of insufficient water depths.

PAs ER 2, ER3 and D. Because of the mercury impacted sediment, the work on these PAs will be from the inside out. Barge access channels will be on the interior of these areas and along the southern perimeter of PA D. An access channel will also be needed between ER2 and ER3 that crosses the circulation channel in an area where there aren't oyster reefs and (see Figures 20 and 23, Appendix A). These areas have been surveyed for cultural resources and oysters.

PA G. The areas where the stone would be required (south, west and east points) are deep enough for barge access (–6 to –8 ft MLT). However, access channels may be required at the northeast and northwest corners of the site (see Figure 24 of 46, Appendix A). Most of the area has been surveyed for cultural resources and oysters.

G-Levee. This is an area where barge access will be needed for construction (see Figure 42 of 46, Appendix A). An access channel will be needed the length of the levee (see Figure 25 of 46, Appendix A). Water depth and wave action did not allow this area to be surveyed.

Because these potential barge access channels would occur within or immediately adjacent to the proposed PAs, potential impacts associated with each of them is included in the general discussion of impacts that could occur from construction of each of the PAs in Section 4.

2.6 DETERMINATION OF THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

The goal of the alternatives analysis is to identify the environmentally preferable alternative(s) (i.e., the one(s) with the least overall negative impacts to the environment). According to NEPA, the "environmentally preferable" alternative is the one that promotes the national environmental policy. In general, the selected alternative should minimize damage to the biological and physical environment while protecting, preserving, and enhancing historic, cultural, and natural resources. NEPA requires that impacts to the human environment be addressed. Human Environment "shall be interpreted comprehensively to include the natural and physical environment and the relationship of people to that environment" (40 CFR 1508.14).

The environmentally preferred alternative need not be stated in the DEIS. In fact, NEPA guidelines encourage public input on the determination of the preferred alternative. Much of the public input would be gathered after publication of the DEIS. The preferred alternative may be identified in the Final EIS. It is only required in the Record of Decision (ROD) by the USACE.

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3.0 AFFECTED ENVIRONMENT

The following subsections provide a description of the existing environment for the Matagorda Ship Channel Improvement Project (MSCIP) study area. For the purposes of analysis in this EIS, unless otherwise defined, the project area is defined as the footprint of the construction area within the channel plus a 1-mile buffer area and the PAs (Figure 3.0-1). Because impacts may affect resources outside of this project area, unless otherwise noted, the study area consists of all of or portions of Calhoun, Jackson, Victoria, and Matagorda counties (Figure 3.0-2). If the project or study area differs from this for a specific resource, it will be defined in that section.

3.1 AIR QUALITY

3.1.1 Climatology

The climate of the Matagorda Bay area is humid subtropical (URS, 2006b). Humid, warm to hot conditions occur in the summer months with average daily temperatures ranging from 82 degrees Fahrenheit (°F) to 85°F with maximum daily temperatures of about 92°F (National Climatic Data Center [NCDC], 2006a). The dominating air mass is maritime tropical, in which sea breezes lower the afternoon temperatures and the bay area is cooler than areas further inland. Winters are mild with considerable day-to-day variation between the tropical air mass and modified continental polar and maritime polar air masses (URS, 2006b). Average temperatures in the winter months range from 55°F to 57°F with minimum temperatures of about 46°F. Infrequent periods of freezing temperatures may occur, usually averaging about 8 days annually (NCDC, 2006a).

Climatic conditions are affected by the direction and intensity of persistent winds. Southeasterly winds (ranging from 8 to 12 miles per hour) from March through November and northerly winds from December through February (ranging from 10 to 11 miles per hour) are the two principal wind regimes dominating the area. Annual average wind speed is about 10 miles per hour (NCDC, 2006b).

Rainfall averages about 44 inches annually. Historically, annual rainfall distribution is greater for the early summer through early fall (ranging from 3 to 6 inches monthly), and least for the winter and spring (ranging from 2 to 3 inches monthly). The convective origin of summer rainfall results in heavy downpours for short time periods over small areas. Winter rains are more widespread, less intense and may continue for several days. Annual mean snowfall is 0.1 inch. Severe weather conditions in the form of hurricanes, tornadoes, thunderstorms and tropical storms occasionally occur (NCDC, 2006a).

Annual average humidity is 66% in the afternoon and 90% in the morning (NCDC, 2006b). On average, the sun shines 59% of the time possible from sunrise to sunset. The highest percent of possible sunshine occurs during the summer months (NCDC, 2006c).

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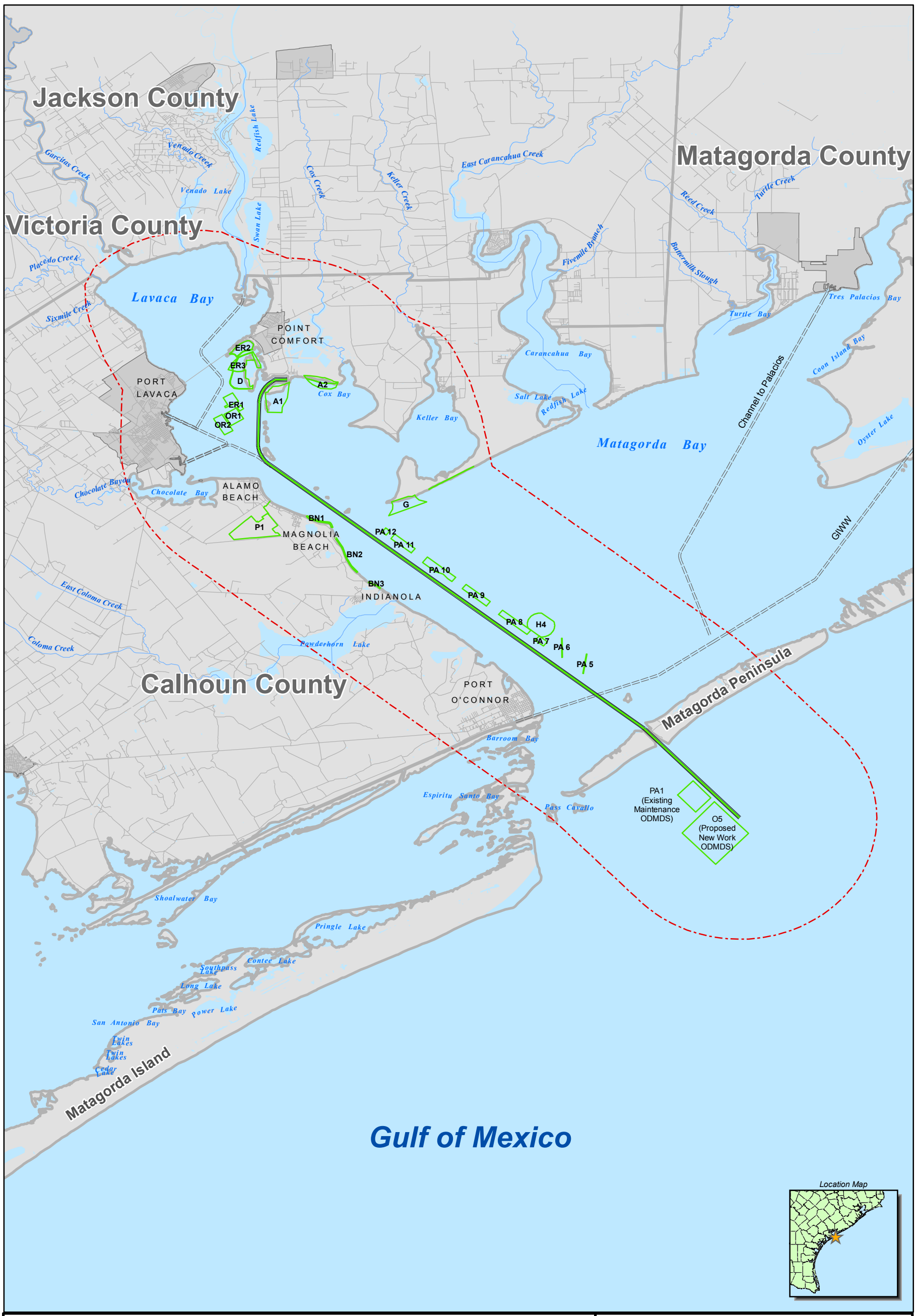


LEGEND

- Project Area
- Project Component
- Proposed Ship Channel
- Navigable Waterway

N W E S

Source:
Base map provided by URS.
Reference Coordinates:
Texas State Plane South Central U.S. Survey Feet
Horizontal Datum: NAD 83.

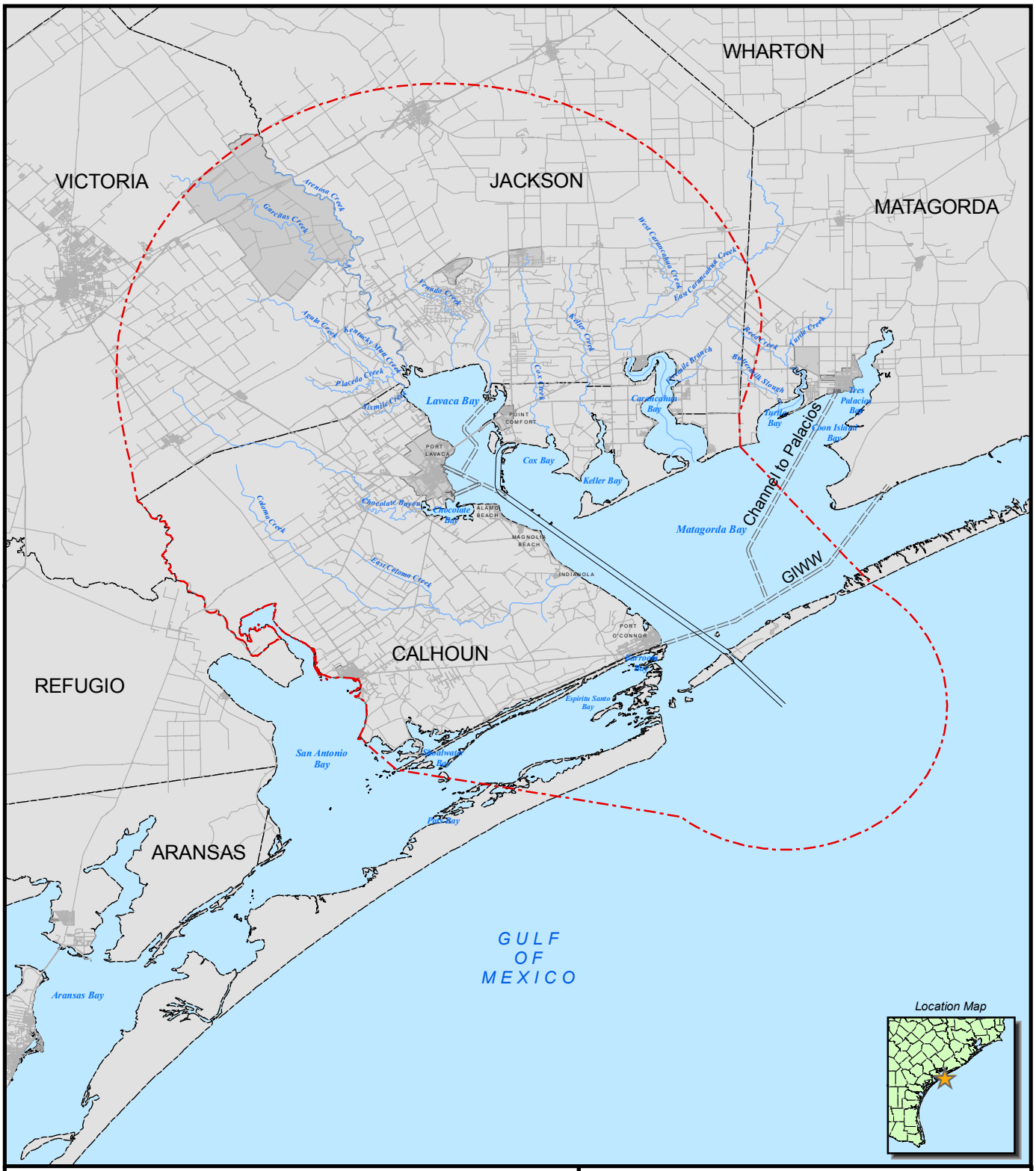
4 2 0 4
Miles

PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
Phone: (512) 329-8342 Fax: (512) 327-2453

Figure 3.0-1

Matagorda Ship Channel Improvement Project Area

Prepared for: CCND-MSCIP	
Job No.: 441652.00	Scale: 1:253,440
Prepared by: DRohrer	Date: 20061128
File: N:/44165200/projects/Fig3_0_1_VR2.mxd	



LEGEND

- Study Area
- County
- Matagorda Ship Channel
- Navigable Waterway

N W E S

10 5 0 10
Miles

Source:
Base map provided by URS.
Reference Coordinates:
Texas State Plane South Central U.S. Survey Feet
Horizontal Datum: NAD 83.

PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
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Figure 3.0-2

Matagorda Ship Channel Improvement Study Area

Prepared for: CCND-MSCIP	
Job No.: 441652.00	Scale: 1:633,600
Prepared by: DRohrer	Date: 20061127
File: N:/44165200/projects/Fig3_0_2_VR2.mxd	

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3.1.2 Air Quality Baseline Condition

The Clean Air Act Amendments of 1970 and 1990 (42 USC 7409) mandated the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment and to provide for reductions in acid rain, urban air pollution, and toxic air emissions. The Clean Air Act established two types of national air quality standards:

- Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.
- Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The EPA Office of Air Quality Planning and Standards has set NAAQS for six criteria pollutants: carbon monoxide (CO); lead (Pb); nitrogen dioxide (NO_2); ozone (O_3); particulate matter with particle diameters of 10 micrometers or less (PM_{10}) and 2.5 micrometers or less ($PM_{2.5}$); and sulfur dioxide (SO_2) (40 CFR Part 50). In its General Air Quality Rules (30 TAC Chapter 101), the TCEQ enforces the Federal NAAQS. In addition, the TCEQ has set standards for net ground-level concentrations for sulfur compounds. Air quality is generally considered acceptable if pollutant levels are less than or equal to established standards on a continuous basis, as represented in Table 3.1-1.

The Clean Air Act also required the EPA to assign an attainment designation to each area of the U.S. regarding compliance with the NAAQS. EPA categorizes the level of compliance or noncompliance as follows:

- Attainment – an area that currently meets all the NAAQS;
- Maintenance – an area that currently meets the NAAQS, but has previously been out of compliance for at least one criteria pollutant;
- Nonattainment – an area that currently does not meet the NAAQS for at least one criteria pollutant; and
- Unclassifiable – an area that cannot be classified on the basis of available information as meeting or not meeting the NAAQS for a criteria pollutant.

Calhoun, Jackson, and Matagorda Counties border the proposed MSC project area, and each is currently designated as unclassifiable or in attainment for all criteria pollutants (EPA, 2006a). Therefore, these counties are not subject to the TCEQ State Implementation Plan (SIP), which is an enforceable plan required under the Clean Air Act and developed by the TCEQ that explains how areas that are designated nonattainment will comply with the NAAQS. In addition, the proposed project area will not be subject to the General Conformity Rules as they are applicable only to projects located in nonattainment areas (EPA, 2006b).

Table 3.1-1
EPA National Ambient Air Quality Standards[1] and
TCEQ Ground Level Concentration Standards[2]

Air Pollutant	Time Averaging Period	NAAQS Primary	NAAQS Secondary	TCEQ Standards
Carbon Monoxide (CO)	1-hour[3]	35 ppm* 40 mg/m^3	None	–
	8-hour[3]	9 ppm 10 mg/m^3	None	–
Lead (Pb)	Quarterly Average	1.5 µg/m^3	1.5 µg/m^3	–
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.053 ppm 100 µg/m^3	0.053 ppm 100 µg/m^3	–
Ozone (O_3)	8-hour[4]	0.08 ppm	0.08 ppm	–
Particulate Matter (Total Suspended Particulate – TSP)	1-hour	–	–	400 µg/m^3
	3-hour	–	–	200 µg/m^3
Particulate Matter – Respirable (PM_{10})	24-hour[3]	150 µg/m^3	150 µg/m^3	–
	Annual[5] Arithmetic Mean	50 µg/m^3	50 µg/m^3	–
Particulate Matter – Respirable ($PM_{2.5}$)	24-hour[6]	65 µg/m^3	65 µg/m^3	–
	Annual[7] Arithmetic Mean	15.0 µg/m^3	15.0 µg/m^3	–
Sulfur Oxides (measured as SO_2)	30-minute	–	–	0.4 ppm 1,021 µg/m^3
	3-hour[3]	–	0.5 ppm (1300 µg/m^3)	–
	24-hour[3]	0.14 ppm	–	–
	Annual Arithmetic Mean	0.03 ppm	–	–

*parts per million = ppm.

[1]NAAQS as codified in 40 CFR Part 50.

[2]TCEQ Standards as codified in 30 TAC §111.155 and §112.3.

[3]Not to be exceeded more than once per year.

[4]To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

[5]To attain this standard, the 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 µg/m^3.

[6]To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 65 µg/m^3.

[7]To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.

The TCEQ is responsible for monitoring air and water quality within the State and for reporting that information to the public. The staff examines and interprets the causes, nature, and behavior of air pollution in Texas. The TCEQ currently operates one monitoring station (CAMS C657) located at Port O'Connor in Calhoun County that has provided real-time monitoring data since October 2005 (TCEQ, 2006a). Port O'Connor is located on the southwest extreme of Matagorda Bay, and has the nearest emission monitor to Matagorda Bay and the proposed project area. The TCEQ maintains this monitoring station as part of the University of Texas Center for Energy and Environmental Resources TEXAQSII Air Quality Study Project. The monitoring station measures the concentrations of O_3 and $PM_{2.5}$ in the air, as well as meteorological parameters such as air temperature and wind velocity. The O_3 and PM monitors operate continuously and are checked by technicians who perform equipment maintenance and conduct quality assurance checks. The Port O'Connor monitoring station has not gathered a full year of data; therefore the data from this station does not yet represent an accurate image of annual averaging data when reviewing the NAAQS standards. No monitoring data are available for CO, NO_2, Pb, PM_{10}, or SO_2 for Calhoun County.

Matagorda County and Jackson County do not have TCEQ or EPA ambient monitoring stations at this time. Victoria County, which is northwest of the Matagorda/Lavaca Bay system, has a monitoring station (CAMS 87) located on the western side of the City of Victoria (TCEQ, 2006a). This station is maintained by the TCEQ Corpus Christi Regional Office and records O_3 and meteorological data. However, because of its proximity to Matagorda Bay, these data may be considered representative of the regional attainment status. A summary of the O_3 data for Victoria County since 1995 are shown in Table 3.1-2.

Table 3.1-2
Ozone Monitored Values Summary for Victoria County

Year	4th Maximum 8-hour Value for O_3 (ppm)	3-year Average of 4th Maximum 8-hour O_3 Values (ppm)
1995	0.087	—
1996	0.071	—
1997	0.078	0.079
1998	0.073	0.074
1999	0.086	0.079
2000	0.079	0.079
2001	0.073	0.079
2002	0.078	0.077
2003	0.084	0.078
2004	0.075	0.079
2005	0.071	0.077

Source: EPA AirData, 2006c.
— Not enough data to determine 3-year average.

As shown in Table 3.1-2, because the 3-year average of the 4th maximum 8-hour O_3 values do not exceed 0.08 ppm, Victoria County is in attainment with the 8-hour NAAQS for O_3. Air emissions inventory data for Calhoun, Jackson, and Matagorda County are available in EPA's public database. The emissions information is broken out by area source, point source, highway vehicle, and off-highway vehicle emission categories based on emissions inventory for 2001, as presented in Table 3.1-3. Although this emissions inventory is not from more recent years, these are the most current data that have been reviewed and posted by the EPA, and they provide a base from which to compare the proposed project emissions.

Table 3.1-3
Air Emissions Inventory for Calhoun, Jackson, and Matagorda Counties by Source Category (2001)
(Tons per Year)

Source Category	CO	NH_3*	NO_x*	PM_{10}	$PM_{2.5}$	SO_2	VOC
Area	2,701	2,508	160	22,748	4,150	45	5,819
Point	7,300	10	15,435	762	531	480	3,854
Highway Vehicles	14,259	62	1,883	55	42	69	1,245
Off-Highway Vehicles (Non-Marine Vessels)	21,667	3	2,126	431	396	215	6,661
Marine Vessels	481	0	3,650	156	144	564	114
Total	46,408	2,583	23,254	24,152	5,263	1,373	17,693

Source: EPA AirData, 2006c.

*NH_3 = Ammonia; NO_x = Nitrogen Oxide.

Although the surrounding area is typically rural, air quality is currently affected by dust from local agricultural plowing; highway and off-highway vehicle emissions; and commercial, manufacturing, and industrial activities. As shown in Table 3.1-3, the major producers of CO emissions are highway and off-highway vehicles. NO_x emissions are mostly attributed to point sources such as fuel combustion equipment at industrial facilities. The majority of the PM emissions are area source emissions from agricultural activities. Major sources of VOC emissions include off-highway gasoline vehicles and oil and gas production facilities. Marine vessels, compared to other off-highway vehicles, produce the majority of SO_2 emissions in the project area, in direct proportion to the sulfur content in the diesel fuel and size of the engines.

Potential sources of air contaminant emissions associated with Matagorda Bay activities will include nonroad mobile air emission sources derived from waterborne traffic, including ships, barges, tugs, dredges, and other recreational and commercial vessels. Other activities include the loading and unloading of bulk cargo vessels and tankers.

3.2 NOISE

3.2.1 Fundamentals and Terminology

Noise is defined as unwanted sound that disrupts or interferes with normal activities, or that diminishes the quality of the environment. Noise is usually caused by human activity and is added to the natural, or ambient, acoustic setting of an area. Exposure to high levels of noise over an extended period can cause health hazards such as hearing loss; however, the most common human response to environmental noise is annoyance. Individuals respond to similar noise events differently based upon various factors that may include the existing background level, noise character, level fluctuation, time of day, the perceived importance of the noise, the appropriateness of the setting, and the sensitivity of the individual.

Sound is sensed by the human ear when a source emits oscillations through an elastic medium, such as air. The vibrations produce alternating bands of dense and sparse particles of air. This movement of the particles creates a fluctuation in the normal atmospheric pressure known as sound waves. Sound is characterized by two magnitudes; frequency and amplitude. The frequency of a sound corresponds to the human sensation of pitch and is measured in Hertz (Hz). The amplitude of a sound corresponds to the human sensation of loudness. Human reaction to loudness, or sound pressure, is measured in terms of sound pressure levels, and expressed in terms of decibels (dB). Decibels are measured on a logarithmic scale in order to compress the wide range between the human threshold of hearing and the threshold of pain. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels of approximately 120 dB begin to be felt inside the ear as discomfort and increases to pain at higher levels (EPA, 1976).

Sounds of the same pressure but different frequencies are not perceived by the human ear as equally loud. The human ear is less sensitive to low frequencies and extremely high frequencies, and most sensitive to the mid-range frequencies that correspond with human speech. Therefore, in order to measure sound in a manner similar to human perception, an adjustment known as "A-weighting" is used. All regulatory agencies require that measurements be taken using the A-weighted sound level (dBA).

Although A-weighted sound measurements indicate the level of environmental noise at any given time, community noise levels vary constantly. Typical noise environments consist of numerous noise sources that vary and fluctuate over time. Because of the varying noise levels within a community, it is necessary to use a descriptor called the equivalent sound level (L_{eq}). L_{eq} provides a way to describe the average sound level, in dB, for any time period under consideration.

Another measurement descriptor of the total noise environment is the Day-Night Sound Level (L_{dn}), which is the A-weighted L_{eq} for a 24-hour period with an additional 10 dB weighting imposed on the L_{eq} occurring during nighttime hours (10 P.M. to 7 A.M.). For example, an environment that has a measured daytime L_{eq} of 60 dBA and a measured nighttime sound level of 50 dBA, would have a weighted nighttime sound level of 60 dBA (50 + 10), and an L_{dn} of 60 dBA. Numerous Federal agencies including

the EPA, Department of Defense (DOD), Department of Housing and Urban Development (HUD), and Department of Transportation/Federal Aviation Administration (DOT/FAA) have adopted this descriptor in assessing environmental impacts. Regulatory agencies generally recognize an L_{dn} of 55 dBA as a goal for the outdoor noise environment in residential areas. Studies have found that outdoor noise environments across the U.S. range from approximately 40 L_{dn} in rural residential areas, to nearly 60 L_{dn} in older urban residential areas, to as much as 90 L_{dn} in congested urban settings (EPA, 1974).

3.2.2 Existing Noise Environment

Noise-sensitive receptors are facilities or areas where excessive noise may disrupt normal activity, cause annoyance, or loss of business. Land uses such as residential, religious, educational, recreational, and medical facilities are more sensitive to increased noise levels than are commercial and industrial land uses. Noise-sensitive receptors in the vicinity of the project area are located in the City of Port Lavaca and the communities of Port O'Connor, Magnolia Beach, Indianola, Alamo Beach, and Point Comfort. The existing noise environment of these communities is affected by a number of sources, most of which are transportation-related (i.e., barges, roadway, etc.). Waterborne transportation activities that currently contribute to the region's ambient noise environment include ship traffic, barges, commercial fishing/ shrimping vessels, sport and recreation boats, and current maintenance dredging of the channel. Other sources that contribute to the existing noise environment of these communities include activities at nearby commercial enterprises, such as restaurants, marinas, activities at commercial fishing and shrimping businesses, and light industrial uses. Measured ambient noise levels at noise-sensitive receptors in communities with a similar degree of activity ranged between 60.9 and 65.1 L_{dn} (HFP Acoustical Consultants, Inc., 2002).

3.3 PHYSIOGRAPHY, TOPOGRAPHY, AND BATHYMETRY

The physiographic environments of the study area include fluvial-deltaic, barrier-strandplain and offshore systems, marsh-swamp, bay-estuary-lagoon, and eolian systems. The Coastal Zone within the study area is underlain by sedimentary deposits that originated in ancient, but similar, physiographic environments. These ancient sediments were deposited by the same natural processes that are currently active in shaping the present coastline, such as long shore drift, beach swash, wind deflation and deposition, tidal currents, wind-generated waves and currents, delta outbuilding, and river point-bar and flood deposition (McGowen et al., 1976).

Matagorda Bay is a broad, shallow estuary, separated from the Gulf by a barrier island-peninsula complex. Interspersed within the bay is a network of dredged navigation channels; principal among these are the MSC and the GIWW. The Lavaca-Navidad River system and several smaller rivers and creeks drain into Matagorda Bay providing the primary source of freshwater inflow. Five saltwater inlets connect the Matagorda Bay system to the Gulf, including major connections at Pass Cavallo, the MSC landcut, and the Colorado River Mouth Complex (URS, 2006b).

Mapping by the U.S. Geological Survey (USGS) indicates the surface topography of the study area is flat to gently rolling and slopes toward the southeast (USGS, 1951, 1989a, 1995a). The Lavaca-Navidad River drains areas to the north of the study area and discharges into Lavaca Bay, forming a bayhead delta. Marshes are present on the bayside of barrier islands, peninsulas and along parts of the mainland shoreline. The most extensive marshes occur at the river mouths, and beside the major river valleys (McGowen et al., 1976). Along the bay shorelines are bluff banks, ranging from 5 to 10 ft in elevation that form by wave erosion from prevailing southeasterly winds. McGowen and Brewton (1975) state that shoreline erosion is a long-term trend in the study area, primarily from wind waves. This was supported by their results, which indicated that approximately 8,450 ac of land were lost to natural erosion of bay and Gulf shorelines in the Matagorda-Lavaca Bays system between 1856 and 1957 versus a natural accretion of roughly 615 ac, during the same time period.

A variety of marsh types, ranging from salt to freshwater marsh, characterize the Lavaca delta (McGowen et al., 1976). Marsh areas expand as the delta continues to grow. Vegetation is sparse at most places, but there are oak clusters and other vegetation in more sandy areas and in the uplands along streams. Broad areas of coastal prairies, pastureland and farmland occur inland from the Gulf. The most common coastal features are bays, estuaries, marshes, beach ridges, open sand beaches, dunes, mudflats, and deltas.

The Lavaca-Navidad River is a fine-grained meanderbelt system characterized by frequent cutoff and abandoned channel courses, relatively high mud load, and narrow to broad floodplains. Natural ponds, lakes, holding ponds and artificial reservoirs are present on the floodplains of the Lavaca-Navidad River.

The GIWW bisects the study area and provides a protected navigational shipping route along most of the Texas Gulf Coast. Dredged material has been placed along most of these navigation channels. The MSC extends approximately 27 miles from the Point Comfort turning basin in Lavaca Bay through the southwest section of Matagorda Bay and offshore into the Gulf through the Matagorda Peninsula landcut.

An offshore segment of the MSC extends about 4 miles into the Gulf and is confined to the shelf area, which is largely devoid of significant physiographic features. The shelf slopes at a rate of approximately 36 ft per mile from 0 to 18 ft, about 17 ft per mile from 18 to 30 ft, and about 5 ft per mile from 30 to 48 ft (McGowen et al., 1976). The entrance channel (offshore segment) is a high energy environment with two man-made rock jetties. The Matagorda Bay system is a relatively low-energy environment protected on the seaward side by barrier islands and/or peninsulas.

The bathymetry of the study area has been partially modified by human activity, mainly by channel dredging and subsequent formation of dredged material PAs. Water depths in the bay and offshore segments of the MSC are currently maintained by the USACE to depths of –36 and –38 ft MLT, respectively. The existing MSC is approximately 300 ft in width for the offshore segment and 200 ft in width for the bay segment. Increased flow through the jetties at the MSC entrance channel has caused severe erosion at several locations along the jetties. The scour areas range in depth from 36 to over 100 ft and occur inside the bottleneck at the bay, on both sides of the bottleneck as it opens to the wider part of

the jetties, at the Gulfward end of the south jetty, and at the Gulfward end of the north jetty (USACE, 2000). According to Waterways Experiment Station (WES) studies, these scour areas pose an immediate threat to the stability of the jetties. Area tidal channels, passes, and dredged channels are greater than average depth. Mean water depth for Matagorda Bay is about 12 ft, while adjacent bays average 6 to 7 ft (USACE, 1989). Area winds can significantly alter the mean diurnal tide, which is about 0.7 ft. During winter, strong north winds from cold fronts can lower water surfaces by up to 2 ft below MLT. Conversely, water levels can rise up to 15 ft during tropical storms. The bathymetry of the study area is presented on Figure 3.3-1.

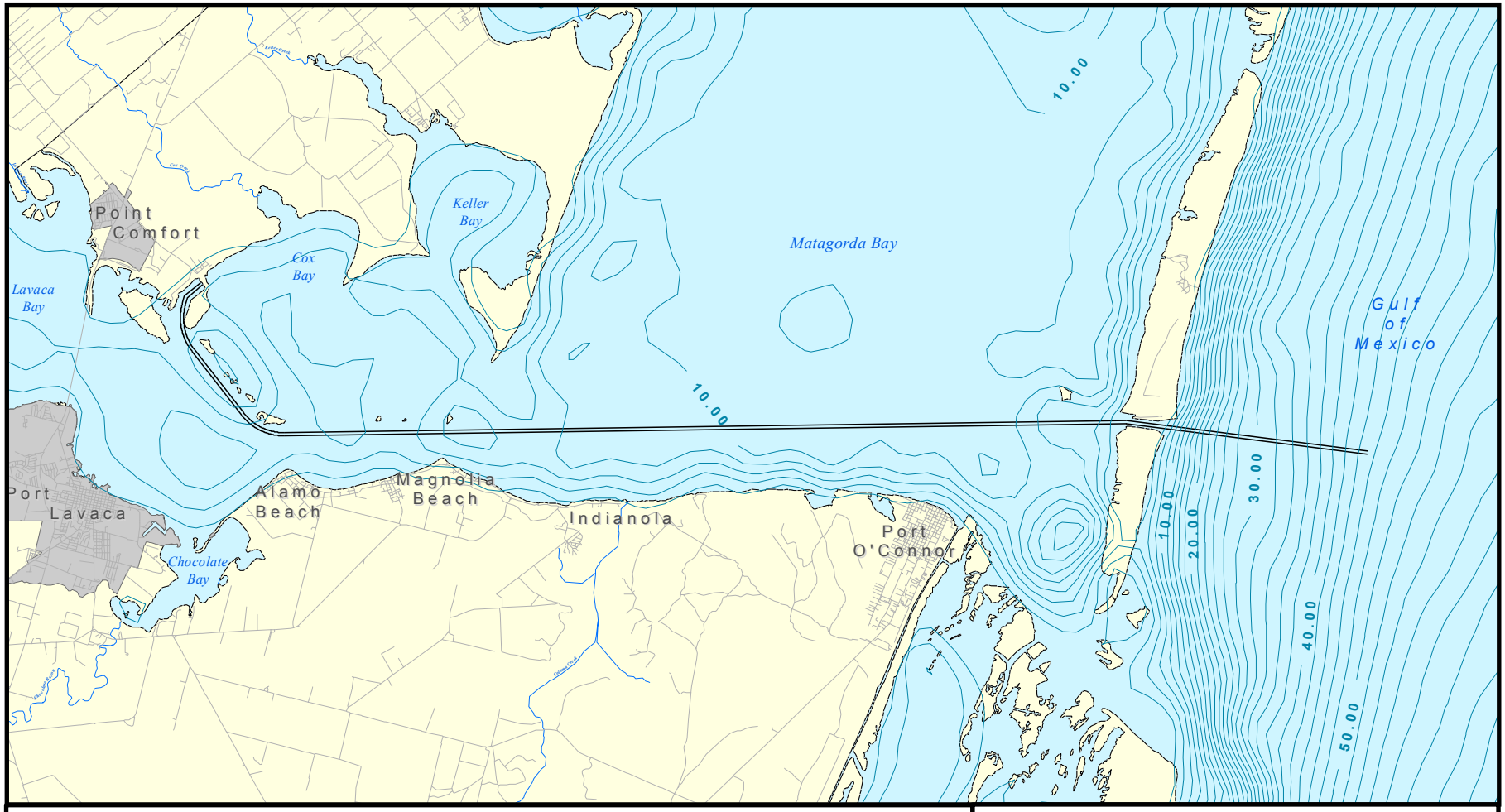
3.4 GEOLOGY

The project area is situated near the seaward margin of the West Gulf Coastal Plain Physiographic Province. The regional geology is characterized as a nearly continuous series of marginal marine embayments separated from the Gulf by a system of barrier islands and peninsulas (Lankford and Rehkemper, 1969). Area coastline features are a result of several active, geologic processes including long shore drift, beach swash, wind deflation and deposition, tidal currents and waves, delta outbuilding, and river point bar and flood deposits. The coastal zone is underlain by sedimentary deposits that originated in ancient but similar coastal systems (McGowen et al., 1976).

The coastal plain near the Gulf is located within the Gulf Coast geosyncline, a major center of sediment deposition since the middle to late Jurassic period. More than 30,000 ft of Jurassic to Pleistocene-age sedimentary deposits dip and thicken toward the Gulf. During part of the Mesozoic Era (late Triassic to Jurassic), the seas in the area were isolated and water inflow was restricted, resulting in the deposition of evaporite sediments dominated by salt (Wermund et al., 1989). After evaporite deposition, the region was overlain primarily by prograding sands and muds. Interspersed throughout these layers are salt domes, which have migrated upwards through the underlying strata to within a few 1,000 ft of the land surface. Additionally, the regional dip is bisected by belts of arcuate growth faults that are typically downthrown to the Gulf, or by faults in the proximity of salt domes.

The geology of the study area is characterized as Quaternary-age (Recent and Holocene) Alluvium containing thick deposits of clay, silt, sand, and gravel overlying the Pleistocene-age Beaumont Formation. These formations consist mainly of stream channel, point bar, natural levee, marsh, and backswamp deposits associated with former and current river channels and bayous. The Alluvium outcrops in a zone that is approximately 70 to 90 miles wide, which parallels the Texas coastline. The underlying Beaumont Formation is estimated to be less than a 1,000 ft thick and consists primarily of clay, silt, sand, and gravel (Barnes, 1975).

Dredging within intracoastal waterways, irrigation and drainage canals, and access channels have resulted in extensive channelization and associated disposal of dredged material in the area (McGowen et al., 1976). The project study area is further characterized by numerous subaqueous bay-bottom dredged material deposits (PA5 to PA19) arbitrarily located along the north side of the MSC associated with ship



Legend

Existing Channel

2 Foot Contours

3.3 1.65 0 3.3
Miles

PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
Phone: (512) 329-8342 Fax: (512) 327-2453

Figure 3.3-1
Bathymmetry of Matagorda Bay

Job No.: 441652	Scale: 1:209,088
Prepared by: EMonshaugen	Date: 06/06/2006
File: N:/44165200/projects/Fig3_3_1.mxd	

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channel construction for the City of Lavaca's chemical processing complex. An additional (offshore) subaqueous dredged material deposit (PA1) is located immediately south of the Entrance Channel segment. The composition of subaqueous dredged material at these locations is dictated by the origin of the material; however, dredging and disposal typically make the material less coherent and more permeable. Subaqueous dredged material usually consists of mixed mud, silt, sand, shell, and reworked dredged material. Reworked dredged material is commonly sandy and moderately sorted with high to very high permeability and low water-holding capacity.

Modern geologic processes have partly filled the bays and estuaries with sediment originating from wave erosion of valley walls, transportation by rivers and small, headward-eroding streams, and movement through tidal inlets into the bay-estuary system. The development of barrier islands was fed by longshore transport of riverborne sediment from the Colorado-Brazos delta area located to the northwest. Matagorda Bay was separated from the Gulf by spit accretion forming Matagorda Peninsula (McGowen et al., 1976). Sediment distributions within the fluviatile-deltaic system consist primarily of sand, silt, and mud. Beyond the Colorado-Brazos delta front, is an area of prodelta muds. Muddy sands also occur adjacent to dredged material placement mounds, in the shallow bay margin areas next to the mainland shore and at the edge of wind-tidal flats. Muddy sand distribution is not controlled by depth, rather it is related to hurricane washovers, dredging activities, and reworking of relict sediment (McGowen and Morton, 1979).

The seaward extension of the barrier-strandplain system is called the shoreface. Offshore of Matagorda Bay, the width of the shoreface averages about 1.0 to 1.1 miles. The sediment at the top of the shoreface (the beach) is primarily sand and at the 30-ft depth it becomes mud and muddy sand. At the 30-ft depth, the shoreface merges with the innercontinental shelf, which is predominately mud (McGowen et al., 1976).

The inner continental shelf is an area where sands and muds of the lower shoreface and inner shelf are mixed by burrowing organisms. This area undergoes considerable erosion and resedimentation during the hurricane season. The sand-mud boundary lies between 1.8 and 2.6 miles offshore from Matagorda Peninsula and is farther from shore near Pass Cavallo (McGowen et al., 1976).

From the Gulf across Matagorda Peninsula and into Matagorda Bay, the components of the barrier-standplain and offshore systems are shelf mud and sand, shoreface sand and muddy sand, beach sand and shell, fore-island dune ridge sand, beach ridge and barrier flat sand, barren wind-tidal flat sand and mud, salt marsh underlain by mud and sand, and marsh covered shell spits. Also included as part of the modern barrier-strandplain system are washover channels and fans, tidal inlets, flood and ebb deltas, and accretionary spits (McGowen et al., 1976).

Coastal zone faults form primarily by natural geologic processes, including deposition and differentiation, compaction of sediment, upward movement of salt deposits to form diapirs, Gulfward creep of coastal landmass, and warping of landmass due to regional tectonics. There are two types of faults that occur in the region, growth and salt dome. Growth faults form by subsurface slumping, creep, and consolidation of

sediments during deposition. These faults are confined to Cenozoic-aged sediments and usually parallel the Gulf Coast, with lengths exceeding 6 miles. Salt dome faults occur in radial and crestal graben type patterns over and around the dome top revealing linear surface traces that are somewhat curved with numerous intersections. These faults are typically localized (<3 miles long) and numerous.

Subsidence occurs as sudden sinking or gradual downward settling of land with little or no horizontal motion, caused by surface faults and are intensified and/or accelerated by subsurface mining or the pumping of oil and/or groundwater. Subsidence is the major manifestation of surface faulting throughout the Texas Gulf Coast, and typically occurs on the downthrown side of the fault. Extensive groundwater withdrawal, with the consequence of land subsidence and activation of surface faulting, is not a major problem in the Port Lavaca area (McGowen et al., 1976). However, the extraction of oil and gas in the Port Lavaca area has caused land subsidence in the order of 0.8 to 0.9 ft in the Jackson County vicinity. Conversely, localized subsidence has been observed to lessen and diminish altogether as groundwater, oil, and gas pumping has decreased or ceased (Verbeck and Clanton, 1981; Holzer and Gabrysch, 1982).

3.5 ENERGY AND MINERAL RESOURCES

The project area has numerous natural resources, including oil and gas, sulfur, salt, shell, clay, sand, magnesium, and bromine. Among these the most significant is oil and gas (McGowen, 1976). Oil, natural gas, and natural gas liquids are major factors in the economy of the area and serve not only for fuel, but also for raw material and for many petrochemical processes. The Port Lavaca area has various mineral resources that contribute to the regional economy either directly through the value of raw material, or indirectly through the industries they support, supply, and attract.

Sulfur generally occurs in the cap rock of certain salt domes, but it can also be extracted from sour gas. Sulfur is not commonly used by individual consumers but rather in the manufacture of a variety of products, prominent among them, sulfuric acid. Salt domes are numerous in the area and provide an abundant supply of high-grade sodium chloride. The bulk of Texas salt production comes from the Texas coastal zone. The nearest brine production site is located 3.8 miles east at the Bryan Mound facility.

The nearest conventional source of industrial calcium carbonate is approximately 150 miles inland in central Texas. Within the project area, shell occurs as discrete reefs and banks mixed with bottom sand and mud in the shallow bays. The oyster *Crassotrea* is the main source of shell (McGowen, 1976). Parts of certain reefs support living oysters, while others are composed entirely of dead shells. The physical and chemical properties of shell make it suitable for use as aggregate, road base, and the production of lime, cement, and chemicals.

Sand deposits in the area have the potential for industry or specialty uses such as foundry sands, glass sands, and chemical silica. Common clays are used in the manufacture of brick and tile. Gypsum, used mainly as a construction raw material, occurs in the cap rock deposits of certain salt domes in the area but unlike salt and sulfur is not easily mined and significant production is unlikely. The production of oil and natural gas plays a prominent role in the economy of the Port Lavaca area.

According to the Railroad Commission of Texas (RRC) records, the exploration and production of oil and gas within a 1-mile radius of the project area includes 479 records of oil and gas exploration and production (Appendix C). These records indicate the following well records for the project area:

- 12 cancelled or abandoned drilling locations;
- 197 dry holes;
- 58 gas wells;
- 1 injection/disposal well;
- 4 oil wells;
- 23 oil/gas wells;
- 29 permitted drilling locations;
- 101 plugged gas wells;
- 28 plugged oil wells; and
- 25 plugged oil/gas wells.

The presence of significant reserves of petroleum and the large scale processing and refining capacities in the region has resulted in an abundance of pipelines for the transmission of raw petroleum and petroleum products. According to the RRC records, there are 52 pipeline systems in the project area (Table 3.5-1; see Appendix C). Forty-four are listed as active and 8 are listed as abandoned. Twenty-six transport petroleum and the remaining 26 transport product.

3.6 SOILS

The majority of the project area is inundated with saltwater from the Gulf and/or Matagorda Bay system and is therefore incapable of producing and/or sustaining soil associations and series. Mapping by the Soil Conservation Service (SCS, 1979), Soil Survey of Matagorda County, Texas shows two soil series within a potential beach nourishment area located adjacent to the ship channel landcut at Matagorda Peninsula, the Galveston fine sand, undulating and the Mustang fine sand. It should be noted that the peninsula shoreline boundaries presented in 1979 for the Matagorda County soil survey have undergone erosion and the mapped boundaries for these soil series have probably changed. A potential upland PA (PA P1, see Figure 3.0-1) located south of Alamo Beach shows two soil series, the Dacosta clay loam and the Livia clay loam.

The Galveston fine sand, undulating is a nearly level, nonsaline, sandy soil that forms on coastal dunes that parallels the Gulf (SCS, 1979). This soil is loose, moderately alkaline, light gray fine sand to about 60 inches thick. The underlying layer is loose, moderately alkaline, gray fine sand about 6 inches thick. Below this, from 66 to 80 inches, is loose, moderately alkaline, light gray fine sand. This soil drains very well, surface runoff is very slow and permeability is very rapid. After heavy rains the water table can rise up to 3 ft in the soil; however, in most places the water is saline due to its proximity to the Gulf. This soil is used mainly for recreational areas and as rangeland; however, it is not suitable for pastureland or crop production. The potential for urban use is low, the most restrictive features being sandy texture, lateral water seepage, hurricane flooding, and soil wetness. This soil is susceptible to wind erosion when disturbed.

The Mustang fine sand (0–1% slopes) is a nearly level, nonsaline, sandy marshy soil that forms on coastal flats and depressions (SCS, 1979). This soil has a surface layer of neutral, saline, light gray fine sand

Table 3.5-1
Summary of Pipelines within a 3-mile Buffer of the Matagorda Ship Channel

T4PERMIT	P5_NUM	Operator Name	System Name	Diameter	Commodity	Status
90009	115750	BUTTES RESOURCES COMPANY	ME-84-221	8.63	CRUDE OIL	Active
06073	190698	CROSSTEX GULF COAST TRANS, LTD.	GULF COAST TRANSMISSION	12.75	NATURAL GAS	Active
06234	230717	DUKE ENERGY NGL OPERATING, LLC	SEABREEZE PIPELINE SYSTEM	8.63	NATURAL GAS LIQUIDS	Active
05846	230762	DUKE ENERGY INTRAST. NETWORK LLC	DUKE ENERGY INTRASTATE NETWORK	6.63	NATURAL GAS	Abandoned
03882	250202	EL PASO FIELD SERVICES, L.P.	16A1	4.50	NATURAL GAS	Abandoned
00654	253161	ENTERPRISE PRODUCTS OPERATING LP	805L-100 TOMCAT	20.00	NATURAL GAS	Active
03970	253316	EQUISTAR CHEMICALS, LP	ARCO PETROCHEMICAL SYSTEM	6.63	ETHYLENE	Active
00749	404520	HOUSTON PIPE LINE COMPANY LP	1359-000	4.50	NATURAL GAS	Active
05554	424745	INNOVENE USA LLC	BP CHEMICALS AMMONIA PIPELINE	8.63	AMMONIA	Active
00774	463328	KINDER MORGAN TEJAS PIPELINE, LP	TGPL MUSTANG	20.00	NATURAL GAS	Active
00276	489680	LAVACA PIPE LINE COMPANY	MAGNOLIA BEACH GATHERING SYSTEM	10.75	NATURAL GAS	Active
04261	489680	LAVACA PIPE LINE COMPANY	ME-3306	0.00	NATURAL GAS	Active
04651	489680	LAVACA PIPE LINE COMPANY	FGH-O-007A	2.38	NATURAL GAS	Active
04663	489680	LAVACA PIPE LINE COMPANY	C4M-O-003-AAB	8.63	BUTADIENE	Active
04663	489680	LAVACA PIPE LINE COMPANY	CSH-O-019-AAB	10.75	CAUSTIC	Active
04663	489680	LAVACA PIPE LINE COMPANY	EDC-O-018-AAB	12.75	ETHYLENE DICHLORIDE	Active
04663	489680	LAVACA PIPE LINE COMPANY	EPM-O-009-AAB	10.75	EP MIX	Active
04663	489680	LAVACA PIPE LINE COMPANY	ETH-O-024-ACA	8.63	ETHYLENE	Abandoned
04663	489680	LAVACA PIPE LINE COMPANY	ISB-O-032-AAB	8.63	ISOBUTANE	Active
04663	489680	LAVACA PIPE LINE COMPANY	MEG-O-021-SSA	6.63	ETHYLENE GLYCOL	Active
04663	489680	LAVACA PIPE LINE COMPANY	MET-O-008-ABB	3.50	METHANE	Active
04663	489680	LAVACA PIPE LINE COMPANY	NAP-O-002-AAB	14.00	NAPHTHA	Active
04663	489680	LAVACA PIPE LINE COMPANY	NBT-O-013-AAB	6.63	BUTANE	Active
04663	489680	LAVACA PIPE LINE COMPANY	NFO-O-001-AAB	8.63	FUEL OIL	Active
04663	489680	LAVACA PIPE LINE COMPANY	PFO-O-004-AAB	12.75	OIL	Active
04663	489680	LAVACA PIPE LINE COMPANY	PGO-O-005-AAB	10.75	PYROLYSIS GASOLINE	Active
04663	489680	LAVACA PIPE LINE COMPANY	SPR-O-022-AAB	8.63	NAPHTHA	Active
04663	489680	LAVACA PIPE LINE COMPANY	SPR-O-053-AAB	14.00	EMPTY	Active
04663	489680	LAVACA PIPE LINE COMPANY	VG/EDC-O-017-AAB	8.63	REFINERY GAS	Active
04663	489680	LAVACA PIPE LINE COMPANY	WHO-O-006-AAB	3.50	OIL	Active
04663	489680	LAVACA PIPE LINE COMPANY	WWE-O-015	30.00	SLOP OIL/WATER	Abandoned
04663	489680	LAVACA PIPE LINE COMPANY	WWT-O-020-AAB	8.63	SLOP OIL/WATER	Abandoned

Table 3.5-1
Summary of Pipelines within a 3-mile Buffer of the Matagorda Ship Channel

T4PERMIT	P5_NUM	Operator Name	System Name	Diameter	Commodity	Status
04663	489680	LAVACA PIPE LINE COMPANY	WWT-O-033-AAB	4.50	SLOP OIL/WATER	Abandoned
06345	489680	LAVACA PIPE LINE COMPANY	PROP-001	6.63	PROPANE	Active
05359	522438	MAIN ENERGY, INC.	PT. O'CONNER PLANT TO DOW	8.63	NATURAL GAS	Active
06095	522438	MAIN ENERGY, INC.	ST 141 TO ST 136 TIE-IN	3.50	NATURAL GAS	Active
06334	522438	MAIN ENERGY, INC.	ST 141 BOGGY BAYOU SYSTEM	8.63	NATURAL GAS FWS	Active
90080	596926	MUSTANG OIL & GAS CORPORATION	ME-93-006	4.50	NATURAL GAS	Active
90147	605990	NEUMIN PRODUCTION COMPANY	ME-81-179	2.38	NATURAL GAS	Active
00441	624405	ONYX NATURAL GAS, L.C.	KELLER BAY FIELD GATH. SYS.	4.50	NATURAL GAS	Active
00513	667883	PLAINS MARKETING, L.P.	POINT COMFORT PL.-374	3.50	CRUDE OIL	Active
00787	709230	RICHARDSON, SID PIPELINE CO.	MAGNOLIA BEACH	4.50	NATURAL GAS	Abandoned
90110	777400	SHIPWRECK SHOALS PIPELINE	ME-80-365	4.50	ETHYLENE	Active
03357	819006	STERLING EXPL. & PROD. CO., LLC	MATAGORDA BAY GATHERING SYSTEM	4.50	NATURAL GAS	Active
04832	819006	STERLING EXPL. & PROD. CO., LLC	ST 145 #1 TO ST 171 PLATFORM	2.88	NATURAL GAS	Active
07025	819006	STERLING EXPL. & PROD. CO., LLC	POWDERHORN SYSTEM	16.00	NATURAL GAS	Active
00583	843050	TEPPCO CRUDE PIPELINE, L. P.	TP-906A-100, FORMOSA LATERAL	4.50	NATURAL GAS LIQUIDS	Active
00687	845650	TEXAS EASTERN TRANSMISSION CORP.	ME-89-097	30.00	NATURAL GAS	Abandoned
04143	845690	TEXAS EASTERN TRANSMISSION, LP	TIVOLI	30.00	NATURAL GAS	Active
06146	876520	UNION OIL COMPANY OF CALIFORNIA	ST 150 #1 TO ST 135 FACILITY	8.63	NATURAL GAS FWS	Active
01269	877144	UNITED BRINE PIPELINE CO, LLC	CLEMVILLE TO INGLESIDE	16.00	BRINE	Active
90134	881288	VALERO INTERSTATE TRANSMISS CO	ME-80-110	6.63	NATURAL GAS	Active

about 8 inches thick. Below is a layer of neutral, saline, light gray fine sand about 32 inches thick. The underlying layer from 40 to 60 inches is neutral, saline, grayish-brown fine sand. This soil is poorly drained, surface runoff is very slow and permeability is rapid above the water table. The water table occurs at depths from 0 to 6 inches below the soil surface; however, it is generally saline. Main uses are for rangeland and wildlife habitat. Wetness, salinity, and flooding caused by high tides makes this soil unsuitable for crop production and pastureland. Potential for urban use is low, restrictive features being wetness, soil salinity, and susceptibility to flooding by high tides and hurricanes.

The Dacosta clay loam (0–1% slopes) is a nearly level, saline soil that forms on coastal uplands (SCS, 1979). The surface layer of this soil is a dark gray, firm clay loam about 10 inches thick. Below is a layer of saline dark gray clay about 50 inches thick. The underlying material to a depth of 84 inches is a moderately saline, reddish yellow silty clay. The soil is suited to some crops, poorly drained, and has a high available water capacity.

The Livia clay loam (0–1% slopes) is a nearly level, noncalcareous and saline loamy soil that forms on low coastal uplands (SCS, 1979). Occasionally it is covered with Gulf water blown by stormwinds. The surface layer is typically dark gray loam about 6 inches thick. Below is 20 inches of dark gray clay and 36 inches of light gray clay loam mottled with brownish yellow. The underlying material to a depth of 90 inches is very pale brown clay loam mottled with light brown. This soil is suited to rice, poorly drained, and has a medium water capacity.

The Francitas clay is part of the Francitas Series that consists of deep, nearly level, noncalcareous and saline clayey soils on low coastal uplands (Mowery and Bower, 1978). These soils formed under salt-tolerant grasses in calcareous clayey sediments that accumulated in slightly concave basins. Francitas soils are poorly drained and have medium available water capacity. The upper layer of this soil is a very dark gray clay about 16 inches thick. It is underlain by 43 inches of clay that is dark gray in the upper half and dark gray and saline in the lower half. Below this is 10 inches of very pale brown, saline clay (Mowery and Bower, 1978). The Francitas clay slopes are 0.3 to 1%. Some areas are covered occasionally by windblown seawater. It is not well suited to crops; however, in the 1970s, approximately 70% of the acreage was in crops, mostly in rotation between rice and pasture grass (Mowery and Bower, 1978).

3.6.1 Prime and Other Important Farmland

The Farmland Protection Policy Act of 1981 (FPPA, 7 CFR 658) requires that Federal agencies consider alternatives to projects that would result in conversion of agricultural land. The 1985 Farm Bill revised the FPPA (P.L. 97-98, Sec. 1539–1549; 7 U.S.C. 4201, et seq.) to provide for limited enforcement of the requirements of the FPPA. According to 658.2a (FPPA Rule, 7 CFR 658), if a site is not designated as prime, unique, statewide or local farmland, then the FPPA does not apply. Prime farmland is defined by the FPPA as land that is best suited for producing food, feed, forage, fiber, and oilseed crops and is not

urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are appropriate for producing a sustained high yield of crops in an economic manner.

The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) maintains a national database of prime and other important farmlands that is organized by county. The three counties in the study area are Calhoun, Jackson, and Matagorda. Prime and Other Important Farmland Soil Map units are listed by county in the following tables (Tables 3.6-1, 3.6-2, and 3.6-3).

The Calhoun County Soil Survey (NRCS, 2007) lists eight mapping units as prime farmland and no other types of important farmland (Table 3.6-1).

Table 3.6-1
Prime and Other Important Farmland
Calhoun County, Texas

Map symbol	Map unit name	Classification*
Dc	Dacosta-Contee complex, 0 to 1 percent slopes	PF
Dn	Dacosta-Contee complex, 1 to 3 percent slopes	PF
Ed	Edna very fine sandy loam	PF
La	Laewest clay, 0 to 1 percent slopes	PF
Mb	Dacosta clay loam, 0 to 1 percent slopes	PF
Mc	Dacosta clay loam, low	PF
Md	Contee-Dacosta complex	PF
En	Edna very fine sandy loam, low	PF, if drained

*NRCS (2007).
PF = prime farmland.

The Jackson County Soil Survey (NRCS, 2007) lists seven mapping units as prime farmland and two mapping units as prime farmland, if drained, and no other types of important farmland (Table 3.6-2).

Table 3.6-2
Prime and Other Important Farmland
Jackson County, Texas

Map symbol	Map unit name	Classification*
DaA	Dacosta sandy clay loam, 0 to 1 percent slopes	PF
DaA	Dacosta sandy clay loam, 1 to 3 percent slopes	PF
EdA	Edna fine sandy loam, 0 to 1 percent slopes	PF
InB	Inez fine sandy loam, 0 to 2 percent slopes	PF
LaA	Laewest clay, 0 to 1 percent slopes	PF
LaB	Laewest clay, 1 to 3 percent slopes	PF
TfA	Teleferner fine sandy loam, 0 to 1 percent slopes	PF
MrA	Morales-Cieno Complex, 0 to 1 percent slopes	PF, if drained
TxA	Texana-Cieno Complex, 0 to 1 percent slopes	PF, if drained

*NRCS (2007).
PF = prime farmland.

The Matagorda County Soil Survey (NRCS, 2007) lists 17 mapping units as prime farmland, 1 as prime farmland, if drained, and no other types of important farmland (Table 3.6-3).

Table 3.6-3
Prime and Other Important Farmland
Matagorda County, Texas

Map symbol	Map unit name	Classification*
Aa	Asa silt loam, rarely flooded	PF
As	Asa silty clay loam, rarely flooded	PF
Br	Brazoria clay, rarely flooded	PF
Cm	Clemville silty clay loam, rarely flooded	PF
DaA	Dacosta sandy clay loam, 0 to 1 percent slopes	PF
FaA	Faddin loam, 0 to 1 percent slopes	PF
FuC	Fulshear fine sandy loam, 2 to 5 percent slopes	PF
KaB	Katy fine sandy loam, 0 to 2 percent slopes	PF
LaA	Laewest clay, 0 to 1 percent slopes	PF
LaB	Laewest clay, 1 to 3 percent slopes	PF
LoA	Laewest silty clay, 0 to 1 percent slopes, overwashed	PF
No	Norwood silty clay loam, rarely flooded	PF
Pe	Pledger clay, rarely flooded	PF
Pg	Pledger clay, occasionally flooded	PF
TxA	Texana fine sandy loam, 0 to 1 percent slopes	PF
TxB	Texana fine sandy loam, 1 to 3 percent slopes	PF
BaA	Bacliff clay, 0 to 1 percent slopes	PF, if drained

*NRCS (2007).
PF = prime farmland.

Besides the proposed PA P1 in Calhoun County, all other activities occur within the bay, on the adjacent shoreline, or on the Gulf shoreline, so the FPPA regulations do not apply and no impacts to prime or other important farmland would result from the activities associated with the proposed alternative.

3.7 GROUNDWATER HYDROLOGY

In southeastern Texas, the Gulf Coast Aquifer system is the principal source of groundwater for public, agricultural and industrial needs (Texas Water Commission, 1963). Within the aquifer system, the Chicot Aquifer is the uppermost aquifer, and all public and private water supply wells in the area are supplied by this aquifer. The Evangeline Aquifer underlies the Chicot Aquifer. The Chicot and Evangeline aquifers are commonly used hydrogeologic-unit designations for subdivisions of the upper, mostly sandy part of the deposits; and the lower permeable zones make up the Jasper Aquifer. The geologic and hydrologic units are presented on Figure 3.7-1.

Figure 3.7-1: Geologic and Hydrologic Units within the Matagorda Bay Study Area

<table>
<tr><th>System</th><th>Series</th><th colspan="2">Stratigraphic Unit</th><th colspan="3">Hydrologic Unit</th></tr>
<tr><td rowspan="5">Quaternary</td><td>Holocene</td><td colspan="2">Quaternary Alluvium</td><td rowspan="5">Chicot Aquifer</td><td colspan="2" rowspan="3">Upper Unit</td><td rowspan="9">Gulf Coast Aquifer</td></tr>
<tr><td rowspan="4">Pleistocene</td><td></td><td>Beaumont Clay</td></tr>
<tr><td rowspan="2">Lissie Formation</td><td>Montgomery Formation</td></tr>
<tr><td>Bently Formation</td><td rowspan="2">Lower Unit</td><td rowspan="2">Alta Loma Sand</td></tr>
<tr><td colspan="2">Willis Sand</td><td></td></tr>
<tr><td rowspan="4">Tertiary</td><td>Pliocene</td><td colspan="2">Goliad Sand</td><td colspan="3" rowspan="2">Evangeline Aquifer</td></tr>
<tr><td rowspan="3">Miocene</td><td colspan="2" rowspan="3">Fleming Formation</td></tr>
<tr><td colspan="3">Burkeville Aquiclude</td></tr>
<tr><td rowspan="2">Jasper Aquifer</td><td colspan="2">Upper Unit</td></tr>
<tr><td colspan="2">Lower Unit</td></tr>
</table>

Sources: Baker, 1979; Jorgensen, 1975.

The lithology of the Gulf Coast Aquifer system consists of sand, silt and clay, reflecting three depositional environments: continental (alluvial plain), transitional (delta, lagoon, and beach), and marine (continental shelf). These deposits thicken as they dip toward the Gulf, resulting in a wedge-shaped configuration of the hydrologic units. Numerous retreats and advances of ancient shorelines have resulted in a complex, overlapping mixture of sand, silt and clay. These complex deposits have been divided into seven units (five permeable zones and two confining units) based on permeability differences, water depths and vertical differences in hydraulic head.

The Chicot aquifer is the uppermost water-bearing unit in the Gulf Coast Aquifer system. The Chicot-Evangeline boundary runs approximately parallel to the coast, and forms an outcrop about 90 miles inland (Baker, 1979). All industrial, public and private water supply wells in the Point Comfort, Port Lavaca, and Port O' Connor areas draw primarily from the Chicot Aquifer (Texas Water Development Board [TWDB], 2006).

Groundwater recharge into the aquifers occurs primarily by precipitation onto outcropped areas and downward leakage from overlying saturated (perched) layers and/or aquifers. Regional groundwater flow in the aquifers is generally in a southeastward direction from outcrop areas towards areas of natural discharge (Wesselman, 1971). Superimposed upon this natural discharge regime is artificial discharge from groundwater pumping.

The EPA does not designate any sole source aquifers (SSA) within the study area (EPA, 2006d). A SSA is an aquifer that has been designated by the EPA as the sole or principal source of drinking water for an area. As such, a designated SSA receives special protection. The program for protecting SSAs was established by the Safe Drinking Water Act of 1974. The EPA designates an aquifer as a sole source based upon a petition from an individual, company, association, or government entity.

Records from the TWDB indicate there are a total of two private water supply wells located within 1 mile of the project area (TWDB, 2006). The nearest public supply well (school in Port O' Connor) is located about 2 miles west-southwest of the study area. This well was reportedly drilled in 1952 and is 160 ft deep. All nearby wells are typically screened in the Chicot Aquifer and range from about 160 to 500 ft in total depth.

3.8 HAZARDOUS MATERIAL

PBS&J performed a review and evaluation of the available public information relating to the hazardous material issues within the study area. The objective of this preliminary assessment was to identify the existence of, and potential for, hazardous, toxic, and radioactive waste (HTRW) contamination, which could impact or be impacted by the proposed project. The evaluation included the MSC, inclusive of both dredge locations and adjacent properties within a 2-mile radius of the channel. The assessment consisted of a review of recent and historic aerial photographs and a review of regulatory agency database information. A site reconnaissance was not conducted in this assessment to verify the status and location of sites referenced in the regulatory database search or to locate any additional unreported hazardous materials sites.

3.8.1 Aerial Photographic Review

Aerial photographs of the project area were obtained to examine the historic usage of Matagorda Bay, Lavaca Bay, Keller Bay, and the surrounding watershed. The photographs depict the project area as it appeared in 1958, 1973, 1995, and 2004. The aerial photographs were obtained from the USGS (1995b, 2004), and the Agricultural Stabilization Conservation Service (ASCS, 1958, 1973).

The earliest aerial photography available for the area was taken in 1958. These aerial photographs depict the project site from the northern end of Lavaca Bay Gulfward to include Matagorda Island. The aerial photographs indicate that in 1958 the project area included several communities (Port Lavaca, Point Comfort, Port O'Connor, Alamo Beach, and Magnolia Beach), a large industrial complex, cultivated cropland, undeveloped coastal prairie, recreational areas, marshland, and the GIWW. The communities consisted predominantly of residential, commercial, and recreational development. These communities were linked with SH 35, SH 185, Farm to Market Road (FM) 1593, and FM 316. The coastline and upland areas surrounding Lavaca Bay were predominantly undeveloped. An industrial complex, identified as Alcoa, occupied a large area immediately south of Point Comfort. This area was accessed by FM 1593 and two railroad lines. The complex, which initially operated as an aluminum smelter, now conducts alumina refining operations. The facility included a process area, and two large, rectangular ponds adjacent to the bank of Lavaca Bay. Land use in the undeveloped areas appears to have included cultivated cash crops, livestock grazing, and sparse oil and gas exploration and production.

The aerial photographs collected in 1973 indicate that the area had undergone observable development in urban areas and at the Alcoa complex since 1958. The urban development appears to have been limited to existing communities and included new roadways and residential and commercial development. The new facilities at Alcoa included an additional four evaporation ponds adjacent to the two existing ponds, and a series of smaller ponds built on an island offshore from the facility.

The aerial photographs collected in 1995 indicate that residential, commercial, and industrial development had continued to occur in the same areas noted in the 1973 aerial photographs. The most notable industrial development involved the presence of an industrial complex northeast of Point Comfort. The facility, identified as Formosa Plastics Corporation, Texas (Formosa), was accessed by one improved roadway and a railway. The undeveloped property, which included the majority of the study area, remained basically unchanged from the previous photographs.

Current photography indicates that land uses in the study area include highly developed residential-urban, heavy industrial, State and Federal government land, recreational areas, range-pasture, and saline and brackish-water marsh. Generally, the land in the immediate vicinity of the communities of Point Comfort, Port Lavaca, and Port O'Connor are highly developed, while the areas along the shore of Lavaca Bay, Cox Bay, and the west side of Matagorda Bay are moderately developed to undeveloped. The Point Comfort area is heavily industrialized containing Alcoa, Formosa, and the Port.

The project area and immediate vicinity is mostly rural with the exception of urban areas, which include the communities of Port Lavaca, Point Comfort, and Port O'Connor. The majority of industry is located in the Port area.

According to records reviewed by PBS&J, the Matagorda Bay area was used extensively by the Texas National Guard and the DOD (Army and Air Force) for military training from 1926 to 1956. In addition, these military training areas had target ranges used for training for small arms, anti-tank, artillery, air to

ground gunnery and bombing practice. The target ranges and ordnance fan areas cover a majority of Lavaca and Matagorda Bays in both Calhoun and Matagorda Counties, some of which appear to cross the existing MSC.

3.8.2 Regulatory Agency Records Review

Due to the expansive aerial extent of the project area, the regulatory agency database searches were subdivided into four regions (Environmental Data Resources [EDR], 2006a, 2006b, 2006c, 2006d; see Appendix C). The scope of the regulatory information search included the following databases: the National Priority List (NPL); Record of Decision database (ROD); the State Superfund List (SSF); Comprehensive Environmental Response Compensation and Liability Information System Database (CERCLIS); Resource Conservation and Recovery Act Information System Database (RCRA) Generators and Violators List (RCRA-G); RCRA Corrective Actions List (CORRACT); RCRA Treatment, Storage, or Disposal List (RCRA-TSD); RCRA Administrative Action Tracking System database (RAATS); PCB Activity Database (PADS); Underground Storage Tank Database (UST); and Aboveground Storage Tank Database (AST); Leaking Underground Storage Tank Listings (LUST); City/County Solid Waste Landfill listings (TXLF); Emergency Response Notification System (ERNS) database; Spills Incident Information System database (SPILL); Toxic Release Inventory System (TRIS) database; Aerometric Information Retrieval System (AIRS); and Facility Index System (FINDS) database. Many of these listings were associated with the same industrial facilities or property (e.g., a facility or property contained multiple storage tanks and/or was the site of multiple spills or multiple agency enforcement actions). In totaling the results of the multiple searches, duplicate sites under each category were only counted one time per group of reports. On the basis of the results of the regulatory database searches, the following type and number of sites are located within the study area:

- 1 NPL site;
- 1 ROD site;
- 1 PADS site;
- 2 CORRACT sites;
- 1 RAATS site;
- 21 RCRA Gen/RCRA-TSDF) sites;
- 75 registered UST sites;
- 22 registered AST sites;
- 27 LUST sites;
- 704 reported spills or emergency response actions;
- 3 AIRS sites; and
- 2 TRIS listings.

The following provides a summary of the results of the regulatory agency database information search.

3.8.2.1 NPL Sites

The NPL is a priority subset of the CERCLIS list and is a list of priority sites that the EPA has determined to pose a threat to human health and/or the environment and where remedial action is required. The NPL facility identified within the study area during the database search is Alcoa, located on SH 35, along the eastern shore of Lavaca Bay. Alcoa is an active metal refining facility that refines bauxite ore to produce alumina. The facility has been in continuous operation since 1948. Previous operations also included a cryolite plant and a chlor-alkali processing unit. The 3,500-ac facility includes 375-ac Dredge Island,

located in Lavaca Bay and historically used for the disposal of dredged material, gypsum, and wastewater from the former chlor-alkali processing unit. Dredge Island includes a 91-ac gypsum lagoon and a 50-ac dredged material PA, which includes five lagoons. According to the EPA, the two primary sources of hazardous substances at the site are the gypsum lagoon and the dredged material area. From 1966 to 1970, the Alcoa Point Comfort Operation (PCO) discharged mercury-containing wastewater into Lavaca Bay from the chlor-alkali processing operations (GLO et al., 2001). Discharge of the contaminated water was discontinued in 1970 at the request of the Texas Water Quality Board (now TCEQ). The site was placed on the NPL under the CERCLA in 1994, based on the level of mercury found in certain aquatic species and in the sediments found in Lavaca Bay adjacent to the Alcoa Facility (GLO et al., 2001).

3.8.2.2 ROD Sites

The ROD document defines the mandate to perform remedial action at an NPL site. The ROD will contain technical guidance to assist in the cleanup of the facility. Alcoa was the one ROD facility identified within the study area during the database search.

A ROD was published by the EPA Region 6, in late 2001, which presented the selected remedial actions to address the contaminated sediments, ongoing unpermitted discharges into Lavaca Bay, and soil contamination from the former Chlor-Alkali Process Area (CAPA) and the former Witco Tank Farm (Witco) Area (EPA Region 6, 2001). The major components of the remedial actions affecting the Lavaca Bay system include groundwater treatment, sediment dredging, landfill capping, natural attenuation, institutional controls, and surface water and sediment monitoring.

3.8.2.3 PADS Sites

The PADS identifies generators, transporters, commercial storers and/or brokers and disposers of PCBs who are required to notify the EPA of such activity. Alcoa was the one PADS facility identified within the study area during the database search. PCBs were detected at relatively low levels in association with contaminated sediments in the vicinity of the facility.

3.8.2.4 CERCLIS/CORRACT Sites

The CERCLIS database is EPA's official repository for site and nonsite specific Superfund data in support of the CERCLA. The database contains information on hazardous waste site assessment and remediation from 1983 to the present and is used by EPA in evaluating the status and progress of site cleanup actions, and to communicate planned activities and budgets. The CORRACT database includes typically a subset of CERCLIS sites with RCRA corrective action activity. The database search identified one CERCLIS site and two CORRACT sites:

- Alcoa. A preliminary assessment was first conducted at the Alcoa facility in 1980. However, a remedial investigation (RI)/feasibility study (FS) was subsequently conducted (1988) that determined that mercury was being released into Lavaca Bay via groundwater discharge from beneath the Point Comfort facility. The RI also determined that polycyclic aromatic hydrocarbons

(PAHs) were detected at elevated levels within the same area of elevated mercury contamination. Since PAHs do not bioaccumulate in a receptor-like exposure to mercury does, the PAHs were determined to be a secondary contaminant of concern (COC). This classification was based on the potential indirect effects of direct exposure only to PAHs on the ecosystem food chain (GLO et al., 2001). Several early response actions were successfully conducted during the RI/FS to address the source of mercury and PAH contamination, thereby reducing the mercury exposure and initiating the reduction of existing contaminant levels over time (EPA Region 6, 2001). The corrective actions (CA) already taken include:

  - The large-scale removal of mercury-containing sediments from 1997–2001, including removal in the vicinity of Dredge Island, which removed or immobilized sediments that may have entered the bay system through surface water runoff.
  - The removal of mercury-contaminated sediments in the channel adjacent to the CAPA area where resuspension of the sediments could take place by the movement of marine vessels.

- Formosa, located at 101 Formosa Point Comfort, Texas 77978. Information was limited concerning the extent and nature of the facilities' CA. A RCRA facility investigation (RFI) was determined to be an appropriate course of CA in 1990. In January 1992, the RFI work plan was approved. In the following month, the CA prioritization was assigned as a high CA priority. A total of 35 solid waste management units (SWMUs) were identified in the CA. The report stated that the facility groundwater monitoring has determined that the migration of contaminated groundwater is under control.

3.8.2.5 RAATS Sites

The RAATS database contains records on enforcement actions issued under RCRA and pertaining to major violators. It includes administrative and civil actions brought by the EPA. One RAATS facility was identified within the study area during the database search, Formosa, located at 101 Formosa Point Comfort, Texas 77978. Formosa had 56 violation records with EPA from 1991 to 2001. The violations include a variety of permit infractions. Each of the violation records report a date when compliance was achieved.

3.8.2.6 RCRA Generators Sites

Under RCRA, generators and transporters of hazardous waste are required to provide information concerning their activities to State agencies and the EPA. The RCRA-G list is a subset of the RCRIS database and tracks facilities that are registered generators or transporters of hazardous waste. According to the regulatory review, a total of 19 regulated generator/transporter facilities are located within the study area. Seventeen of these facilities are listed as small quantity generators (generates at least 100 kg/month but less than 1,000 kg/month of hazardous waste), and 2 were listed as large quantity generators (generates at least 1,000 kg/month of hazardous waste).

3.8.2.7 RCRA Treatment, Storage, and Disposal Sites

The RCRA TSD database is also a subset of RCRIS. The database tracks facilities that treat, store, or dispose of hazardous materials, which are required to provide information to State agencies and EPA. Two RCRA-TSD facilities were identified within the study area. Alcoa and Formosa are permitted under RCRA to treat, store, or dispose of hazardous waste.

3.8.2.8 Registered Storage Tanks Sites

The AST and UST databases are maintained by TCEQ to track permitted petroleum storage tank sites. According to the database, 22 facilities operate ASTs and 75 facilities operate USTs within the study area.

3.8.2.9 Leaking Underground Storage Tank Sites

The LUST database is a list maintained by TCEQ of facilities were a known UST release has occurred. According to the database, a total of 27 sites within the project area are reported as LUST sites. Final concurrence has been issued by TCEQ and the cases have been closed for 22 of the LUST facilities. Final concurrence is pending on two additional sites; one is currently undergoing a site assessment, and the remaining site is involved in a CA plan.

Of the 27 LUST sites, 15 sites have been reported to have impacted groundwater. The remaining 12 sites reported either that groundwater was not impacted, or the impacts were limited to soil contamination only.

3.8.2.10 ERNS/State Spill Sites

The ERNS supports the release notification requirements of CERCLA and serves as a mechanism to document and verify incident location information as initially reported. The TXSPILL database includes cases where emergency response was needed for cleanup of toxic substances. In either database, many of these cases occur at a single facility/property and the spill or release locations are usually difficult to locate precisely within the facility. The databases contained documentation for a total of 704 spill notifications. The majority of the ERNS spill sites within the study area reportedly occurred at Formosa.

3.8.2.11 Toxic Release Inventory Sites

The TRIS database contains information on chemical releases to environmental media based on reports provided to EPA from individual facilities. The TRI was mandated by Title III of the Superfund Amendments and Reauthorization Act and was enacted to provide information to the public about releases of toxic chemicals. According to the regulatory agency review report, two sites were reported throughout the study area. Alcoa and Formosa are reported as the responsible parties for releases to the environment.

3.9 WATER AND SEDIMENT QUALITY

3.9.1 Water Exchange and Inflows

The Matagorda Bay system consists of the Colorado-Lavaca and Lavaca-Guadalupe Coastal Basins or estuaries. The major sources of freshwater inflows from north to south are the Colorado River, Tres Palacios Creek, the Navidad River through Lake Texana, the Lavaca River, and intervening coastal drainages. Tidal exchange with the Gulf occurs to a limited degree in the north through the Mouth of the Colorado River that connects to the GIWW and to Matagorda Bay, the MSC and Pass Cavallo. Of these, the MSC is the deepest and most efficient opening to the Gulf.

The average Gulf tide is 1.45 ft (Closest station Galveston Pleasure Pier, TCOON, 2006) but this tide range can vary substantially with astronomical factors as well as winds. The average tide range at Port O'Connor is 0.79 ft (TCOON, 2006). With an average bay depth of approximately 5 ft, roughly 16% of the bay volume is exchanged on each tidal cycle. With a bay surface area of approximately 352 square miles (9.8 billion square ft) (Lower Colorado River Authority [LCRA], 1997), the average tidal exchange is roughly 7.7 billion cubic ft. That is roughly 178 thousand acre-feet (ac-ft) of water exchanged in each tidal cycle.

The long-term average and range of freshwater inflows to the bay system were tabulated by LCRA (1997). A summary is shown in Table 3.9-1.

Table 3.9-1
Matagorda System Freshwater Water Inflows, 1940–1991
(Thousands of ac-ft/year)

	Gaged	Ungaged	Total
Average	1,961	963	2,979
Minimum	327	31	438
Maximum	4,702	2,655	6,726

Source: LCRA (1997).

The gaged flows include the major rivers and streams and the ungaged flows were calculated using a TWDB rainfall-runoff model, TxRR. The average direct evaporation was estimated to be 1,195 thousand ac-ft/year, while average direct precipitation was about 29% less or 853 thousand ac-ft/year.

The relative magnitude of the tidal and freshwater inflows can be appreciated by comparing the tidal prism estimate with the inflows. The entire average yearly freshwater inflow of 2,979 thousand ac-ft is exchanged by the tide in just 17 tidal cycles.

Under average wind, freshwater inflow, and tidal influence conditions, the general pattern of water movement is from the inflow areas (Mueller and Matthews, 1987) to the Gulf. Patterns of circulation are very complicated and display large variations from month to month. The MSC also has a major effect on

the tidal circulation in the bay. High salinity waters from the Gulf are transported into Lavaca Bay in the deeper areas of the MSC, which can cause significant vertical stratification and affect circulation. Frontal passages can cause changes in water levels and exchanges between the bays and the Gulf. These can also cause wind direction shifts, forcing water from one bay to another for short-lived low energy fronts and from the bays into the Gulf for longer-duration fronts.

3.9.2 Salinity

Salinity in the Matagorda Bay system depends on tidal exchange and freshwater inflows. The bays of the Texas coast are very dynamic, responding to perturbations of greater and lesser impact. Ward et al. (1980) studied salinity regimes in the Matagorda Bay system from 1952 to 1980. From their findings, the mean salinity in the bay area ranged between 8–31 parts per thousand (ppt). As expected, the spatial variation of monthly salinity averages showed that areas of lower salinity were located near the mouths of major rivers and minor tributaries, while higher salinity values were observed near points of major tidal inflows. Lavaca Bay was consistently the freshest bay area, while the open body of Matagorda Bay and the western half of the eastern arm of Matagorda Bay were the most saline.

Ward and Armstrong (1980) found that, due to the relatively shallow depth of the system and strong wind-induced mixing, vertical stratification with respect to salinity was generally absent. The exception to this was the MSC, with a depth of 36 ft. Stratification was normally associated with transient freshet events rather than with equilibrium. Interpreting vertical salinity profiles in the MSC, the authors stated that the upper profiles along the MSC indicated strong near-surface stratification resulting from large freshwater inflows, while the lower profiles, which were more typical, represented periods of low inflow and little stratification.

While vertical stratification was infrequent, large horizontal salinity gradients frequently exist, resulting from the seawater salinities at the bay system tidal exchange passes. Ward and Armstrong (1980) reported that horizontal gradients in Matagorda Bay were relatively weak compared to the stronger gradients observed in Lavaca Bay. The limited direct influences of freshwater inflows and tidal exchange in Matagorda Bay resulted in the small salinity gradients, except in the area of the Gulf tidal inlet in the MSC landcut. In the MSC landcut, strong gradients exist due to the salinity intrusion and tidal exchange. The freshwater inflows to Lavaca Bay result in the pronounced salinity gradients observed in this area. Based on a statistical analysis of seasonal salinity variation, Ward and Armstrong (1980) indicated that the seasonal freshwater inflows to the bay system resulted in a corresponding seasonal pattern of salinity variation. The normal high freshwater inflows observed in April, May, and June resulted in lower salinities during this time. The gradual decrease in inflows from late fall and winter resulted in increases in salinity until a maximum in March is observed. The areas of the bay system more directly impacted by inflows showed more pronounced seasonal variation in salinity. Ward and Armstrong (1980) also noted that there was a significant increase in salinities observed after October 1963 as a direct result of the MSC landcut through Matagorda Peninsula. The amount of salinity increase ranged from 2–5 ppt in adjacent areas.

Figure 3.9-1 shows long-term average salinity values (1985–2006) at stations in the bay system. On this figure, the number of observations is presented in parenthesis and data from TCEQ include observations from January 1985 to January 2006. Half reporting limits were used as detection limits. The values for Lavaca Bay and Tres Palacios Bay are combined from several adjacent stations while the others are single stations. The station in the Eastern Arm of Matagorda Bay has experienced a drop in salinity since the Colorado River Diversion (1989–1992) was completed. This project routed the river into the Eastern Arm of Matagorda Bay and also closed off Parker's Cut, a link between the Eastern Arm and Gulf.

The TWDB has been carrying out automated collection of water quality data including salinity in Matagorda and Lavaca Bay and other locations along the Texas Gulf coast since the fall of 1986. Salinity data have been collected by datasondes, which in addition to salinity also measure temperature, conductivity, dissolved oxygen (DO), and water level. Data sets for 3 years – 1988, 1993, and 2003 were obtained from TWDB, and though inconsistent, did give some trends. Figure 3.9-2 shows the locations of some TWDB Intensive Survey monitoring stations. For 1988, the MSC entrance into Matagorda Bay showed salinity ranging between 23–27 ppt; for Pass Cavallo 30–44 ppt, while the study area near the MSC at the entrance of Lavaca Bay ranged from 28–33 ppt. In 1993 Pass Cavallo showed salinity ranging from 3–30 ppt. For the year 2003, the MSC entrance into Matagorda Bay had salinity ranging between 25–32 ppt, with some scattered lower values. Salinity near Pass Cavallo and the study area near the MSC at the entrance of Lavaca Bay were in the region of 17–25 ppt. The datasets did show more salinity for the study areas near major tidal inflows (MSC entrance and Pass Cavallo) than near freshwater inflows (entrance of Lavaca Bay), which was expected.

3.9.3 Water Quality

3.9.3.1 TCEQ Efforts

The TCEQ has designated water quality segments for the Matagorda Bay system. These are shown on Figure 3.9-3. The designated uses for the waters of the system (segments 2451 to 2456) are contact recreation and aquatic life support (TCEQ Surface Water Quality Standards, 2000). All bay segments are assigned an Exceptional Aquatic Life Use subcategory (E) and Oyster Waters (O). Under TCEQ procedures, the E/O designation translates to a DO criteria for saltwater of an average of 5 milligram per liter (mg/L) and a minimum of 4 mg/L. The oyster use designation criterion for bay and gulf waters is a fecal coliform (FC) median concentration not to exceed 14 cfu/dL (colony forming units per deciliter or 100 mL with no more than 10% of all samples exceeding 43 cfu/dL). Figure 3.9-4 shows a tabulation of the values at the same stations used for salinity. On this figure the number of observations is presented in parenthesis and TCEQ data include observations from July 1969 to January 2006 for DO and from November 1973 to March 2005 for FC. Half reporting limits were used as detection limits. It can be seen that most of the stations have average data that indicate the designated uses are being attained. However, the station at the Eastern Arm of Matagorda Bay has an FC geometric mean (roughly equivalent to median) concentration (21 cfu/dL) that exceeds the oyster water criterion, possibly reflecting the influence of the river diversion.

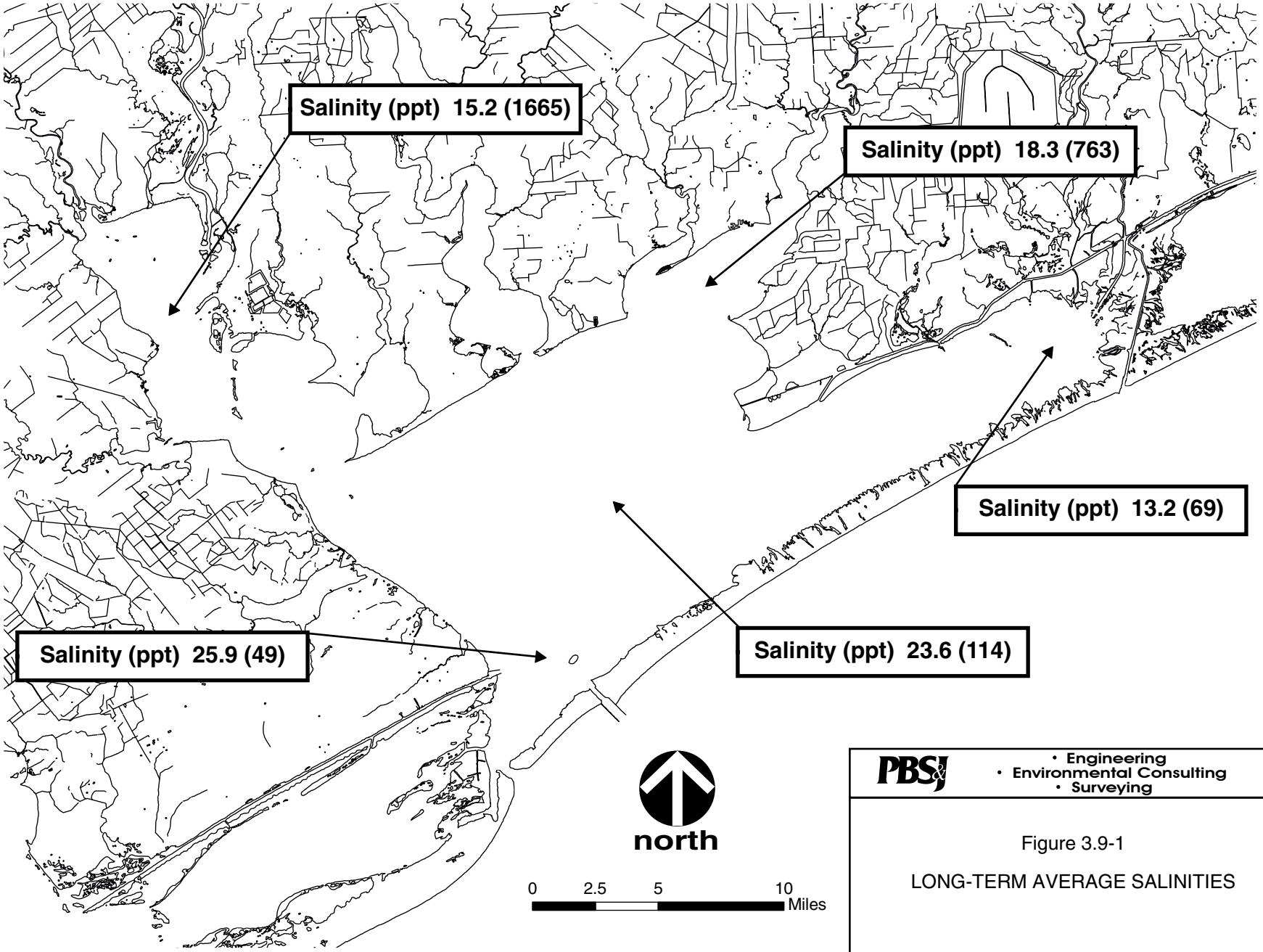

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Figure 3.9-1

LONG-TERM AVERAGE SALINITIES

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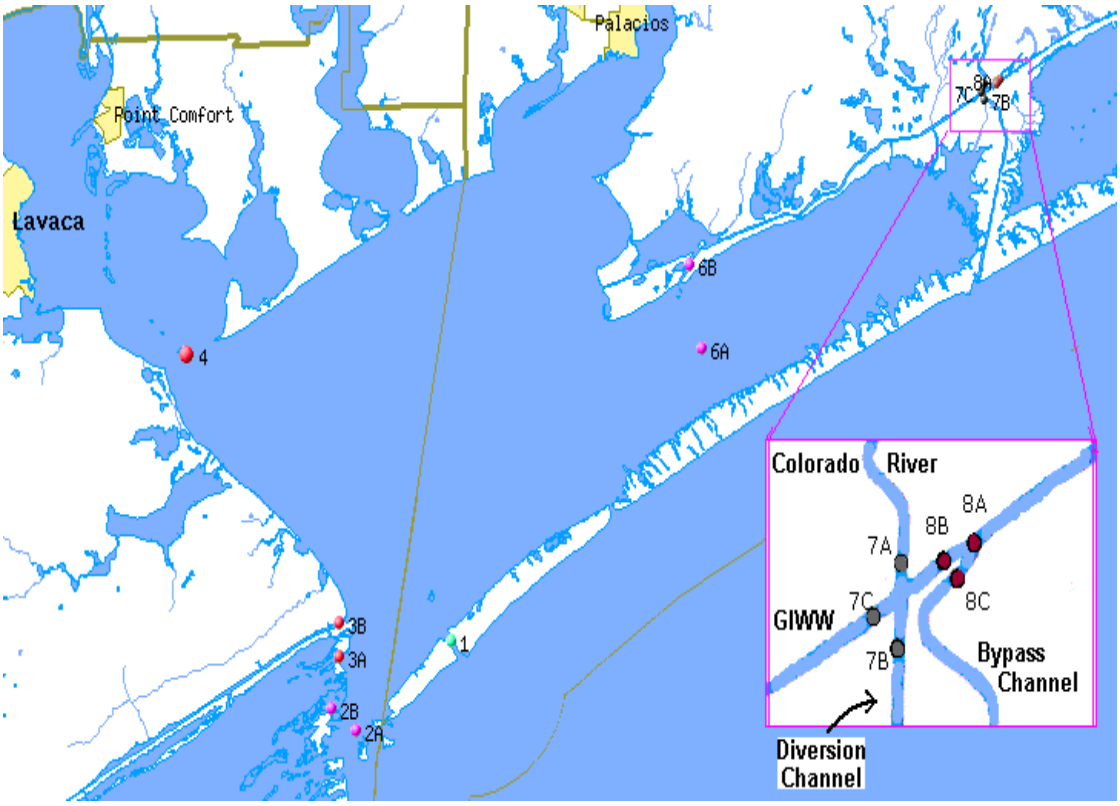

Figure 3.9-2: TWDB Salinity Monitoring Stations Near the MSC

In addition to the averages of the periodic longer-term monitoring data shown above, the TCEQ conducts water quality assessments with a special set of procedures (TCEQ, 2004) every 2 years to determine whether the uses are being attained. Table 3.9-2 provides a status summary of segments identified by the TCEQ to have potential water quality concerns.

Matagorda Bay (Segment No. 2451) and Lavaca Bay/Chocolate Bay (Segment No. 2453) were both placed on the TCEQ 2002 impaired or threatened waterbody (or 303(d)) list, and a TMDL study was initiated for each segment. The TMDL work for Matagorda Bay was designed to determine the extent of low DO and high pH values and to determine whether action was needed. If needed, a plan would be developed to restore the water quality in this segment. The bacteria impairment was not addressed as part of the TMDL.

A summary of the project, provided by TCEQ (TCEQ, 2005a) indicated:

1. Monitoring for 24-hour DO began at seven stations in June 2004. The monitoring occurred monthly from April to October and continued through August 2005; and
2. Preliminary results through August 2005 indicated the water quality standards were met at all stations in the bays and harbor.

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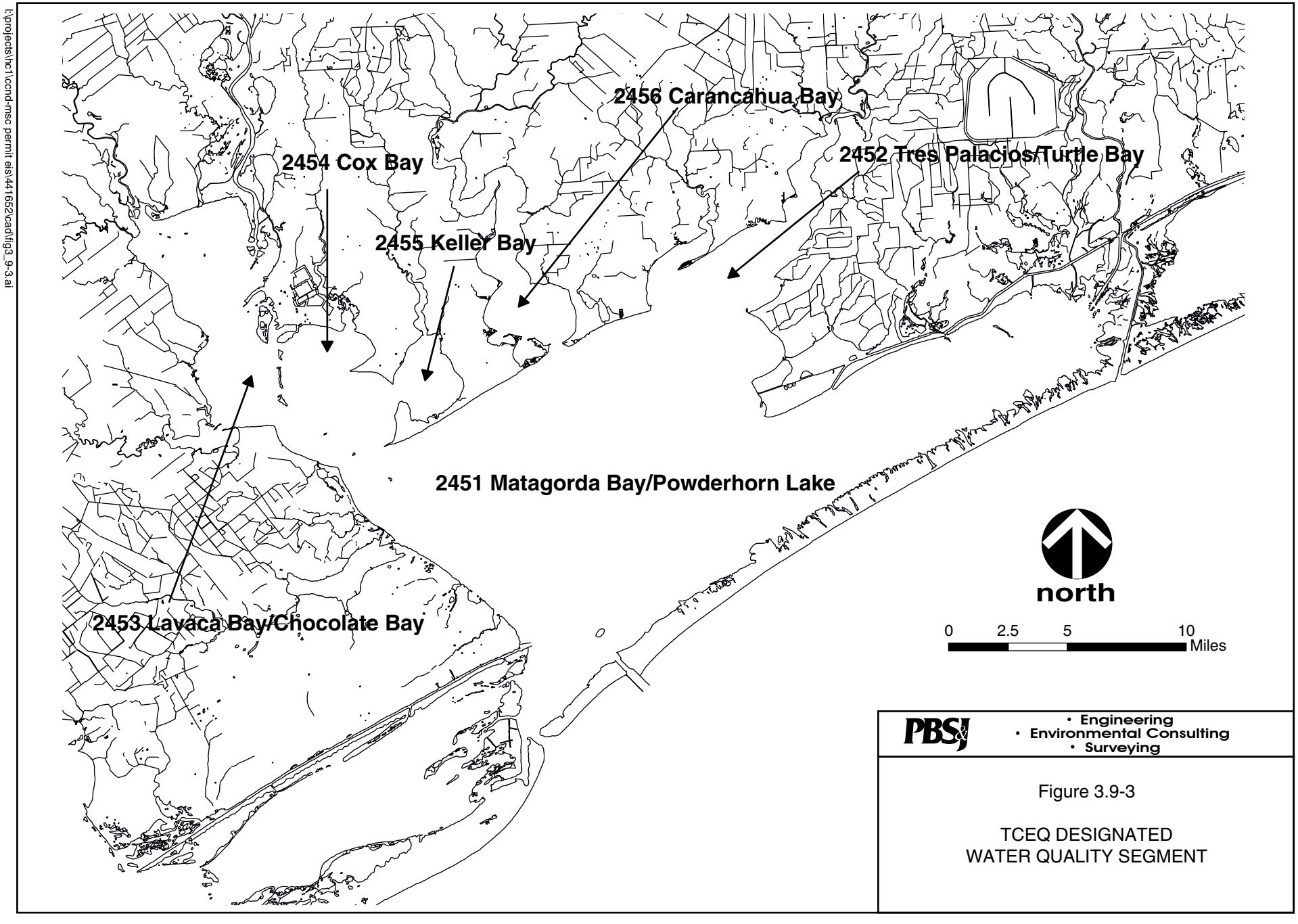

Figure 3.9-3

TCEQ DESIGNATED
WATER QUALITY SEGMENT

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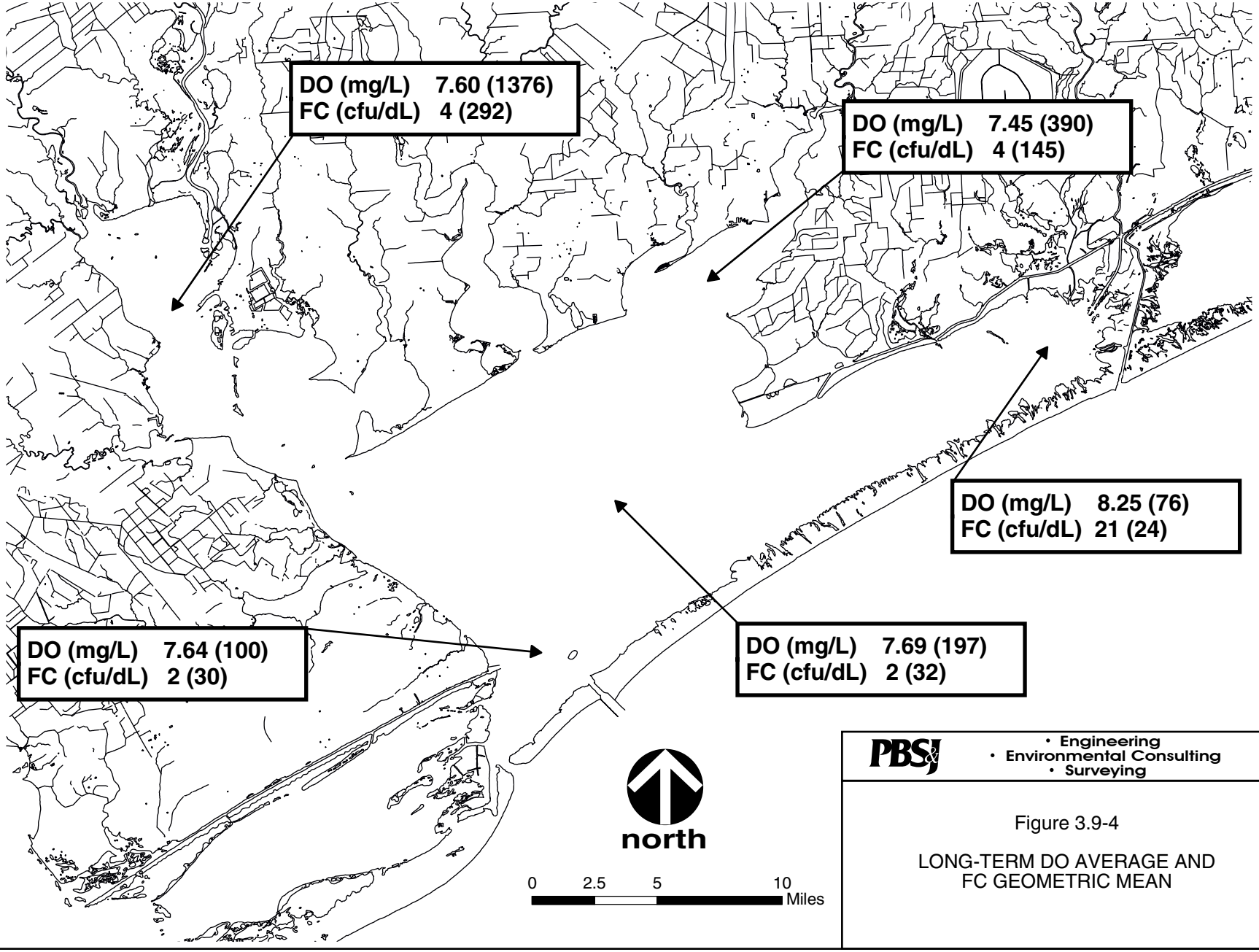

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Figure 3.9-4

LONG-TERM DO AVERAGE AND FC GEOMETRIC MEAN

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Table 3.9-2
Summary of Draft 305(B)/303(D) Water Quality
Assessment Status for Bay Segments

Segment	Name	Uses	Level of Use Support	Use Impairment or Concern	303(d) Status
2451	Matagorda Bay/	Contact Rec	Full	None	
	Powderhorn Lake	General	Full	None	
		Oysters	Full	None	
		Aquatic Life	Full	None	Delist for DO, Original listing in error
2452	Tres Palacios Bay/Turtle Bay	Contact Rec	Full	None	
	Palacios Harbor	Aquatic Life	Non Support	Impairment	Listed, TMDL underway
	Palacios Harbor	Oysters	Non Support	Impairment	Listed, TMDL underway
	Upper Creek	Oysters	Non Support	Impairment	Listed, TMDL underway
	Turtle Bay	Oysters	Non Support	Impairment	Listed, TMDL underway
2453	Lavaca Bay/Chocolate Bay	Contact Rec	Full	None	
	Center portion of Bay	General	Full	None	
		Aquatic Life	Full	None	
		Oysters	Full	None	
	NE Portion near	Contact Rec	Full	None	
	Point Comfort	General	Full	None	
		Aquatic Life	Full	Concern Hg in Sed	
		Oysters	Non Support	Impairment	Listed, TMDL underway
	Chocolate Bay area	Contact Rec	Full	None	
		General	Full	None	
		Aquatic Life	Full	None	
		Oysters	Non Support	Impairment	Listed, TMDL underway
	Area near Causeway	Contact Rec	Full	None	
	and Channel	General	Full	None	
		Aquatic Life	Non Support	Impairment	Listed, 5c more data
		Oysters	Non Support	Impairment	Listed, TMDL underway
		Fish Consumption	Non Support	Hg Advisory	Not Listed, 4c (1)
2454	Cox Bay	Contact Rec	Full	None	
		General	Full	None	
		Aquatic Life	Full	None	
		Oysters	Full	None	
2455	Keller Bay	Contact Rec	Full	None	
		General	Full	None	
		Aquatic Life	Full	None	
		Oysters	Full	None	

Summary of Matagorda Bay segments status, C. Kolbe, TCEQ Assessment Team, 2006.
Information included is subject to revision.
(1) Corrective action underway with Superfund Program.

As shown in Table 3.9-2, the TCEQ is recommending that Matagorda Bay (Segment 2451) be removed from the 2006 303(d) list.

Lavaca Bay and Chocolate Bay, Segment 2453, involved both DO and mercury monitoring. In a study performed by Texas A&M Galveston (TAMUG, 2004), samples were collected from seven stations from August 2002 to August 2003. These samples were analyzed for total and dissolved mercury, temperature, salinity, pH and DO. A summary of the data showing the range of results is presented in Table 3.9-3. Based on the findings presented by the TCEQ, the sampling results for DO and mercury in water indicated that a TMDL was not necessary for those parameters. The 303(d) listing for mercury in crab and fish tissues has been moved to Category 4c reflecting ongoing Superfund work. Portions of segment 2453 are listed for oysters (bacteria) and the area near the Causeway is listed for aquatic life (DO). Segment 2452 has also been subdivided for assessment. The Palacios Harbor portion is listed for both aquatic life (DO) and oysters (bacteria), while the rest of the segment is listed for oysters.

3.9.3.2 USACE Water and Elutriate Chemistry

The data collected by the USACE were analyzed to determine the water quality of the project area. Also included below is a discussion of the elutriate, which provides information on those constituents that are dissolved into the water column during dredging and placement because it is prepared by thoroughly mixing site water and sediment, followed by filtration or centrifugation. Since the elutriate represents the dissolved concentrations that would be expected in the water column, they (and the water from which they are prepared) are compared to the Texas Surface Water Quality Standards (TWQS) provided by the TCEQ (TNRCC, 2000) for the protection of aquatic life in the waters of Texas and to EPA water quality discrete criteria (WQC) for the protection of aquatic life nationwide. Since the values are from grab samples, not long-term composites or averages, and are from a marine environment, the acute marine TWQS and WQC are used for comparison. Sediment data are also included in the tables in Appendix D-1, since the elutriate is a measure of the release of constituents from the sediment into the water column and it may be informative to be able to compare elutriate results to sediment results. Also provided in most of the tables in this section, are the USACE Channel Stations, which can be compared to Figure 1.1-1 to determine station locations.

Table 3.9-3
Ranges of TMDL Study Data for Lavaca/Chocolate Bay

Sampling Station ID	Total Mercury (ng/L)	Dissolved Mercury (ng/L)	Salinity (ppt)	pH	Dissolved Oxygen (mg/L)
17558	2.03–7.54	0.44–2.08	8.422.6	6.99–8.66	6.20–9.31
13384	2.46–25.21	0.53–4.19	11.4–24.1	7.87–8.41	6.25–9.34
17853	2.39–14.35	0.55–3.24	6.8–24.1	7.77–8.58	5.98–9.58
13563	2.26–11.9	0.45–2.0	3.5–19.2	7.22–8.53	6.14–9.24
13385	2.31–13.9	0.52–1.71	15.9–24.6	7.86–8.42	5.78–8.79
14394	5.24–24.6	0.60–2.03	13.6–26.1	7.87–8.37	5.80–8.07
17857	4.68–17.26	0.58–3.68	13.0–22.9	7.97–8.46	5.88–8.53

Source: TAMUG, 2004.

Available data in the Galveston District's database includes samples collected since 1987. These collection efforts are included in Table 3.9-4. Some parameters, for which analyses were conducted in the past but have been determined not to be constituents of concern (EPA/USACE, 2003), are not included in the tables in Appendix D-1. The EPA does not consider data more than 5 years old to be relevant for determining if there is a cause for concern and, therefore, only samples collected since 2001; i.e., the last 5 years, are analyzed in detail in the following discussion, although the data are included in some tables and in Appendix D-1.

As shown in Table 3.9-5, there were several exceedances in 1987, when total metals concentrations, rather than concentrations for dissolved metals, were being compared to the WQC and TWQS. In May 2000, 23 samples were collected in the Point Comfort Turning Basin (PCTB) (PBS&J, 2001a). No WQC or TWQS were exceeded but there was some concern about mercury concentrations in the sediment (Section 3.9.4.1), so in August 2000, two sets, of three composite samples each, were collected: one set from the MSC between Gallinipper Point and the PCTB and one set from the PCTB. The WQC for copper, but not the TWQS, was exceeded in one of the MSC composite samples (MSC-1) and both the WQC and the TWQS for copper were exceeded in another MSC composite sample (MSC-3) (see Table 3.9-5; see Appendix D-1). Both the WQC and TWQS for silver were exceeded in both water and elutriate samples from the other MSC composite sample (MSC-2). The WQC for copper, but not the TWQS, was also exceeded in one of the PCTB composite samples (PCTB-2). However, as can be seen from Table 3.9-6, in bioassays with the Suspended Particulate Phase (SPP, equivalent to the elutriate), survival in the SPP of channel samples was not less than in the Dilution-Water Control by at least 10% (PBS&J, 2001a, 2001b). Therefore, the dredged material would not be predicted to be acutely toxic to water column organisms.

A comparison of the Entrance Channel elutriate results with the corresponding water concentrations for the 2001 data indicates moderate increases in zinc at station MEC-01-01 and MEC-01-02; and larger dramatic increases in zinc at station MEC-01-03 and the reference station (see Appendix D-1). There were also larger increases in elutriate ammonia, relative to water ammonia for all stations, but there were no trends in the total petroleum hydrocarbon (TPH) data. No WQC or TWQS were exceeded. SPP bioassays (Table 3.9-6) were also conducted on the samples collected from the Entrance Channel in 2001 (PBS&J, 2001c). In one of six bioassays, test survival was at least 10% less than control survival, requiring statistical analysis. That analysis revealed that test survival was significantly less than survival in the Dilution-Water Control (PBS&J, 2001c). In this case, the test survival was 88% (Table 3.9-6), thus the LC_{50} (that concentration of a medium that is lethal to 50% of tested organism at the end of the bioassay — 48 hours, in this case) could not be calculated. Therefore, the LPC for water column toxicity/SPP was met and there was no indication of toxicity (EPA/USACE, 2003).

Table 3.9-4
Samples Collected and Analyzed by or for the Galveston District

Date	USACE Data
1987	21 channel stations in Matagorda and Lavaca Bays from just bayward of the GIWW to the PCTB (20+000 - 117+000), plus PAs 8 and 10 and Reference Stations on the southwest side of the MSC opposite the PAs.
1988	3 Entrance Channel Stations (-10+000 - -20+000), plus 1 PA and 1 Reference Stations.
1989	9 MSC stations in Lavaca Bay from roughly Indian Point to the PCTB (80+00 - 117+000), plus PAs 14, 15, 16 and 17 and Reference Stations opposite PAs 15, 16, and 17.
1991	17 MSC stations in Matagorda and Lavaca Bays from the GIWW to the PCTB (15+000 - 117+000), plus PAs 8, 11, 15, and 17 and Reference Stations on the other side of the MSC opposite those PAs.
1993	13 MSC stations in Matagorda and Lavaca Bays from the GIWW to the PCTB (15+000 - 115+000), plus PAs 9 and 14 and Reference Stations on the other side of the MSC opposite those PAs.
1995	38 MSC stations in Matagorda and Lavaca Bays from the GIWW to the PCTB (15+000 - 116+000), plus PAs 9 and 14 and Reference Stations on the other side of the MSC opposite those PAs.
1997	11 MSC stations in Lavaca Bay from roughly Gallinipper Point to the PCTB (95+000 - 115+000), plus 2 Reference stations.
1998	3 Entrance Channel Stations (-10+000 - -20+000), plus 1 PA and 1 Reference Stations.
May-00	23 stations in the Point Comfort Turning Basin.
Aug-00	3 composite stations in the MSC (105+000 - 109+000, 110+000 - 114+000, and 115+000 - 120+000) between Gallinipper Point and including the PCTB, plus 1 Reference sample and 3 composite samples from the some of the same stations collected in May 2000, plus 1 Reference samples. These composites samples were for bioassay and bioaccumulation studies in addition to the chemistry.
October-00	26 MSC stations in Matagorda and Lavaca Bays from the GIWW to the PCTB (20+000 - 105+000), plus PAs 9 and 14 and Reference Stations on the other side of the MSC opposite those PAs.
2001	3 Entrance Channel stations (-11+000 to -19+000), plus 1 PA and 1 Reference Stations.
Jan-03	23 MSC stations in Lavaca Bay from roughly Gallinipper Point to the PCTB (95+000 - 117+000), plus a PA 16 Station.
Apr-03	15 MSC stations in Lavaca Bay from roughly Gallinipper Point to the PCTB (95+000 - 117+000), plus a PA 16 station.
2005	3 Entrance Channel Stations (-9+000 - -19+000), 1 Reference Station.
2006	4 MSC stations in upper Matagorda and Lower Lavaca Bay (65+000 - 85+00) and 1 PA stations. Sediment samples only were collected for chemistry, bioassays, and bioaccumulation studies and only for metals.

Table 3.9-5
Exceedances Of WQC and/or TWQS in Samples Collected by the USACE

Date	Parameter	Comment
1987	Copper	WQC, but not TWQS, exceeded in elutriate at 5 (30+00, 40+000, 70+000, 75+000, 105+000) of 21 channel stations (20+000 – 117+000)
		WQC, but not TWQS, exceeded in water but not elutriate at both Reference stations
	Nickel	WQC, but not TWQS, exceeded in elutriate at 2 (40+000, 90+00) of 21 channel stations (20+000 – 117+000)
	Zinc	WQC and TWQS exceeded in elutriate but not water at 1 (40+00) of 21 channel stations (20+000 – 117+000)
		WQC and TWQS exceeded in water but not elutriate at 1 (100+00) of 21 channel stations and both PA stations
1988		No Exceedances, 3 channel, 1 PA, and 1 Reference stations
1989		No Exceedances, 9 channel, 3 PA, and 3 Reference stations
1991		No Exceedances, 17 channel, 3 PA, and 4 Reference stations
1993		No Exceedances, 13 channel, 2 PA, and 2 Reference stations
1995		No Exceedances, 38 channel, 2 PA Stations, and 2 Reference stations
1997		No Exceedances, 11 channel and 2 Reference stations
1998		No Exceedances, 3 channel, 1 PA, and 1 Reference stations
May 00		No Exceedances, 23 stations
Aug 00	Copper	WQC, but not TWQS, exceeded in elutriate at 1 of 3 MSC stations and both exceeded at 1 of 3 stations
	Silver	WQC and TWQS exceeded in water and elutriate at 1 of 3 MSC stations
	Copper	WQC, but not TWQS, exceeded in elutriate at 1 of 3 PCTB stations
Oct 00		No Exceedances, 26 channel, 2 PA Stations, and 2 Reference stations
2001		No Exceedances, 3 channel, 1 PA, and 1 Reference stations
Jan 03		No Exceedances, 23 channel and 1 PA Stations
Apr 03		No Exceedances, 15 channel, 2 PA, and 2 Reference stations
2005	Mercury	WQC and TWQS exceeded in elutriate samples from all 3 Entrance Channel stations
2006		No Exceedances, 4 channel and 1 PA sediment-only stations
2007		No Exceedances, 7 channel and 3 Reference stations

There were very few trends when the elutriate data were compared to water data in the January 2003 chemistry results. These trends were: copper was only detected in 3 of 22 elutriate samples but was found in all water samples; zinc was consistently higher in the water samples although the differences were sometimes slight; when TPH was detected (4 of 22 samples), it was found only in the elutriate; and ammonia was only detected in elutriate samples. Mercury was not detected in any water or elutriate sample. The only organic compound detected (excluding TPH and total organic carbon [TOC]) was the plasticizer and common laboratory contaminant, bis(2-ethylhexyl) phthalate. No WQC or TWQS were exceeded.

Table 3.9-6
Number and Percentages of Surviving Organisms
in Suspended Particulate Phase Bioassays

Date	Species	Percent Survival							
August 2000		Reference		PCTB-1		PCTB-2		PCTB-3	
		Control	Test	Control	Test	Control	Test	Control	Test
	Americamysis bahia juveniles	98	98	98	100	100	100	98	100
	A. bahia adult	98	92	100	98	98	94	100	100
	Menidia beryllina	96	100	98	100	88	96	96	100
October 2000		Reference		MSC-1		MSC-2		MSC-3	
		Control	Test	Control	Test	Control	Test	Control	Test
	A. bahia juveniles	96	98	100	96	100	96	100	100
	A. bahia adult	100	98	98	94	100	100	98	94
	M. beryllina	98	98	100	98	100	100	98	100
May 2001		Reference		MEC-1		MEC-2		MEC-3	
		Control	Test	Control	Test	Control	Test	Control	Test
	A. bahia juveniles	100	100	98	96	100	88	98	94
	A. bahia adult	96	92	98	100	88	92	94	96
	M. beryllina	100	100	100	98	100	100	100	100
November 2005		Reference		MEC-1		MEC-2		MEC-3	
		Control	Test	Control	Test	Control	Test	Control	Test
	A. bahia juveniles	100	98	100	94	100	100	100	88
	A. bahia adult	100	100	100	100	100	100	100	100
	M. beryllina	96	90	96	90	100	82	96	84

For the April 2003 samples, chromium was only detected in elutriate samples; copper was only detected in a few water samples and was consistently higher in the elutriate samples, relative to the water concentrations; and mercury was found in all elutriate samples and exceeded the WQC and TWQS in all but one elutriate sample. These mercury results are inconsistent since mercury was not detected in any of the water or sediment samples from which the elutriates were prepared (see Appendix D-1). The mercury values in the elutriates ranged from 1.07 µg/L to 4.77 µg/L versus a TWQS of 2.1 µg/L. Nickel was detected in all water samples but no elutriate samples and zinc, TOC, and ammonia were consistently higher in the elutriate samples than in the water samples. Except for the mercury in the elutriates, no WQC or TWQS were exceeded.

The WQC and TWQS for mercury were exceeded in all three elutriate samples collected from the Entrance Channel in 2005 and, while mercury in the water samples was below the WQC and TWQS, it was high relative to concentrations generally found in nearshore Gulf water (USACE historic data base). Mercury was not detected in the sediment samples that were used in the elutriate preparation and between 1997 and 2005, these are the only times mercury has been detected in either a water or elutriate sample. Bioassays were conducted and survival in 3 of 9 SPP bioassays with these samples was significantly less than survival in the Dilution-Water Control (PBS&J, 2006a). However, survival in no test was less than 82% (see Table 3.9-6), and the LC_{50} could be calculated. Therefore, the LPC for water column toxicity/SPP was met. The only trend in these data, other than the mercury, was that ammonia was consistently higher in the elutriates.

There are no exceedances of any TWQS or WQC in the elutriates prepared from stations along the MSC where construction dredging would occur for the MSC CIP. At the request of the EPA, samples were collected to a depth of 5 ft below the bay bottom and composited for analysis. SPP bioassays were conducted on three channel stations and three reference stations (PBS&J, 2007). There were no tests in which the survival in the True Control was greater than survival in the channel treatments and the difference exceeded 10%, thus requiring statistical analysis. Therefore, these data yield no indication of expected toxicity to sensitive marine organisms during dredging or placement. The sediment from the stations subjected to bioassays is expected to be placed in offshore PAs, so the RIS was used as guidance for conducting the bioassays and interpreting the results. Since less than 50% mortality occurred in all of the construction material treatments, it is not possible to calculate an LC_{50}. In such cases, the, LC_{50} is assumed to be ≥100% (RIA Section 9.3.3) and the Limiting Permissible Concentration (LPC) for the SPP is met.

3.9.3.3 Alcoa Monitoring

Alcoa performed a study of mercury and methyl mercury concentrations in the Lavaca Bay water column (Alcoa, 1996), as part of the Superfund investigations. Five habitat types were identified for sampling: open water (>0.6 m water depth, naturally occurring bottom, little or no vegetation), mudflats (unvegetated, intertidal, nearshore areas that are typically submerged), grass flats (emergent *Spartina alterniflora*, 0.5–1.0 m water depth), oyster reefs (within 5 m of large oyster reefs), and the deep-draft

ship channel (samples collected in >10 m water depth). Three sample locations were identified for each habitat type. The primary constituents of interest were mercury and methyl mercury (both unfiltered and filtered). For total mercury in the water column, the range of values was as follows: open water, 0.004 to 0.101 µg/L; mudflats, 0.015 to 0.043 µg/L; grass flats, 0.008 to 0.051 µg/L; oyster reefs, 0.008 to 0.041 µg/L; and shop channel, 0.008 to 0.219 µg/L Alcoa (1996). Total methyl mercury ranged from 0.0001 to 0.0006 µg/L for all samples and dissolved methyl mercury ranged from <0.0001 to 0.0002 µg/L. Only the total mercury samples nearest the Chlor- Alkali Process Area would have been detectable under the USACE protocols and the highest value, 0.219 µg/L, is 12% of the WQC and 10% of the TWQS.

While the techniques used in the Superfund study allow detection limits in the nanogram/liter (ng/l) range (1 µg/L = 1,000 ng/L), the range of total mercury values agrees with the lack of detection of total mercury in the USACE studies with a detection limit of 0.2 µg/L.

From an ecological risk assessment conducted for the Superfund site (Alcoa, 2000), the constituents of potential concern (COPC) identified for Lavaca Bay included mercury (both inorganic mercury and methyl mercury) and PAHs. The surface water mercury results are discussed above and PAHs were not detected in the surface water samples.

In the May 2001 Final Feasibility Study report (Alcoa, 2001), Alcoa summarized the findings of sampling events for mercury in the water column offshore of the CAPA conducted in 1998 and 1999. The initial (January 1998) sampling results indicated the presence of unfiltered and filtered mercury ranging from 0.012 µg/L to 0.322 µg/L and 0.002 µg/L to 0.183 µg/L, respectively. Carbon tetrachloride ranged from 9.09 µg/L to 11.5 µg/L, with the highest concentrations being present at the bottom depths of the water column.

Alcoa also evaluated the concentrations of mercury and carbon tetrachloride following the initiation of the groundwater extraction and treatment system (June 1998). Alcoa reported (Alcoa, 2001) that there was a significant decrease offshore of the CAPA (located northwest of the channel to the PCTB) in both mercury and carbon tetrachloride levels after the groundwater treatment system operations began. The maximum concentrations of total and dissolved mercury were 0.053 µg/L and 0.003 µg/L, respectively. Most total mercury concentrations were below 0.030 µg/L. Carbon tetrachloride was not detected in any samples above the analytical detection limit.

A follow-up sample event was conducted in June 1999 (approximately 1 year after initiation of the groundwater treatment system). The data were consistent with the previous year's sample results. Only 2 of 21 samples collected offshore the CAPA contained unfiltered mercury concentrations greater than 0.030 µg/L (most concentrations were less than 0.010 µg/L). The maximum unfiltered was 0.081 µg/L. The maximum filtered concentration was 0.001 µg/L. Carbon tetrachloride concentrations were also low. Alcoa The low samples concentration indicate that the mercury and carbon tetrachloride dense nonaqueous phase liquids (DNAPLs) were contained and not migrating to Lavaca Bay (Alcoa, 2001).

3.9.3.4 Formosa Plastics Monitoring Program

Another long-term monitoring program in the area is that conducted in relation to the Formosa Plastics Company (FPC) discharge into Lavaca Bay. This quarterly monitoring effort was placed on the company as a permit condition in 1992 and continues to this day. The quarterly monitoring includes field physico-chemical parameters, conventional water and porewater chemistry parameters, conventional sediment chemistry parameters, total and dissolved trace metals, volatile organics, pesticides and polychlorinated biphenyls (deleted in 1996), and base neutral organics. In addition to chemical parameters, sampling is performed for nekton, ichthyoplankton, benthos, phytoplankton and zooplankton, bioassays for site water and sediment, and oyster tissue analysis.

Table 3.9-7 summarizes conventional parameter data from this monitoring program. It includes only minimum and maximum values, identifying when the maximum was detected. Figure 3.9-5 shows the samples station locations. Table 3.9-8 presents similar information for dissolved metals.

Table 3.9-7
Conventional Parameters in Lavaca Bay from FPC Monitoring, 1993–2005
(mg/L)

Parameter	Minimum Value	Maximum Value	Maximum Station	Maximum Date	Notes
BOD5	<1.00	35.6	A3	4/1999	Independent laboratory result. Next highest: 32.0 at C2, 1/2004
COD	<5.00	126	B4	4/1994	
Organic Nitrogen	<0.10	7.00	B3	4/1994	
Ammonia	<0.01	1.54	B3	10/1999	Next highest: 0.86 at A2, 1/2000
Nitrate	<0.01	10.70	A3	10/2000	Since the inception of the program, 62 detected values ranging from 0.11 to 10.7, 18 of the values were taken in 10/1998 and 38 between 10/2000 and 1/2001
Nitrite	<0.01	0.04	R4, R1	4/1995–10/1998	
Total Phosphorus	<0.01	2.49	A3	6/1994	Next highest: 1.01 at C3, 1/1997
Ortho Phosphate	<0.01	0.73	C1	7/2002	Next highest: 0.72 at C4, 7/2002
TOC	<1.00	84.8	C3	1/1997	Next highest: 42.0 at B3, 4/1997 and A1, 7/1996
TSS	<1.00	3,012	C1	4/1997	Values greater than 260 were reported during 10/1994, 1/1997, 4/1997, 7/2003, and 1/2004: flood events; and 4/2004.
Chlorides	<100	30,000	A3	9/1993	Next highest: 16,006 at B1, 4/1996
Turbidity (NTU)	1.40	657	B1	9/1993	Values greater than 200 were reported during 9/1993, 1/1997, and 4/1997: flood events
Oil and Grease	<0.20	14.7	C1	10/1998	
Sulfate	3.77	2,500	A1	10/2000	Next highest: 2,400 at B4, 10/2000
TDS	196.0	35,868	A1	10/2000	

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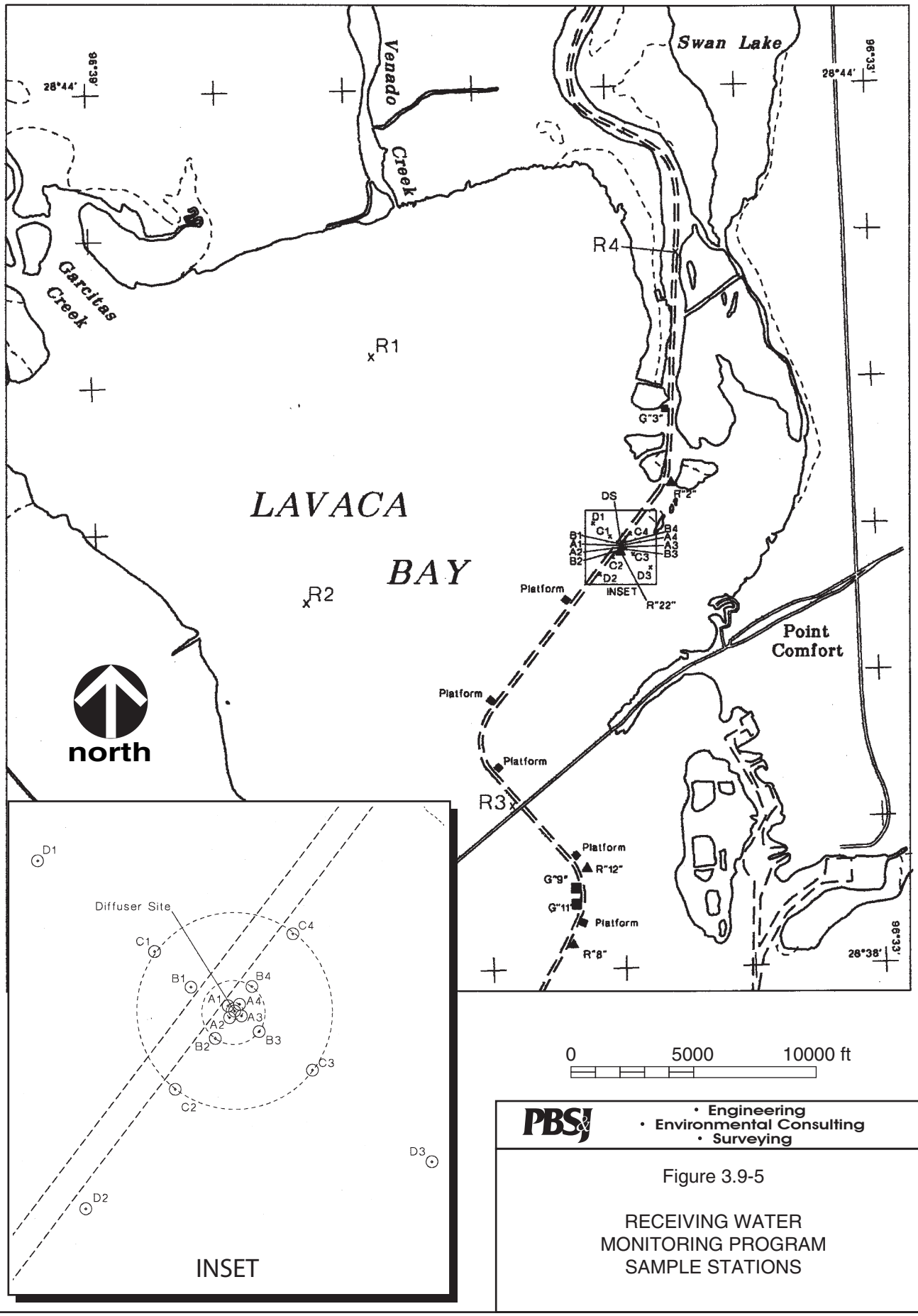

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Figure 3.9-5

RECEIVING WATER
MONITORING PROGRAM
SAMPLE STATIONS

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Table 3.9-8
Dissolved Metals Detected in Lavaca Bay from FPC Monitoring, 1993–2005 (µg/L)

Parameter	Minimum Value	Maximum Value	Maximum Station	Maximum Date	Notes
Aluminum	<20.0	80	C1	10/1997	
Cadmium	<1.0	2.4	B1	10/1997	Only 2 detected values: 2.2 at A1, 10/1997; and 2.4 at B1, 10/1997
Chromium	<10.0	17.5	C3	4/2001	Next highest: 17.0 at A4, 1/1998
Copper	<5.0	59.9	B4	7/1998	Only detected 6 times
Lead	<5.0	10.8	B2	4/1999	Maximum value was only time detected
Mercury	<0.20	2.30	B1	7/1996	Only 5 detected values: 0.3 at A1, 1/1996; 0.6 at R1, 4/1996; 2.3 at B1, 7/1996; aberrant 4.71 at B3, 11/1999, and 0.73 at A3, 7/2004
Nickel	<9.0	39.0	A1	1/1996	Only 2 detected values: 12.4 at A4, 1/1999; and 39.0 at A1, 10/1995
Silver	<2.0	2.5	A1	10/1997	Maximum value was only time detected
Zinc	<5.0	60.0	B1	12/1993	

To date the monitoring program and analysis has included both spatial and long-term trend analyses. No adverse impacts to water, sediment, or porewater have been detected in the vicinity of the outfall, except those related to natural events; i.e., floods. Biological data have also been subjected to trend analysis and no adverse effects to the quality, benthic structure, planktonic structure, or higher trophic levels in Lavaca Bay have been detected (PBS&J, 2005a).

3.9.4 Sediment Quality

As with the water quality data, a considerable amount of sediment quality information exists in the MSCIP project area (Figure 3.9-6). The data originate from the same three primary sources: the USACE's maintenance dredging program for the existing MSC, the Alcoa (Point Comfort)/Lavaca Bay Superfund investigation, and Formosa Plastic's Lavaca Bay Monitoring Program. Additionally, a sediment study was recently conducted by Alcoa in November 2005 to obtain more updated data in Lavaca Bay (Alcoa, 2006).

3.9.4.1 USACE Data

The data collected by the USACE (see Table 3.9-4) were analyzed to determine the sediment quality of the project area. As with the water and elutriate data, the sediment data in Appendix D-1 extend back to 1987. There are no sediment quality criteria comparable to the TWQS with which to compare concentrations in the sediment. However, there are several different guidelines that are used to look for a cause for concern in sediment samples, one of which is the Effects Range Low, or ERL. ERLs were developed by a technique that demonstrates no cause and effect from the chemicals in the data set and when ERLs derived from sets of data from different areas are compared, the results are inconsistent (WES, 1998). Since the ERLs are not based on cause and effect data, they are used only to determine a

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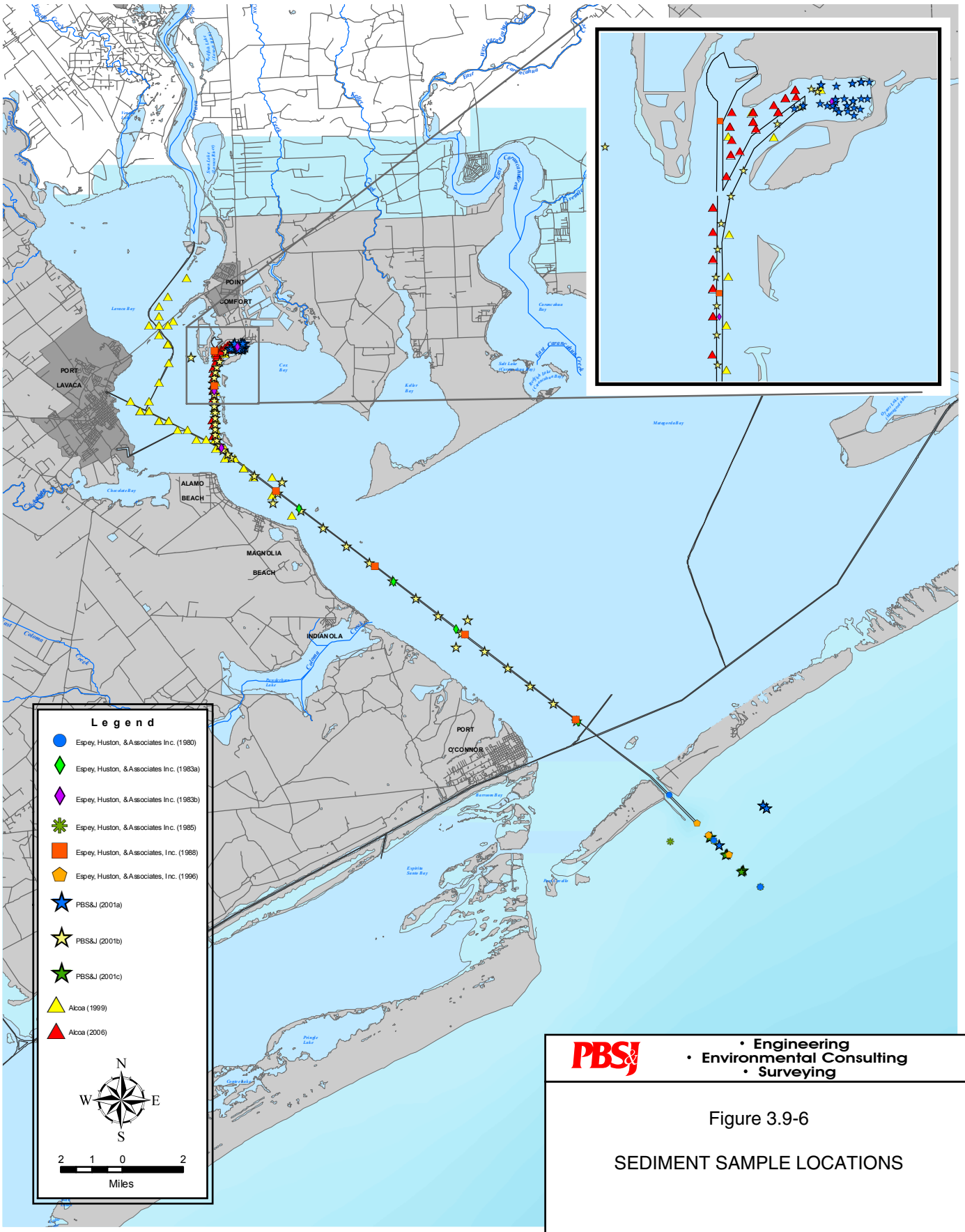

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Figure 3.9-6

SEDIMENT SAMPLE LOCATIONS

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possible "cause of concern." The ERLs presented in Appendix D-1 are those given in the National Oceanic and Atmospheric Administration (NOAA) 1999 Screening Quick Reference Tables (Buchman, 1999). Exceedances of ERLs in the USACE data are presented in Table 3.9-9. Sediment concentrations of detected compounds and grain size data are included in Appendix D-1.

Table 3.9-9
Exceedances of ERLs in Samples Collected by the USACE

Date	Parameter	Comment
1987	Nickel	ERL exceeded at 1 (85+000) of 21 Channel stations
1988		No Exceedances, 3 channel, 1 PA, and 1 Reference station
1989	Copper	ERL exceeded at 1 (85+000) of 9 channel stations (80+00 to 117+000) and 1 of 3 Reference stations
1991		No Exceedances, 17 channel, 3 PA, and 4 Reference stations
1993	Nickel	ERL exceeded at 1 (115+000) of 13 Channel stations (15+000 to 115+000)
1995	Nickel	ERL exceeded at 1 of 2 Reference stations
1997		No Exceedances, 11 channel and 2 Reference stations
1998		No Exceedances, 3 channel, 1 PA, and 1 Reference station
May 00	Mercury	ERL exceeded at 20 of 23 stations in the PCTB
Aug 00	Mercury	ERL exceeded at all 3 composite stations in the MSC between Gallinipper Point and the PCTB and in the Reference sample
	Mercury	ERL exceeded at all three composite stations in the PCTB and in the Reference sample
Oct 00	Silver	ERL exceeded at 1 (105+000) of 26 Channel stations (20+000 to 105+000)
2001	Arsenic	ERL exceeded at 1 (–15+000) of 3 Channel stations (–11+000 to –19+000)
Jan 03		No Exceedances, 23 channel and 1 PA Station
Apr 03		No exceedances, 14 stations
2005		No Exceedances, 3 channel, 1 PA, and 1 Reference station
2006		No Exceedances, 4 channel and 1 PA sediment-only station

As would be expected, the sediment concentrations of most metals and TOC in the 2001 samples are tied to the total solids and grain size data (PBS&J, 2001c). The ERL for arsenic was exceeded slightly (8.42 mg/kg versus 8.2 mg/kg) in MEC-01-02 sediments. The ammonia concentration was high at MEC-01-01, relative to the other sediments collected in 2001 but not high relative to sediments collected in other years (see Appendix D-1). The concentrations of all organics, except TOC, TPH, and four PAHs were below detection limits. Three of the four detected PAHs (benzo(ghi)perylene, fluoranthene, and pyrene) were found only in MEC-01-03 sediments, which curiously, had the highest percent sand and the lowest concentrations of all metals and most other parameters. The other detected PAH (phenanthrene) was found only in the reference sediments. However, all PAH concentrations were near the detection limit and were well below the ERLs for those PAHs for which ERLs have been determined. Solid Phase (SP or whole mud) bioassays were conducted on the sediments collected in May 2001 with the burrowing amphipod, *Ampelisca abdita*, and the epifaunal opossum shrimp, *Americamysis bahia*. There were no tests in which survival in the Reference Control was greater than survival in the treatments and the

difference exceeded 10% (20% for the amphipods), requiring statistical analysis (Table 3.9-10). Therefore, the survival data from the solid phase bioassay indicated no potential for environmentally unacceptable toxic impacts to benthic organisms from the placement of sediments from MSC Entrance Channel stations onto nearby bottom sediments. Bioaccumulation studies (PBS&J 2001c) were conducted on the sediments using the bentnose clam, *Macoma nasuta*, and the sand worm, *Nereis virens* (PBS&J, 2001). No organic chemicals were found above detection limits in test organism tissues. No metal concentrations in tissues of *N. virens* or *M. nasuta* exposed to test sediments were significantly higher than the respective concentrations in Reference Control organisms. Therefore, there is no indication of bioaccumulation from exposure to these sediments.

The concentrations of metals in PA 16 sediments were generally less that the concentrations of metals in the channel sediments collected in January, 2003. However, the highest sand concentration in the channel sediments was 6.1%, the remainder were below 5% sand and often below 1% sand. The sediment from the PA station was 23.3% sand and since there is normally a inverse relation between percent sand and trace metals concentrations, the slightly higher metals concentrations in the channel sediments is not surprising. No ERLs were exceeded and no organic compounds were detected except for TOC. Mercury was not detected in any sediment sample. Likewise, for the samples collected in April 2003, the percent sand in the PA and Reference sediments is higher than that of the channel sediments and the concentrations of metals and TOC tend to be slightly higher in the channel sediments. No ERLs were exceeded, no organics but TOC were detected, and mercury was not detected in any sediment sample.

The only trend evident in the sediment concentrations of detected compounds from samples collected in November 2005 (PBS&J, 2006a) is that concentrations in MEC-06-01 and the Reference tend to be generally highest, although the channel stations contain about the same concentrations as the reference sediments. This is probably because all of these sediments are dominated by silts and clays and MEC-06-01 and the Reference have the highest clay concentrations. The concentrations of all organics, except TOC were below detection limits and no ERLs were exceeded. There were no tests in which survival of the amphipod, *Leptocheirus plumulosus*, or *A. bahia* in the Reference Control was greater than survival in the treatments and the difference exceeded 10% (20% for the amphipods), requiring statistical analysis (see Table 3.9-10). Therefore, the survival data from the solid phase bioassay indicate no potential for environmentally unacceptable toxic impacts to benthic organisms from the placement of sediments from MSC Entrance Channel stations onto nearby bottom sediments. No organic chemicals were found above detection limits in test organism tissues, except for bis(2-ethylhexyl) phthalate and the reference control tissue concentrations of this compound were higher than the test tissue concentrations. The concentrations of none of the metals in tissues of *N. virens* or *M. mercenaria* exposed to test sediments were significantly higher than the respective concentrations in Reference Control organisms, except zinc in *N. virens* exposed to MEC-06-01 and MEC-06-02 sediments. Therefore, there is a potential indication of bioaccumulation from exposure to these sediments. However, when the concentrations of the polychaetes exposed to the channel sediments are compared to the Archive worms, which represent constituent concentrations at the beginning of the 28-day study, there is no significant difference in the

Table 3.9-10
Number and Percentage of Surviving Organisms
in Solid Phase Bioassays

Date	Species	Percent Survival				
August 2000		True Control	Reference Control	PCTB-1	PCTB-2	PCTB-3
	Ampelisca abdita	98	90	81	80	80
	Palaemonetes pugio	98	92	99	96	98
	Total organisms	98	91	90	88	89
October 2000		True Control	Reference Control	MSC-1	MSC-2	MSC-3
	A.abdita	98	87	90	90	91
	P. pugio	98	97	98	96	97
	Total organisms	98	92	94	93	94
May 2001		True Control	Reference Control	MEC-1	MEC-2	MEC-3
	A.abdita	92	73	81	68	62
	Americamysis bahia	98	96	100	94	96
	Total organisms	94	81	87	77	73
November 2005		True Control	Reference Control	MEC-1	MEC-2	MEC-3
	Leptocheirus plumulosus	93	73	92	92	97
	A. bahia	96	96	95	97	97
	Total organisms	94	85	94	94	97
November 2005		True Control	Reference Control	MPC-13	MPC-14	MPC-15
	L. plumulosus	99	96	100	98	97
	A. bahia	100	99	96	98	97
	Total organisms	100	98	98	98	97

concentrations. Therefore, these results indicate that the channel organisms did not depurate as efficiently as the Reference organisms but there is no indication of bioaccumulation.

As with the other bay station samples, the Reference Station sediments contained a higher sand percentage than the maintenance material and slightly but consistently lower metals concentrations in samples collected in 2006. No ERLS were exceeded. Solid phase bioassays were conducted with *L. plumulosus* and *A bahia* and indicated no potential for environmentally unacceptable toxic impacts to benthic organisms from the placement of sediments from MSC stations onto nearby bottom sediments (see Table 3.9-10). No organic chemicals were found above detection limits in test organism tissues. The concentrations of none of the metals in tissues of *N. virens* or *M. nasuta* exposed to test sediments were significantly higher than the respective concentrations in Reference Control organisms. Therefore, there is no indication of bioaccumulation from exposure to these sediments.

As noted in Section 3.9.3.2, samples of virgin sediment destined for offshore placement were collected along the channel in Matagorda Bay and offshore and subjected to chemical analysis and bioassays (PBS&J, 2007; Appendix D-2). There were no trends evident in the data except that Stations C-MC and BS4 consistently contained the lowest concentrations metals, as would be expected because they also contained the highest percent sand and percent solids. Therefore, they had less fines to bind with the metals and increase the metals concentration. The concentrations of all organics, except total organic carbon (TOC) were below detection limits. No ERLs were exceeded. Mercury was detected in only one sample, Reference A, at less than half the ERL. No dredging will occur at Reference A. The grain size distribution of the sediments varies widely from 12.4 to 67.2 percent fines. All samples contained some shell and sediment from Station BS2 was 20% shell.

As with the SPP data (Section 3.9.3.2), even though survival in the dredged material treatments was sometimes less than survival in the reference sediment treatments, the difference did not exceed 10% (20% for amphipods) and the data do not require statistical analysis. Therefore, the survival data from the solid phase bioassay indicate no potential for environmentally unacceptable toxic impacts to benthic organisms from the placement of sediments from the GC and the LPC for benthic toxicity is met (RIA Section 10.1.3).

3.9.4.2 Alcoa Investigations

Extensive sediment sampling was conducted as part of the RI to characterize and delineate the extent of contamination within the Alcoa/Lavaca Bay Superfund site area. The RI was conducted in several phases (Alcoa, 1999). Phase 2A of the RI consisted of collection of 111 sediment samples in the area nearest to the Alcoa facility and analysis of those samples for a range of constituents including metals/metalloids, volatile organic constituents, semivolatile organic constituents, PCBs, and PAHs to determine COPCs (Alcoa, 1999). As a follow-up to the Phase 2A investigation, the Phase 2B study was conducted to further delineate COPCs identified in the Phase 2A study areas and to characterize sediment quality in areas that had not been previously sampled (Alcoa, 1997b). Sediment from 367 stations was collected in Lavaca

Bay, Keller Bay, upper Matagorda Bay, Cox Marsh, and Cox Lake (Keller Bay, Cox Marsh and Cox Lake are not in an area subject to dredging). Both surficial sediments (0–5 centimeters [cm]) and sediments at depths of 5–30 cm, 30–50 cm, and 50–70 cm were collected.

An annual sediment program has been initiated at over 100 sampling stations and has, so far, been conducted in 2005 and 2006. In November 2005, the first of the annual studies was performed by Alcoa and focused on the proposed CCND turning basin area and also the area that would be dredged as part of the proposed MSCIP (Alcoa, 2006). As part of this study, 38 samples were collected from 23 sampling stations up to a depth of approximately 4.5 ft. Fourteen sampling stations were located in the proximity of the entrance to the Turning Basin, and 9 sampling stations were located south of the Turning Basin, immediately to the west of the MSC.

3.9.4.2.1 Mercury

The vertical profile of mercury in the sediments was reported in Alcoa (1996). This phase of the investigation focused on the basic fate and transport mechanisms related to methyl mercury. In this study, 15 sampling stations were selected in the vicinity of the Dredge Island on the side away from the footprint of the MSCIP, since mercury concentrations were shown to be highest in the area sampled.

A sediment quality triad investigation (determination of sediment chemistry and physical parameters, bioassays, and benthic community structure) was conducted in an area of Lavaca Bay known to have concentrations of mercury in sediment that ranged from 0.3 mg/kg to 4.6 mg/kg (Alcoa, 1997a). Ten sampling stations in a north-south trending transect in Lavaca Bay (southwest of Dredge Island) and three reference stations were selected.

These phases of the RI process and the more recent sediment study have created a considerable database of sediment quality data that can be used to characterize sediments subject to removal/placement for the MSC expansion project. The results of these investigations are discussed in the following sections.

Mean mercury concentrations in the MSC and adjacent to the Alcoa facility were 0.55 mg/kg at the 0–10 cm depth interval, 1.07 mg/kg at the 10–20 cm depth interval, 3.07 mg/kg at the 20–50 cm depth interval, and 0.78 mg/kg at the >50 cm depth interval (Alcoa, 1995).

Mercury was detected in all 367 surficial sediment samples and in nearly all samples collected at-depth. The concentrations in surficial sediments in Lavaca Bay, Keller Bay, and Upper Matagorda Bay ranged from 0.002 mg/kg to 1.38 mg/kg and from 0.008–1.09 mg/kg in the 5-to-30-cm layer, from 0.007 to 4.106 mg/kg in the 30-to-50-cm layer, and 0.008 to 7.70 mg/kg in the 50-to-70-cm layer (Alcoa, 1997b).

From data presented in Alcoa (1996) (Table 3.9-11), detected concentrations of mercury in sediment ranged from 0.004 mg/kg to 11.45 mg/kg in the 15 samples that were collected within Lavaca Bay, in the vicinity of Dredge Island on the side away from the MSC. It was determined that maximum total mercury concentrations typically occurred in the top 30 cm of sediment.

Table 3.9-11
Mercury Concentrations in Sediments Collected in the Vicinity of Dredge Island

Sampling Station ID	Total Depth Evaluated (cm)	Range of Detected Concentrations (mg/kg)	Depth Interval at which Maximum Concentration Occurred (cm)
CF-3	0–90	0.0041–0.0102	40–50
IM-3	0–100	0.0075–0.149	30–40
OW-3	0–80	0.0398–4.33	20–30
GF-2	0–80	0.24–1.57	30–40
OR-3	0–87	0.0114–1.44	3–5
GF-1	0–80	0.153–11.19	20–30
IM-2	0–80	0.0234–11.45	20–30
OW-2	0–89	0.0115–2.52	10–12
SC-3	0–93	0.227–1.05	0–1
IM-1	0–90	0.0292–1.12	10–20
OR-2	0–90	0.0047–0.349	20–30
SC-2	0–50	0.183–0.304	3–5
OW-1	0–80	0.0139–1.18	5–7
OR-1	0–67	0.0123–1.05	10–20
SC-1	0–100	0.166–0.510	0–10

As part of Sediment Quality Triad Investigation (Phase 3 of the RI), 10 sampling stations in a north-south trending transect in Lavaca Bay, southwest of Dredge Island, and three reference stations were sampled. The concentration of mercury in sediment in the reference area was less than 0.2 mg/kg. The sediment triad evaluation indicated that there was no apparent toxicity exhibited at any of the 10 stations, including the stations having the highest concentrations of mercury in sediment. There were no apparent differences in benthic community structure that could be attributed to the presence of mercury in sediment. The report concluded that concentrations of total mercury in sediment ranging up to 4.6 mg/kg in Lavaca Bay were not associated with any adverse effects (Alcoa, 1997b).

The concentrations of total mercury in sediment samples collected in November 2005 ranged from 0.0024 mg/kg to a maximum concentration of 0.543 mg/kg. A summary table of the range of detected mercury concentrations in the Bay System is shown in Table 3.9-12.

3.9.4.2.2 Organics

Volatile organic constituents, semivolatile organic constituents, PCBs, and PAHs were analyzed for in sediment samples collected as part of the Phase 2A investigation of the RI process (Alcoa, 1999). The results of these investigations are discussed below.

Watershed drainages discharging into Lavaca Bay traverse a considerable amount of agricultural land, and detected constituents in sediment in part reflect the quality of historical runoff of suspended soils from the watershed into the bay system. According to information presented in Table 5.3.2-1 of Alcoa

Table 3.9-12
Summary of Detected Mercury Concentrations in the Bay System

Location	Sample Depth (cm)	Range of Detected Concentrations (mg/kg)
Preliminary Site Characterization *		
Lavaca Bay and Upper Matagorda Bay	0–10	0.10–1.2
	10–20	0.12–1.65
	20–50	0.036–1.2
MSC, adjacent to Alcoa facility	0–10	0.55
	10–20	1.07
	20–50	3.07
	>50	0.78
Phase 2B Investigation		
Lavaca Bay, Keller Bay, and Upper Matagorda Bay	0–5	0.002–1.38
	5–30	0.008–1.09
	30–50	0.007–4.106
	50–70	0.008–7.70
Phase 2C Investigation		
Lavaca Bay	0–100	0.004–11.45
Alcoa November 2005 Sampling		
Lavaca Bay	0–1305	0.0024–0.543

Source: Alcoa, 1999; 2005.
*Mean Concentrations shown.

(1995), pesticides including chlordane, hexachlorobenzene, heptachlor epoxide, dichloro-diphenyl-trichloroethane (DDT), and lindane were detected at µg/kg concentrations in sediment collected from the watershed discharging to Cox Bay near the Alcoa facility. These pesticides were detected in Cox Bay sediment at mean concentrations ranging from 0.02 µg/kg to 0.62 µg/kg (Alcoa, 1995). Some of these pesticides have been detected in sediment collected from areas subject to dredging, although the detected concentrations have not been associated with any adverse human health or ecological effects.

Although PCBs and pesticides have been historically detected in Cox Bay sediments, these constituents were not detected during the Phase 2A investigation (Alcoa, 1999) and were eliminated as COPCs for the site.

PCBs have been detected in oyster tissue collected from both Lavaca Bay and Matagorda Bay (Alcoa, 1995). Concentrations of pesticides, PCBs, and other constituents detected in oyster tissue are presented in Table 3.9-13 (Alcoa, 1995).

Table 3.9-13
Constituent Concentrations in Oyster Tissue Collected
from Lavaca Bay and Matagorda Bay

Constituent	Lavaca Bay – Oyster Tissue Concentration (µg/kg for organic constituents; mg/kg for inorganic constituents)	Matagorda Bay[1] – Oyster Tissue Concentration (µg/kg for organic constituents; mg/kg for inorganic constituents)
Total PCBs	94	86
Total DDT	55	63
Total Chlordane	14	12
Dieldrin	4	6
Lindane	0.8	1.4
Hexachlorobenzene	0.1	0.1
Mirex	0.2	0.7
Low Molecular Weight PAHs	64	34
High Molecular Weight PAHs	54	58

[1]Two sample locations in Eastern Matagorda Bay, Tres Palacios Bay, and Carancahua Bay.

The results of the Phase 2A investigation indicated that volatile organic constituents including acetone and toluene, semivolatile organic constituents including 2,4-dimethylphenol and phenol, and PAHs including anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, naphthalene, phenanthrene, and pyrene were detected in sediment samples collected in the vicinity of the Alcoa facility (Alcoa, 1999) but not in the footprint of the proposed MSCIP.

Analysis of PAHs during the Phase 2B investigation of the RI in the area closed to fishing in Lavaca Bay showed many samples with total PAH concentrations exceeding 20 mg/kg but less than 44.8 mg/kg, which was established as a probable level of ecological concern (Alcoa, 1997b).

3.9.4.3 Formosa Plastics Monitoring Program

As noted in Section 3.9.3.4, sediment samples were also collected and analyzed as part of the Formosa Plastics' Lavaca Bay Monitoring Program. Sample locations were the same for sediment and water and are shown on Figure 3.9-5.

Percent sand for two reference stations is presented on Figures 3.9-7 and 3.9-8 since the beginning of the Monitoring Program in 1993. These stations are R-3, which is located at the Causeway and is thus closest to the project footprint, and R-4, which is located at the mouth of the Lavaca River as it enters into Lavaca Bay. As can be seen, the sediment in the river mouth is consistently coarser than at the causeway and not particularly correlated ($R^2 = 0.25$). A lower than average percent of sand can be noted following some flood events at Station R4 (October 1994, April 1995, October 1998, January 2003, and January 2004), although this trend was not always observed (July 2002 and April 2005).

Figure 3.9-7
Temporal Trends in % Sand - May 1993 - April 2005 - Station R3

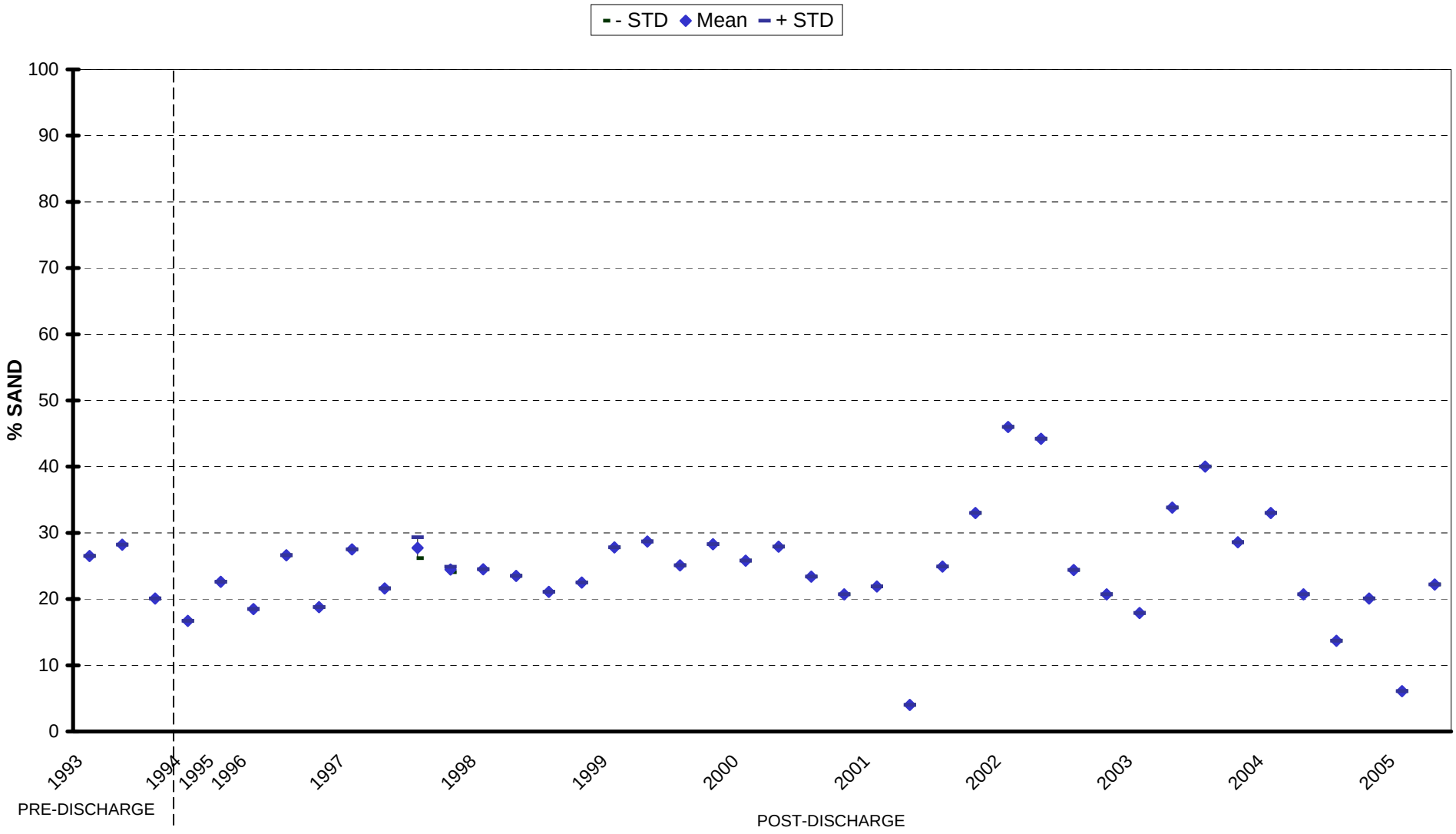

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Figure 3.9-8
Temporal Trends in % Sand - May 1993 - April 2005 - Station R4

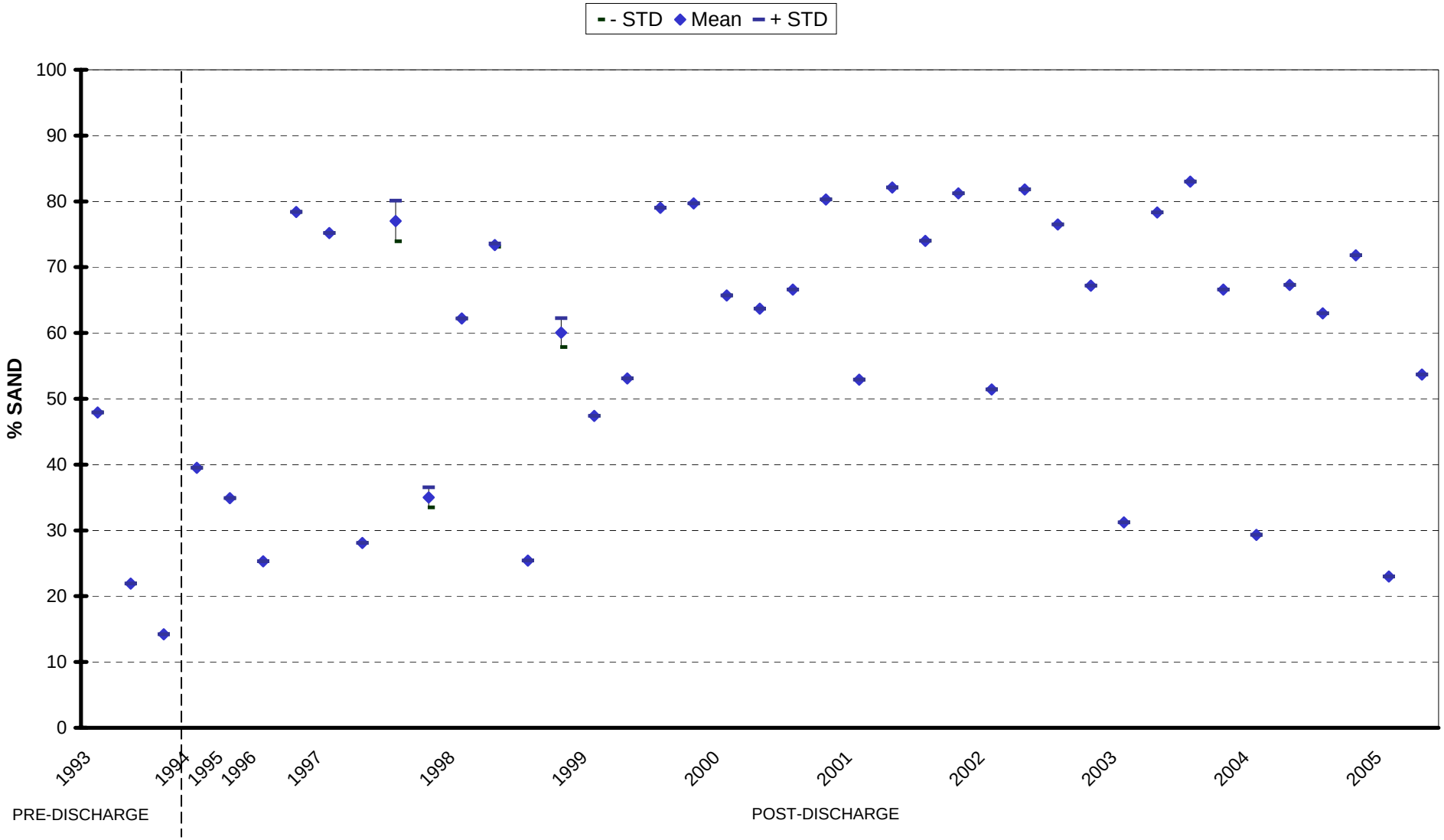

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Table 3.9-14 presents the standard parameters that have been detected above Scope-specified detection limits since the inception of the Monitoring Program. As with the water data in Section 3.9.3.4, only the range of values detected is presented in the table.

Table 3.9-14
Conventional Parameters in Lavaca Bay From FPC Monitoring, 1993–2005
(mg/kg)

Parameter	Minimum Value	Maximum Value	Station	Trip	Notes
Oil and Grease	<1.0	405.4	R1	19	Next highest: 402 at D2, 10/1995; 401 at A3, 7/1997; and 294 at R3, 7/1997
Ammonia	<0.05	648.0	B4	14	Next highest: 629.3 at B2, 10/2000, and 619.0 at A3, 10/2002
Organic Nitrogen	<10.0	25,133.1	A4	8	Next highest: 17,645.7 at A3, 8/1994
Nitrate	<10.0	896.0	C4	16	Next highest: 519.1 at R4, 7/1996
Nitrite	<0.05	35.8	B3	43	Next highest: 35.2 at B4 and R3, 10/2002
TOC	3.78	70,400.0	A2	6	

The Texas 85th Percentile Values for sediments in Texas bays (TNRCC, 2002) for the metals detected in Formosa Plastics Monitoring Program sediment samples, and the range of trace metals concentrations are listed in Table 3.9-15.

Table 3.9-15
Sediment Metals Concentrations Versus Texas 85th Percentile Values

Metal	Texas 85th Percentile (mg/kg)	Monitoring Program Range (mg/kg)	Notes
Arsenic	6.9	<0.02–44.82	Station C4, 10/1994; the next highest value was 10.9 mg/kg, Station A2, 6/1994
Cadmium	0.95	<0.05–0.75	
Chromium	31	<1.0–48.0	
Copper	19	<1.0–109.0	Station A2, 6/1994; the next highest values were 103.2 mg/kg, Station A2, 4/1994; 102.8 mg/kg, Station R3, 7/1993A; 93 mg/kg, Station A2, 4/1994
Lead	24.39	<0.50–58.0	
Mercury	0.304	<0.004–3.90	Station A4, 1/1999; the next highest values were 2.46 mg/kg, Station A3, 4/1995; 1.7 mg/kg, Station R1, 9/1993
Nickel	18.4	1.1–51.8	
Silver	0.92	<0.2–1.7	Only 3 detected values all from Station R1, 10/1997; 0.52, 0.65, and 1.7 mg/kg
Zinc	97	1.58–191.9	Station A2, 6/1994; the next highest value was 141 mg/kg, Station R3, 9/1993

Using all values from all trips, these sediment metals were compared to grain size composition, in particular percent fines, with the R^2 values for each parameter provided in Table 3.9-16.

Table 3.9-16
Correlation of Sediment Metals to
Percent Fines of the Sediment Samples

Parameter	R^2 value
Aluminum	0.4043
Iron	0.5890
Arsenic	0.5222[1]
Chromium	0.4706
Copper	0.2282
Lead	0.4030
Mercury	0.1611
Nickel	0.4153
Zinc	0.4395

[1] Excluding 44.82 mg/kg flood value.

As can be seen, there is generally a solid relationship between metals concentration and percent fines, except for mercury and copper. Greater than 40% of the variation in each metal concentration can be explained by the variation in percent fines, again, except for copper and mercury. For copper, if the extremely high values found at the A-series in trips 6 (93.0 and 103.2 mg/kg) and 7 (109.0 mg/kg) and at Station R3 in Trip 2A (102.8 mg/kg) are excluded, 34% of the variation in copper concentration can be explained by the variation in percent fines.

Except for di-N-butyl phthalate and bis(2-ethylhexyl)phthalate, no organic priority pollutants were found in the sediment samples above Scope-specified detection limits in the Monitoring Program. Di-N-butyl phthalate was detected 17 times ranging from 397 µg/kg at B2, Trip 7 to 19,500 µg/kg at B3, Trip 6. Bis(2-ethylhexyl)phthalate was detected 16 times and ranged from 153 µg/kg at B1, Trip 1 to 391 µg/kg at A4, Trip 5. Phthalate esters are common laboratory/sampling contaminants, and the presence of these compounds at some stations may be the result of sampling and analytical contamination (ENSR, 1995).

3.10 COMMERCIAL AND RECREATIONAL NAVIGATION

The Port, part of the CCND, is the major destination for commercial navigation on the MSC. This section reviews recent information on commodity tonnage and vessel movements through the port.

Table 3.10-1 is a summary of waterborne commerce data (USACE, 2006a) for 2003, 2001, and 1999. To simplify the presentation, commodities with very small tonnages were omitted and internal and coastwise shipments were combined into domestic commerce.

The largest tonnage commodity is the foreign import of aluminum ore (bauxite) that ranges from 3.5 to 5.0 million tons per year (tpy) and averages about 4.3 million tpy. It is interesting to note that domestic shipments of bauxite are also substantial, about a million tpy and domestic receipts are almost half that large. With these movements combined, bauxite accounts for over half of the port tonnage. These domestic movements of bauxite are from old stockpiles that are being emptied (Van Borssum, 2006).

Table 3.10-1
Cargo Movements in MSC
(thousands of short tons)

	2003				2001				1999			
	Foreign		Domestic		Foreign		Domestic		Foreign		Domestic	
Commodity	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
Crude oil			37	59			24	86			9	55
Gasoline	361			267				167			24	147
Distillate fuel oil								8			13	18
Residual fuel oil							1	24			2	8
Lube oil	40							3				
Naptha & solvents	951		106	19	691		98		498		170	3
Asphalt, tar, pitch		8									3	5
Liquid natural gas												3
Petroleum products											14	
Nitrogen fertilizer	124		149	40	27		149				147	
Phosphatic fertilizer			1	273			31				46	
Other fertilizer							13				16	
Benzene & toluene				51								
Acyclic hydrocarbons								103				90
Other hydrocarbons		420		98		532		35	11	103	4	82
Alcohols		61		17		31		65	4	7		22
Nitrogen compounds		384	6			435	10			31		
Organic compounds		13				3				2		
Sulphuric acid			119	2			111	1			8	35
Ammonia	435		15	257	419		5	124				
Sodium hydroxide		583		349		573		504				
Aluminum ore	4,459	17	547	1,027	3,558		273	663	5,003		415	1,120
Inorganic salts			1	80		9	2	58				
Non-metal mineral	81				72				71			
Wheat		22				38						
TOTALS	6,451	1,508	981	2,539	4,767	1,621	717	1,841	5,587	143	871	1,588
Foreign-Domestic	7,959		3,520		6,388		2,558		5,730		2,459	
Inbound		7,432				5,484				6,458		
Outbound		4,047				3,462				1,731		

Source: USACE, Waterborne Commerce Center.

The other major commodity trends in recent years are the increase in imports of naphtha, solvents and ammonia, and the increased exports of organic and nitrogen compounds, and sodium hydroxide. Both foreign and domestic commerce have been increasing since 1999.

The trips and draft distribution of the vessel traffic on the MSC in 2003 is shown in Table 3.10-2. The table is taken from Waterborne Commerce data (USACE, 2006a) and shows the major patterns. The dry cargo vessels in foreign commerce are principally bauxite carriers. Most of these enter the Port loaded to the maximum allowable draft and leave in ballast. The tankers in foreign commerce are largely smaller chemical and fuel carriers and do not show a dominant shift in draft between entering and departing. These different patterns are illustrated on Figure 3.10-1 for dry cargo and on Figure 3.10-2 for tankers.

The domestic vessel traffic is dominated by barge movements, typically on the GIWW with a draft of 12 ft or less. Exceptions included a small number of coastwise tankers and a moderate number of inbound dry cargo barges with a draft of 22 ft. These oceangoing barges are believed to be involved in the coastwise movement of bauxite from the old stockpile areas.

The last major portion of commercial navigation is fishing. This includes commercial shrimping, oyster harvesting and finfishing. Recreational fishing includes both trips on commercial vessels (headboats or boats that charge by the person for fishing trips) and privately owned recreational fishing boats. All of these are part of the commercial and recreational navigation baseline. The number of commercial fishing and recreational boats registered in Calhoun and Matagorda counties are shown in Table 3.10-3.

3.11 VEGETATION

The project area is located in the Gulf Prairies and Marshes Ecological Region as described by Gould et al. (1960). This ecoregion spans the Texas coastline, extending 30 to 80 miles inland. Elevations range from sea level to approximately 250 ft. The Gulf Marshes are low, wet areas with salinities ranging from fresh to saline. Submerged aquatic vegetation (SAV), including seagrasses, grow in open water areas and are also considered wetland. The Gulf Prairies are primarily uplands, dominated by tallgrass and post oak savannah. However, woody encroachment by trees and scrub species, including Chinese tallow (*Sapium sebiferum*), mesquite (*Prosopis glanduosa*), huisache (*Acacia farnesiana*), and oaks (*Quercus* sp.) (Hatch et al., 1990), plus agricultural and urban development have modified much of the coastline. Diamond and Smeins (1987) describe the forest and woodland communities that occur in the Upper Coastal Prairie, including coastal live oak (*Quercus agrifolia*)/post oak *(Quercus stellata)* forest, water oak (*Quercus nigra*)/coastal live oaks forest, and mesquite/huisache shrublands.

The upland grasslands within the Gulf Prairie include the following communities :

- **Pasture and range:** These uplands are dominated by introduced species such as bermudagrass (*Cynodon dactylon*) and bahiagrass (*Paspalum notatum*).

Table 3.10-2
Numbers and Drafts of Vessels in the MSC in 2003

	FOREIGN				DOMESTIC							
	Dry Cargo		Tanker		Dry Cargo		Tanker		Dry Barge		Tank Barge	
Draft	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
(ft)												
36	6	2	1									
35	73	3	10	9			1					
34	2		8	10								
33	1		11	11				2				
32	4		25	15								
31	1	1	10	6							1	1
30	1	3	9	15			1	1			2	4
29		1	11	12							1	
28	1	1	9	19								1
27	2		13	25					1			
26	1	4	13	15								
25	2	7	21	18			1	1				
24	2	16	9	17								
23		18	12	7								
22		42	6	7				1	29			
21	1		10	5				1				
20												2
19	1		5	6					1			
18			4	1			2	2				
17		1	6	2			1					
16			5	1								1
15		1	2									
14			2								3	1
13											1	
≤12	2	1			80	77	1		755	782	761	785
Totals	100	101	202	201	80	77	7	8	786	782	769	795

Source: USACE Waterborne Commerce Data Center

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Figure 3.10-1: Draft Distribution of 2003 Foreign Dry Cargo Vessel Traffic

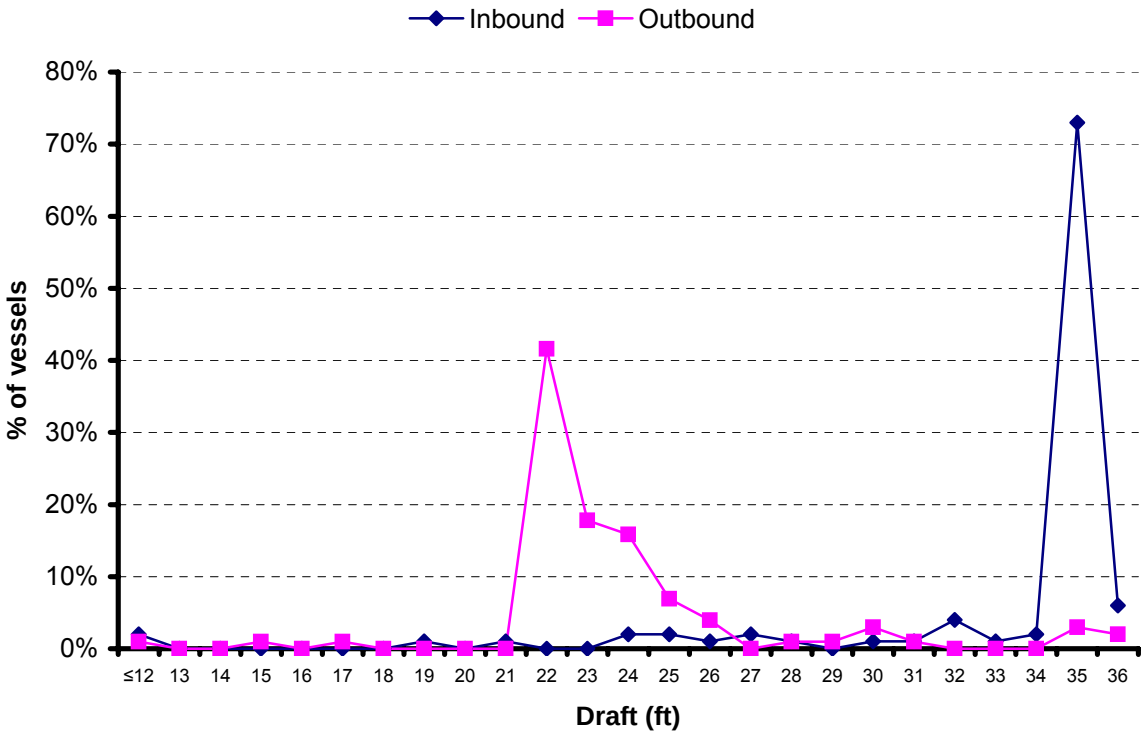

Figure 3.10-2: Draft Distribution of 2003 Foreign Tanker Traffic

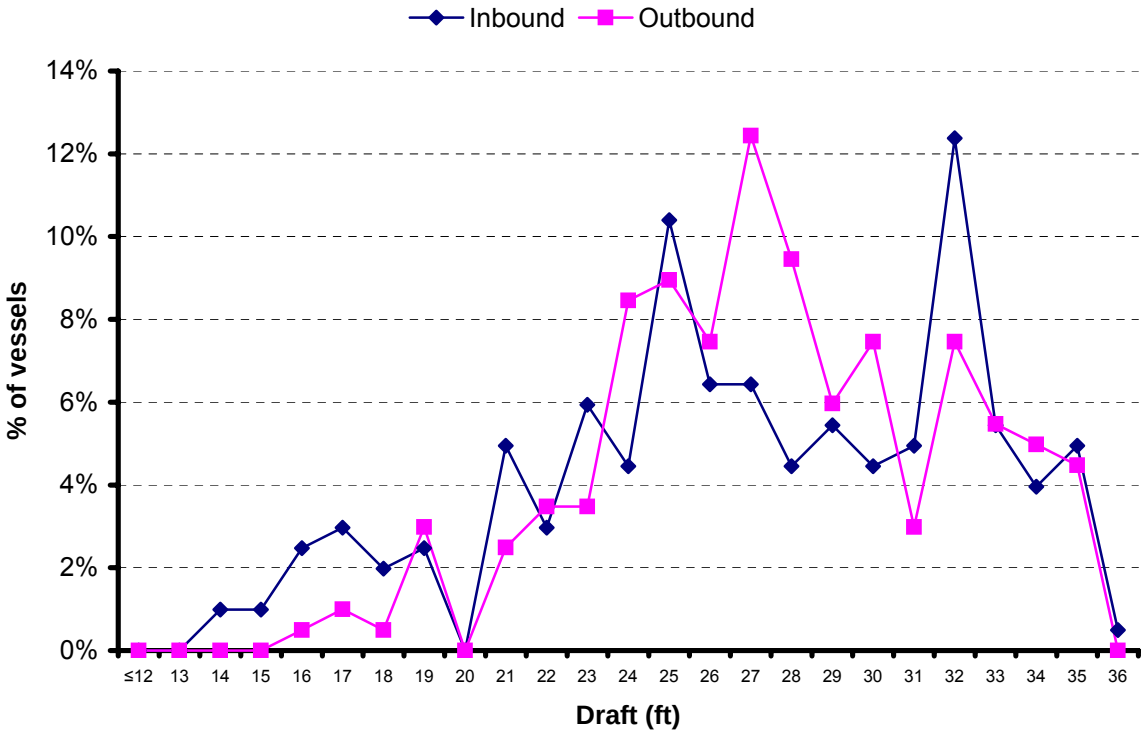

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Table 3.10-3
Number of Registered Commercial Fishing and Recreational Boats

	Calhoun County	Matagorda County
Commercial fishing	215	227
Recreational	1,813	2,540

Source: TPWD. Data as of December 27, 2005.

- **Coastal prairie:** Remnants of the original coastal prairie, with common species including little bluestem (*Schizachyrium scoparium),* brownseed paspalum *(Paspalum plicatulum),* indiangrass *(Sorghastrum nutans),* rosettegrass *(Panicum oligosanthes),* and thin paspalum *(Paspalum setaceum*) are scattered throughout the ecoregion. Less than 5% of the original area in this community still exists.
- **Beach and dune communities:** Typical plant species of the primary dunes fronting the Gulf include sea oats (*Uniola paniculata*), bitter panicum *(Panicum amarum),* Gulf croton *(Croton punctatus),* beach morning glory *(Ipomea pes-caprae)*, and fiddleleaf morning glory *(Ipomea stolonifera).* Secondary dune species include marshhay cordgrass *(Spartina patens),* seashore dropseed (*Sporobolus virginicus*), seacoast bluestem (*Schizachyrium littorale*), seashore saltgrass, pennywort *(Hydrocotyle bonariensis)*, and partridge pea *(Chamaecrista fasciculata).* The secondary dune community, which is located in the hummocky area leeward of the higher and drier primary dunes, is often a wetland community or considered a transitional community between upland and wetland (Britton and Morton, 1989).

Beaches along the south Texas coastline are dynamic habitats subject to a variety of environmental influences such as wind and wave action, salt spray, high temperature, and moisture stress (Britton and Morton, 1989). The harsh conditions associated with the beach/dune system support a relatively small number of adapted animals and plants. Sand dunes help absorb the impacts of storm surges and high waves and also serve to slow the intrusion of water inland. In addition, dunes store sand that helps deter shoreline erosion and replenish eroded beaches after storms. The dune complexes are of two types, primary and secondary, each of which supports a unique plant community. The coastal shore areas serve as buffers protecting upland habitats from erosion and storm damage, and adjacent marshes and waterways from water-quality problems. The primary dunes are taller and offer more protection from wind and hurricane storm surge.

3.12 WETLANDS AND SUBMERGED AQUATIC VEGETATION

Coastal wetlands (saline to freshwater) are distinct areas between terrestrial and aquatic systems where the water table is at or near the surface or the land is covered by shallow water with emergent or without vegetation. They are important natural resources that provide essential habitat for fish, shellfish, and other wildlife. Coastal wetlands also serve to filter and process agricultural and urban runoff and buffer coastal areas against storm and wave damage. The condition and distribution of wetland types are affected by water depth, frequency of inundation, salinity, and erosive/accretive forces.

The wetlands in the study area, as mapped by the FWS National Wetland Inventory (NWI) (1980–1995), appear on Figure 3.12-1. An additional area of seagrass was observed during a field visit in April 2006 and is included on Figure 3.12-1. Descriptions of the wetland plant communities (including aquatic vegetation) that occur in the study area appear in the following subsections.

3.12.1 Estuarine Wetlands and Submerged Aquatic Vegetation

The estuarine system extends from the open waters of the estuary, inland to freshwater areas (< 0.5 ppt during average annual low flow) (Cowardin et al., 1979). The estuarine wetlands include several distinct communities, described separately in Subsections 3.12.1.1–3.12.1.4.

3.12.1.1 Estuarine Submerged Aquatic Vegetation

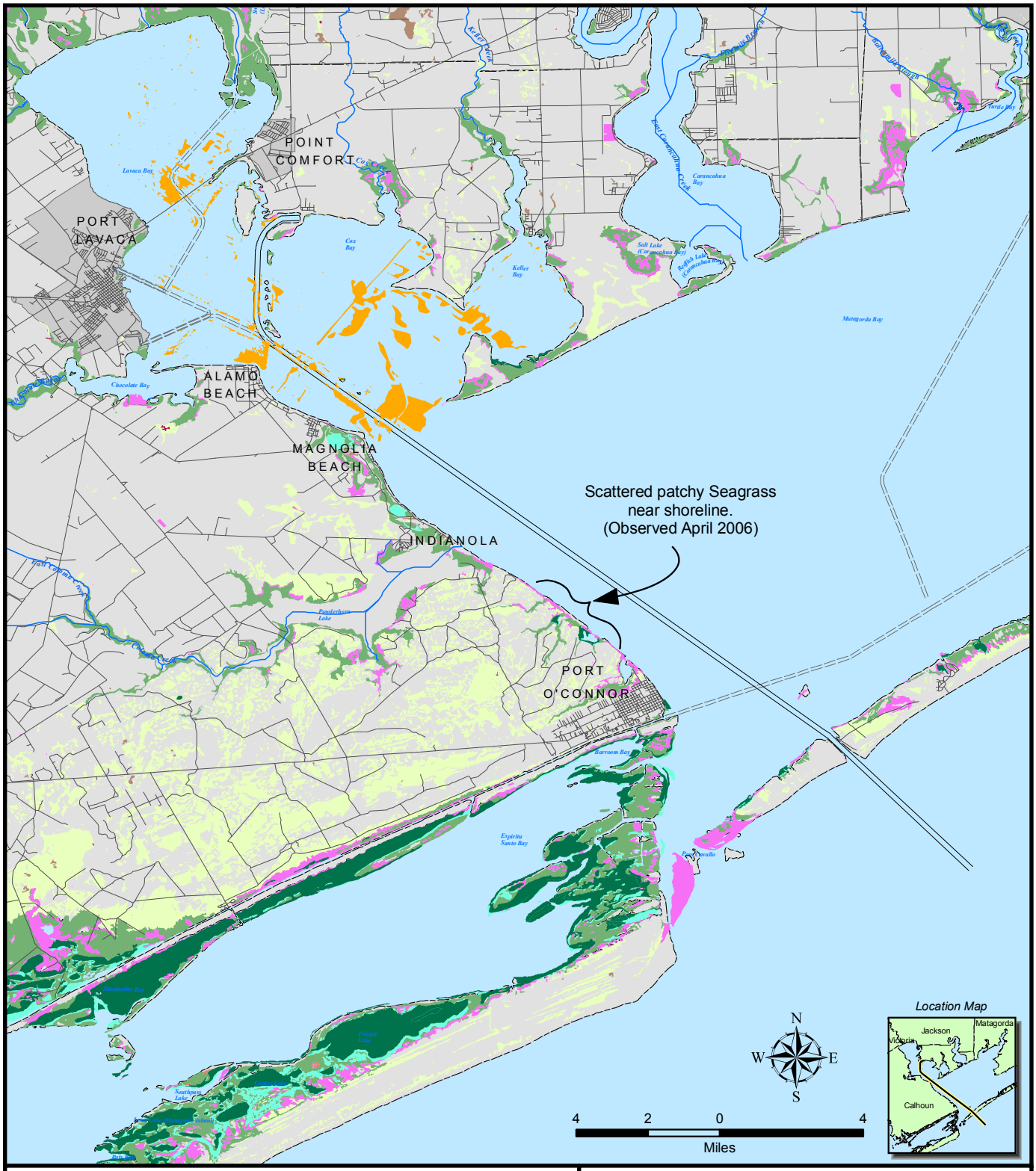
Estuarine SAV includes the true seagrasses such as shoalgrass (*Halodule wrightii),* turtlegrass *(Thalassia testudinum),* manateegrass (*Syringodium filiforme),* and clovergrass (*Halophila engelmannia*), but also includes widgeongrass (*Ruppia maritima*), not considered a true seagrass because it also grows in freshwater environments. Widgeongrass also differs from the other species in that is annual rather than perennial. Widgeongrass populations can be very transient, changing from year to year (i.e., a large distribution may disappear or appear from year to year).

Estuarine SAV beds occur in shallow areas (generally <6 ft water depth depending on water clarity) in open bay and inlet interior marsh environments. Seagrass communities generate high primary productivity and provide refuge for numerous species including shrimp, fish, crabs and their prey. Animal abundances in seagrass beds can be 2–25 times greater than in adjacent unvegetated areas (TPWD, 1999). Shoalgrass, widgeongrass, and turtlegrass have been documented in the Matagorda Bay estuary (Adair et al., 1994; TPWD, 1999; White et al., 2002; Lower Colorado River Authority and San Antonio Water System [LCRA/SAWS], 2006). Shoalgrass and widgeongrass have been mapped in Keller Bay and Carancahua Bay (Salt Lake and Redfish Lake) (Adair et al., 1994; GLO, 2003). Shoalgrass was mapped along the southern shoreline of Keller Bay, in Boggy Bayou (north of Port O'Connor, near the bayside marshes of the barrier island (Matagorda Peninsula) north of the MSC cut (GLO, 2003), and associated with the marshes west of Pass Cavallo where turtlegrass was also noted (White et al., 2002; GLO, 2003). The Seagrass Conservation Plan of Texas (TPWD, 1999) lists shoalgrass, widgeongrass and clovergrass in the Matagorda Bay system.

Nonvascular SAV, such as freshwater algae and marine seaweed (*Sargassum* spp.) can be found drifting into the study area. Sargassum is common near the openings to the Gulf.

3.12.1.2 Estuarine Tidal Flats

This community type includes coastal wetlands periodically flooded by tidal waters and with less than 30% areal coverage by vegetation. This category includes sandbars, mud flats, and other nonvegetated or sparsely vegetated habitats called salt flats. Sparse vegetation of salt flats may include glasswort, saltwort,



LEGEND

Wetlands

- Estuarine Marsh
- Estuarine Shrub Wetland
- Flats (Mud, Sand)
- Palustrine Forested Wetland
- Palustrine Shrub Wetland
- Palustrine Marsh
- Sea Grass
- Submerged Vegetation
- **Oyster Reef

Waterways

- Ship Channel
- Navigable Waterway

Source:
**Oyster Reef surveys were conducted by Simons Subsea et al. (2005), Benchmark (2006), & NCS (2006).
Base map provided by URS.
Reference Coordinates:
Texas State Plane South Central U.S. Survey Feet
Horizontal Datum: NAD 83.

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Figure 3.12-1
Wetlands and Aquatic Vegetation in the Matagorda Ship Channel Improvement Project Area

Prepared for: CCND-MSCIP	
Job No.: 441652.00	Scale: 1:253,440
Prepared by: EMonshaugen	Date: 20060530
File: N:/44165200/projects/Wetland/Fig3_12_1.mxd	

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and shoregrass (*Monanthochloe littoralis*). These tidal flats serve as valuable feeding grounds for coastal shorebirds, including the threatened piping plover; fish; and invertebrates.

White et al. (2002) found that the area of tidal flats in the barrier islands in this region have declined since the 1950s. They attribute some of this loss to "an accelerated rate of relative sea-level rise from the 1960s to through the late 1970s." These areas were subsequently colonized by estuarine marsh, seagrass or remained as open water.

3.12.1.3 Estuarine Marsh (Saline and Brackish)

These wetlands are closely associated with estuarine waters and account for the majority of the wetlands in the Matagorda Bay system. There are three basic geographic settings for the estuarine marshes in the study area.

- Interior marshes that occur in somewhat protected areas (lower energy environments) such as inlets and interior bays (e.g., Powderhorn Lake, Keller Bay). These marshes are commonly located within local drainage basins that drain the surrounding pasture, range, and croplands. Much of the cropland is in rice fields. The hydrology of the marshes within these watersheds is affected by the use of the surrounding lands. In the case of the rice fields, irrigation and rice growing practices such as the timing and frequency of inundation and draining of rice fields may impact the wetlands within their watersheds.

- Pass Cavallo/Port O'Connor area. White et al. (2002) describe this area as a flood-tidal-delta complex. The most extensive estuarine marsh and SAV in the immediate area (excluding southern Espiritu Santo Bay) are located here.

- Matagorda Peninsula (barrier island) bayside marshes. These are shoreline marshes on the leeward side of the barrier island.

The regularly flooded areas support low marshes and the less frequently flooded, at somewhat higher elevations, support high marshes. In the Matagorda Bay area, low salt marsh is typically dominated by smooth cordgrass (*Spartina alterniflora*) and common species such as saltgrass (*Distichlis spicata*), saltwort (*Batis maritima*), glasswort (*Salicornia* spp.) and saltmarsh aster (*Symphyotrichum tenuifolium*) (White et al., 2002; LCRA/SAWS, 2006). High salt marshes do not include smooth cordgrass, but may include the other species plus more halophytic species such as shoregrass, annual seepweed (*Sueda linearis*), sea ox-eye daisy (*Borrichia frutescens*), and sea-purslane (*Sesuvium portulacastrum*).

Low brackish marshes are located in less saline waters at similar elevations as the low salt marshes. These marshes are generally dominated by salt-marsh bulrush (*Bolboschoenus robustus*). Other species include marshhay cordgrass, black needlerush (*Juncus roemerianus*), and glasswort. As the low brackish marshes grade into high brackish marshes, salt-marsh bulrush and black needlerush drop out and marshhay cordgrass becomes dominant. High brackish marsh species also include saltgrass, marsh fimbry

(*Fimbrystylis castanea*), asters (*Symphyotrichum* spp.), Gulf cordgrass (*Spartina spartinae*), and Carolina wolfberry (*Lycium carolinianum*).

In the Matagorda Bay area, the saline and brackish marshes often form mosaics or mixtures of the two communities. In general, smooth cordgrass will fringe open water areas, sometimes only a few feet wide. There is often a rapid transition (only a few feet) from low saline to low brackish marsh (LCRA/SAWS, 2006).

White et al. (2002) report that the extent of estuarine marsh on and near the barrier islands have increased since the 1950s in West Matagorda Peninsula due to washover fans deposited by Hurricane Carla in 1961 and from accretion into Pass Cavallo due to longshore drift. That study also reported a minor net gain in marsh cover on Matagorda Island over the same time period (1950s to 2001); however, there were local losses of marshes due to subsidence in interior marshes and erosion along bay shorelines. White et al. (2002) point out the importance of relative sea level rise in the decline of these marshes and all estuarine habitats including tidal flats.

3.12.1.4 Estuarine Shrub-Scrub Wetland

There are low and high scrub/shrub estuarine wetlands in the Matagorda Bay area (White et al., 2002; LCRA/SAWS, 2006). The low wetland is dominated by black mangrove (*Avicennia germinans*) and is found on Matagorda Island. Scattered black mangroves also occur in the estuarine marshes, primarily in the Pass Cavallo-Port O'Connor areas. Common woody species in the high (irregularly flooded) scrub/shrub wetland include big-leaf sumpweed (*Iva frutescens*) and eastern false-willow (*Baccharis halimifolia*). Marshhay cordgrass, southern reed (*Phragmites australis*), and Gulf cordgrass are common herbaceous species in this community.

3.12.2 Fresh-Intermediate Plant Communities (Palustrine, Riverine, and Lacustrine Systems)

Figure 3.12-1 shows that the majority of the fresh to intermediate plant communities are not adjacent to the bay or directly connected to the bay waters. Most of the fresh-intermediate wetlands within the project study area occur outside of the area included in White et al. (2002). However, within the White et al. (2002) study area (East Matagorda Bay to San Antonio Bay), there was a net decrease in the fresh-intermediate marshes from the 1950s to 2001.

3.12.2.1 Fresh-Intermediate Submerged Aquatic Vegetation

Fresh-Intermediate SAV may occur in the upstream parts of drainages, in ditches and abandoned channels or in depressional areas or swales within uplands on the mainland and on the barrier islands. Figure 3.12-1 shows very limited areal coverage for this community; however, small patches may also occur within the areas mapped as palustrine marsh. Species may include widgeongrass, Sago pondweed (*Potamogeton pectinatus*), cabomba (*Cabomba caroliniana*), mermaid weed (*Proserpinica palustris*), water hyacinth

(*Eichornia crassipes*), water lettuce (*Pistia stratiotes*), frogbit (*Linobium spongia*), or alligator-weed (*Alternanthera philoxeroides*) (White et al., 2002; LCRA/SAWS, 2006; NWI, 1980–1995).

3.12.2.2 Fresh-Intermediate Marsh

This community can be found along shorelines in the fresher, upstream parts of drainages and in depressional areas or swales on the mainland and on the barrier islands (White et al., 2002; LCRA/SAWS, 2006; NWI, 1980–1995). Figure 3.12-1 shows that this is the most common fresh-intermediate type of wetland in the study area. Common species in low fresh-intermediate marshes include coastal cattail (*Typha domingensis*), California bulrush (*Schoenoplectus californicus*), southern reed, swamp smartweed (*Polygonum hydropiperoides*), Gulfcoast spikesedge (*Eleocharis cellulosa*), large spike spikerush (*Eleocharis palustris*), green flat-sedge (*Cyperus virens*), sand spikerush (*Eleocharis montevidensis*), longlobe arrowhead (*Sagittaria longiloba*), giant cut-grass (*Zizaniopsis milacea*), seashore paspalum (*Paspalum vaginatum*), three-square bulrush (*Schoenoplectus pungens*), and coastal water-hyssop (*Bacopa monnieri*). High marsh, also known as 'wet meadow', supports many of the same species, but will not include species such as cattails, California bulrush or southern reed. Awl-leaf aster (*Symphyotrichum subulatum*), deep-rooted sedge (*Cyperus entrerianus*), green flat-sedge (*Cyperus virens*), and caric-sedge (*Carex* sp.) are also common in the wet meadows.

3.12.2.3 Fresh-Intermediate Scrub/Shrub Wetland

These wetlands are found in the same general areas as the fresh-intermediate marshes. Figure 3.12-1 shows limited areal coverage for this community. Common species include buttonbush (*Cephalanthus occidentalis*), Chinese tallow tree, and coastal cattail (White et al., 2002; LCRA/SAWS, 2006; NWI, 1980–1995).

3.13 TERRESTRIAL WILDLIFE

The project area is located within the Texan Biotic Province, as described by Blair (1950). This province represents a transitional area between the forested Austroriparian Biotic Province to the east and grassland provinces to the west. Such integration of forests and grasslands results in a mixture of vertebrate species typical of the two general habitats. At least 49 species of mammals are known to have occurred in the Texan province in recent times, in addition to 39 snake species, 16 lizards, 2 land turtles, 18 anurans (frogs and toads), and 5 urodeles (salamanders and newts) (Blair, 1950). There are no endemic vertebrate species in this region.

According to Blair (1950), only five urodele species (salamanders and newts) occur in the Texan Biotic Province, which is a barrier to the distribution of the endemic urodele fauna that occurs in the Balconian Biotic Province to the west and the fauna of the Austroriparian Biotic Province to the east. The five urodele species found in the Texan Biotic Province also occur in the Austroriparian Biotic Province. Urodele fauna that could occur in the project area include the small-mouthed salamander (*Ambystoma texanum*), eastern tiger salamander (*Ambystoma tigrinum tigrinum*), central newt (*Notophthalmus*

viridescens louisianensis), and western lesser siren (*Siren intermedia nettingi*), all of which are restricted to moist bottomland or hydric habitats (Bartlett and Bartlett, 1999; Dixon, 2000).

Anuran species expected to occur in the project area include Blanchard's cricket frog (*Acris crepitans blanchardii*), Gulf Coast toad (*Bufo nebulifer*), eastern narrow-mouthed toad (*Gastrophryne carolinensis*), Great Plains narrow-mouthed toad (*Gastrophryne olivacea*), Strecker's chorus frog (*Pseudacris streckeri*), upland chorus frog (*Pseudacris feriarum feriarum*), American bullfrog (*Rana catesbeiana*), southern leopard frog (*Rana sphenocephala*), Hurter's spadefoot (*Scaphiopus hurterii*), and several treefrogs, including the green treefrog (*Hyla cinerea*), Cope's gray treefrog (*Hyla chrysoscelis*), and gray treefrog (*Hyla versicolor*) (Bartlett and Bartlett, 1999; Dixon, 2000).

Common reptiles expected to occur in the project area include turtles such as the red-eared slider (*Trachemys scripta elegans*) and three-toed box turtle (*Terrapene carolina triunguis*); and lizards such as the green anole (*Anolis carolinensis*), six-lined racerunner (*Aspidoscelis sexlineatus*), common five-lined skink (*Eumeces fasciatus*), broadhead skink (*Eumeces laticeps*), southern prairie skink (*Eumeces septentrionalis obtusirostris*), little brown skink (*Scincella lateralis*), prairie lizard (*Sceloporus consobrinus*), and western slender glass lizard (*Ophisaurus attenuatus attenuatus*) (Bartlett and Bartlett, 1999; Dixon, 2000).

Snakes of the project area include the eastern yellow-bellied racer (*Coluber constrictor flaviventris*), Texas ratsnake (*Elaphe obseleta*), eastern hog-nosed snake (*Heterodon platirhinos*), prairie kingsnake (*Lampropeltis calligaster calligaster*), western coachwhip (*Masticophis flagellum testaceus*), diamond-backed watersnake (*Nerodia rhombifer*), rough greensnake (*Opheodrys aestivus*), and several venomous species such as the southern copperhead (*Agkistridon contortrix contortrix*), western cottonmouth (*Agkistridon piscivorous leucostoma*), Texas coral snake (*Micrurus tener*), and western diamond-backed rattlesnake (*Crotalus atrox*) (Dixon, 2000; Werler and Dixon, 2000).

Numerous avian species are found within the project area. Common year-round residents include the great blue heron (*Ardea herodias*), turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), killdeer (*Charadrius vociferus*), mourning dove (*Zenaida macroura*), belted kingfisher (*Ceryle alcyon*), blue jay (*Cyanocitta cristata*), American crow (*Corvus brachyrhynchos*), tufted titmouse (*Baeolophus bicolor*), Carolina wren (*Thryothorus ludovicianus*), northern mockingbird (*Mimus polyglottos*), northern cardinal (*Cardinalis cardinalis*), lark sparrow (*Chondestes grammacus*), red-winged blackbird (*Agelaius phoeniceus*), eastern meadowlark (*Sturnella magna*), great-tailed grackle (*Quiscalus mexicanus*), brown-headed cowbird (*Molothrus ater*), northern bobwhite (*Colinus virginianus*), and house sparrow (*Passer domesticus*) (Texas Ornithological Society [TOS], 1995; Sibley, 2000; Lockwood and Freeman, 2004).

Texas is one of the most significant waterbird wintering regions in North America and the project area is located within the Central Flyway for waterfowl. An extensive list of birds recorded in the nearby Matagorda Island National Wildlife Refuge and State Natural Area, compiled by the FWS, is included in Appendix E. Some common species that occur within the project area include little blue heron (*Egretta*

caerulea), sanderlings (*Calidris alba*), least sandpiper (*Calidris minutilla*), great blue heron (*Ardea herodias*), white ibis (*Eudocimus albus*), roseate spoonbill (*Platalea ajaja*), royal tern (*Sterna maxima*), sandwich tern (*Sterna sandvicensis*), laughing gull (*Larus atricilla*), and ring-billed gull (*Larus delawarensis*). Other bird species that are associated with the prairies and marshes region include a variety of raptors, songbirds, and migratory waterfowl.

The project area also provides nesting habitat for several species of colonial waterbirds, according to the Texas Colonial Waterbird Census (TCWC) database (FWS, 2006). This database provides the location of colonies recorded along the Texas coast and the estimated number of breeding pairs at each colony. The census, which began in 1973, is conducted annually in late May to early June. These data are collected by a variety of volunteers from State, Federal, and nonprofit organizations and compiled into a database by the FWS, Clear Lake Ecological Services Field Office. Table 3.13-1 provides a list of colonies identified during the TCWC in Matagorda Bay and the estimated number of breeding pairs of each species observed at these colony sites censused during the last 10 years. Preliminary census data for 2004 and 2005 are currently being verified by the FWS.

The project area is within the TPWD's Coastal Survey Zone, which includes the Gulf Prairies and Marshes region. The TPWD Midwinter Waterfowl Survey (January 2004) documents a total of 5,331,301 birds, representing at least 24 species. The Coastal Zone accounted for 44% (2,363,028 birds, 21 species) of this total (Morrison, 2004). Waterfowl species expected to migrate through the project area include the blue-winged teal (*Anas discors*), mallard (*Anas platyrhynchos*), gadwall (*Anas strepera*), green-winged teal (*Anas crecca*), Canada goose (*Branta canadensis*), and wood duck (*Aix sponsa*).

Many other species of birds migrate through the project area in the spring and fall or use the area for overwintering. Migrant or winter residents expected to occur in the project area include the double-crested cormorant (*Phalacrocorax auritus*), cackling goose (*Branta hutchinsii*), snow goose (*Chen caerulescens*), northern pintail (*Anas acuta*), gadwall (*Anas strepera*), ring-necked duck (*Aythya collaris*), lesser scaup (*Aythya affinus*), common merganser (*Mergus merganser*), northern flicker (*Colaptes auratus*), ruby-crowned kinglet (*Regulus calendula*), cedar waxwing (*Bombycilla cedrorum*), yellow-rumped warbler (*Dendroica coronata*), chipping sparrow (*Spizella passerina*), field sparrow (*Spizella pusilla*), vesper sparrow (*Pooecetes gramineus*), savannah sparrow (*Passerculus sandwichensis*), white-throated sparrow (*Zonotrichia albicollis*), dark-eyed junco (*Junco hyemalis*), and American goldfinch (*Carduelis tristis*) (TOS, 1995; Sibley, 2000; Lockwood and Freeman, 2004). Numerous other migrating species, such as arctic shorebirds wintering on the Gulf coast, northern passerines wintering in Central America, and raptors and waterfowl pass through or over the project area during spring and fall migrations (TOS, 1995; Sibley, 2000; Lockwood and Freeman, 2004).

Summer residents expected to occur in the project area include the yellow-billed cuckoo (*Coccyzus americanus*), chuck-will's widow (*Caprimulgus carolinensis*), common nighthawk (*Chordeiles minor*), chimney swift (*Chaetura pelagica*), eastern kingbird (*Tyrannus tyrannus*), scissor-tailed flycatcher (*Tyrannus forficatus*), purple martin (*Progne subis*), barn swallow (*Hirundo rustica*), summer tanager

Table 3.13-1
Annual Texas Waterbird Census for Lavaca and Matagorda Bay, Texas, 1996–2005

Colony Name (Code)/Species	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996
Lavaca Bay dredged material 63-77 (609-121)										
American oystercatcher					5					
Black skimmer	375	20			18	15	40			60
Black-crowned night-heron		6	10	8	1	5			1	30
Brown pelican		1			5	1				3
Caspian tern	21		11	22	25	1			253	20
Cattle egret	630	1,565	2,157	674	1,470	5,000	1,597		920	1,400
Forster's tern										30
Glossy ibis			11	17						
Great blue heron	32	44	62	83	38	17	52		46	20
Great egret	17	61	49	46	21	5	47		44	
Gull-billed tern	45									85
Laughing gull	5,625	9,179	3,928	5,603	1,700	3,560	1,350		1,570	2,000
Least tern										20
Little blue heron	11	110	35	90	29	30	43		88	40
Reddish egret		5	6	2	3	3	4		1	
Roseate spoonbill	75	34	48	56	14	10	11		38	65
Royal tern	450	147	235	53	53	5			95	
Sandwich tern	188	54	235	93					110	
Snowy egret	105	115	265	227			357		120	350
Tricolored heron	172	310	253	277	97	300	854		323	500
White ibis	900	3,323	2,070	908	320	450	1,292		1,800	400
White-faced ibis	1,012	1,550	207	206	80	780	544		547	750
Yellow crowned night heron		2								
Mouth of Lavaca River (609-122)										
American oystercatcher					2					
Black skimmer		30		12	30					
Caspian tern										
Forster's tern		60		151	50					
Great blue heron										1
Gull-billed tern		27		3	40					
Least tern										
Royal tern				10						
Sandwich tern				3						
Lavaca Bay Dredged Material 51-63 (609-220)										
American oystercatcher					2					
Black skimmer			37		60	30	85		79	210
Black-crowned night-heron										
Caspian tern						3				
Cattle egret									2	20
Forster's tern							4		30	
Great blue heron									4	3
Great egret										8
Gull-billed tern							10		25	30

Table 3.13-1 (Cont'd)

Colony Name (Code)/Species	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996
Laughing gull			5	24	95	60	21		100	215
Least tern										160
Little blue heron										
Reddish egret						1			4	6
Roseate spoonbill										
Royal tern				2	85	12				15
Sandwich tern					115	5				
Snowy egret					1		2		35	25
Tricolored heron					1	1	1		20	20
White ibis										
White-faced ibis									3	
Mouth of Choc. Bayou (609-221)										
American oystercatcher					3					
Black skimmer	79	157	115	173	77	130	130		210	150
Black-crowned night-heron										
Caspian tern		2								
Forster's tern	16	70	23	85	74	180	45		30	50
Great blue heron			1		1					
Gull-billed tern	23	40	35	48	8	75	2		90	30
Least tern				6			8			
Royal tern						4				
Tricolored heron		1								
Sundown Island (609-300)										
American oystercatcher			2		1					
Black skimmer	200	380	185	350	573	400	325	200	200	125
Black-crowned night-heron	57	27	169	114	51	147	195	165	70	208
Brown pelican	1,714	987	820	1,300	1,900	698	1,200	1,000	1,250	1,132
Caspian tern	33	17	14	2						
Cattle egret	8	21	135	200	80	15	61	287	150	300
Forster's tern		1,054								
Great blue heron	69	41	50	48	18	27	36	44	50	38
Great egret	149	91	90	120	32	27	52	69	90	50
Gull-billed tern	18	12	12			15	8	5	3	
Laughing gull	3,000	6,000	6,500			6,000	5,500	5,000	10,000	10,000
Least tern										
Little blue heron		18	45	6		8	32	85	40	10
Neotropic cormorant					1					
Reddish egret	18	9	146	34	17	8	65	44	40	40
Roseate spoonbill	27	35	146	35	58	48	153	60	70	60
Royal tern	2,115		3,855	4,030	7,855	3,650	5,316	3,535	4,150	7,000
Sandwich tern	105	1,257	1,450	1,180	2,660	1,300	1,868	1,400	1,250	930
Snowy egret	23	72	126	104	39	22	130	164	75	80
Tricolored heron	112	570	365	710	199	665	400	310	450	300
White ibis	114	98	358	416	40	287	86	50	200	200
White-faced ibis			18				3	64	90	

Source: FWS (2006).

(*Piranga rubra*), indigo bunting (*Passerina cyanea*), painted bunting (*Passerina ciris*), and dickcissel (*Spiza americana*).

Mammals using the coastal fields and forests of the project area include the Virginia opossum (*Didelphis virginiana*), least shrew (*Cryptotis parva*), eastern mole (*Scalopus aquaticus*), eastern red bat (*Lasiurus borealis*), evening bat (*Nycticeius humeralis*), nine-banded armadillo (*Dasypus novemcinctus*), eastern cottontail (*Sylvilagus floridanus*), eastern gray squirrel (*Sciurus carolinensis*), eastern fox squirrel (*Sciurus niger*), Attwater's pocket gopher (*Geomys attwateri*), hispid pocket mouse (*Chaetodipus hispidus*), American beaver (*Castor canadensis*), fulvous harvest mouse (*Reithrodontomys fulvescens*), white-footed mouse (*Peromyscus leucopus*), hispid cotton rat (*Sigmodon hispidus*), marsh rice rat (*Oryzomys palustris*), eastern woodrat (*Neotoma floridana*), nutria (*Myocastor coypus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), common gray fox (*Urocyon cinereoargenteus*), ringtail (*Bassariscus astutus*), northern raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), bobcat (*Lynx rufus*), and white-tailed deer (*Odocoileus virginianus*) (Davis and Schmidly, 1994; Schmidly, 2004).

3.13.1 Commercially and Recreationally Important Terrestrial Species

Many species of wildlife that occur within the project area provide human benefits through both consumptive and nonconsumptive uses. Nonconsumptive uses are those activities that do not require the physical taking of a species, such as photography, birding, and study of the natural environment. These uses, although difficult to quantify, deserve consideration in the evaluation of wildlife resources. Consumptive uses of wildlife, such as hunting and trapping, are more easily quantified. Nonconsumptive issues are discussed in Section 3.17.3. Consumptive and nonconsumptive uses of wildlife are often enjoyed contemporaneously, and are generally compatible. Many species occurring in the project area provide consumptive benefits. The following provides a discussion of these species and their occurrence in the project area.

Several wildlife species occurring in the project area are considered game animals or game birds that are important both recreationally and economically. Game species occurring in the project area include the white-tailed deer (*Odocoileus virginianus*), squirrels (*Sciurus* spp.), rabbits (*Sylvilagus* spp.), northern bobwhites (*Colinus virginianus*), mourning doves, and various species of waterfowl.

The white-tailed deer is the most important big game mammal in the State (Davis and Schmidly, 1994). It requires forested or wooded stands containing good shrub layers that provide food and cover. Edge situations are often favored for browsing. Although food habits vary regionally and seasonally, leaves of shrubs and trees, mast, and various forbs make up most of the species' diet.

The TPWD includes Matagorda and Calhoun counties within the Gulf Prairies and Marshes Ecological Area, for purposes of data reporting. The TPWD 2003 spotlight surveys of the region indicate that the Gulf Prairies and Marshes supported approximately 70,329 deer, a 22.6% decline from the estimated 2002 population (Lockwood, 2004). The estimated harvest of 7,089 deer in the Gulf Prairies and Marshes for 2003 was the lowest in the last 10 years, as well as the number of hunters (12,010). Hunting pressure,

estimated at 8.33 hunters per 1,000 ac, was also the lowest in the last 10 years (Liu, 2004). The negative trend in deer population numbers can also be attributed to increased livestock stocking rates and habitat destruction. Approximately 1,441,255 ac of deer range occurred in the Gulf Prairies and Marshes region in 2003, approximately 1.7% of the deer habitat in Texas (Lockwood, 2004).

TPWD estimates for the 2003 season show the deer population of Matagorda County at 5,514 deer, an increase of 18% from the previous year (Lockwood, 2004). The deer harvest in Matagorda County in 2003 was 659, the second highest harvest over the last 5 years (Liu, 2004).

TPWD estimates for the 2003 season show the deer population of Calhoun County at 6,040 deer, a decrease of 22% from the previous year (Lockwood, 2004). Deer harvest in Calhoun County in 2003 was 165, the second highest harvest over the last 5 years (Liu, 2004).

Eastern fox squirrels and eastern gray squirrels (*Sciurus carolinensis*) are important game mammals that inhabit oak groves, forests, and savannahs over much of the eastern half of Texas. Gray squirrels generally prefer bottomland hardwood forests, while fox squirrels inhabit both upland and bottomland forests.

The eastern gray squirrel population is decreasing due to widespread destruction of bottomland hardwood forests, and oak woodlands in eastern Texas (Davis and Schmidly, 1994). Squirrel population density is highly variable depending on the availability of oak mast, which comprises the bulk of the diet of both species. The 2003 and 2004 squirrel harvest in the Gulf Prairies and Marshes region was approximately 12,346, which represents 4.0% of the statewide harvest (Purvis, 2004).

Although not strictly defined as game animals, the eastern cottontail (*Sylvilagus floridanus*) and swamp rabbit (*Sylvilagus aquticus*) are widely hunted in the State. The eastern cottontail requires brush for cover, and grass and herbaceous vegetation for food and cover (Schmidly, 1983). It is also found in managed pastures, but densities are lower in these areas due to reduced cover. Habitat for the swamp rabbit includes bottomland hardwood swamps, marsh vegetation, and dense thickets of shrubs, trees, and vines bordering floodplains (Schmidly, 1983). Approximately 3,751 rabbits were harvested in the Gulf Prairies and Marshes during the 2003 and 2004 season, with a statewide harvest of approximately 206,509 (Purvis, 2004).

The northern bobwhite is an extremely popular game bird throughout much of Texas. It prefers open areas and edges that provide grasses, forbs for food, and dense, low woody and herbaceous vegetation for cover. The northern bobwhite requires a high degree of habitat interspersion because of its comparatively low mobility. Among the preferred foods found in the expansion area are *Croton* sp., *Panicum* sp., ragweed, partridge pea (*Cassia fasciulata*), *Paspalum* sp., and American beautyberry (*Callicarpa americana*) (Lay, 1969). Statewide, 106,589 hunters harvested approximately 705,449 bobwhite quail in 2003 and 2004 (Purvis, 2004).

The mourning dove is the most widespread and abundant game bird in Texas. Doves prefer semi-open country, cultivated fields, and pastures. They typically nest in wooded areas and feed in open areas. Doves are semimigratory in that they retreat somewhat from cooler portions of the State during winter. Food habit studies have shown that seeds comprise nearly 100% of the diet of the mourning dove (Martin et al., 1951). Important food plants include *Croton* spp., ragweed, and various species of *Panicum* and *Paspalum* (Martin et al., 1951). The mourning dove harvest in Texas during the 2003 and 2004 season was 4,296,080 doves.

The wild turkey (*Meleagris gallopavo*) has a low population in the Gulf Prairies and Marshes region. Of the total statewide harvest of 27,035 turkeys for the Spring 2004 season, only 168 (1.0%) came from the Gulf Prairies and Marshes (Purvis, 2004). Turkeys prefer to nest in vegetation that is at least 18 inches high and prefer to roost in trees. They feed on acorns, fruit, and seeds.

Furbearers (e.g., common raccoon, ringtail [*Bassariscus astutus*], beaver [*Castor canadensis*], nutria [*Myocastor coypus*], Virginia opossum, red fox [*Vulpes vulpes*], gray fox [*Urocyon cinereoargenteus*], striped skunk [*Mephitis mephitis*], bobcat [*Lynx rufus*], coyote, and mink [*Mustela vison*]) are of economic and recreational importance in Texas. Furbearers are generally more abundant in woodlands, especially bottomland forests. On a statewide basis, furbearers harvested during the 2001 and 2002 season had an estimated worth of approximately $545,267.00 (McGinty and Young, 2003). The raccoon has by far brought in the most revenue each year. Each year the TPWD conducts surveys for furbearers in conjunction with spotlight surveys within each ecological region of Texas. Within the Gulf Prairies and Marshes, the abundance of furbearers (expressed as animals per 100 miles) is as follows: northern raccoon (13.79), skunk (13.79), gray fox (6.9), and Virginia opossum (3.45) (McGinty and Young, 2003).

3.14 AQUATIC ECOLOGY

3.14.1 Aquatic Communities

The Matagorda Bay System is the third largest estuary on the Texas coast (Armstrong et al., 1987; EPA, 1999; LCRA, 1997) and includes Lavaca, East Matagorda, Keller, Carancahua, and Tres Palacios bays (see Figure 3.12-1). Open water areas include the unvegetated, bottom portion (excluding hard substrates such as oyster reefs) of the subtidal estuarine environment. Open water habitats support communities of benthic organisms and corresponding fisheries populations.

Phytoplankton (microscopic algae) are the major primary producers (plant life) in the open-bay, taking up carbon through photosynthesis and nutrients for growth. Phytoplankton are fed upon by zooplankton (small crustaceans), fish, and benthic consumers. In Lavaca Bay, phytoplankton species composition changes seasonally with maximum abundance occurring in the winter and minimum in the summer, dominated by diatoms. Zooplankton are most abundant during the spring, with the minimum occurring in the fall. The dominant species are the copepod *Acartia tonsa* and the barnacle nauplii. They are important because they are the basis of the food chain and are the source of food for larval and juvenile fish. Zooplankton are limited by turbidity (which limits the phytoplankton production, and therefore food

availability) and currents, which can carry them out to sea and away from concentrated food masses (Armstrong et al., 1987). It is expected that plankton assemblages in Matagorda Bay would be similar to those of Lavaca Bay.

Nekton assemblages (organisms that swim freely in the water column) consist mainly of secondary consumers feeding on zooplankton or juvenile and smaller nekton. The Matagorda Bay system supports a diverse nekton population including fish, shrimp, and crabs. Some of these species are resident species, spending their entire life in the bay, whereas others are migrant species spending only a portion of their life cycle in the estuary (Armstrong et al., 1987).

The dominant nekton species inhabiting the Matagorda Bay estuary are bay anchovy (*Anchoa mitchilli*), Atlantic croaker (*Micropogonias undulatus*), white shrimp (*Litopenaeus setiferus*), brown shrimp (*Farfantepaneus aztecus*), hardhead catfish (*Arius felis*), sand trout (*Cynoscion arenarius*), blue crab (*Callinectes sapidus*), and Gulf menhaden (*Brevoortia patronus*), which are all estuarine dependent (Armstrong et al., 1987; TPWD, 1975). These species are ubiquitous along the Texas coast and are unaffected by seasonal or other short-term changes in salinity. Seasonal differences occur in abundance, with biomass and number usually being the smallest in the fall after Gulfward migrations. Newly spawned fish and shellfish begin migrating into the bay in winter and early spring, with the maximum biomass observed during the summer months (Armstrong et al., 1987; Parker, 1965).

3.14.1.1 Recreational and Commercial Fisheries

Matagorda Bay has one of the lowest percentages of the total finfish harvest of all Texas bay systems, contributing less than 5% of the coast-wide landings from 1997 to 2001 (Culbertson et al., 2004). Table 3.14-1 lists the commercial landings for Matagorda Bay from 1991 through 2001. During that time period, an average of only 18,181 pounds of finfish were commercially harvested in Matagorda Bay with a value averaging $18,955. These values have fluctuated substantially throughout the years. Commercially caught species include black drum, flounder, striped mullet, and sheepshead (Culbertson et al., 2004).

The main commercially harvested shellfish species in Matagorda Bay are brown, pink (*Litopenaeus duorarum*), and white shrimp and blue crabs (see Table 3.14-1). From 1997 through 2001, 24% of brown and pink shrimp; 29% of white shrimp; and 13% of blue crabs were landed from Matagorda Bay (Culbertson et al., 2004). From 1991 to 2001, 85,936 pounds of blue crab, 154,223 pounds of brown and pink shrimp, and 124,021 pounds of white shrimp were landed annually, with an annual value averaging $2,712,306, $2,753,215, and $3,570,126, respectively (Culbertson et al., 2004). Although eastern oysters are commercially harvested from Matagorda Bay, they contribute only about 5% of all oysters landed in Texas. From 1991 to 2001, 14,502 pounds of oysters were landed with an annual value averaging $299,884 (Culbertson et al., 2004).

Table 3.14-1
Texas Commercial Landings for Matagorda Bay
Annual Summaries, 1991–2001

Species	1991		1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	lbs. (x 1,000)	$	lbs. (x 1,000)	$	lbs. (x 1,000)	$	lbs. (x 1,000)	$	lbs. (x 1,000)	$	lbs. (x 1,000)	$	lbs. (x 1,000)	$	lbs. (x 1,000)	$	lbs. (x 1,000)	$	lbs. (x 1,000)	$	lbs. (x 1,000)	$
Fish																						
Black Drum	0.54	0.34	0.06	0.05	1.49	0.94	0	0	0.41	0.37	5.57	5.29	26.40	0.99	6.51	7.18	10.79	8.27	0.37	0.35	2.38	1.43
Flounder	33.02	32.05	2.61	3.79	25.29	31.07	16.21	21.88	10.84	16.41	9.52	15.86	4.18	3.94	0.52	1.33	9.32	19.69	1.11	2.52	1.29	2.51
Mullet	0.03	0.01	0.61	1.06	0.14	0.07	1.73	1.18	5.81	3.14	2.22	2.58	2.22	2.59	3.56	4.76	3.93	5.99	4.13	5.56	2.13	3.59
Sheepshead	0.50	0.17	0	0	0.01	0.01	0	0	0.12	0.06	0.19	0.11	1.55	0.01	0.40	0.20	1.32	0.50	0.45	0.51	0.51	0.15
TOTAL FISH	**34.09**	**32.57**	**3.28**	**4.90**	**26.93**	**32.09**	**17.94**	**23.06**	**17.18**	**19.98**	**17.50**	**23.84**	**34.35**	**7.53**	**10.99**	**13.47**	**25.36**	**34.45**	**6.06**	**8.94**	**6.31**	**7.68**
Shellfish																						
Blue Crab	976.37	3,322.19	940.30	1765.96	1276.34	1996.96	870.60	4667.65	656.55	2386.48	787.19	1677.74	963.06	3597.67	898.47	2,041.50	789.69	925.29	500.63	3,315.28	793.71	4,138.65
Eastern Oyster	25.59	46.51	55.86	91.09	59.84	84.27	30.33	45.98	167.49	231.86	238.77	503.02	317.33	709.36	295.23	745.29	93.79	188.76	146.87	282.29	164.09	370.29
Shrimp (Heads On):																						
Brown and Pink	2,438.73	3,322.19	1,308.13	1,765.96	1,377.96	1,996.96	2,342.47	4,667.65	1,744.66	2,836.48	1,087.79	1,677.74	1,478.19	3,597.67	1,264.50	2,041.50	679.44	925.29	1,276.52	3,315.28	1,966.13	4,138.65
White	932.61	2,932.01	1,554.82	4,133.79	1,331.53	2,892.86	1,504.54	5,349.71	1,043.59	2,767.45	1,598.37	4,538.02	1,666.33	5,327.85	1,437.80	3,369.33	754.73	2,164.01	725.44	2,419.44	1,092.54	3,376.92
TOTAL SHELLFISH	**4,373.30**	**9,622.90**	**3,859.11**	**7,756.80**	**4,045.67**	**6,971.05**	**4,747.94**	**14,730.99**	**3,612.29**	**8,222.27**	**3,712.12**	**8,396.52**	**4,424.91**	**13,232.55**	**3,896.00**	**8,197.62**	**2,317.65**	**4,203.35**	**2,649.46**	**9,332.29**	**4,016.47**	**12,024.51**
GRAND TOTAL	**4,407.39**	**9,655.47**	**3,862.39**	**7,761.70**	**4,072.60**	**7,003.14**	**4,765.88**	**14,754.05**	**3,629.47**	**8,242.25**	**3,729.62**	**8,420.36**	**4,459.26**	**13,240.08**	**3,906.99**	**8,211.09**	**2,343.01**	**4,237.80**	**2,655.52**	**9,341.23**	**4,022.78**	**12,032.19**

Source: Culbertson et al., 2004

The following discussion of the life cycles of important recreational and commercial aquatic species is included to facilitate understanding of how and when these species utilize estuarine habitat in the project area.

Eastern Oysters. Eastern oysters spawn in the spring. Rising temperatures and chemical cues stimulate the release of sperm into the water column by males. When this occurs, the female oysters release their eggs into the water. Larval oysters prefer estuarine conditions. They will remain as plankton in the water column for 2 or 3 weeks before settling onto a hard substrate and eventually transforming into an adult (Britton and Morton, 1989).

Blue Crabs. Female blue crabs mate and migrate to the higher salinity areas of the estuary (near tidal inlets or just offshore) where they lay their eggs. These eggs are attached to the underside of their abdomen and are brooded in this capacity for about 2 weeks. Prior to egg hatching, females move seaward and hatch offshore. The larvae pass through several larval stages in the marine plankton before they begin to move back into the estuary with the surface plankton. Female blue crabs occur in the bay year round, but peak in June and July, whereas males remain in the lower salinity portions of the bay throughout their life (Britton and Morton, 1989).

Shrimp. Brown, pink and white shrimp all have similar life cycles. All spawning occurs in the Gulf. Male shrimp transfer sperm to the female, who carries it around until she releases the eggs to be fertilized by the sperm. Eggs hatch into the larval stage within 24 hours and remain in the Gulf, undergoing various larval stages for several weeks. Postlarvae are carried by the currents into the shallow areas of the estuary, tidal creeks and marshes to mature. Here the shrimp increase in size and soon move to the deeper waters of the estuary, eventually moving offshore in the Gulf to spawn. Peak spawning season for brown shrimp occurs from September to May, and for pink and white shrimp, March to September (Britton and Morton, 1989).

Black Drum. Mature black drum spawn in the open bay, in nearshore Gulf waters, or in connecting passes from January to mid-April. During spawning, eggs and sperm are randomly released into the water column for fertilization. Black drum larvae and small young move into upper bay areas and tidal creeks, where they remain until they reach about 4 inches in size and then move into the open bay. Black drum remain in the bay until they reach sexual maturity (about 2 years) (Patillo et al., 1997).

Southern Flounder. Adult southern flounder leave the bay for offshore waters to spawn during the late fall and early winter. Eggs and sperm are randomly released into the water column for fertilization. Immediately after spawning, adults return to the estuaries and rivers. Larval flounder remain offshore in the plankton for 4 to 8 weeks; then metamorphosis begins and the larvae are carried into the estuaries. Juvenile southern flounders begin migrating to low salinity water up rivers, where, according to some researchers, juvenile and young adults remain for the first 2 years. Once they reach sexual maturity (2 years) they begin migrating to the Gulf to spawn (Patillo et al., 1997; Daniels, 2000).

Atlantic Croaker. Eggs and sperm of the Atlantic croaker are randomly released into the water column for fertilization. Spawning occurs nearshore in the Gulf, near passes, from September to May. Early larval stages are found offshore in plankton and are carried by currents inshore to estuarine areas. Juvenile Atlantic croaker move into rivers and creeks where they spend 6 to 8 months. Adults migrate offshore in March and April (Patillo et al., 1997).

Sheepshead. Sheepshead spawn offshore during March and April. Eggs and sperm are randomly released into the water column for fertilization. The larvae move into the seagrass beds of the estuary. They remain in this planktonic stage for 30 to 40 days, then metamorphose into juveniles. The juveniles "settle out" in the seagrass beds becoming substrate-oriented, then move to nearshore reefs where they mature. Sheepshead reach sexual maturity by age two (Patillo et al., 1997).

Striped Mullet. Striped mullet spawning occurs offshore near the water's surface from October to March. Eggs and sperm are randomly released into the water column for fertilization. The eggs and larvae remain offshore where they develop into prejuveniles, then enter the bays and estuaries to mature. Sexual maturity occurs at 3 years of age, adults remain near inshore waters during their life (Patillo et al., 1997).

Sand Seatrout. Sand seatrout migrate to the Gulf in late fall or winter to spawn. Eggs and sperm are randomly released into the water column for fertilization. Larvae are carried into the estuary by the currents and migrate to the upper areas of the estuary, preferring channels, small bayous, and shallow marshes to develop. Adult sand seatrout reach sexual maturity at 12 months (Patillo et al., 1997).

In 1970, the Federal Food and Drug Administration (FDA) began investigating the possibility of mercury contamination in seafood. Initial samples collected from Lavaca Bay found mercury levels exceeding the 0.5 ppm tolerance level established by the FDA. As a result, the Texas Department of State Health Services (TDSHS) (formerly the Texas Department of Health) initiated a program to collect samples from several areas along the coast, including Lavaca Bay, to determine where mercury contamination in seafood was present (Wiles, 1979).

It was found that there were high levels of mercury in oysters and crab with only a few slightly elevated levels in finfish from Lavaca Bay. Affected areas were closed to harvesting of shellfish in July of 1970. By October of 1971, the levels in oysters had decreased drastically (well below 0.5 ppm) and some of the restricted areas were reopened. In 1976, TDSHS noticed another increase in the mercury levels in crabs, raising the question about the mercury levels in finfish. Therefore, TDSHS also began collecting samples from select species of finfish and discovered a definite mercury contamination in finfish from Lavaca Bay. Blue crabs are bottom dwelling organisms associated with sediments, and therefore exposed to the mercury; many finfish prey on blue crabs, and therefore the mercury concentrations were increasing in the finfish. At the time, the restricted areas only included oysters because the TDH did not have the authority to close areas to the taking of crabs or finfish; however, the public was warned that consuming crabs and finfish might be dangerous (Wiles, 1979).

Studies by Alcoa in the 1990s showed that mercury-contaminated sediments near the Alcoa plant (closed area) remain. This is the area containing the greatest risk for elevated mercury levels in fish, sediments, and marsh habitats. These studies have shown that mercury concentrations in adult finfish and shellfish tissue decreased the more distant from the closed area (Alcoa, 2001).

The Lavaca Bay system has been the only bay system affected by mercury in oysters, having to be closed during periods of high levels of mercury. It is open to oystering now. Only finfish and crabs have prolonged closure in the area, which were located in the area at SH 35 near the Alcoa plant (Heideman, pers. com).

3.14.1.2 Open-Bay Bottom

Benthic organisms are divided into two groups: epifauna, such as crabs and smaller crustaceans, which live on the surface of the bottom substrate, and infauna, such as mollusks and polychaetes, which burrow into the bottom substrate (Green et al., 1992). Mollusks and some other infaunal organisms are filter feeders that strain suspended particles from the water column. Others, such as polychaetes, feed by ingesting sediments and extracting nutrients. Many of the epifauna and infauna feed on plankton, and are then fed upon by numerous fish and birds (Armstrong et al., 1987; Lester and Gonzales, 2001). The open-bay bottom includes flat areas consisting of mud and sand that contribute large quantities of nutrients and food, making them one of the most important components of this habitat type. The distribution of the benthic macroinvertebrates is primarily influenced by bathymetry and sediment type (Calnan et al., 1989). Benthic macroinvertebrates found in the sediments of the Matagorda Bay area are primarily polychaetes, bivalves, gastropods, and crustaceans (Calnan et al., 1989). The dominant bivalves include the dwarf surf clam (*Mulinia lateralis*), the concentric nut clam (*Nuculana concentrica*), and the scorched mussel (*Brachidontes exustus*); the dominant gastropods are the Eastern white slipper shell (*Crepidula plana*), the channelled barrel-bubble (*Acteocina canaliculata*), and the beautiful little caecum (*Caecum pulchellum*); the dominant polychaetes are *Mediomastus californiensis* and *Spiophanes bombyx*; and the dominant crustaceans are *Pseudohaustorius* sp. and *Ampelisca abdita* (Calnan et al., 1989).

3.14.1.3 Oyster Reef

Eastern oysters (*Crassostrea virginica*) are present in the Matagorda Bay system and provide ecologically important functions. Oyster reefs are formed where a hard substrate and adequate currents are plentiful. Currents carry nutrients to the oysters and take away sediment and waste filtered by the oyster. Most oyster reefs are subtidal or intertidal and found near passes and cuts, and along the edges of marshes. Oysters can filter water 1,500 times the volume of their body per hour which, in turn, influences water clarity and phytoplankton abundance (Powell et al., 1992a; Lester and Gonzalez, 2001). Due to their lack of mobility and their tendency to bioaccumulate pollutants, oysters are an important indicator species for determining contamination in the bay (Lester and Gonzalez, 2001).

While oysters can survive in salinities ranging from 5 to 40+ ppt, they thrive within a range of 10 to 25 ppt where pathogens and predators are limited. The low salinity end of the range is critical from an

osmotic balance perspective. Oysters can survive brief periods of salinities less than 5 ppt by remaining tightly closed. Oysters will remain closed until normal salinities are reestablished or until they deplete their internal reserves and perish. In contrast, predators, such as oyster drills, welks, and crabs, reduce oyster populations during long periods of high salinities (Cake, 1983). *Perkinsus marinus* (Dermo) is the most common and deadly oyster pathogen in the bays bordering the Gulf. It is a primary factor affecting habitat suitability. On infected reefs, greater than 50% of oysters will be killed by Dermo. Obviously, the optimal condition for adult and seed oysters is the absence of the disease (Cake, 1983). Data on the degree of Dermo infection in Matagorda Bay oysters has been collected since 2002 by Dermowatch.org operated by Dr. Sammy Ray of Texas A&M University. Currently, none of the locations sampled are causing significant oyster mortalities (Dermowatch.org accessed June 8, 2006).

Many organisms, including mollusks, polychaetes, barnacles, crabs, gastropods, amphipods, polychaetes, and isopods can be found living on the oyster reef, forming a very diverse community (Sheridan et al., 1989). Oyster reef communities are dependent upon food resources from the open bay and marshes. Many organisms feed on oysters including fish, such as black drum, crab, and gastropods, such as the oyster drill (*Thais haemastoma*) (Sheridan et al., 1989; Lester and Gonzales, 2001). When oyster reefs are exposed during low tides, shore birds will use the reef areas as resting places (Armstrong et al., 1987).

Oyster reefs are prominent in parts of Lavaca Bay (see Figure 3.12-1) and Matagorda Bay; however, the current distribution of oyster reefs in Matagorda Bay has not been mapped. The Port will be conducting oyster surveys within the proposed dredged placement and project footprint area. Oysters are commercially harvested from the Matagorda Bay system. The TDH has classified shellfish harvesting areas in Lavaca, Matagorda, Carancahua, and Tres Palacios bays. Shellfish harvesting areas are classified as approved (an area where harvesting is allowed), conditionally approved (status changes based upon meteorological or hydrological conditions), or restricted (no harvesting allowed). Much of the Matagorda Bay estuary is approved or conditionally approved; however, there are some restricted areas within the bay system. Most of the restricted areas are located in the upper portion of Lavaca, Keller, Carancahua, and Tres Palacios bays (TDH, 2006). A detailed map of the restricted areas can be found at http://www.dshs.state.tx.us/seafood/classification.shtm#maps

3.14.1.4 Offshore Sands

There are few seagrasses or attached algae found in the offshore sands due to the strong currents and unstable sediments. Most of the bottom surface is populated with macroinfauna, with the exception of an occasional hermit crab, portunid crab, or ray. Even though there is little life on the sand surface itself, the overlying waters are highly productive. Phytoplankton are abundant, including microscopic diatoms, dinoflagellates, and other algae (Britton and Morton, 1989).

Much of the faunal diversity lies buried in the sand and relies on the phytoplankton for food. Bivalves found in offshore sands include the blood ark (*Anadara ovalis*), incongruous ark (*Anadara brasiliana*), southern quahog (*Mercenaria campechiensis*), giant cockle (*Dinocardium robustum*), disk dosinia

(*Dosinia discus*), pen shells (*Atrina serrata*), common egg cockle (*Laevicardium laevigatum*), cross-barred venus (*Chione cancellata*), tellins (*Tellina* spp.), and the tusk shell (*Dentalium texasianum*). One of the most common species occurring in the shallow offshore sands is the sand dollar (*Mellita quinquiesperforata*) as well as several species of brittle stars (*Hemipholis elongata*, *Ophiolepis elegans*, and *Ophiothrix angulata*). Many gastropods are common, including the moon snail (*Polinices duplicatus*), ear snail (*Sinum perspectivum*), Texas olive (*Oliva sayana*), Atlantic auger (*Terebra dislocata*), Salle's ager (*Terebra salleano*), scotch bonnet (*Phalium granulatum*), distroted triton (*Distrosio clathrata*), wentletraps (*Epitonium* sp.), and whelks (*Busycon* spp.). Crustaceans inhabit these waters including white and brown shrimp (both commercially caught species), rock shrimp (*Sicyonia brevirostris*), blue crabs, mole crabs (*Albunea* spp.), speckled crab (*Arenaeus cribrarius*), box crab (*Calappa sulcata*), calico crab (*Hepatus epheliticus*), and pea crab (*Pinotheres maculatus*). The most abundant infaunal organism, with respect to the number of individuals, are the polychaetes (Capitellidae, Orbiniidae, Magelonidae, and Paraonidae) (Britton and Morton, 1989).

3.14.1.5 Artificial Reefs

In the Gulf, two types of artificial reefs exist, those structures placed to serve as oil and gas production platforms and those intentionally placed to serve as artificial reefs (Gulf of Mexico Fisheries Management Council [GMFMC], 2004). The more than 4,500 oil and gas structures in the Gulf form unique reef ecosystems that extend throughout the water column providing a large volume and surface area, dynamic water flow characteristics, and a strong profile (Ditton and Falk, 1981; Dokken, 1997; Stanley and Wilson, 1990; Vitale and Dokken, 2000). Fish are attracted to oil platforms because these structures provide food, shelter from predators and ocean currents, and a visual reference which aids in navigation for migrating fishes (Bohnsack, 1989; Duedall and Champ, 1991; Meier, 1989; Vitale and Dokken, 2000). The size and shape of the structure affect community characteristics of pelagic, demersal, and benthic fishes (Stanley and Wilson, 1990). Many scientists feel that the presence of oil platform structures allows for the fish populations to grow, which increases fishery potential (Scarborough-Bull and Kendall, 1992).

Artificial reefs are colonized by a diverse array of microorganisms, algae, and sessile invertebrates including shelled forms (barnacles, oysters, and mussels), as well as soft corals (bryozoans, hydroids, sponges, and octocorals) and hard corals (encrusting, colonial forms). These organisms (referred to as the biofouling community) provide habitat and food for many motile invertebrates and fishes (GMFMC, 2004).

Species associated with the platforms that are not dependent on the biofouling community for food or cover include the Atlantic spadefish (*Chaetodipterus faber*), lookdown (*Selene vomer*), Atlantic moonfish (*Selene setapinnis*), creole-fish (*Paranthias furcifer*), whitespotted soapfish (*Rypticus maculatus*), gray triggerfish (*Balistes capriscus*), and lane snapper (*Lutjanus synagris*), all transients (move from platform to platform), and resident species (always found on the platforms) including red snapper, large tomate (*Haemulon aurolineatum*), and some large groupers. Other resident species that are dependent upon the biofouling community for food or cover include numerous species of blennies, sheepshead, and small

grazers (butterflyfishes, Chaetodontidae). Highly transient, large predators associated with these structures include barracuda (*Sphyraena barracuda*), almaco jack (*Seriola rivoliana*), hammerhead sharks (*Sphyrna* spp.), cobia (*Rachycentron canadum*), mackerels (Scombridae), other jacks (*Caranx* sp.), and the little tunny (*Euthynnus alletteratus*) (GMFMC, 2004).

3.14.2 Essential Fish Habitat

Congress enacted amendments to the Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265) in 1996 that established procedures for identifying Essential Fish Habitat (EFH) and required interagency coordination to further the conservation of Federally managed fisheries. Rules published by the NMFS (50 CFR Sections 600.805–600.930) specify that any Federal agency that authorizes, funds or undertakes, or proposes to authorize, fund, or undertake an activity which could adversely affect EFH is subject to the consultation provisions of the above mentioned act and identifies consultation requirements. A letter (Appendix F) was submitted requesting EFH comments for the project.

The GMFMC has identified the study area as EFH for white shrimp, brown shrimp, pink shrimp, Gulf stone crab (*Menippe adina*), gray snapper (*Lutjanus griseus*), Spanish mackerel (*Scomberomorus maculatus*), and red drum.

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." When referring to estuaries, it is further defined as "all waters and substrates (mud, sand, shell, rock, and associated biological communities) within these estuarine boundaries, including the sub-tidal vegetation (seagrasses and algae) and adjacent tidal vegetation (marshes and mangroves)" (GMFMC, 2004).

The following describes the preferred habitat, life history stages, and relative abundance of each EFH-managed species based on information provided by GMFMC (2004). Table 3.14-2 describes EFH for each of these species.

3.14.2.1 Brown Shrimp

Brown shrimp eggs are demersal and are deposited offshore. The larvae begin to migrate through passes with flood tides into estuaries as postlarvae. Migrating occurs at night mainly from February to April, with a minor peak in the fall. Brown shrimp postlarvae and juveniles are associated with shallow vegetated habitats in estuaries, but are also found over silty sand and nonvegetated mud bottoms. Postlarvae and juveniles occur in salinity ranging from zero to 70 ppt. The density of late postlarvae and juvenile brown shrimp are highest in marsh edge habitat and submerged vegetation, followed by tidal creeks, inner marsh, shallow, open water and oyster reefs. Muddy substrates seem to be preferred in unvegetated areas. Juvenile and subadult brown shrimp can be found from secondary estuarine channels out to the continental shelf, but prefer shallow estuarine habitats, such as soft, muddy areas associated with plant-water interfaces. Subadult brown shrimp migrate from estuaries at night on ebb tides during new and full moon phases in the Gulf. Their abundance offshore correlates positively with turbidity and

Table 3.14-2
Essential Fish Habitat – Adult and Juvenile Presence
in the Matagorda Bay Ship Channel Project Area

Species	Life Stage	Relative Abundance*			
		April–June	July	Aug–Oct	Nov-March
White shrimp	Adult	C	Absent	C	C-A
	Juvenile	C-A	C-A	C-A	C-A
Brown shrimp	Adult	H-C	A-C	R	R
	Juvenile	C-H	C-A	C	C-H
Pink shrimp	Adult	C	Absent	Absent	C
	Juvenile	R	R	R	R
Gulf stone crab	Adult	C	C	C	C
	Juvenile	C	C	C	C
Gray snapper	Adult	Absent – R	Absent – R	R – Absent	Absent
	Juvenile	R	R	R	R
Spanish mackerel	Adult	C	C	C	R
	Juvenile	R	R	R	Absent
Red drum	Adult	C	C	C	C
	Juvenile	C	C	C	C

Source: NMFS, 2006a.

* C = common; R = rare; A = abundant; H = highly abundant. Periods are: Low Salinity Season (April–June); Increasing Salinity Season (July); High Salinity Season (August – October); and Decreasing Salinity Season (November – March).

negatively with hypoxia (low levels of oxygen in the water). Adult brown shrimp inhabit neritic Gulf waters (marine waters extending from MLT to the edge of the continental shelf) and are associated with silt, muddy sand, and sandy substrates (GMFMC, 2004). Juvenile brown shrimp are common to highly abundant within the Matagorda Bay estuary year-round, while adult brown shrimp are common to highly abundant from April to July and rare August through March.

Larval brown shrimp feed on phytoplankton and zooplankton. Postlarvae brown shrimp feed on phytoplankton, epiphytes, and detritus. Juvenile and adult brown shrimp prey on amphipods, polychaetes, and chironomid larvae, but graze on algae and detritus (Pattillo et al., 1997).

3.14.2.2 White Shrimp

White shrimp inhabit Gulf and estuarine waters and are pelagic or demersal, depending on their life stage. Their eggs are demersal and larval stages are planktonic and both occur in nearshore Gulf waters. Postlarvae migrate into estuaries through passes from May to November with most migration occurring in June and September. Migration is in the upper 6.5 ft of the water column at night and at mid-depths during the day. Postlarval white shrimp become benthic once they reach the estuary. Here they seek shallow water with mud or sand bottoms high in organic detritus or rich marsh where they develop into

juvenile white shrimp. Postlarvae and juveniles prefer mud or peat bottoms with large quantities of decaying organic matter or SAV. Densities are usually highest along marsh edge and in SAV, followed by marsh ponds and channels, inner marsh, and oyster reefs. White shrimp juveniles prefer salinities of less than 10 ppt and occur in tidal rivers and tributaries. As white shrimp juveniles mature, they migrate to coastal areas where they mature and spawn. Adult white shrimp are demersal and inhabit soft mud or silt bottoms (GMFMC, 2004). Adult and juvenile white shrimp are common to abundant in the Matagorda Bay estuary throughout the year, except July when adult white shrimp are absent. Adult white shrimp also occur throughout the Gulf to depths of about 131 ft.

White shrimp larvae feed on phytoplankton and zooplankton. White shrimp postlarvae feed on phytoplankton, epiphytes, and detritus. Juvenile and adult white shrimp prey on amphipods, polychaetes, and chironomid larvae, but also graze on algae and detritus (Pattillo et al., 1997).

3.14.2.3 Pink Shrimp

Pink shrimp inhabit Gulf and estuarine waters and are pelagic or demersal, depending on their life stage. After spawning offshore, postlarval pink shrimp recruitment into the estuaries occurs in the spring and fall through passes. Juveniles can be found in SAV meadows where they burrow into the substrate; however, postlarvae, juvenile, and adults may prefer a mixture of course sand/shell/mud. Densities of pink shrimp are lowest or absent in marshes, low in mangroves, and greatest near or in SAV. Adults occur offshore in depth of 30 to 145 ft and prefer substrates of coarse sand and shell (GMFMC, 2004). Adult pink shrimp are common from November through June in the Matagorda Bay estuary, while juvenile pink shrimp are rare year-round.

Pink shrimp feed on phytoplankton and zooplankton. Postlarvae feed on phytoplankton, epiphytes, and detritus. Juveniles and adults prey on amphipods, polychaetes, and chironomid larvae but also on algae and detritus (Patillo et al., 1997). The habitat of these prey is essentially the same as that required by shrimp, estuarine, and marine.

3.14.2.4 Gulf Stone Crab

Gulf stone crab inhabit Gulf (to depths of 200 ft) and estuarine waters and are pelagic or demersal, depending on their life stage. Both adults and juveniles are benthic and mainly associated with hard substrates such as oyster reefs, rock jetties, and other submerged artificial structures, as well as seagrass beds. Adults and juveniles appear to be able to tolerate wide ranges of temperatures and salinities. Gulf stone crab larvae are planktonic and, for optimal growth, require warm water (about 30°C) and high salinity (30–35 ppt) (GMFMC, 2004). Adult and juvenile Gulf stone crab are common year-round in the Matagorda Bay estuary.

All life stages of Gulf stone crab are carnivorous. Juvenile Gulf stone crab feed on polychaetes, crustaceans, mollusks, and seagrass. Adults feed on oysters and mussels, other stone crabs, vegetation, and dead organisms (GMFMC, 2004).

3.14.2.5 Gray Snapper

Gray snapper can be demersal, structure, or mid-water dwellers inhabiting marine, estuarine, and riverine habitats. They inhabit depths to about 550 ft in the Gulf. Juvenile gray snapper are common in shallow water around SAV, while adult gray snapper tend to congregate in deeper Gulf waters around natural and artificial reefs. Spawning occurs in the Gulf from June to August around structures and shoals. Their eggs are pelagic and the larvae are planktonic, both occurring in Gulf shelf waters and near coral reefs. Postlarvae migrate into the estuaries and are most abundant over *Halodule* and *Syringodium* grassbeds. Juveniles seem to prefer *Thalassia* grassbeds, seagrass meadows, marl bottoms, and mangrove roots and are found in estuaries, bayous, channels, grassbeds, marshes, mangrove swamps, ponds, and freshwater creeks (GMFMC, 2004).

Juvenile gray snapper feed on estuarine-dependent organisms such as shrimp, small fish, and crabs. Gray snapper are classified as opportunistic carnivores at all life stages (Pattillo et al., 1997). In estuaries, juvenile gray snapper feed on shrimp, larval fish, amphipods, and copepods. Adult gray snapper feed primarily on fish, but smaller individuals will prey on crustaceans (GMFMC, 2004). Adult and juvenile gray snapper are found in the Gulf waters of the study area.

3.14.2.6 Spanish Mackerel

Spanish mackerel are pelagic, inhabiting depths to 245 ft throughout the coastal zone of the Gulf. Adult Spanish mackerel are usually found from nearshore to the edge of the continental shelf. However, they may also migrate seasonally into estuaries with high salinity, but this migration is infrequent and rare. Spawning occurs in the Gulf from May through October. Larvae typically occur in the Gulf in depths ranging from 30 to 275 ft. Juveniles inhabit the Gulf surf and sometimes estuarine habitats. However, juvenile Spanish mackerel prefer marine salinities and are not considered estuarine-dependent. Adult and juvenile Spanish mackerel are found in the Gulf year-round within the study area. Juvenile Spanish mackerel prefer clean sand bottoms, but the substrate preferences of the other life stages are unknown (GMFMC, 2004).

While Spanish mackerel rarely use estuarine environments, estuaries are important for most of their prey. They feed on a variety of fishes, extensively herrings. Squid, shrimp, and other crustaceans are also fed upon by Spanish mackerel.

3.14.2.7 Red Drum

Red drum occupy a variety of habitats, ranging from offshore depths of 131 ft to very shallow estuarine waters. Spawning occurs in the Gulf near the mouths of bays and inlets during the fall and early winter. Eggs usually hatch in the Gulf and larvae are transported with tidal currents into the estuaries where they mature. Adult red drum use estuaries, but tend to migrate offshore where they spend most of their adult life. Red drum occur over a variety of substrates including sand, mud, and oyster reefs and can tolerate a wide range of salinities (GMFMC, 2004).

Estuaries are especially important to larval, juvenile, and subadult red drum. Juvenile red drum are most abundant around marshes, preferring quiet, shallow, protected waters over mud substrate or among SAV. Subadult and adult red drum prefer shallow bay bottoms and oyster reefs (GMFMC, 2004). Adult red drum that migrate into the Gulf are pelagic.

Estuaries are also important for the prey of larval, juvenile, and subadult red drum. Red drum larva feed primarily on shrimp, mysids, and amphipods, while juvenile red drum prefer fish and crabs. Adult red drum feed primarily on shrimp, blue crab, striped mullet, and pinfish (GMFMC, 2004). Within the Matagorda Bay estuary, juvenile red drum are common year-round.

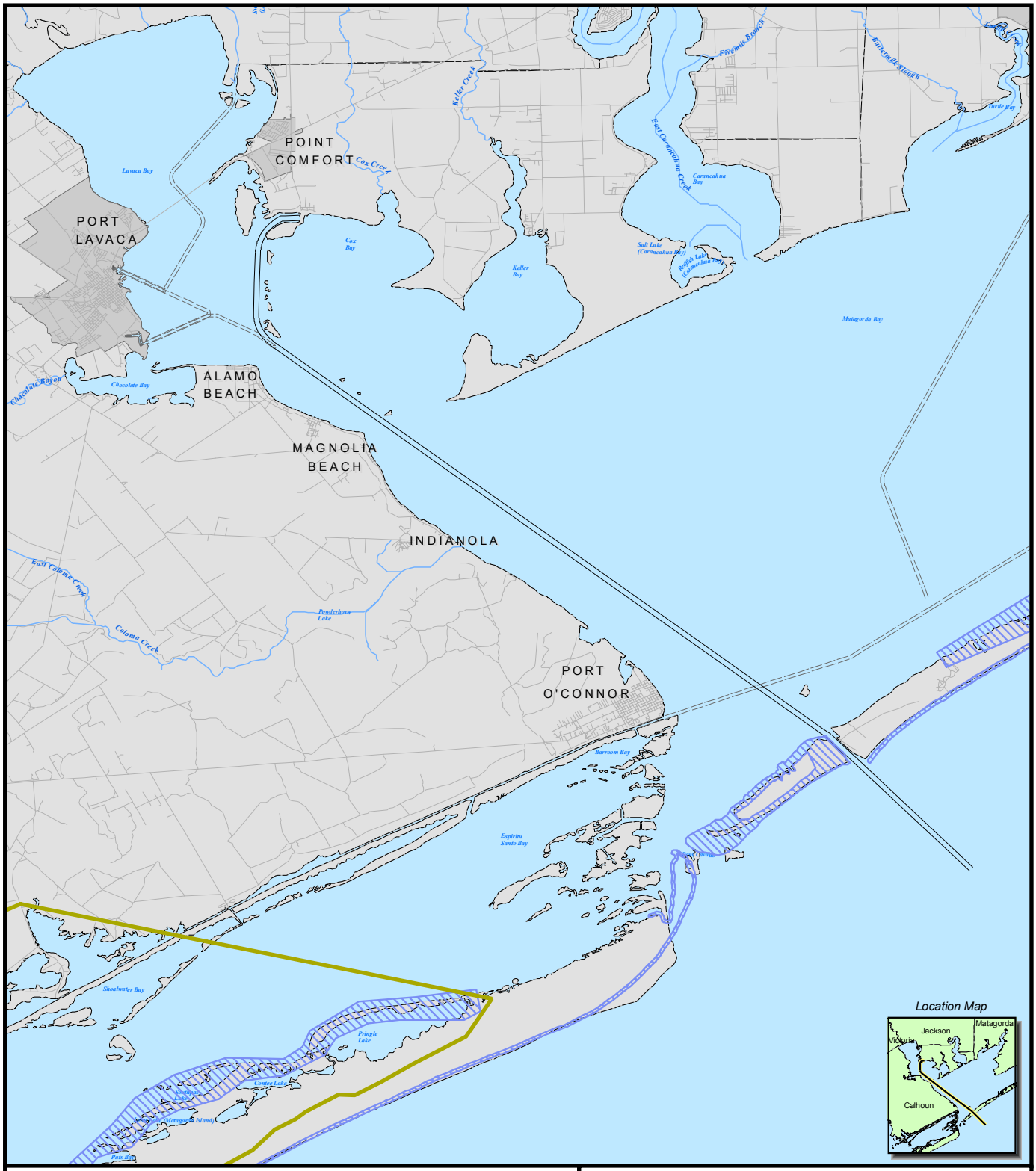
3.15 ENDANGERED AND THREATENED SPECIES

The Endangered Species Act (16 USC 1531 et. Seq.) of 1973 (ESA), as amended, was enacted to provide a program for the preservation of endangered and threatened species and to provide protection for the ecosystems upon which the species depend for their survival. All Federal agencies are required to implement protection programs for these designated species and to use their authorities to further the purpose of the Act. The FWS and the NMFS are the primary agencies responsible for implementing the ESA. The FWS is responsible for flora and fauna, including freshwater species, while the NMFS is responsible for nonbird marine species.

FWS and NMFS have identified 16 Federally listed threatened and endangered species as potentially occurring in the project area (Calhoun and Matagorda counties, Texas; Table 3.15-1; a full listing is found in Appendix G). The ESA defines an endangered species as "a species that is in danger of extinction throughout all or a significant portion of its range," and a threatened species as "a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (50 CFR 424.02).

When a species is listed as endangered or threatened, the ESA requires the designation of critical habitat unless designation would not be prudent or the critical habitat is not determinable. Critical habitat is defined as: "(1) the specific areas within the geographical area currently occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection, and (2) specific areas outside the geographical area occupied by a species at the time it is listed upon a determination by the Secretary [Secretary of the Interior or the Secretary of Commerce] that such areas are essential for the conservation of the species" (50 CFR 424.02). Federal agencies are required to consult with the FWS or NOAA about the effect of actions they authorize, fund or carry out, on designated critical habitat. Critical habitat has been designated in the vicinity of the project area for the piping plover (*Charadrius melodus*) and the whooping crane (*Grus americana*). Figure 3.15-1 provides a general map of critical habitats designated in the project vicinity.

TPWD has identified 13 threatened and endangered State species as potentially occurring in the project area (Calhoun and Matagorda counties, Texas; see Table 3.15-1). State-listed wildlife and plant species



LEGEND

- Piping Plover
- Whooping Crane
- Ship Channel
- Navigable Waterway

N W E S

4 2 0 4
Miles

Source:
**Oyster Reef surveys were conducted by Simons Subsea et al. (2005), Benchmark (2006), & NCS (2006).
Base map provided by URS.
Reference Coordinates:
Texas State Plane South Central U.S. Survey Feet
Horizontal Datum: NAD 83.

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Figure 3.15-1
Critical Habitats in the Matagorda Ship Channel Improvement Project Area

Prepared for: CCND-MSCIP	
Job No.: 441652.00	Scale: 1:253,440
Prepared by: EMonshaugen	Date: 20060530
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Table 3.15-1
Endangered and Threatened Wildlife Species of Possible Occurrence
in Matagorda and Calhoun Counties, Texas[1]

Common Name[2]	Scientific Name[2]	Status[3] FWS/ NOAA	Status[3] TPWD
BIRDS			
Whooping crane	*Grus americana*	E	E
Brown pelican	*Pelecanus occidentalis*	E	E
Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*	E	E
Eskimo curlew	*Numenius borealis*	E	E
Bald eagle	*Haliaeetus leucocephalus*	T (PDL)	T
Piping plover	*Charadrius melodus*	T	T
Arctic peregrine falcon	*Falco peregrinus tundrius*	DL	T
White-faced ibis	*Plegadis chihi*	NL	T
Reddish egret	*Egretta rufescens*	NL	T
Wood stork	*Mycteria americana*	NL	T
White-tailed hawk	*Buteo albicaudatus*	NL	T
Sooty tern	*Sterna fuscata*	NL	T
MAMMALS			
Ocelot	*Leopardus pardalis*	E	E
Gulf Coast jaguarundi	*Herpailurus yaguarondi cacomitli*	E	E
Red wolf	*Canis rufus*	E	E
West Indian manatee	*Trichechus manatus*	E	E
Louisiana black bear	*Ursus americanus luteolus*	T	T
American black bear	*Ursus americanus*	T/SA; NL	T
Southern yellow bat	*Lasiurus ega*	NL	T
REPTILES			
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	E
Hawksbill sea turtle	*Eretmochelys imbricata*	E w/CH	E
Leatherback sea turtle	*Dermochelys coriacea*	E w/CH	E
Green sea turtle	*Chelonia mydas*	T w/CH	T
Loggerhead sea turtle	*Caretta caretta*	T	T
Texas horned lizard	*Phrynosoma cornutum*	NL	T
Texas (Berlandier's) tortoise	*Gopherus berlandieri*	NL	T
Timber rattlesnake	*Crotalus horridus*	NL	T
Smooth greensnake	*Opheodrys vernalis*	NL	T
Texas scarletsnake	*Cemophora coccinea lineri*	NL	T
FISH			
Opossum pipefish	*Microphis brachyurus*	NL	T

[1]According to FWS (2003, 2004) and NDD (2005a, 2005b).

[2]Nomenclature and taxonomic orders follow American Ornithologists' Union (AOU, 1998, 2000, 2002, 2003, 2004, and 2005), Crother et al. (2000, 2001, and 2003), Baker et al. (2003), FWS (2003, 2004), and NDD (2005a).

[3]E – Endangered; T – Threatened; DL – Federally delisted; PDL – Proposed for delisting; NL – Not listed; CH – Critical habitat; T/SA – Threatened by similarity of appearance.

are protected under Sections 65 and 69 of Title 31 of the Texas Administrative Code (TAC), respectively. These regulations prohibit, without the issuance of a permit, the taking, possession, transportation, or sale of any of the animal species designated by State law as endangered or threatened; and commerce in threatened and endangered plants and the collection of listed plant species from public land. The Executive Director of the TPWD defines endangered species as an animal that is being "threatened with statewide extinction" and a plant that is “in danger of extinction throughout all or a significant portion of its range.” Threatened species are defined by the Executive Director of the TPWD as those, which are likely to become endangered in the foreseeable future.

While State-listed species and Federally designated candidate species and species of concern were considered during project planning and are addressed in this assessment, only those species identified by the FWS and/or NMFS as threatened or endangered are afforded Federal protection under the ESA.

3.15.1 Flora

There are no Federally or State-listed threatened or endangered plant species. However, there are 2 species listed by the State as rare. These are coastal gay feather (*Liatris bracteata*) and threeflower broomweed (*Thurovia triflora*).

Coastal Gay-Feather (*Liatris bracteata*)

Coastal gay-feather is endemic to Texas (Correll and Johnston, 1979). It is listed by the State as rare. It is a spike-shaped member of the Sunflower (Asteraceae) Family. Purple flowers occur in composite heads along the spike from late summer to fall. It can range in height from 1 to 3 ft (Correll and Johnston, 1979). It occurs in coastal prairies on a variety of loamy substrates (Carr, 2002). Potentially suitable habitats may be available in upland grasslands around Matagorda and Lavaca bays. There are no known populations in the immediate area of the proposed project (Natural Diversity Database [NDD], 2006a).

Threeflower Broomweed (*Thurovia triflora*)

Threeflower Broomweed, a member of the Sunflower Family, is endemic to Texas and listed by the State as rare. It is found in sparsely vegetated slicks within salt prairies (Gulf cordgrass – dominated grasslands) and along the drier margins of salt prairies and tidal flats (Carr, 2002). It varies in height from 4 inches to 1 ft and is profusely branched. Numerous, small, white-pale yellow composite flowers bloom from September to November (Correll and Johnston, 1979). This species is known from NDD records to occur in the upland areas northwest of Lavaca Bay.

3.15.2 Wildlife

Table 3.15-1 lists wildlife species whose geographic range includes the project area and that are considered threatened or endangered by FWS, NMFS, and TPWD. It should be noted that inclusion on the list does not imply that a species is known to occur in the project area, but only acknowledges the potential for occurrence. The following paragraphs present distributional data concerning each State or

Federally listed species, along with a brief evaluation of the potential for the species to occur in the project area.

Threatened and endangered species considered in this analysis were identified from county species lists provided by the TPWD, FWS, and NOAA. It should be noted that, although several whale species were included on NOAA's list of protected species for the State of Texas, they are not included in Table 3.15-1 because it is highly unlikely they would occur in this study area. However, a discussion of each is provided in Section 3.15.2.2.

Information regarding the potential occurrence of a species in this area was obtained from the literature. The NDD was also consulted to identify which species have been recorded in the study area. The NDD includes records of the following rare, threatened, and endangered species in the vicinity of the proposed project: Texas diamondback terrapin, Kemp's ridley sea turtle, whooping crane, and the piping plover.

3.15.2.1 Birds

Arctic Peregrine Falcon (*Falco peregrinus tundrius*)

The Arctic peregrine falcon is listed by the TPWD as threatened in Calhoun and Matagorda counties, but has been delisted by the FWS. This species nests in the Arctic islands and the tundra regions of Alaska, Canada, and Greenland. Arctic peregrine falcons winter along the Texas coast and occur statewide during migrations to and from South America. Arctic peregrines are known to overwinter on the Texas Coast. This species is a potential migrant in the project area.

Attwater's Greater Prairie-Chicken (*Tympanuchus cupido attwateri*)

Historically, Attwater's prairie chickens occurred throughout the coastal prairie grasslands of southwestern Louisiana to the Nueces River in Texas (FWS, 1992). The species is restricted to native prairie intermixed with cropland. This species is now mostly restricted to the only known remaining wild population in Colorado and Galveston counties, Texas. However, there were recorded occurrences of this species in the project area, according to NDD data obtained from TPWD. The FWS (1992) describes preferred habitats as properly grazed native prairie grasslands that are dominated in the climax community by perennial bunchgrasses such as little bluestem (*Schizachyrium scoparium*), indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), and big bluestem (*Andropogon gerardii*).

Bald Eagle (*Haliaeetus leucocephalus*)

Bald eagles typically inhabit coastal areas, rivers, and other large bodies of water throughout North America. This species feeds mainly on fish and waterfowl, making proximity to open water an important feature of its nesting habitat and foraging activities. The bald eagle breeds primarily in the eastern third of Texas and winters throughout the state. Nests are typically built in the dominant trees of woodlands, woodland edges, or open areas, and are positioned such that a clear flight path exists between the nest and

the nearest body of water. No nests are known to occur in the vicinity of the MSCIP, but this species could occur in the project area as a rare migrant or post-nesting visitor.

Brown Pelican (*Pelecanus occidentalis*)

The State and Federally endangered brown pelican is distributed throughout the coastal areas of the Gulf. This species primarily feeds in shallow estuarine waters and is rarely found more than 20 miles offshore, except to take advantage of exceptional foraging opportunities. Sand spits and offshore sand bars are used extensively as daily loafing and nocturnal roosting sites. The brown pelican is a colonial nester that prefers to nest in small bushes and trees. Preferred nesting sites are small, coastal islands that provide protection from predators and with sufficient elevation to prevent flooding of the nests. Nesting colonies known to occur in the project area include the Lavaca Bay Spoil Island 63-77 (code 609-121) and Sundown Island (code 609-300) colonies. The brown pelican is a common resident in the Matagorda/Lavaca bay system and is likely to occur in the project area. The brown pelican is currently being considered for delisting in the western Gulf due to recovery of the population.

Eskimo Curlew (*Numenius borealis*)

Historically, the Eskimo curlew ranged from the Arctic to South America. Breeding habitat for this species consisted of treeless arctic and subarctic tundra; nonbreeding birds used a variety of habitats, including grasslands, pastures, plowed fields, and less frequently, marshes and mud flats. This species would migrate through the midwestern U.S. in the spring, including Texas, from mid-March to late April (Oberholser, 1974). However, this species is possibly extinct throughout most or all of its historical range. Since the mid-1980s, coordinated efforts to locate birds have failed, but isolated unconfirmed sightings continue to surface and drive efforts to identify areas and habitats still used by the species. The Eskimo curlew is not expected to occur in the vicinity of the proposed project.

Piping Plover (*Charadrius melodus*)

Piping plovers breed in northern Great Plains of the U.S. and Canada, along beaches of the Great Lakes, and along the Atlantic coast. Following the breeding season, this species migrates to the southern U.S. Atlantic coastline, the Gulf coastline, and to scattered Caribbean islands. Thus, piping plovers are potential winter residents (November–March), and spring and fall migrants in the project area. This species can be found along Texas beaches, tidal flats, mud/sand flats, dunes, and offshore islands. This species has been observed in the project area according to NDD records.

Critical habitats have been designated along the Texas coast, including portions of the Matagorda/Lavaca bay system. Critical habitat units in the vicinity of the proposed project include Texas Units 19 through 27 (see Figure 3.15-1).

Reddish Egret (*Egretta rufescens*)

The reddish egret is a fairly common, permanent resident along the central and lower Texas coast, where this species typically inhabits shallow regions of saltwater bays and marshes. Breeding is restricted to the Gulf Coast where nesting occurs in colonies with herons, egrets, and cormorants in brushy thickets of yucca and prickly pear on dry coastal islands of Texas, but may occur inland during post-breeding movements. Nesting pairs have been observed in the project area in the Lavaca Bay Spoil Island 63-77 (code 609-121), Lavaca Bay Spoil Island 51-63 (code 609-220), and Sundown Island (code 609-300) colonies (see Table 3.15-1). The reddish egret is common in the Matagorda/Lavaca bay system and is likely to occur in the open water and marshes located in the project area.

Sooty Tern (*Sterna fuscata*)

The sooty tern inhabits marine bays and beaches along the central and lower Texas coast, where it is a local summer resident. This is a pelagic species that spends the majority of its time in flight, foraging over open water. The sooty tern nests primarily on the Dry Tortugas, Florida. During the breeding season, sooty tern colonies nest on coral cays, atolls, sandbanks, rock stack, cliffs, or other offshore islets. No nesting colonies were recorded in the project area during the annual TCWC from 1973 to 2003.

White-Faced Ibis (*Plegadis chihi*)

The white-faced ibis is a common to uncommon resident along the Texas coast, where this species uses habitats ranging from freshwater marshes, sloughs, and irrigated rice fields to saltwater marshes. This species typically overwinters in south Texas, southeast Louisiana, Mexico, and South and Central America. The nesting range of the white-faced ibis includes most of the western U.S. and Mexico. Nesting occurs in colonies with individual nests built in large reed beds lined with grasses. Nesting pairs have been observed in the project area in the Lavaca Bay Spoil 63-77 (code 609-121), Lavaca Bay Spoil 51-63 (code 609-220), and Sundown Island (code 609-300) colonies (see Table 3.15-1). The white-faced ibis is common in the Matagorda/Lavaca bay system and is likely to occur in the open water and marshes located in the project area.

White-Tailed Hawk (*Buteo albicaudatus*)

The white-tailed hawk is an uncommon, local resident of coastal grasslands from the Rio Grande delta to the upper coast and farther inland in open-country with scattered mesquite, yucca, and large cacti. There were no NDD records of this species occurring in the project area. The white-tailed hawk is uncommon in the project area (see Table 3.15-1).

Whooping Crane (*Grus americana*)

The entire breeding population of whooping crane migrates from Canada's Northwest Territories to a narrow section of the Texas coast centered on the Aransas National Wildlife Refuge located south of the project area. Thus, individuals are likely to fly through/over the project area en route to their primary

wintering destination. In Texas, the principal winter habitats include brackish bays, marshes, and sand flats. Whooping cranes are also known to forage in nearby upland areas.

Critical habitats have been designated in Calhoun County, but are restricted to the Aransas National Wildlife Refuge and adjacent areas (see Figure 3.15-1). The whooping crane has not been recorded in the project area (according to NDD occurrence records) but cranes overwintering in the Aransas National Wildlife Refuge could move through or utilize habitats in Matagorda and Lavaca bays.

Wood Stork (*Mycteria americana*)

The wood stork inhabits freshwater and brackish wetlands, and primarily nests in cypress or mangrove swamps. This species feeds in freshwater marshes, narrow tidal creeks, or flooded tidal pools. Wood storks are common summer residents and migrate along the coastal prairies of Texas in the fall and spring. Nests are typically located in the upper branches of cypress trees or in mangroves on islands. This species winters in coastal marshes, swamps, and wet meadows of the eastern half of Texas. The NDD did not include any records of this species in the project area.

3.15.2.2 Mammals

Black Bear (*Ursus americanus*) and Louisiana Black Bear (*U. a. luteolus*)

The black bear (*Ursus americanus*) is Federally listed as threatened due to similarity in appearance to the Louisiana black bear (*Ursus americanus luteolis*). The black bear is also state-listed as threatened. The Louisiana black bear is listed as threatened throughout its historic range (57 FR 588, January 7, 1992). Currently, the Louisiana black bear population is concentrated in Louisiana, with occasional sightings in east Texas. This subspecies of black bear historically inhabited east Texas, Arkansas, Louisiana, and southern Mississippi, but is now confined to small numbers in Mississippi, close to the Mississippi River, and to core populations in the Tensas and Atchafalaya River basins in Louisiana (55 FR 37724). Although individual bears may wander in from Louisiana, no extant populations are believed to be in eastern Texas (Schmidly, 1983, 2004; Davis and Schmidly, 1994; FWS, 1995). Although black bears are periodically reported from various counties of east Texas, no significant bear activity has been reported from east Texas in recent years (Taylor, 2000). The black bear is increasing in Texas, mainly, however, in the mountains in the western part of the State and central Texas. These bears are the result of elements of a burgeoning Mexican population that has reclaimed territory in areas of Texas that have suitable habitat to support them. Both the black bear and the Louisiana black bear are extremely unlikely to be found within the study area.

Gulf Coast Jaguarundi (*Herpailurus yaguarondi*)

The jaguarundi is a secretive, small slender-bodied cat that inhabits dense thornscrub and brushland (Schmidly, 2004). The jaguarundi has a neotropical distribution and historically occurred in southeast Arizona, south Texas, and Central and South America (Davis and Schmidly, 1994). Today, the jaguarundi has a similar distribution, but with significantly reduced numbers. In Texas, its distribution includes

Cameron, Hidalgo, Starr, and Willacy counties where it is extremely rare (Davis and Schmidly, 1994). The jaguarundi is the least common feline in Texas, and the current population likely consists of no more than 15 individuals (Schmidly, 2004). The jaguarundi is not expected to occur in the project area.

Ocelot (*Leopardus pardalis*)

The ocelot is a medium-sized spotted cat that historically inhabited dense thornscrub and thickets in southeast Texas, along the Texas Gulf Coast, and in the Big Thicket in East Texas, but currently occurs only in small remnant patches of dense thornscrub in the Lower Rio Grande Valley (Schmidly, 2004). The ocelot once occurred throughout much of the chaparral habitats of South Texas, but is now extremely rare and is believed to only occur in the shrub lands around Laguna Atascosa National Wildlife Refuge near Brownsville, Texas. This species is very rare and is not likely to occur in the project area.

Red wolf (*Canis rufus*)

Historically, the red wolf occurred throughout the eastern half of Texas, but this species is now considered to be extirpated in Texas due to overhunting, habitat destruction, and inbreeding with coyotes. This species, whose range extended into the Edwards Plateau region of Central Texas, was once a common predator of eastern Texas. Recent report is this species within Texas are considered dubious. The last known individuals of this species in Texas are believed to have been collected in Chambers and Kennedy counties in the early 1960s (Davis and Schmidly, 1994). The red wolf is not expected to occur in the project area.

Southern Yellow Bat (*Lasiurus ega*)

The southern yellow bat is a neotropical species that has been recorded from southern California, southern Arizona, extreme southwestern New Mexico and south Texas (Davis and Schmidly, 1994). The southern yellow bat is nocturnal, hunting for insects at night and roosting in palm trees during the day. Within its Texas range, this species seems to preferentially roost in palm trees and Davis and Schmidly (1994) suggest that populations of the southern yellow bat in Texas may be increasing due to the increased number of ornamental palm trees used in landscaping. This species could occur in the project area.

West Indian Manatee (*Trichechus manatus*)

The West Indian manatee (*Tnichochus manatus*) is a Federally and State-listed endangered aquatic mammal which inhabits brackish water bays, large rivers, and saltwater (Davis and Schmidly, 1994). They feed upon submergent, emergent, and floating vegetation with the diet varying according to plant availability (O'Shea and Ludlow, 1992). The manatee is more common in the warmer waters off of coastal Mexico, the West Indies, and Caribbean to northern South America (NatureServe, 2000). In the U.S., populations are primarily found in Florida, but occasional vagrants migrate along the coast into Texas. Although extremely rare in Texas, recent Texas records include specimens from Cameron, Galveston, Matagorda, and Willacy counties (FWS, 1995). The NDD records did not include any occurrences in this area.

Blue Whale (*Balaenoptera musculus*)

The blue whale (*Balaenoptera musculus*) is listed as endangered under the ESA. This species inhabits and feeds in both coastal and pelagic environments. The distribution of blue whales is presumably governed largely by food requirements. Populations move toward the poles in the spring to take advantage of high zooplankton production during summer months. Blue whales move toward the subtropics in the fall to reduce energy expenditure while fasting and engage in reproductive activities in warmer waters. The blue whale is considered only an occasional visitor in the U.S. Atlantic waters. This may represent the southern limit of the western North Atlantic blue whales feeding range, although the actual southern limit of its range is unknown. Some records have suggested an occurrence of this species in waters near Florida and in the Gulf (NMFS, 2006b). The blue whale is not expected to occur in the study area.

Finback Whale (*Balaenoptera physalus*)

The finback or fin whale (*Balaenoptera physalus*) is listed as endangered under the ESA. Finback whales are found offshore and tend to be nomadic. The high food availability in high latitudes and cold currents make it a desired habitat for the finback whale. In the fall these whales migrate several thousand miles to equatorial waters. Fin whales fast almost completely in the winter, living off fat reserves. Mating occurs throughout the winter and young are born a year later between December and April (NYSDEC, 2006a). The finback whale is not expected to occur in the study area.

Humpback Whale (*Megaptera novaengliae*)

Humpbacks are listed as endangered throughout their range and consequently are considered “depleted” under the Marine Mammal Protection Act. Distribution of the humpback whale is worldwide in all ocean basins, but this species is less common in Arctic waters. Humpback whales are seasonal migrants and are found in temperate and tropical waters of both hemispheres during the winter breeding season. In the summer feeding season, most humpbacks occur in higher latitude waters with high biological productivity. Humpback whales are generally considered to inhabit waters over continental shelves, along their edges and around some oceanic islands (NMFS, 2006c).

There are currently four recognized stocks (based on geographically distinct winter ranges) of humpback whales in the U.S.: Gulf of Maine, the eastern North Pacific, the central North Pacific, and the western North Pacific stocks. Prior to commercial whaling the worldwide population of humpback whales is thought to have been in excess of 125,000. Currently, it is estimated that the U.S. population of humpbacks is less than 7,000 whales.

The overall North Atlantic population (including the Gulf of Maine) is estimated at 11,570 individuals. The current best estimate for humpback whales in the Gulf of Maine is 902. The minimum population estimate for this stock is 647 whales. Current data suggest that the Gulf of Maine humpback whale stock is steadily increasing in size (NMFS, 2006c). The current estimated abundance of humpback whales in eastern North Pacific waters is 1,314; the minimum population estimate is 681 animals. This stock

appears to have decreased in abundance between 1998 and 1999, but the most recent estimate shows that this stock is increasing in abundance (NMFS, 2006c).

Recovery plans have been in place for the humpback whale where in the major focus is veered towards maintenance and enhancement of habitats, to identify and reduce direct human impact, regular monitoring and update of data, and enhanced coordination and cooperation between recovery program units. The humpback whale is not expected to occur in the study area.

Sei Whale (*Balaenoptera borealis*)

The Sei whale is currently designated as an endangered species under the ESA. The Sei whale inhabits, breeds and feeds in open oceans, and is usually restricted to more temperate waters. These whales migrate several thousand miles to the equator in the fall. The mating season lies between April to December, during which time they eat very little or fast, living off their fat reserves. Sei whales are found in the North Atlantic Ocean ranging from the south of Iceland to the northeastern Venezuelan coast, and northwest to the Gulf. Sei whales are also known to occur near Cuba, the Virgin Islands and infrequently in U.S. waters (NYSDEC, 2006b).

Sei whales of the U.S. waters are grouped into four stocks: East North Pacific, Hawaii, Nova Scotia (formerly part of Western North Atlantic), and Western North Atlantic stocks. Due to lack of data there are currently no trends on the Sei whale population of most of the stocks or on their recovery rate. The protection status accorded to the Sei whale since 1976 might have increased the population; however, unauthorized hunting (NMFS, 2006c) and incidental ship strikes and gillnet mortality make this uncertain. The Sei whale is not expected to occur in the study area.

Sperm Whale (*Physeter macrocephalus*)

The sperm whale (*Physeter macrocephalus*) is endangered throughout its range due mostly to overexploitation from commercial whaling during the past two centuries. This species is found throughout the world's oceans in deep waters between about 60° N and 60° S latitudes. Sperm whales tend to inhabit areas with water depths of 1,970 ft or more, and are uncommon in waters less than 985 ft deep. Their distribution is dependent on their food source and suitable conditions for breeding, and varies with the sex and age composition of the group. Sperm whale migrations are not as predictable or well understood. In some mid-latitudes, there seems to be a general trend to migrate north and south depending on the seasons (whales move poleward in the summer). However, in tropical and temperate areas, there appears to be no obvious seasonal migration (NMFS, 2006b). The sperm whale is not expected to occur in the study area.

North Atlantic Right Whale (*Eubalaena glacialis*)

The right whale (*Eubalaena glacialis*) has been listed as endangered under the ESA since its passage in 1973. This species is among the rarest of all marine mammal species. Historically, right whales probably occurred in coastal and continental shelf waters of all the world's oceans from temperate to subpolar

latitudes. Right whales were hunted to near extinction by the nineteenth century. The distribution of right whales in the northern hemisphere is strongly correlated to the distribution of calanoid copepods, their primary food source (NMFS, 2006b). North Atlantic right whale sightings have been reported as far south as the Gulf. A female and calf were recently (on January 16, 2006) observed in Corpus Christi Bay, Texas (personal communication with K. Baker, NOAA Fisheries Service – Protected Resources Division).

The main factor limiting right whales is their critically low population size, the result of extensive exploitation since the beginning of commercial whaling. Other principal threats include incidental collisions with vessels and entanglement in fishing gear. The right whale is not expected to occur in the study area (NMFS, 2006b).

3.15.2.3 Reptiles

Five species of sea turtle occur in Texas waters: Kemp's ridley sea turtle (*Lepidochelys kempii*), hawksbill sea turtle (*Eretmochelys imbricata*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), and green sea turtle (*Chelonia mydas*). Kemps' ridley, the hawksbill, and the leatherback are Federally and State-listed as endangered, while the loggerhead and green sea turtle are Federally and State-listed as threatened. The loggerhead and Kemps' ridley are the two most common species in Texas waters and the leatherback sea turtle is the rarest. All except the leatherback turtle have nested on Texas beaches, with the vast majority of nests belonging to the Kemp's ridley (NMFS, 2006c; Shaver, 2006; National Park Service [NPS], 2007).

Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle inhabits shallow coastal and estuarine waters, usually over sand or mud bottoms. Adults are primarily restricted to the Gulf, although juveniles may range throughout the Atlantic Ocean since they have been observed as far north as Nova Scotia (Musick, 1979) and in coastal waters of Europe (Brongersma, 1972). Almost the entire population of Kemp's ridley's nests on an 11-mile stretch of coastline near Rancho Nuevo, Tamaulipas, Mexico, approximately 190 miles south of the Rio Grande. Sporadic nesting has been reported from Mustang Island, Texas, southward to Isla Aquada, Campeche. Kemp's ridley occurs in Texas in small numbers and in many cases may well be in transit between crustacean-rich feeding areas in the northern Gulf and breeding grounds in Mexico. It has nested sporadically in Texas in the last 50 years. The number of nestings in Texas, however, has increased over the last 12 year from four nests in 1995 to 102 nests in 2006, 64 of which were from the Padre Island National Seashore (Shaver, 2006; NPS, 2007; Yeargan, 2007). Several of the ridley nests were from headstarted individuals. Such nestings, together with the proximity of the Rancho Nuevo rookery, probably account for the occurrence of hatchlings and subadults in Texas.

This species has been recorded from the study area. Seven Kemp's ridleys were captured during netting operations conducted by TAMUG at Magnolia Beach from May to October 1996. These seven ridleys were outfitted with radio or satellite transmitters and tracked between May and November 1996. While most of the subsequent locations were within 4 miles (2.5 km) of the western shoreline of Matagorda Bay,

other locations included Lavaca Bay, Carancahua Bay, Tres Palacios Bay, and Powderhorn Lake (Williams and Renaud, 1998). In addition to the netting records, a Kemp's ridley nested on Matagorda Peninsula in 2002 (Yeargan, 2006), four Kemp's ridleys nested on Matagorda Island in 2006 (NPS, 2007), and two Kemp's ridleys were taken in the entrance channel of the MSC during dredging operations in 2006 (USACE, 2007).

Hawksbill Sea Turtle

The hawksbill sea turtle is circumtropical, occurring in tropical and subtropical seas of the Atlantic, Pacific, and Indian oceans (Witzell, 1983). This species is probably the most tropical of all marine turtles, although it does occur in many temperate regions. The hawksbill sea turtle is widely distributed in the Caribbean Sea and western Atlantic Ocean, with representatives of at least some life history stages regularly occurring in southern Florida and the northern Gulf (especially Texas), south to Brazil (NMFS, 2006c). The hawksbill generally inhabits coastal reefs, bays, rocky areas, passes, estuaries, and lagoons, where it occurs at depths of less than 70 ft. Like some other sea turtle species, hatchlings are sometimes found floating in masses of marine plants (e.g., sargassum rafts) in the open ocean (National Fish and Wildlife Laboratory [NFWL], 1980). In the continental U.S., the hawksbill largely occurs in Florida where it is sporadic at best. In 1998 the first hawksbill nest recorded on the Texas coast was found at Padre Island National Seashore. This nest remains the only documented hawksbill nest on the Texas coast (Shaver, 2006; NPS, 2007). Elsewhere in the western Atlantic, hawksbills nest in small numbers along the Gulf Coast of Mexico, the West Indies, and along the Caribbean coasts of Central and South America (Musick, 1979). Texas is the only state outside of Florida where hawksbills are encountered with any regularity. Most of these sightings involve posthatchlings and juveniles, and are primarily associated with stone jetties. These small turtles are believed to originate from nesting beaches in Mexico (NMFS, 2006c). This species is of potential occurrence in the study area.

Leatherback Sea Turtle

The leatherback sea turtle is probably the most wide-ranging of all sea turtle species. It occurs in the Atlantic, Pacific and Indian oceans; as far north as British Columbia, Newfoundland, Great Britain and Norway; as far south as Australia, Cape of Good Hope, and Argentina; and in other water bodies such as the Mediterranean Sea (NFWL, 1980). The leatherback is mainly pelagic, inhabiting the open ocean, and seldom approaches land except for nesting (Eckert, 1992) or when following concentrations of jellyfish (TPWD, 2006a), when it can be found in inshore waters, bays, and estuaries. It dives almost continuously, often to great depths. Leatherbacks nest primarily in tropical regions and only sporadically in some of the Atlantic and Gulf states of the continental U.S., with one nesting reported as far north as North Carolina (Schwartz, 1976). In the Atlantic and Caribbean, the largest nesting assemblages occur in the U.S. Virgin Islands, Puerto Rico, and Florida (NMFS, 2006c). No nests of this species have been recorded in Texas for at least 70 years (NPS, 2007); the last two, one from the late 1920s and one from the mid-1930s, were both from Padre Island (Hildebrand, 1982, 1986). Apart from occasional feeding aggregations such as the large one of 100 animals reported by Leary (1957) off Port Aransas in December 1956, or possible concentrations in the Brownsville Eddy in winter (Hildebrand, 1983), leatherbacks are rare along the

Texas coast, tending to keep to deeper offshore waters where their primary food source, jellyfish, occurs (NMFS and FWS, 1992). No leatherback sea turtles have been taken by dredging activities in Texas (USACE, 2007); however, a leatherback was caught by a trawler in a shipping channel approximately 1.5 miles north of Aransas Pass (NMFS, 2003). This species is unlikely to occur in the study area.

Loggerhead Sea Turtle

The loggerhead sea turtle is widely distributed in tropical and subtropical seas, being found in the Atlantic Ocean from Nova Scotia to Argentina, the Gulf, Indian and Pacific oceans (although it is rare in the eastern and central Pacific) and the Mediterranean Sea (Rebel, 1974; Ross, 1982; Iverson, 1986). In the continental U.S., loggerheads nest along the Atlantic coast from Florida to as far north as New Jersey (Musick, 1979) and sporadically along the Gulf Coast, including Texas. Like the worldwide population, the population of loggerheads in Texas has declined. The loggerhead is the most abundant turtle in Texas marine waters, preferring shallow inner continental shelf waters and occurring only very infrequently in the bays. It is often seen around offshore oil rig platforms, reefs, and jetties. Loggerheads are probably present year-round but are most noticeable in the spring when one of their food items, the Portuguese man-o-war, is abundant. Loggerheads constitute a major portion of the dead or moribund turtles washed ashore (stranded) on the Texas coast each year (Sea Turtle Stranding and Salvage Network [STSSN], 2007). A large proportion of these deaths is the result of accidental capture by shrimp trawlers, where caught turtles drown and their bodies dumped overboard. In 1999, two loggerhead nests were confirmed in Texas, while in 2000, five loggerhead nests were confirmed (Shaver, 2000a). Between 2001 and 2005, up to five loggerhead nests per year have been recorded from the Texas coast (Shaver, 2006). Two loggerhead nests were recorded in 2006: one on Padre Island National Seashore and the other on South Padre Island (NPS, 2007). Within the study area, a loggerhead turtle was killed in 1996 during dredging operations in the entrance channel of the MSC, and two loggerheads were taken in the entrance channel of the MSC during dredging operations in 2006 (USACE, 2007).

Green Sea Turtle

The green sea turtle is a circumglobal species in tropical and subtropical waters. In U.S. Atlantic waters, it occurs around the U.S. Virgin Islands, Puerto Rico, and continental U.S. from Massachusetts to Texas. Major nesting activity occurs on Ascension Island, Aves Island (Venezuela), Costa Rica, and in Surinam. Relatively small numbers nest in Florida, with even smaller numbers in Georgia, North Carolina, and Texas (NMFS and FWS, 1991; Hirth, 1997). The green turtle in Texas inhabits shallow bays and estuaries where its principal foods, the various marine grasses, grow (Bartlett and Bartlett, 1999). While green turtles prefer to inhabit bays with seagrass meadows, they may also be found in bays that are devoid of seagrasses. The green turtles in these Texas bays are mainly small juveniles. Adults, juveniles, and even hatchlings are occasionally caught on trotlines or by offshore shrimpers or are washed ashore in a moribund condition (Shaver, 2000b; STSSN, 2007).

Green turtle nests are rare in Texas. One nest was recorded at the Padre Island National Seashore in 1987, five in 1998, none in 1999, and one in 2000 (Shaver, 2000a, 2000b; NPS, 2007). Between 2001 and 2005,

up to five nests per year were recorded from the Texas coast, all on Padre Island National Seashore (Shaver, 2006). In 2006, two green turtle nests were recorded at Padre Island National Seashore (NPS, 2007). No green turtle have been recorded from the study area (Shaver, 2006; NPS, 2007). Since long migrations of green turtles from their nesting beaches to distant feedings grounds are well documented (Meylan, 1982; Green, 1984), the adult green turtles occurring in Texas may be either at their feeding grounds or in the process of migrating to or from their nesting beaches. The juveniles frequenting the seagrass meadows of the bay areas may remain there until they move to other feeding grounds or, perhaps, once having attained sexual maturity, return to their natal beaches outside of Texas to nest. In the study area, four juvenile/subadult green turtles were captured during netting operations conducted by TAMUG at Magnolia Beach between May and October 1996. These four turtles were outfitted with radio or satellite transmitters and tracked between May 1996 and March 1997. Subsequent locations included Lavaca Bay, western Matagorda Bay, and Powderhorn Bayou (Williams and Renaud, 1998). In addition to the netting records, a green turtle was taken in the entrance channel of the MSC during dredging operations in 2004 (USACE, 2007), and a green turtle was recorded in the MSC southeast of Matagorda Peninsula (NDD, 2006a). However, this may have been the same individual.

Texas (Berlandier's) Tortoise (*Gopherus berlandieri*)

The Texas tortoise occurs in south Texas and northeastern Mexico, where it prefers sandy soils in areas of open scrub, semidesert, and desert habitats. Texas tortoises are active primarily during the morning hours and spend the hotter period of the day in burrows or beneath leaf litter and soil at the base of shrubs. The distribution maps provided in Dixon (2000) for this species include Matagorda County, but there are no records for Calhoun County. NDD records did not include any occurrences in the study area.

Texas Horned Lizard (*Phrynosoma cornutum*)

Historically, the Texas horned lizard occurred throughout the State of Texas. However, populations have since declined. This species is now only found in abundance in the western half of the state. Populations have nearly vanished from the eastern half of the state in the last 20 years. This decline is mostly attributable to the widespread use of insecticides, the proliferation of exotic fire ants, and other factors contributing to the decline of this species' primary food source—harvester ants (*Pogonomyrmex* spp.). Harvester ants comprise major component of the horned lizard's diet and are, consequently, an important component of horned lizard habitat. Suitable habitats are generally characterized as areas with flat, open terrain, scattered vegetation, and sandy or loamy soils (Dixon, 2000). This species has been reported in Calhoun and Matagorda counties (Dixon, 2000), but NDD records did not include any occurrences in the study area.

Texas Scarletsnake (*Cemophora coccinea lineri*)

The Texas scarletsnake prefers loose sandy soils suitable for burrowing and is associated with hardwood, mixed, or pine forest and adjacent open areas. In Texas, it is primarily found in sand-floored baygall thickets adjacent to the lower Gulf Coast (Tennant, 1998). Eggs of other reptiles seem to be the preferred

food (National Wildlife Federation, 2005). This species has been reported in Calhoun and Matagorda counties (Dixon, 2000), but NDD records did not include any occurrences in the study area.

Smooth Greensnake (*Opheodrysvernalis*)

The smooth greensnake occurs throughout much of the central and northeastern U.S. and Canada but is considered very rare in Texas. This species uses a wide range of habitats including grasslands, "old field" habitats, shrubland/chaparral, suburban/orchard, coniferous and deciduous woodlands, riparian areas, and scrub/shrub and herbaceous wetlands. Smooth greensnakes are reported to occur in Matagorda County (Dixon, 2000), but NDD records did not include any occurrences in the study area.

Timber Rattlesnake (*Crotalus horridus*)

The timber rattlesnake is a state-listed threatened species that occurs throughout much of the eastern half of North America, including Texas. In the southern portion of its range, the timber rattlesnake prefers hardwood forests, swampy areas, river bottoms, hydric hammocks, and cane fields. The distribution maps for this species provided in Dixon (2000) did not include Matagorda or Calhoun County.

3.15.2.4 Fish

Only one species of fish which may occur within Matagorda or Calhoun counties, the opossum pipefish (*Microphis brachyurus*), is State listed as threatened. The remainder of the fish species discussed below do not carry a Federal or State designation of threatened or endangered, but are considered rare "species of concern," and will not be found in Table 3.15-1.

Opossum Pipefish (*Microphis brachyurus*)

The opossum pipefish (*Microphis brachyurus*) is a state-listed threatened species and a Federal species of concern because of the apparent need of adults for very specific habitat conditions in the lower reaches of streams entering warm-temperate and tropical estuaries. Males incubate fertilized eggs in an abdominal pouch for a few days. Once they hatch, the larval and early juvenile offspring require brackish conditions and reflect a physiology adapted for downstream transport to estuarine and marine environments during wet seasons. Development to adulthood apparently occurs mainly in oceanic or coastal marine habitats, after which the pipefish move back into freshwater. Habitat destruction, declining water quality, and an increase in disease are the major threats to the opossum pipefish. There are very few records of opossum pipefish in northwestern Gulf estuaries (NMFS, 2006d). In Texas, this species has only been found in the lowermost reaches of the Rio Grande River in Cameron County and is not likely to occur in the study area (Hubbs et al., 1991).

American Eel (*Anguilla rostrata*)

While the American eel (*Anguilla rostrata*) is not formally listed as threatened or endangered in Texas, it has been identified as a candidate species (those species of concern that are actively being considered for listing as endangered or threatened) by the NMFS (2006d). This concern stems from general declines in

the apparent numbers, which are believed to be largely due to main-stem impoundments on rivers (Haro et al., 2000). The American eel occurs primarily in the Great Lakes and rivers with open access to the Atlantic Ocean and Gulf of Mexico. The American eel is catadromous, spending most of its life in rivers while migrating to the sea to spawn. Spawning occurs in the Sargasso Sea and after spawning, it is thought that the adults die. The young develop while drifting as plankton in the open sea; when they become juveniles (often referred to as "glass eels") they migrate into estuaries to mature. American eels are opportunistic carnivores, feeding on a vast array of animal life depending on the size of the eel and the availability of prey within a given habitat (Van Den Avyle, 1984). In Texas, records include American eels from the Red River to the Rio Grande in most large river systems; however, it is unlikely this species will occur in the study area (Hubbs et al., 1991).

Dusky Shark (*Carcharhinus obscurus*)

The dusky shark (*Carcharhinus obscurus*), also known as the bronze whaler or black whaler, was added to the NMFS species of concern list in 1997. It has a wide-ranging (but patchy) distribution in warm-temperate and tropical continental waters (NMFS, 2006d). It is coastal and pelagic in its distribution where it occurs from the surf zone to well offshore and from surface depths to 1,300 ft (Compagno, 1984). Because it apparently avoids areas of lower salinities, it is not commonly found in estuaries (Compagno, 1984; Musick et al., 1993). The dusky shark is not likely to occur in the study area.

Goliath Grouper (*Epinephelus itajara*)

The goliath grouper (formerly jewfish) is the largest of the western Atlantic groupers, and is also the one that tends to occur in the shallowest and lower salinity areas (NMFS, 2006a). Adults are typically associated with reefs of other hard bottom habitats (e.g., around jetties), while juveniles tend to occur in mangroves and other vegetated areas. The Goliath grouper is considered a species of concern because of sharp stock declines in the 1970s and 1980s. This is believed to be due to overexploitation, to which they are particularly vulnerable because of a tendency to aggregate in relatively shallow water.

Largetooth Sawfish (*Pristis pristis*)

The largetooth sawfish (*Pristis pristis*) is a sluggish demersal (bottom-dwelling) fish inhabiting near-shore marine, coastal, estuarine, and tidal freshwater habitats. It is listed as a species of concern due to declining stocks in recent decades, thought to be caused by incidental commercial catch and (mainly in inshore areas) habitat degradation (NMFS, 2006d). In the U.S., largetooth sawfish have most commonly been reported in the northern Gulf, although records are sporadic. The species is somewhat more common in tropical areas. Since most of the records in the northern Gulf are of adults, it is believed that spawning may be confined to more southern waters (McEachran and de Carvalho, 2002). The largetooth sawfish has been rarely reported in the Gulf and is not likely to occur in the study area (Hoese and Moore, 1998).

Night Shark (*Carcharhinus signatus*)

NMFS designated the night shark (*Carcharhinus signatus*) a species of concern in 1997. Data on this species are minimal because the shark is a deepwater species, exceeding 525 ft in depth. The shark has been reported in waters from Delaware south to Brazil, including the Gulf. It has also been reported from West Africa. It was formerly abundant in deep waters off the northern coast of Cuba and the Straits of Florida (NMFS, 2006d). The night shark is not likely to occur in the study area.

Saltmarsh Topminnow (*Fundulus jenkinsi*)

NMFS designated the saltmarsh topminnow (*Fundulus jenkinsi*) as a species of concern in 1997. This rare species is restricted to coastal streams and adjacent bay shores on the western side of Galveston Bay and from Vermilion Bay to the Florida Panhandle. Usually found in low salinities, it has been taken from the Chandeleur Islands (Hoese and Moore, 1998). This species tends to live in salt marshes and brackish water, although it has been known to survive in freshwater. This species can also be found in shallow tidal meanders of *Spartina* marshes (NMFS, 2006d). In Texas, the saltmarsh topminnow is known only from Dickinsons Bayou near Galveston Bay and is not likely to occur in the study area (Hubbs et al., 1991).

Sand Tiger Shark (*Odontaspis taurus*)

The Atlantic and the Gulf populations of the sand tiger shark (*Odontaspis taurus*) were added to the species of concern list in 1997. Sand tiger sharks have a broad inshore distribution. In the western Atlantic, this shark occurs from the Gulf of Maine to Florida, in the northern Gulf, in the Bahamas and in Bermuda. Although first reported in Texas in the 1960s, this species does not seem to be uncommon. A cool temperate species, it is more common north of Cape Hatteras (Hoese and Moore, 1998). They are generally coastal, usually found from the surf zone down to depths around 75 ft. However, they may also be found in shallow bays, around coral reefs and to depths of 600 ft on the continental shelf. They usually live near the bottom, but may also be found throughout the water column (NMFS, 2006d). The sand tiger shark is uncommon in the Gulf and is not likely to occur in the study area (Hoese and Moore, 1998).

Speckled Hind (*Epinephelus drummondhayi*)

The speckled hind (*Epinephelus drummondhayi*) inhabits warm, moderately deep waters from North Carolina to Cuba, including Bermuda, the Bahamas and the Gulf. The preferred habitat is hard bottom reefs in depths ranging from 150 to 300 ft, where the temperatures are from 60 to 85°F. The speckled hind was listed as a species of concern 1997 (NMFS, 2006d). This species is rare in the northwestern Gulf and is not likely to occur in the study area (Hoese and Moore, 1998).

Warsaw Grouper (*Epinephelus nigritus*)

The Warsaw grouper (*Epinephelus nigritus*) was listed as a species of concern in 1997. It is a very large fish found on the deepwater reefs of the southeastern United States. Warsaw grouper range from North Carolina to the Florida Keys and throughout much of the Caribbean and Gulf to the northern coast of South America. The species inhabits deepwater reefs on the continental shelf break in waters 350 to 650 ft

deep. As for all of the candidate species above, the main threat to them has been mortality associated with fishing (NMFS, 2006d). Although Warsaw grouper are not likely to occur in the study area, they have been found near jetties and offshore oil platforms (Hoese and Moore, 1998).

3.16 CULTURAL RESOURCES

The cultural history of the project study area has been assigned to four primary developmental stages: Paleoindian, Archaic, Late Prehistoric, and Historic. These divisions generally are believed to reflect changes in subsistence as reflected by the material remains and settlement patterns of the people occupying this portion of Texas in prehistoric and early historic times.

3.16.1 Cultural Setting

The earliest generally accepted culture of the Americas, the Paleoindian period (ca. 10,000 to 6,500 B.C.), appears to have extended over most, if not all, of North America by the end of the Pleistocene epoch. It has been hypothesized that in Texas, the Pleistocene coastline extended as much as 25 miles into the present Gulf and that rivers cut deep canyons into sediments deposited during previous periods of glaciation (Aten, 1983). With the close of the Pleistocene came a period of climatic warming and a consequent rise in sea level as surface water was released from glaciers and polar ice. Paleoindian cultural developments in the Gulf Coastal Plain region, as in most areas of North America, appear to have been intimately related to these gradual but vast changes in the world climate and local environmental conditions.

Occupation of the Texas Gulf Coast during the terminal Pleistocene is evidenced by the recovery of several types of well-made, lanceolate, parallel-flaked projectile points such as *Scottsbluff*, *Clovis*, *Plainview*, *Angostura*, and possibly *San Patrice* types. The presence of these distinctive projectile point types along the coastal plain appears to reflect activities that would typically have occurred in areas further inland where the environment is characterized by a mixture of deciduous and pine woodlands (Aten, 1983). According to Aten (1983), this type of habitat typically supports low-density human populations. Archeological evidence synthesized by Story et al. (1990) from numerous counties comprising the greater Gulf Coastal Plain in Texas, Louisiana, Arkansas, and Oklahoma supports the suggestion that the Paleoindian groups probably existed in small nuclear families or bands which migrated widely in pursuit of seasonal subsistence resources.

Paleoindian sites in Galveston Bay (the sites closest to the project area) that have been investigated include the Galena Site (41HR61) and the Crystal Beach Site (41GV101) on Bolivar Peninsula. Both of these sites yielded singular surface finds of the *Clovis* type, with the Galena site also yielding a later *Scottsbluff* type point. Another Paleoindian site, the McFaddin Beach Site (41JF50) in Jefferson County has yielded 33 early culture points from a 25 miles stretch of beach over a span of several years (Story et al., 1990). The site has also yielded an extensive array of associated tools and faunal remains. An important aspect of the McFaddin Beach Site is its potential to refine geoarcheological predictive models for locating submerged cultural deposits within the bays and deltas of the Gulf Coasts' numerous rivers

and their tributaries (Story et al., 1990). The parent deposit for the many artifacts recovered along McFaddin Beach appears to be a submerged Pleistocene shelf located just offshore, which is being eroded by wave action (Aten, 1983). As this formation has been buried beneath the relatively shallow sediments of a minor stream that empties into the Gulf, it has been impacted by littoral erosion forces that have contributed to the redistribution of artifacts above the nearby beach.

In the Archaic period (6500 B.C. to A.D. 700), cultural developments appear to have progressed somewhat beyond those of the Paleoindian period with the onset of the Holocene epoch. Changes in the world climate caused sea levels to rise, inland prairies to expand and regional weather patterns to become more variable (Aten, 1983). This time period of cultural development in the New World has been further subdivided into Early, Middle, and Late stages, based on changes observed in the archeological record that appear to coincide with episodic shifts in the Holocene climate and environment. It is commonly thought that human lifestyles and subsistence strategies maintained the patterns developed during the previous Paleoindian period, but with some notable differences.

Aten (1983) suggests that Early Archaic groups, like their Paleoindian predecessors, probably continued to migrate seasonally in small bands and relied on a generalized projectile point technology to facilitate their hunting and gathering of a variety of faunal and vegetal foodstuffs. Despite a paucity of intact Archaic components at sites in the Texas Gulf Coast region, it has been observed that Archaic lithic technologies appear to show an increased diversity of functional types and styles over those associated with the Paleoindian period. However, the level of artisanship and the use of fine exotic materials appear to have declined. In addition, the greater array of Archaic projectile point styles appears to reflect a greater degree of regional cultures. Story et al. (1990) surmise that Archaic period human populations may have become more dense with individual bands covering less overall territory on their seasonal rounds.

Differentiation between Early, Middle, and Late Archaic culture sites in the Texas Gulf Coastal region, without the benefit of sufficient associated cultural features and artifacts from which strong chronological dates and sequences can be derived, has been based largely on observation and comparison of projectile point styles associated with more intact archeological contexts elsewhere in Texas and North America. The assumption has been that similar point styles are probably related chronologically despite sometimes, vast geographical distances. According to these lines of reasoning, Early Archaic point types are usually considered to include *Baird*, *Bell*, *Andice,* and *Wells*, whereas *Bulverde*, *Carrollton*, and *Trinity* points are usually attributed to the Middle Archaic stage. Based on a relatively greater database for defining the Late Archaic, point types considered diagnostic of this cultural stage typically include *Gary*, *Kent*, *Yarbrough*, *Ellis*, *Palmillas*, and *Refugio* (Patterson, 1979).

The Late Preceramic, which coincides, in part, with Late Archaic elsewhere in Texas, extends from the approximate period in which sea level attained its present state until the advent of ceramic service and storage vessels, ca. A.D. 100 (Aten, 1983). During this period, the population increased significantly, marked by an increase in the number of sites as well as intrasite artifact frequencies (Aten, 1983). Hall

(1981) has also noted an increase in traumatic death and the development of trade relations with Woodland cultures to the east during the Late Archaic. A settlement system, which may have included a seasonal round with group dispersal in coastal areas during the summer and consolidation in inland areas during the winter months, may have begun during the Late Archaic (Aten, 1983). However, the occurrence of shell middens at Late Archaic sites is not as common as at later sites (Patterson, 1979). Projectile points diagnostic of Late Archaic occupations include *Gary*, *Kent*, *Yarbrough*, *Ellis*, *Palmillas*, and *Refugio* (Patterson, 1979).

The addition of *Perdiz* and *Scallorn* arrow points to the inventory marks the beginning of the Late Ceramic period. Ceramics of the earlier period may include *Goose Creek Plain* variety *Anahuac, O'Neal Plain* variety *Conway*, *Mandeville Plain*, *Tchefuncte Plain*, *Goose Creek* variety unspecified, and *Tchefuncte Stamped*. In the Late Ceramic period, the ceramic inventory may include *San Jacinto Incised* and *Baytown Plain* varieties *Phoenix Lake* and *San Jacinto* (Aten, 1983). It should be noted, however, that several varieties of *Goose Creek Plain* as well as *Goose Creek Incised* (and *Red-Filmed*), and the occurrence of bone tempering, span much of the Ceramic period.

Population during the Late Prehistoric tended to increase until European-introduced disease helped to decimate the aboriginal inhabitants. Patterson (1979) observed an increase in numbers of Late Prehistoric sites, while individual sites exhibit fewer cultural remains. He interprets this as evidence of a more mobile lifestyle.

3.16.2 Historic Period (A.D. 1519 to present)

3.16.2.1 Native Inhabitants

When Europeans arrived in the central Texas coast, they encountered several linguistically related groups of Karankawa Indians, who occupied territories from Galveston Bay to Corpus Christi Bay. The Karankawan groups spoke a language of the Coahuiltecan family and were more closely related to the Indians further south in Texas and Mexico. The Karankawan groups were nomadic, and subsisted on shellfish, turtles, marine and land plants, alligator, deer, bison, bear, and peccary (Ricklis, 1996). They lived in portable windbreak-style huts.

The Karankawa also used pottery and the bow and arrow, along with dugout canoes propelled by poles, basketry, cane weirs, milling stones, drums and whistles, tambourines, lances, clubs, axes, and bone tools. They buried their dead in burial mounds and left refuse middens (primarily shell), they also wore breechcloths and skirts and decorated themselves with tattoos. These groups were equally unprepared to defend themselves and their cultural traditions from the newly arrived Europeans. By the late eighteenth century, all of the Karankawa groups were in serious decline (Newcomb, 1983).

3.16.2.2 European Exploration and Colonization

Alonso Alvarez de Pineda led an expedition to map the Gulf in 1519. This expedition is believed to have been the first time a European visited Matagorda Bay. Guido de Lavazares followed Alvarez de Pineda's expedition and sailed to the Bay in 1558. He named it San Francisco and took possession for the king of Spain (Kleiner, 1996c; Weddle, 1991). These early explorers were the first and last Europeans to sail ships to Matagorda Bay until La Salle arrived more than a century later.

Matagorda Bay was all but forgotten for 14 years until René Robert Cavelier, Sieur de La Salle wandered into Matagorda Bay with three ships and 300 colonists in 1685 mistaking it for a Mississippi River tributary. One of La Salle's ships, *L'Amiable*, was lost on the shallow bar of Pass Cavallo while attempting to enter the bay.

La Salle erected a crude fort on Matagorda Island and attempted to establish a permanent colony, which he named Fort St. Louis, on Lavaca Bay. The expedition was plagued with misfortune, and La Salle soon lost a second ship, La Belle, inside the bay (Weddle, 1991). Low morale weakened the resolve of the would-be settlers, and members of La Salle's crew eventually murdered him during an inland expedition in search of the Mississippi River. The remaining inhabitants of Fort St. Louis gradually succumbed to the elements and to the natives. The empty fort was later discovered by a Spanish expedition.

Though La Salle did not succeed in establishing a permanent colony in Matagorda Bay, he did launch the "…most intense coastal reconnaissance ever made in the Gulf of Mexico" (Weddle, 1991). Meanwhile, Spain was infuriated with the French incursion. Determined to prevent foreign control of their possession, the Spaniards launched many coastal voyages with the dual purpose of exploring their ignored territory and locating La Salle's colony. Several of these expeditions were aboard ships that passed through Pass Cavallo, Matagorda Bay's only natural entrance. Juan Corso first followed La Salle in 1685, hoped to capture the French supply ship but passed Matagorda Bay, never sighting the French camp on Matagorda Island (Weddle, 1991).

Martin de Rivas and Pedro de Iriarte, with two shallow-draft piraguas, were the first Spaniards to officially search for La Salle. Their expedition reached Pass Cavallo in 1687. Rivas's expedition sailed into Matagorda Bay and located the abandoned wreck of the French ship *La Belle.* Rivas explored the bay northeast to Palacios Point and the Colorado River, then northwest to Sand Point and the Lavaca Bay entrance. French colonists at Fort St. Louis were narrowly overlooked. Rivas next sailed down the shore and recrossed Matagorda Bay to Pass Cavallo. Depths were sounded during this crossing revealing Matagorda Bay's maximum depth as little more than 2 fathoms (12 ft). The expedition concluded, "if the French intruders had attempted to land here, …they certainly had met with disaster and no longer posed a threat" (Weddle, 1991).

Martin de Rias returned with Andres de Pez in 1688 to further explore Matagorda Bay. Rivas and Pez explored the entire shore of the bay, possibly into Lavaca Bay. Only later when Alonso de Leon sailed Matagorda Bay in 1689 was Fort St. Louis discovered abandoned. Spain subsequently sent two

expeditions in 1690 to determine the feasibility of occupying the uninhabited French fortification. Alonso de Leon was sent again, as was Francisco de Llanos, the latter onboard the Nuestra Senora de la Encarnacion (Weddle, 1991).

Several other European explorers visited and/or explored Matagorda Bay, including the English Pilot Juan Poule (Poole or Powell), who careened his ships in the bay in 1684, the English Captain William Bond, who sailed to the bay in 1699, and Marques de San Miguel de Aguayo, who produced a schematic map of Matagorda Bay and established a fortification (La Bahia del Espiritu Santo) on La Salle's previous occupation site in 1722 (Weddle, 1991). The Presidio at La Bahia, and its neighboring mission (Nuestra Senora del Espiritu Santo de Zuniga) became an established port in the 1770s with its own garrison. Spanish ships from Havana and Vera Cruz often passed through Pass Cavallo on a supply mission to these Spanish settlements.

3.16.2.3 Anglo American Colonization and Occupation

The period between 1782 and 1810 was one of much interest to Europeans and Americans, and brought increased ship traffic to the bay. The port that would later become Matagorda was investigated in 1804 and found to have good depth to permit vessel access (Guthrie, 1988). Matagorda, however, would wait a few more years before colonization. Traders and the Mexican government used the area around present day Port Lavaca in 1815 to offload supplies destined for the American interior. Louis Aury, who throughout 1816 and 1817 commanded the Mexican Republic fleet in its rebellion against Spain, spent time in Matagorda Bay. Aury convoyed the filibustering expedition of Francisco Xavier Mina into Mexico (April 1817) and returned afterwards to Matagorda Bay. His fleet was kept in the bay and a fort was established. Aury failed, however, to establish a permanent presence in the area and eventually returned to Galveston Bay (Freier, 1979; Guthrie, 1988; Warren, 1996).

Official Anglo-American settlement of Matagorda Bay began in 1822, when 52 immigrant families sailed from New York to Stephen F. Austin's colony at the mouth of the Colorado River. Austin's colony was supplemented again in 1827 with 300 families. A steady stream of immigrants subsequently arrived at the Colorado River via both sailing ships and steamers. The town of Matagorda was established to handle this influx of settlers and supplies, and it soon became the seaport for Austin's colony. A customshouse was subsequently established in 1831, while a military post was also erected to protect immigrants from Indian attacks. With settlers and protection, Matagorda soon flourished and expanded. Immigration increased in the early 1830s and Matagorda, being the closest port to New Orleans, became known as the gateway port into Texas.

Matagorda Bay became engulfed in the Texas War for Independence in 1835, spurred by unrest towards the Mexican government and Texas's declaration of independence. Goods were shipped through the port towns of Matagorda, Linnville, and Dimmitt's Landing on Cox's Point in order to supply the Texas Army in the interior (Guthrie, 1988). The town of Lavaca likely participated and prospered in this provisioning, although little information is available for this period.

3.16.2.4 Texas Republic

Matagorda Bay's port towns and their economies boomed following Texas independence. Moreover, several new towns sprouted to take advantage of the lucrative trade occurring within and beyond Matagorda Bay. Vessel owners beginning in the late 1930s were licensed to operate lighters, sloops, and schooners along the entire Matagorda Bay coastline. The port of Matagorda continued trade in cotton, sugar, and molasses while importing slaves, immigrants, and their goods. The town, for a short time, additionally possessed the only customshouse, thereby insuring all goods passed through Matagorda. Wealth and growth followed (Guthrie, 1988).

The relatively young town of Lavaca also flourished after the war. Lavaca, from its beginning, was envisioned as an important shipping and trading location and it was not long before this was realized. The separate customs district of Lavaca was established in 1839, thus eliminating Matagorda's preeminence. Linnville, the district's official port of entry also benefited. Shipping to these ports increased dramatically for a brief time until 1841, when both the Matagorda and Lavaca districts were abolished and the district of Calhoun was created (Guthrie, 1988).

3.16.2.5 American Civil War

Texas ports were blockaded by the U.S. Navy beginning early in the war, and those in Matagorda Bay were of no exception. Virtually all trade that had up to this point created a booming economy in the port communities ceased as a result of this blockade. The Federal blockade ended the lives of several bay towns and threatened the existence of all. Blockade runners operating out of Matagorda had some success exporting cotton and delivering arms and clothing to the Confederacy, but such successes were rare. Virtually the only trade conducted through the bay was internal. This type of trade, however, could not sustain a bay that prospered from extensive and diverse external exchange.

Federal ships controlled the entire bay and frequently entered. Ships fired on the port of Matagorda in December 1863, but did not come ashore. Matagorda was spared occupation; other communities were not. Federal troops landed and occupied Fort Experanza (located on Matagorda Island at Pass Cavallo), Port Cavallo, Saluria, Indianola and Port Lavaca. Before their occupations, Indianola and Port Lavaca were bombarded in October and November 1862. The effect of the Union blockade was so complete during the war that the backlog of ships at Indianola ceased and business dropped to zero. This stranglehold on Matagorda Bay continued until the blockade was lifted in June 1865 (Guthrie, 1988; Kleiner, 1996a; Leatherwood, 1996).

Shipping slowly returned to Matagorda Bay following the war, and business once again boomed. Some bay towns, however, never recovered from the effects of the Civil War. With the destruction of shipping infrastructure to prevent Union capture of the economy, Saluria suffered irreparably due to the loss of activity resulting from the blockade. Saluria was destroyed after storms in 1875 and then again in 1886. The shipping industry at the port of Matagorda did, however, experience a brief resurgence after the war with cattle being the main export. River transport was still provided and the Morgan lines continued

service. However, even with the resurgence of Matagorda's shipping business it never reclaimed its former status. This was attributed to the development of other coastal ports and the railroad (Guthrie, 1988; Kleiner, 1996b).

Matagorda Bay was first surveyed by the U.S. Army in 1853. Reporting on Port Cavallo, Lt. George B. McClellan noted that the pass had the best accessibility past the sand bar other than the entrance to Galveston Bay, although he was less than enthusiastic about undertaking any improvements to the pass. In its natural state the pass could only accommodate shallow-draft vessels. Despite McClellan's recommendations, a proposal was made in 1879 for improvements. A jetty was begun under the direction of Major Mansfield at the south side of the pass in 1881. The jetty was designed to extend 7,600 ft (2,316 m) from Matagorda Island. Construction continued on the project for 5 years until inadequate funding forced its abandonment. After the abandonment of the jetty project at Pass Cavallo in 1888, no improvements were attempted between the Gulf and Matagorda Bay for several decades (Alperin, 1977).

3.16.3 Previous Investigations

3.16.3.1 Terrestrial Surveys

Reviews of previous research along the central Texas Coast have been presented by Shafer and Bond (1985), Black (1989), and Weinstein et al. (1992). In addition Gadus et al. (1999) presented an indepth review of more recent investigations in the lower Guadalupe/San Antonio rivers region.

The earliest archeological investigations in the central Texas Coast region were conducted by George Martin and Wendal Potter, avocational archeologists who recorded 126 sites in the Aransas Bay area in the late 1920s (Martin, 1929, 1930a, 1930b, n.d.; Potter, 1930). In the early 1930s E.B. Sayles visited sites and collections throughout the State and published a synthesis of Texas prehistory, within which he initially defined the Brownsville and Rockport phases of the Texas coast (Sayles, 1935). Sayles seems to have been largely concerned with the relationship between Texas cultures and southwestern origins.

The earliest extensive site excavation along the central Texas Coast was the Works Progress Administration's (WPA) work during the 1930s. Campbell reported on work at the Johnson, Kent-Crane, and Live Oak Point sites (Campbell, 1947, 1952, 1958a). A number of sites including 41CL14 (Indianola), 41CL7 (Sonneman), and 41CL6 (Steinburg) were investigated, but no analysis or report was ever published. Campbell's interpretations were instrumental in further defining the Aransas and Rockport foci (Campbell, 1956, 1958b, 1962). The 1960s saw several large survey investigations in the region (Corbin, 1963; Hester, 1969), including excavations of the Ingleside Cove and Anaqua sites (Story, 1968). In the early 1970s, Fritz (1972, 1975) conducted a survey of several areas as part of a multidisciplinary Matagorda Bay-Estuarine Resource Management Study. The study included sections of Navidad, Delta, Lavaca, Cox, and Keller bays and recorded 94 archeological sites.

Archeological surveys in Matagorda County have been conducted in recent years for oil and gas and other development project. Few large scale investigations have been conducted on land among them are the

Matagorda Bay Survey (Fritz and Dillehay, 1975) and the Mad Island Wildlife Management Area (WMA) survey (Hubbard et al., 1996; Ricklis, 1997).

The 1975 Matagorda Bay Survey is one of the most comprehensive surveys conducted in the county and resulted in the identification of 94 sites in Calhoun, Jackson, Matagorda and Victoria counties. Of these, 28 of the sites were in Matagorda County. The sites recorded during this survey included 79 prehistoric and 15 historic occupations. The prehistoric components represented were Archaic and Late Prehistoric and consisted of lithic scatters, shell middens, and ceramic sherd scatters (Fritz and Dillehay, 1975). Three sites were also tested during the course of the fieldwork.

The Mad Island WMA survey was conducted by Moore Archeological Consulting in 1996. The survey was conducted in an effort to identify archeological sites prior to the construction of a seismic line (Hubbard et al., 1996). The survey resulted in the identification of 18 archeological sites, 14 shell middens, 1 historic site, and 3 scatters of cultural material. One previously recorded SAL designated site 41MG60 was revisited at this time. In 1997 Ricklis conducted geoarcheological investigations at the site (Ricklis, 1997). Additional work at the Mad Island WMA was conducted in 2003 on Rattlesnake Island. The work was conducted for El Paso Corporation which proposed to build an oil well on the northern portion of the island. No cultural resources were recorded during this survey (Reams and DeLaunay, 2003).

Other smaller cultural resources surveys were also conducted for the Palacios Seawall (Warren, 1985) and the Palacios Railroad Park (Warren, 1988). The seawall project included a pedestrian survey with shovel testing and backhoe trenching and a boat survey in off-shore area. No prehistoric archeological sites were recorded but six early-twentieth-century houses adjacent to the project area were identified (Warren, 1985). The Palacios Railroad Park did not result in the identification of any archeological resources (Warren, 1988).

More recently a 42-ac tract was surveyed for the Edward David Estates Project by Brazos Valley Research Associates (Moore, 2005). Oyster shells were observed on the surface during the survey and there may have been a historic site present in the 42-ac tract, but no significant cultural resources remained at the time of the survey.

Horizon Environmental conducted a cultural resources survey of three proposed well pads covering approximately 9 ac and three access roads, which covered about 2 miles for Brigham Oil and Gas on the western shore of the Palacios Point peninsula (Weinstein, 2006). During the survey archeologists documented remnants of a historic townsite, which is known locally as Palacios Town, site number 41MG113 was assigned to this site.

3.16.3.2 Nautical Surveys

The petroleum industry, oyster shell dredging operations, and USACE projects have served as impetus for cultural resources surveys in Matagorda Bay. The search for French explorer La Salle's shipwrecked

vessels additionally contributed to the survey and identification of several historic sites. The locations of these surveys are delineated on Figure 3.16-1. Some survey areas have been approximated.

Modern archeological surveys for historic submerged sites in the Matagorda Bay area commenced in 1971. Seven State-owned tracts in the northwest region of the bay were surveyed as part of an assessment related to a shell dredging operation (Institute for Underwater Research, Inc., 1971). Sixteen potential shipwreck sites were isolated during the course of the survey, only one of which produced artifacts indicating it to be a modern wreck.

In 1978, North Texas State University surveyed portions of Matagorda Bay as part of a liquid natural gas terminal project (McCormick et al., 1978). Marine survey areas included (1) a deep-water approach channel, a turning basin, and a docking basin near the abandoned site of Indianola; (2) portions of the MSC, which was to be widened and deepened; and (3) a proposed dredged material PA east of the MSC measuring 43,000 ft in length and 5,500 ft in width (McCormick et al., 1978). The project located several suspicious magnetic anomalies and subbottom profile targets within each of the survey areas, and test excavations were recommended at these sites.

Also in 1978, the Texas Historical Commission (THC) conducted a magnetometer survey of portions of Matagorda Bay, followed by underwater site test excavations of selected anomalies (Arnold, 1982). One main objective of the survey was to locate and identify the remains of one or both of La Salle's shipwrecks, *La Belle* and *L'Amiable*. Arnold (1982) selected 12 anomalies for diver investigation. Five of those anomalies were associated with nineteenth- and twentieth-century shipwrecks, three of which were possibly eligible for inclusion in the National Register of Historic Places (NRHP). Six of the remaining seven anomalies were ruled out as associated with a shipwreck; the source of the seventh anomaly was buried too deeply for successful diver investigation.

Mid-Matagorda Peninsula, east of the MSC, was surveyed in late 1986 as part of the Placid Oil Company Pipeline Tow Project (Pearson, 1987). The survey included both an inland magnetometer survey and offshore remote-sensing. Twenty-nine anomalies located during the inland survey were found to be associated with modern debris. Four anomalies were identified during the offshore segment of the survey; one of these was discovered to be the wreckage of a modern vessel.

A 1988 survey by Coastal Environments, Inc. (CEI) included, in part, 5.4 miles of the lower MSC (Pearson and Hudson, 1990). CEI located 53 new magnetic targets, 12 of which were labeled as exhibiting some characteristics expected for shipwreck remains. Diver ground-truthing was conducted at 5 anomaly locations, all of which were demonstrated to not be shipwreck-related. Eventually, all 12 of the initially recommended anomalies were removed from further consideration and were determined to be the result of modern debris.

A portion of upper Lavaca Bay was surveyed in 1992 in conjunction with proposed maintenance dredging for lower Navidad and Lavaca Rivers in Jackson County, Texas (Pearson et al., 1993). CEI was contracted by the USACE to survey four historic shipwrecks in the proposed project area. Very few

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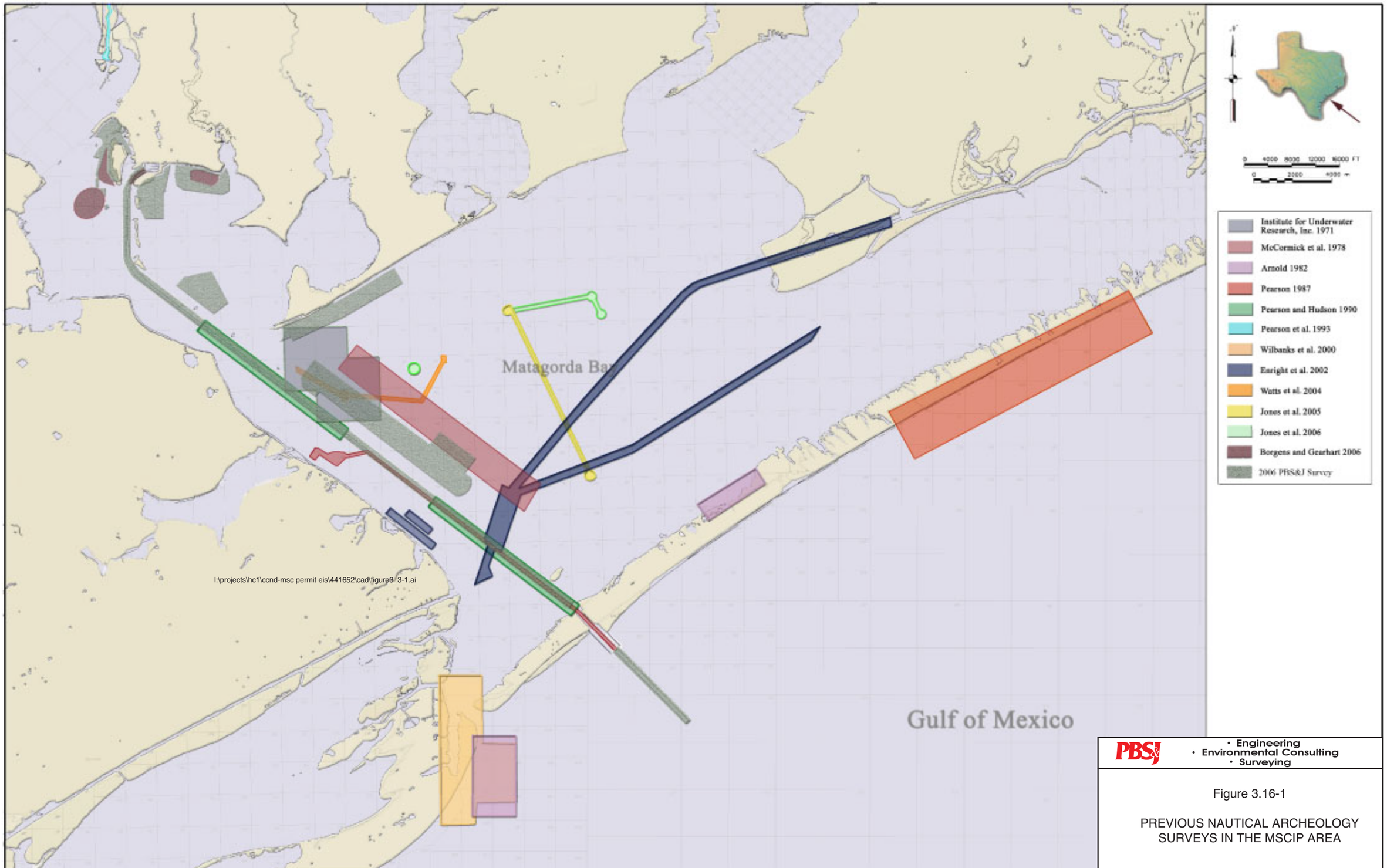

Figure 3.16-1

PREVIOUS NAUTICAL ARCHEOLOGY SURVEYS IN THE MSCIP AREA

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magnetic anomalies were discovered during the course of work and only two were identified as shipwrecks. These vessels were a wooden fishing trawler (41JK188), and the previously recorded wreckage of a side-wheel steamer (41JK9) (Pearson et al., 1993).

The National Underwater and Marine Agency conducted a multiphase extensive survey of Pass Cavallo begun in late 1997 and concluded in July of 1999 (Wilbanks et al., 2000). Phase I involved an aerial magnetometer survey conducted by World Geoscience, Inc. The second phase of the survey consisted of detailed remote sensing, identification, and evaluation of isolated targets. The primary goal of the combined surveys was to locate the wreck site of *L'Amiable*, a supply vessel of La Salle's that ran aground and sank in 1685. Sixty-six targets were identified during the survey, 18 of which were determined to be shipwrecks or wreck sites. Based on diver assessment of the sites, 10 were determined to be twentieth-century shipwrecks, 5 were nineteenth-century wrecks, 2 were eighteenth-century wrecks, and 1 could not be identified due to its depth under sediment.

In 1999 and 2000, PBS&J conducted a remote-sensing survey of portions of Matagorda Bay on behalf of the USACE (Enright et al., 2002). The purpose of this work was to assess alternate routes proposed for expansion of the GIWW through Matagorda Bay and associated PAs. The study included mapping potential shipwrecks and shell reefs. Nine remote-sensing targets were recommended for cultural resource avoidance along the alternate routes; however, a subsequent close-order remote-sensing survey resulted in a reversal of the original recommendations for all nine of those anomalies. Another remote-sensing survey of two proposed PAs was conducted later, which resulted in the recommendation of five additional anomalies for avoidance. All but one of those anomalies were successfully avoided, and the exception proved, upon further analysis, to be associated with a capped petroleum well.

In 2004, PBS&J performed a cultural resources marine remote-sensing survey of 2 proposed well pads and 4 flow lines in Matagorda Bay for Sterling Exploration and Production Co., LLC (Watts et al., 2004). Five magnetic anomalies were recommended for further investigation or avoidance as a result of that survey.

Also in 2004, PBS&J performed a similar cultural resources remote-sensing survey of 2 proposed flow lines and 2 proposed well pads in Matagorda Bay for Cinco Natural Resource Corporation (Jones et al., 2005). As a result of that survey, three magnetic anomalies were recommended for further investigation or avoidance.

In November 2005, PBS&J performed a cultural resources marine remote-sensing survey of 3 proposed well pads and a collective 5.3 kilometers of related flow lines in Matagorda Bay for BOSS Exploration and Production Company (Jones et al., 2006). PBS&J determined 4 of the recorded magnetic anomalies to be potentially significant and recommended that they be avoided by all bottom disturbance activities.

3.16.4 File Review for Terrestrial Cultural Resource Sites

The records review and literature search for the current project in Calhoun County were conducted at the Texas Archeological Research Laboratory (TARL) and at the THC. The files at TARL were used to identify previously recorded archeological sites near the study area. The files at the THC were examined to learn if any sites listed on or determined eligible for listing on the NRHP are within the study area boundaries. The files at the THC were also examined to identify State Archeological Landmarks (SAL) and State Historical Markers in the vicinity of the study area.

The records at TARL identified about 100 recorded archeological sites in Calhoun County. The THC files identified 65 SAL designated sites, most of which are shipwrecks, and one NRHP listed property, the Matagorda Island Lighthouse, in the county. Forty-seven historical markers are recorded in the county.

3.16.5 File Review for Shipwrecks

Potential shipwrecks occurring within the project area are presented in Table 3.16-1. Source material for Table 3.16-1 was drawn primarily from 3 database collections. The THC maintains a database of shipwrecks which is drawn from a variety of sources, especially historical accounts. PBS&J also maintains a database drawn from historical accounts, industry reports, and Automated Wreck and Observation System (AWOIS) listings. The AWOIS is maintained by the NOAA and focuses on shipwrecks and other navigational hazards along the coastal United States. This database lists approximately 10,000 wrecks and provides locations and historical information.

3.17 LAND USE/RECREATION/AESTHETICS

This section presents a brief summary of land use, recreation, and aesthetic conditions for Calhoun, Jackson, Matagorda, and Victoria counties. Assessments were made based on review of USGS topographic maps and aerial photography, interviews with local planning officials, and internet research.

3.17.1 Historical Development Patterns

The land that would become the communities, cities, and counties of the study area was first home to numerous Native American tribes. Also, several explorers landed in the area in the sixteenth and seventeenth centuries. Mexican and United States settlers temporarily occupied the area before permanent establishments were made by Anglo-American colonizers. In the 1800s, the area was predominantly an agricultural center and served as a port for the shipping and receiving of mainly agricultural products.

Numerous tropical storms and hurricanes during the early part of the twentieth century damaged the area's infrastructure and served to impede population and economic growth. Yet natural amenities continued to attract homebuyers and tourists, and proximity and access to the major ports along the Gulf continued to attract industries.

Table 3.16-1
Potential Shipwrecks in Project Area

Name of Vessel	PBS&J No	AWOIS No	THC No	Rig	Length	Date Built	Gross Tons	Date Lost	Nature	Locality
Agnes	1016		1795	mail boat				9/16/1875	lost	Off of Indianola, Matagorda Bay
Agnes Gregg (Grey)	1069		1796	schooner			13.68	6/1875	stranded	Powderhorn Bayou, 8 miles, southwest of Indianola, Matagorda Bay Area, Texas
Alecia	994			Oil screw		1910	13	1928		Matagorda Bay, opposite Beacon 13
Alice	1516			mail boat				9/16/1875		Off of Indianola, Matagorda Bay
Alice	1656			schooner			23	1886	driven ashore	Indianola, Matagorda Bay
Annetta	1655			schooner				1886	driven ashore	Indianola, Matagorda Bay
Balvaneda	1020		112					1769		Matagorda Bay
Ben Hur	1096			gas screw		1908	10	1917	stranded	Port Lavaca, Matagorda Bay Area, Texas
Black Prince	1107			schooner			36.64	1879	stranded	Matagorda Island, 2 miles east of lighthouse
Buffalo Bill	1521			fishing boat				1886		Off of Indianola, Matagorda Bay
Caroline	1658							1886	driven ashore	Indianola, Matagorda Bay
Carousal	1021	5476						1984		Matagorda Bay, GLO block 188
Cheetah	1022	5509						1987		Matagorda Bay, GLO block 166
Commodore Morbitt	1511			schooner				9/16/1875		Off of Indianola, Matagorda Bay.
Constitution	1023		196					1838		Matagorda Bay, GLO block 109
Cora Bickford	1657			schooner				9/16/1875		Inland, 5 miles from Indianola.
Cosamaloapan	1140			river steamer			100	1271	foundered	Matagorda Peninsula; 12 miles northeast Saluria LSS
Decros Point Light	1024		919/ 925					1875		Matagorda Bay GLO block 138
Delmore	1517			sloop				9/16/1875		Off of Indianola, Matagorda Bay
Democrat				schooner				9/16/1875	beached	Indianola, Matagorda Bay
Dena H.	995			Gas screw			13	11/7/1911	burned	Alamo Beach, Matagorda Bay, Texas
Eclipse	1589			schooner			13	1866		Matagorda Bay
Edgar	1590			schooner	36'			1886?		unknown, Matagorda/Lavaca area
Edith Bell Nason Dover	1157		64	schooner			35.82	1875	stranded	Indianola, 300 yards northwest south of Powderhorn Bayou, Matagorda Bay Area, Texas
El Senor Yedra	1025		1919					1778		Matagorda Bay
Emeline	130		81							Between Sand Point and Cavallo Pass, Matagorda Bay Area, Texas
Emory	1515			mail boat				9/16/1875		Off of Indianola, Matagorda Bay
Envoy	1026		243					1850		Matagorda Bay
Faithful Lady	1027	5804						1984		Matagorda Bay, GLO block 600
Fina V	1653	2501						1976		Matagorda Bay, near Alamo Beach, GLO block 21
Flounder	1514			schooner				9/16/1875		Off of Indianola, Matagorda Bay
Fortuna	1184			schooner		1902	44	1916	stranded	Matagorda Peninsula, 11 1/2 miles west of Matagorda, on beach
General Bustament	1588			sloop				1830		Sand bar or beach in Lavaca or Matagorda Bay
Grand Prize	1031	5443						1972		Matagorda Bay, GLO block 113

Table 3.16-1
Potential Shipwrecks in Project Area

Name of Vessel	PBS&J No	AWOIS No	THC No	Rig	Length	Date Built	Gross Tons	Date Lost	Nature	Locality
Helen Story	998		295	schooner		1893	58	2/1/1913	stranded	Matagorda Penninsula, Texas
I.X.L.	1212			schooner		1890	7	4//1905	stranded	Matagorda, Texas
Illinois	1214		306	barge		1925	67	8/29/1942	foundered	Matagorda Bay, Texas
J.G. Cass	1035		3003					1863		Matagorda Bay
Jolly Roger	1037	5510						1987		Matagorda Bay, GLO block 168
Josephine	1236		12	Schooner			14.37	10/18/1887	stranded	Southwest end Matagorda Peninsula, east northeast, about 5 miles (5 1/2?) from Saluria LSS - GLO 139
Lake Austin	1660			scow						Ashore near Indianola, Matagorda Bay
Lizzie Dine	1264			schooner			6.48	1875	stranded	Indianola, 7 miles southwest of city, Matagorda Bay Area
Lue Ella	1272			sch.b.		1903	8	9/19/1919	stranded	Matagorda Bay, Texas
Maggie	1276		1470	schooner			12.2	1875	stranded	Indianola, 7 1/2 miles from Powderhorn Bayou, Matagorda Bay Area, Texas. Vessel was anchored in Powderhorn Bayou.
Matagorda Pilot	1045	5810						1966		Gulf of Mexio, Matagorda Bay Area, GLO 625
Miss Connie	1046		379					1967		Matagorda Bay
Miss Hayes	1047	5807	918					1967/1968		Gulf of Mexico - Matagorda Bay area GLO 656
Monterey	1048		1005					1848		Matagorda Bay
Nettie	1310			schooner		1876	12	8/15/1916	stranded	Port Lavaca, Matagorda Bay Area, Texas
Patomskia	1445		1677					1866		Matagorda Bay, Calhoun County, GLO block 111
Perseverance	1510			steamboat				1856		Off Indianola, Matagorda Bay Area
Phoenix	1512			schooner				9/16/1875		Off of Indianola, Matagorda Bay.
Pioneer	1448		428					1915		Matagorda Bay, Calhoun County
Prouty	1659			sloop				1886	capsized	Indianola, Matagorda Bay
Rasina Pinto	1339			schooner			12.93	1875	foundered	Matagorda Bay, "in bayou at Matagorda"
Rose	1350			sloop			7	1926	stranded	Matagorda, Texas
Royinia	1518			sloop				9/16/1875		Off of Indianola, Matagorda Bay
San Mary	1455	5433						1975		Matagorda Bay, Matagorda County, GLO block 181
San Mary	1454	5432						1974		Matagorda Bay, Matagorda County, GLO block 181
Santa Rosa	992		471					1815		Off Matagorda
Santa Rosa	993		472					1886		Matagorda Bay
Sea Gull	997			gas screw		1922	28	3/1829	foundered	Matagorda Bay, Texas
Sea Gull #23723	1457		966					1875		Matagorda Bay, Calhoun County
Shell Fish	1519			sloop				9/16/1875		Off of Indianola, Matagorda Bay
Star of the South	1520			sloop				9/16/1875		Off of Indianola, Matagorda Bay
Susan Smith	1370			schooner			16.3	1875	stranded	Matagorda, 7 miles east southeast from Matagorda
Thistle	1380			gas screw		1909	11	6/19/1929	foundered	Port Lavaca, Matagorda Bay Area, Texas
Tidal Wave	1513			schooner				9/19/1875		Off of Indianola, Matagorda Bay
U&I	1591			Lugger				9/16/1875	burned	Lavaca Bay, Calhoun County, Matagorda Bay Area
Unknown	1480		1495					1817		Matagorda Bay, Matagorda County
Unknown	1481		1496					1817		Matagorda Bay, Matagorda County
Unknown	1483		1498					1817		Matagorda Bay, Matagorda County
Unknown	1485		1500					1817		Matagorda Bay, Matagorda County

Table 3.16-1
Potential Shipwrecks in Project Area

Name of Vessel	PBS&J No	AWOIS No	THC No	Rig	Length	Date Built	Gross Tons	Date Lost	Nature	Locality
Unknown	1486		1501					1817		Matagorda Bay, Matagorda County
Unknown	1487		1502					1817		Matagorda Bay, Matagorda County
Unknown	1488		1503					1817		Matagorda Bay, Matagorda County
Unknown	1489		1504					1817		Matagorda Bay, Matagorda County
Unknown	1490		1505					1817		Matagorda Bay, Matagorda County
Unknown	1479		1494					1817		Matagorda Bay, Matagorda County
Unknown	1492		1956							Matagorda Bay, Calhoun County
Unknown	1482		1497					1817		Matagorda Bay, Matagorda County
Unknown	1505		927							Matagorda Bay, Calhoun County, GLO block 113
Unknown	1506		931							Matagorda Bay, Calhoun County, GLO block 135
Unknown	1507		932							Matagorda Bay, Matagorda County, GLO block 169
Unknown	1508									Matagorda Bay, Calhoun County, GLO block 145
Unknown	1491		1788					1770		Matagorda Bay, Calhoun County
Unknown	1464	5471						1986		Matagorda Bay, Matagorda County, GLO block 185
Unknown	1459	7912						1988		Matagorda Bay, Calhoun County, GLO block 130
Unknown	1460	5456						1983		Matagorda Bay, Calhoun County, GLO block 142
Unknown	1461	5463						1983		Matagorda Bay, Matagorda County, GLO block 164
Unknown	1462		926							Matagorda Bay, Matagorda County, GLO block 165
Unknown	1484		1499					1817		Matagorda Bay, Matagorda County
Unknown	1463	5467						1985		Matagorda Bay, Matagorda County, GLO block 165
Unknown	1478		1493					1817		Matagorda Bay, Matagorda County
Unknown	1465		935							Matagorda Bay, Matagorda County, GLO block 192
Unknown	1466		936							Matagorda Bay, Matagorda County, GLO block 192
Unknown	1467		921							Gulf of Mexico, Matagorda County, GLO block 616
Unknown	1468		1676					1766		Gulf of Mexico, Matagorda County, GLO block 630
Unknown	1063			schooner			7.73	1875	broken up	Matagorda Peninsula; 25 miles northeast of Indianola
Unknown	1477		1280					1935		Matagorda Bay, Calhoun County
Unknown	1476		879							Matagorda Bay, Matagorda County
Unknown (Target 12)	1587							"modern"		Matagorda Bay, GLO block 65
Vivian	1654	5472						1991		Matagorda Bay, GLO block 169
Volunteer	1397			gas screw		1893	9	4/14/1919	stranding	Port Lavaca, Matagorda Bay Area, Texas
West Carancahua	1401			schooner			14.04	1875	stranded	Matagorda Bay Area

During the late 1920s and early 1930s, access within Calhoun County was improved by the surfacing of roads in the county and by the completion of a causeway from Port Lavaca to Point Comfort. Major industries, such as Alcoa, moved to the area. Alcoa moved to Calhoun County and opened Alcoa PCO in 1947. The facility employed 2,600 workers and was the first aluminum production facility to be powered by natural gas. Alcoa PCO supplies alumina—the compound from which aluminum is made—to Alcoa's global production system. Since 1980, alumina has been PCO's primary product (Alcoa, 2006). In the mid-twentieth century, other major industries in the area included the Hartzog Shipyards, the U.S. Cold Storage Company, as well as the fishing and shrimping industry. By 1958, Calhoun County had a total of 11 manufacturers and 77 mineral-related enterprises. In the 1980s, Calhoun County farmers raised cattle, sorghum, rice, corn, pecans, and soybeans. Calhoun County's principal natural resources, after discoveries around 1935, remained industrial sand, oil, and gas. In 1988, the Formosa Plastics Corporation of Taiwan established a petrochemical factory at Point Comfort.

Port O'Connor, originally named Alligator Head, became the destination of permanent residents and tourists alike in the late nineteenth century. The community's growth suffered devastating setbacks after four separate hurricanes. In 1919, 1942, and 1945, hurricanes damaged the town, but Hurricane Carla in 1961, which came ashore at Port O'Connor, leveled the town and destroyed the five-block downtown area. Growth resumed after the disaster, aided by the increased military presence at the Matagorda Air Force Base. Despite its growth in population and popularity, Port O'Connor chooses not to incorporate (Port Lavaca Calhoun County, n.d.).

Historically, the City of Palacios, in the eastern quadrant of the study area, was never home to heavy industry, but grew steadily due to its proximity to a number of major industrial areas, such as the Alcoa plant in the 1940s, Celanese Chemical Company in the 1960s, and the South Texas Nuclear Project in the 1970s. The South Texas Nuclear Project, now known as the South Texas Project, employed more than 10,000 persons during construction in 1985, and after construction was completed, more than 1,000 permanent employees remained. The South Texas Project, located northeast of the study area, is situated on land within the Palacios Independent School District (ISD) and the district benefits from the additional tax revenue. In 1990, the marine and seafood-processing industry was the largest industry in the Palacios area. Agriculture, the second largest local industry, produced cattle, rice, maize, cotton, soybeans, corn, and turf. Petroleum and natural gas were also vital parts of the Palacios area economy, and in 1990, aquaculture was the newest developing industry.

In 1939, the GIWW, a coastal canal from Brownsville, Texas, to the Okeechobee waterway at Fort Myers, Florida, reached Port O'Connor, linking New Orleans with Corpus Christi (Texas State Historical Association [TSHA], 2002). Also, the location of the Alcoa plant at Point Comfort gave impetus to efforts in the 1950s to acquire a deep-sea channel for Matagorda and Lavaca bays. Construction of the MSC began in 1961, the cargo dock was completed in 1963, and the first ship arrived in 1965. The channel was completed with side channels branching off to Port Lavaca. In 1963, the Port was designated a United States customs port of entry. Between 1976 and 2004, numerous additions and improvements have been made to the infrastructure surrounding the channel, such as the completion of the barge bulk dock and

expansion of the liquid cargo ship pier, barge terminal, and multipurpose dock. MSC traffic in 1981 totaled 4,148,664 short tons, including 3,347,547 tons of imports, 153,501 tons of exports, and 647,616 tons of domestic shipments. Important exports included oil, cotton, seafood, and cattle (Van Borssum, 2005).

3.17.2 Identification of Existing Land Use

Calhoun, Jackson, Matagorda, and Victoria counties lie in the Coastal Bend region of Texas. Overall, land use within the four-county area consists of agriculture, rangeland, industrial, urban-residential and commercial, and recreation. Water use includes transportation, commercial and sport fishing, and recreation.

The study area for the proposed project encompasses Matagorda Bay, Lavaca Bay, Cox Bay, and Keller Bay. The coastline of this area extends across Calhoun, Jackson, and Victoria counties and includes the cities of Point Comfort and Port Lavaca, as well as the unincorporated communities of Alamo Beach, Indianola, Magnolia Beach, and Port O'Connor. Matagorda County, the City of Palacios, Carancahua Bay, and Tres Palacios Bay are situated at the northeast quadrant of Matagorda Bay. Jackson County spans the northeast portion of the study area, yet the closest incorporated town, La Ward, is approximately 10 miles northeast of Lavaca Bay.

Based on review of aerial photography, the project area consists of concentrated industrial and commercial development near the cities of Point Comfort, Port Lavaca, and the Port, and sparse residential development, agriculture, and undeveloped land beyond the coast.

The City of Port Lavaca is the largest city in the project area, population 12,035, and recreation and tourism are major draws to the area, as discussed in Section 3.17.3. Port Lavaca is largely residential with commercial development adjacent to US 87 and SH 35. Agricultural land exists west of the city and commercial and recreational uses dot the coastline. North of Port Lavaca, the land use is predominantly agricultural with scattered low density single family residences near Lavaca Bay. South of Port Lavaca, industrial land uses dominate the area.

Several locations adjacent to Matagorda Bay are dominated by industrial uses. For instance, numerous facilities, such as ore processing, gas, and chemical plants, and associated infrastructure, such as tailings ponds, gas wells, and electricity substations are located in or near Point Comfort. North and east of Point Comfort, the land is undeveloped or used for transport or storage of industry related products. Most undeveloped land in this area, as well as the overall study area, is likely owned by the industrial companies since these areas are crisscrossed by service roads. South of Point Comfort, in the southeastern quadrant of the study area, land surrounding Keller Bay is predominantly marsh.

On the western boundary of the project area, Indianola and Magnolia Beach are primarily tourist beach towns with few commercial businesses and no industry present. Between Magnolia Beach and Port O'Connor, the land is largely undeveloped. The community of Port O'Connor is laid out in a grid pattern

of mostly residential use. Various tourist-related commercial businesses are located within the community, but the primary land use is related to recreation along the south shore of Port O'Connor.

Land use estimates are provided every 5 years for each county in the State by the NRCS, with the most recent data available for 1997. From 1992 to 1997, the cumulative land use estimates and percentages within the study area counties display a development pattern in which the area experienced a 3% decrease in agricultural land and a 1% increase in rangeland and urban land (Table 3.17-1) (NRCS, 1994, 2000).

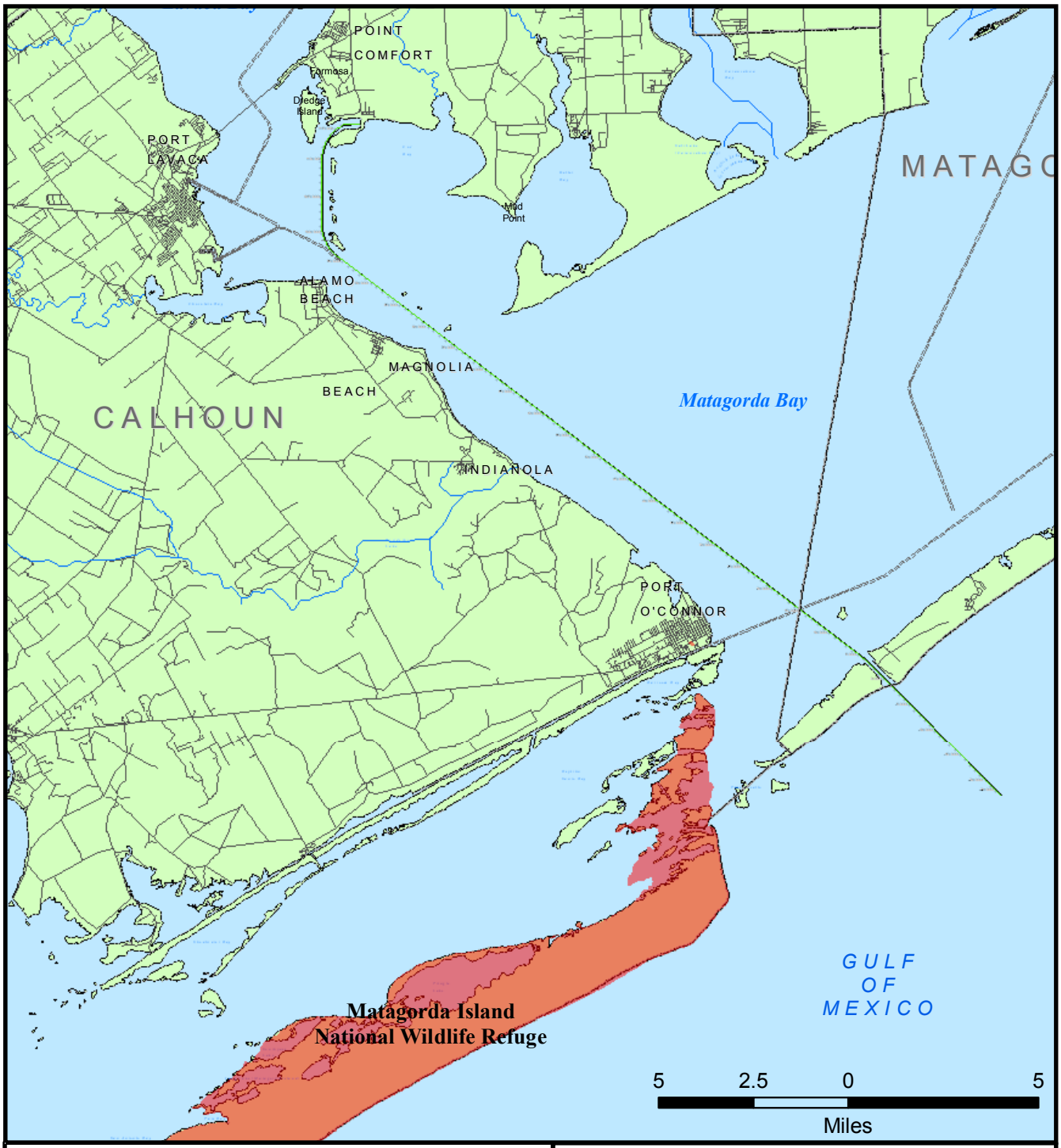
Table 3.17-1
Calhoun, Jackson, Matagorda, and Victoria Counties Land Use Estimates

	Percent of Land Use Type		Percent Change 1992–1997
	1992	1997	
Calhoun County			
Agricultural*	19%	17%	–12%
Rangeland	26%	23%	–12%
Urban	3%	4%	33%
Jackson County			
Agricultural*	53%	56%	6%
Rangeland	34%	34%	0%
Urban	1%	1%	0%
Matagorda County			
Agricultural*	61%	57%	–7%
Rangeland	13%	17%	31%
Urban	3%	3%	0%
Victoria County			
Agricultural*	25%	23%	–8%
Rangeland	64%	65%	2%
Urban	7%	8%	14%

*Agricultural is a combination of cropland and pastureland.

3.17.3 Recreation

The marshes, lakes, bays, and other natural amenities found in the study area have historically attracted residents and tourists to the Matagorda Bay System, and the climate and area provide public and private recreational facilities year round. For example, the 56,688 ac Matagorda Island WMA is an offshore barrier island with bayside marshes yet access is restricted to private or charter boats (Figure 3.17-1). The WMA is jointly owned by the Texas GLO and the FWS and cooperatively managed by TPWD as the Matagorda Island National Wildlife Refuge and State Natural Area. TPWD manages the WMA for public use and the FWS has the main responsibility for managing the wildlife and habitat on the island. The island is 38 miles long and varies in width from less than 1 mile to about 4½ miles. The island supports a wide variety of migratory birds, some 19 State or Federally listed threatened or endangered species, a



LEGEND

Existing Channel Centerline

Navigable Waterway

National Wildlife Refuge

PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
Phone: (512) 329-8342 Fax: (512) 327-2453

Figure 3.17-1

Proposed Matagorda Ship Channel Improvement Project
Matagorda Island National Wildlife Refuge

Job No.: 441652.00	Scale: 1:190,080
Prepared by: EMonshaugen	Date: 20060530
File: N:/44165200/projects/Fig3_17_1.mxd	

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large herd of white-tailed deer, alligators, and other wildlife. Seasonal hunting for deer and waterfowl is allowed. Other activities include salt-water fishing, biking, camping, hiking, birding, picnicking, and historical interpretation. A lighthouse dating from 1852 still stands at the north end of the island. Matagorda Island WMA is known for its seclusion and untouched natural beauty.

Birding along the Texas Gulf Coast, including areas within and near the project area, is another major recreation opportunity. The Coastal Birding Trail is a 500-mile trail that is jointly sponsored by TPWD and the Texas Department of Transportation (TxDOT), stretches along the Texas Gulf Coast from north of Beaumont to the Rio Grande Valley. The trail establishes viewing areas at feeding, roosting, and nesting points, thereby encouraging the preservation of woods and wetlands for both migrating and endemic bird species. Launched in October 1994, the Central Texas Coast (CTC) section of the trail encompasses 95 of the total 308 distinct wildlife-viewing sites throughout communities on the Central Texas Gulf Coast. The Calhoun Loop encompasses seven sites within or near the project area and includes Matagorda Island WMA, Powderhorn Lake, Indianola, Magnolia Beach, Port Lavaca Bird Sanctuary, Olivia/Port Alto, and Perry R. Bass State Marine Fisheries Research Station (TPWD, 2006a). The Tres Palacios Loop encompasses Oyster Lake Road, Palacios Marine Education Center Nature Trail, Lookout Point, and Palacios Waterfront and Texas Baptist Encampment sites; however, most of these sites are located east of the project area (TPWD, 2005a; Port Lavaca Calhoun County, n.d.). In addition to the trail, numerous birding sites and facilities are available in Matagorda County, mainly in areas east of the project area. For instance, the Matagorda County Birding and Nature Center hosts multiple birding sites within the county, along West Matagorda Bay, Tres Palacios Bay, and several smaller lakes and bays in the area (Matagorda County Birding and Nature Center, 2004). All sites within and beyond the project area have become especially active in the annual national Christmas bird count.

Recreational fishing, sailing, and boating within the study area is a major draw of locals and tourists alike. Matagorda Bay, Espiritu Santo Bay, San Antonio Bay, Lavaca Bay, and Carancahua Bay offer redfish, shark, trout, flounder, pompano, gafftop, whiting, croaker, sheephead, drum, jack crevalle, Spanish mackerel, and tarpon. Also, Calhoun County offers natural passes or entries to the Gulf, including Pass Cavallo, Cedar Bayou, and MSC Jetties. The county also hosts numerous accessible public boat ramps (Port Lavaca Calhoun County, n.d.). The GIWW is also used extensively for recreation. In 1980, an estimated 2.4 million boat trips originated in Texas waters, 79% of the trips used the waterway, and most traversed 5 to 50 miles of the waterway (TSHA, 2002).

The Texas Independence Trail, a joint partnership of TxDOT, TPWD, THC, Office of the Governor – Economic Development and Tourism, and Texas Commission on the Arts, follows SH 35 from east of Palacios to west of Port Lavaca. Two points of interest along the trail are located in Palacios and near Port Lavaca. In Palacios, a half-scale seaworthy replica of French explorer La Salle's ship, the *Belle*, is being constructed at the port of Palacios. South of Port Lavaca in Indianola, there stands a 25-ft granite statue of La Salle (THC, 2004).

The LCRA operates the Matagorda Bay Nature Park, a 1,600-ac park and preserve located at the mouth of the Colorado River on the Matagorda Peninsula, east of the project area (LCRA, 2006). The park offers fishing, camping, and 70 RV sites with full utility hook-ups.

Calhoun County offers visitors a wide variety of public park facilities, many of which have recreational vehicle (RV) accommodations. For instance, Lighthouse Beach and Bird Sanctuary in Port Lavaca offers 55 RV sites with full utility hook ups, a 2,200-ft boardwalk from the beach to the birding tower, a lighted fishing pier, picnic area, playground, white sand beach, covered pavilion, walking paths, and camper facilities (City of Port Lavaca, n.d.).

In addition to Lighthouse Beach, other popular area recreation attractions in Port Lavaca include the Port Lavaca Fishing Pier Park, campground, boardwalk, and boat ramp as well as the Formosa Wetlands Walkway and Alcoa Bird Tower. The Formosa Wetlands Walkway is an elevated walk of recycled plastic stretching over coastal wetlands and tidal exchange basin for 3,200 ft into Lavaca Bay. It is a prime area for spotting indigenous Coastal wildlife. The Alcoa Bird Tower and elevated gazebo on the Walkway provide a quiet place to view the many birds that populate the area (Port Lavaca Calhoun County, n.d). Beyond the Port Lavaca area, the towns of Port O'Connor, Magnolia Beach, and Indianola also offer recreational opportunities, such as Port O'Connor King Fisher Beach and Park as well as Indianola Park and Picnic Area near Indianola Island (City of Port Lavaca, n.d.; Port Lavaca Calhoun County, n.d.).

Historical sites within the project area include Halfmoon Reef Lighthouse, a historic landmark near the Lavaca Bay Causeway in Port Lavaca; a Historical Monument near Indianola Island; Ranger Cemetery; the LaSalle Monument; the old Indianola Townsite; the historic Olivia Cemetery; the Matagorda Island Lighthouse; Calhoun County Museum; numerous other cemeteries; and a total of 32 historic markers (Port Lavaca Calhoun County, n.d.).

3.17.4 Aesthetics

The term aesthetics deals with the subjective perception of natural beauty in a landscape by attempting to define and measure an area's scenic qualities. Consideration of the visual environment includes a determination of aesthetic values (where the major potential effect of a project on the resource is considered visual) and recreational values (where the location of a proposed project could potentially affect the scenic enjoyment of the area). Aesthetic values considered in this study, which combine to give an area its aesthetic identity, include:

- Topographical variation (hills, etc.)
- Prominence of water in the landscape (rivers, lakes, beach, wetlands, etc.)
- Vegetation variety (woodlands, meadows, etc.)
- Diversity of scenic elements
- Degree of human development or alteration
- Overall uniqueness of the scenic environment compared to the larger region.

The study area lies in the Coastal Bend region of Texas, and land uses consist of agricultural, industrial, residential, commercial, and recreational. Matagorda Bay is primarily used for transportation of goods, commercial and sport fishing, and recreation. The topography of the area is mostly flat to gently rolling, with the highest elevations occurring along the north study area boundaries. However, the study area consists mostly of open-water areas. Landscapes with water as a major element are generally considered visually pleasing, and this is generally the case along the southern coast and barrier islands as well as the numerous parks along Matagorda Bay. However, the study area is more industrial and residential than the surrounding landscape. The study area includes a variety of land uses, including shoreline residential development, commercial development, public and private marinas, parkland, relatively undisturbed natural areas, fishing and tourism-related businesses, civic uses, transportation systems (highways and railways), port facilities, and heavy industry areas. The study area offers a variety and abundance of vegetation, although much of the Port area has been altered for agricultural, industrial, infrastructure, or other uses. The degree of human alteration is extremely high, and a review of the Scenic Overlooks and Rest Areas of Texas revealed no overlooks or rest areas within the study area (Texas Highways, 1998). Since the landscape exhibits a generally moderate to high level of impact from human activities, the overall study area exhibits a low level of aesthetic quality.

3.18 SOCIOECONOMIC RESOURCES

This section presents a summary of economic and demographic characteristics of the project area as well as surrounding areas within Calhoun, Jackson, Matagorda, and Victoria counties. The scope of this review includes both county level and census tract level research (Figure 3.18-1). Provided below are U.S. Census Bureau (USBOC), Texas State Data Center (TSDC), and Texas A&M University Real Estate Center data collected for an analysis of the area's population, employment, economy, historical perspective of economic development, and Environmental Justice (EJ) as well as other categories.

3.18.1 Population and Social Characteristics (Demographics)

The proposed project is located in Calhoun County. However, Jackson County is situated at the northernmost point of Matagorda Bay at Lavaca Bay, Matagorda County is situated at the easternmost point of Matagorda Bay at Tres Palacios Bay, and Victoria County is located at the northwestern point of Matagorda Bay at Lavaca Bay; thus both counties are included in demographic analyses as residents of either county may be affected by the proposed project.

The 2000 population of Calhoun County was 20,647 persons. The City of Port Lavaca, population 12,035, is located on the northwest corner of Matagorda Bay and the City of Point Comfort, population 781, is located on the northeast corner of Matagorda Bay. The nearby city of Palacios, population 5,153, is located to the east of the project area. The USBOC does not record populations for the unincorporated communities of Port O'Connor, Magnolia Beach, Indianola, or Alamo Beach. Calhoun County displayed fluctuating population growth, losing 2.7% of its population between 1980 and 1990 and then increasing its population by 8.4% between 1990 and 2000 (Table 3.18-1). The 2000 population of Calhoun County

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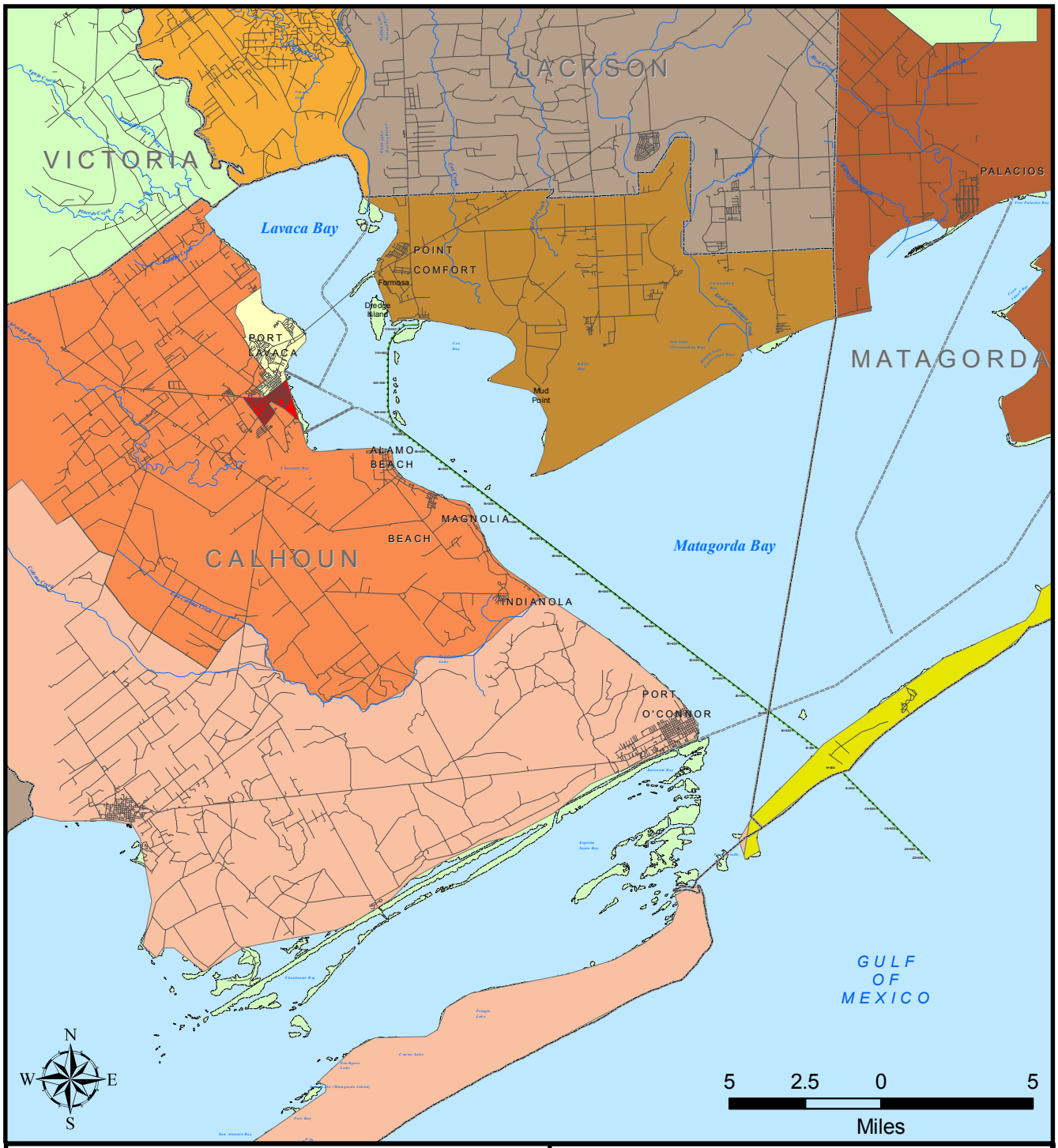

Legend

Existing Channel Centerline

Navigable Waterway

Census Tracts

7305	9902
7306	9903
9501	9904
9503	9905
9901	Non-Applicable Census Tract

PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
Phone: (512) 329-8342 Fax: (512) 327-2453

Figure 3.18-1
Proposed Matagorda Ship Channel Improvement Project Census Tract Map

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Prepared by: EMonshaugen	Date: 20060530
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TABLE 3.18-1
POPULATION TRENDS AND PROJECTIONS BY COUNTY, 1980–2030

	Population						Percent Change				
Place	1980	1990	2000	2010	2020	2030	1980–90	1990–2000	2000–10	2010–20	2020–30
Calhoun County	19,574	19,053	20,647	22,706	24,457	25,773	-2.7%	8.4%	10.0%	7.7%	5.4%
Jackson County	13,352	13,039	14,391	15,586	16,763	17,454	-2.3%	10.4%	8.3%	7.6%	4.1%
Matagorda County	37,828	36,928	37,957	41,433	44,773	47,135	-2.4%	2.8%	9.2%	8.1%	5.3%
Victoria County	68,807	74,361	84,088	94,193	104,236	112,380	8.1%	13.1%	12.0%	10.7%	7.8%
State of Texas	14,229,000	16,986,000	20,851,000	24,330,000	28,005,000	31,830,000	19.4%	22.8%	16.7%	15.1%	13.7%

Source: USBOC, 1983; 1990; 2000; TSDC, 2004

was 20,647 persons. Like Calhoun County, Jackson and Matagorda counties showed population decreases (2.3% and 2.4%, respectively) from 1980 to 1990 and population increases between 1990 to 2000 (10.4% and 2.8%, respectively). Victoria County recorded steady growth during the past two decades (8.1% and 13.1%). By comparison, during the same decades, the State of Texas recorded steady population growth of 19.4% and 22.8%, respectively (USBOC, 1983, 1990, 2000).

As shown in Table 3.18-1 population projections provided by the TSDC indicate that growth in all four counties is expected to continue; however, none of the counties are expected to surpass the State growth rates through 2030. Between 2000 and 2030 Calhoun County is projected to grow by 25%, Jackson County is projected to grow by 21%, Matagorda County is projected to grow by 24%, and Victoria County is projected to grow by 34%. Growth rates in all three counties are expected to remain high through 2020 and then decline slightly by 2030. However, since 2030 is the outermost projection possible, this figure may not be as accurate as projections for 2010 and 2020 (TSDC, 2004).

In general, the populations within the study area are similar in terms of ethnic diversity to the State of Texas (Table 3.18-2). In 2000, Calhoun and Matagorda counties had percentages of White persons (52.2% and 52.4%, respectively) that were equal to the percentage of the State of Texas. Jackson County recorded a higher White population of approximately 66.3%, while Victoria County recorded a white population of 60.8%. An average of the percentage of African Americans within Jackson, Matagorda, and Victoria counties (7.5%, 12.6%, and 6.1%, respectively) was similar to that of the State (11.3%). Calhoun County recorded a much lower percentage of African Americans (2.5%) than the other study area counties. An average percentage of Hispanics within the counties (36.2%) was almost the same as that for the State of Texas (32.0%). Calhoun County recorded the highest percentage of Hispanics (40.9%) followed by Victoria, Matagorda, and Jackson counties (39.2%, 31.3%, and 24.7%, respectively). An average of the percentage of persons of all other races for the study area counties (4.4%, 1.5%, 3.3%, and 1.8%, respectively) was lower than that of the State (4.2%) (USBOC, 2000).

Table 3.18-2
Population Characteristics for Cities and Counties of the Study Area

	Population	# White	% White	# African American	% African American	# Hispanic Origin	% Hispanic Origin	# Other	% Other
City of Point Comfort	781	587	75.2%	11	1.4%	153	19.6%	30	3.8%
City of Port Lavaca	12,035	4,697	39.0%	472	3.9%	6,272	52.1%	594	4.9%
Calhoun County	20,647	10,774	52.2%	521	2.5%	8,448	40.9%	904	4.4%
Jackson County	14,391	9,546	66.3%	1,081	7.5%	3,551	24.7%	213	1.5%
City of Palacios	5,153	1,613	31.3%	226	4.4%	2,638	51.2%	676	13.1%
Matagorda County	37,957	19,900	52.4%	4,778	12.6%	11,898	31.3%	1,256	3.3%
Victoria County	84,088	51,129	60.8%	5,137	6.1%	32,959	39.2%	1,502	1.8%
State of Texas	20,851,000	10,933,000	52.4%	2,364,000	11.3%	6,669,000	32.0%	884,000	4.2%

Source: USBOC, 2000.
"Other" equals American Indian and Alaska Native alone, Asian alone, Native Hawaiian and Other Pacific Islander alone, some other race alone, and two or more races.

Table 3.18-3 shows the age characteristics for the project area census tracts and provides a comparison with the overall age characteristics in Calhoun, Jackson, Matagorda, and Victoria counties and the State of Texas. Relative to the State, the project area population had higher proportions of the population for residents age 5 to 14 (16.4%), 20 to 34 (17.0%), and 55 and over (22.4%). The project area population had lower proportions than the State for residents age under 5 (7.5%), 15 to 19 (8.2%), and 35 to 54 (28.5%) (USBOC, 2000).

Table 3.18-3
Age Characteristics of Study Area, 2000 (Years of Age)

Place	under 5	5 to 14	15 to 19	20 to 34	35 to 44	45 to 54	55 to 64	65 to 74	75 to 84	85 and over	Total Persons
Calhoun County Census Tracts											
9901	424	850	403	1050	777	639	463	387	207	101	5,301
9902	410	771	321	901	673	446	355	307	143	30	4,357
9903	103	237	80	265	237	181	149	177	68	18	1,515
9904	431	956	464	1033	887	779	598	470	214	41	5,873
9905	248	521	256	504	503	553	440	364	172	40	3,601
Total	1,616	3,335	1,524	3,753	3,077	2,598	2,005	1,705	804	230	20,647
Jackson County Census Tracts											
9501	356	765	431	874	775	715	477	462	271	108	5,234
9503	322	696	442	741	714	659	461	379	303	117	4,834
Total	678	1461	873	1615	1489	1374	938	841	574	225	10,068
Matagorda County Census Tracts											
7305	129	368	219	380	473	577	514	412	212	51	3,335
7306	592	1,161	574	1,024	895	705	487	385	241	82	6,146
Total	721	1,529	793	1,404	1,368	1,282	1,001	797	453	133	9,481
Victoria County Census Tracts											
7	295	616	268	701	508	473	341	243	127	31	3,602
8	132	333	162	283	304	209	171	132	60	21	1,807
16.03	462	1,201	609	1,012	1,274	1,126	537	357	189	85	6,852
17	385	821	417	873	640	523	327	255	122	31	4,394
Total	1,274	2,971	1,456	2,869	2,726	2,331	1,376	987	498	168	16,56
Total for all study area census tracts	4,289	9,296	4,646	9,641	8,660	7,585	5,320	4,330	2,329	756	56,852
State of Texas	1,623,000	1,701,000	1,635,000	1,538,000	3,321,000	2,610,000	896,000	1,142,000	691,000	237,000	15,394,000

Source: USBOC, 2000.

An examination of average family size and persons per household among the project area census tracts reveals that each county census tract is nearly identical to the figures posted for the State of Texas. For example, the average persons per household within the project area census tracts is 2.8, similar to that of the State, and the average family size within the project area census tracts is 3.3, identical to that of the State (3.3) (Table 3.18-4) (USBOC, 2000).

Table 3.18-5 shows the educational attainments of the population within the project area census tracts and provides a comparison with the overall educational attainment in Calhoun, Jackson, Matagorda, and Victoria counties as well as the State of Texas. Relative to the state, the project area census tract and county population had a higher proportion of the population receiving a high school diploma or GED (32.5% and 32.0%, respectively). A similar proportion of the project area census tract population received an associate's degree to that of the State (5%). Also, lower proportions of the project area census tract and

TABLE 3.18-4
HOUSING CHARACTERISTICS OF PROJECT AREA CENSUS TRACTS, 2000

	Total Number of Housing Units	# Occupied Household Units	% Occupied Household Units	Owner Occupied Units	% Owner Occupied Units	Renter Occupied Units	% Renter Occupied Units	# Vacant Households	% Vacant Households	Persons per Household	Average Family Size
Calhoun County Census Tracts											
9901	2,098	1,855	88.4%	1,271	68.5%	584	31.5%	243	11.6%	2.8	3.3
9902	1,716	1,484	86.5%	947	63.8%	537	36.2%	232	13.5%	2.9	3.4
9903	1,163	584	50.2%	401	68.7%	183	31.3%	579	49.8%	2.6	3.0
9904	2,665	2,109	79.1%	1,614	76.5%	495	23.5%	556	20.9%	2.8	3.2
9905	2,596	1,410	54.3%	1,184	84.0%	226	16.0%	1,186	45.7%	2.6	3.0
Total/Average	10,238	7,442	72.7%	5,417	72.8%	2,025	27.2%	2,796	27.3%	2.7	3.2
Jackson County Census Tracts											
9501	2,443	1,910	78.2%	1,515	79.3%	395	20.7%	533	21.8%	2.7	3.1
9503	2,030	1,789	88.1%	1,337	74.7%	452	25.3%	241	11.9%	2.6	3.2
Total/Average	4,473	3,699	82.7%	2,852	77.1%	847	22.9%	774	17.3%	2.7	3.2
Matagorda County Census Tracts											
7305	3,882	1,474	38.0%	1,286	87.2%	188	12.8%	2,408	62.0%	2.2	2.8
7306	2,492	2,014	80.8%	1,455	72.2%	559	27.8%	478	19.2%	3.0	3.6
Total/Average	6,374	3,488	54.7%	2,741	78.6%	747	21.4%	2,886	45.3%	2.6	3.2
Victoria County Census Tracts											
7	1,330	1,218	91.6%	971	79.7%	247	20.3%	112	8.4%	3.0	3.3
8	695	620	89.2%	511	82.4%	109	17.6%	75	10.8%	2.9	3.3
16.03	2,614	2,442	93.4%	2,030	83.1%	412	16.9%	172	6.6%	2.8	3.2
17	1,625	1,394	85.8%	1,116	80.1%	278	19.9%	231	14.2%	3.2	3.6
Total/Average	6,264	5,674	90.6%	4,628	81.6%	1,046	18.4%	590	9.4%	3.0	3.4
Total/Average for all counties	27,349	20,303	75.2%	15,638	77.5%	4,665	22.5%	7,046	24.8%	2.7	3.2
State of Texas	8,157	7,393	90.6%	4,716	63.8%	2,676	36.2%	764	9.4%	2.7	3.3

Source: USBOC, 2000.

Table 3.18-5
Educational Attainment of Project Area Census Tracts, 2000

	Less than 9th Grade	9th to 12th Grade, no Diploma	High School Graduate or GED	Some College	Associate's Degree	Bachelor's Degree	Graduate or Professional Degree
Calhoun County Census Tracts							
9901	14.1%	12.9%	28.0%	18.6%	5.5%	13.9%	6.9%
9902	16.7%	22.6%	36.0%	19.0%	2.1%	3.1%	0.6%
9903	5.1%	13.9%	38.1%	14.4%	8.4%	6.1%	4.1%
9904	13.1%	16.2%	36.0%	18.0%	4.2%	8.6%	3.8%
9905	15.1%	22.0%	30.7%	20.1%	4.8%	5.4%	3.9%
Average	12.8%	17.5%	33.8%	18.0%	5.0%	7.4%	3.9%
Calhoun County	13.4%	17.5%	33.1%	19.2%	4.6%	8.1%	4.0%
Jackson County Census Tracts							
9501	11.5%	15.2%	35.4%	20.7%	5.8%	8.7%	2.7%
9503	10.6%	13.4%	29.5%	22.7%	5.5%	13.7%	4.5%
Average	11.1%	14.3%	32.5%	21.7%	5.7%	11.2%	3.6%
Jackson County	12.7%	14.6%	34.4%	20.7%	4.9%	9.5%	3.3%
Matagorda County Census Tracts							
7305	7.7%	16.1%	33.4%	24.8%	4.5%	10.3%	3.2%
7306	22.8%	16.4%	25.2%	14.8%	5.7%	11.8%	3.3%
Average	15.3%	16.3%	29.3%	19.8%	5.1%	11.1%	3.3%
Matagorda County	14.4%	15.3%	31.2%	21.8%	4.8%	9.5%	2.9%
Victoria County Census Tracts							
7	15.1%	14.0%	38.0%	19.1%	6.2%	5.1%	2.4%
8	13.8%	12.4%	36.0%	25.8%	6.9%	4.7%	0.5%
16.03	1.2%	4.1%	24.2%	29.5%	7.5%	21.0%	12.7%
17	18.1%	19.5%	32.1%	20.2%	4.6%	4.5%	1.3%
Average	12.1%	12.5%	32.6%	23.7%	6.3%	8.8%	4.2%
Victoria County	11.2%	12.6%	29.1%	24.6%	6.3%	11.0%	5.3%
Average for all census tracts	12.7%	15.3%	32.5%	20.6%	5.5%	9.0%	3.4%
Average for all counties	12.9%	15.0%	32.0%	21.6%	5.2%	9.5%	3.9%
State of Texas	11.4%	12.9%	24.8%	22.4%	5.2%	15.6%	7.7%

Source: USBOC, 2000.
Note: Data for population 25 years and over.

overall county population received bachelor degrees (9.0% and 9.5%, respectively) or graduate or professional degrees (3.4% and 3.9%, respectively) compared to that of the State (USBOC, 2000).

3.18.2 Community Values

Future development within the study area, likely industrial, commercial, and residential, must follow local guidelines and regulations. For instance, the City of Port Lavaca's master drainage plan requires developers to direct site drainage toward appropriate facilities. Specifically, in northern Port Lavaca, Lynn Bayou is at flow capacity and cannot receive additional runoff. Developers in the northern area of

Port Lavaca must construct a north relief channel that directs drainage away from Lynn Bayou and to the bay. Development in other areas of the city is not restricted, since the city has no official comprehensive plan and no zoning (Weaver, 2006).

The City of Palacios has historically been by-passed by business and industry but the potential exists for expansion in tourism, retirement housing, light industrial, and service related businesses (Palacios Chamber of Commerce, n.d).

In general, Matagorda County offers a variety of sites and facilities for purchase or lease. Industrial sites range from 2,000–3,000 ac; and 2- to 3-ac industrial park sites are free with new construction and proven job creation. Available commercial and industrial buildings range in size from 1,800–78,000 square ft (Matagorda County Economic Development Corporation, n.d.).

The Matagorda County Navigation District #1 (MCND#1) owns over 300 ac of near shoreline property that is included in the area designated as a Foreign Trade Zone (FTZ). The MCND#1 is actively seeking proposals for the development of this area for use as an industrial repair shop or seafood processing plant. Also, the MCND#1 is seeking to sell land for development as a restaurant/marina. The MCND#1 seeks to develop the South Bay Marina area as a waterfront restaurant, a hotel/motel complex, a condominium housing complex, or a pleasure boat marina (Port of Palacios, n.d.).

3.18.3 Housing

The number of residential building permits issued in Calhoun and Matagorda counties from 1994 to 2004 demonstrated a steady increase over the 10-year period, while Jackson and Victoria counties demonstrated a fluctuating pattern during the same time period (Table 3.18-6). A review of Calhoun, Jackson, Matagorda, and Victoria counties building permit data obtained from the Texas A&M Real Estate Center shows that Calhoun and Matagorda counties recorded an increase in permits each year, except for 1997 and 1998 in Calhoun County and 1999 in Matagorda when a decrease in permits was recorded. During the 10-year period, Jackson County recorded increases in permits one year, followed by decreases in permits the next year. Victoria County displayed similar fluctuations in permit issuance. In addition, no multifamily building permits (dwellings for five-plus families) were issued in Calhoun or Jackson counties between 1994 and 2004, while Matagorda County recorded one year (2000) in which 28 multifamily building permits were issued, and Victoria County recorded four years (1996, 1997, 1998, 2004) in which multifamily building permits were issued (Real Estate Center, 2005).

An examination of the availability of various housing types and costs is provided in Table 3.18-6. Among Calhoun, Jackson, Matagorda, and Victoria counties, approximately 930, 298, 995, and 1,909 single-family housing starts, respectively, were recorded from 1994 to 2004, and the average value of these residences was $84,891, $93,427, $91,809, and $98,118, respectively. Very few multifamily housing starts were recorded in Calhoun and Jackson counties from 1994 to 2004. However, Matagorda County recorded a total of 152 multifamily housing starts during this time period at an average value of $36,533,

Table 3.18-6
Housing Starts by County, 1994 to 2004

Year	Single-Family #	Average Value $	Multifamily #	Average Value $
Calhoun County				
1994	49	$ 67,500	0	$ 0
1995	71	62,300	0	0
1996	148	54,400	0	0
1997	49	88,100	0	0
1998	48	93,700	0	0
1999	55	103,000	0	0
2000	64	88,500	0	0
2001	77	89,000	0	0
2002	109	96,200	0	0
2003	125	83,600	0	0
2004	135	107,500	20	29,500
Total/Average	930	$ 84,891	20	$ 29,500
Jackson County				
1994	28	$ 66,800	0	$ 0
1995	27	78,200	0	0
1996	42	74,000	0	0
1997	32	82,400	0	0
1998	36	83,100	0	0
1999	29	103,600	0	0
2000	25	94,400	0	0
2001	16	116,700	0	0
2002	19	111,700	0	0
2003	24	110,400	0	0
2004	20	106,400	0	0
Total/Average	298	$ 93,427	0	$ 0
Matagorda County				
1994	63	$ 61,300	60	$ 41,300
1995	64	76,100	0	0
1996	68	69,400	0	0
1997	77	87,700	0	0
1998	106	91,300	0	0
1999	82	97,200	0	0
2000	90	102,700	28	21,400
2001	92	115,000	0	0
2002	101	111,600	0	0
2003	115	90,800	0	0
2004	137	106,800	64	46,900
Total/Average	995	$ 91,809	152	$ 36,533

Table 3.18-6 (Cont'd)

Year	Single-Family #	Average Value $	Multifamily #	Average Value $
Victoria County				
1994	202	$ 104,000	0	$ 0
1995	172	89,400	0	0
1996	160	80,600	14	35,700
1997	189	78,400	160	27,000
1998	212	92,600	324	33,100
1999	196	108,000	2	79,600
2000	167	109,800	0	0
2001	144	99,200	0	0
2002	212	94,600	0	0
2003	117	109,600	0	0
2004	138	113,100	260	53,900
Total/Average	1,909	$ 98,118	758	$ 45,860

Source: Real Estate Center, 2005.

and Victoria County recorded a total of 758 multifamily housing starts during this period at an average value of $45,860 (Real Estate Center, 2005).

Occupancy and vacancy status of residences within the project area census tracts is provided in Table 3.18-4. In Calhoun, Jackson, Matagorda, and Victoria counties, approximately 72.7%, 82.7%, 54.7%, and 90.6%, respectively, of residences were occupied in 2000. Inversely, approximately 27.3%, 17.3%, 45.3%, and 9.4%, respectively, of residences were vacant in 2000. These figures demonstrate that more housing is available in Matagorda County for employees of the proposed project and less housing is available in Jackson and Victoria counties (USBOC, 2000).

"Household tenure" is a category that distinguishes between owner-occupied housing units and renter-occupied housing units. Within Calhoun, Jackson, Matagorda, and Victoria county census tracts, owner-occupied units represent 72.8%, 77.1%, 78.6%, and 81.6%, respectively, while renter-occupied units represent 27.2%, 22.9%, 21.4%, and 18.4%, respectively (see Table 3.18-4) (USBOC, 2000).

3.18.4 Economic Characteristics of Area Population

The study area's economy rests on the petrochemical industry, commercial fishing, agriculture and livestock, construction, mineral extraction, and tourism. Most recently, the City of Port Lavaca and Calhoun County are experiencing an economic boom due to the $1.3 billion expansion of the Formosa Plastics Plant located in the county. Also, Calhoun County is home to four other large industrial facilities including Alcoa, the Carbon/Graphite Group, Union Carbide, and BP Chemicals as well as other smaller industry operation support companies.

Commercial fishing within the Matagorda Bay system is a relatively moderate contributor to the study area economy compared to other industry sectors. Commercial fishing is considered any activity involving the taking or handling of fresh or saltwater aquatic products for pay or for the purpose of barter, sale, or exchange (TPWD, 2005b). Table 3.18-7 compares the commercial fishery landings of Matagorda Bay with all Texas bay systems in 2004. The total wholesale value for all finfish and shellfish landings in the Matagorda Bay system in 2004 was $3,310,875 or 12.2% of the wholesale value of all such landings for all Texas bay systems in that same year **(**$27.1 million). For the Matagorda Bay system, shrimp had the greatest wholesale value by far, worth $2,192,765 in 2004 or 66.2% of wholesale value for all finfish and shellfish. Eastern oyster also represented a substantial share of the overall wholesale value of finfish and shellfish from landings in the Matagorda Bay system at $860,488 (25.9%) in 2004. The total weight of all finfish and shellfish landings in the Matagorda Bay system in 2004 was 2,009,387 or 12.0% of the weight of all such landings for all Texas bay systems in 2004 (at 16.7 million pounds) (TPWD, 2006c).

In July 2005, direct employment associated with the MSC was approximately 5,300 jobs, induced employment totaled 4,600 jobs, and indirect employment totaled 6,700, for an approximate total employment associated with the channel of 16,600. Wages and salaries associated with the ship channel include $273,000,000 per year in direct wages and salaries, $470,000,000 per year in respending, and $245,000,000 per year in indirect wages and salaries (Martin Associates, 2005). The MSC and the Port provide the study area and the Texas Gulf Coast with direct deep and shallow draft access to global markets. For instance, public port tonnage has grown from approximately 900,000 tons in 1994 to approximately 4,877,498 tons in 2005. The key commodities moved through the ship channel include chemicals, agricultural fertilizer, aluminum ore, and petrochemicals. The bulk of export tonnage from the Port is chemicals produced by Texas manufacturers (Martin Associates, 2005).

Branch channels of the MSC connect with the GIWW and link the study area with the thousands of miles of navigable waterways and markets in the nation's inland waterway system. Efficient barge traffic on the GIWW helps make the study area an integral part of the huge Gulf Coast petrochemical and refining complex.

The Port has facilities for handling break bulk, containerized, heavy-lift, dry bulk, and bulk liquid cargoes. Also, the port is part of FTZ No. 155, located in Calhoun and Victoria counties, managed by the Calhoun-Victoria Foreign-Trade Zone, Inc. A foreign-trade zone is an area where foreign and domestic merchandise or commodities are considered to be in an international commerce zone and not within a U.S. Customs territory.

An examination of location of work as well as travel times to work for workers 16 and older is provided in tables 3.18-8 and 3.18-9. Table 3.18-8 shows the place of work for workers in the project area. The project area percentages are similar to the overall county populations and the State of Texas when comparing working within the county and state of residence; however, the project area has a much higher percentage of persons that work outside the place of residence when compared to the county or state. Generally speaking, the project area has a higher percentage of persons working outside their county and

TABLE 3.18-7
TRENDS IN COMMERCIAL FISHERY LANDINGS
MATAGORDA BAY AND ALL TEXAS BAY SYSTEMS, 2004

	Matagorda Bay System						All Texas Bay Systems	
	Weight (lbs) of Fish Landed	% of Total Weight of all Matagorda Bay Finfish and Shellfish	% of Total Weight from all Texas Bay System Landings	Wholesale Value ($) of Fish Landed	% of Total Wholesale Value ($) from all Matagorda Finfish and Shellfish	% of Total Wholesale Value ($) from all Texas Bay System Landings	Weight (lbs) from all Texas Bay System Landings	Wholesale Value ($) from all Texas Bay System Landings
Black Drum	2,047	0.10%	0.01%	$2,406	0.07%	0.01%	1,717,000	$1,444,000
Flounder	4,570	0.23%	0.03%	$9,875	0.30%	0.04%	151,000	$324,000
Sheepshead	0	0.00%	0.00%	$0	0.00%	0.00%	68,000	$28,000
Mullet	547	0.03%	0.00%	$964	0.03%	0.00%	73,000	$139,000
Other	39,354	1.96%	0.24%	$97,483	2.94%	0.36%	216,000	$708,000
Total Finfish	46,518	2.32%	0.28%	$110,727	3.34%	0.41%	2,226,000	$2,645,000
Brown and Pink	620,081	30.86%	3.71%	$551,995	16.67%	2.03%	1,616,000	$1,455,000
White	767,581	38.20%	4.60%	$1,640,770	49.56%	6.04%	3,308,000	$5,336,000
Other	0	0.00%	0.00%	$0	0.00%	0.00%	0	$0
Total Shrimp	1,387,662	69.06%	8.31%	$2,192,765	66.23%	8.08%	4,923,000	$6,791,000
Blue Crab	225,046	11.20%	1.35%	$144,189	4.36%	0.53%	3,961,000	$2,663,000
Eastern Oyster	347,033	17.27%	2.08%	$860,488	25.99%	3.17%	5,520,000	$14,819,000
Other	3,128	0.16%	0.02%	$2,706	0.08%	0.01%	71,000	$230,000
Total Shellfish	1,962,869	97.68%	11.75%	$3,200,148	96.66%	11.79%	14,475,000	$24,502,000
Total Finfish and Shellfish	**2,009,387**	100.00%	12.03%	**$3,310,875**	100.00%	12.20%	**16,700,000**	**$27,147,000**

Source: TPWD, 2006b

Table 3.18-8
Place of Work for Workers in the Project Area, 2000

Place	Work in State of Residence	Work Outside State of Residence	Work in County of Residence	Work Outside County of Residence	Work in Place of Residence	Work Outside Place of Residence
Calhoun County Census Tracts						
9901	99.4%	0.6%	87.4%	12.6%	48.3%	51.7%
9902	99.7%	0.3%	82.1%	17.9%	49.0%	51.0%
9903	97.5%	2.5%	78.7%	21.3%	20.5%	79.5%
9904	99.5%	0.5%	82.8%	17.2%	22.1%	77.9%
9905	98.6%	1.4%	83.9%	16.1%	22.2%	77.8%
Average	98.9%	1.1%	83.0%	17.0%	32.4%	67.6%
Calhoun County	99.2%	0.8%	83.7%	15.5%	47.9%	52.1%
Jackson County Census Tracts						
9501	99.7%	0.3%	56.2%	43.8%	28.7%	71.3%
9503	99.6%	0.4%	65.7%	34.3%	43.4%	56.6%
Average	99.7%	0.4%	61.0%	39.1%	36.1%	64.0%
Jackson County	99.8%	0.2%	63.8%	35.9%	38.6%	61.4%
Matagorda County Census Tracts						
7305	99.6%	0.4%	60.6%	39.4%	0.0%	100.0%
7306	100.0%	0.0%	80.5%	19.5%	48.4%	51.6%
Average	99.8%	0.2%	70.6%	29.5%	24.2%	75.8%
Matagorda County	99.3%	0.7%	75.8%	23.5%	46.3%	53.7%
Victoria County Census Tracts						
7	100.0%	0.0%	86.9%	13.1%	74.2%	25.8%
8	100.0%	0.0%	65.5%	34.5%	4.5%	95.5%
16.03	99.5%	0.5%	80.1%	19.9%	60.9%	39.1%
17	99.3%	0.7%	73.1%	26.9%	13.1%	86.9%
Average	99.7%	0.3%	76.4%	23.6%	38.2%	61.8%
Victoria County	99.6%	0.4%	85.2%	14.8%	26.8%	73.2%
Average for all study area census tracts	99.4%	0.6%	75.7%	24.3%	33.5%	66.5%
Average for all study area counties	99.5%	0.51%	77.1%	22.4%	39.9%	60.1%
Texas	99.0%	1.0%	78.6%	21.4%	44.3%	55.7%

Source: USBOC, 2000.

Table 3.18-9
Median Travel Time to Work by Project Area Census Tracts, 2000

Place	Worked at Home	Less than 5 Minutes	5 to 14 Minutes	15 to 24 Minutes	25 to 44 Minutes	45 Minutes or More
Calhoun County Census Tracts						
9901	1.0%	7.9%	46.5%	28.7%	10.8%	5.1%
9902	2.5%	6.3%	38.7%	30.9%	14.5%	7.2%
9903	2.9%	10.7%	38.1%	32.1%	16.9%	7.3%
9904	1.2%	4.5%	34.6%	17.4%	14.9%	20.3%
9905	3.5%	8.3%	26.0%	23.9%	23.8%	15.6%
Average	2.2%	7.5%	36.8%	26.6%	16.2%	11.1%
Calhoun County	1.9%	6.8%	39.5%	27.8%	14.3%	8.7%
Jackson County Census Tracts						
9501	2.8%	7.8%	26.0%	23.9%	23.8%	15.6%
9503	2.9%	10.6%	32.8%	15.9%	27.2%	10.6%
Average	2.9%	9.2%	29.4%	19.9%	25.5%	13.1%
Jackson County	2.8%	9.7%	29.6%	18.2%	25.5%	14.3%
Matagorda County Census Tracts						
7305	1.8%	6.2%	10.1%	30.2%	25.8%	25.9%
7306	1.1%	12.1%	39.4%	19.9%	17.5%	9.9%
Average	1.5%	9.2%	24.8%	25.1%	21.7%	17.9%
Matagorda County	1.8%	5.6%	34.3%	23.6%	20.6%	14.2%
Victoria County Census Tracts						
7	2.8%	4.0%	29.2%	34.3%	21.4%	11.2%
8	0.8%	6.6%	12.8%	30.0%	33.7%	16.9%
16.03	1.9%	2.0%	36.5%	27.4%	22.0%	12.1%
17	0.9%	2.8%	22.8%	38.6%	26.7%	9.1%
Average	1.6%	3.9%	25.3%	32.6%	26.0%	12.3%
Victoria County	2.1%	3.4%	36.6%	32.3%	16.2%	11.4%
Average for all study area census tracts	2.0%	6.9%	30.3%	27.2%	21.5%	12.8%
Average for all study area counties	2.2%	5.7%	35.1%	25.5%	19.2%	12.2%
Texas	2.8%	3.0%	24.7%	29.9%	25.0%	14.5%

Source: USBOC, 2000.

place of residence compared to the overall counties and state. Also, 41% and 44%, respectively, of the project area census tract and overall county population travels between less than 5 minutes to 14 minutes to work. More than half (59.0% and 55.7%, respectively) of the project area census tract and overall county population travel over 15 minutes or more to work (USBOC, 2000).

3.18.5 Leading Economic Sectors

According to the Texas Workforce Commission (TWC), employment change from the third quarter of 2000 to the same quarter of 2005 in the leading economic sectors of Calhoun, Matagorda, and Victoria counties has shown similar trends (Table 3.18-10). However, in most sectors, Jackson County has recorded an opposite trend. For instance, in Calhoun, Matagorda, and Victoria counties, substantial declines were recorded for employment in the construction sector (55.5%, 38.1%, and 10.9%, respectively), information (23.4%, 39.4%, and 35.0%, respectively), and other sectors (31.9%, 12.4%, and 15.5%, respectively). Also, increases in employment for the same counties were recorded for the education and health services sector (40.6%, 11.8%, and 20.2%, respectively) as well as an increase in professional and business service employment (31.7%) for Calhoun County. Jackson County experienced an overall increase in total employment (7.0%), with the largest employment gains in the natural resources and mining (22.9%), information (32.8%), financial activities (32.8%), and other services (22.6%) sectors. Victoria County's largest gain was the natural resources and mining sectors with an increase of 25.8%. The State of Texas recorded employment trends similar to that of Jackson County, with employment gains in natural resources and mining, trade, transportation, and utilities, financial activities, professional and business services, education and health services, leisure and hospitality services, and government (TWC, 2006a).

Table 3.18-11 provides a list of the top 20 major employers in the Matagorda Bay area. The majority of the employers are concentrated in industry/port related enterprises, followed by support companies and community services. Nine employers, including Formosa Plastics, Inteplast Group, Ltd, DOW, Alcoa, Lyondell, Hoechst Celanese, King Fisher Marine Services, BP Chemicals, and Turner, have operations directly related to the Port, providing more than 8,000 jobs within the study area.

3.18.6 Labor Force and Employment

In Calhoun County, the total civilian labor force decreased 23% between the third quarter of 2000 and 2005 from 12,058 to 9,235 persons; however, the unemployment rate remained constant at approximately 4.7% during this period (Table 3.18-12). Also, the civilian labor force decreased in Matagorda County by 12% from 11,488 in 2000 to 10,126 persons during the third quarter 2005, yet the unemployment rate increased, from 6.6% in 2000 to 7.3% in the third quarter 2005. However, in Jackson County, the civilian labor force increased by 7% from 3,525 in 2000 to 3,773 persons during the third quarter 2005. During the same time period, the unemployment rate increased, from 3.6% in 2000 to 4.2% in the third quarter of 2005. In Victoria County, the labor force increased slightly by 0.3%, and the unemployment rate increased from 3.7% in 2000 to 4.1% in 2005. These figures demonstrate that the civilian labor force is

Table 3.18-10
Covered Employment and Wages by County, 3rd Quarter 2000 and 2005

Employment Sector	3rd Quarter Employment 2000	3rd Quarter Employment 2005	% Total Employment 2000	% Total Employment 2005	% Change 2000–2005
Calhoun County					
Natural Resources & Mining	236	184	1.96%	1.99%	–22.03%
Construction	3,162	1,406	26.22%	15.22%	–55.53%
Manufacturing	4,197	3,100	34.81%	33.57%	–26.14%
Trade, Transportation & Utilities	1,164	1,160	9.65%	12.56%	–0.34%
Information	77	59	0.64%	0.64%	–23.38%
Financial Activities	361	402	2.99%	4.35%	11.36%
Professional & Business Services	249	328	2.07%	3.55%	31.73%
Education & Health Services	328	461	2.72%	4.99%	40.55%
Leisure & Hospitality	696	676	5.77%	7.32%	–2.87%
Other Services	166	113	1.38%	1.22%	–31.93%
Federal/State/Local Government	1,422	1,346	11.79%	14.57%	–5.34%
Total Employment	12,058	9,235			–23.41%
Jackson County					
Natural Resources & Mining	231	284	6.55%	7.53%	22.94%
Construction	524	599	14.87%	15.88%	14.31%
Manufacturing*	N/A	N/A	N/A	N/A	N/A
Trade, Transportation & Utilities	810	843	22.98%	22.34%	4.07%
Information	58	77	1.65%	2.04%	32.76%
Financial Activities	137	181	3.89%	4.80%	32.12%
Professional & Business Services	115	110	3.26%	2.92%	–4.35%
Education & Health Services	238	252	6.75%	6.68%	5.88%
Leisure & Hospitality	227	238	6.44%	6.31%	4.85%
Other Services	133	103	3.77%	2.73%	–22.56%
Federal/State/Local Government	1,052	1,086	29.84%	28.78%	3.23%
Total Employment	3,525	3,773			7.04%
Matagorda County					
Natural Resources & Mining	809	795	7.04%	7.85%	–1.73%
Construction	693	429	6.03%	4.24%	–38.10%
Manufacturing	541	397	4.71%	3.92%	–26.62%
Trade, Transportation & Utilities	3,321	2,824	28.91%	27.89%	–14.97%
Information	132	80	1.15%	0.79%	–39.39%
Financial Activities	347	346	3.02%	3.42%	–0.29%
Professional & Business Services	725	639	6.31%	6.31%	–11.86%
Education & Health Services	687	768	5.98%	7.58%	11.79%
Leisure & Hospitality	986	942	8.58%	9.30%	–4.46%
Other Services	532	466	4.63%	4.60%	–12.41%
Federal/State/Local Government	2,715	2,440	23.63%	24.10%	–10.13%
Total Employment	11,488	10,126			–11.86%

Table 3.18-10 (Cont'd)

Employment Sector	3rd Quarter Employment 2000	3rd Quarter Employment 2005	% Total Employment 2000	% Total Employment 2005	% Change 2000–2005
Victoria County					
Natural Resources & Mining	2,145	2,699	5.8%	7.2%	25.8%
Construction	2,636	2,348	7.1%	6.3%	–10.9%
Manufacturing*	2,953	2,526	7.9%	6.8%	–14.5%
Trade, Transportation & Utilities	8,038	8,130	21.6%	21.8%	1.1%
Information	857	557	2.3%	1.5%	–35.0%
Financial Activities	1,820	1,644	4.9%	4.4%	–9.7%
Professional & Business Services	2,838	3,179	7l.6%	8.5%	12.0%
Education & Health Services	4,641	5,577	12.5%	15.0%	20.2%
Leisure & Hospitality	3,312	3,333	8.9%	8.9%	0.6%
Other Services	1,581	1,336	4.3%	3.6%	–15.5%
Federal/State/Local Government	6,326	5,938	17.0%	15.9%	–6.1%
Total Employment	37,147	37,267	–	–	0.3%
State of Texas					
Natural Resources & Mining	210,566	230,255	2.26%	2.40%	9.35%
Construction	581,548	574,328	6.25%	6.00%	–1.24%
Manufacturing	1,071,167	907,535	11.51%	9.48%	–15.28%
Trade, Transportation & Utilities	1,972,114	1,980,021	21.19%	20.68%	0.40%
Information	278,813	223,365	3.00%	2.33%	–19.89%
Financial Activities	555,128	603,678	5.96%	6.30%	8.75%
Professional & Business Services	1,111,662	1,164,172	11.94%	12.16%	4.72%
Education & Health Services	913,976	1,085,999	9.82%	11.34%	18.82%
Leisure & Hospitality	836,868	925,004	8.99%	9.66%	10.53%
Other Services	280,017	277,007	3.01%	2.89%	–1.07%
Federal/State/Local Government	1,495,013	1,603,314	16.06%	16.75%	7.24%
Total Employment	9,306,872	9,574,678			2.88%

Source: TWC, 2006.
*Data is unavailable due to TWC confidentiality agreement.

Table 3.18-11
Study Area Major Employers, 2004

Top 20 Study Area Employers	Number of Employees
Formosa Plastics	3,600
South Texas Project	2,100
Inteplast Group, Ltd.	1,500
DOW (a subsidiary of Union Carbide Corp.)	1,100
Alcoa, Inc.	800
Wal-Mart	430
Lyondell	400
Hoechst Celanese	400
Memorial Medical Hospital	300
King Fisher Marine Services, Inc.	253
BP Chemicals	240
HEB Grocery	220
Palacios ISD	215
Industrial ISD	171
Harmony Industrial (now Turner)	150
Jackson County Hospital District	115
County of Jackson	110
City of Port Lavaca	82
TA Travel Centers of America	74
Mercer Construction	65

Sources: City of Palacios Economic Development Corporation; Port Lavaca-Calhoun County Chamber of Commerce; Jackson County Chamber of Commerce.

Table 3.18-12
Unemployment Rates by County

	Unemployment Rate		
	1990	2000	December 2005
Calhoun County	6.4%	4.7%	4.7%
Jackson County	3.2%	3.6%	4.2%
Matagorda County	12.6%	6.6%	7.3%
Victoria County	4.6%1	3.7%	4.1%
State of Texas	6.4%	4.4%	4.8%

Source: BLS, n.d.

decreasing in Calhoun and Matagorda counties, increasing in Jackson and Victoria counties, and the unemployment rate for the project area is either remaining the same or increasing (U.S. Bureau of Labor Statistics, n.d.; TWC, 2006b).

Table 3.18-13 shows the class of worker within the project area. According to the USBOC 2000 data, the study area census tract population is similar to the overall county and State of Texas population when examining the percentage of government workers and unpaid family workers. The census tracts have a lower percentage of private wage and salary workers and a higher percentage of self-employed workers.

Table 3.18-13
Class of Worker in the Study Area, 2000

Place	Private Wage and Salary Worker	Government Worker	Self-employed Workers (not incorporated business)	Unpaid Family Workers
Calhoun County Census Tracts				
9901	74.0%	19.3%	6.4%	0.3%
9902	82.4%	12.1%	5.5%	0.0%
9903	73.8%	20.7%	4.1%	1.5%
9904	76.1%	15.0%	8.5%	0.4%
9905	71.5%	10.7%	15.6%	2.0%
Average	75.6%	15.6%	8.0%	0.8%
Calhoun County	75.9%	15.3%	8.1%	0.6%
Jackson County Census Tracts				
9501	74.2%	13.5%	11.4%	0.8%
9503	71.7%	18.2%	9.5%	0.6%
Average	73.0%	15.9%	10.5%	0.7%
Jackson County	74.0%	14.7%	10.4%	0.8%
Matagorda County Census Tracts				
7305	66.4%	15.9%	17.0%	0.7%
7306	70.0%	18.3%	11.0%	0.8%
Average	68.2%	17.1%	14.0%	0.8%
Matagorda County	75.3%	16.1%	8.0%	0.5%
Victoria County Census Tracts				
7	81.0%	9.7%	9.3%	0.0%
8	78.0%	15.7%	6.3%	0.0%
16.03	77.7%	17.5%	4.8%	0.0%
17	82.0%	11.2%	6.4%	0.3%
Average	79.7%	13.5%	6.7%	0.1%
Victoria County	79.8%	13.3%	6.7%	0.2%
Average for all study area census tracts	75.3%	15.2%	8.9%	0.6%
Average for all study area counties	76.2%	14.9%	8.3%	0.5%
Texas	78.0%	14.6%	7.1%	0.3%

3.18.7 Personal Income

An examination of per capita incomes for census tracts within the project area in Calhoun County shows that the average per capita income in 1999 was $17,072. There were minor variations among the census tracts in the project area (Table 3.18-14; see Figure 3.18-1). The lowest per capita income ($12,416) was recorded in census tract 9902 and the highest per capita income ($19,051) was recorded in census tract 9901. For the two project area census tracts in Jackson County, the average per capita income in 1999 was $17,247, and no major variations were recorded. For the project area census tracts in Matagorda County, the average per capita income in 1999 was $15,466. There was a significant variation among the two census tracts, and census tract 7306 was $2,735 lower than census tract 7305. In Victoria County, the per capita income in 1999 was $18,379, with significant variation among the four census tracts, the highest being 16.03 with $26,551, and the lowest being CT 7 with $14,117 (USBOC, 2000).

3.18.8 Tourism

Tourism is a major contributor to the study area economy. The natural resources of the Gulf and Coastal Bend of Texas provide extensive recreational opportunities year round (as mentioned in Section 3.17.3). Outdoor recreation in the area includes saltwater fishing, bird-watching, boating, swimming, shelling, beach combing, and more.

Birding along the Texas Gulf Coast, including areas within and near the study area, is another major tourist attraction. The 500-mile trail, jointly sponsored by TPWD and TxDOT, stretches along the Texas Gulf Coast from north of Beaumont to the Rio Grande Valley (TPWD, 2005a; Port Lavaca Calhoun County, n.d.). In addition to the trail, numerous birding sites and facilities are available in Matagorda County, mainly in areas east of the project area (Matagorda County Birding and Nature Center, 2004). All sites within and beyond the project area have become especially active in the annual national Christmas Bird Count.

Calhoun County offers visitors a wide variety of public park facilities such as Lighthouse Beach, Port Lavaca Fishing Pier Park, Port O'Connor King Fisher Beach and Park, and Indianola Park and Picnic Area (City of Port Lavaca, n.d.; Port Lavaca Calhoun County, n.d). Also, numerous historical sites and cemeteries are located throughout the project area (Port Lavaca Calhoun County, n.d.).

3.18.9 Oil and Gas Production

According to the RRC, in February 2006, Calhoun County had 148 oil and 300 gas wells, Jackson County had 905 oil and 560 gas wells, Matagorda County had 478 oil and 512 gas wells, and Victoria County had 472 oil and 735 gas wells (RRC, 2006). In 2005, oil and gas extraction and support industries provided approximately $1.4 million, $3.7 million, $1.2 million dollars, and $2.7 million, respectively, to the economies of Calhoun, Jackson, Matagorda, and Victoria counties (TWC, 2006b).

Table 3.18-14
Economic Characteristics by Study Area Census Tracts, 2000

		Per Capita Income (in dollars)		% of State Per Capita Income		% Change	# Below Poverty	% Below Poverty
	Population*	1990	2000	1990	2000	1990–2000	2000	2000
Calhoun County Census Tracts								
9901	5,156	11,368	19,051	88.10%	97.11%	67.6%	742	14.4%
9902	4,278	8,842	12,416	68.52%	63.29%	40.4%	1,066	24.9%
9903	1,504	14,490	18,334	112.29%	93.46%	26.5%	144	9.6%
9904	5,864	10,024	18,783	77.68%	95.75%	87.4%	883	15.1%
9905	3,587	9,387	16,776	72.74%	85.52%	78.7%	505	14.1%
Total/Average	20,389	10,822	17,072	83.87%	87.03%	57.7%	3,340	15.6%
Calhoun County	20,389	10,374	17,125	80.39%	87.30%	65.1%	3,340	16.4%
Jackson County Census Tracts								
9501	5,192	10,418	17,295	80.73%	88.16%	66.0%	657	12.7%
9503	4,647	11,286	17,198	87.46%	87.67%	52.4%	664	14.3%
Total/Average	9,839	10,852	17,247	84.10%	87.92%	58.9%	1,321	13.5%
Jackson County	14,088	10,225	16,693	79.24%	85.09%	63.3%	2,074	14.7%
Matagorda County Census Tracts								
7305	3,282	12,499	16,833	96.86%	85.81%	34.7%	523	15.9%
7306	6,044	10,768	14,098	83.45%	71.87%	30.9%	1,383	22.9%
Total/Average	9,326	11,634	15,466	90.15%	78.84%	32.9%	1,906	19.4%
Matagorda County	37,367	11,374	15,709	88.14%	80.08%	38.1%	6,913	18.5%
Victoria County Census Tracts								
7	3,603	**	14,117	**	71.96%	**	446	12.7%
8	1,807	**	14,333	**	73.06%	**	160	8.5%
16.03	6,8532	**	26,551	**	135.35%	**	221	3.3%
17	4,394	**	12,171	**	62.04%	**	640	14.7%
Total/Average	16,656	**	16,793	**	85.60%	**	1,467	8.8%
Victoria County	84,088	12,196	18,379	94.51%	93.69%	50.70%	10,681	12.9%
Study Area Total	39,554	11,009	16,766	85.3%	85.47%	52.3%	8,034	14.3%
Texas	20,287,300	12,904	19,617			52.0%	3,117,609	15.4%

Source: USBOC, 1990, 2000.
* Population in 1999 for whom poverty status is determined.
**1990 Census tract data not available for Victoria County
Note: Per capita income is in 1989 figures for 1990 Census and 1999 figures for 2000 Census.

3.18.10 Public Finance

In Texas, property is appraised and property tax is collected by local (county) tax offices or appraisal districts, and these funds are used to support many local needs including public schools, city streets, county roads, and police and fire protection (Texas Comptroller of Public Accounts, n.d.). Property taxes within Calhoun, Jackson, Matagorda, and Victoria counties are collected by each county's respective appraisal district or tax office. Table 3.18-15 provides a summary of property tax jurisdictions and tax rates for jurisdictions that affect large portions of the population living in the vicinity of the study area.

Table 3.18-15
Taxing Jurisdictions by Study Area County, 2005

Tax Jurisdiction	Tax Rate per $100 of Appraised Valuation
Calhoun County	
Calhoun County ISD	1.4176
City of Point Comfort	0.5429
City of Port Lavaca	0.7200
Calhoun County	0.5210
Navigation District	0.0043
Water Control and Improvement District 1	0.0426
Drainage District 6	0.5260
Drainage District 8	0.2905
Drainage District 10	0.1485
Drainage District 11	0.2450
Port O' Connor Municipal Utility District	0.2000
Jackson County	
Industrial ISD	1.7361
Jackson County	0.5179
Jackson County Emergency Services District	0.0298
Jackson County Flood Control District	0.1054
Jackson County Hospital District	0.2661
Jackson County WCID #1 (aka Lolita Water District)	0.1416
Jackson County WCID #2 (aka Vanderbilt Water District)	0.2396
Matagorda County	
Palacios ISD	1.4500
City of Palacios	0.7452
Coastal Plains Groundwater Conservation District	0.0050
Matagorda County	0.3085
Matagorda County Conservation and Reclamation	0.0060
Matagorda County Drainage District #1	0.1224
Matagorda County Drainage District #2	0.0995
Matagorda County Drainage District #3	0.0322
Matagorda County Drainage District #4	0.1948
Matagorda County Hospital District	0.2124
Matagorda County Navigation District #1	0.0398
Matagorda County Water Control & Improvement #2	0.2016
Matagorda County Water Control & Improvement #5	0.2297
Matagorda County Water Control & Improvement #6	0.2200
Palacios Area Seawall Commission District	0.0354

Table 3.18-15 (Cont'd)

Tax Jurisdiction	Tax Rate per $100 of Appraised Valuation
Victoria County	
County General Fund	0.3486
County – RD & BR	0.0500
Victoria College	0.1416
Navigation District	0.0369
Ground Water District	0.0000
Victoria ISD	1.5535
Bloomington ISD	1.6433
Nursery ISD	1.3700
Refugio ISD	1.4600
Drainage District 2	0.1240
Drainage District 3	0.0460
Drainage District 4	0.0000
Water District 1	0.4947
Water District 2	0.9016
City of Victoria	0.6900
Quail Creek MUD	0.0000

Sources: Calhoun County Central Appraisal District, 2005; Jackson County Central Appraisal District, 2005; Matagorda County Central Tax Office, 2005; Palacios ISD, 2005.

The Texas State sales and use tax rate is 6.25%, but local taxing jurisdictions (cities, counties, special purpose districts, and transit authorities) may also impose sales and use tax up to 2% for a total maximum combined rate of 8.25%. Within the general vicinity of the study area, local sales/use taxes are as follows:

- The unincorporated communities of Alamo Beach and Indianola sales/use tax is 6.75%, a combination of a 0.5% Calhoun County tax and the state's 6.25% tax.
- The City of Palacios sales/use tax is 8.25%, a combination of a 2.0% Palacios city tax and the state's 6.25% tax.
- The City of Point Comfort sales/use tax is 7.75%, a combination of a 1.0% Point Comfort city tax and a 0.5% Calhoun County tax.
- The City of Port Lavaca sales/use tax is 8.25%, a combination of a 1.5% Port Lavaca city tax and a 0.5% Calhoun County tax.
- The unincorporated community of Port O'Connor sales/use tax is 6.75%, a combination of a 0.5% Calhoun County sale tax and the State's 6.25% tax (Texas Comptroller of Public Accounts, n.d.).

3.18.11 Environmental Justice

In compliance with Executive Order (EO) 12898 – Federal Action to Address Environmental Justice (EJ) in Minority Populations and Low-Income Populations, an analysis has been performed to determine whether the proposed project would have a disproportionate adverse impact on minority or low-income population groups within the study area. The EO requires that minority and low-income populations do not receive disproportionately high adverse human health or environmental impacts and requires that representatives of minority or low-income populations, whom could be affected by the project, be involved in the community participation and public involvement process.

The data used in this study to determine the potential for disproportionate impacts to low-income and/or minority populations within the study area and the State are presented in tables 3.18-16 and 3.18-17. The information is based on 2000 USBOC state, county, and census tract level data for ethnicity and income.

In terms of ethnicity, the population living within the project area census tracts is slightly less ethnically diverse than the overall population of Calhoun, Jackson, Matagorda, and Victoria counties and the State of Texas (see Table 3.18-16). For instance, the number of White persons within the census tracts is 57.2%, only slightly higher than the counties (53.9%) and higher than the state, with 52.4%. The percentage of minority persons within the study area census tracts range from 17.9% in Census Tract 9903 to 69.3% in Census Tract 9902. Within the study area, Calhoun, Matagorda and Victoria counties have similar percentages of minority populations (47.8%, 47.2%, and 47.1%, respectively), while Jackson County has a much smaller minority population (33.7%). Calhoun County has the highest percentage of people living below the poverty line ($17,029 in 1999) in the study area, with 24.9% in CT 9902, while Victoria County has the lowest percentage, with 3.3% in CT 16.03. An average percentage of persons living below poverty within the study area counties is lower by 0.5% than that of the State of Texas (14.9% and 15.4%, respectively). Although variations in minority and low-income status exist within the census tracts, an average percentage of the study area compared to that of the State reveal that no disproportionate effects will be experienced by minority and low-income populations.

EO 13166, "Improving Access to Services for Persons with Limited English Proficiency (LEP)," signed by President Clinton on August 11, 2000, calls for all agencies to ensure that their Federally conducted programs and activities are meaningfully accessible to LEP individuals. Table 3.18-17 contains the percent LEP population for the study area.

As shown in Table 3.18-17, a low percentage of persons in the study area do not speak English or have difficulty speaking English. Data for "Ability to Speak English" for the population 5 years and over indicates 1 to 9% of the population in the study area speak English "Not Well," while 0 to 4% of the population speak English "Not at All." None of the LEP populations would be discriminated against as a result of the proposed project because steps would continue to be taken to ensure that such persons have meaningful access to the programs, services, and information currently provided in the study area. Therefore, the requirements of EO 13166 appear to be satisfied.

Table 3.18-16
Environmental Justice Analysis by Census Tract, 2000

	Population	Number White	% White	Number Minority	% Minority	Number Below Poverty	% Below Poverty*
Calhoun County Census Tracts							
9901	5,301	2,456	46.3%	2,845	53.7%	742	14.4%
9902	4,357	1,336	30.7%	3,021	69.3%	1,066	24.9%
9903	1,515	1,244	82.1%	271	17.9%	144	9.6%
9904	5,873	3,190	54.3%	2,683	45.7%	883	15.1%
9905	3,601	2,548	70.8%	1,053	29.2%	505	14.1%
Total/Average	20,647	10,774	52.2%	9,873	47.8%	3,340	15.6%
Calhoun County	20,647	10,774	52.2%	9,873	47.8%	3,340	16.4%
Jackson County Census Tracts							
9501	5,234	3,753	71.7%	1,481	28.3%	657	12.7%
9503	4,834	3,444	71.2%	1,390	28.8%	664	14.3%
Total/Average	10,068	7,197	71.5%	2,871	28.5%	1,321	13.5%
Jackson County	14,391	9,546	66.3%	4,845	33.7%	2,074	14.7%
Matagorda County Census Tracts							
7305	3,335	2,571	77.1%	764	22.9%	523	15.9%
7306	6,146	2,236	36.4%	3,910	63.6%	1,383	22.9%
Total/Average	9,481	4,807	50.7%	4,674	49.3%	1,906	19.4%
Matagorda County	37,957	19,900	52.4%	17,932	47.2%	6,913	18.5%
Victoria County Census Tracts							
7	3,603	1,761	48.9%	1,842	51.1%	446	12.7%
8	1,807	1,117	61.8%	690	38.2%	160	8.5%
16.03	6,852	5,217	76.1%	1,635	23.9%	221	3.3%
17	4,394	1,656	37.7%	2,738	62.3%	640	14.7%
Total/Average	16,656	9,751	58.5%	6,905	41.5%	1,467	8.8%
Victoria County	84,088	44,490	52.9%	39,598	47.1%	10,681	12.9%
Total/Average for all census tracts	56,852	32,529	57.2%	24,323	42.8%	8,034	14.3%
Total/Average for all counties	157,083	84,710	53.9%	72,248	46.0%	23,008	14.9%
State of Texas	20,851,000	10,933,000	52.4%	9,918,000	47.6%	3,117,609	15.4%

Source: USBOC, 2000.

Note: Minority is considered any race or ethnicity not White.

* Calculated using population for whom poverty has been determined.

Table 3.18-17
Percentage of Limited English Proficiency Persons in the Study Area

Area	Percent of Persons Who Speak English "Not Well"	Percent of Persons Who Speak English "Not at All"
Calhoun County Census Tracts		
9901	3.7	0.8
9902	4.4	0.3
9903	0.7	0.0
9904	3.9	3.1
9905	2.4	1.6
Average	3.0	1.2
Calhoun County	3.2	0.8
Jackson County Census Tracts		
9501	3.9	1.0
9503	1.2	3.7
Average	2.6	2.4
Jackson County	2.8	1.1
Matagorda County Census Tracts		
7305	0.9	1.2
7306	9.2	3.9
Average	5.1	2.6
Matagorda County	4.2	2.1
Victoria County Census Tracts		
7	2.2	0.6
8	4.6	1.3
16.03	1.6	0.0
17	4.6	1.0
Average	3.3	0.7
Victoria County	2.7	0.7
Average for all census tracts	3.3	1.4
Average for all counties	3.2	1.2
State of Texas	4.7	2.7

Source: USBOC, 2000.

3.19 COMMUNITY INFRASTRUCTURE AND MUNICIPAL SERVICES

This section presents a brief description of the utilities, public safety and health services, schools and libraries, parks and recreational facilities, and surface transportation within the study area. Data was collected from local chambers of commerce and governments in addition to internet research.

3.19.1 Utilities

Within Calhoun, Jackson, Matagorda, and Victoria counties, a variety of entities provide electric utility, natural gas, water, wastewater, and solid waste disposal services. These services are summarized in Table 3.19-1.

Table 3.19-1
Public Services and Utilities for the Study Area, 2006

	Electric Utility Service	Natural Gas Service	Water	Wastewater	Solid Waste Disposal Service
City of Point Comfort	American Electric Power (AEP) Texas	Center Point/Entex, Inc.	City of Point Comfort	City of Point Comfort	City of Point Comfort
City of Port Lavaca	AEP Texas	Center Point/Entex, Inc.	City of Port Lavaca	City of Port Lavaca	Waste Management, Inc. of Southeast Texas
Community of Port O' Connor	Victoria Electric Cooperative (VEC)	Commercial Propane dealers	Port O'Connor MUD	Port O'Connor MUD	Waste Management, Inc. of Southeast Texas
Unincorporated Areas of Calhoun County	AEP Texas; VEC; TXU	Center Point/Entex, Inc.	City of Port Lavaca; Guadalupe-Blanco River Authority (GBRA), Port O' Connor MUD	City of Port Lavaca; GBRA, Port O' Connor MUD	Waste Management, Inc. of Southeast Texas
Unincorporated Areas of Jackson County	AEP Texas; Central Power & Light (CP&L); Jackson Electric Cooperative, Inc. (JEC); VEC	Center Point; Reliant; commercial propane dealers	Jackson County Water District #2; Local city suppliers	Jackson County Water District #2; Local city suppliers	Jackson County
City of Palacios	CP&L; JEC	Center Point/Entex, Inc.	City of Palacios	City of Palacios	Waste Management, Inc./BFI
Unincorporated Areas of Matagorda County	AEP Texas; CP&L	Bay City Gas Co.; Entex, Inc.	Matagorda Waste Disposal and Water Supply Corp.; Wadsworth Water Supply Corp.; Local city suppliers	Matagorda Waste Disposal and Water Supply Corp.; Wadsworth Water Supply Corp.; Local city suppliers	Waste Management, Inc. of Southeast Texas
City of Victoria	VEC	Center Point/Entex Inc.	City of Victoria	City of Victoria	City of Victoria

American Electric Power (AEP) – Texas provides electric service for the cities of Port Lavaca and Point Comfort, as well as the unincorporated areas of Calhoun, Jackson, and Matagorda counties. AEP Texas is connected to and serves more than 900,000 electric consumers in the deregulated Texas marketplace. AEP – Texas is headquartered in nearby Corpus Christi, with regulatory and external affairs offices in Austin. Also, Victoria Electric Cooperative (VEC) serves approximately 7,000 electric consumers in six counties in and along the Texas Coastal Bend, including approximately 2,000 consumers in Port O'Connor and other unincorporated portions of Calhoun and Jackson counties. TXU Energy also provides electric service to the unincorporated portions of Calhoun County. Consumers in the City of Palacios and the unincorporated areas of Jackson and Matagorda counties chose between Jackson Electric Cooperative, Inc. (JEC) and Central Power and Light (CPL) for electric service.

Natural gas service within the study area is provided mainly by Center Point/Entex, Inc.; however, Port O'Connor and the unincorporated areas of Jackson County are also served by local commercial dealers. In addition, Jackson and Matagorda counties are served by Reliant and Bay City Gas Company, respectively.

The Guadalupe-Blanco River Authority (GBRA), City of Port Lavaca, and Port O'Connor Municipal Utility District (MUD) provide public water and wastewater services for the unincorporated areas of Calhoun County. The unincorporated areas of Jackson and Matagorda counties are supplied by Jackson County Water District #2 as well as Matagorda Waste Disposal and Water Supply Corp. and Wadsworth Water Supply Corp., respectively. Otherwise, water and wastewater services are provided by each municipality. For instance, the City of Palacios supplies its own water, primarily from groundwater wells.

The City of Point Comfort and Jackson County supply their own solid waste disposal service. The remainder of the study area is under contract with Waste Management of Southeast Texas to provide residential and commercial waste collection and disposal (Port Lavaca Calhoun County, n.d.). The City of Palacios is served by Waste Management of Southeast Texas as well as BFI.

Time Warner, Cable One, and CableVision are cable television and high speed internet service providers, and Verizon GTE provides telephone service, including DSL, within the study area.

3.19.2 Public Safety and Health Services

The study area has a well developed infrastructure to provide health, police, fire, emergency, and social services. A wide range of public programs, services, and facilities are offered at different locations throughout the study area. For instance, the Matagorda County Local Emergency Planning Committee (LEPC) is made up of city and county elected law enforcement, fire, and emergency medical officials, representatives of area industries, and volunteer organizations such as the American Red Cross. This group supports emergency planning for chemical hazards and provides local government as well as the public with information about possible chemical hazards.

In short, LEPC members prepare for emergencies which might pose health and safety hazards to Matagorda County residents. Such emergencies include releases of hazardous chemicals, such as gasoline or agricultural chemicals like pesticides, from any of the plants within the county or from any of the thousands of trucks, barges, and railroad cars which carry chemicals through the county each year. The LEPC also prepares for natural disasters like hurricanes and tornados.

Year round, members of the LEPC meet to discuss response plans and means of better informing the public about what to do in the event of an emergency. The members of the LEPC participate in drills at industrial plants, help find ways to improve safety, and aid the various involved organizations—police, sheriff's, fire, and EMS departments, school districts and other governmental agencies, hospitals and civic and volunteer groups – to work together smoothly in the event of an actual emergency (Matagorda County LEPC, 2001).

Fire protection within the study area is provided by a combination of municipal and volunteer fire departments (VFD). Fire departments serving the study area include the Port Lavaca Fire Department, Point Comfort Fire Department, Port O'Connor VFD, Magnolia Beach VFD, and the Victoria County VFD. Also, the docks within the Port provide full firefighting capabilities tied into the harbor's high-capacity firewater and foam supply system (Port of Port Lavaca-Point Comfort, n.d.).

The Port Lavaca Fire Department, the largest fire protection service in the study area, is considered a combination department with 30 suppression personnel, comprised of paid and volunteer firefighters. Port Lavaca Fire Department currently has two fire stations: Fire Station One is located at 1501 West Austin and Fire Station Two is located on 800 North Highway 35. The Port Lavaca Fire Department is responsible for fire protection for Port Lavaca and the surrounding areas of Calhoun County. The department also serves as the primary rescue responders for Calhoun County including vehicle rescue as well as water rescues. The department works closely with the U.S. Coast Guard in water rescue in Lavaca Bay, San Antonio Bay, Espiritu Santo Bay, Keller Bay, and Matagorda Bay. Most of the water rescue calls are for search/rescue of missing boats and possible missing drowned persons. In addition, the Coast Guard provides boats, helicopters, and jets for search assistance. The Port Lavaca Fire Department also acts as a backup to the Calhoun County Emergency Medical Services (described below) (Port Lavaca Fire Department, 2005).

The Point Comfort VFD is primarily a first responder agency of 18 volunteers who serve within the city limits of Point Comfort. The VFD operates one station, one engine, one rescue unit, and one brush truck. Currently, the department's resources limit responses within the Point Comfort city limits; however, when possible the department assists with emergency calls in Port Lavaca and Seadrift (Point Comfort City Hall, 2006).

The Magnolia Beach VFD is a small organization of approximately 11 volunteers operating from an unmanned fire station. The agency has a 15-mile-radius service area that extends into Port O'Connor. The Magnolia Beach VFD operates one engine, two brush trucks, two support vehicles, and one ambulance;

however, the department does not use the ambulance for transporting patients. The department's normal response time to emergency scenes is 2 to 3 minutes (Magnolia Beach VFD, 2006).

The Port O'Connor VFD is a small organization of approximately 20 volunteers operating from one station. Matagorda County's fire protection is provided by the Bay City Volunteer Fire Department which currently has 52 nonpaid fire fighters.

Law enforcement within the study area is provided by municipal and county agencies. For instance, the Port Lavaca Police Department employs 19 full time officers who operate from one station in Port Lavaca. Dispatch services are provided by the department, and the department's service area is within the Port Lavaca city limits. Calhoun County Sheriff's Office provides law enforcement for the entire county and coordinates with Port Lavaca and Point Comfort police departments during emergencies. The department employs 20 patrol deputies, operates one station in Port Lavaca, and provides its own dispatch services. The Matagorda County Sheriff's Office employs 52 officers to patrol approximately 39,000 persons within Matagorda County. In addition to patrol, the agency operates a S.W.A.T. Team, Marine Division, K-9 Officers, and two License and Weight Officers. The dispatch center is located within the Sheriff's Office. Jackson County Sheriff's Office employs 10 full-time officers to patrol the county, operates one station and its own dispatch center, and coordinates with the municipal police departments in Jackson County to respond to emergencies (Matagorda County Sheriff's Office, n.d.).

Emergency management services (EMS) within the study area are provided by Calhoun County EMS, which is located in Port Lavaca. Calhoun County EMS provides emergency response to a resident population of over 20,000 persons and covers an area of approximately 520 square miles. The agency was originally established as a hospital based EMS provider in 1980, and since then the service has grown from one ambulance and four paramedics to its present size of four ambulances and 17 licensed and certified paramedics. Calhoun County EMS serves as a Mobile Intensive Care Unit (MICU) provider and also staffs a Special Response Unit (SRU) that provides a communication and command center as well as treatment capabilities for over 30 patients (Calhoun County EMS, n.d.) In the eastern section of the study area, the Palacios Area EMS provides basic and advanced life support with MICU capability.

Memorial Medical Center is a full service medical facility with 25 patient beds, 18 doctors on staff, and over 300 employees located in Port Lavaca (Memorial Medical Center, 2003). The Palacios Community Medical Center (PCMC), an inpatient care facility with 24-hour emergency room service and 17 beds, is located in the town of Palacios in the eastern portion of the study area (PCMC, n.d.). The larger Matagorda General Hospital in Bay City offers 110 beds and has over 200 employees (Matagorda County Hospital District, n.d.). Also, the El Campo Medical Clinic operates a facility in Palacios, and the Texas Medical and Wellness Clinic operates facilities in Palacios and Port Lavaca. All hospital facilities in Jackson County are located in Edna, Ganado, and other areas beyond the study area.

3.19.3 Schools and Libraries

Numerous school districts provide educational services within the study area. The portions of Matagorda Bay which fall within Calhoun County are served by Calhoun County ISD. Calhoun County ISD covers approximately 1,030 square miles and served approximately 4,248 students during school year 2001 and 2002. Educational facilities within the Calhoun County ISD include the Harrison, Jefferson, Madison and the Jackson/Roosevelt complex, Calhoun and Hope high schools, and Travis Middle School in Port Lavaca, Point Comfort Elementary in Point Comfort, and Port O'Connor Elementary in Port O'Connor. The northeast side of Matagorda Bay, within Jackson County, is served by Industrial ISD. The Industrial ISD covers approximately 286 square miles and served approximately 946 students during school year 2001 and 2002; however, all educational facilities within the Industrial ISD are located north of the study area boundaries. The east barrier island and northeast quadrant of Matagorda Bay that fall within Jackson County, is served by Palacios ISD. The Palacios ISD covers approximately 587 square miles and served approximately 1,670 students during school year 2001 and 2002; however, all educational facilities within the Palacios ISD are located east of the study area boundaries. The northwest side of Matagorda Bay is served by Bloomington ISD and Victoria ISD; however, this school district is not included in the analysis as it only serves a very small portion of the study area (Texas Education Agency [TEA], 2003).

The Calhoun County library system serves over 20,000 citizens of Calhoun County and covers a geographic area of approximately 500 square miles. The Calhoun County library system consists of a main library located in Port Lavaca and three branches, located in Point Comfort, Seadrift, and Port O'Connor (Calhoun County Public Library, n.d.) The Palacios Library serves the eastern portion of the study area. The library book collection consists of over 30,000 items, and the library offers computer learning games and public internet access (Palacios Chamber of Commerce, n.d.).

The Bauer Community Center in Port Lavaca is a full service convention center with a 12,500 square ft main room capable of seating 1,000 people. In addition, two separate meeting rooms with 1,250 square ft each can be combined for larger functions (Port Lavaca Calhoun County, n.d.).

3.19.4 Parks and Recreational Facilities

The study area boasts numerous parks and recreational facilities, identified in detail in Section 3.17.3. These areas include Lighthouse Beach, Matagorda County Birding and Nature Center, Matagorda Island WMA, Perry R. Bass State Marine Fisheries Research Station, Port Lavaca Bird Sanctuary, Port Lavaca Fishing Pier Park, and the Texas Independence Trail (Matagorda County Birding and Nature Center, 2004; Port Lavaca Calhoun County, n.d.; THC, 2004; TPWD, 2005a).

Recreational boating and sailing are prevalent in the study area counties, and there are numerous marinas, boat ramps, and boat docks to accommodate these activities. Table 3.19-2 lists these facilities, as well as the number of boat slips at each, if available (GLO, 2003).

Table 3.19-2
Study Area Boating Facilities

Site/Area	County	Boat Ramp	Boat Dock	Number of Boat Slips
Alamo Beach	Calhoun	Yes	No	0
Charlie's Bait Camp	Calhoun	Yes	Yes	0
Chocolate Bayou Park	Calhoun	Yes	No	0
City Harbor	Calhoun	Yes	Yes	Unknown
City Park	Calhoun	Yes	Yes	Unknown
Clark's Marina and Restaurant	Calhoun	Yes	Yes	Unknown
Coloma Creek	Calhoun	Yes	No	0
Florence Bait Camp	Calhoun	Yes	Yes	Unknown
Harbor of Refuge Boat Ramp	Calhoun	Yes	Yes	Unknown
Lighthouse Beach and Bird Sanctuary and RV Park	Calhoun	Yes	Yes	0
Magnolia Beach Park	Calhoun	Yes	Yes	Unknown
Miller's Dock and Dockside Marina and RV Park	Calhoun	Yes	Yes	Unknown
Nautical Landings Marina and Bayfront Peninsula	Calhoun	Yes	Yes	72
Olivia Haterius Park	Calhoun	Yes	Yes	Unknown
Powderhorn RV Park	Calhoun	Yes	Yes	Unknown
Six Mile Park	Calhoun	Yes	No	0
Swan Point Park	Calhoun	Yes	No	0
The Bait Dock	Calhoun	Yes	Yes	20
The Fishing Center	Calhoun	Yes	Yes	23
Tweeties	Calhoun	Yes	Yes	Unknown
Crescent V	Jackson	Yes	No	0
Frel's Landing	Jackson	Yes	No	0
Garcita's Creek	Jackson	Yes	No	0
Lolita's Boat Ramp	Jackson	Yes	Yes	Unknown
West Carancahua Creek	Jackson	Yes	No	0
Allens Landing	Matagorda	Yes	Yes	Unknown
Bayfront Camper and RV Park	Matagorda	No	Yes	Unknown
Bayside Camper Park	Matagorda	Yes	Yes	Unknown
Bridgecove Marina	Matagorda	Yes	Yes	Unknown
C&R Marina	Matagorda	Yes	Yes	Unknown
Caney Creek Marina	Matagorda	Yes	Yes	Unknown
Chinquapin Road	Matagorda	Yes	Yes	Unknown
East Bay Park	Matagorda	Yes	Yes	Unknown
FM 521 River Park	Matagorda	Yes	Yes	Unknown
FM 1095, Collegeport	Matagorda	Yes	Yes	Unknown
Jensons Point	Matagorda	Yes	Yes	Unknown
Linda's Marina	Matagorda	Yes	Yes	Unknown

Table 3.19-2 (Cont'd)

Site/Area	County	Boat Ramp	Boat Dock	Number of Boat Slips
Matagorda Harbor	Matagorda	Yes	Yes	220
Palacios Pavilion	Matagorda	Yes	No	0
Palacios River	Matagorda	Yes	Yes	Unknown
Rawling's Bait Camp	Matagorda	Yes	Yes	0
River Bend Tavern and Marina	Matagorda	Yes	Yes	Unknown
Serendipity Resort, RV Park, and Marina	Matagorda	No	Yes	120
South Bay Boat Ramp	Matagorda	Yes	No	0
Tipps Bait Camp	Matagorda	Yes	Yes	Unknown
Turtle Bridge	Matagorda	Yes	Yes	Unknown
West Mooring	Matagorda	No	Yes	Unknown

Source: GLO, 2003.

In addition to the Port Lavaca area, the communities of Port O'Connor, Magnolia Beach, and Indianola also offer recreational opportunities, such as Port O'Connor King Fisher Beach and Park as well as Indianola Park and Picnic Area near Indianola Island (City of Port Lavaca, n.d.; Port Lavaca Calhoun County, n.d.).

Calhoun County also operates numerous accessible public boat ramps as well as a wide variety of public park facilities, many of which have RV accommodations. For instance, Lighthouse Beach and Bird Sanctuary in Port Lavaca offers 55 RV sites with full utility hook ups (City of Port Lavaca, n.d.; Port Lavaca Calhoun County, n.d.).

Also, the LCRA plans to open the Matagorda Bay Nature Park in the summer of 2006 (LCRA, 2006a).

3.19.5 Transportation

Surface transportation in the vicinity of Matagorda Bay is provided by a network of primary, secondary, and local roads. For instance, SH 35 spans the northern section of the study area and connects the towns of Palacios, Point Comfort, and Port Lavaca. In Port Lavaca, SH 35 intersects US 87, which provides access to the town of Victoria, approximately 27 miles northwest of the project area. Numerous state highways, such as SH 172, SH 185, SH 238, SH 316, and State Spur 159, as well as county roads, such as CR 1090, CR 1289, CR 1593, CR 2143, CR 2717, CR 2760, CR 3084, and CR 3280, combine with SH 35 to provide access to Port O'Connor, Magnolia Beach, Indianola, and Alamo Beach.

Several FAA-registered (public) and non-FAA-registered (private) airports and heliports serve the industrial areas located within or adjacent to the project area. These include the FAA-registered Calhoun County Airport as well as the non-FAA-registered Tanner's Airport and CIG 806 Heliport in the Port Lavaca area. In addition, two non-FAA-registered airports and five non-FAA-registered heliports are

located in the Port O'Connor area and include Pierce Field Airport, Port O'Connor Private Airport, Air Logistics Heliport, HHI-Port O'Connor Heliport, Industrial Helicopters, Inc. Heliport, PHI Heliport, and Port O'Connor Base (EHI) Heliport. Also, one FAA-registered and four non-FAA-registered facilities are located to the east of the project area boundary in the Palacios area and include the public Palacios Municipal Airport and the private Kubecka Aviation Airport, Sartwelle Ranch Airport, Trull Airport, South Texas Project Heliport, and Wagner Heliport. Big Duke's Place Airport is a private airport facility located in Indianola, along the western boundary of the project area (air.nav., 2006; FAA, 2006).

Water-based transportation is provided through the GIWW. The Texas portion of the canal system extends 426 miles, from Sabine Pass to the mouth of the Brownsville Ship Channel at Port Isabel. The major function of the waterway is the transportation of goods. This commercial trade route links the Port with inland consumers through the Mississippi River system, and with world commerce through the Gulf; thus, the GIWW is of major economic significance to Texas and the United States. The canal is directly linked to 10 deep-draft ports (ports with water 25 ft or more deep) and 26 shallow-draft channels. An average of 65 million tons of goods moved along the GIWW each year between 1968 and 1984. A record 72 million tons was carried through the GIWW in 1986. The principal commodities transported are crude petroleum and petroleum products, iron and steel, building materials, fertilizers, liquid sulfur, and other bulk products. TxDOT estimated that $35.5 billion worth of goods was moved over the waterway in 1986, by a work force of 145,000 people. Also, work boats supporting the hundreds of offshore oil rigs gain access to the Gulf through the GIWW (TSHA, 2002).

Rail transportation is provided by the Union Pacific Railroad (UPRR) as well as the Point Comfort and Northern Railway (PCN) and is integral to the industrial operations within the study area. The UPRR is the country's largest rail provider, linking every major West Coast and Gulf Coast port, and providing service to the east through Chicago, St. Louis, Memphis, and New Orleans. Additionally, the UPRR operates key north/south corridors and is the only railroad to serve all six major gateways to Mexico. The railroad is the nation's largest hauler of chemicals, much of which originates along the Gulf Coast near Houston (Union Pacific, 2006). The UPRR exchanges with the PCN, which provides transportation services primarily for Alcoa's bauxite, alumina, and chemicals facility in Point Comfort. The 13-mile railroad, which originates at Alcoa's plant, terminates in Lolita, Texas.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 AIR QUALITY

4.1.1 No-Action Alternative

No new construction or dredging air contaminant emission sources are associated with the No-Action alternative. However, it is anticipated that air contaminants in the project area would increase due to continued operational constraints on the existing system and a possible increase in ship traffic resulting both from growth of existing business and from new business.

Air contaminant emissions that may result from ongoing maintenance dredging activities would include exhaust emissions from fuel combustion in engines that power the marine vessels (dredge and support), on-shore construction equipment for dredged material placement, and employee commuter vehicles. Emissions associated with maintenance dredging are not expected to change from current conditions.

4.1.2 Proposed Alternative

4.1.2.1 Construction Dredging

Diesel-fired engines would be used to remove the dredged material, transport it to a designated location by pipeline, scow, or hopper, and support any associated dredging equipment. Dredge and support equipment in service during the Matagorda Bay dredging will primarily include dredges, booster pumps and associated barges, dredge tender barges, tug boats, work-related transport and supply boats, survey boats, crew boats, generators, welding machines, and air compressors. The rate of emissions from these equipment is directly related to the horsepower rating of each engine, load factor, duration of use, and the amount of material to be dredged. The rate of emissions from employee commuter vehicles is directly related to the total miles traveled for each vehicle. Emission sources associated with project construction dredging are listed in Table 4.1-1.

4.1.2.2 Construction Timeline

Total volume of new work material to be dredged has been calculated to be approximately 46.5 mcy. The capacity of the two hydraulic dredges is estimated to be about 30,000 cubic yards (CY) of soft clay/sand per day or 24,000 CY of stiff clay per day; the clamshell dredge will have a capacity of about 14,000 CY per day; and the hopper dredge may displace about 18,000 CY per day. The proposed construction dredging may proceed up to 20 hours per day, 7 days per week (with some scheduled down time). The emission rate calculations used in support of this report conservatively assumed maximum operations for an estimated project life of approximately 2 years with construction beginning in January 2008 and ending in December 2009. The total volume of material to be dredged, production rate, and total days of operation for each dredge type are shown in Table 4.1-2.

Table 4.1-1
Proposed Project Construction Emission Sources

Construction Emission Sources	Quantity	Horsepower Rating
Dredging Equipment		
30-inch Hydraulic Dredge	2	13,200
Hopper Dredge	1	18,000
Clamshell Dredge	1	2,340
Dredging Support Equipment		
Booster Pump Barge	2	5,400
Dredge Tender Barge	4	150
Tug for Supply Barge	2	1,000
Tug Boat	2	850
Tug Boat for Dump Scowl	1	3,500
Work Boat	2	350
Survey Boat	2	350
Crew Boat	2	350
Generator	2	7
Welding Machine	2	10
Air Compressor	2	55
Placement Area Construction Equipment		
Cat D6 LPG Dozers	3	225
Hydraulic Excavator	3	250
200-ton Crane – Dragline	2	550
Spill Barge/Crane	2	416
Cat 325 Marshbuggy	2	250
Generator	2	7
Mules	2	50
Air Compressor	2	55
Dump Truck – 20 yard	4	430
Light Plant	4	300
Commuter Vehicles		
Vans	5	n/a
Cars	8	n/a
Trucks	17	n/a

* All equipment information based experience from past projects

Table 4.1-2
Volume of Material, Dredge Production Rate, and Total Days of Operation

Dredge	Total Volume Dredged (CY)	Production Rate (CY/day)	Total Days of Operation
Clamshell	8,694,000	14,000	621
Hopper	3,204,000	18,000	178
Hydraulic #1	17,301,000	28,086	616
Hydraulic #2	17,301,000	28,086	616
Total	46,500,000		

*An estimated production rate of 28,086 CY/day for the hydraulic dredges was derived based on the volume of soft clay, stiff clay and sand to be dredged.

The dredges would operate in continuous 10-hour shifts, during which supporting equipment would be utilized to transport the crew to and from the dredges for each shift. It is expected that the same boat that brings one work crew to the dredge would return to shore with the exiting crew. Light plants would be used in the late afternoon and evening time frames to provide additional lighting for the crew and to serve as safety beacons to surrounding water borne traffic.

Commuter vehicles would transport the crew and staff from the shore to land-side locations and back to the shore. Crew and staff sizes were determined based on estimates from previous dredging projects. An average commute of 50 miles roundtrip was assumed for each vehicle. Vans were assumed to transport the dredge crew inland twice per month, passenger cars were assumed to transport management staff and support crew 30 days per month, and trucks were assumed to transport management staff 15 days per month.

4.1.2.3 Construction Dredging Emissions

The combustion of diesel fuel in internal combustion engines during the dredging operations would result in air emissions of CO, NO_x, PM, SO_2, and VOC.

Air contaminant emissions from marine vessels were estimated using emission factor equations from a EPA published study, *Analysis of Commercial Marine Vessels and Fuel Consumption Data*, February 2000. Air contaminant emissions from generators, welding machines, and air compressors were estimated based on emission factors published in the EPA, AP 42, *Compilation of Air Emission Factors*, Fifth Edition, Volume I, Chapter 3.3, Gasoline and Diesel Industrial Engines, Supplement B, October 1996. These emission factors, in combination with the equipment lists, engine load rate levels, and scheduling information prepared in support of the project, served as the basis for calculating annual and total emissions over the site preparation phase.

Onshore construction equipment related to the dredged material PAs would include cranes, trucks, dozers, front-end loaders, backhoes, compactors, graders, and dump trucks. Air contaminant emission factors for these diesel-fired equipment were derived from the EPA-approved software, NONROAD, Version 2005. Sulfur dioxide emissions from onshore construction equipment in this and other activity categories

described later were estimated based on an assumed 0.05% by weight fuel sulfur content in order to conservatively estimate the emissions, even though the EPA reduced the sulfur standards in diesel fuel to 15 ppm (0.0015 %) in 2006.

Employee commuter vehicles would include a mix of light-duty gas vehicles and light-duty gas trucks. Mobile on-road emissions associated with these commuter vehicles were calculated using the EPA's mobile source emissions model, MOBILE6.2. An average commute of 25 miles each way per day of work was assumed for each vehicle. The total number of miles traveled was estimated from the number of miles per trip multiplied by the total number of days of travel to and from the worksite times the number of vehicles.

Fugitive dust that may be generated by the physical disturbance of soils caused by earth-moving and equipment/vehicle traffic at the land-based PA construction sites would be minimal as the dredged material (sand, silt, and clay) is assumed to be moist; and therefore, quantitative estimates are not necessary. However, dust reduction measures, such as the use of a water truck at the site, may be employed, if required.

The annual construction dredging emissions broken out for each source for operations in 2008 and 2009 are summarized in tables 4.1-3 through 4.1-6. The project total annual construction dredging emissions for 2008 and 2009 are summarized in Table 4.1-7. Summary tables showing the basis and methodology used to estimate those air contaminant emission rates are found in Appendix H of this document.

Table 4.1-3
2008 Annual Construction Dredging Emissions

Emission Sources	Quantity	CO	NO_x	PM_{10} (tpy)	SO_2	VOC
Initial Dredge						
30-inch Hydraulic Dredge	2	187.02	1,431.09	32.53	32.53	16.26
Hopper Dredge	1	0.00	0.00	0.00	0.00	0.00
Clamshell Dredge	1	19.64	150.32	3.41	3.41	1.71
Support Equipment						
Booster Pump Barge	2	76.51	585.45	13.31	13.31	6.66
Dredge Tender Barge	4	1.89	19.41	0.45	0.45	0.22
Tug for Supply Barge	2	0.74	7.56	0.18	0.18	0.09
Tug Boat	2	5.34	54.98	1.26	1.26	0.63
Tug for Dump Scowl	1	13.03	134.14	3.07	3.07	1.53
Work Boat	2	1.84	18.87	32.50	0.43	0.22
Survey Boat	2	0.37	3.78	0.09	0.09	0.05
Crew Boat	2	0.37	3.78	0.09	0.09	0.05
Generator	2	0.50	0.80	0.07	0.02	0.13
Welding Machine	2	0.21	0.96	0.07	0.07	0.08
Air Compressor	2	0.99	2.04	0.14	0.07	0.22
2008 Total		308.41	2,413.14	87.13	54.94	27.82

Table 4.1-4
2009 Annual Construction Dredging Emissions

Emission Sources	Quantity	CO	NO_x	PM_{10} (tpy)	SO_2	VOC
Initial Dredge						
30-inch Hydraulic Dredge	2	187.02	1,431.09	32.53	32.53	16.26
Hopper Dredge	1	36.85	281.95	6.41	6.41	3.21
Clamshell Dredge	1	13.78	105.43	2.40	2.40	1.20
Support Equipment						
Booster Pump Barge	2	76.51	585.45	13.31	13.31	6.66
Dredge Tender Barge	4	1.89	19.41	0.45	0.45	0.22
Tug for Supply Barge	2	0.74	7.56	0.18	0.18	0.09
Tug Boat	2	5.34	54.98	1.26	1.26	0.63
Tug for Dump Scowl	1	9.14	94.08	2.15	2.15	1.08
Work Boat	2	1.84	18.87	32.50	0.43	0.22
Survey Boat	2	0.37	3.78	0.09	0.09	0.05
Crew Boat	2	0.37	3.78	0.09	0.09	0.05
Generator	2	0.50	0.80	0.07	0.02	0.13
Welding Machine	2	0.21	0.96	0.07	0.07	0.08
Air Compressor	2	0.99	2.04	0.14	0.07	0.22
2009 Total		335.50	2,610.14	91.61	59.42	30.06

Table 4.1-5
Annual Placement Area Construction Emissions

Emission Sources	Quantity	CO	NO_x	PM_{10} (tpy)	SO_2	VOC
Placement Area Equipment						
Cat D6 LPG Dozers	3	1.92	6.56	0.31	0.26	0.49
Hydraulic Excavator	3	2.05	6.95	0.33	0.29	0.53
200-ton Crane (550-hp) – Dragline	2	2.66	10.45	0.34	0.31	0.63
Spill Barge/Crane	2	4.82	18.98	0.62	0.56	1.14
Cat 325 Marshbuggy	2	1.35	4.09	0.20	0.19	0.32
Generator	2	0.11	0.18	0.02	0.002	0.03
Mules	2	0.27	0.82	0.04	0.04	0.06
Air Compressor	2	0.50	1.03	0.07	0.03	0.11
Dump Truck – 20 yard	4	5.80	15.53	0.63	0.67	0.79
Light Plant	4	3.95	14.40	0.63	0.40	1.21
Placement Area Total:		23.42	78.99	3.19	2.77	5.32

*Annual placement area construction emissions were assumed to be the same for 2008 and 2009.

Table 4.1-6
Annual Commuter Vehicle Emissions

Emission Sources	Quantity	CO	NO_x	PM_{10} (tpy)	SO_2	VOC
Commuter Vehicles						
Vans	5	0.07	0.004	0.0002	0.00005	0.007
Cars	8	1.56	0.107	0.0040	0.0012	0.159
Trucks	17	1.92	0.114	0.0043	0.0016	0.181
Commuter Vehicles Total:		3.55	0.226	0.0084	0.0029	0.347

*Annual commuter vehicles emissions were assumed to be the same for 2008 and 2009.

Table 4.1-7
Total Annual Construction Dredging Emissions

Year	CO	NO_x	PM_{10} (tpy)	SO_2	VOC
2008	335.38	2,492.36	90.33	57.71	33.49
2009	362.47	2,689.36	94.80	62.19	35.73
Project Total:	697.85	5,181.72	185.13	119.90	69.22

4.1.2.4 Maintenance Dredging

Routine dredging would be required to maintain the channel at the depth authorized to accommodate larger vessels and tankers. Maintenance dredging would occur along different segments of the Matagorda Bay and Lavaca Bay channels approximately every 2 years and offshore portions of the channel would occur approximately every 4 years. It is anticipated that on average, about 5.15 mcy per year of dredged material would be excavated to maintain the channel depth. The maintenance emissions were conservatively estimated based on the ratio of volume of dredged material displaced from maintenance activities to the total volume of new work dredging performed by either a hydraulic dredge or hopper dredge used for the maintenance dredging activities. The total emissions, not annual emissions, produced by the hydraulic or hopper dredge used for the new work dredging were multiplied by the maintenance-to-new work dredging material ratio to conservatively estimate the emissions for the maintenance dredging activity. The maintenance emissions estimates also considered a 10-hour-per-day work schedule, working 7 days per week for about 178 days or about 25 weeks for the maintenance placement activities. The estimated air contaminant emissions from this activity are shown in Table 4.1-8.

Table 4.1-8
Annual Maintenance Dredging Emissions
(tpy)

Project	Operating Duration*	CO	NO_x	PM_{10}	SO_2	VOC
Maintenance Dredging	178 days	59.00	451.44	10.26	10.26	5.13
Placement Area	25 weeks (178 days)	11.44	38.57	1.57	1.35	2.60
Total		70.44	490.01	11.83	11.61	7.73

*Operating duration is estimated at 178 days per year. The emissions shown in Table 4.1-8 are based on the operation of one hydraulic dredge for dredging of the Matagorda Bay and Lavaca Bay channels and one hopper dredge for dredging of offshore portions of the channel plus the emissions from the placement area equipment.

4.1.2.5 Estimated Air Quality Impacts

It is expected that air contaminant emissions from construction dredging activities would result in minor short-term impacts on air quality in the immediate vicinity of the dredging site. Each dredging operation would be relatively independent of the other, although, there may be some overlap. In addition, these activities are considered one-time activities (i.e., the construction dredging activities would not continue past the date of completion). VOC and NO_x can combine under the right conditions in a series of photochemical reactions to form ozone, possibly increasing ozone concentrations in the region. However, these reactions take place over a period of several hours with maximum concentrations of ozone often far downwind of the precursor sources. Due to the phased, one-time construction dredging, it is expected there would be no long-term impacts (i.e., beyond the project duration) to air quality in the area.

It is expected that air contaminant emissions from maintenance dredging activities would also result in minor short-term impacts on air quality in the immediate vicinity of the dredging site. As previously noted, VOC and NO_x can combine under the right conditions to form ozone, possibly increasing the concentration of ozone in the region. However, these reactions take place over a period of several hours, with maximum concentrations of ozone often far downwind of the precursor sources. The estimated emission rates for these and the other products of combustion are relatively minor and would be intermittent and of relatively short-term duration for each segment. Therefore, emissions from the maintenance dredging are not expected to result in a serious impact to the regional air quality, nor differ significantly from present maintenance dredging activities.

Atmospheric dispersion modeling of emissions was not performed. Dispersion modeling tools are available to estimate local air quality impacts; however, these models are best used for estimating air contaminant impacts from well-defined, stationary emission points. In the case of this project, local dispersion of emissions cannot readily be characterized with any degree of accuracy because they would be emitted from a variety of mobile sources that operate intermittently, as well as at a variable level of activity.

Regional dispersion models available to characterize the potential ozone contribution from VOC and NO_x emissions, which are ozone precursors and may result in regional ozone air quality impacts, are not intended to estimate a specific project's emission contribution to regional ozone concentrations. Therefore, regional dispersion models would not be useful in estimating the projects construction and operational impact on regional ozone concentrations.

Airshed pollutant loading determined by the magnitude of emissions expected to result from the project compared to area emissions can be used to estimate air quality impacts of the criteria pollutants. Based on available air emissions inventory information provided on the EPA's AIRData website (EPA, 2001), Table 4.1-9 provides a summary of emissions for the Calhoun, Jackson, and Matagorda County area. The emissions data are available for area, mobile, and point source emissions, based on emissions inventory information for 2001. This emissions inventory provides a basis from which to compare the proposed

project emissions to the existing industrial sources required to submit annual emissions inventories in the affected counties.

Table 4.1-9
Summary of Air Emissions from Dredging Activities Compared with Calhoun, Jackson, and Matagorda Counties Emissions for 2001

Air Pollutant	County Area, Mobile, and Point Sources (tpy)	2008 Annual Construction Dredging Emissions (tpy)	Construction Dredging Percentage of County Emissions (%)	2009 Annual Construction Dredging Emissions (tpy)	Construction Dredging Percentage of County Emissions (%)	Annual Maintenance Dredging Emissions (tpy)	Maintenance Dredging Percentage of County Emissions (%)
CO	46,407	335.38	0.72	362.47	0.78	70.44	0.15
NO_x	23,254	2,492.36	10.72	2,689.36	11.57	490.01	2.11
PM_{10}	24,153	90.33	0.37	94.80	0.39	11.83	0.05
SO_2	1,374	57.71	4.20	62.19	4.53	11.61	0.85
VOC	17,694	33.49	0.19	35.73	0.20	7.73	0.04

*2001 year is the most recent and complete year at http://www.epa.gov/air/data/geosel.html.

As shown in Table 4.1-9, construction dredging for the proposed project would result in an increase in emissions above those resulting from existing sources in the Calhoun, Jackson, and Matagorda County area. Emissions of NO_x may result in a temporary increase of about 11.6% over existing area emissions. SO_2 emissions may result in a temporary increase of about 4.5% over existing area emissions. However, the SO_2 emissions do not take into account the federal mandated low sulfur diesel fuel standards. Therefore, the SO_2 emissions in this report potentially overestimate the predicted actual SO_2 emissions. Emissions of CO, PM_{10}, and VOC are expected to result in 1% or less increase over existing emissions based on available air emissions inventory information provided on the EPA's AIRData website (EPA, 2001).

Also shown in Table 4.1-9, emissions during maintenance dredging are estimated to contribute about 2% to existing NO_X emissions and less than 1% to existing CO, PM_{10}, SO_2, and VOC emissions for these counties.

The TCEQ and EPA's air quality New Source Review permitting program applies to stationary sources of air emissions, and would therefore, not apply to emissions from the dredging activities. However, emissions are expected to be within the NAAQS and the rules and regulations of the EPA and the TCEQ.

4.2 NOISE

Project-related noise impacts were evaluated by considering the noise emissions related to dredge and placement operations of the proposed channel improvement project at noise-sensitive receivers. Impacts were assessed by comparing the predicted noise emitted by typical dredge and construction equipment with the existing ambient noise levels in the vicinity of the project area. Noise levels at noise-sensitive receivers were estimated based on the properties of noise attenuation and industry accepted standards.

The following information summarizes the assumptions and properties used in the calculation of estimated noise levels.

Sound pressure levels of two separate sources are not directly additive. Therefore, as shown in Table 4.2-1, if a sound of 60 dB is added to another sound of 60 dB, the resulting noise level is 63 dB, not 120 dB. For example, if the noise level of a hopper dredge is measured at 85 dB at 50 ft, and the noise level of a tug boat is measured at 82 dB at 50 ft, the combined noise level of both would be approximately 87 dB. Also, noise attenuation between dredge activities and sensitive receivers was calculated based on the assumption that noise attenuates 6 dB per doubling distance from its source. For example, if dredging activities are measured at 87 dB at 50 ft, the noise levels would decrease 6 dB to 81 dB at 100 ft, decrease an additional 6 dB to 75 dB at 200 ft, and decrease to 69 dB at 400 ft, etc.

Table 4.2-1
Decibel Addition

Difference Between Two Sources	For Example	Add To Higher Level	Resultant Sound Level
0 dB	60 and 60 dB	3 dB	63 dB
1 dB	60 and 61 dB		64 dB
2 dB	60 and 62 dB	2 dB	64 dB
3 dB	60 and 63 dB		65 dB
4–9 dB	60 and 65 dB	1 dB	66 dB
10 or more	60 and 70 dB	0 dB	70 dB

Source: TxDOT, 1996.

4.2.1 No-Action Alternative

Under the No-Action alternative, the channel would not be widened and deepened to project specifications. However, the existing regime of maintenance dredging, which generally includes a hopper dredge and various tending/crew boats would continue as normal. The majority of mechanical dredging equipment on a hopper dredge is housed below the vessel's deck, therefore noise levels associated with the equipment are comparable to tug boats. Table 4.2-2 summarizes dredging-related noise levels produced by equipment type.

Table 4.2-2
Typical Noise Levels

Equipment	Noise Level (dBA)
Cutterhead Dredge (at 160 ft)	79[1]
Hopper Dredge (at 50 ft)	87[2]
Large Tug boat (at 50 ft)	87[3]
Small Tug Boat	72[3]
Bulldozer (at 50 ft)	82[4]
Bucket Crane (at 50 ft)	82[4]

[1] Geier & Geier Consulting, 1997. [2] Assumed same as large tug .
[3] Epsilon Associates, 2006. [4] FHWA, 2006.

No permanent noise impacts will result under the No-Action alternative. Maintenance dredging activities generally occur within the channel, which is located a great distance from the shoreline and noise-sensitive receivers. The nearest noise sensitive receivers, which are located at Magnolia Beach, lie approximately 3,000 ft from the channel. The large distance between the noise sources and receivers would greatly reduce dredging-related noise levels at these receivers. Table 4.2-3 summarizes the approximate distances of noise-sensitive receivers from the ship channel and the calculated noise levels from maintenance dredging at the receivers. As discussed in Section 3.2, existing ambient noise levels within the project area range between 52.4 and 65.1 dBA (L_{dn}) (Table 4.2-4 compares common noise levels present in the daily environment). The No-Action alternative would not result in permanent or short-term noise impacts. Maintenance dredging noise levels at sensitive receivers would be less than the existing ambient conditions beyond 3,000 ft from the channel. Therefore, noise-sensitive receivers would not be impacted.

Table 4.2-3
Calculated Noise Levels for Maintenance Dredging

Noise Sensitive Receiver Location	Distance From Channel	Calculated Noise Level From Dredging Activities
Port O'Connor	8,100 ft	44 dBA (L_{eq})
Indianola	8,000 ft	44 dBA (L_{eq})
Magnolia Beach	3,000 ft	52 dBA (L_{eq})
Alamo Beach	4,100 ft	50 dBA (L_{eq})
Port Lavaca	16,500 ft	38 dBA (L_{eq})
Point Comfort	10,000 ft	42 dBA (L_{eq})

4.2.2 Proposed Alternative

Under the Proposed alternative, the channel would be improved as described in Section 2. Equipment to be used for the Proposed alternative will include separate crews operating in 10-hour shifts consisting of pipeline, scow, or hopper dredges, and smaller survey/crew vessels within the channel. The crews would operate on opposite ends of the channel, and therefore both would not be within the vicinity of noise sensitive receivers at the same time. Dredging operations are expected to occur approximately 20 hours/day for a total of 2 years. Dredging activities would generate noise from a variety of equipment sources; however, the primary sources of equipment noise would include the dredges (with their associated pumps and generators), dredge tender barges, and tugboats (see Table 4.2-2). Smaller vessels, such as tending boats and survey boats, would not substantially contribute to the noise associated with dredging activities.

Table 4.2-4
Common Sound/Noise Levels

Outdoor	dBA	Indoor
	110	Rock band at 5 meters
Jet flyover at 3,000 meters		
Pneumatic hammer	100	Subway train
Gas lawnmower at 1 meter		
	90	Food blender at 1 meter
Downtown (large city)	80	Garbage disposal at 1 meter
		Shouting at 1 meter
Lawnmower at 30 meters	70	Vacuum cleaner at 3 meters
Commercial area		Normal speech at 1 meter
Air conditioning unit	60	Clothes dryer at 1 meter
Babbling brook		Large business office
Quiet urban (daytime)	50	Dishwasher (next room)
Quiet urban (nighttime)	40	Library
	30	
	20	
	10	
		Threshold of hearing
	0	

Source: TxDOT, 1996.

The proposed action under Alternative 2 is not expected to result in long-term noise impacts. No permanent noise sources will be installed as part of this project. In the short-term, however, the proposed action could result in slightly elevated noise levels at noise-sensitive receivers located at Magnolia Beach and Alamo Beach. As in the case of the No-action alternative, the large distance between the noise sources and receivers would greatly reduce dredging-related noise levels at the receivers. Table 4.2-5 summarizes the approximate distances of noise-sensitive receivers from the ship channel and the calculated noise levels of the proposed action's dredge activities at the receivers. As discussed in Section 3.2, existing ambient noise levels within the project area range between 52.4 and 65.1 dBA (L_{dn}). The proposed project's dredging noise levels at sensitive receivers would be less than the existing ambient conditions beyond 4,100 ft from the channel. Short-term impacts related to these operations, therefore,

would be nearly identical to the short-term impacts that occur during current maintenance dredging as discussed above in Section 4.2.1.

Table 4.2-5
Calculated Noise Levels for Proposed Alternative

Noise Sensitive Receiver Location	Distance From Channel	Calculated Noise Level From Dredging Activities
Port O'Connor	8,100 ft	49 dBA (L_{eq})
Indianola	8,000 ft	49 dBA (L_{eq})
Magnolia Beach	3,000 ft	57 dBA (L_{eq})
Alamo Beach	4,100 ft	54 dBA (L_{eq})
Port Lavaca	16,500 ft	43 dBA (L_{eq})
Point Comfort	10,000 ft	47 dBA (L_{eq})

The proposed action's DMMP would utilize dredged material for various beneficial uses. One of the options would include beach nourishment along the public beaches of the Magnolia-Indianola shoreline (proposed areas BN1 and BN2). Approximately 1.4 mcy of dredged material will be pumped onto this shoreline through pipelines connected to the 30-inch cutterhead suction dredge in the channel. Construction equipment would be operated in the placement areas on an as-needed basis, and minimal equipment would be required to maneuver the pipeline during placement, therefore, onshore noise levels during placement activities would not be expected to increase substantially. As shown in Table 4.2-2, the typical noise level of a bulldozer operating at 50 ft is approximately 82 dBA. Noise emissions would be reduced to 76 dBA at 100 ft, 70 dBA at 200 ft, and diminish quickly as the distance from the noise source increases.

Another option for the proposed action's DMMP would include placement in Area P, a 700-acre site located south of FM 2760. The area is planned to be an upland site that would be built over a 50-year period. Initially levees would be raised around the site's perimeter and provide the capacity for future maintenance material. As with the beach nourishment operations, construction equipment would be operated on an as-needed basis. Material would be delivered to the site through a pipeline and moved by various earth-moving equipment. As shown in Table 4.2-2, the typical noise level of a bulldozer operating at 50 ft is approximately 82 dBA. Noise emissions would be reduced to 76 dBA at 100 ft, 70 dBA at 200 ft, and diminish quickly as the distance from the noise source increases further. The proposed site is currently in agricultural use and the existing noise environment is influenced by farm equipment and machinery. The proposed action would not be expected to substantially increase noise levels above current conditions.

4.3 PHYSIOGRAPHY, TOPOGRAPHY, AND BATHYMETRY

4.3.1 No-Action Alternative

The No-Action alternative would have no impact on physiography, topography, and bathymetry. However, alterations to bathymetry from maintenance dredging of existing ship channels, in addition to topographic changes from the placement of dredged materials at PAs, would continue under the No-Action scenario.

The existing wave climate and resulting shoreline erosion potential in the project area are dominated primarily by wind waves. The relative wave energy from wind waves is estimated to comprise 97% to 99% of the total wave energy and approximately 1% to 3% of the total wave energy is estimated to be from existing ship traffic (Appendix I). Under the No-Action alternative, there is anticipated to be no significant change in the total wave energy and erosion potential attributable to vessel traffic.

In the absence of project activity, the existing patterns of shoreline erosion are expected to continue, especially along a peninsula separating Keller Bay from Matagorda Bay. A breach of this peninsula would cause the Bay areas to be connected, resulting in the loss of seagrass and marsh habitats that currently exist in Keller Bay.

As described in the Habitat Equivalency Analysis (HEA, Appendix J), it is likely a category 1 hurricane would cause a storm surge that could reach the peninsula separating Keller Bay from the Gulf. Based on NOAA climatological data, such a hurricane is likely to occur in the area every 9 years.

4.3.2 Proposed Alternative

The total estimated amount of dredged material generated from the Proposed alternative would be approximately 46.5 mcy of new work material and approximately 257.5 mcy of maintenance material over 50 years after the project is constructed. This material would be placed in existing open-bay unconfined PAs, existing and new offshore unconfined PAs, an UCPA, and in-bay confined PAs, as described in Section 2.5.

One upland PA would be created (P1, see Figure 3.0-1). The area where the UCPA would be created is currently being used for rice production. Dredged material would also be used to create marshes, oyster reefs, sand platforms, and a bird island, and would be used to cover mercury-impacted sediment and for beach nourishment. Habitat protection areas would also be created to protect marshes and seagrass. Further information pertaining to specific PA descriptions and quantities of new work and maintenance material involved are presented in Section 2.4 and Appendix B.

About 3 miles of shoreline located along the Magnolia-Indianola beaches would be affected by the proposed beach nourishment. This area will be used to contain approximately 1.9 mcy of new work material. The material will increase the elevation of the beach by 1 to 2 ft and move the shoreline

contours out by a substantial distance, on the order of 150 to 300 ft. During placement of the material, a high degree of turbidity is expected because the material does not consist entirely of beach quality sand. When the material is exposed to wave action, the finer particles will be carried away and the remaining sand should be suitable for beach use.

It is impossible to know how long the material will remain on the beach areas, as erosion tends to occur in relatively brief storm events which may or may not occur in any given year. However, confinement systems (groins) are planned for the beaches, and these structures should reduce beach erosion rates.

In-bay upland PA G (and associated shoreline protection) would prevent the breaching of the shoreline along the peninsula separating Keller Bay from Matagorda Bay. Area G is a marsh located 300 ft offshore of Sand Point Marsh and continues for about 4 miles as shoreline protection to the end of Keller Bay. Approximately 4.7 mcy of new work material would be used for marsh creation and the construction of an armoured levee for shoreline protection to about 8 ft above MLT.

Deepening and widening the navigation channel will result in a reduction in primary wave (drawdown) and secondary wave (wake) heights for existing vessels (see Appendix I). A proposed LNG vessel passing through the modified channel will result in a greater drawdown than an existing vessel passing through the existing channel at a comparable vessel speed, but the increase in the depth of the channel is projected to result in a reduction of wave energy from passing vessel wakes. For example, a proposed LNG vessel passing through the modified channel will result in a smaller wake than an existing vessel passing through the existing channel (see Appendix I). Under the Proposed alternative, there is anticipated to be no significant change in the total wave energy and shoreline erosion potential attributable to vessel traffic (see Appendix I).

While local changes would occur to bathymetry and topography during construction of the proposed project, these alterations would be expected to have negligible impacts on the regional physiography, topography, and bathymetry of the submerged and subaerial portions of the study area.

4.4 GEOLOGY

4.4.1 No-Action Alternative

The No-Action alternative would not impact geology within the study area.

4.4.2 Proposed Alternative

The impacts on the local geology during dredging associated with the proposed project would include redistribution of existing sediment, local increases in turbidity, and potential increases of local scouring and shoaling rates. Net impacts on local geology would be minimal from these operations. Additionally, no impacts or modifications to geologic hazards such as faulting and subsidence are expected.

In an October 2006 Memorandum for Record (USACE, 2006b), results of a study performed concerning the cross-sectional area stability of Pass Cavallo were disclosed. According to the study, the width of Pass Cavallo is known to have decreased since construction of the MSC into Matagorda Bay in 1966. The purpose of the study was to investigate whether Pass Cavallo would remain open or gradually close as a result of improving the MSC. Subject to the uncertainties that enter all coastal sediment processes studies, it was concluded that Pass Cavallo would remain open at its present cross-sectional channel area or increase in area. In addition, the proposed widening of the MSC is not expected to notably change the stability of Pass Cavallo because the additional capture of the tidal prism by the ship channel would be small relative to past changes in tidal prism (see Appendix I).

An ongoing study for jetty stability at the MSC Entrance Channel has been conducted by the USACE (2006b). In May 2000, an Initial Appraisal Report under Section 216 authority was prepared which recommended the initiation of a reconnaissance study in FY 2002. The purpose was to determine the best alternative to reduce flow velocity through the jetties and repair the current scour areas. According to the report, the natural narrowing of Pass Cavallo Inlet along with Matagorda Bay currents and other influences has increased current velocities through the jetties, causing severe erosion. Multibeam survey results show extreme scour at the throat of the jetties and at locations along the north and south jetties. The scour ranges from depths of 36 ft to depths over 100 ft in some places. Subsequently, a Reconnaissance Report Section 905(b) Analysis for MSC was completed in March 2004 (USACE, 2004). This report concluded that jetty stabilization that would improve the efficiency and safety of the channel appeared feasible. In August 2006, a Jetty Stability Study was completed by the USACE Coastal and Hydraulics Laboratory. The goal of this study was to identify and evaluate alternatives to stabilize the jetties at the entrance to the MSC through reduction of the current velocity. Further information pertaining to jetty stability for the project area can be found in the USACE report(s) referenced above.

4.5 ENERGY AND MINERAL RESOURCES

4.5.1 No-Action Alternative

The No-Action alternative would have no impact on energy and mineral resources. However, large quantities of sand and sediment will be available from maintenance dredging of existing ship channels and from future channel deepening and/or widening projects. In the absence of project activity, the existing patterns of area shoreline erosion are expected to continue.

4.5.2 Proposed Alternative

Alternative 2 would include the widening and deepening the existing MSC. This action would result in an estimated 46.5 mcy of new work material and an additional 257.5 mcy of maintenance material over the next 50 years after project completion. A range of dredged material PAs is also being considered including uplands, marsh creation, oyster reefs, and habitat protection (URS, 2006b). The locations identified for dredged material placement do not appear to impact known areas of mineral production. However, the project would result in the excavation and use of selected material. Material of appropriate

quality will be dredged and used for beach nourishment at PAs BN1, BN2, and BN3 (Figure 3.0-1). The new work material that is adjacent to these proposed PAs (Reaches 5, 6, 7, 8, and 9) contain sufficient quantity of appropriate particle size (i.e., sand) for beach nourishment.

The DMMP was designed to minimize impacts to oil and gas wells and pipelines. Table 4.5-1 summarizes the energy resources identified within the proposed PAs (Appendix C). A permitted well location is mapped in PA OR1. A total of four plugged gas wells are mapped within PAs A1, A2, and OR2. Dry holes were reported drilled within PAs A1, A2, OR2, and P1. A total of five active pipelines are reported to be located in PAs A1, BN1, and BN2. Three active 20-inch natural gas pipelines (two Enterprise Products Operating, LP, and one Kinder Morgan Tejas Pipeline, LP) are crossed by the drainage ditch associated with PA P1. A portion of the drainage ditch corridor would also parallel existing CCND pipeline easement (Appendix A, Plate 46). Because the ditch is expected to be only 1 to 2 ft deep, no impacts are likely. One abandoned pipeline is reported in PA A1.

Table 4.5-1
Summary of Oil/Gas Wells and Pipelines Identified
Within The Proposed Placement Areas

Placement Area	Oil/Gas Wells				Pipelines		
	Gas	Plugged Gas	Dry Hole	Permitted Location	Natural Gas	Ammonia	Status
A1	0	**1**	**1**	0	**2**	0	**1** Active **1** Abandoned
A2	0	**2**	**1**	0	0	0	NA
BN1	0	0	0	0	**1**	0	**1** Active
BN2	0	0	0	0	**2**	0	**2** Active
BN3	0	0	0	0	0	0	NA
D	0	0	0	0	0	0	NA
ER1	0	0	0	0	0	0	NA
ER2	0	0	0	0	0	0	NA
ER3	0	0	0	0	0	0	NA
H4	0	0	0	0	0	0	NA
O5	0	0	0	0	0	0	NA
PA1	0	0	0	0	0	0	NA
PA5–PA12	0	0	0	**1**	0	0	NA
OR1	0	0	0	**1**	0	**1**	**1** Active
OR2	0	**1**	**1**	0	0	0	NA
P1	0	0	**2**	0	**3***	0	**3** Active
Total	0	**4**	**5**	**2**	**8**	**1**	

* The proposed drainage ditch/dredge pipeline corridor associated with PA P1 would cross three active natural gas pipelines.

Well and pipeline locations reported by the RRC are approximate. No mitigation is expected for well sites, plugged wells, or dry holes. Pipeline relocation will be assessed by the owners and lines would be relocated if conditions warrant.

4.5.3 Energy and Natural or Depletable Resource Requirements and Conservation Potential of Various Alternatives and Mitigation Measures

NEPA regulations in 40 CFR 1502.16 (e) and (f) requires a discussion of project energy requirements and natural or depletable resource requirements, along with conservation potential of alternatives and mitigation measures in an EIS.

Under the No-Action alternative, the energy requirements for maintaining the MSC will continue as before. The navigation requirements for energy (fuel) to transport commercial products, however, would be expected to increase in the future as commerce increases and additional one-way traffic increases congestion and navigation time into and out of the port. As a result, it is reasonable to expect that air quality impacts would increase with an increase in traffic congestion and travel time along the channel.

Deepening and widening the MSC is expected to reduce energy (fuel) requirements for transporting products on a ton/mile basis within the existing channel. Two-way traffic and heavier loaded ships in the channel will decrease congestion and reduce transit times.

Although energy (fuel) will be required to construct and maintain the improved channel, this impact is expected to be more than offset by the fuel savings from increased efficiency for ship traffic within the channel. The larger channel should also help reduce air emissions slightly over the No-Action alternative.

Increased efficiency in moving commodities to the local port users is expected to help conserve natural or depletable resources in the future. The reduced energy requirements will result in lower (or at least a smaller increase in) transportation costs in the future, which should reduce overall production costs for the consumer.

4.6 SOILS

4.6.1 No-Action Alternative

Impacts to surface soils from the No-Action alternative are primarily from placement of dredged material and commercial and/or residential development, which would continue according to historic trends (see Section 3.17).

4.6.2 Proposed Alternative

Under this alternative, the proposed beach nourishment areas (PAs BN1, BN2, and BN3) located along public beaches of the Magnolia-Indianola shoreline would be impacted by placement of dredged material.

However, due to ongoing shoreline erosion and periodic beach maintenance such as grooming and/or sand importation, impacts to native surface soils within the project area would be minimal. Therefore, adverse impacts are not expected to occur during dredge pipeline placement and discharge operations. Because a large portion of the new work material removed from the bay bottom consists of clay and some sand, these resources are discussed in Section 4.5.

Under this alternative, the proposed terrestrial upland area PA P1 located south of Alamo Beach on existing agricultural land would be impacted by the placement of dredged material. This would cover soils currently used for agriculture. See Section 4.6.3 for additional details.

Possible impacts to surface soils exist from the potential release of petroleum products during construction and hazardous material spills from hazardous cargo during shipping operations. However, the use of BMPs in the project area would greatly minimize the potential for this type of impact.

4.6.3 Prime Farmland Impacts

4.6.3.1 No-Action Alternative

Impacts to prime farmland from the No-Action alternative may occur from commercial and/or residential development, which would continue according to historic trends (see Section 3.17).

4.6.3.2 Proposed Alternative

Under this alternative, the proposed PA P1 located south of Alamo Beach on existing agricultural land (approximately 700 ac) would be converted to a leveed dredged material placement area. This area is inactive or recent rice production and/or pasture and is in rotation between the two, according to NRCS (2007) and historical aerial photography. None of the mapping units designated by NRCS as prime farmland in Calhoun County occur within the proposed footprint of PA P1 (Mowery and Bower, 1978), so the FPPA regulations do not apply and no impacts to these resources would result from the activities associated with the proposed alternative.

4.7 GROUNDWATER HYDROLOGY

4.7.1 No-Action Alternative

The No-Action alternative would not impact groundwater hydrology within the project area and would continue according to historic trends (Section 3.7).

4.7.2 Proposed Alternative

Construction and operation activities associated with the proposed project are not expected to result in impacts to groundwater hydrology. In addition, no groundwater withdrawals are anticipated for the project. No apparent private, public or industrial water wells registered with the TWDB (2006) would be

destroyed and/or affected from the proposed project based on their proximal distances and completed depths below surface grade.

Possible impacts to shallow groundwater exist from the potential release of petroleum products during construction and hazardous material spills from shipping interests. However, the use of BMPs in the project area would greatly minimize the potential for this type of impact. BMPs that meet local, State, and Federal requirements would be developed and implemented as part of the Spill Response Plan for the project to address potential spills. In addition, packages for hazardous material must conform to standards set by Research and Special Programs Administration (RSPA) of the DOT and the International Maritime Organization (IMO). A carrier accepting hazardous cargo from a shipper or intermediary is obliged to exercise reasonable care to be sure that the shipment has been properly prepared. This obligation exists each time the cargo is handed off during the transportation process. Specific requirements apply to highway, rail, air, and ocean transport. Compliance within these procedures would greatly reduce the risk of impact to the underlying groundwater in the project area.

4.8 HAZARDOUS MATERIAL

4.8.1 No-Action Alternative

The No-Action alternative would have no impact on hazardous materials associated with regulated facilities in the region. However, maintenance dredging of existing ship channels and from future channel deepening and/or widening projects, in addition to the placement of dredged materials at PAs, would continue under the No-Action scenario. In the absence of project activity, the existing historic impacts related to area industry are expected to continue.

4.8.2 Proposed Alternative

The Proposed alternative is the widening and deepening of the MSC from the Entrance Channel, Matagorda Bay, Lavaca Bay, and New Turning Basin and Harbor. The potential for encountering impacted material during the construction of the project is very limited. Impacts associated with regulated facilities are most likely to be encountered near the source of the contaminants. These sources include, but are not limited to, industry located in the Point Comfort area.

A review of a regulatory agency database information search and an aerial photographic review was conducted to determine the location and status of sites regulated by the State of Texas and the EPA. The database review revealed a total of 860 separate records of regulated facilities, material releases, and corrective and/or remedial actions. This assessment determined that there are approximately 150 regulated properties or facilities in the project area. The majority of the records (704) are attributed to spills of regulated materials at 21 separate facilities. The environmental impacts that have resulted from these facilities vary greatly. The vast majority of these facilities do not appear to pose an environmental concern to the project. However, according to a review of the database records and research of the

environmental history of the region, the industrial activity adjacent to Lavaca Bay has caused measurable impacts to the terrestrial and marine environments adjacent to this and adjacent waterways.

The industrial activity adjacent to Lavaca Bay is extensive and is primarily related to two large industrial complexes located immediately adjacent to the project. Industrial activity at the Alcoa Point Comfort Operation and Formosa has resulted in quantifiable impacts to groundwater, surface water, soil, and sediment. Recent corrective action performed at both facilities has minimized the potential to encounter impacted media during project construction. However, in spite of prior remedial activities, the potential for the project to encounter impacted media remains. The documented areas impacted by previous industrial activity are isolated to the portion of Lavaca Bay adjacent to Point Comfort. According to the regulatory agency database report, the northern extent of the project enter into an area defined as an NPL (Superfund) site. This area has been defined as having been impacted by contaminant releases from the Alcoa facility. Data provided by the NOAA delineates elevated levels of mercury within sediment in the vicinity of Dredged Island. The concentrations of mercury within the impacted area range from below detection limits to 2.00 mg/kg. portion of dredged material that will result from the project is proposed to be used to create a clay cap over the impacted area of bay floor. This aspect of the project will result in a positive impact to the environment by encapsulating mercury-containing sediment and eliminating future exposure potential.

The construction of these upland areas will involve the placement of new work material. The placement of this dense clay material to build the dikes/levees may result in the displacement of the existing sediment from beneath the new dikes in the form of a mud wave (see Section 4.9.4). Precaution should be taken to minimize displacement of impacted sediment.

Due to the prolonged use of portions of the project area as military training, the potential of unexploded ordinance within the project does exists. However, the potential to encounter unexploded ordinance during dredging activity is considered to be quite low. The existing channel has been maintained through maintenance dredging for the last 40 years and there have been no reported incidence of unexploded ordnance encountered in the Matagorda Bay area (USACE, St. Louis District, 2001a, b).

4.9 WATER AND SEDIMENT QUALITY IMPACTS

4.9.1 Water Exchange and Inflows

The proposed MSC improvements and the associated DMMP are expected to have impacts on some aspects of water flows and quality parameters in Matagorda Bay and Lavaca Bay. In describing the effects it is important to distinguish between those associated with the Proposed alternative, an increase in channel dimensions (from 36 x 200 ft to 44 x 400 ft in the Bayside Channel and 600 x 46 ft versus 300 x 38 ft in the Entrance Channel) and those from the proposed removal of the “bottleneck” through the land cut portion at the entrance to the bay. The bottleneck removal is a separate project being considered by the USACE that would reduce peak velocities and channel scour within the Jetty Channel. While reducing peak current velocities is desirable from a navigation and scour control perspective, it is not part of the

channel improvement project evaluated in this EIS. However, to create a worst-case scenario, it was included as part of the hydrosalinity modeling.

There were two main sources of information considered in this analysis. One was a study of the bottleneck removal project conducted by the USACE's Engineering Research and Development Center (ERDC), Coastal Hydraulics Laboratory (USACE, 2006c), and the other was the numerical modeling results performed for the MSC improvements project to assess salinity effects (Appendix K). Both studies included analyses of water movements, tides, and salinity, but the effects of each are addressed in different combinations. In general, the removal of the bottleneck appears to have the greatest effect on increasing the tidal flows in and out of Matagorda Bay and would have a modest effect on bay salinity, while modeling indicates that deepening the MSC would have a larger effect on bay salinity and a smaller effect on tidal flows, when compared to the bottleneck removal. Additional information is provided in Section 4.9.1.2.

4.9.1.1 No-Action Alternative

With this alternative the channel dimensions would remain as they are. Water quality conditions would continue on the same path as described in Section 3.9.

4.9.1.2 Proposed Alternative

The Proposed alternative would not have any effect on freshwater inflows, but would to a limited extent, modify the tidal exchange of water with the Gulf. There would also be modifications to the tidal movement of water produced by the PA features. With tidal exchange, the main constriction points for water entering and leaving the bay are the inlet at the MSC entrance and at Pass Cavallo. There are no modifications to Pass Cavallo under consideration. However, it could be affected by altering the inlet cross-section as discussed below.

Table 4.9-1 shows changes in the average flood and ebb tides expected to occur with the bottleneck removed. Alternative 3 from USACE (2006c), illustrated on Figure 4.9-1, assumes the channel would be essentially the same width as the jetties. Table 4.9-1 shows the results from a calibrated ADCIRC model of the system for both flood and ebb tides for two different periods. The general pattern is that more flow enters and leaves through the MSC with the bottleneck removed. With more flow being exchanged through the MSC, there is less flow going in and out of Pass Cavallo. USACE notes that the changes in tidal flow through Pass Cavallo were relatively small, but that if Pass Cavallo were to close as a result of the increased MSC cross-section, it should be preserved to avoid an increase in discharge through the MSC. Simulations performed with Pass Cavallo closed indicated that flow velocities through the MSC would increase relative to both the existing condition and Alternative 3 from USACE (2006c).

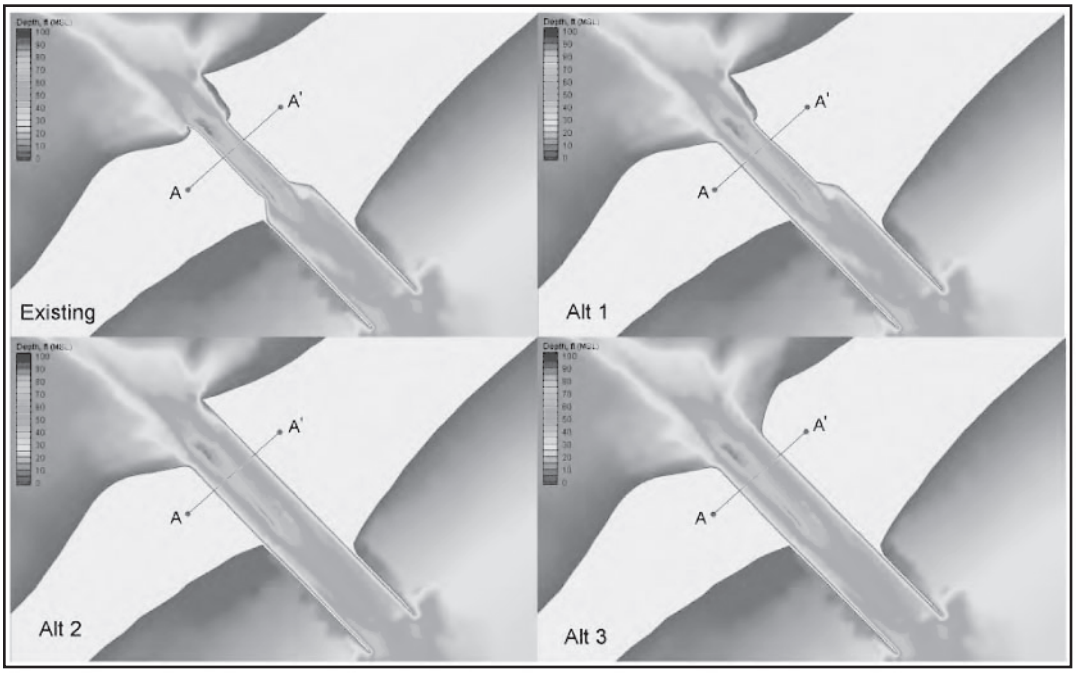
Table 4.9-1
Changes in Tidal Flows with Bottleneck Removal

			Inlet discharge (thousands cfs)		
			Existing	Alt 3	% Change
Table 21, January	Flood	MSC	225	286	27%
		Pass C	86	80	–7%
		Total	311	366	18%
	Ebb	MSC	211	249	18%
		Pass C	79	74	–6%
		Total	290	323	11%
Table 22, July	Flood	MSC	192	245	28%
		Pass C	74	71	–4%
		Total	266	316	19%
	Ebb	MSC	202	226	12%
		Pass C	71	64	–10%
		Total	273	290	6%

Source: USACE, 2006c, Section 4.

Increased tidal flow through the MSC would increase the tidal amplitude throughout Matagorda Bay. The average increase in tidal flows from Table 4.9-1, including the reduction in Pass Cavallo flow, is 13.5%. The average reduction in flows through Pass Cavallo is 6.8% ((–7 –6 –4 –10)/4 = –6.8).

Table 4.9-2 presents a summary of tidal elevation results produced by Wise et al. (see Appendix K) using the MIKE3-FM model to simulate the period March to September, 2003. The first part of the table has the bottleneck removed as with Alternative 3 from USACE (2006c) and Pass Cavallo held at the existing dimensions. This is the model configuration used for the salinity results shown in Section 4.9.2.2. The average increase in tidal amplitude or range (MHW-MLW) is 17% (4 cm increase relative to the present average tide range of 23.4 cm), which is consistent with the average difference in tidal circulation observed by USACE (2006c). The increase in the tide range and high tide elevation would shift the boundary between the bay and land to a variable degree depending on the slope of the shoreline. The second part of Table 4.9-2 shows the tide differences without bottleneck removal. The increase in tidal range from the channel enlargement alone is less than 1%.



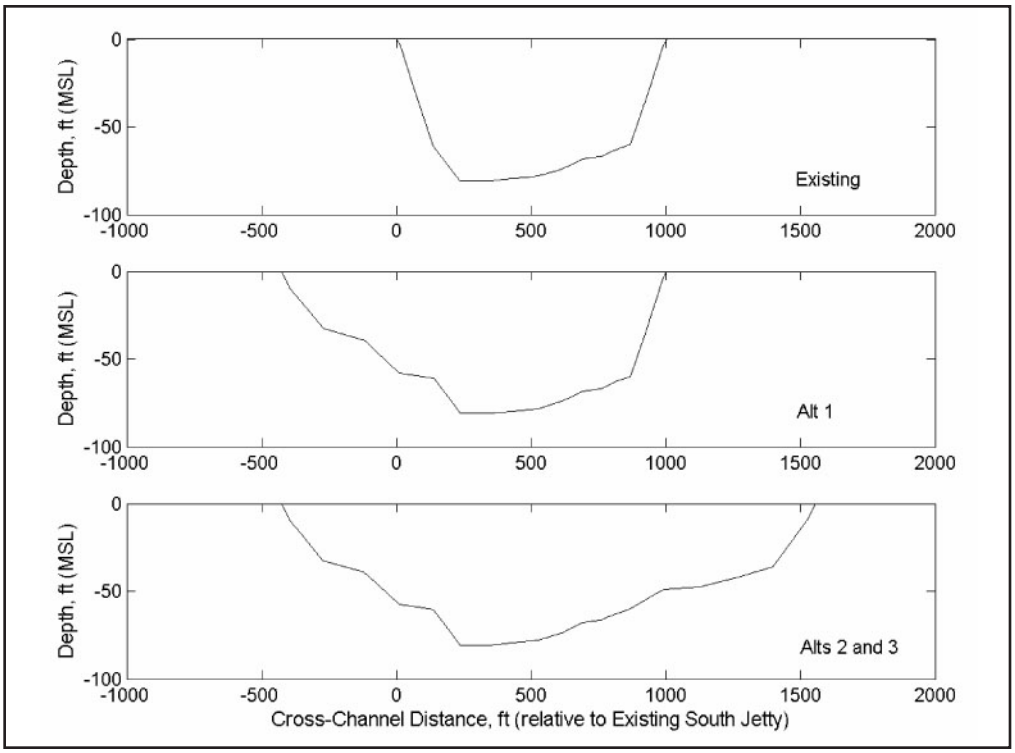


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Figure 4.9-1

CHANNEL GEOMETRY AND CROSS-SECTIONS FOR EXISTING AND ALTERNATIVE CONDITIONS ANALYZED BY KRAUS, ET AL. 2006

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Table 4.9-2
Change in Tidal Datums Estimated with MIKE3-FM Model
(values in cm)

Station	Present MHW	Proposed MHW	Change	Present MLW	Proposed MLW	Change	Present Range	Proposed Range	Change
With bottleneck removal									
Point Comfort	21.7	23.6	1.9	–4.8	–7.1	–2.3	26.5	30.7	4.2
Bird Island	16.3	17.6	1.3	–6.1	–8.6	–2.6	22.3	26.2	3.9
Pass Cavallo	15.1	16.4	1.4	–5.4	–7.8	–2.4	20.5	24.2	3.8
Colorado River	20.2	22.0	1.9	–2.7	–4.8	–2.1	22.9	26.9	4.0
Port Lavaca SH 35	22.6	24.4	1.8	–4.3	–7.0	–2.7	26.9	31.3	4.4
Port O'Connor	16.5	18.0	1.5	–5.0	–7.3	–2.4	21.5	25.4	3.9
Averages	18.7	20.3	1.6	–4.7	–7.1	–2.4	23.4	27.5	4.0
Without bottleneck removal									
Point Comfort	21.7	22.3	0.6	–4.8	–4.4	0.4	26.5	26.8	0.2
Bird Island	16.3	16.7	0.4	–6.1	–5.6	0.5	22.3	22.3	0.0
Pass Cavallo	15.1	15.4	0.3	–5.4	–5.6	–0.2	20.5	21.0	0.5
Colorado River	20.2	21.0	0.8	–2.7	–1.9	0.8	22.9	22.9	0.0
Port Lavaca SH 35	22.6	22.9	0.3	–4.3	–4.0	0.3	26.9	26.9	0.0
Port O'Connor	16.5	17.1	0.6	–5.0	–4.7	0.3	21.5	21.8	0.3
Averages	18.7	19.2	0.5	–4.7	–4.4	0.4	23.4	23.6	0.2

Values are average tidal elevations from 6-month MIKE3-FM model runs for the present and proposed channel, w/ and w/o bottleneck removal (see Appendix K).

4.9.2 Salinity

4.9.2.1 No-Action Alternative

With this alternative the channel dimensions would remain as they are. Water quality conditions would continue on the same path as described in Section 3.9.

4.9.2.2 Proposed Alternative

One effect of deepening the MSC would be to allow the density current to transport more higher salinity Gulf water up the bay under certain conditions. The biggest effects are expected to occur following larger freshwater inflow events when there is a strong salinity gradient from the upper to the lower bay. In this case, the deeper channel can be expected to reduce the time required for the density current to move higher salinity Gulf water to Lavaca Bay. This can be expected to increase the average salinity in the upper Matagorda and Lavaca Bays. During dry periods when salinity levels are relatively high throughout the bay, density differences would be small and the deeper channel would have relatively little effect.

The detailed MIKE3-FM 3-D modeling results are presented in Appendix K and summarized here. Figures 4.9-2a–c present existing condition model results for three flow cases, low, median and high. The model results shown are 6-month average bottom salinity values. In the low flow case, salinities are up to 30 practical salinity units (PSU) in much of the bay and about 26 PSU in Lavaca Bay. In the median flow

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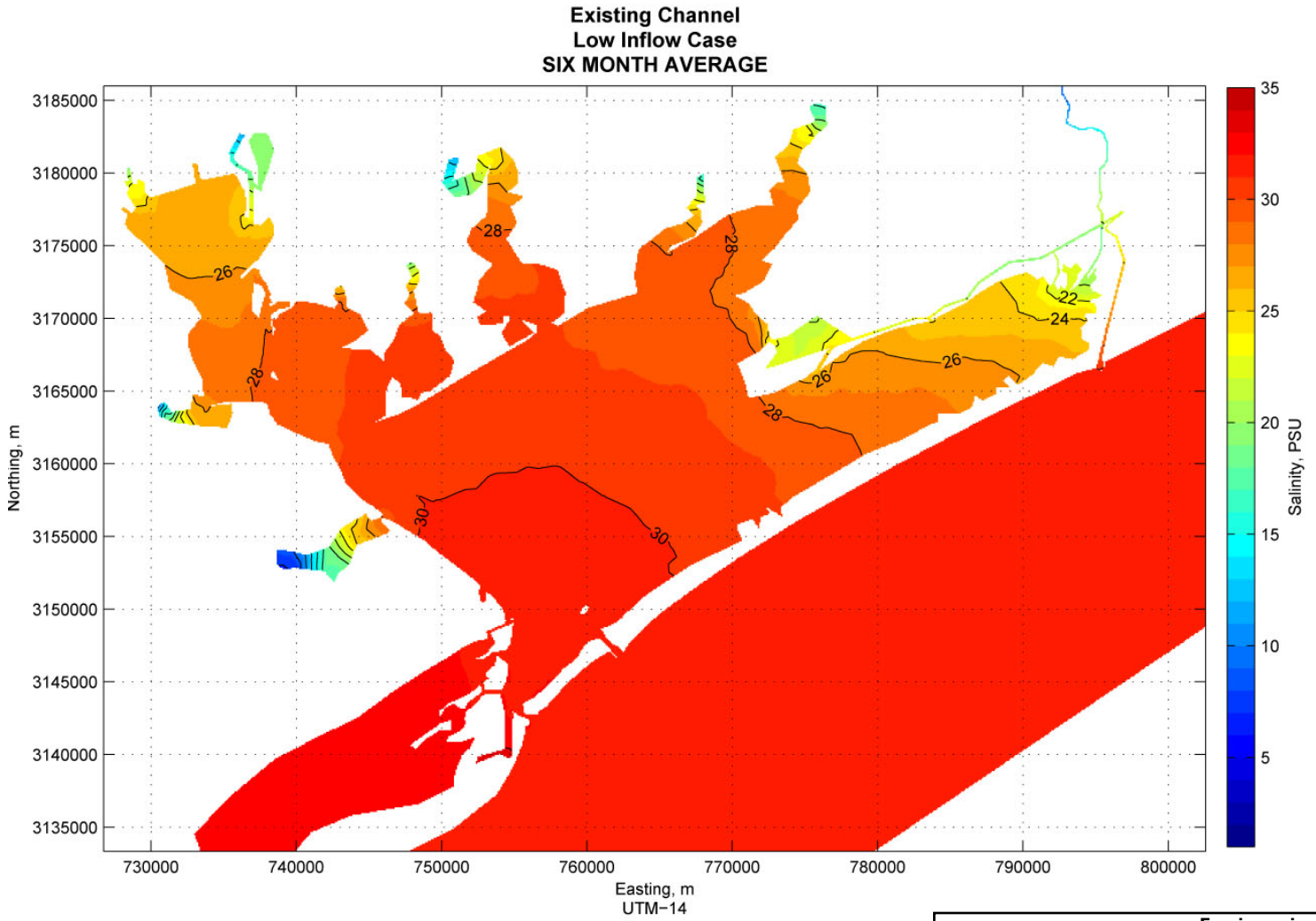

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Figure 4.9-2a

SALINITY FOR EXISTING CHANNEL, LOW FLOW, SIX MONTH AVERAGE

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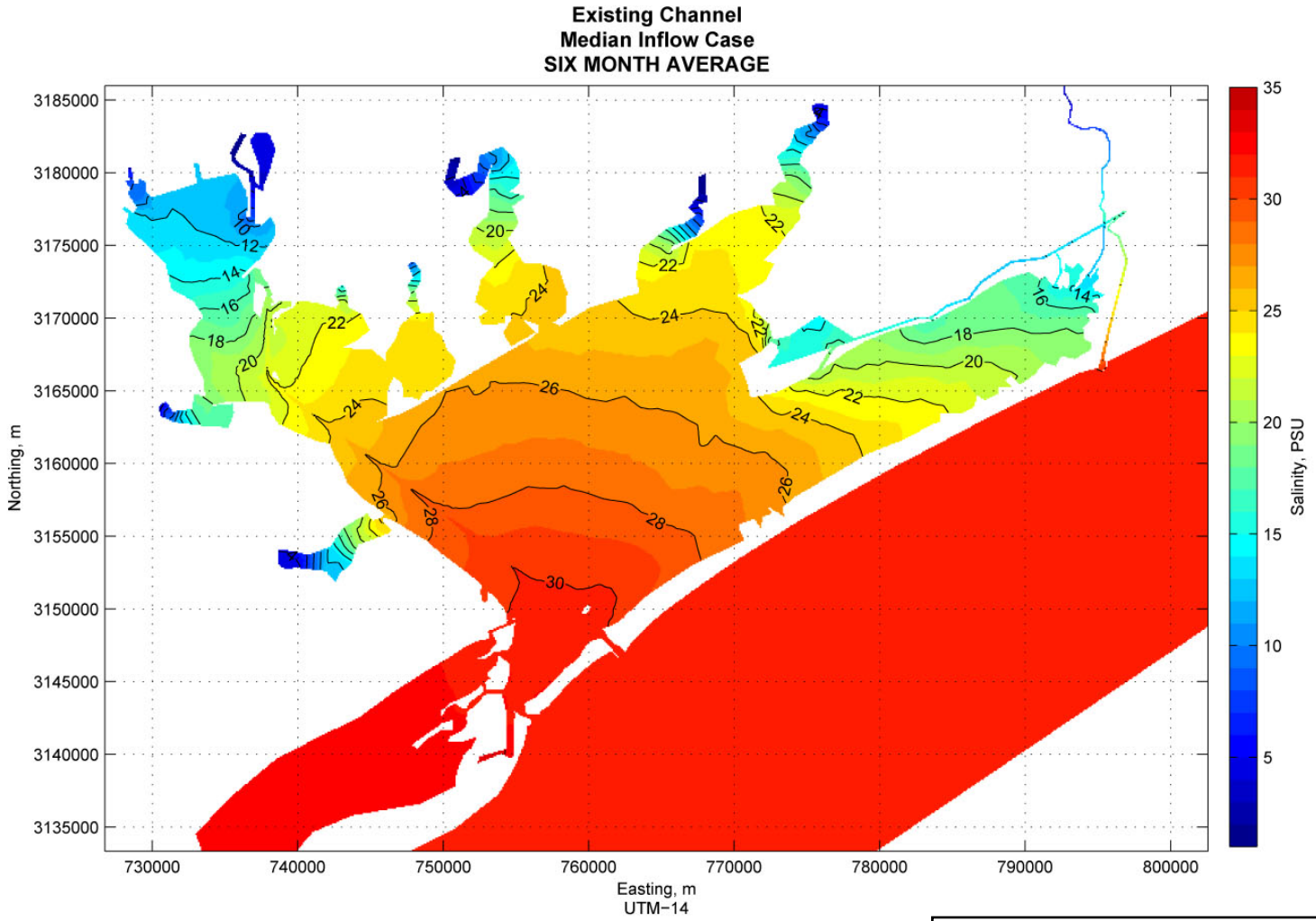

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Figure 4.9-2b

SALINITY FOR EXISTING CHANNEL, MEDIAN FLOW, SIX MONTH AVERAGE

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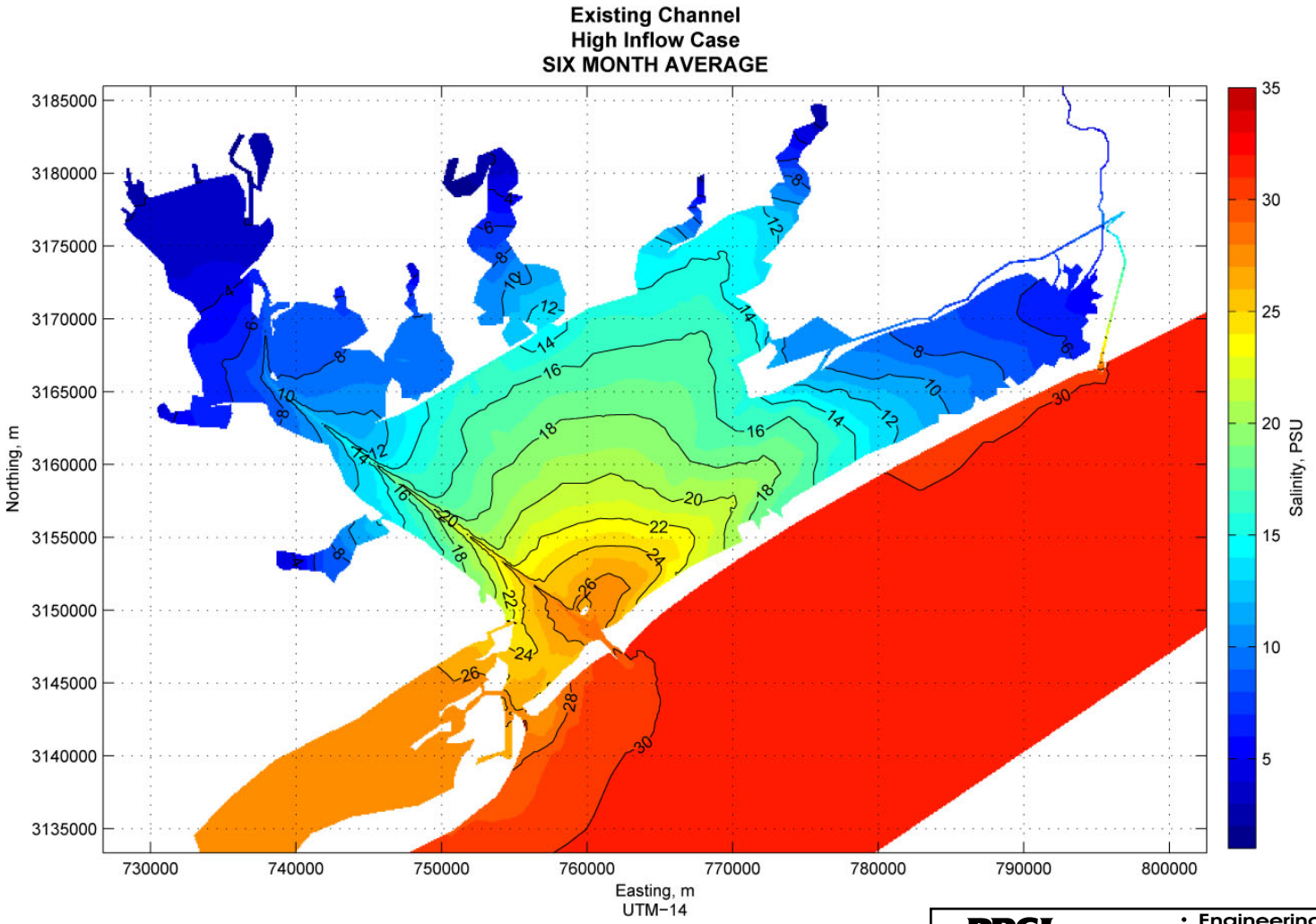

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Figure 4.9-2c

SALINITY FOR EXISTING CHANNEL, HIGH FLOW, SIX MONTH AVERAGE

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simulation, salinities are in the 16–24 PSU range in Lavaca Bay and only get to 30 PSU near the Gulf. In contrast, during the high flow period (August 1998–March 1999) all of Lavaca Bay averages less than 10 PSU.

The effect of the proposed project was also simulated with the 3-D model. However, these simulations also included removal of the bottleneck that allows more water to exchange with the Gulf. These results thus represent conservative predictions of salinity change. Figures 4.9-3a–c show salinity differences for the same 6-month average periods. With the low flow case, the differences are zero over most of the bay, and only up to 0.5 PSU in Lavaca Bay. At the median flow, the differences are 1.5 to 2.5 PSU in Lavaca Bay, but very small over the rest of Matagorda Bay. The high flow period shows salinity differences of up to 5 PSU in lower Lavaca Bay, and several parts per thousand along the channel. Outside the immediate area adjacent to the channel, there do not appear to be any significant salinity differences.

The model predicts salinity increases along the channel. The amount of the salinity increase is greater during times of higher inflow. Figures 4.9-4a–b present two plots of the frequency distribution of monthly average inflows, one for Lavaca Bay and the other for all of Matagorda Bay. The watershed inflow sources for each figure are tabulated. The inflow values are for 1977–2003, which corresponds to the period when daily inflows from the ungaged watersheds have been produced by the TWDB using a runoff model known as Tx-RR. These flows, along with USGS stream gaging records, are the source of the information. The months (August 1998 to March 1999) that went into the high flow simulation are highlighted in the figure. The three values at the top of the curve are for September, October, and November 1998. These are higher flows and the salinity differences are larger for those months, as shown in Appendix K.

An examination of Figure 4.9-4c, which presents a comparison of total Matagorda Bay freshwater inflows for a 6-month running average based on the 1977 to 2003 measurements, shows that the largest changes in salinity are predicted to occur fairly rarely—less than 10% of the time for most months. At the other end, about a quarter of the time the low flows shown with the horizontal bar, would be low enough so that there is little change in salinity. The median salinity changes should correspond to the flow that is exceeded 50% of the time. The range of salinity differences can be expected to track along these flow frequency curves from near zero at the low flow point to the maximum values at the high flow months.

4.9.3 Water Quality

The effects of the proposed project are assessed relative to the water quality parameters considered in the baseline section—dissolved oxygen, indicator bacteria, and mercury.

4.9.3.1 No-Action Alternative

Under the No-Action alternative, the effects of maintenance material disposal on water quality would remain as described in Section 3.9.3. There would be no construction dredging; therefore, there would be

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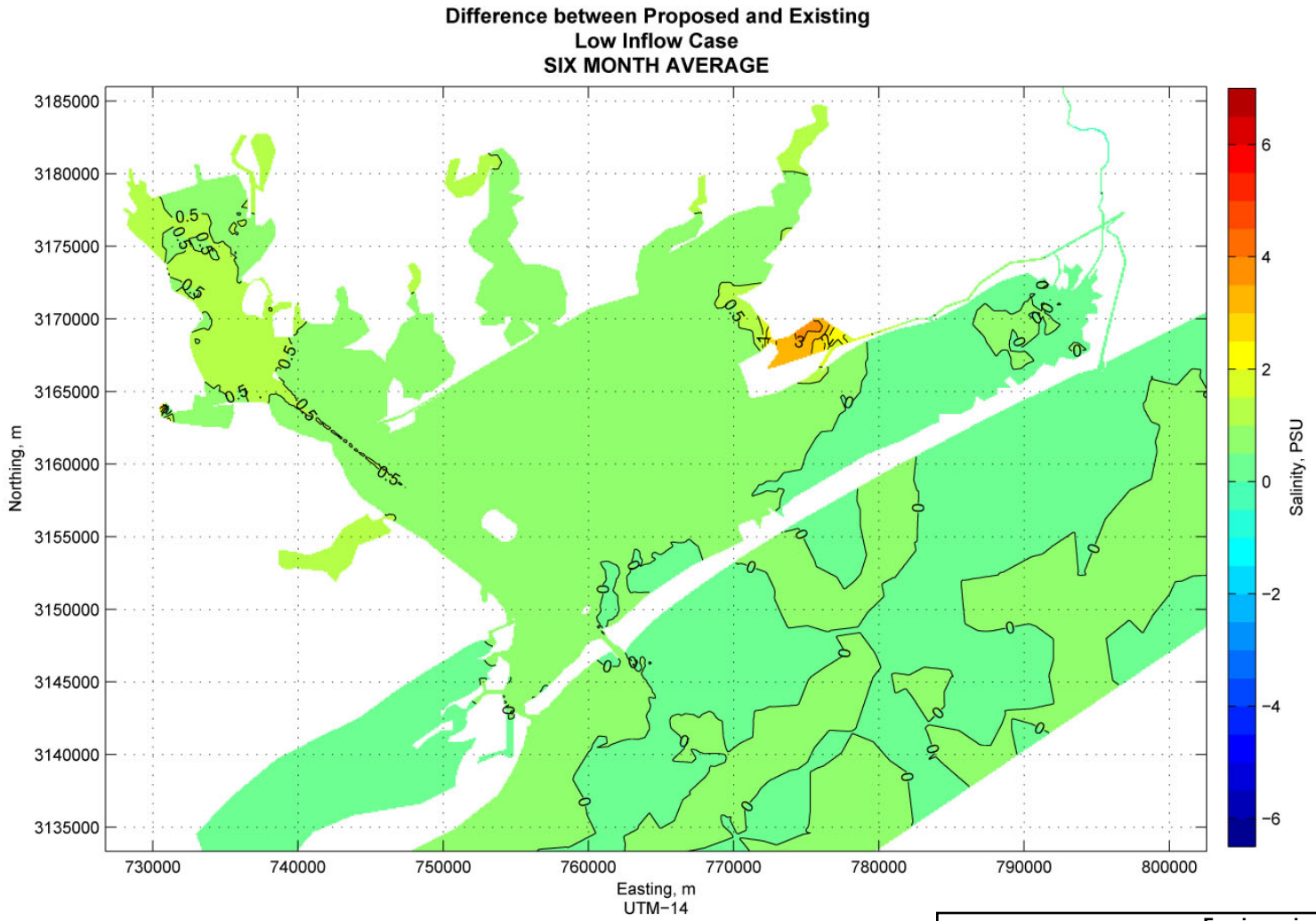

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Figure 4.9-3a

SALINITY DIFFERENCES WITH PROPOSED PROJECT AND BOTTLENECK REMOVED FOR LOW FLOW, SIX MONTH AVERAGE

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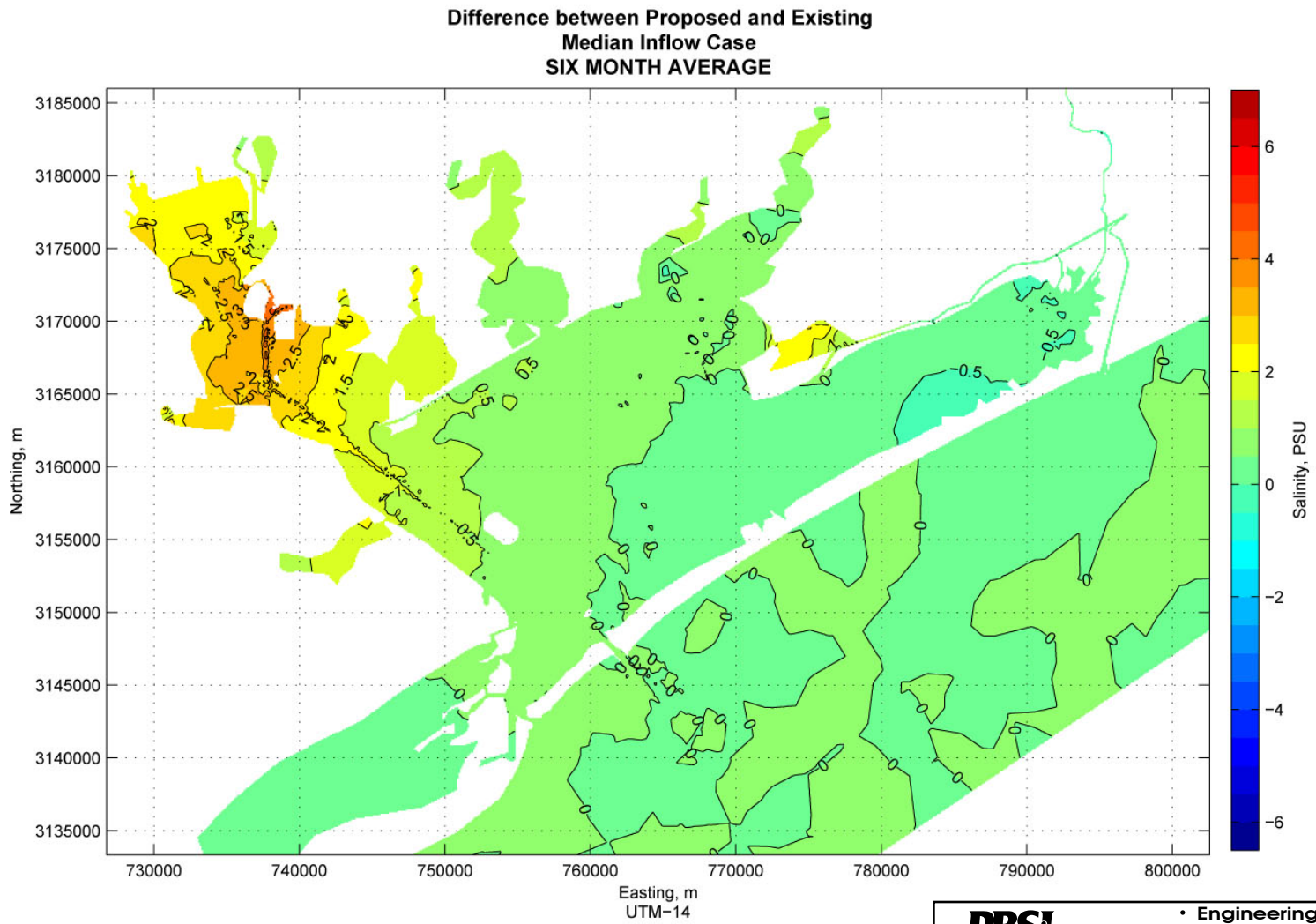

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Figure 4.9-3b

SALINITY DIFFERENCES WITH PROPOSED PROJECT AND BOTTLENECK REMOVED FOR MEDIAN FLOW, SIX MONTH AVERAGE

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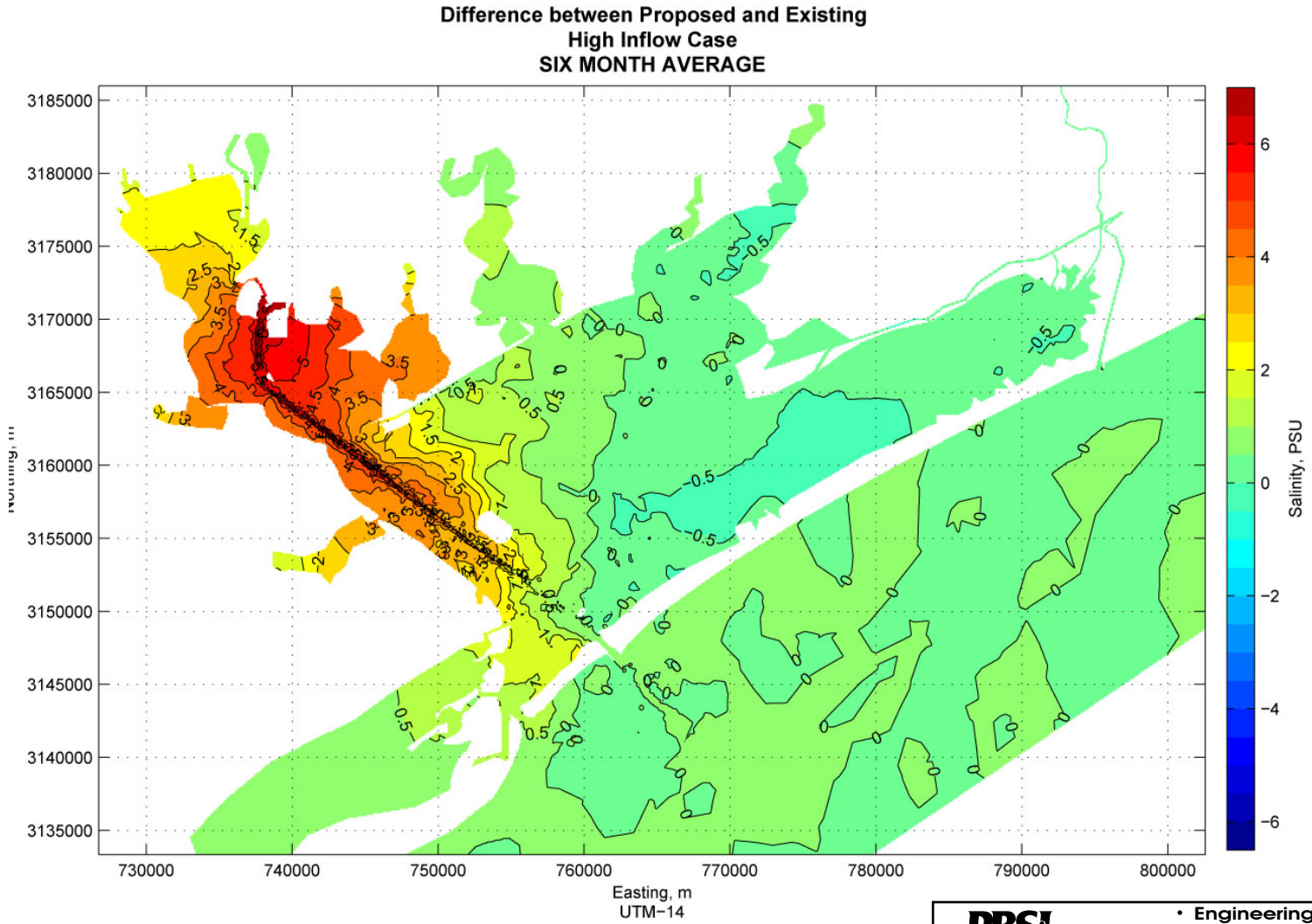

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Figure 4.9-3c

SALINITY DIFFERENCES WITH PROPOSED PROJECT AND BOTTLENECK REMOVED FOR HIGH FLOW, SIX MONTH AVERAGE

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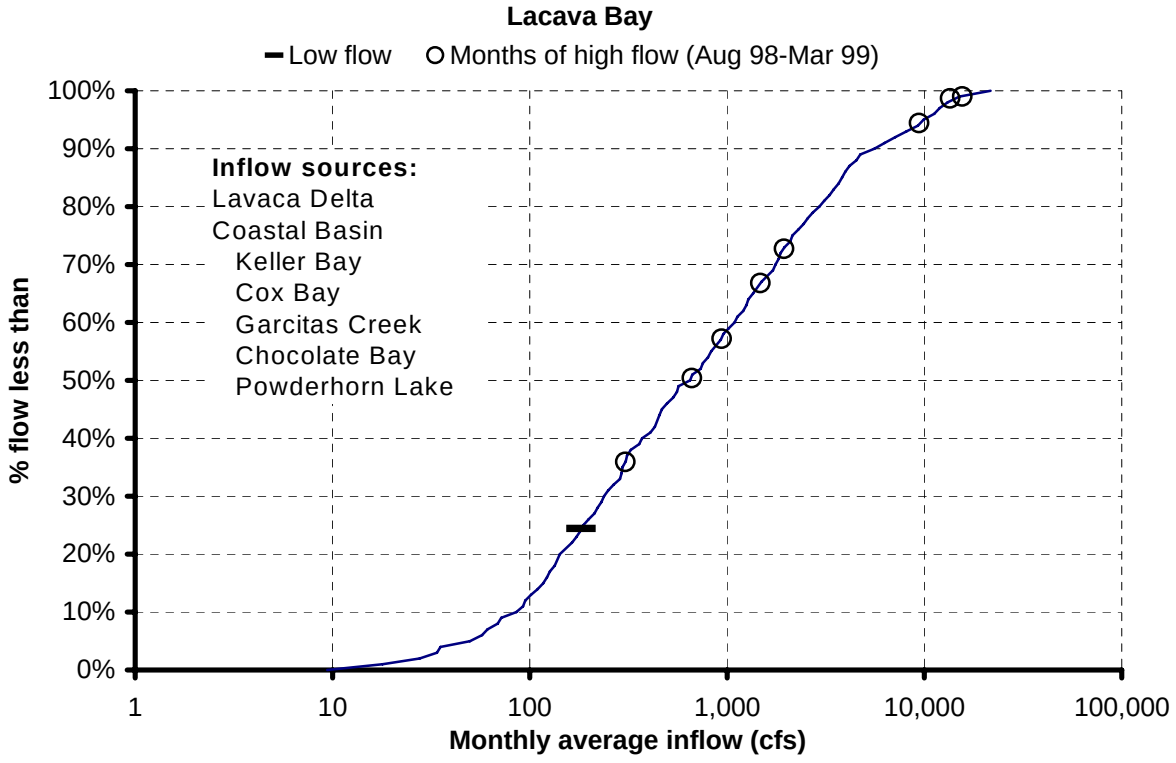
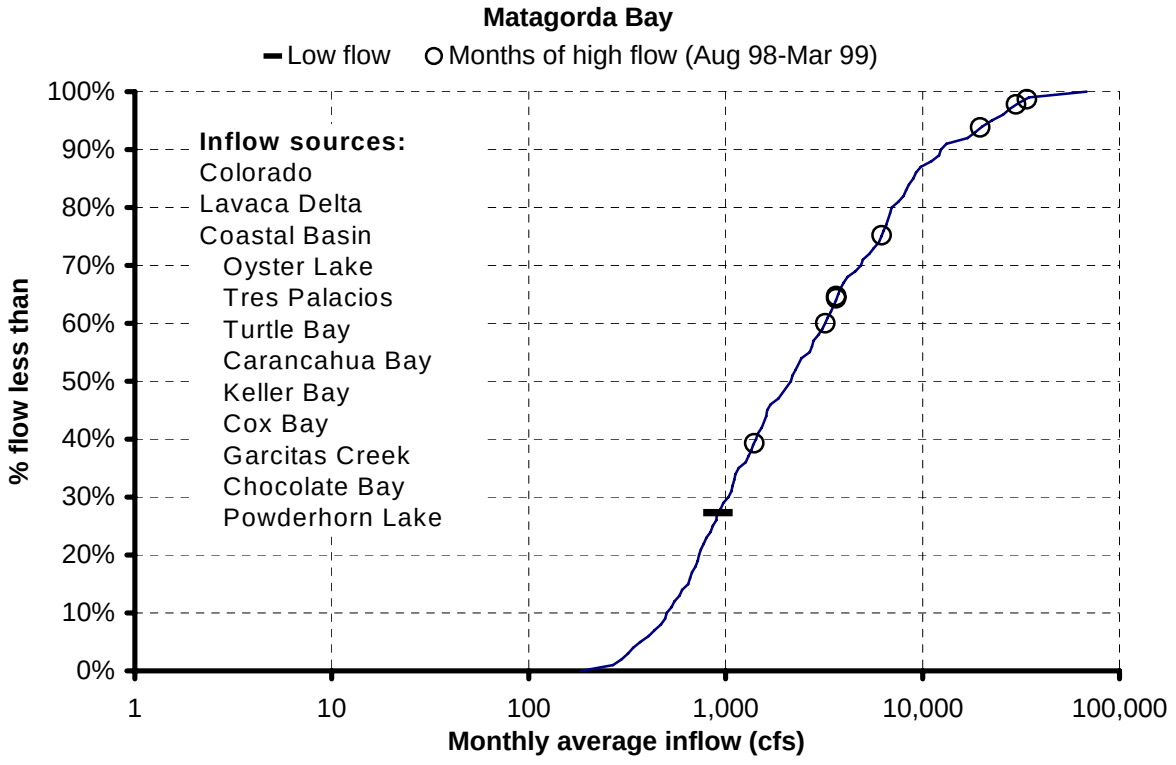
FIGURE 4.9-4
FREQUENCY DISTRIBUTION OF INFLOWS TO LAVACA BAY AND MATAGORDA BAY (1977-2003)





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no new work material for placement. Although no turbidity or possibility for the release of undesired chemicals would occur because there would be no dredging or placement of new work material, there would also be no chance for the decrease in long-term turbidity that would result from the reduction of open bay placement in Lavaca Bay.

The No-Action alternative may or may not affect DO concentrations in the water column at PAs (Brown and Clark, 1968; Pearce, 1972; Hopkins, 1972; May, 1973; Windom, 1972; Wakeman, 1974). May (1973) found that although the water column DO did not change, there was a temporary decrease in DO at the water/sediment interface in the areas of mud flow, which results from the discharge of the semifluid maintenance material. Since much maintenance material is at least slightly anaerobic, this finding is not surprising. He also found little apparent difference in the immediate oxygen demand between recently deposited sediments from dredged material placement and other sediments. May (1973), Jones and Lee (1978), Peddicord (1979), and Lee (1976) agree that high total oxygen demand, as measured in the laboratory, does not necessarily lead to oxygen depletion upon placement since only a small part of the oxygen demand is exerted at placement. This would apply to both the No-Action and Proposed alternatives.

The most obvious impact of the No-Action alternative to the estuarine water column is turbidity associated with maintenance dredging and placement, which has been shown to reduce primary production in laboratory studies (Sherk, 1971). Field studies, however, have shown essentially no biological impacts from turbidity (Odum and Wilson, 1962; May, 1973) associated with dredging activities. May (1973) found that on a still day, the turbidity plume from an open-bay PA was detectable from an aircraft only a little more than 1 mile down current. On days when winds caused natural turbidity in an estuarine system, the plume was not detectable more than a few hundred yards down current from active disposal in an open-bay PA.

4.9.3.2 Proposed Alternative

Under the Proposed alternative, factors that could affect DO include the increase in both water circulation and salinity. The increased tidal activity is primarily associated with the bottleneck removal, which is not part of this project. In general, increased water velocity would contribute to improved mixing and oxygen transport. The increase in salinity along the axis of the MSC will slightly reduce the DO saturation concentration and thus the absolute value by a similar amount. For example, a change in salinity from 20 to 21% would reduce the DO saturation concentration at 25°C from 7.39 to 7.35 mg/L. This magnitude of change is not likely to have a significant effect on the system or any of the TMDL studies underway.

Although there will be more maintenance material placed in Matagorda Bay under the Proposed alternative, the source of the maintenance material will not change, and the method of placement will not change. However, open-bay placement of maintenance material would not occur in Lavaca Bay and turbidity should decrease somewhat in that bay since the turbidity caused by placement of dredged material would not be added to the natural, wind-and-wave-generated turbidity. Also, the fine material

that would have resulted from open-bay placement would not be available for resuspension in the water column. There is the possibility of contamination of the maintenance material by a spill or other event, as there is now, but deepening and widening the channel should increase safety and decrease the probability of a spill. Additionally, the USACE routinely tests the elutriates prepared from maintenance material according to the Inland Testing Manual (ITM, EPA/USACE, 1998) and the Regional Implementation Agreement (RIA, EPA/USACE, 2003) protocols before dredging to ensure that there are no causes for concern. The ITM and RIA provide guidance for testing sediments for in-bay and offshore placement, respectively. Tier I (use of readily available information), Tier II (sediment and water chemistry information, including comparison of elutriates to WQSs and WQC), and Tier III (bioassays and bioaccumulation testing) testing of elutriates with chemical analyses and water column bioassays indicated no cause for concern. Additionally, significant detrimental environmental effects have not been noted in past maintenance dredging operations and are not expected with the Proposed alternative.

Roughly 80% of the construction material and 9% of the maintenance material will be used beneficially to create oyster reefs, cover contaminated sediments, create and protect marshes, and nourish beaches. All of these activities will create turbidity, but since the open bay areas will be leveed, armored, or covered with pads for oysters, the turbidity should be temporary. Open-bay placement of maintenance material in Lavaca Bay will cease, which should decrease turbidity associated with dredged material placement in the bay system as noted in the preceding paragraph. Open-bay placement of maintenance material will continue in Matagorda Bay so turbidity impacts there should be roughly equivalent to the No-Action alternative. Offshore placement of construction material will cause a one-time increase in turbidity at the construction material ODMDS, and offshore placement of future maintenance material will periodically create turbidity, as it does now. More detail on these impacts is included in the ODMDS Site Designation Appendix (Appendix L).

Indicator bacteria are a water quality issue in the bay system, and TMDL studies prompted by bacteria levels exceeding the oyster water use criteria are underway in segments 2452 and 2453 (Table 3.9-2). The specific locations (Palacios Harbor, Turtle Bay, the area near Point Comfort) are areas near land that tend to have bacteria levels associated with rain runoff events. The project will not produce any significant alterations in runoff hydrology so there should not be any change in runoff-related bacteria levels. However, because indicator bacteria are found in sediments (Fries et al., 2006) and the project will disturb sediments as part of the dredging process, some localized and short-term increases in indicator bacteria concentrations during dredging can be expected.

A similar situation exists for mercury in sediment. While the project will not involve dredging in the areas that have the highest mercury concentrations, there will be some amount of resuspension of sediment associated with the construction dredging process, and there is some concentration of mercury in sediments. On the other hand, the project will involve dredged material placement features that serve to cap sediments with higher mercury levels, offsetting the dredging effect to some degree. On balance no significant change in ambient or sediment mercury concentrations are expected.

4.9.4 Sediment Quality

4.9.4.1 No-Action Alternative

The quality of sediments in the bay system is not expected to change with the No-Action alternative and will remain as discussed in Section 3.9.4. Areas of concern with historical elevated mercury concentrations above the Remedial Action Objective (RAO) of 0.5 mg/kg for open water habitat in the vicinity of the Alcoa (Point Comfort)/Lavaca Bay Superfund Site and Dredge Island will continue to undergo natural recovery by sedimentation as stated in the ROD for the Alcoa Superfund Site.

4.9.4.2 Proposed Alternative

The Proposed alternative could result in the disturbance of bay sediments and subsequently impact the sediment quality in the project area, particularly in Lavaca Bay. As discussed in Section 3.9.4, the primary concern with regard to sediment quality in the project area is mercury. Activities performed as part of the Proposed alternative that may potentially disturb the bay sediments include direct dredging, placement of dredged material to build dikes or levees, and building access channels for moving equipment. There is potential for a change in bay bottom velocities due to a wider and deeper channel and the actions taken as part of the DMMP. The specific impacts are further discussed below.

According to the ITM, dredged material may be classified using vertical subdivisions, which "should reflect the actual removal precision to be employed during the dredging operation." Using this guidance and the soil borings data along the channel alignment, a 6-ft dredge cut is the minimum economical dredge cut. This determination is based on the conditions that 1 to 3 ft of maintenance or soft mud overlies new work clay, a large cutter suction dredge (30-inch-diameter discharge) will be used, and more than 20 ft of material would be dredged.

Alcoa (Alcoa, 2006) collected samples approximately every 2 ft from the mudline, through the unconsolidated sediment, to the consolidated material. Utilizing the data from Alcoa (2006) and the procedures outlined in the ITM, mercury concentrations were averaged over a 6-ft dredge cut. The mercury concentration in the material underlying unconsolidated sediment was assumed to be negligible or, for calculation purposes, 0 mg/kg. Tables 4.9-3 and 4.9-4 shows the depth/concentration intervals, as well as an average mercury concentration (mg/kg) for a 6-ft dredge cut at several sample stations.

Based on the analysis, all average mercury concentrations were below the RAO of 0.25 mg/kg established for critical habitats (fringe marsh-type) during the RI for the Alcoa (Point Comfort)/Lavaca Bay Superfund Site (Superfund Site). Thus, there should be no restrictions on the use of the dredged material.

The use of the new work material and maintenance material from the Proposed alternative would allow the creation of approximately 298 ac of oyster reef (PAs OR1, OR2, and ER1 on Figure 3.0-1), 325 ac of shallow, unvegetated seagrass platform (PA H4 on Figure 3.0-1), 432 ac marsh would be protected (PA G on Figure 3.0-1), 570 ac of marsh would be created (PAs A2, D, ER2, ER3, G, and H4 on Figure 3.0-1),

with a long-term concomitant decrease in turbidity, and 485 ac of bay bottom (PAs ER1, ER2, and ER3 on Figure 3.0-1) with higher mercury concentrations would be capped.

Table 4.9-3
Average Concentrations Over Dredge Cut for Turning Basin Sample Locations

Sample Station	Interval I - Thickness	Interval I - Conc	Interval II - Thickness	Interval II - Conc	Interval III - Thickness	Interval III - Conc	Interval IV - Thickness	Interval IV - Conc	Total Depth	Average Conc
LNG0001	1.4	0.0142	4.6	0	n/a	n/a	n/a	n/a	6	**0.003**
LNG0002	2	0.0206	0.5	0.0083	3.5	0	n/a	n/a	6	**0.008**
LNG0003	2	0.121	1.2	0.014	2.8	0	n/a	n/a	6	**0.043**
LNG0004	1.1	0.0086	4.9	0	n/a	n/a	n/a	n/a	6	**0.002**
LNG0005	1.2	0.0399	4.8	0	n/a	n/a	n/a	n/a	6	**0.008**
LNG0015	2	0.26	1.2	0.0378	2.8	0	n/a	n/a	6	**0.094**
LNG0016	2.7	0.502	3.3	0	n/a	n/a	n/a	n/a	6	**0.226**
LNG0017	2	0.055	0.8	0.0205	3.2	0	n/a	n/a	6	**0.021**
LNG0018	1.8	0.543	4.2	0	n/a	n/a	n/a	n/a	6	**0.163**
LNG0020	2	0.0571	1.9	0.0164	2.1	0	n/a	n/a	6	**0.024**
LNG0021	2	0.0658	0.4	0.0136	3.6	0	n/a	n/a	6	**0.023**
LNG0023	1.9	0.0487	4.1	0	n/a	n/a	n/a	n/a	6	**0.015**
LNG0024	2	0.0525	1.3	0.0209	2.7	0	n/a	n/a	6	**0.022**
LNG0025	2	0.0404	0.8	0.0319	3.2	0	n/a	n/a	6	**0.018**

Table 4.9-4
Average Concentrations Over Dredge Cut for Ship Channel Sample Locations

Sample Station	Interval I - Thickness	Interval I - Conc	Interval II - Thickness	Interval II - Conc	Interval III - Thickness	Interval III - Conc	Interval IV - Thickness	Interval IV - Conc	Total Depth	Average Conc
LNG0006	2	0.0982	0.7	0.0057	3.3	0	n/a	n/a	6	**0.033**
LNG0007	1.5	0.0883	4.5	0	n/a	n/a	n/a	n/a	6	**0.022**
LNG0008	2	0.165	2.3	0.0052	1.7	0	n/a	n/a	6	**0.057**
LNG0009	2	0.215	2	0.009	1.3	0.0042	0.7	0	6	**0.076**
LNG0010	2	0.109	0.7	0.0024	3.3	0	n/a	n/a	6	**0.037**
LNG0011	0.8	0.0709	5.2	0	n/a	n/a	n/a	n/a	6	**0.009**
LNG0012	2	0.147	1.8	0.0197	2.2	0	n/a	n/a	6	**0.055**
LNG0013	2.3	0.175	3.7	0	n/a	n/a	n/a	n/a	6	**0.067**
LNG0014	2	0.324	2	0.0183	2	0	n/a	n/a	6	**0.114**

The areas southwest (PA ER1) and north (PAs ER2 and ER3) of Dredge Island (see Figure 3.0-1) were identified as areas of concern following the remedial investigation at the Superfund Site. Recent sampling data from 2005 obtained from Alcoa confirms elevated mercury concentrations in these areas (see Section 3.9.4). These areas are currently undergoing natural recovery by sedimentation. However, the sedimentation rates in these areas are lower than the rates in the rest of the bay (Alcoa, 1997b). Under the Proposed alternative, the natural recovery would be enhanced by the placement of dredged material over

the impacted sediments. No change in surficial sediment quality is expected in other placement areas under the Proposed alternative because the areas were not impacted by the Superfund Site; the contamination was already removed from the areas as part of the remedial action for the Superfund Site; or the areas have recovered from natural sedimentation processes.

4.9.4.2.1 Placement of Dredged Material

In addition to impacts due to the location of the placement areas, disturbance of bay sediments can also result from building dikes/levees to contain the dredged material within the placement areas. There is the possibility that the placement of dredged material to build the dikes/levees may have potential to displace sediments from underneath the dikes, referred to as a mud wave. Mud waves occur when excessive dredged material is rapidly placed on top of soft, weak sediments exceeding the sediment's bearing capacity. This is a concern in areas where soft sediment is present and where mercury concentrations are elevated because of the potential for the exposure of buried mercury. The areas where mud waves might be of concern include PAs ER2, ER3, A1, and D, where dikes/levees have to be placed and which are within areas of historical mercury contamination. According to sediment probing performed in June 2006, PAs A1 and D have soft sediments with depths ranging from 19 to 62 inches with the largest depths from PA A1. No recent analytical data are available for Cox Bay where PA A1 is located, but historical data show mercury concentrations above 0.5 mg/kg in Cox Bay (Alcoa, 1995). Due to the fact that Cox Bay has deeper waters, the potential for mercury-impacted sediments to be displaced by a mud wave onto emergent marsh is unlikely. Therefore, the RAO of 0.5 mg/kg for open-water habitat is used as the basis for comparison. When compared to the RAO for open water habitats, there is a possibility for mercury-impacted sediments to be exposed in the event of a mud wave occurring in PA A1 within Cox Bay. However, more recently the TDH removed Cox Bay from the Fish Closure (instituted in 1988) in January 2000 because of reduced contaminants in surficial sediments in Cox Bay and reduced levels of mercury in tissues of fish taken from Cox Bay.

Historical data also indicate elevated mercury concentrations at depth in PA D within Lavaca Bay (Alcoa, 1999). Current analytical data show mercury concentrations above 0.5 mg/kg along the shoreline of Dredge Island within PA D. PAs ER2 and ER3 have residual elevated mercury concentrations at the surface and at depth according to recent 2005 sampling results from Alcoa (Alcoa, 2006; Figures 4.9-5 and 4.9-6). Even if a mud wave were to occur in PA ER2, potentially exposing mercury-contaminated sediments, the Proposed alternative would still be preferable to the No-Action alternative. Since PA ER2 would be capped with the Proposed alternative, and the elevated mercury concentrations exist over the entire area at present, and since the area of the mud wave would be much less than the area to be capped, potential exposure to higher mercury concentrations would be lessened with the Proposed alternative. Furthermore, the issue of exposing sediments with elevated mercury concentrations in these areas has been recognized. Work in these areas is planned to progress from the outside to the inside of contaminated areas, which provides for any disturbed area to be covered by the subsequent placement of clean dredged material. For PAs D, ER2, and ER3, a 100-ft-wide bench would be created first, prior to

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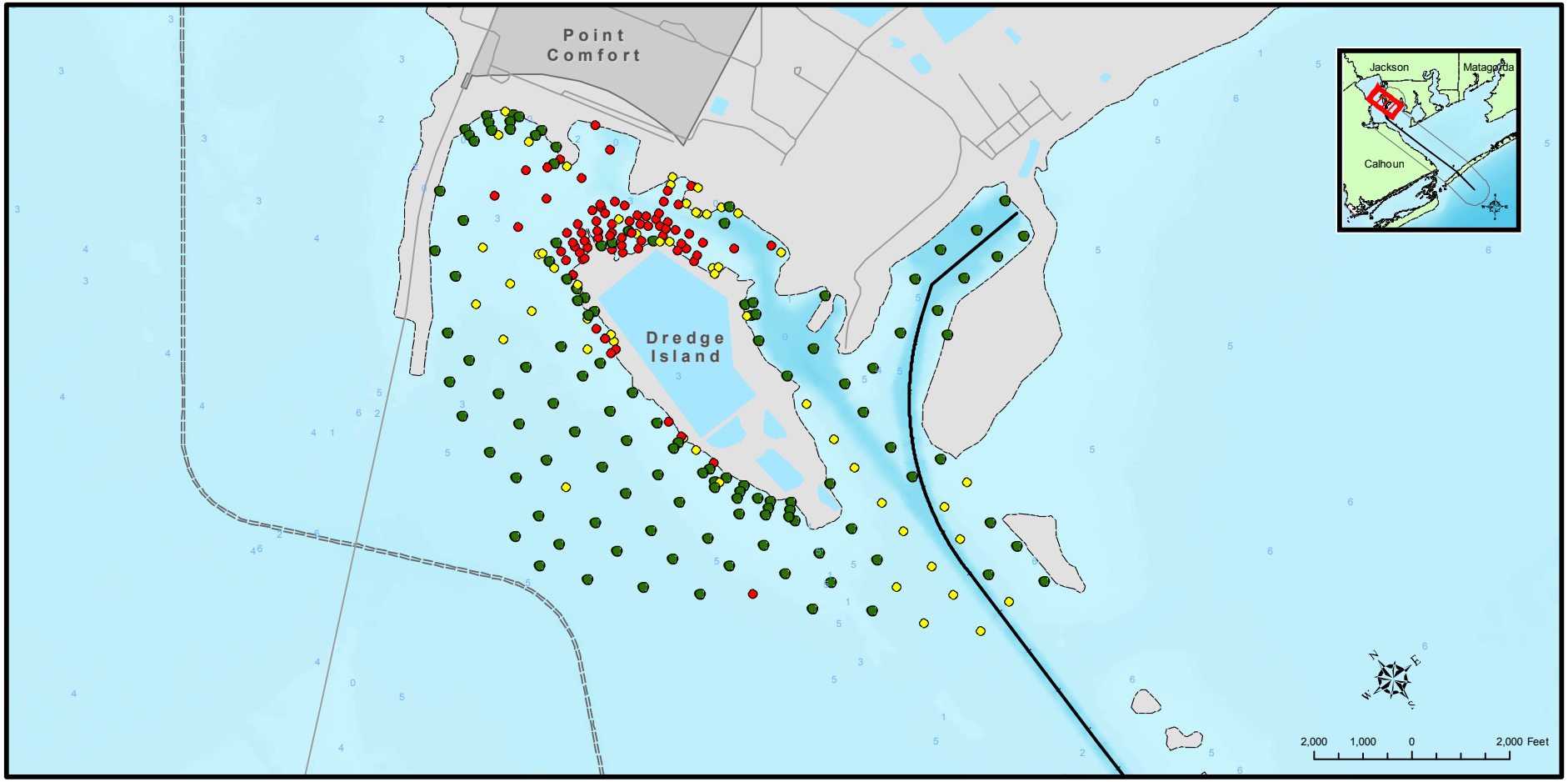

Mercury Concentration

- < 0.25 mg/Kg
- 0.25 - 0.50 mg/Kg
- >0.50 mg/Kg

Base map provided by URS Corportation

PBSJ
• Engineering
• Environmental Consulting
• Surveying

Figure 4.9-5

2005 SURFACE SEDIMENT MERCURY CONCENTRATIONS IN LAVACA BAY

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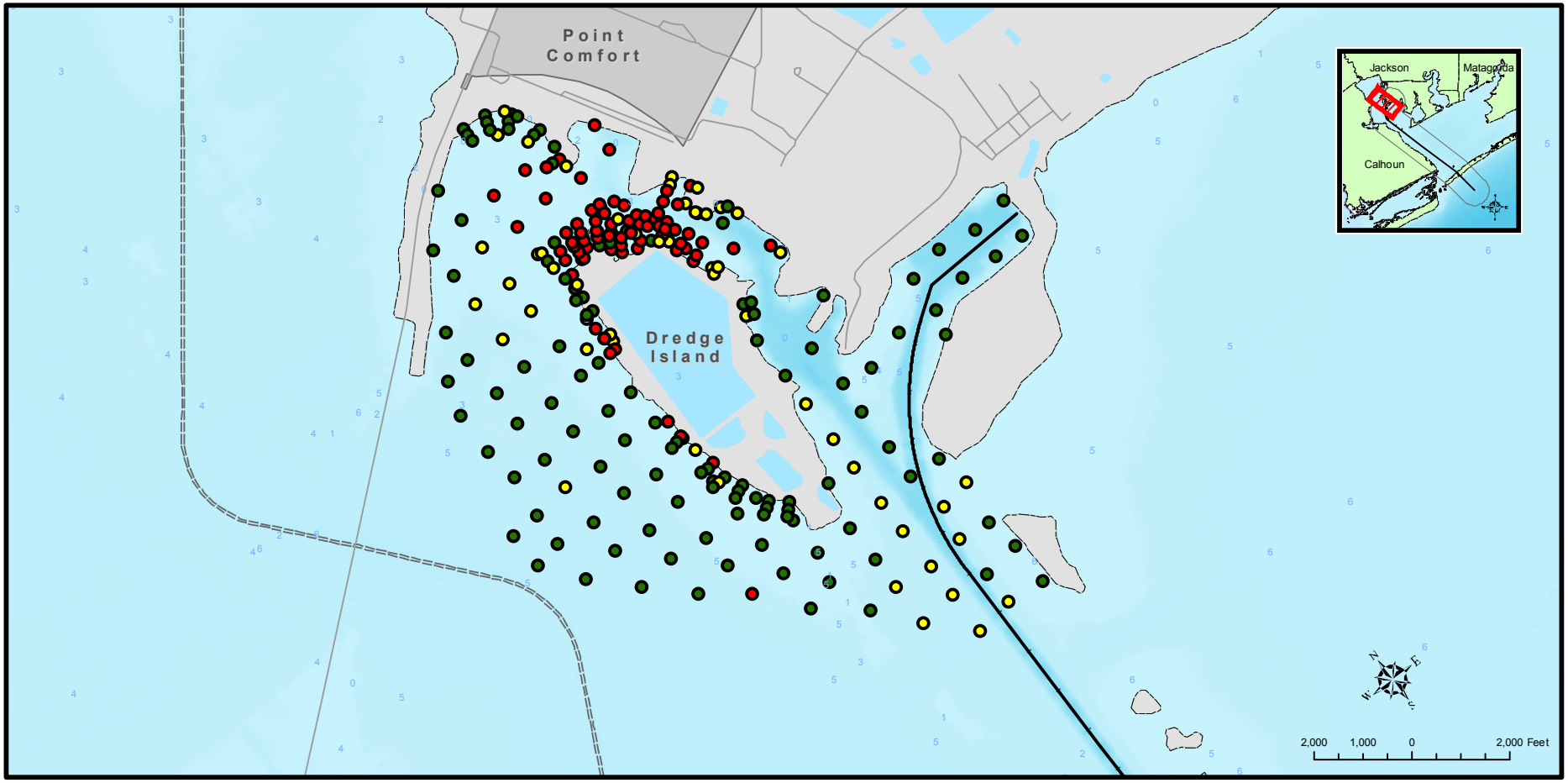

Mercury Concentration

- < 0.25 mg/Kg
- 0.25 - 0.50 mg/Kg
- >0.50 mg/Kg

Base map provided by URS Corportation

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• Engineering
• Environmental Consulting
• Surveying

Figure 4.9-6

2005 AT-DEPTH SEDIMENT MERCURY CONCENTRATIONS IN LAVACA BAY

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levee creation. The bench would be placed to just below the water line and would cover the area that may be affected by a mud wave during the raising of the perimeter levee. A mud wave at the toe of the bench is possible but would occur at a much lesser extent and the toe area would be covered with mudflow from the construction of the levee. Were that to occur, data from stations just outside PA ER2 (Stations LVB8713 and ST00128; Alcoa, 1999), where any mud wave would actually occur, indicate that the mercury concentration is either below 0.5 mg/kg at all depths, or that the depth at which the mercury concentration exceeds 0.5 mg/kg is at least 10 cm below the surface, which is more than the height of any expected mud wave.

The existing maintenance material was also described in Section 3.9.4. The quality of this material would not be expected to change from the No-Action alternative. While more maintenance material is estimated with the Proposed alternative, the source of the maintenance material will not change and the method of placement will not change in Matagorda Bay. However, the material from the Channel in Lavaca Bay will all be used beneficially or be confined. As noted above, project actions should increase safety and decrease the probability of a spill. The USACE also routinely tests the maintenance material according to ITM and RIA protocols before dredging to ensure that there are no causes for concern. As noted in Section 3.9.4, past testing of maintenance material with chemical analyses, whole mud bioassays, and bioaccumulation studies has indicated no cause for concern.

4.9.4.2.2 Construction of Barge Access Channel

Under the Proposed alternative, equipment barges that would support the construction operations of the MSC improvement can work in 6 ft of water, which is the deepest portion of Lavaca Bay outside of the navigation channels. In some bay areas, the water depth is less than 6 ft. In these areas, barge flotation channels may be required to provide access to the PAs. The construction of the access channels has the potential for disturbing mercury-impacted sediment in those areas with elevated mercury concentrations. In areas with a history of mercury contamination, backfilling the access channel with the dredged sediments, which were temporarily placed along the perimeter, can potentially disturb surface sediment with mercury concentrations above the RAO. As discussed in Section 3.9.4 and above, the concern over mercury-impacted sediments is presently limited to areas in the vicinity of Dredge Island and in Cox Bay. According to the RI performed in 1999, surficial mercury concentrations had decreased southwest of Dredge Island and were no longer elevated in Lavaca Bay near Matagorda Bay (Alcoa, 1999). Recent data obtained from Alcoa's sampling program in 2005, however, show that PA ER2 still has residual surface and at-depth mercury concentrations above the RAO. While constructing the access channels may resuspend some mercury, overall the capping procedure should make the Proposed alternative preferable to the No-Action alternative because elevated surface mercury concentrations are already present over a large area. Additionally, the proposed capping would assist in the prevention of resuspending sediment with higher mercury concentrations. Should post-construction monitoring determine that sediments with mercury concentrations above the RAO of 0.5 mg/kg for open water habitats exist, the sediments will be placed in an upland confined PA.

Barge access channels are not expected to be required in PA D, where residual mercury-impacted sediments also exist. No recent data exist for Cox Bay but as noted above, the Fish Closure has been removed, based in part on reduced mercury concentrations in Cox Bay. Recent probing results in the area indicate that water depths in Cox Bay are presently shallower (by approximately 1.5 ft) than were historical water depths, because of natural sedimentation. Efforts will be made to avoid constructing barge access channels through areas in Cox Bay with known at-depth mercury-impacted sediments. However, because of the locations of PAs A1 and A2 and the water depths in Cox Bay, constructing barge access channels through these areas may be unavoidable. Post-construction sampling will be performed to determine whether sediments with mercury concentrations above the RAO of 0.5 mg/kg for open water habitats exist and if so, the sediments will be placed in an upland confined PA.

4.9.4.2.3 Increase in Channel Bottom Velocities

An increase in channel bottom velocities as a result of the MSC improvement project is not expected to occur. Therefore, impacts related to this concern are not expected with the Proposed alternative.

4.10 COMMERCIAL AND RECREATIONAL NAVIGATION

4.10.1 No-Action Alternative

Under the No-Action alternative, the channel would continue to be maintained at its present dimensions. Commercial and recreational navigation activity would be expected to continue along historical trends, as described in Section 3.10.

4.10.2 Proposed Alternative

This section addresses effects of the Proposed alternative on the existing commercial and recreational navigation uses in the study area. The Proposed alternative includes making the MSC wider and deeper (400 x 44 ft versus 200 x 36 ft on the Bayside Channel and 600 x 46 ft versus 300 x 38 ft on the Entrance Channel). The effects are considered in terms of spatial alterations, time or schedule effects, and safety. Effects on both normal operations and during construction are addressed.

4.10.2.1 Effects on Commercial Navigation during Construction

During channel construction there will be dredging operations conducted along the MSC that will impose temporary delays and the need for slow speeds. The overall effect of these delays should be minor and well within the range of delays experienced in routine operations.

4.10.2.2 Effects on Commercial Navigation during Normal Operations

The wider and deeper channel would allow the use of larger vessels in the existing bauxite and specialty chemical trades that currently dominate commercial navigation in the MSC. This potential to use larger vessels will have the effect of either reducing the number of vessel trips required to carry the same

tonnage, or allowing greater shipping efficiencies that could induce additional tonnage and economic activity. Smaller vessels and tows would experience no beneficial effects of the larger channel.

Also, the existing channel dimensions restrict oceangoing vessels to one-way traffic. If the Proposed alternative is implemented, this restriction may be relaxed in some cases, potentially saving time for some operations. However, any improvement in this regard may be offset with the addition of the two to three port calls per week by LNG carriers, if the Calhoun LNG facility is constructed. This facility would add up to 120 port calls per year to the existing traffic. These vessels will likely operate with a moving safety zone while in transit that may result in some delays to existing commercial traffic. Overall, this time or schedule effect will be small as only a few vessels will benefit from two-way traffic, and the LNG-related delays will only involve a few hours every 2 to 3 days.

From a safety perspective, the existing commercial traffic will be well isolated from any new LNG traffic and should experience no adverse safety effect. In contrast, the larger channel dimensions should be a positive factor in improving navigation safety for the existing commercial traffic.

4.10.2.3 Effects on Recreational Navigation

Recreational vessels will experience some additional delays that arise both during construction and in avoiding the moving traffic safety zone around the LNG carrier transits, if that facility were constructed. Because recreational vessels tend to be small, there will be no offsetting benefits to those vessels from a larger channel to reduce these delays. However, the Proposed alternative is not expected to have a significant effect on existing recreational navigation uses.

4.11 VEGETATION

Sources of information that were used to assess the possible effects of the proposed project activities on vegetation include:

- Environmental Impact Report (EIR) including updated NWI wetland map provided by URS
- DMMP – Alternative 2A (see Appendix B)
- 3-Dimensional Hydrosalinity Model (see Appendix K)
- HEA (see Appendix J)
- Shoreline Erosion Study (see Appendix I)
- Draft Dredge Island Wetland Determination Report (Benchmark Ecological, 2006)

Potential beneficial and adverse impacts to vegetation may be caused by several factors such as development, habitat conversion, shoreline erosion and shoreline protection. Indirect impacts may also be caused by changes in the physical environment resulting from a specific action. Urban, commercial or agricultural development can directly impact vegetation by replacing natural areas with other forms of land cover.

Shoreline erosion caused by wave energy may be due to man-made (e.g., boat/vessel traffic) and/or natural (e.g., fetch, hurricanes) sources. Impacts from natural causes may be increased or reduced by man-made activities (e.g., removal of a natural breakwater may increase shoreline erosion, or beneficial use placement of dredged material to create a breakwater may decrease shoreline erosion). A shoreline erosion report prepared by Moffat and Nichols (see Appendix I) indicates that shoreline erosion rates in Matagorda and Lavaca bays vary widely (1–32 ft/year) depending on location. Additionally, the report indicates that the locations with the highest bluffs on the shoreline correspond to the highest erosion rates. The report also found that erosion was predominantly caused by wind-generated waves (i.e., 97–99% of total wave energy based on the existing channel and traffic). The report concluded that the proposed modifications, including the increased depth of the channel and larger LNG vessels, would result in a reduction of wave energy from vessels.

Loss or conversion of a vegetation community in the geographic footprint of an activity such as dredging or placement of dredged material may also occur. For example, if a channel was dredged through SAV beds, the SAV would be lost. If dredged material was placed on SAV, it could be converted to tidal flats or marsh, or depending on the amount, may have a temporary impact. In contrast, shoreline protection caused by placement of breakwaters or marsh, may also protect vegetation in addition to the shoreline. For example, PA G protects the marshes and SAV in Keller Bay.

There may also be effects not necessarily in the immediate footprint of the activity but caused by the activity. For example, SAV cover or productivity could decrease in response to lowered water clarity that was caused by increased turbidity associated with dredging or dredged material placement. Also, changes in salinity due to modifications of the channel may lead to changes in marsh species composition, productivity, or a loss of marsh cover. Shoreline erosion, caused by the loss of protective shoreline vegetation or beach/dune complex, may also result in the loss of upland vegetation.

The potential impacts associated with the Proposed alternative were assessed using a Habitat Equivalency Analysis (HEA) structured for this study (see Appendix J). The HEA measured impacts using standardized functional values for various habitats (including estuarine marshes, seagrass, oyster reef, and open bay bottom) over a 50-year period. Tidal flats were not addressed in that report. The HEA found that the Annual and Cumulative Functional Values of the Proposed alternative, considering all habitats, showed that the construction activities (dredging and placement) during the first 10 years cause it to have lower overall habitat functional value than the No-Action alternative. After this initial period, the Proposed alternative has greater habitat functional value due to the creation and maturing and protection of the habitats, especially the marshes. Graphs of these curves (showing the overall impacts over 50 years) appear in the HEA report (see Appendix J).

4.11.1 No-Action Alternative

Under the No-Action alternative upland plant communities would remain as described in Section 3.12, except for losses due to shoreline erosion, relative sea level rise (including subsidence) and development.

At current erosion rates, the southern shoreline of Keller Bay would breach before the year 2042; however, the probability of a hurricane causing the breach is much sooner (see Appendix J). After the breach, Sand Point would become an island, be more susceptible to erosion, so the upland portions, as well as associated wetlands and aquatic vegetation, would be lost to erosion. The No-Action alternative would not create new uplands. The study area would continue to be developed as described in Sections 3.17 (Land Use) and 3.18 (Socioeconomics). Potential impacts to wetland vegetation are discussed in Section 4.12.

4.11.2 Proposed Alternative

The Proposed alternative (including DMMP) would have no direct impact to existing areas of upland vegetation associated with the channel modifications. However, the DMMP would result in the creation, protection, and modification of uplands. Approximately 700 ac of agricultural lands (rice farms/pastures) would be converted to a dredged material placement area at PA P1, located south of Alamo Beach. This area is described in the DMMP as agricultural lands and is mapped by NWI as upland; however, it is actively or in-rotation farmed for rice (i.e., agricultural wetland). Additionally, about 1,368 ac of in-bay uplands would be created, as shown in Table 4.11-1. The DMMP does not include habitat development on the new in-bay uplands with the exceptions as noted because they will be subject to considerable disturbance through the years and quality habitats may not persist. If there is no planting, grasses, forbs and shrubs would be expected to vegetate these islands. Potential impacts to wetland vegetation, including marshes and SAV, are discussed in Section 4.12.

4.12 WETLANDS AND SUBMERGED AQUATIC VEGETATION

The wetlands in the study area, as mapped by the FWS NWI (1980–1995), appear in the Affected Environment Section of this EIS (see Figure 3.11-1). Wetland delineations have been performed at Dredge Island (BESI, 2006) within the footprints of PAs D and ER3, and on parts of P1 (NRCS, 2007; Diane Arnold, pers. comm.) as noted on Table 4.12-1. See Appendices A and D for maps of these wetlands. The condition and distribution of wetland types can be affected by changes in depth and frequency of inundation as well as salinity. The physiological tolerances of species with respect to many factors, such as salinity, water depth, and frequency of inundation, determines the species composition of plant communities. However, wetland communities are often classified by salinity characteristics, although the actual salinity ranges vary by location. In general, many species can grow and have higher productivity values under fresher conditions; however, there is competition from more species in the fresh water. For example, although smooth cordgrass can grow in fresh-intermediate water, it is not dominant in those areas because there are many salt-intolerant species that out-compete it. Table 4.12-2 shows wetland types and corresponding salinity ranges according to Cowardin et al. (1979). Table 4.12-2 also provides the salinity ranges for optimal conditions for that wetland type as determined by the Wetland Value Assessment (WVA) produced for the USACE Sabine-Neches Waterway EIS (USACE, 2006d), which is a much fresher system than Matagorda Bay.

Table 4.11-1
Proposed Alternative: Summary of Impacts to Vegetation

Habitat/Plant Community Type	Total Created/Lost	PAs	Total Protected	PAs	Net Change
Estuarine Marsh	Created 610.8 ac of estuarine marsh (587.6 low marsh and 23.2 high marsh) Lost: 36.4 ac (8.4-ac low marsh, 28.0-ac high marsh)	A2, D, ER2, ER3, G, and H	432 ac	G	574.3 ac increase in marsh cover (579.2 ac increase of low marsh; 4.9 ac decrease of high marsh)
Sand platform (SAV suitable habitat)	Created 325 ac	H			325 ac increase
Submerged Aquatic Vegetation (SAV)			250 ac (Keller Bay)	G	
Beach Nourishment	3 miles (Magnolia Beach, Indianola)	BN1, BN2, BN3			3 miles
Shoreline Protection			4 miles (southern shoreline of Keller Bay)	G	4 miles
In-Bay Upland	Creates 1,368.4 ac Lost (i.e., modified by placement of DM on existing upland): 40 ac	A1, A2, D, H including 25-ac bird island (PA H)			1,328.4 ac increase
Agricultural lands (rice fields/pastures)	Lost 700 ac	P1			700 ac decrease
Farmed wetlands	Lost 1.5 ac	P1			1.5 ac decrease*

*NRCS (Port Lavaca) data for part of P1 area. Wetland delineation required to certify no additional farmed wetlands in P1.

Table 4.12-1
Available Wetland Delineations on Impacted Areas

Location/PA	Wetland Type	Acreage	Performed by
D, ER3	Estuarine Marsh Low Marsh High Marsh	 8.4 28	BESI (USACE Delineation ID D19131
P1	Freshwater Marsh (Farmed Wetland)	1.5	NRCS (12/2/05)

Table 4.12-2
Salinity Ranges for Wetland Types

Wetland Type	Salinity Range	Optimal Salinity Range for Sabine-Neches Estuary
Saline	30–40 ppt	9–21 ppt
Brackish (-subsaline)	10–30 ppt	≤10 ppt (brackish only)
Intermediate	0.5–10 ppt	≤4 ppt
Fresh	<0.5 ppt	<2 ppt

Note: Gulf open water average annual salinity 36 ppt.

The 3-Dimensional Hydrosalinity Model (see Appendix K) provided salinity values in the project study area for three flow scenarios (low, medium, and high) for a period from March into October, which includes most of the growing season. The model also included the proposed USACE project to remove the bottleneck at the entrance channel. Several patterns are evident based on the graphs of salinities and the table of the annual differences:

- The Proposed alternative is always more saline than the No-Action alternative. The differences between the alternatives are more pronounced during the summer months. The difference in average annual salinities is less than 1 ppt during the more saline conditions (i.e., low flow conditions) and as much as 4.56 ppt under medium flow conditions. The differences under high flow conditions during the summer months are as high as 8 ppt. However, this occurs during low salinity periods (high flow), so absolute values of salinity are relatively low. Thus, salinity-induced stress is not expected.
- Bay salinities are much lower at higher flow regimes.
- The range of salinities across the year is much greater (at all locations) than the predicted average annual change.
- Under the low flow scenario, bay salinities are higher and thus, more similar to the Gulf salinities, so the differences caused by the proposed modifications to the channel (deepening and widening) are minor.
- The higher the flow regime, the greater the range of salinities over the year.
- There are increased differences between the Proposed and No-Action alternatives as the flow increases. During high flow conditions, the bay itself is fresher (due to the increased freshwater inflow). This makes it less like the Gulf waters which are more saline, so differences in salinity are more evident during periods of higher flow.

4.12.1 Estuarine Wetlands Including Submerged Aquatic Vegetation

4.12.1.1 Estuarine Submerged Aquatic Vegetation

SAV beds, including shoalgrass, widgeongrass, and clovergrass, which are known to occur in the Matagorda Bay system (TPWD, 1999), are restricted to relatively shallow areas (generally <6 ft water depth depending on water clarity). Five estuarine SAV occur in the Matagorda Bay system, including the true seagrasses and widgeongrass. Shoalgrass and widgeongrass, which occur across the widest range of salinities and water depth, were the dominant species followed by turtlegrass and manateegrass. Adair et al. (1994) provide information on the salinity and water depth ranges for seagrass species in the Matagorda Bay system:

- shoalgrass – more prominent in salinities (30–40 ppt)
- widgeongrass – more prominent in less saline (10–30 ppt), shallow waters, <90 cm (<2.9 ft)
- turtlegrass – occurs in salinities (30–40 ppt) in Matagorda Bay in water depths 35–110 cm (1.1–3.6 ft)

- clovergrass – 30–40 ppt and water depths, 35–110 cm (1.1 ft) in Matagorda Bay
- manateegrass – Adair et al. (1994) did not include manateegrass, but Stutzenbaker (1999) states that it is common in western Gulf coast at salinities ranging from 20 to well over 35 ppt

4.12.1.1.1 No-Action Alternative

Under the No-Action alternative, SAV communities would remain as described in Section 3.12.1.1, with notable exception of the impact in Keller Bay when the southern shoreline is breached (see Appendix J). That would cause a loss of approximately 250 ac of SAV (shoalgrass and widgeongrass) in the same manner as occurred in nearby Redfish Bay (a sub-bay of Carancahua Bay). The HEA (see Appendix J) found slowly decreasing cumulative functional values for SAV for the No-Action alternative.

4.12.1.1.2 Proposed Alternative

There are no known occurrences of SAV in the footprint of the proposed dredging or placement of dredged material, so SAV would not be directly impacted by excavation or burial. There may be short term rises in turbidity and associated reduced water clarity during the channel dredging and placement, but these would not be expected to have any lasting, measurable effect on SAV beds.

The DMMP (see Appendix B) would protect approximately 250 ac of SAV in Keller Bay by protecting the southern shoreline from breaching and opening to the larger bay, as happened in nearby Redfish Bay resulting in extensive SAV and marsh losses. The DMMP would create 250 ac of SAV-suitable sand platform (PA H), which is expected to be naturally colonized by seagrass beds. The DMMP would also create marsh habitat (PAs A2, D, ER2, ER3, G, and H) that would possibly result in the creation of some SAV-suitable habitats and tidal flats. The HEA (see Appendix J) found significantly improved (over No-Action) cumulative functional values for the SAV and SAV-suitable platforms over the course of the project.

The 3-Dimensional Hydrosalinity Model (see Appendix K) predicts an increase of <1 ppt in average annual salinity throughout the project area over most of the growing season under low flow conditions (i.e., periods of highest absolute salinities). This would not be expected to have a measurable impact on any wetland communities, including SAV. Although high flow conditions show greater differences in salinities for the alternatives (more saline for Proposed alternative), the absolute values would be relatively low, and so would not stress the estuarine SAV beds.

The Shoreline Erosion Report (see Appendix I) concluded that the proposed project (channel modifications and new vessels) would result in lower wave energy, so SAV beds along the shoreline north of Port O'Connor, would not be negatively impacted and may experience some minor benefit.

Nonvascular vegetation, such as freshwater algae and free-floating marine seaweed (*Sargassum* spp.) that occur more commonly near outlets to the Gulf should not be impacted. The freshwater algaes are remote

from the proposed activities and sargassum which drifts into the bay from the Gulf would be carried by currents and/or drift away from turbulent areas.

4.12.1.2 Estuarine Tidal Flats

4.12.1.2.1 No-Action Alternative

Under the No-Action alternative tidal flats would remain as described in Section 3.12.1.2, that is, there may be a continued decline due to relative sea-level rise. However, tidal flats may be created by washover fans on the Matagorda Peninsula caused by tropical storms.

4.12.1.2.2 Proposed Alternative

There would be no losses of tidal flats expected with the Proposed alternative greater than what would be expected for the No-Action alternative. The predicted increases in tidal amplitude from the Proposed alternative are expected to be less than 1/3 inch (see Appendix J). Thus, it is unlikely tidal flats would be impacted. Although the DMMP does not specifically address tidal flats, the marsh creation would be expected to also create some associated flats (PAs A2, D, ER2, ER3, G, H). In particular, PA G would likely result in the development of flats deposited by longshore currents on the northeastern side of the created marsh.

4.12.1.3 Estuarine Marsh (Saline and Brackish)

The salinity tolerance ranges for these marshes are fairly wide (0–30 for saline (hypersaline is >30 ppt) and 10–30 ppt for brackish marshes. However, the functionality of marshes may vary within the tolerance ranges. WVAs produced for the USACE Sabine–Neches Waterways EIS (USACE, 2006d) indicate that the optimal annual salinity ranges for brackish marsh are 0–10 ppt and for saline marsh are 9–21 ppt.

4.12.1.3.1 No-Action Alternative

Under the No-Action alternative, estuarine marsh would remain as described in Section 3.12.1.3. Like the tidal flats, there may be a continued decline due to relative sea-level rise and some marshes may be created by washover fans associated with tropical storms. There may also be continued increases in marsh cover in Pass Cavallo associated with longshore drift. The 3-Dimensional Hydrosalinity Model (see Appendix K) shows wide ranges in salinity. These salinity ranges support the existing distribution of saline and brackish marshes.

4.12.1.3.2 Proposed Alternative

No estuarine marsh occurs within the footprint of the Proposed alternative, so no direct impacts associated with construction are anticipated. The DMMP would result in a net increase if 579 ac of marsh by creating approximately 610 ac of estuarine marsh (587 low marsh and 23 high marsh). The difference between the created and net values of marsh is because some existing marsh is lost (8.4-ac low marsh, 28.0-ac high marsh) by the placement of the DM to create some of the PAs (Table 4.11-1). The only

impacted estuarine marshes that have been documented by a wetland delineation are on Dredge Island. Impacts are associated with the construction of PAs D and ER3. They include approximately 5 ac of low estuarine marsh and 28 ac of high estuarine marsh. The DMMP would also protect an additional 432 ac of marsh in Keller Bay. The location of PA G, which would create 320 ac of marsh, may lead to sediment build-up (deposited by longshore currents) on the northeastern side of the created marsh. This may create additional flats and marsh. The HEA indicates that the largest contribution to the increased functional value associated with the Proposed alternative (via the DMMP) is due to marsh creation.

Changes in salinity predicted by the 3-Dimensional Hydrosalinity Model may cause some adjustments in the saline to brackish marshes (i.e., some areas may become more saline or species typical of saline marshes may increase in brackish marshes). However, the salinity ranges provided by the 2-D model show less than 1 ppt differences in average annual salinities between Proposed and No-Action alternatives and so, are not expected to have greater impact on these marshes. They are well within the salinity tolerance and WVA-determined optimal ranges for the wetland communities. The predicted differences are minor under low flow (high stress) conditions, thus no loss or reduction in marsh function is anticipated.

The predicted increases in tidal amplitude associated with the Proposed alternative (see Appendix K) are less than 1/3 inch. Thus, it is unlikely there would be any measurable impacts to the vegetation. However, it is possible that vegetation might exhibit minor shifts in distribution in response to elevated water levels and if there is any response, it would likely be that small parts of high salt/brackish marshes would become low marsh. Since low marshes are generally considered better habitat for fish and wildlife, this would not necessarily be considered a negative impact.

4.12.1.4 Estuarine Shrub-scrub Wetland

4.12.1.4.1 No-Action Alternative

Under the No-Action alternative, estuarine shrub-scrub wetlands would remain as described in Section 3.12.1.4. The black mangroves that occur in the Pass Cavallo-Port O'Connor areas, may adjust to changes in elevation associated with continued longshore current deposition.

4.12.1.4.2 Proposed Alternative

No negative impacts to existing shrub-scrub wetlands are anticipated. There may be some creation of this plant community via the DMMP (see Table 4.11-1) as a by-product of the creation of marshes (PAs A2, D, ER2, ER3, G, H) and the bird island (PA H). It may be assumed that some shrub-scrub species would naturally recruit to some of these sites. It is also assumed that there would be some plantings on bird island including shrub species that provide bird habitat.

4.12.2 Fresh-Intermediate Plant Communities including Palustrine, Riverine and Lacustrine Systems

Intermediate wetlands have an average annual salinity range of 0.5–10 ppt. Intermediate wetlands are sometimes categorized with brackish, other times with fresh wetlands. If classified as fresh-intermediate, assume 0–10 ppt is the average annual salinity range. Fresh marshes are generally 0–0.5 ppt. Sabine-Neches WVA assigns 0–4 ppt the optimal range for intermediate marshes and 0–2 ppt as optimal for freshwater marshes.

4.12.2.1 Fresh-Intermediate Submerged Aquatic Vegetation, Marsh and Scrub/Shrub Wetlands

4.12.2.1.1 No-Action Alternative

Under the No-Action alternative fresh-intermediate wetlands will remain as described in Section 3.12.2.2.

4.12.2.1.2 Proposed Alternative

No impacts to fresh-intermediate wetlands (including aquatic vegetation) are anticipated either by dredging, placement of dredged material or salinity changes. The exception is the 700 ac of agricultural wetlands (rice fields/pasture) that will be converted to a DMPA (i.e., DMMP P1).

Information provided by the local NRCS office (Port Lavaca, Texas) indicates that there are 1.5 ac of Farmed Wetland and 87.9 ac of Prior Converted Cropland within the footprint of the proposed P1. This information comes from certified wetland delineations. These delineations do not cover all of the property. An additional 10.1 ac of Prior Converted Cropland are estimated to occur within this footprint. Wetland delineations on the areas not previously delineated will need to be performed to accurately quantify this estimate. A map of the farmed wetlands and prior converted cropland areas in the P1 area are shown on Figure 27 in Appendix A (Permit Application) and Appendix B (DMMP).

No wetlands are mapped (Figure 27 in Appendix A) in the ROW for the pipeline or drainage ditch that will drain P1. There is one stream crossing the ROW on the northeast corner of the proposed placement area; however, no impacts are expected because of the method (i.e., inverted siphon) that will be used to cross this stream.

In summary, the only known waters of the U.S. (i.e., regulated by CWA, Section 404) associated with the construction and maintenance of P1 are the 1.5 ac of farmed wetland within the DMPA, which would be lost, and the small stream crossing, which would not be impacted as described above. As noted above, additional wetlands delineations in the P1 area will need to be performed to confirm this.

4.13 WILDLIFE

Impacts to wildlife can occur as a result of dredging and construction activities, as well as operational activities. These potential impacts are discussed in the sections below.

4.13.1 No-Action Alternative

The No-Action alternative would result in no immediate direct impacts to the wildlife species or wildlife habitats at or near the proposed project area. Some of the habitats may change over time, independent of the project. Continued commercial and residential development occurring in the area could have an impact on wildlife. Likewise, continued dredging and placement of dredged material occurring in the area could result in increased sedimentation and altered hydrology, which could have an impact on the wildlife community, including aquatic species that constitute the food source of many coastal birds and other terrestrial species.

4.13.2 Proposed Alternative

The following sections discuss potential impacts associated with the proposed MSCIP. Both construction and operational impacts are considered.

4.13.2.1 Dredging and Construction

The dredged material would be deposited in one upland confined PA, two ODMDSs, and several in-bay confined PAs. Several of the in-bay confined PAs would be bordered by marshes to reduce potential sedimentation impacts from open-bay placement. Construction of these PAs would have similar impacts to the dredging activities in that they would be unlikely to have a direct impact on wildlife species but may have an indirect impact by affecting the food supply (aquatic organisms) of many terrestrial species. As a result of the proposed DMMP, there would be a net gain of approximately 1,300 ac of upland habitat, and approximately 580 ac of marsh habitat. Approximately 125 ac of beach nourishment and 25 ac of a bird island would also be gained.

The primary direct adverse impact of the Proposed alternative on wildlife would result from the placement of dredged material over the 50-year life of the project. Construction of some of the in-bay confined PAs would impact existing marsh (36.4 ac) or upland (40 ac) habitat. Likewise, PAs BN1, BN2, and BN3 would impact existing beach habitat. Construction of PA P1 would impact about 700 ac of existing upland. Construction activities in these areas might result in the direct destruction of those organisms not mobile enough to avoid construction equipment. These would potentially include individuals of several species of reptiles, mammals, and if construction occurs during the breeding season, the young of some species, including nesting and fledgling birds. Fossorial animals (i.e., those that live underground), may similarly be negatively impacted as a result of soil compaction caused by heavy machinery. For the most part, mobile wildlife species, particularly adult birds and larger wildlife species, would avoid the initial construction activity and move into available habitat outside the project area. Each

species, however, is dependent upon available resources such as food, shelter, water, territory, and nesting sites in any given area of habitat (Dempster, 1975). The availability of these resources determines the carrying capacity for a given area. It is assumed, for the purpose of impact analysis, that habitats are at their carrying capacity for the species in that particular area. Therefore, displaced wildlife populations would be forced into competition with resident populations in adjoining habitats, creating an inevitable decreased birthrate and/or increased mortality rate until populations are reduced to numbers that the habitat can support. Thus construction activity would ultimately result in a reduction in the local wildlife populations proportional to the amount of habitat preempted. Temporary, local impacts to terrestrial communities and habitats may occur due to these activities.

Construction of the PAs and associated levees would be unlikely to have a direct impact on wildlife species but may have an indirect impact through impacts to aquatic organisms that serve as a food source for terrestrial species. Temporary impacts to aquatic communities and habitat from increased sedimentation and turbidity would be expected. This in turn may temporarily impact birds in the area by potentially reducing the availability of their local food supply. Noise and increased human activity during construction may temporarily impact wildlife in areas adjacent to the machinery. These impacts are expected to be minor and short term.

As described in Section 2.5 and the DMMP (see Appendix B), under the Proposed alternative, dredged material would be deposited in one upland confined PA (Figure 3.0-1). This area is currently dominated by agricultural land (mostly rice fields). While this area might provide limited wildlife habitat, the conversion of a rice field to a PA is not expected to have a significant impact on local wildlife resources.

While dredging activities are unlikely to have a direct impact on wildlife species, they may have an indirect impact. Such activities may cause temporary impacts to aquatic communities and habitats, which in turn may indirectly impact seabirds in the area by potentially reducing the availability of the food supply. These impacts are local and temporary, and considering the large size of the bay and the mobility of birds, these effects are not likely to be significant. The increased potential for accidental spills of petroleum products, chemicals, or other hazardous materials during dredging activities, however slight, also poses a potential, although very small, threat to the aquatic community, and thus the food source of many coastal birds in the area.

The noise of equipment and increased human activity during dredging activities near shorelines may disturb some local wildlife, particularly coastal birds, especially during the breeding season. Such impacts, however, would be temporary and without significant long-term implications.

Once the initial dredging activities associated with the project have been completed, only minor additional impacts are anticipated. Maintenance dredging activities would have similar temporary impacts as the initial dredging, but on a lesser scale and for a shorter term. Accidental chemical or petroleum product spills that may occur during dredging operations would pose a potential, albeit minor, threat to the aquatic community, and thus the food source of many coastal birds in the area. Impacts from noise

and human activity are unlikely to be a substantial factor, although these impacts may force some mobile species to avoid the immediate vicinity of the project and move into similar adjacent habitats. However, these effects would be short-term and no different from impacts associated with current maintenance dredging activities.

As noted in Section 2.5.2, placement of dredged maintenance material may occur at Sundown Island and the Port O'Connor Beach. If this occurs, it would be limited to the appropriate times of year to avoid impacts to shorebirds. Periodic placement of dredged material at these locations may enhance existing shoreline habitat, thus providing a benefit to local wildlife, especially shorebirds, in the area.

4.13.2.2 Operational Activities

Once the initial dredging activities associated with the project have been completed, little additional impact is anticipated. Proposed improvements to the MSC are not expected to result in substantial increases in ship traffic (see Section 4.10). Thus, impacts from noise and human activity are unlikely to be a factor. The PAs would provide a substrate for seagrass beds, thus increasing the habitat for some aquatic species, which in turn could locally increase the food source for birds in the area.

Species that can be expected to benefit from increased upland habitat, including wooded areas, for the purposes of cover, foraging, and nesting include, but are not limited to the northern mockingbird (*Mimus polyglottos*), northern cardinal (*Cardinalis cardinalis*), yellow-rumped warbler (*Dendroica coronata*), nine-banded armadillo (*Dasypus novemcinctus*), least shrew (*Cryptotis parva*), northern raccoon (*Procyon lotor*), eastern gray squirrel (*Sciurus carolinensis*), eastern fox squirrel (*Sciurus niger*), white-footed mouse (*Peromyscus leucopus*), deer mouse (*Peromyscus maniculatus*), and eastern woodrat (*Neotoma floridana*), Hurter's spadefoot (*Scaphiopus hurterii*), little brown skink (*Scincella lateralis*), Texas ratsnake (*Elaphe obsoleta*), and Texas coralsnake (*Micrurus tener*). Species that would directly benefit from upland herbaceous cover and woodland edge habitats include eastern meadowlark (*Sturnella magna*), brown-headed cowbird (*Molothrus ater*), field sparrow (*Spizella pusilla*), vesper sparrow (*Pooecetes gramineus*), white-throated sparrow (*Zonotrichia albicollis*), white-tailed deer (*Odocoileus virginianus*), fulvous harvest mouse (*Reithrodontomys fulvescens*), northern pygmy mouse (*Baiomys taylori*), hispid cotton rat (*Sigmodon hispidus*), eastern cottontail (*Sylvilagus floridanus*), eastern narrow-mouthed toad (*Gastrophryne carolinensis*), ornate box turtle (*Terrapene ornata ornata*), green anole (*Anolis carolinensis*), Texas spotted whiptail (*Aspidoscelis gularis gularis*), and western coachwhip (*Masticophis flagellum testaceus*). Species that would directly benefit from increased upland territorial range would include the coyote (*Canis latrans*), bobcat (*Lynx rufus*), and common gray fox (*Urocyon cinereoargenteus*).

Species that can be expected to benefit from the increased marsh habitat for cover and foraging include, but are not limited to the great blue heron (*Ardea herodias*), belted kingfisher (*Ceryle alcyon*), red-winged blackbird (*Agelaius phoeniceus*), little blue heron (*Egretta caerulea*), white ibis (*Eudocimus albus*), double-crested cormorant (*Phalacrocorax auritus*), cackling goose (*Branta hutchinsii*), northern pintail

(*Anas acuta*), lesser scaup (*Aythya affinus*), common merganser (*Mergus merganser*), American beaver (*Castor canadensis*), marsh rice rat (*Oryzomys palustris*), nutria (*Myocastor coypus*), swamp rabbit (*Sylvilagus aquaticus*), American alligator (*Alligator mississipiensis*), snapping turtle (*Chelydra serpentina*), gray treefrog (*Hyla versicolor*), southern leopard frog (*Rana sphenocephala utricularia*), American bullfrog (*Rana catesbeiana*), speckled kingsnake (*Lampropeltis getula holbrooki*), broad-banded watersnake (*Nerodia fasciata confluens*), Graham's crayfish snake (*Regina grahamii*), and western cottonmouth (*Agkistrodon piscivorous leucostoma*).

Temporary impacts to aquatic communities and habitat from increased sedimentation and turbidity would be expected. This in turn may impact birds in the area by potentially reducing the availability of their local food supply, temporarily. This impact may be more noticeable at sites located near known bird rookeries. For example, PAs 5–12 are located adjacent to several rookeries along the existing channel.

Upland PA P1 would convert 700 ac of farmland, predominantly rice fields, to an upland dredged material PA, so mitigation would be minimized, as would impacts to species utilizing these wetland environments. Although agricultural land may serve some ecological value to selected species, impacts to wildlife would be minimal. This areas connection to adjacent uplands would allow for species adapted to edge habitats to utilize the break in vegetative structure.

PA A1 (in-bay upland), will provide an additional 530 ac of upland habitat adjoining existing USACE PAs 18 and 19. Not only will the size of the upland habitat increase, but linear feet of shoreline habitat will also increase, thus increasing the habitat for some shorebirds and aquatic species, which in turn could locally increase the food source for birds in the area. Similar benefits can be expected from PA A2 (140 ac of upland and 120 ac of marsh habitats), and PA D (260 ac of upland and approximately 14 ac of low marsh). PA D would add upland surface area to an already existing Dredge Island, and therefore also increase the linear feet of shoreline habitat of this island.

The beach nourishment areas (PAs BN1, BN2, and BN3) would create approximately 125 ac of new beach habitat. Furthermore, considering the locations proximity to documented critical habitat zones for the piping plover (TX-19, 22, 23, 24 shown on Figure 3.14-1), it is possible that these beach nourishment areas would provide constituent elements necessary for this species. Beach nourishment would provide foraging habitat for shorebirds which feed upon invertebrates along the beach. Additionally, waders and divers would benefit from the shallow open water habitat near the beach for foraging for fish and other food items. Species that can be expected to benefit from beach nourishment include shoreline bird species such as the sanderling (*Calidris alba*), least sandpiper (*Calidris minutilla*), willet (*Catoptrophorus semipalmatus*), Wilson's plover (*Charadrius wilsonia*), semipalmated plover (*Charadrius semipalmatus*), pectoral sandpiper (*Calidris melanotos*), and ruddy turnstone (*Arenaria interpres*) among others.

PA G (in-bay upland with Sand Point and Keller Bay protection) would create 12 ac of upland habitat and approximately 320 ac of low marsh habitat. In addition to these created habitat areas, a 13,000-ft breakwater levee and marsh platform would be constructed to prevent breaching of the existing marsh

surrounding Keller bay, and therefore would preserve the existing marshes (about 432 ac) and seagrass beds (about 250 ac) within Keller Bay. Upland habitat in PA G would provide possible nesting areas for avian and reptile and amphibian species, loafing, roosting, and nesting areas for migratory bird species, and additional habitat for terrestrial mammals and reptiles and amphibians. The extensive marsh habitat (320 ac) would also provide essential foraging habitat for aquatic avian and reptile and amphibian species. In addition, it is anticipated that the proposed levee north of PA G would result in accretion of sediments over time based on water current, rather than the existing erosional situation in this area that threaten the habitats in Keller Bay.

PA H4 would create approximately 20 ac of upland habitat, 100 ac of low marsh habitat, 325 ac of sand platform, and a 25-ac bird island. This area will be a mosaic of habitat including sandy shallow-water habitats at a depth of –2 to –3 ft MLT, marsh islands/terraces, and a potential bird island. A perimeter levee with gaps for water circulation will be installed and armored to an elevation of 8.0 ft MLT and silty/sand material will be placed inside to create the variety of habitats. The bird island would provide habitat for colonial waterbird rookeries and other nesting/loafing areas for migratory birds. Seagrass beds would potentially develop around the low marsh, which would provide habitat for aquatic species, providing the prey base for predatory birds and reptiles. Shallow, open water areas within this PA would also provide areas for waders and divers to feed.

PAs ER2 and ER3 would create approximately 369 ac of upland habitat, 40 ac of low marsh habitat, and 16 ac of high marsh habitat. These areas would be in-bay uplands and marsh habitats, with areas of upland vegetation consisting of oak motts. Two open water ponds within the center of PA ER2 would provide habitat for waders, divers, and reptile/amphibian species. The upland oak motts created in PA ER2 would also provide loafing/nesting habitat for migratory birds. The surrounding low marsh habitat would provide additional habitat for various birds, reptiles, amphibians, and invertebrates, which constitute the prey base for many species inhabiting the area. PA ER3 would provide additional upland habitat adjacent to PA D, expanding the current Dredge Island in size. This would effectively increase the size of the Dredge Island and therefore increase both the acres of upland habitat and the linear feet of shoreline habitat on the island. Terrestrial mammals, reptiles, birds, amphibians, and invertebrates would benefit from this increase, as well as waders, divers, and various shorebirds.

4.14 AQUATIC ECOLOGY

4.14.1 Habitat Equivalency Analysis for Bay/Offshore Bottom Impacts

A HEA was conducted to assess the proposed DMMP for impacts to bay bottom as a result of the ship channel improvements and the placement of new work and maintenance materials from the channel over the 50-year planning period. The HEA model compared the total habitat functional value of areas potentially lost from construction of the project to the total functional values provided by mitigation and habitat created by in-bay confined PAs. This process was used to ensure that the benefits provided by the project replace the losses in functional value. The results of the HEA show that the annual functional

value and cumulative value of the Proposed alternative have a significant positive benefit on the Matagorda Bay system as a whole when compared to the No-Action alternative. A detailed description of the HEA methodology and results can be found in Appendix J.

4.14.2 Aquatic Communities

4.14.2.1 No-Action Alternative

Under the No-Action alternative, aquatic communities would remain as described in Section 3.14.1. Impacts from current maintenance dredging include increased water column turbidity during and for a short time after dredging activities and burial of benthic organisms. No long-term effects are expected.

4.14.2.2 Proposed Alternative

The Proposed alternative directly affects the aquatic communities by loss of open water habitat. However, the area involved is a small fraction of the total available habitat within the entire system.

Turbidity in estuarine and coastal waters is generally credited with having a complex set of impacts on a wide array of organisms (Thompson, 1973; Hirsch et al., 1978; Stern and Stickle, 1978; Wright, 1978). Suspended material can play both beneficial and detrimental roles in aquatic environments. Turbidity from TSS tends to interfere with light penetration and thus reduce photosynthetic activity by phytoplankton. Such reductions in primary productivity would be localized around the immediate area of the maintenance dredge operations and construction dredging and placement, and would be limited to the duration of the plume at a given site. Conversely, the decrease in primary production, presumably from decreased available light, has been found to be offset by increased nutrient content (Morton, 1977). In past studies of impacts of dredged material placement from turbidity and nutrient release, the effects are both localized and temporary (May, 1973; Odum and Wilson, 1962; Brannon et al., 1978). Thus, due to the capacity and natural variation in phytoplankton populations, the impacts of dredged material placement within the project area are not expected to be significant.

Although water column turbidity would increase during project construction and maintenance dredging, such effects are usually temporary and local. Detrimental effects are generally recognized at TSS concentrations greater than 500 mg/L and for durations of continuous exposure ranging from several hours to a few days. Turbidities exceeding 500 mg/L have been observed around maintenance dredging and placement operations (EH&A, 1980), and such turbidities may affect some aquatic organisms near the active dredges and outflow weirs. In a study in Corpus Christi Bay, Schubal et al. (1978) reported TSS values greater than 300 mg/L but only in a relatively small area near the bottom. They also found that TSS from maintenance dredging in Corpus Christi Bay is not greater than that from shrimping and affects the bay for much shorter time periods. May (1973) found that TSS was reduced by 92% within 100 ft of the discharge point, by 98% at 200 ft, and that concentrations above 100 mg/L were seldom found beyond 400 ft from the point of placement. Elevated turbidities during construction and maintenance dredging may affect some aquatic organisms near the dredging activity; however, turbidities can be expected to

return to near ambient conditions within a few hours after dredging ceases or moves out of a given area. Shideler (1984) reports similar TSS levels from dredging and storm events. Overall, motile organisms are mobile enough to avoid highly turbid areas (Hirsch et al., 1978). Under most conditions, fish and other motile organisms are only exposed to localized suspended-sediment plumes for short durations (minutes to hours) (Clarke and Wilber, 2000). At areas where levees are proposed to be built, there would be a one time water column turbidity increase during construction.

Effects of elevated turbidities on the adult stages of various filter-feeding organisms such as oysters, copepods, and other species include depression of pumping and filtering rates and clogging of filtering mechanisms (Stern and Stickle, 1978). These effects are pronounced when TSS ranges from 100 to 1,000 mg/L and higher, but are apparently reversible once turbidities return to ambient levels. Notwithstanding the potential harm to some individual organisms, compared with the existing condition, no significant impacts to finfish or shellfish populations are anticipated from project construction or maintenance dredging activities associated with the Proposed alternative.

A slight increase in salinity is likely to be observed as a result of the proposed channel improvements. Results of a hydrodynamic salinity model suggest that an average salinity change of 2 ppt can be expected (see Appendix K). Most organisms occupying the bay are ubiquitous along the Texas coast and can tolerate a wide range of salinities (Pattillo et al., 1997; Parker, 1965). Therefore no adverse effects are expected to occur to finfish or shellfish populations as a result of salinity changes.

In the unlikely event a petroleum product spill should occur, however low the probability, adult crustaceans, such as shrimp and crabs, and adult finfish are probably motile enough to avoid most areas of high oil concentration. Larval and juvenile finfish and shellfish tend to be more susceptible to oil than adults and could be affected extensively by an oil spill during their active immigration periods. Due to their lack of mobility, they are less likely to be able to avoid these areas and could be negatively impacted if a spill were to occur. Benthic fauna could suffer high mortality due to being smothered by the oil; however, they are able to repopulate affected areas soon after a spill. Phytoplankton may be adversely affected by oil spills; however, due to their inconsistent distribution and high rate of propagation, the overall impact of an oil spill can be reduced (Kennish, 1992). An oil spill in the project area could result in impacts to phytoplankton and benthic communities. However, since these organisms have the ability to recover rapidly from a spill, due primarily to their rapid rate of reproduction and to the widespread distribution of dominant species, significant, long-term impacts would not be expected. There is no increase in the likelihood of oil spills with the Proposed alternative.

The Proposed alternative would create marsh habitat, oyster reefs, and topographic relief and protect marshes and seagrass beds. The additional habitat would be more productive than the open water habitat it would be replacing. Therefore, the aquatic community may benefit from the higher productivity of the bay. Some of the dredged material is to be placed on top of mercury-contaminated sediments (PAs ER1, ER2, and ER3). The capping of the contaminated sediments would help reduce the risk of ecological injuries to the aquatic community. The HEA annual functional values for all habitats combined for the

Proposed alternative has a significant positive benefit to the bay system throughout the life of the 50-year project when compared to the No-Action alternative (Figure 4-14.1; see Appendix J).

4.14.3 Recreational and Commercial Fisheries

4.14.3.1 No-Action Alternative

Under the No-Action alternative current dredging operations would continue and impacts to recreational and commercial species would remain as described in Section 3.14.1.1. Impacts from current maintenance dredging include altering or removing productive fishing grounds and short-term increases in turbidity, although reductions in the numbers of important species are not expected.

4.14.3.2 Proposed Alternative

Temporary and minor adverse effects to recreational and commercial fisheries may result from altering or removing productive fishing grounds and interfering with fishing activity during construction and maintenance dredging. However, no significant impacts to food sources for nekton are likely; therefore, reductions of nekton standing crops would not be expected. Major species of nekton, including sciaenid fishes and penaeid shrimp, should not suffer any significant losses in standing crop. Thus, the recreational and commercial fishing would not be expected to suffer from reductions in the numbers of important species.

Repeated dredging and placement operations for channel maintenance may temporarily reduce the quality of recreational and commercial fisheries in the vicinity of construction and dredging operations. This may result from decreased water quality and increased turbidity during dredging as well as from a loss of attractiveness to game fish resulting from loss of benthic prey. This condition is not permanent, and the quality of fishing in the vicinity of the channel and PAs should steadily improve after dredging is completed and would likely be similar to existing maintenance dredging, as described for the No-Action alternative. Maintenance dredging operations would only cause temporary affects to the immediate area during the proposed dredging process.

During construction dredging, game fish would leave prime recreational fishing areas for more favorable, less turbid locations; however, once construction is completed, conditions would improve and game fish would return to the area. Placement of new work and maintenance dredged material in an existing open dredged material disposal site (ODMDS) (PA1) offshore and a new ODMDS (PA O5) may result in a localized effect on recreational and commercial fishing in the area. However, construction activity should not significantly affect overall fishing in the general project area. The Proposed alternative should enhance habitat for recreational and commercial fishing throughout the Matagorda Bay system and offshore through the creation of marsh habitat, oyster reefs, and protection of marshes and seagrass beds. Protection and creation of marshes and seagrass beds would increase the nursery areas which recreational and commercial species utilize during portions of their life cycles.

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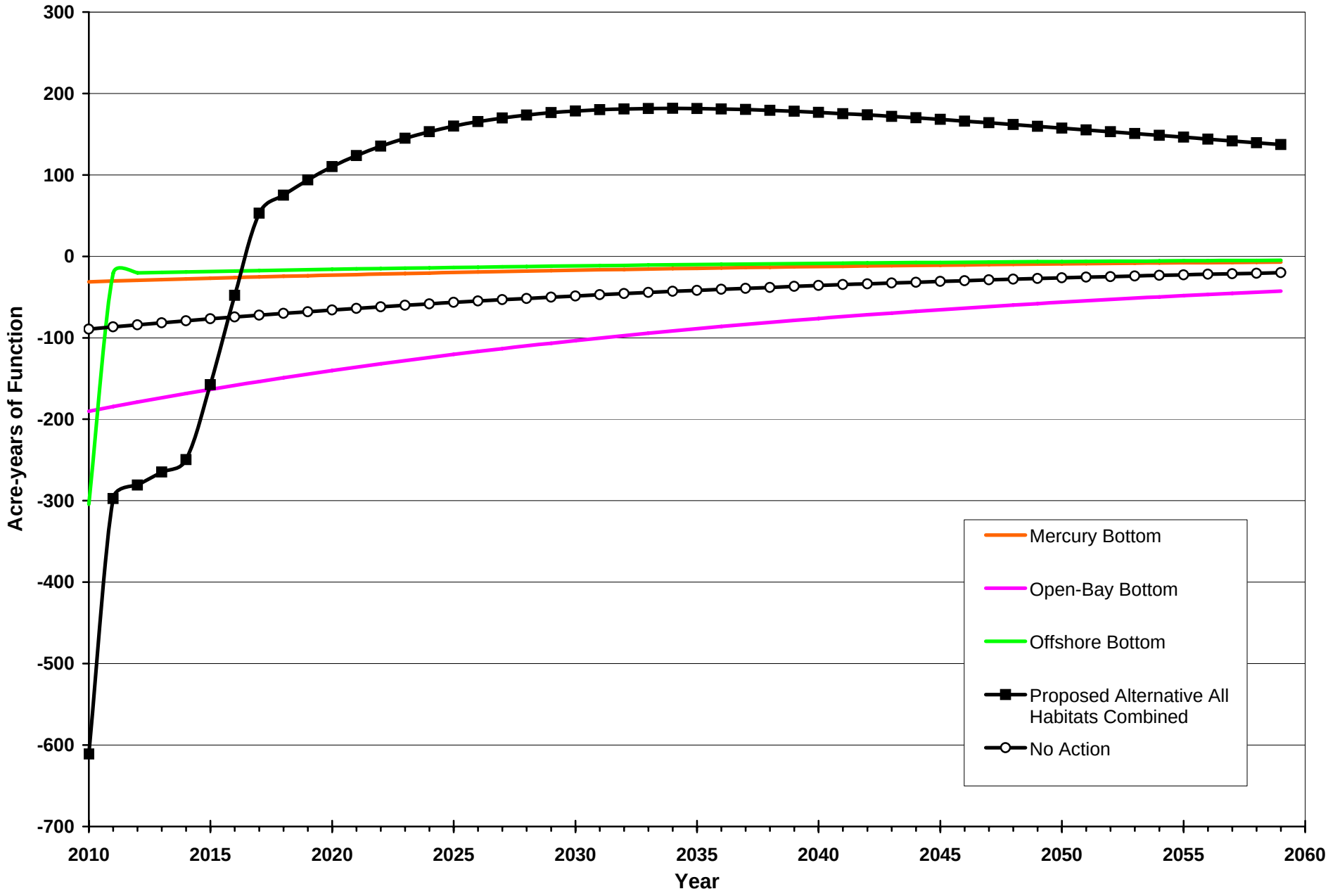
FIGURE 4.14-1
PROPOSED ALTERNATIVE – HEA ANNUAL FUNCTIONAL VALUE



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The HEA annual functional values for all habitats combined for the Proposed alternative has a significant positive benefit to the bay system throughout the life of the 50-year project when compared to the No-Action alternative (see Figure 4-14.1 and Appendix J). Therefore, commercial and recreational species would benefit from the habitat protected and provided by the proposed DMMP.

4.14.4 Open-Bay Bottom

4.14.4.1 No-Action Alternative

Under the No-Action alternative, open-bay bottom would remain as described in Section 3.14.1.2. Impacts from current maintenance dredging include increased water column turbidity during and for a short time after dredging activities and burial of benthic organisms. No long-term effects are to be expected.

4.14.4.2 Proposed Alternative

The Proposed alternative directly affects open-bay bottom by loss of benthic habitat. A total of 4,060 ac of open-bay bottom would be lost; however, the acreage involved is a small fraction of the total available habitat within the entire system (Table 4.14-1). Most of the open-bay bottom lost would be converted to marsh, oyster reefs, SAV platform, or uplands.

Table 4.14-1
MSCIP DMMP
Acres af Aquatic Areas Impacted

Placement Area	Acres of Bay Bottom Impacted	Acres of Oyster Reef Created	Acres of Oyster Reef Covered	Creation Type
A1	530			in-bay uplands
A2	260		0.75	in-bay uplands and marsh
BN1, BN2, and BN3	125			beach
D	252		0.66	in-bay uplands and marsh
ER1*	126	63		submerged cap oyster reef
ER2*	174		0.6	upland cap and marsh
ER3*	185		17	upland cap and marsh
G	354			uplands and marsh
H4	470			in-bay uplands, SAV platform, marsh, bird island
O5**	1,600			offshore placement, topographic relief
OR1 and OR2	235	235		oyster reef
PA1**	453			offshore bottom
PA 5–12	1,350			bay bottom
Total Acres Bay Bottom Impacted:		4,060		
Total Acres Offshore Bottom Impacted:		2,053		
Total:		6,133		

*Mercury-impacted bay bottom.

**Offshore bottom.

The Proposed alternative would alter the benthic habitat through dredging and placement activities. Dredging represents two problems for benthic communities: excavation and disposal; however, disposal is more harmful than excavation. Excavation buries and removes organisms, but organisms can rapidly recolonize, whereas disposal smothers or buries existing benthic communities. Placement of dredged material may cause ecological damage to benthic organisms in three ways: (1) physical disturbance to benthic ecosystems; (2) mobilization of sediment contaminants, making them more bio-available; and (3) increasing the amount of suspended sediment in the water column (Montagna et al., 1998). Organisms that are buried must vertically migrate or die (Maurer et al., 1986). Maurer et al. (1986) demonstrated that many benthic organisms were able to migrate vertically through 35 inches of dredged material under certain conditions; however, the species present in early successional stages of recovery are not the same as those buried by the dredged material. Although vertical migration is possible, most organisms at the center of the disturbance do not survive, and survivability was shown to increase as distance from the disturbance increased (Maurer et al., 1986).

Repeated dredging during biennial maintenance dredging operations may prevent benthic organisms from fully developing (Dankers and Zuidema, 1995). Excavation destroys the community that previously existed but creates new habitat for colonization (Montagna et al., 1998) and can actually maintain high rates of macroinfauna productivity (Rhoades et al., 1978). By repeatedly creating new habitat via disturbance, new recruits continually settle and grow. However, these new recruits are always small, surface-dwelling organisms with high growth rates. Large, deep-dwelling organisms that grow slower and live longer are lost to the areas of repeated excavation. In this way, excavation associated with maintenance dredging may not cause a decrease in production, but rather a shift in community structure (Montagna et al., 1998). Sheridan (1999) found that benthic communities can take anywhere from 18 months to over 3 years to recover for certain parameters.

Placement of construction and maintenance dredged material at the ODMDS would bury those benthic organisms incapable of escaping or burrowing up through the dredged material. Burial of benthic organisms would occur during initial construction placement offshore, but the material is virgin ocean bottom, thus recolonization should be rapid. Benthic community structure and abundance would never fully return to pre-placement levels at the maintenance ODMDS since this site would be used for placement of dredged material over the 50-year period. However, benthic communities at the new one-time use ODMDS should recover over time. Potential beneficial effects of the suspended material associated with dredging operations include resuspension of nutrients thereby promoting primary productivity, removal of some contaminants from the water column, and addition of a protective cover allowing certain nekton to avoid predation (Stern and Stickle, 1978). As with various potential detrimental effects, the importance of each of these latter effects would vary among groups and with the physiochemical parameters existing at the time of dredging and placement operations.

For both the No-Action alternative and the Proposed alternative, maintenance material would be placed on the bay bottom and the areas would be allowed to recover naturally. The model also took into account that the natural condition of the bay often has high levels of suspended solids similar to conditions after

open-bay placement of dredged material. The HEA annual functional value of open-bay bottom habitat for the Proposed alternative is similar to the No-Action alternative and has a slight negative loss to the bay system through the 50-year project when compared to the No-Action alternative (see Figure 4.14-1).

HEA also evaluated the mercury-impacted open-bay bottom habitats (see Appendix J). The Proposed alternative includes placement of dredged material over mercury contaminated sediments, thus providing a benefit to the bay through burial of contaminated areas. The HEA calculated the annual functional value of PAs over mercury-impacted bottom (PAs ER1, ER2, and ER3) for the Proposed alternative would have a benefit to the bay system through the 50-year project, when compared to the No-Action alternative (see Figure 4.14-1).

4.14.5 Oyster Reef

4.14.5.1 No-Action Alternative

Under the No-Action alternative, oyster reef habitat would remain as described in Section 3.14.1.3.

4.14.5.2 Proposed Alternative

During the construction phase of the Proposed alternative, approximately 19 ac of oyster reefs and habitat would be covered at PAs A1, D, ER2, and ER3 (see Table 4.14-1). The dredged material is to be placed on top of oyster reefs located in an area of mercury-contaminated sediments at PAs ER2 and ER3. However, a total of 298 ac of potential oyster reef habitat would be constructed at areas PAs OR1, OR2, and ER1 (see Table 4.14-1). Bay bottom in these areas would be capped with a stiff to hard clay material with a suitable layer of crushed limestone or other suitable media to enhance oyster recruitment. At PA ER1, the clay material will be 2 ft thick providing substantial separation between impacted sediments and the created oyster reefs. Although it is unknown how long the process may take, an oyster reaches the legal size of 3 inches in about 2 years, which is a good estimate of the time required for a reef to become productive (Hofstetter, 1998).

Indirect effects to oyster reef habitat may result from a higher salinity regime due to the effects of channel improvements. This has the potential to cause an increase in predators such as oyster drills and pathogens such as Dermo (Britton and Morton, 1989). Impacts to oysters from salinity increases due to channel enlargement were modeled and evaluated for the Proposed alternative (Appendix M). During median flow conditions between April and September, the model shows an increase in salinity on reefs in Lavaca and Keller bays. The intensity of Dermo infection increases during the warmer months (August and September) when salinities are greater. With the improved channel, an overall rise in salinity of about 2 to 4 ppt could be expected. Dr. Sammy Ray believes that the higher salinities would intensify the impact of Dermo on oysters and, when combined with higher water temperatures, could cause losses of oysters of 10 to 40 percent in years when the arrival of cool weather is delayed. However, as noted in the modeling report, although rising salinities and rising temperatures have significant control over the intensity of Dermo, there are a combination of factors related to oyster health that should be considered, such as

availability of food, siltation, current flow, crowding, and harvest intensity (see Appendix M). Numerous studies have been conducted on the effects of temperature and salinity on Dermo. Crosby and Roberts (1990) found that both temperature and salinity increased infection intensity; however, it was demonstrated that temperature was more important. In a laboratory experiment, Fisher et al. (1992) also found that temperature was a more important factor than salinity in relation to Dermo infection. Conversely, Craig et al. (1989) surveyed Gulf oysters and found that variation in disease intensity between sites studied had no relationship to temperature. Long-term monitoring in the Gulf by Powell et al. (1992b) showed that long-term climate changes through the years as influenced by the El Niño Southern Oscillation may have a significant affect on the presence and intensity of Dermo in this region. Through numerous studies, it is apparent that both temperature and salinity affect Dermo infection on oysters (Maryland Sea Grant College, 1996).

A methodology to assess decreases in oyster survival and production as a result of increased Dermo infection from salinity increases resulting from the improved channel was developed (Appendix M). The methodology assumed a 25 percent increase (the average of the 10 to 40 percent range estimated by Dr. Sammy Ray) in oyster mortality for reefs with predicted salinity greater than 25 ppt in September of years when cool weather is delayed by 2 weeks or more compared with the average. An additional loss of 5 percent of biomass production in reefs with predicted salinity greater than 20 ppt in September was also assessed for each year. Using this methodology, the total calculated loss of oysters due to increased Dermo infection was an equivalent of 105.7 ac of reef.

Water column turbidity would increase during project construction and maintenance dredging that could affect survival or growth of oysters. Such effects are usually temporary and local. The location of oyster populations can gradually shift in response to natural and man-made modifications in the bay system (Britton and Morton, 1989). Therefore, it is likely oyster reefs affected by implementation of the Proposed alternative could adjust to new conditions over time. The shifting process can be improved by placing new reef material adjacent to existing reefs or creating new reefs where favorable conditions are expected to occur. As previously noted, approximately 298 ac of oyster reef would be created by placement of new work dredged material from construction of the Proposed alternative. PAs OR1 and OR2 (235 ac) would use these techniques to place the new reefs in optimal areas to maximize benefits.

4.14.6 Offshore Sands

4.14.6.1 No-Action Alternative

Under the No-Action alternative, offshore sand habitat would remain as described in Section 3.14.1.4. Impacts from current maintenance dredging include increased water column turbidity and burial of benthic organisms, although no long-term effects are expected (see Section 4.14.2.2).

4.14.6.2 Proposed Alternative

The Proposed alternative directly affects offshore sands by loss of bottom habitat at the ODMDS sites. A total of 1,600 ac at PA O5 and 453 ac at PA1 of bottom habitat would be lost; however, the acreage involved is a small fraction of the total available habitat within the entire system (see Table 4.14-1). PA1 would be a continuous use dispersive site for maintenance dredging, whereas PA O5 would be a one time placement.

Water column turbidity would increase during the project construction and maintenance dredging. Such effects are usually temporary and local. Offshore placement of construction and maintenance dredged material is located at PA1 and PA O5. At PA O5, benthic organisms would be buried and subsequently killed during placement of the construction dredged material; however, recolonization should be rapid. Benthic community structure and abundance would eventually return to pre-placement levels at PA O5 since it would be used only once for placement of construction material. Repeated placement of maintenance material at the offshore site PA1 would bury benthic organisms and colonies may not fully recover before the next dredging cycle. However, PA1 is currently an active ODMDS, thus conditions would not change from what currently occurs.

HEA assumed the functional value of offshore sands to be the same as open-bay bottom since the DMMP would only impact these areas, not create them (see Appendix J). These areas are deeper than bay bottom and receive less sunlight, so they might be less productive; however, they may support greater diversity than bay areas. HEA also assumed that these areas would return to their maximum functional value in one year following dredged material placement. The HEA annual functional value indicates offshore sands with the Proposed alternative has an overall positive benefit throughout the 50-year project when compared to the No-Action alternative (see Figure 4.14-1).

4.14.7 Artificial Reefs

4.14.7.1 No-Action Alternative

Under the No-Action alternative, artificial reefs would remain as described in Section 3.14.1.5.

4.14.7.2 Proposed Alternative

No artificial reefs are located in the vicinity of the project area and therefore no impacts are expected with the Proposed alternative.

4.14.8 Essential Fish Habitat

EFH for white shrimp, brown shrimp, pink shrimp, Gulf stone crab, gray snapper, Spanish mackerel, and red drum occur in the project area and includes estuarine emergent wetlands, estuarine mud and sand substrates, estuarine water column, marine water column, and marine nonvegetated bottoms.

4.14.8.1 No-Action Alternative

Under the No-Action alternative, EFH would remain as described in Section 3.14.2. Impacts from current maintenance dredging include increased water column turbidity during and for a short time after dredging activities and burial of benthic organisms. No long-term effects are expected.

4.14.8.2 Proposed Alternative

An increase in turbidity would temporarily and locally impact EFH species during project construction and maintenance dredging. Teeter et al. (2003) found that the area of high turbidity extended roughly to the edge of the fluid mud flow, or about 1,300 to 1,650 ft from the discharge pipe. Modeling of dredged material discharge in the Laguna Madre determined that turbidity caused by dredging only lasts on the order of weeks to a few months, and therefore impacts to the estuarine and offshore water column would be minimal (Teeter et al., 2003). These impacts would be minimal since these species are motile enough to avoid areas of high turbidity. Material to be dredged is not contaminated and should not pose contamination issues with respect to EFH. Accidental spills have the potential to impact EFH, and larval and juvenile finfish could be affected significantly should a spill occur. Larval and juvenile finfish tend to be more susceptible to spills than adults and could be affected extensively by a spill during their active immigration periods. Due to their lack of mobility, they are less likely to be able to avoid these areas and could be negatively impacted if a spill were to occur; however, there would be no increase in the likelihood of oil spill chances with the Proposed alternative (refer to Section 4.14.2.2 for a more-detailed discussion).

Initial placement of dredged material would cover benthic organisms resulting in a loss of food source. Recovery of some benthic organisms would likely occur relatively quickly, although the assemblage in the dredged material might differ from the assemblage that existed at the PA prior to construction. Sheridan (1999) found that recovery of the benthic community would continue for at least 18 months for some parameters and beyond 3 years for others.

All of the EFH species utilize estuarine habitat during some portion of their life for spawning, food, development, and/or protection (GMFMC, 2004). The Proposed alternative would enhance habitat for EFH present throughout the Matagorda Bay system and offshore by the creation of marsh habitat, oyster reefs, and protection of marshes and seagrass beds in Matagorda and Lavaca bays. Protection and creation of marshes and seagrass beds would increase the amount of nursery areas, protective habitat, and food sources within the Matagorda Bay system. While bay bottom habitat would be lost, the creation of marshes offsets the effects of bay bottom habitat loss since marshes provide essential habitat for EFH species. HEA annual functional values for the Proposed alternative shows a significant positive benefit throughout the 50-year project, when compared to the No-Action alternative (see Figure 4.14-1 and Appendix J).

The DEIS would serve to initiate EFH consultation under the Magnuson-Stevens Fishery Conservation and Management Act. The NMFS would review the DEIS and provide comments to EFH impacts. The

HEA model input and analysis were conducted by the Resource Agency Working Group, which included members of the NMFS, FWS, EPA, USACE, TPWD, GLO, and TCEQ.

4.15 ENDANGERED AND THREATENED SPECIES

The following sections provide an assessment of potential impacts to listed species. A formal Biological Assessment (BA) has been prepared for the project to fulfill USACE requirements as outlined in Section 7(c) of the Endangered Species Act of 1973 as amended (Appendix N). The BA will be reviewed by FWS and NMFS to render a Biological Opinion (BO) and to ensure that all potential project impacts have been discussed and coordinated with the appropriate parties during various workgroup meetings.

4.15.1 No-Action Alternative

The No-Action alternative would result in no immediate direct impacts to the threatened and endangered wildlife species or designated critical habitats at or near the proposed project area.

4.15.2 Proposed Alternative

4.15.2.1 Terrestrial Species

Terrestrial reptiles such as the Texas tortoise, Texas horned lizard, timber rattlesnake, Texas scarletsnake, and smooth greensnake are known to occur in Matagorda and Calhoun counties but are not likely to utilize the upland habitats affected by the placement of fill materials. No effect is anticipated for these species by dredging activities.

The brown pelican is a common resident in the Matagorda/Lavaca bay system and is likely to occur in the project area. Nesting colonies are known to occur in Lavaca Bay Spoil Island 63-77 (code 609–121) and Sundown Island (code 609–300), approximately 3 miles south-southeast of Sand Point. These two spoil islands were first documented in 1973. According to NDD records, however, one of the islands eroded away in 1978. Dredging activities in the area could have some minor, indirect impacts on these species and their nesting activities. Noise during construction may also have an indirect impact on the rookeries. No impacts to nesting brown pelicans as a result of this project are anticipated. Any nonnesting pelicans occurring in the general area could be impacted indirectly. Dredging activities may cause temporary impacts to aquatic communities and habitats, including increased sedimentation and turbidity, which in turn may indirectly impact coastal birds in the area by potentially reducing the availability of the food supply. The increased possibility of accidental spills of petroleum products, chemicals, or other hazardous materials during dredging activities also poses a potential, although small, threat to the aquatic community and, thus, the food source of these individuals. Noise and human activities would likely cause this species to move elsewhere. The increased potential for spills during construction and temporary dredging impacts and noise are not likely to adversely affect brown pelicans.

Piping plovers, a federally endangered, and federal and state listed threatened species are potential winter residents (November–March), and spring and fall migrants in the project area. According to NDD records, piping plovers are known to occur in the project area. Critical habitats occur in the vicinity of the project area in Texas Units 19 through 27. Minor changes in salinity and tidal amplitude as a result of the Proposed alternative are expected to have no impact on the piping plover. The primary constituent elements (PCEs) for the piping plover wintering habitat are those components that are essential for the primary biological needs of foraging, sheltering, and roosting, and only those areas containing these PCEs within the designated boundaries are considered critical habitat. The PCEs are found in coastal areas that support intertidal beaches and flats (between annual low and high tide) and associated dune systems and flats above annual high tide (FR, 2001). No placement of dredged material will occur within areas of designated critical habitat or in areas that include PCEs for this species. If placement of suitable quality dredged material occurs within designated critical habitat or areas with PCEs, then it will be done in accordance to protocol set by FWS. The designated critical habitat for the piping plover would not be directly affected by construction or dredging activities. Any indirect impacts that may occur (e.g., disturbances related to noise) are expected to be minimal. The piping plover has been recorded at several places in the vicinity of the project area according to NDD records. The minor changes in salinity and tidal amplitude as a result of the project are not likely to adversely affect piping plovers.

Critical habitat units for the piping plover that would be affected by the widening of the channel include TX-19, 22, 23, and 24. TX-19 occurs on Matagorda Island Beach (976 ac) in Calhoun County. This stretch of beach occurs along the Gulf side for 36 miles from Cedar Bayou to Pass Cavallo on the northeast. These lands are infrequently inundated by seasonal winds and fall entirely within the boundaries of Matagorda Island National Wildlife Refuge (FR, 2001). TX-22 occurs on Decros Point (1,114 ac) at the Matagorda/Calhoun County line. This unit includes about 4.3 miles of beach habitat around the island at the western tip of Matagorda Peninsula between the natural opening to Matagorda Bay and the MSC. This area is a wind tidal flat that is infrequently inundated by seasonal winds (FR, 2001). TX-23 is a 769-ac shoreline along West Matagorda Peninsula in Matagorda County. This unit extends 24 miles along the Gulf from the jetties at the MSC to the old Colorado River channel. This area is also known as a wind tidal flat and is infrequently flooded by seasonal winds (FR, 2001). TX-24 is a 1,868-ac tract on West Matagorda Bay/Western Peninsula Flats in Matagorda County. This unit extends along the bayside of Matagorda Peninsula southwest of Greens Bayou to 1.6 miles north of Greens Bayou. This unit is also considered a wind tidal flat that is infrequently inundated by seasonal winds (FR, 2001). Placement of dredged materials (i.e., gulf shoreline nourishment) will not adversely affect piping plovers or designated critical habitat for the piping plover. Placement of material in non-designated habitat should result in positive affects on the piping plover by increasing the extent of suitable habitat in the project area. It is unlikely that a tidal amplitude change of 0.2 inch will be enough to impact piping plover habitat in TX-19 through TX-27.

Attwater's greater prairie-chicken is not known to occur in the project area as per data obtained from TPWD, therefore, impacts to this species are not anticipated. Records for this species occur inland from the project area and do not occur in the study area. The current distribution of this species includes only

Galveston and Colorado counties (Lockwood and Freeman, 2004). Other federal and state listed species such as arctic peregrine falcon, bald eagle, whooping crane, sooty tern, white-tailed hawk, and wood stork could occur in the project vicinity. These species are not likely to be adversely effected by project activities. According to NDD records, the whooping crane has been recorded from Aransas County in St. Charles Bay (Aransas Wildlife Refuge, Matagorda Island, and nearby wetlands). Also, one documented occurrence of a single whooping crane was recorded on marsh area between Keller Bay and Matagorda Bay approximately 11 air miles east of Port Lavaca and 3 air miles south of Olivia. Critical Habitat for the whooping crane has been documented adjacent to the project area to the southwest, but no critical habitat will be affected by this project. Eskimo curlew are absent from the project area, and therefore no effect from the proposed work is expected.

There are several known nesting colonies of the white-faced ibis, a state-threatened species, within the proposed project area. The state-threatened reddish egret has also been recorded from rookeries located within the project area (NDD, 2006b). The state-threatened reddish egret's and white-faced ibis nesting colonies are known to occur in the project area 4 miles due east of Port O'Connor on a dredged material island. Both species have also been recorded on a series of four dredged material islands within the intracoastal waterway, 1 mile north-northeast to east of Magnolia Beach. NDD records further indicate three spoil islands in the intracoastal waterways off Gallinipper Reef consisting of unvegetated shell, grasses, and sub-shrubs have documented records of the white-faced ibis and reddish egret. Given the specific location of these rookeries from the proposed project, the noise and human activity associated with dredging and construction activities is unlikely to impact them, even if the project actions occurred during the nesting season. No effects to these two species as a result of the project are anticipated, although the increased possibility of spills during construction poses a potential, although minor, threat to the nekton community, and thus the food source of the white-faced ibis and reddish egret. Therefore, there are no significant adverse impacts to the species expected as a result of project construction and maintenance. The preferred foraging habitat of the reddish egret is brackish waters in bay margins, lagoons, and tidal inlets. These areas allow the bird to exploit the time between tides when prey may be trapped in shallow water.

Terrestrial mammals potentially occurring in the project area or its vicinity are the ocelot, Gulf Coast jaguarondi, red wolf, Louisiana black bear, American black bear, and southern yellow bat. The project is not expected to have any noticeable impacts on terrestrial animals. According to NDD records, these mammalian species have no known records of occurrence in the project area, and therefore the proposal work will not likely adversely affect these species.

4.15.2.2 Sea Turtles

4.15.2.2.1 No-Action Alternative

Sea turtles may be present in the study area during certain times of the year. Thus, construction and post-construction maintenance activities could result in impacts to sea turtles, should they be present in the study area. Five species of sea turtle occur in Texas waters: Kemp's ridley sea turtle, hawksbill sea turtle,

leatherback sea turtle, loggerhead sea turtle, and green sea turtle. Kemps' ridley and the loggerhead are the two most common species in Texas waters. All sea turtle species except the leatherback have nested on Texas beaches, with the vast majority of nests belonging to Kemp's ridley (NMFS, 2006c; Shaver, 2006; NPS, 2007). Three species have been recorded from the study area: Kemp's ridley, loggerhead, and green turtle. Seven Kemp's ridleys and four green turtles were captured during netting operations conducted by TAMUG at Magnolia Beach from May to November 1996 (Williams and Renaud, 1998). A Kemp's ridley nested on Matagorda Peninsula in 2002 (Yeargan, 2006), and four Kemp's ridleys nested on Matagorda Island in 2006 (NPS, 2007). Since October 1996, three loggerheads, two Kemp's ridleys, and one green turtle, have been taken during maintenance dredging of the entrance channel of the MSC (USACE, 2007). The No-Action alternative would result in no immediate direct impacts to sea turtles or their habitat from the proposed project. Periodic maintenance dredging would continue with its inherent potential to directly impact sea turtles and their habitat.

4.15.2.2.2 Proposed Alternative

Dredging and Placement Activities: The proposed project calls for the use of both pipeline dredges and hopper dredges. It has been well documented that hopper dredging activities occasionally result in sea turtle entrainment and death, even with seasonal dredging windows, v-shaped turtle-deflector dragheads, and concurrent relocation trawling (NMFS, 2003). Between February 1995 and November 2006, hopper dredging activities within the USACE Galveston district resulted in 60 lethal takes of sea turtles: 26 loggerheads, 21 green turtles, and 13 Kemp's ridleys (USACE, 2007). Thirteen of these (11 green turtles and 2 Kemp's ridleys) were taken during the winter months (December through February), while 45 were taken between March and November; the dates of 2 green turtle takes are unknown (USACE, 2007). Kemp's ridley tends to move offshore in December when cooler waters occur, returning with warmer waters in March (NMFS, 2003). Green turtles may be found year-round in inshore waters, although in lesser numbers during the winter months, and are known to move into warm waters during the winter months (Shaver, 2000b). Two green turtles captured at Magnolia Beach and tracked using satellite telemetry moved 112 miles (180 km) south into south Texas offshore waters during the winter (Williams and Renaud, 1998). Sea turtles easily avoid pipeline dredges due to the slow movement of the dredge. Apart from direct mortality, dredging activities could have an impact on sea turtles through an increase in sedimentation, turbidity, and resuspension of toxic sediments.

The sedimentation may affect food sources for the turtles, and the turbidity could affect primary productivity. However, this would be short-term. The increased possibility of chemical or oil spills could pose a threat to turtles both directly and indirectly through their food source. While adult sea turtles may be mobile enough to avoid areas of high oil or chemical concentrations, hatchlings, post-hatchlings, and juveniles in the area would be more susceptible. An increase in marine traffic may result in a higher incidence of collision with sea turtles. Other potential impacts as a result of the project include disorientation because of lighting on vessels, increased accumulation of plastic detritus, and beach nourishment activities.

PAs would result in the direct loss of approximately 3,087 ac (1,249 hectares) of bay bottom over the course of the project. This bay bottom may be foraging or resting habitat for sea turtles. If sea turtles are present at disposal sites, they may be affected by sedimentation and turbidity. They could also be exposed to trash and debris; however, turtles should be easily able to overcome a descending plume and available food sources should not be seriously reduced. As noted elsewhere in this document, the project is not expected to impact seagrasses. Thus, no impacts on foraging green turtles are anticipated.

One potential benefit to sea turtles from the project is that several areas are planned for beach nourishment. Kemps' ridley has nested in the study area and may be attracted to the beach nourishment areas. It is possible, however, that the material used for the beach nourishment projects may not be conducive to sea turtle nesting. These areas are at least 16 miles from the MSC entrance channel. Furthermore, Kemp's ridley nests in the daytime and crowded beaches may discourage this species from nesting.

Potential Species Impacts: A Kemp's ridley nested on Matagorda Peninsula in 2002 (Yeargan, 2006), and four Kemp's ridleys nested on Matagorda Island in 2006 (NPS, 2007). Because Kemps' ridley nests during daylight hours, no disorientation for adults from boat lighting would occur. Hatchlings, however, emerge from the nest at night and may be adversely affected by lighting on the boats. Under natural conditions, hatchlings typically take the shortest route to the water's edge. Bright lights on a nearshore hopper dredge may cause the hatchlings to move toward the lights, resulting in a more circuitous route to the water or open ocean, thereby exposing them to more danger. Although the loggerhead and green turtle have not been recorded nesting in the study area, these two species have been reported from the study area (USACE, 2007). The hawksbill and leatherback are extremely unlikely to nest in the study area. While nesting in the study area is uncommon, hopping dredging outside of the nesting/emergence season (which occurs between April 1 and September 30), turning off/lowering/shielding unessential lighting, and use of shielded, low-sodium vapor lights for those that cannot be safely eliminated, would reduce this potential disorientation impact. The proposed project may affect, is not likely to adversely affect nesting of the Kemp's ridley sea turtle, loggerhead sea turtle, green sea turtle, and hawksbill sea turtle. The proposed project will have no effect on the nesting of the leatherback sea turtle.

As noted above, hopper dredging may result in mortality of individual Kemps' ridleys. Since October 1996, two Kemp's ridleys have been taken during maintenance dredging of the MSC (USACE, 2007). This species is seasonal in nearshore waters of Texas. During the onset of colder waters in December, Kemp's ridley will move away from inshore waters into deeper waters, returning in March with warmer waters, ready to nest on the Texas coast and to forage in tidal passes and bays (NMFS, 2003). Restriction of hopper dredging activities to between December 1 and March 31, whenever possible, would reduce the likelihood of direct mortality. Hopper dredging impacts on sea turtles will be minimized by following the reasonable and prudent measures included in the Biological Opinion being prepared by the NMFS for construction and the most recent Biological Opinion for mitigation dredging in the Gulf of Mexico. No significant impact to Kemp's ridley as a result of the project is anticipated.

Since October 1996, three loggerhead sea turtles and one green sea turtle have been taken during maintenance dredging of the MSC (USACE, 2007). As with the Kemp's ridley sea turtle, these two species could be negatively impacted by dredging activities. The green turtle is known to move into warmer waters during the winter (Shaver, 2000b). Two green turtles captured at Magnolia Beach in the study area and tracked using satellite telemetry moved 112 miles (180 km) south into south Texas offshore waters during the winter (Williams and Renaud, 1998). Working within similar windows to Kemp's ridley and having relocation trawlers working ahead of the dredges, if required, would help to reduce these impacts. The proposed hopper dredging activity is likely to adversely affect both the loggerhead sea turtle and the green sea turtle.

The hawksbill sea turtle has not been recorded from the study area and no hawksbills have been taken during hopper dredging activities in Texas (USACE, 2007). Nevertheless, the proposed hopper dredging activity can be considered as likely to adversely affect the hawksbill sea turtle.

Of the five species of sea turtles occurring in Texas waters, the leather back is the species least likely to be affected by the proposed project because of its rare occurrence and pelagic nature. It is unlikely to occur in the action area and has not been caught in hopper dredges. The proposed hopper dredging activity may affect, is not likely to adversely affect the leatherback sea turtle.

In summary, for nesting sea turtles (Kemp's ridley, loggerhead, green, and hawksbill) the conclusion is "may affect, is not likely to adversely affect." For nesting leatherback sea turtles the conclusion is "no effect." For hopper dredging activities, the conclusion for the Kemp's ridley, loggerhead, green, and hawksbill sea turtles is "is likely to adversely affect," while the conclusion for the leatherback sea turtle is "may affect, is not likely to adversely affect."

4.15.2.3 Aquatic Species

Under the No-Action alternative, endangered and threatened fish species would remain as described in Section 3.14.2.4.

No endangered or threatened fish species are located in the vicinity of the project area and therefore no impacts are expected.

The West Indian manatee is extremely rare in Texas and to date has not been seen in the project area. Potential impacts to the manatee of the proposed work would be indirect and minor. Should a manatee wander into the project area, the greatest threats to it would be from boat traffic or dredging operations. However, due to its rare occurrence, the project is not expected to have any significant impact on this species. Whales occur in offshore waters and similarly would not be impacted by the proposed project.

No endangered or threatened aquatic mammal species are located in the vicinity of the project area, and therefore no impacts are expected.

4.15.2.4 Vegetation

As noted in Section 3.15.1, there are no Federally or State-listed threatened or endangered plant species in the study area. Thus, no impacts to such species are expected.

4.16 CULTURAL RESOURCES

Activities associated with any proposed project have the potential to adversely impact cultural resources through changes in the quality of the archeological, historical, or cultural characteristics that qualify a property to meet the criteria of eligibility to the NRHP. These impacts occur when an undertaking alters the integrity of location, design, setting, materials, construction, or association that contributes to a resource's significance in accordance with the National Register criteria.

As discussed in 36 CFR 800, adverse impacts on National Register-listed or eligible properties may occur under conditions that include, but are not limited to:

1. destruction or alteration of all or part of a property;
2. isolation from or alteration of the property's surrounding environment (setting); or
3. introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting.

Impacts may be direct or indirect. Direct impacts are caused by the proposed activities and generally occur concurrently. Indirect impacts include those caused by the activities that occur later in time or are further removed, but are foreseeable. Both direct and indirect impacts may include destruction of a site, alterations in the pattern of land use, changes in population density, or accelerated growth rates, all of which may have an impact on properties of historical, architectural, archeological, or cultural significance.

The preferred form of mitigation for direct or indirect impacts for cultural resources is avoidance. An alternative form of mitigation of direct impacts can be developed for archeological and historical sites with the implementation of a program of detailed data retrieval. Additionally, relocation may be possible for some historic structures. Indirect impacts on historical properties and landscapes can be lessened through careful design considerations and landscape.

4.16.1 No-Action Alternative

Under the No-Action alternative there would be no additional impacts to cultural resources. Maintenance dredging and placement activities would continue as previously described.

4.16.2 Proposed Alternative

Remote-sensing surveys, conducted by PBS&J and NCS, have been completed on approximately 12,700 ac for areas within Lavaca Bay, Matagorda Bay, and the Gulf of Mexico that could be impacted

by the MSC improvements and associated PAs. Thirty-nine potentially significant magnetometer anomalies are located within the project survey areas. Four of these anomalies, M4, M12, M35, and M41, have structural characteristics visible in the sonar images.

Recorded anomalies that are considered potentially significant will be avoided where possible. If avoidance is not possible, an additional close-order survey of each anomaly will be performed. During a close-order survey, closely-spaced survey transects are conducted over the source of the magnetometer anomalies as a means of acquiring more data. The data collected during the close-order survey can possibly eliminate anomalies from further consideration. Following the close-order survey, anomalies that are still designated as potentially significant will require additional assessment through either probing or diver investigation of each anomaly source, dependant upon water depths. A diver-conducted visual assessment and/or probing of the seabed can further eliminate anomalies that are not shipwrecks. Any anomalies that are discovered to be historic shipwrecks will require NRHP assessment conducted by diver investigation of the site.

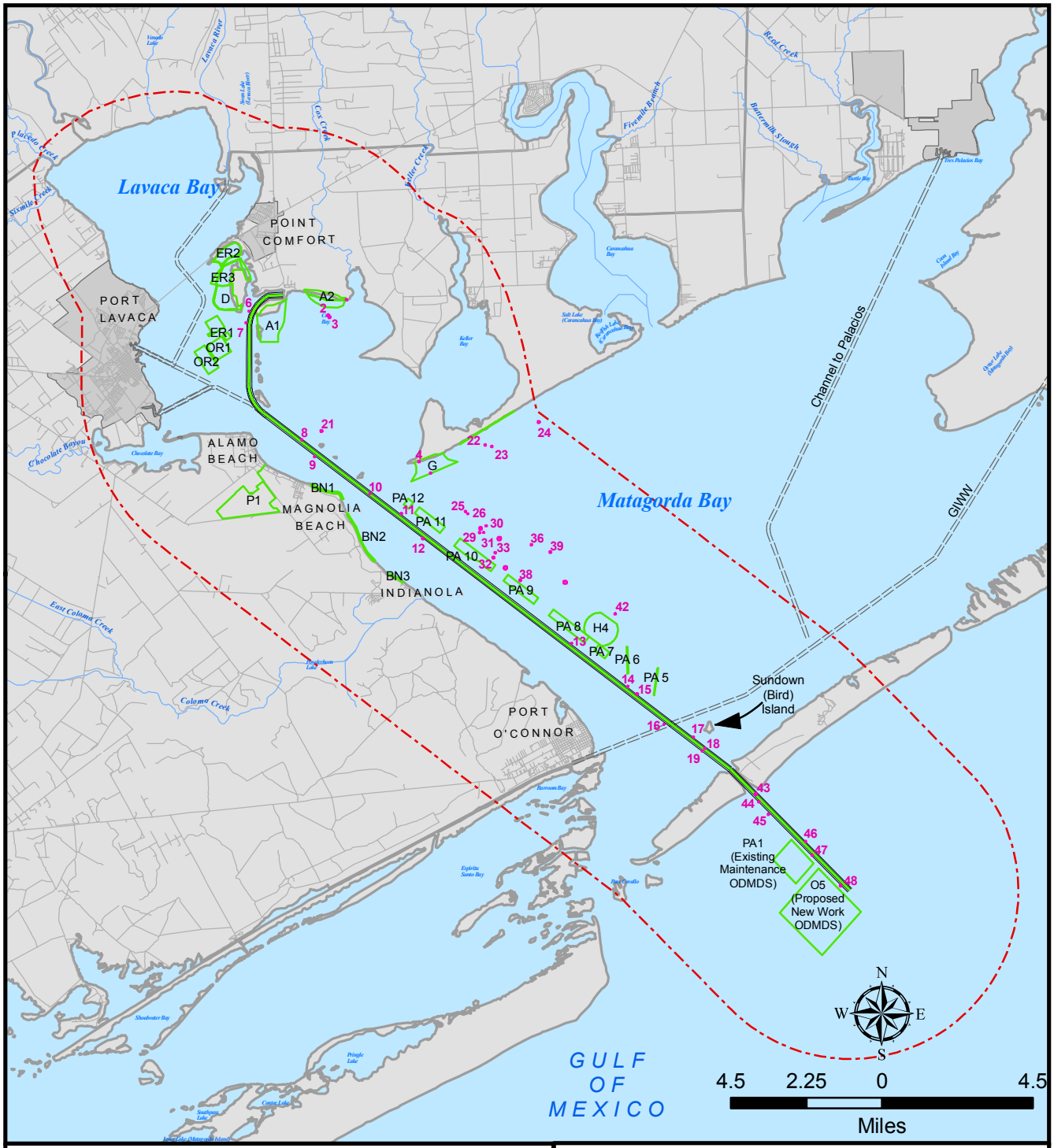
CCND is committed to complying with Section 106 of the National Historic Preservation Act, and will perform the remaining surveys and coordinate additional work, as required, with THC and USACE. Should the decision be made to issue a permit for the proposed MSCIP, it would be conditioned to require completion of historical and archeological surveys to meet Section 106 requirements. CCND will obtain clearance from THC and USACE prior to performing construction activities in these areas. The following sections and Table 4.16-1 describe the work that has been performed for channel improvements and PAs as well as additional work that is planned for the areas. CCND and USACE will continue to coordinate with THC in regards to additional work.

4.16.2.1 Navigation Channel Improvement

The remote-sensing survey conducted by PBS&J along the MSC identified 20 anomalies, 6 through 19 and 46 through 48 (Figure 4.16-1), in the channel. Anomalies 46 through 48 are in the off-shore segment of the channel. Eleven magnetometer anomalies and one associated sonar target in the MSC project area lie within 164 ft (50 m) of the proposed work area or estimated channel slope and therefore could be impacted by the proposed project. These anomalies are M6, M7, M8, M9, M10, M12 (S5), M18, M19, M46, M47, and M48. Additional close-order surveys will be performed for these anomalies.

4.16.2.2 DMMP and Mitigation Plan

The Dredged Material Management Plan (DMMP) includes 24 placement areas located onshore, in Matagorda and Lavaca Bays, and in the Gulf of Mexico. These areas would be used for the placement of both new work and maintenance material from the channel improvements. Several of the placement areas and other project features provide productive habitat, which serves as mitigation for ecological impacts from the proposed project.



LEGEND

- Proposed Ship Channel
- Navigable Waterway
- Project Area
- Project Component
- Magnetometer Anomalies
  **Anomaly 20 has been ommitted

Source:
Base map provided by URS.
Reference Coordinates:
Texas State Plane South Central U.S. Survey Feet
Horizontal Datum: NAD 83.

Location Map

PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
Phone: (512) 329-8342 Fax: (512) 327-2453

Figure 4.16-1

Matagorda Ship Channel Magnetometer Anomalies

Prepared for: CCND-MSCIP	
Job No.: 441652.00	Scale: 1:285,120
Prepared by: EMons/ AC	Date: 20061128
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Ten of the proposed placement areas have been surveyed (Table 4.16.-1). Those not surveyed include the existing in-bay dispersive PAs (5 through 12), the two ODMDSs (PA1 and O5), the three beach nourishment sites (BN1, BN2, and BN3), and the upland site (PA P1). Additionally, the area designated for construction of OR1 and OR2 has been partially surveyed. Within the areas that were surveyed, three potentially significant magnetometer anomalies and one associated sonar target are located in the footprint or within 164 ft (50 m) of the placement areas. Additional close-order surveys will be performed for anomalies M1, M4 (S1), and M5, located in or near the proposed placement areas, to determine whether they are historically significant sites. Surveys will also be conducted for each of the other new placement areas. Existing placement areas will not be surveyed. The survey activities as well as additional work are described for each placement area:

Table 4.16-1
Status of Cultural Resource Surveys

Project Feature	Remote-Sensing Surveys	Additional Field Work Required
Proposed Ship Channel Improvements	Surveys complete; eleven anomalies need further investigation	Additional close-order surveys planned
PA A1	Surveys complete; no anomalies	No additional work planned
PA A2	Surveys complete; one anomaly, plan to avoid	Limited terrestrial shoreline survey planned
PA BN1, BN2, and BN3		Archival research, terrestrial and remote-sensing surveys planned
PA D	Surveys complete; no anomalies	No additional work planned
PA ER1	Surveys complete; no anomalies	No additional work planned
PA ER2	Surveys complete; no anomalies	No additional work planned
PA ER3	Surveys complete; no anomalies	No additional work planned
G	Surveys complete; two anomalies found	Additional close-order surveys planned
G Shoreline Protection	Surveys complete; no anomalies	No additional work planned
H4 Habitat Area	Surveys complete; no anomalies	No additional work planned
O5 (New Work ODMDS)		Remote-sensing surveys planned
OR1 and OR2	Limited area has been covered by remote-sensing surveys; no anomalies	Additional remote-sensing surveys planned
PA P1		Archival research and terrestrial surveys planned
Existing PA 1 (Maintenance ODMDS)		No work planned
Existing PAs 5–12		No additional work planned

PA A1 – In-Bay Upland. There are no recorded historic properties or potentially significant remote-sensing targets located in PA A1. Therefore, it is not anticipated that the construction of this PA would have any adverse impacts on significant historic properties and no additional surveys are planned for this area.

PA A2 – Combined Upland/Marsh. This proposed PA of approximately 260 ac is located along the northern shore of Cox Bay. No recorded terrestrial archeological sites are located within the PA, although

a recorded site (41CL12, a shell midden) is located on the bluff to which the site would be adjacent. A remote-sensing survey identified one potentially significant magnetic anomaly that will be avoided. A terrestrial survey is planned for the areas where the proposed PA would tie into the bluff.

PAs BN1, BN2, and BN3 – Beach Nourishment. These proposed beach nourishment PAs are near the historic settlement of Indianola, which was badly damaged by a hurricane in 1875. A second, more devastating hurricane and an accompanying fire resulted in the abandonment of the site in 1887.

A recorded historical site (41CL39) is located on Indian Point between PAs BN1 and BN2. This site could be impacted. The area around Indianola has not been the subject of a marine survey (Figure 3.16-1), however a lack or absence of archeological investigation does not preclude this area from being a significant HPA. Historic accounts attest to an abundance of shipwrecks in the area due to the two hurricanes. Additionally, the former Indianola courthouse has been reported as being submerged of the shoreline (Wolff, 1999). Remnants of Indianola were scattered for miles. Therefore, PAs BN1, BN2, and BN3 have a high potential for association with historic elements of the Indianola townsite.

Additional archival and historic cartographic research is planned for these areas as well as terrestrial and marine surveys. Coordination with USACE and SHPO is ongoing.

PA D – In-Bay Upland. No recorded terrestrial archeological sites were found in this area. Additionally, no magnetic anomalies were recorded during the magnetometer survey. Therefore, it is not anticipated that the actions for this PA would have any adverse impacts on significant historic properties and no additional surveys are planned for this area.

PA ER1 – Submerged Enhanced Recovery Area Oyster Reef. PA ER1 is comprised of two adjacent areas located in mid-Lavaca Bay. No recorded terrestrial archeological sites were found and no potentially significant anomalies would be affected by these areas. Therefore, it is not anticipated that the actions for this PA would have any adverse impacts on significant historic properties and no additional surveys are planned for this area.

PA ER2 – Enhanced Recovery Area In-Bay Upland and Marsh. No recorded terrestrial archeological sites were found in this area. Additionally, no magnetic anomalies were recorded during the magnetometer survey. Therefore, it is not anticipated that the actions for this PA would have any adverse impacts on significant historic properties and no additional surveys are planned for this area.

PA ER3 – Enhanced Recovery Area In-Bay Upland and Marsh. No recorded archeological sites were found in this area. Additionally, no magnetic anomalies were recorded during the magnetometer survey. Therefore, it is not anticipated that the actions for this PA would have any adverse impacts on significant historic properties and no additional surveys are planned for this area.

PA G – Marsh with Sand Point & Keller Bay Protection. Two magnetic anomalies (M4 [S1] and M5), one with an associated sonar target, were identified in this area. Redesign of this PA successfully avoided

one anomaly. Additional close-order remote-sensing surveys will be performed on this area to determine the nature of the anomaly that could still be impacted.

PA H4 – Habitat Site Including Marsh, Sand Platform, and Bird Island. No recorded archeological sites were found in this PA. Additionally no magnetic anomalies were recorded during the magnetometer survey. Therefore, it is not anticipated that construction of this PA would have any adverse impacts on significant historic properties and no additional surveys are planned for this area.

PA O5 – New ODMDS. PA O5 is an unconfined placement area located in the Gulf of Mexico and covers approximately 1,600 ac. No remote sensing survey has been conducted in this area; however, surveys are planned.

PA OR1 and OR2 – Clay Core Oyster Reefs. Proposed PAs OR1 and OR2 will be used to create a base on which an oyster reef can develop. These two areas are located in Lavaca Bay to the southwest of Dredge Island and are in open water. Thus, no terrestrial archeological sites will be impacted by work in these PAs. A limited remote-sensing survey has been conducted for these two areas. The remaining area will be surveyed.

PA P1 – Terrestrial Upland. No terrestrial archeological sites are recorded in proposed PA footprint. However, additional archival and historic cartographic research is planned for this area as well as terrestrial surveys of a potential historic trail located within the site. No recorded terrestrial archeological sites were identified within the propose dredge pipeline corridor/drainage ditch corridor associated with PA P1. Terrestrial surveys will be conducted along the route.

Existing Unconfined Open-Water Placement Areas 5, 6, 7, 8, 9, 10, 11, and 12. These areas are existing PAs used for current maintenance dredging of the MSC. No recorded archeological sites are located in these PAs. Marine remote-sensing surveys were not conducted in these existing PAs.

The DMMP proposes to continue to use these areas in their current configuration. It is not anticipated that continued use of these PAs would have any additional adverse impacts on significant historic properties. Thus, no additional surveys are planned for this area.

PA1 – Existing ODMDS. PA1 is an unconfined PA in the Gulf of Mexico which contains no recorded cultural resource properties. The DMMP proposes to continue to use this area in its current configuration. Therefore, it is not anticipated that this action would have any adverse impacts on significant historic properties and no additional surveys are planned for this area.

4.16.3 Conclusion

The proposed project has the potential to adversely affect historic properties. The CCND, in consultation with the USACE, will coordinate subsequent investigations with the THC to conduct surveys of impact areas, test potentially eligible sites, and manage data recovery or avoidance measures as necessary.

Additional investigations are anticipated at this time, including marine and terrestrial surveys of areas that would be affected by the construction of channel features, DMMP features, and ecological mitigation areas.

Two placement areas have been redesigned to avoid identified anomalies. Additional marine investigations to be completed include remote-sensing surveys of PAs OR1, OR2, BN1, BN2, BN3, and O5. Close-order remote-sensing surveys are anticipated for the anomalies that may be affected by the proposed improvements at PA G and along the existing channel. Based on the results of the close-order remote-sensing survey, additional investigations may be needed. Archival research and terrestrial surveys are planned for PAs P1, A2, and BN1, BN2, and BN3.

4.17 LAND USE/RECREATION/AESTHETICS

4.17.1 No-Action Alternative

Under the No-Action alternative, the Matagorda Bay, Lavaca Bay, Cox Bay, and Keller Bay coastline area would continue on its present course of moderate population growth, and of fairly rapid commercial, residential, and industrial land development. The Port would continue to function as a leader in industrial facilities and international commerce in the study area. The Port would also continue to develop its industrial properties but at a slower rate than it would with the Proposed alternative. Without the channel widening and deepening, increased transportation costs and operational inefficiencies related to large vessels would continue. As a result, future growth at the Port would likely be slower and much less than if the MSC were improved.

4.17.2 Proposed Alternative

4.17.2.1 Land Use

The Proposed alternative would not affect any shoreline land uses; therefore, it would have a minimal impact on land use. All proposed channel improvements occur in open-water locations. The only land use implications for the Proposed alternative relate to proposed beneficial use sites, an upland PA, and indirect future land development that may occur as a result of the proposed project.

Approximately 1.1 mcy of new work and 55.0 mcy of future maintenance material would be placed in PA P1. This PA is about 700 ac located south of Alamo Beach, which is currently used for agricultural purposes. Placement of dredged material at this site would change the use of this land from growing rice to a PA.

The greatest long-term land use consequence of the Proposed alternative would likely be a change in future land uses that would occur in response to the improvements to the channel. These future land uses are not considered part of the proposed project but would be less likely to occur without it. The Port currently owns property along the MSC that is available for development for industrial sites. When the

Proposed alternative is completed, the Port would have a wider and deeper ship channel providing a large incentive for new industrial development at all of the Port properties, based on navigation cost savings. Future industrial development may include oil and gas refineries, petrochemical plants, and bulk grain facilities. The long-term land use effects of these industrial facilities are largely unknown; however, they would likely lead to a substantial increase in demand for new housing development, new roads, commercial services, schools, and other services within Calhoun, Jackson, Matagorda, and Victoria counties.

4.17.2.2 Recreation

The Proposed alternative would have a minimal effect on recreation within the study area. The proposed dredged material PAs are expected to have a beneficial impact to recreational activities such as fishing and bird watching in the area by providing additional habitat. Fishing and wildlife habitat in Keller Bay would be protected by PA G. Additionally, about 1.9 mcy of new work material would be placed in PAs BN1, BN2, and BN3. These PAs are located along the public beaches of Magnolia-Indianola shoreline. Placement of dredged material in this location would extend the existing beaches out by 150 to 355 ft, depending on the composition of the dredged material, thus enhancing and extending the life of these public beaches for recreational use.

4.17.2.3 Aesthetics

The Proposed alternative would have a minimal effect on the overall visual quality within the study area. There would be no negative effect to the appearance of the shorelines that are adjacent to the proposed channel improvements. The study area includes a variety of land uses, including shoreline residential development, commercial development, public and private marinas, parkland, relatively undisturbed natural areas, fishing and tourism related businesses, civic uses, transportation systems (highways and railways), port facilities, and heavy industry areas. The only aspects of the Proposed alternative that would affect the visual quality of the study area would be some of the PAs (see Section 2.4.2). These include PA A1 – In-Bay Upland, PA A2 – Combined Upland/Marsh, PAs BN1, BN2, and BN3 – Beach Nourishment, PA D – In-Bay Upland, PA ER2 – Enhanced Recovery Area, PA ER3 – Enhanced Recovery Area, PA G – In-Bay Marsh and Sand Point Marsh and Keller Bay Protection, and PA P – Terrestrial Upland.

PA A1 – This in-bay upland area would be a 530-ac, semirectangular site located south of the Port of Port Lavaca-Point Comfort facilities. The area is planned to have an initial elevation of 15 ft above MLT and ultimately reaching 30 ft above MLT and would be visible from the Port facilities, which consists of industrial land uses. No negative impact to the visual quality of the area is expected because the new upland would be adjacent to existing uplands.

PA A2 – This combined upland/marsh area would be a 260-ac rectangular site located along the northern shore of Cox Bay, which is an eroding clay bluff. The area is planned to have an elevation of 15 ft above MLT and ultimately reaching 30 ft above MLT including both uplands and marsh in the open bay

adjacent to the bluff and would be visible from shorelines along Point Comfort and Cox Bay. No negative impact to the visual quality of the area is expected because the new feature is adjacent to existing uplands and consistent with the bay setting.

PAs BN1, BN2, and BN3 – Beach nourishment areas would be located along the public beaches of the Magnolia-Indianola shoreline and may be built out between 150 to 300 ft with an elevation of 4 ft above MLT. Confining structures comprising stone or comparable system would be used at the end of the fills near the LaSalle monument to the south and at the public boat ramp to the north. Additional structures would be provided and visible from the Crabbing Bridge and at Indian Point. Turbidity would increase in the area during beach placement and for a brief period after placement. However, any negative impact to the visual quality of the area would be more than offset by long-term beach improvements.

PA D – This in-bay upland area would be a 275-ac site located adjacent to the southwest side of the existing "Dredge Island." The area is planned to be an upland site and portions of the PA are on land with the majority of it located in open water. The area would be visible from Dredge Island and the Causeway for approximately 3,000 ft. No negative impact to the visual quality of the area is expected because it is adjacent to existing upland and is consistent with the existing viewscape.

PA ER2 – This enhanced recovery area would be a 178-ac, confined PA located in shallow water along SH 35. The majority of the placement would have an elevation of 15 ft above MLT, ultimately reaching 30 ft above MLT with most of it visible from SH 35. Some negative impact to the visual quality of the area is expected because the upland PA would be replacing about 3.4 ac of marsh and because of the proximity of this site to SH 35. However, the site is adjacent to existing upland and would be consistent with other features in the viewscape.

PA ER3 – This enhanced recovery area would be a 253-ac, confined PA that wraps around the north end of Dredge Island in Lavaca Bay. The area is planned to have an elevation of 15 ft above MLT, ultimately reaching 30 ft above MLT with only portions visible from Dredge Island, Point Comfort shoreline, and the Causeway. No negative impact to the visual quality of the area is expected because the new feature would be consistent with the existing viewscape.

PA G – This in-bay marsh and Sand Point Marsh and Keller Bay Protection area would be a 320-ac marsh and 12-ac shoreline protection levee located 300 ft offshore of Sand Point Marsh with an elevation of 6 ft above MLT. The majority of the PA would be located in open water with portions visible from Sand Point Marsh and shorelines along southeast Keller Bay and west Matagorda Bay. No negative impact to the visual quality of the area is expected because the feature would be consistent with other features of the existing viewscape.

PA P – This terrestrial upland area would be a 700-ac site located adjacent to the south of Alamo Beach with an elevation of 15 ft above MLT and ultimately reaching 30 ft above MLT. The area would be visible from Alamo Beach and Magnolia Beach. Some negative impact to the visual quality of the area is expected.

4.18 SOCIOECONOMICS RESOURCES

4.18.1 No-Action Alternative

Under the No-Action alternative, the study area would continue on its present course of economic development, population growth trends, and residential and industrial development patterns. The demand for community facilities, services, and housing would increase in response to the projected population growth. The locations of these resources would generally follow development and land use plans identified by surrounding cities and Calhoun, Jackson, Matagorda, and Victoria counties. Because no property is likely to be removed from the tax rolls, the tax base would not be affected. The No-Action alternative could possibly have a negative effect on the local economy within the study area and within Calhoun County. Transportation costs and operational inefficiencies with the existing MSC could possibly change industry trends, thereby changing the number of employed persons. The proposed LNG regasification terminal and modifications to the existing Joslin Unit would generate additional vessel transits on the MSC, which could exacerbate inefficiencies. Employment with local firms providing support services to the seaport (direct jobs) are dependent upon seaport activity and would suffer immediate dislocation if the seaport activity were to cease (Martin Associates, 2005).

4.18.2 Proposed Alternative

4.18.2.1 Population and Social Characteristics (Demographics)

The Proposed alternative would likely have a negligible effect on population growth trends within the study area. Population in this area is projected to grow at a moderate rate regardless of the proposed project. As a result of the Proposed alternative, demand for community facilities, services, and housing would increase at a rate that is consistent with the projected population growth. The location of these resources would generally follow development and land use plans currently identified. Most of the construction workers are likely to come from the labor force that is already living within Calhoun, Jackson, Matagorda, and Victoria counties; therefore, immigration to the study area would be small. As noted in Section 3.18.4, over 30% of housing within the study area is vacant. Thus it is unlikely there would be an increase in single-family home construction. However, were such development to occur in the study area, it would likely be within and near the cities of Point Comfort, Port Lavaca, and Victoria where vacant land is available for such development and is located near such available industrial sites. This slight increase in new residents within the study area would also potentially increase the demand for commercial development, schools, roads, and other services. This alternative would not result in negative impacts.

4.18.2.2 Environmental Justice

The population living within the study area is primarily comprised of White persons (57.2%), followed by Hispanic or Latino persons (35.1%), and Black or African American persons (3.8%). Therefore, the proposed project would not be located within a minority area. However, it should be noted that within the

study area census tract 9902 in Calhoun County has a Hispanic population of 61%, the City of Port Lavaca and the City of Palacios have Hispanic populations of 52.1% and 51.2%, respectively, and CT 17 in Victoria County has a Hispanic population of 55.6% and so would be considered minority areas.

The median household income for the study area census tracts was $30,010, which is above the Department of Health and Human Services (DHHS) poverty guideline of $20,000 for a family of four (DHHS, 2006). The percent of persons living below poverty for the study area was 16.6%, which is higher than the State of Texas (15.4%) but is not more than 10% higher than the percent living below poverty for the counties of Calhoun (16.4%), Jackson (14.7%), Matagorda (18.5%), and Victoria (12.9%); therefore, the study area is not considered a low-income area.

The minority and low-income populations living within the study area would likely experience no adverse changes to the demographic, economic, or community cohesion characteristics within their respective neighborhoods as a result of the proposed project. Generally speaking, the populations living within the study area would likely benefit from the proposed project through increased economic vitality as a result of increased efficiency at the Port. Therefore, the Proposed alternative would not result in disproportionately high and adverse impacts on minority and low-income persons living within the study area.

4.18.2.3 Community Values

The Proposed alternative would neither divide nor isolate any particular neighborhood nor separate residents from community facilities. It would likely have a negligible effect on population growth trends within the study area and residential, commercial, and industrial development would likely continue at the same rate. Population in this area is projected to grow at a moderate rate, regardless of the proposed project and demand for community facilities, services, and housing would increase at a rate that is consistent with the projected population growth. The location of these resources would generally follow development and land use plans identified by local jurisdictions. Therefore, the proposed project would not result in a negative impact to community values.

4.18.2.4 Housing

The Proposed alternative is not expected to result in a substantial increase in population within the study area. As previously discussed in Section 3.18.4, within the study area census tracts, over 30% of total housing is vacant, resulting in an adequate amount of available housing for any potential new residents. Therefore, the proposed project would not have a negative impact on housing.

4.18.2.5 Economic Characteristics of Area Population

With the Proposed alternative, as with the No-Action alternative, the study area will continue to have large industrial facilities such as Alcoa, the Carbon/Graphite Group, Union Carbide, and BP Chemicals as

well as other similar industry operation support companies. The Proposed alternative would not result in negative impacts to the local economy.

4.18.2.6 Leading Economic Sectors

Within the study area, the economic effects accruing from the Proposed alternative would contribute to the current development trends that have historically affected the regional economy. During project construction, Calhoun County would have a small increase in construction employment and local purchases of construction materials. As construction dollars are spent locally, there would be a beneficial effect on local economic output, income, and employment in the area.

4.18.2.7 Labor Force and Employment

The increase in jobs, economic output, and the tax base would be fairly moderate and consistent with historical growth trends. The Port and its associated industries and international commerce currently serve an important role for the study area economy. These industries provide jobs, income, and a tax base for the area, and the effects reverberate within other industries such as housing, retail services, and wholesale trade. The Proposed alternative would likely promote the development of industrial sites along the MSC and in Calhoun County, near the cities of Point Comfort, Port Lavaca, Port O'Connor, Alamo Beach, Indianola, and Magnolia Beach. Larger ships would be able to navigate the channel and would no longer need to be light-loaded, providing cost savings for commercial vessels. In short, the Port would become a more attractive location for companies involved in industry and international commerce to conduct their business. This goal would be consistent with a steady historical trend towards increased reliance on these industries and these types of development within the region.

As previously discussed, the primary economic bases of the study area include petrochemical processing, construction, mineral extraction, tourism, commercial fishing and agriculture. As a result of the proposed project, the positive economic effects to the study area economy would be moderate at the least and substantial at best.

4.18.2.8 Personal Income

Within the study area census tracts, CT 9902 in Calhoun County had the lowest per capita income ($12,416) and CT 16.03 in Victoria County had the highest ($26,551). CT 9902 is located within Port Lavaca and would potentially benefit from an increase in employment opportunities and potentially higher wages as a result of the Proposed alternative.

4.18.2.9 Tourism

Matagorda Bay, Lavaca Bay, Cox Bay, and Keller Bay are widely used by recreational fishermen and boaters year round. Turbidity associated with dredging and placement is expected to temporarily impact local fisheries in small portions of the general study area and a small portion of the bay bottom would be permanently lost. However, there should be no long-term detrimental impact to recreational fishing and

the creation of oyster reef and marsh area should improve fishing in those areas (see Section 4.14). Enhanced recovery of the higher mercury sediment areas should reduce the risk of mercury ingestion by aquatic organisms. Beach nourishment should provide a more attractive area to tourists. Overall, channel improvements associated with the Proposed alternative can be expected to result in increased tourism in the study area.

4.18.2.10 Oil and Gas Production

Because there is little to no refining capacity in the study area, no change in oil and gas production is anticipated as a result of the Proposed alternative.

4.18.2.11 Public Finance

No impacts to public finance are anticipated from the Proposed alternative.

4.19 COMMUNITY INFRASTRUCTURE AND MUNICIPAL SERVICES

4.19.1 No-Action Alternative

Under the No-Action alternative, the study area would continue on its present course of economic development, population growth trends, residential and industrial development patterns. The demand for community facilities and services would increase in response to the projected population growth, as described in Section 3.18.1.

4.19.2 Proposed Alternative

4.19.2.1 Utilities

The Proposed alternative would not affect the delivery of local services, including water, wastewater, or other utilities. Therefore, the Proposed alternative would not result in impacts on utilities within the study area.

4.19.2.2 Public Safety and Health Services

The Proposed alternative would result in minor temporary or no impacts to local community facilities and services such as police, fire, medical, and waste disposal services. Local communities have adequate infrastructure and community services to meet the needs of the nonlocal workers that would be required for the Proposed alternative. Other construction-related demands on community services could include an increase in police enforcement and emergency medical services to treat injuries resulting from construction activities.

The Proposed alternative would provide relief of safety concerns for ships traveling through the MSC. Currently, deep-draft vessels experience constrained calls by light loading or transferring to smaller vessels, which generate increased channel traffic; thereby, increasing delays and potential for accidents.

The Proposed alternative would better accommodate larger vessels that are forecasted to use the channel in a safe manner and with minimal delays.

4.19.2.3 Schools and Libraries

Since only a minimal number of nonlocal workers are anticipated, no impacts to schools and libraries are expected from the Proposed alternative.

4.19.2.4 Parks and Recreational Facilities

As noted in Section 4.17.2.2, the Proposed alternative would have primarily positive impacts on recreation in the study area. Placement of dredged material would enhance public beaches and protect recreational areas in Keller Bay. During placement of dredged material on beaches, there would be minor disruption to use of the public beaches and recreational facilities.

4.19.2.5 Transportation

In response to the Proposed alternative, the existing transportation system within the study area could be temporarily affected by the influx of construction workers and the delivery of construction equipment and materials to the project area. The addition of employees accessing the project area on a daily basis would not result in a significant increase in volume or adversely affecting traffic on area roadways.

The Proposed alternative would potentially benefit water-based transportation by providing a safer navigation channel.

No impacts to rail transportation are anticipated as a result of the Proposed alternative.

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5.0 CUMULATIVE IMPACTS

5.1 INTRODUCTION

Cumulative impact has been defined by the President's Council on Environmental Quality (CEQ) as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or persons undertakes such action." Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Impacts include both direct effects, which are caused by an action and occur at the same time and place as the action, and indirect effects, which are also caused by the action and occur later in time and are farther removed in distance, but which are still reasonably foreseeable. Ecological effects refer to effects on natural resources and on the components, structures, and functioning of affected ecosystems, whether direct, indirect, or cumulative.

In assessing cumulative impact, consideration is given to (1) the degree to which the proposed action affects public health or safety, (2) unique characteristics of the geographic area, (3) the degree to which the effects on the quality of the human environment are likely to be highly controversial, (4) the degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks, and (5) whether the action is related to other actions with individually insignificant, but cumulatively significant impacts, on the environment.

Cumulative effects can result from many different activities including the addition of materials to the environment from multiple sources, repeated removal of materials or organisms from the environment, and repeated environmental changes over large areas and long periods. More complicated cumulative effects occur when stresses of different types combine to produce a single effect or suite of effects. For example, large, contiguous habitats can be fragmented, making it difficult for organisms to locate and maintain populations between disjunctive habitat fragments. Cumulative impacts may also occur when the timings of perturbations are so close that the effects of one are not dissipated before the next occurs, or when the timings of perturbations are so close in space that their effects overlap.

Relative to cumulative impacts, 12 parameters were addressed for 11 past, present, and reasonably foreseeable future projects viewed as pertinent to the future condition of the study area. Parameters to be addressed include ecological, physical, chemical, socioeconomic, and cultural attributes.

5.1.1 Cumulative Impact Assessment Methodology

This discussion describes the application of the cumulative impact assessment methodology to the Proposed alternative. Projects evaluated include the following:

Reasonably foreseeable future actions:

- LCRA-SAWS Water Project;

- Calhoun LNG Facility;
- USACE Jetty Stabilization Project;
- E.S. Joslin Power Plant;
- Formosa Power Plant; and
- USACE GIWW Reroute Project.

Past or present actions:

- The GIWW, which crosses the existing Matagorda Ship Channel;
- Mouth of the Colorado River Diversion;
- Formosa Plastics Corporation;
- E.S Joslin Power Station; and
- Alcoa.

Direct impacts that could be quantified in acreage were considered for habitat assessment when information was available. Habitats for cumulative impact assessment were identified from reports developed for the above proposed projects and include the types of information included in Table 5.1-1.

Table 5.1-1
Cumulative Ecological/Economic Impacts

Ecological Environment	Physical/Chemical Environments	Socioeconomic Assets
Wetlands (coastal marshes)	Air Quality Noise Impacts	Cultural Resources
Benthos	Turbidity	Commercial Fisheries
Essential Fish Habitat	Contaminated Sediments (vicinity of Alcoa)	Recreational Fisheries
Threatened/Endangered Species	Shoreline/Bank Erosion	

5.1.2 Evaluation Criteria

Cumulative effects were determined by reviewing impacts as described in the project documents and determined from recent habitat information obtained from Section 3.0. Acreage of each habitat in the study was determined from this assessment, if available.

5.1.2.1 Individual Project Evaluation

Individual project documents were reviewed for impacts to selected habitats based on the evaluation criteria described above. No attempts were made to verify or update published documents, nor were the disposal practices proposed in reviewed documents verified for current ongoing projects. In addition, no field data were collected to verify project impacts described in reviewed documents. Mitigation outlined in individual project documents may be in place or proposed. This analysis recognizes that some of the

projects assessed are undergoing revisions that may alter their environmental impact. This analysis relied only on existing published documents. If acreage was available, it was summed for each habitat to obtain a cumulative acreage impact for each project. It should be noted that because of the diverse mix of documents that were reviewed for cumulative impacts and because of the fact that not all documents used the same definitions or even the same categories of resources, it was sometimes necessary to lump or modify categories so that the quantities in this section may not be exactly comparable with those presented in sections 3 and 4 of this EIS. However, every attempt has been made to make this section internally consistent, so that all projects included in Cumulative Impacts are evaluated comparably.

5.1.2.2 Resource Impact Evaluation

Biological/ecological, physical/chemical, and cultural/socioeconomic resource impacts were evaluated based on individual project reviews. In Table 5.2-1, a quantitative assessment of biological/ecological resources is presented. A qualitative discussion of biological/ecological resources, physical/chemical resources, and cultural/socioeconomic resources is presented below, using information published in reviewed documents. The following is a brief description of the evaluated projects.

5.2 REASONABLY FORESEEABLE FUTURE ACTIONS

5.2.1 LCRA-SAWS Water Project

The LCRA and SAWS have joined together in the LCRA-SAWS Water Project. The goal of the project is to conserve and develop water for the lower Colorado River basin and the San Antonio area in the twenty-first century by conserving irrigation water and capturing excess river flows. Additionally, limited amounts of groundwater would be pumped for use by farmers in the lower Colorado River basin when surface water is lacking. The project would make available or conserve as much as 180,000 ac-ft of water a year for the lower Colorado River basin. Up to 150,000 ac-ft per year of surface water would go to San Antonio to meet long-term needs (LCRA-SAWS, 2006).

The three main components of the LCRA-SAWS Water Project are:

- Conservation of irrigation water used by rice farmers by improving irrigation canals, leveling farmland with laser technology, and planting higher-yielding and more water-efficient varieties of rice.
- Construction of off-channel reservoirs in the lower Colorado River basin to store excess surface water during flooding.
- Use of groundwater for agriculture in the Lower Colorado River basin when surface water is lacking.

The project includes a 6-year study that began in 2004 to assess benefits and detriments to the community, Colorado River, and Matagorda Bay. During 2006 the Study Teams will:

- Estimate, the amount of water available for the project

TABLE 5.2-1
CUMULATIVE IMPACTS

	Reasonably Foreseeable Future Projects			Past and Present Actions					
Project	MSCIP	Calhoun LNG	GIWW Reroute Project	GIWW	Colorado River Diversion	Formosa Plastics	Joslin Power Plant	Alcoa	Total
RESOURCE									
Wetlands Impacted (acres)	36.4	23.8	NA	NA	104	NA	NA	NA	164.2
Wetlands Created (acres)	610.8	NA	295*	NA	4,000 ac by 2092	NI	NI	NI	4,905.8 ac by 2092
Bay Bottom Impacted	4,633.9	79.3	645	NA	4,000 ac converted to wetland & impacts from delta building	NI	NI	NA	>9,358 by 2092 (>4,600 would be converted to more productive habitat)
Threatened/ Endangered Species	Possible sea turtle takes	NI	Possible sea turtle takes; *benefits to piping plover (beach nourishment), brown pelican (Sundown island)	NA	NI	NA	NA	NA	Sea turtle takes & benefits to piping plover and brown pelican
Submerged Aquatic Vegetation (SAV)	325 ac sand platform created; 250 ac protected	NI	NA impacts from pipeline to Matagorda Peninsula; 70 ac created*	NI	NI	NI	NI	NI	395 ac sand platform created; 250 ac protected
Essential Fish Habitat	Net benefit	NI	Net benefit	NA	White shrimp CPUE*** decreased and brown shrimp increased	NI**	NA	NA	Net benefit
Air Quality	NI	NI	NI	NI	NI	NA	NA	NA	NI
Noise	NI	NI	NI	NI	NI	NA	NA	NA	NI

TABLE 5.1-2 (Concluded)

	Reasonably Foreseeable Future Projects			Past and Present Actions					
Project	MSCIP	Calhoun LNG	GIWW Reroute Project	GIWW	Colorado River Diversion	Formosa Plastics	Joslin Power Plant	Alcoa	Total
Water Quality	Bottom salinity increases between 0.5 and 6.0 PSU (practical salinity units), depending on inflow conditions	NI	NI	NI	Average annual salinity in eastern arm of bay decreased by 1.6 ppt	NI**	NI	Mercury-laden wastewater discharged into Lavaca Bay	Past discharge of Mercury into Lavaca Bay
Sediment Quality	Capping 484 ac of mercury–impacted bay bottom	Benefit from capping contaminated materials	NI	NA	NI	NI**	NA	High mercury levels in sediments	Past high levels of mercury in soils & future benefits of capping impacted soils
Shoreline/Bank Erosion	Protection of 4 miles of shoreline and enhance 3 miles of beach	NI	NA; *shoreline protection	NA	NI	NI	NA	NA	Benefits from protection and enhancement of shoreline
Cultural Resources	Potential impact to cultural resources-investigations ongoing	NI	NI	NA	NI	NA	NA	NA	Potential impact to cultural resources-investigations ongoing
Commercial and Recreational Fisheries	NI	NI	NA	Benefit for navigation access	Some decrease in CPUE and benefit for navigation access to bay but increased currents at GIWW	NI**	NI	1988 DOH banning consumption of finfish and crabs due to elevated mercury level in tissues	Past consumption bans from mercury, reduced CPUE, & benefits from navigation access

NI = No long-term impacts; NA = Not Available; * = with mitigation; ** = since 1993; ***CPUE = catch per unit effort

LCRA/SAWS Water Project, Jetty Stabilization Project, Joslin Power Plant Project, and Formosa Power Plant are not included in Table 5.1-2 because information regarding potential impacts is not currently available.

- Model and measure the health of Matagorda Bay
- Assess how much groundwater is available for agriculture
- Estimate irrigation water savings due to agricultural conservation
- Assess whether river water quality might change as a result of the project
- Assess whether the fish and aquatic life might be affected by the project
- Conceptually design facilities (off-channel storage, pipelines, etc.) and evaluate potential sites
- Develop information for permit applications and coordinate with key agencies

According to the most recent conceptual timeline for the project, the studies, permits, and 50-year implementation plan should be complete by 2010 with water delivery to San Antonio beginning in 2020 (LCRA-SAWS, 2006). Because studies to address potential impacts have not been completed, no impact information is available at this time. Likewise, it is not reasonable to speculate about how this proposed project could impact the proposed MSC Improvement Project.

However, it should be noted that implementation of the proposed LCRA-SAWS Water Project could reduce freshwater inflows into Matagorda Bay. Studies unrelated to the proposed MSCIP are currently underway to assess potential impacts resulting from reduced freshwater inflows in the Matagorda Bay System. It is unknown at this time whether or not changes in salinities would affect marshes, seagrasses, oysters, or other aquatic species and/or habitats in the bay.

5.2.2 Calhoun LNG

Calhoun LNG, L.P. and Point Comfort Pipeline Company, L.P. have proposed construction of an LNG terminal on 73 ac of 89 ac of man-made, industrial land owned by the Port of Port Lavaca – Port Comfort. The LNG terminal would be located in Lavaca Bay near Point Comfort and facilities associated with the project would include the following (FERC, 2006):

- A new marine terminal along Lavaca Bay, including one berth to unload up to 120 LNG ships per year
- Two single containment LNG storage tanks, each with a nominal working volume of approximately 160,000 m^3 (1,006,000 barrels)
- LNG vaporization and processing equipment
- 27.1 miles of 36-inch-diameter natural gas pipeline
- A 0.25 mile, 8-inch-diameter lateral and a 0.25 mile, 16-inch lateral
- Ten delivery points/interconnects
- Pig launcher and receiver facilities at the LNG terminal and the northern pipeline terminus, and mainline valves

Additionally, CCND is developing plans to improve the existing harbor by dredging a new turning basin and Calhoun Point Comfort has planned a new ship berth. The turning basin would be at the confluence of the Point Comfort Channel and the Alcoa Industrial Channel northwest of the LNG terminal site. These improvements would require the dredging of about 4.2 mcy of material from Lavaca Bay. The dredged material would be placed into five DMPAs which would cap contaminated sediments, create coastal marsh habitat, and stabilize shorelines within Lavaca and Cox bays.

The propose project would provide facilities necessary to import, store, and vaporize about 1.0 billion cubic feet per day of LNG. This would supply natural gas to local industrial customers and other energy-consuming customers in Texas and deliver natural gas into existing interstate and intrastate natural gas pipelines near Edna, Texas.

Construction and operation of the proposed LNG facility would require about 73 ac of land and about 79.3 ac bay bottom within Lavaca Bay for the CCND's turning basin and Calhoun Point Comfort's ship berth. The proposed pipeline route would cross mostly agricultural and range land and would follow existing roadway and pipeline easements. Construction of the pipelines would disturb approximately 416.6 ac of land, including temporary access roads and work spaces. Operation of the pipelines would require about 106 ac for permanent easements, permanent access roads, and aboveground facilities. In total, construction and operation of the proposed Calhoun LNG Project would affect approximately 569 ac of land and water, with about 179 ac of permanent land impacts.

According to information presented in the Draft EIS (FERC, 2006), the proposed Calhoun LNG Project would have limited adverse environmental impact, with the majority of impacts being temporary during the construction period. The fact that the LNG terminal site is located on a manmade, industrial site that was created by the placement of dredged material from Lavaca Bay and Cox Bay and the use of FERC's Plan and Procedures to minimize impact on soils, wetlands, and waterbodies have contributed to the reduced amount of long-term impacts associated with the proposed Calhoun LNG Project. No adverse impacts to federally or state-listed threatened or endangered species are expected and dredged material would be used to aid in capping contaminated sediments, create marsh habitat, and stabilize shorelines within Lavaca and Cox bays. Approximately 24 ac of wetlands would be impacted and 65 surface waterbodies would be crossed by the proposed pipelines; a mitigation plan has been submitted for agency review. The proposed LNG project would also result in the removal of 1.7 ac of prime farmland soils from agricultural use.

5.2.3 Jetty Stabilization Project

The entrance to the MSC passes through a man-made cut in the western end of Matagorda Peninsula. North and south jetties were constructed in the 1960s on the Gulfward side of the entrance. The purpose of the jetties is to provide reliable and safe navigation through Matagorda Peninsula to local ports. The jetties also protect the manmade cut through the peninsula from scour and erosion. The existing jetty

channel is 38 ft deep, 300 ft wide and about 4 miles long from the Gulf through the jetties to the inner channel.

The USACE, Galveston District has completed a jetty stabilization project initial appraisal report for a proposal to stabilize the MSC jetty at the entrance channel (USACE, 2006c). In the report, the objectives of the jetty stabilization project are (1) to improve the efficiency and safety of the deep-draft navigation system, and (2) to maintain or enhance the quality of the area's coastal and estuarine resources. The current proposal is to remove the north and south bottlenecks and flange the bay entrance (USACE, 2006c).

At the time this document was prepared, no potential impact information was available for the jetty stabilization project. However as noted in Section 4.9, modeling done for the Proposed alternative indicates that the removal of the bottleneck as currently proposed may increase tidal amplitude in the Matagorda Bay system.

5.2.4 E.S. Joslin Power Plant Project

The E.S. Joslin Power Station is located south of SH 35 on FM 1593 in Point Comfort. CCND and NuCoastal plan to repower and upgrade existing turbines at the power station from 261 megawatts (MW) to 303 MW. Plans include the replacement of the existing natural gas fired boiler with a petroleum coke (petcoke) boiler. The new boiler would have lower emission levels of NO_x, SO_2, and mercury. Improvements would also include limestone and coal unloading, transfer and handling facilities and ash handling, storage and transfer facilities. The facility will also include silos for providing day-to-day usage of the coke and limestone and for collection of the ash. Aqueous ammonia tanks, a small boiler and an emergency generator will also be included at the site. The petcoke feed stock will be received through the facilities of the Port. Operation is scheduled to begin in 2007.

No additional information regarding potential impacts associated with the project was found during the preparation of this document.

5.2.5 Formosa Power Plant

Formosa has proposed construction of a new solid-fuel power generation plant northeast of the intersection of FM 1593 and SH 35 in Point Comfort. The plant will use petcoke as feed stock and would provide power for the existing Formosa chemical processing plant in Point Comfort. The proposed power plant would use cogeneration, which is the simultaneous production of electrical energy and another form of useful thermal energy from the same fuel source. Operation of this facility is scheduled to begin in 2007. The proposed facility will use a similar petcoke and limestone process to the E.S. Joslin Power Plant described above.

No additional information regarding potential impacts associated with the project was found during the preparation of this document.

5.2.6 Gulf Intracoastal Waterway Reroute

The USACE, Galveston District proposes to reroute the GIWW across Matagorda Bay to provide safety improvements for shipping and reduce maintenance dredging frequency. The proposed alignment crosses the bay about a mile north of the existing channel. Based on barge simulation analysis and modeling, the channel will have a bottom width of 125 ft from Station 0+00 until it approaches the bend at Station 550+00. From that point to Station 585+00 the channel width widens to 847 ft and then narrows to 300 ft to Station 670+00. This will allow for both two-way traffic and safe navigational passage of vessels across strong currents at the MSC. The alignment uses the existing GIWW route on the eastward end for approximately 3.9 miles, then turns westward for 13 miles. Approximately 2.5 mcy of new work material would be dredged during construction and maintenance dredging quantities are estimated to be 77,500 cy per year (3,875,000 cy for the 50-year life of the project) (USACE, 2002).

A DMMP was designed for each reach of the new channel based on sediment type and quantity. Based on the DMMP, dredged material for Reach 1 will be used to create a test marsh along the shoreline near Palacios Point or will be placed in the surf zone of Matagorda Peninsula. Material from Reach 2 will be placed in the surf zone of Matagorda Peninsula to supply sediment for littoral transport. Material dredged from Reach 3A will be used to create marsh in the bay to the northwest of Port O'Connor and/or pumped in the surf zone along Matagorda Peninsula, depending on the success of a test marsh. The large amount of sand present in new work material and expected from maintenance material in Reach 3B provides the opportunity for beach nourishment. Thus, material from this reach that is not used in marsh creation associated with Reach 3A will be used to nourish Port O'Connor Beach and Sundown Island. Material not suitable for these uses will be placed in the surf zone along Matagorda Peninsula for beach nourishment and littoral transport (USACE, 2002).

The GIWW reroute will impact approximately 350 ac of open bay bottom from construction of the new channel. Up to 326 ac of bay bottom would be converted to marsh or bird habitat from placement of dredged material. Up to 70 ac of seagrass beds, 295 ac of marsh, and 31 ac of bird habitat could potentially be created in Matagorda Bay as a result of the project (USACE, 2002).

Remote-sensing surveys, including a close-order survey, and coordination with the Texas State Marine Archeologist determined the no cultural resources are present along the proposed channel alignment. Placement areas will be designed to avoid documented shipwrecks and anomalies with signatures similar to that of historic shipwrecks. Thus, no impacts to cultural resources are expected (USACE, 2002).

According to the Finding of No Significant Impact (FONSI) prepared by USACE for the project (USACE, 2002), the following summarizes potential impacts associated with the project:

- Temporary impacts to aquatic habitat, fish, and invertebrates during dredging and placement activities
- Impacts to seagrass, marsh and terrestrial habitats from pipeline crossings on Matagorda Peninsula

- No significant negative impacts to threatened and endangered species or historic resources
- Temporary impacts to air quality and noise during dredging operations
- No impact to water or sediment quality in Matagorda Bay
- No disproportionate impact to minority, low-income, or Native-American tribal populations

Potential benefits resulting from the proposed GIWW reroute include:

- Reduced risk of spills
- Increased productivity in the bay from marsh creation
- Benefits to endangered brown pelican from placement at Sundown Island
- Benefits to threatened piping plover from beach nourishment
- Decreased frequency of maintenance dredging reduces overall effects
- Shoreline erosion protection from marsh creation and beach nourishment
- Potential increase in seagrass beds
- Increased recreational use from beach nourishment at Port O'Connor
- Contributing to littoral drift within the surf zone of Matagorda Peninsula and Island

5.3 PAST OR PRESENT ACTIONS

5.3.1 Gulf Intracoastal Waterway

On July 23, 1942 Congress authorized enlargement of the Gulf Section of the Intracoastal Waterway from Apalachee Bay, Florida, to Corpus Christi, Texas, for a 12-ft-deep and 125-ft-wide channel. Since that time, many improvements have been made. Impacts to the study area are primarily associated with maintenance dredging activities and include periodic impacts to bay bottom at the dredge and placement sites, temporary increases in turbidity, and potential for sea turtle takes.

5.3.2 Mouth of the Colorado River

The River Diversion Project, constructed in 1989–1992, diverted the flow of the Colorado River to the eastern arm of Matagorda Bay and closed Parker's Cut (Wilber and Bass, 1998). The diversion cut was made to restore inflow from the river into the bay, and thus partially restore the fishery conditions that existed before deltaic growth and related dredging produced the direct discharge of river flow into the Gulf. The primary goal was to benefit bay and Gulf commercial fisheries by improving habitat. This included reducing bay salinities, increasing input of nutrients, and creating new intertidal marsh. The diversion cut has lowered bay salinities by 1.6 ppt (eastern arm of Matagorda Bay) and created intertidal marsh that serve as high quality nursery area (Bass, 2003). Although dredging of the channel removed 104 ac of intertidal marsh, 305 ac of marsh had been created by 2004 as the new delta developed (LCRA,

2006b). The original EIS (USACE, 1981) predicted the eventual creation of 4,000 ac of new delta before 2100.

An additional 37 ac of viable oyster reef were created. Catch per unit effort (CPUE) and mean length for oysters remained stable. However, the project led to further burial of the remnants of Dog Island Reef, which had already been impacted by river deposits and dredging. The major oyster producing reefs, Mad Island and Shell Island, are distant enough to avoid or minimize impacts from bacterial contaminations associated with increased inflow and should benefit from decreased occurrences of Dermo, a parasite that thrives in warm, high salinity, warm temperature waters.

There has been no change in finfish landings (i.e., Gulf menhaden, striped mullet, spotted seatrout, red drum) (PBS&J, 2005b); however, mean lengths for all species (except red drum) have decreased. Brown shrimp CPUE has increased, and white shrimp CPUE has decreased. There has been an increase in mean abundance of blue crab.

The diversion cut led to increased currents and navigation dangers at the intersection of the river and the GIWW. This has led to proposals to create another cut from the diversion channel to the old channel.

5.3.3 Formosa Plastics Corporation

Formosa Plastics Corporation currently operates eight plants and a variety of support facilities at a 1,800-ac complex in Point Comfort. Construction of the plant began in 1980 and it was in continuous production by 1983. In 1994 a $1.5 billion expansion was completed at the plant. The facility, which manufactures plastic resins and petrochemicals for a multitude of products and processes, is a major employer in the study area, employing 3,600 people in 2004 (see Table 3.18-11). The facility was cited for environmental violations in 1990 by Texas Water Commission and EPA. Violations included improper storage of oil and other waste, cracked wastewater retention ponds, and releases of acidic wastewater into surface water. Groundwater contamination also exists beneath the facility. Corrective action was taken under an EPA enforcement order in 1991 and entered into an EPA Region 6 – Texas Natural Resource Conservation Commission (now TCEQ) Corrective Action Strategy (CAS) pilot project. This was an aggressive program to assist in streamlining the RCRA Corrective Action Process and is a useful approach for facilities willing to commit resources up front to manage risk at their sites. As a result, approximately one-quarter of the cost for the $1.5 billion expansion in 1994 was for environmental protection features.

In addition, a Formosa Plastics Receiving Water Monitoring Program was established in 1993 to monitor the discharge of treated wastewater into Lavaca Bay from the Point Comfort Facility. The objectives of the Receiving Water Monitoring Program are as follows: (1) to establish baseline background conditions in Lavaca Bay in the area that receives the Outfall 001 discharge; (2) to monitor the health and structure of the biological community in the vicinity of the Outfall 001 discharge; (3) to monitor the sediment and water quality in the vicinity of the outfall discharge; (4) to evaluate compliance with the Texas Surface Water Quality Standards (TAC Chapter 307); (5) to monitor fish and shellfish tissue constituent

concentrations for animals in the vicinity of the outfall discharge to assess any potential human health risks; and (6) to comply with the requirements of the NPDES Sampling and Analysis Program. Data collection began in 1993 and is conducted quarterly as required by the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency. Over 43 sampling events have occurred and more than 10 Annual Reports for the Receiving Water Monitoring Program have been submitted. The results of the monitoring program, to date, indicate that there are no adverse impacts to the health or structure of the biological community in Lavaca Bay. No adverse impacts have been noted in the water and sediment quality of Lavaca Bay in the vicinity of the discharge outfall since discharges first began.

5.3.4 E.S. Joslin Power Station

The E.S. Joslin Power Station generating facility is a 261-MW natural gas-fired facility that began power production in 1971. The facility was shut down in 2004.

The power station was built and activated before it was necessary to obtain an air emissions permit. Instead, several units had been operating under Permit by Rules designed for smaller air emission sources. However, in November 2002 the station did obtain a TCEQ Electric Generating Facility permit that covered the existing parameters for the site at that time, limiting sulfur content in the fuel oil and establishing a NO_x emissions allocation.

Studies were conducted by Central Power and Light Company (Moseley and Copeland, 1973) to assess potential impacts on bay resources from the release of heated effluent from the power station. Baseline field sampling was conducted in Cox Bay for 21 months prior to operation of the facility and post-operation sampling was conducted for 12 months. Sampling was conducted for nekton (i.e., fishes and large, free-swimming invertebrates such as shrimp) and phytoplankton. Environmental temperature ranges for eleven abundant vertebrate and invertebrate species were established and results indicated no significant decrease in phytoplankton abundance or distribution as a result of power plant operations.

5.3.5 Alcoa

The Alcoa PCO plant currently operates one plant and a variety of support facilities at a 3,500-ac complex in Point Comfort, Texas. The PCO has been producing aluminum since at least 1948 and continues today. Other facilities and operations have taken place at the PCO, including chlori-alkali processing from 1966 and into the 1970s, natural gas from 1958–1988, and coal tar from 1968–1985.

During the chloro-alkali processing operation from 1966 into the 1970s, mercury-laden wastewater was discharged into Lavaca Bay (mercury is involved in the processing). Additional contaminated water may have entered Lavaca Bay through groundwater seepage. In 1988, the TDH issued a closure order banning consumption of finfish and crabs due to elevated mercury level in tissues. In 1994, the EPA added PCO contaminated sites to the NPL list and signed an Administrative Order on Consent to conduct a remedial investigation, risk assessment, and feasibility study (RI/FS) under CERCLA.

The RI/FS revealed mercury contamination within the Lavaca Bay System, PCO soils, and groundwater. Within the bay system, the Witco Channel was found to contain 200,000 cubic yards of mercury-contaminated sediment. Proposed remediation measures included dredging and disposal of all contaminated sediments within an on site confined disposal facility on Dredge island. The Witco marsh was also identified as a problematic site due to the high potential for bioaccumulation of mercury in local flora and fauna. Remedial measures of the marsh may include dredging or filling of the site. Bay bottoms in areas north of Dredge Island were also found to have high contamination. Two areas within the PCO were identified to have high mercury levels in soils and are found below the former Witco area and the former chlori-alkali processing areas. These areas will be capped with clays and then crushed rock. Lastly, groundwater below the PCO revealed unsafe mercury levels and this water will be extracted, treated, and then discharged into Lavaca Bay.

5.4 RESULTS

The following sections provide discussion regarding potential cumulative impacts resulting from the Proposed alternative combined with past, present, and reasonably foreseeable actions affecting the study area.

5.4.1 Wetlands

Past actions in Matagorda Bay have negatively impacted wetland habitat within the system. However, recent and future actions are subject to regulatory authority and impacts would be mitigated. Additionally, although the Colorado River diversion project impacted about 104 ac of wetland, it is expected to create 4,000 ac of wetland habitat by 2092 as the new river delta builds. Planned projects in the bay are expected to impact approximately 60 ac of wetland and create about 905 ac, resulting in a net increase in wetland acreage in the bay. Potential changes in salinity and tidal amplitude due to the Proposed alternative and the USACE jetty stability project, combined, could result in a transition of marshes from freshwater to saline/brackish marshes (Section 4.12).

5.4.2 Benthos

Information available at the time of this analysis for each of the past, present, and reasonably foreseeable projects in the study area indicated that greater than 9,358 ac of bay bottom was or will be directly impacted by 2092. This includes the loss of bay bottom associated with the diversion of the Colorado River, which is expected to continue to build marsh habitat as the delta builds. Approximately 5,900 ac would be or have been directly impacted by dredging operations. As noted in Section 4.14, organisms living in the benthos recover fairly quickly following a disturbance. However, the benthos in areas periodically disturbed for maintenance dredging, such as the GIWW and MSC, never fully returns to the pre-disturbed benthic fauna. Impacts to open-bay bottom associated with the proposed project are mitigated for by creating 610 ac of wetland and 325 ac of sand platform suitable for seagrass recruitment and protecting 432 ac of marsh and 250 ac of seagrass in Keller Bay. The proposed GIWW reroute project was expected to result in the conversion of 305 ac of bay bottom to marsh and create 70 ac of

seagrass habitat by 2004, and a total of 4,000 ac of marsh are expected to be created by 2092. Thus, although several acres of open-bay bottom are impacted, habitat created or protected in the bay is expected to increase productivity and potentially benefit the health of the bay system.

5.4.3 Threatened and Endangered Species

In the past, actions that occurred in the study area have resulted in negative impacts to protected species. Hopper dredging activities have resulted in the take of three loggerheads, two Kemp's ridleys, and one green sea turtle in the entrance channel to the MSC since October 1996 (USACE, 2007). However, over time mitigation measures applied to dredging activities and habitat creation, enhancement, and restoration activities resulting from enforcement of the ESA and other regulatory programs and conservation efforts have assisted in an increase in sea turtle populations in the area, particularly for Kemp's ridley (Shaver, 2006; NPS, 2007). Due to past mitigation measures and the associated increase in sea turtle populations it is reasonable to expect that hopper dredging activities associated with the Proposed alternative for both construction and maintenance could result in the take of protected sea turtles. However, many of the mitigation measures proposed for the Proposed alternative and other reasonably foreseeable future actions discussed here would result in the creation of marsh and seagrass habitat that would increase the productivity within the bay beyond existing conditions. The increased productivity may be beneficial to sea turtles in the area. Because hopper dredges would not be used during the GIWW Reroute or the Jetty Stability project, no take of sea turtles is expected from these activities.

Shoreline erosion and increases in tidal amplitude over time have negatively affected habitat in the Matagorda Bay system, including habitat that may have previously supported piping plovers and other shoreline birds. As noted in Section 3.15, critical habitat for the piping plover is present in the study area, including on Matagorda Peninsula where the MSC enters Matagorda Bay. The Jetty Stabilization Project could result in impacts to that habitat. On the other hand, placement of beach quality material from the GIWW Reroute on Matagorda Peninsula and Sundown Island could result in additional potential habitat for the piping plover. The Kemp's ridley sea turtle has nested on Matagorda Peninsula and Matagorda Island (Yeargan, 2006; NPS, 2007). Thus, placement of beach quality material on Matagorda Peninsula and Sundown Island, providing such placement follows FWS guidelines, may be beneficial to nesting sea turtles.

5.4.4 Submerged Aquatic Vegetation

As noted in Section 5.4.2, over 5,000 ac of bay bottom would be impacted in the bay. These impacts could result in the loss of SAV. However, approximately 394 ac of sand platform is expected to be created as a result of the Proposed alternative and the GIWW reroute. This sand platform is likely to recruit seagrass. Additionally, about 250 ac of existing seagrass in Keller Bay would be protected as a result of the Proposed alternative. Thus, no significant cumulative impacts to SAV in Matagorda or Lavaca bays are expected.

5.4.5 Essential Fish Habitat

Although past, present, and reasonably foreseeable projects have or will impact EFH in the bay, as noted above, the creation, enhancement, or protection of more productive habitats, such as marsh and seagrass beds, would benefit these species by providing productive feeding and potential nursery grounds. Thus, cumulative impacts to EFH are not expected to be significant.

5.4.6 Air Quality

The study area is currently considered an attainment area. Existing industrial facilities in the area are operating within regulated parameters. Temporary impacts from dredging activities have occurred and will continue to occur for maintenance dredging of channels in the bay. Air emissions associated with construction of the Proposed alternative and the GIWW reroute may temporarily impact the air quality of the study area. However, with both projects there is potential that maintenance dredging would need to occur less frequently, thus reducing the frequency of maintenance dredging. Therefore, no cumulative long-term impacts to air quality are anticipated.

5.4.7 Noise

Noise receptors are located primarily along the west shoreline in Matagorda Bay. These receptors are far enough away from the MSC and GIWW reroute that ship traffic and dredging operations are not likely to increase noise levels from ambient conditions. Likewise, industrial activities in Lavaca Bay are not likely to impact noise levels at receptors nearest them. Thus, no cumulative impacts to noise are anticipated.

5.4.8 Water Quality

The high mercury levels in sediments, resulting from the Alcoa discharges that led to the superfund site investigations, caused water quality concerns. However, as can be seen by reference to Section 3.9.3, the water quality in the area is good, and as noted in Section 4.9.3, should not be negatively impacted by the proposed dredging and dredged material placement. While Colorado River Diversion lowered the salinity in the eastern arm of the bay system, there will be some increase in the salinity in the bay system with the present project. The beneficial use of construction material to cap high-mercury-content sediments should reduce the probability that these sediments will impact water quality by being suspended in the water column.

5.4.9 Sediment Quality

As noted in Section 3.9.3, as a result of discharges by Alcoa, there are wide areas of Lavaca Bay where the mercury concentrations in sediments are high, but none of these sediments will be dredged for the proposed project. However, 484 ac of these sediments will be capped by the beneficial use of construction material, reducing the chance of contact with these sediments by epibenthic organisms and the chance of resuspension from disturbances such as wave action or boating.

5.4.10 Shoreline/Bank Erosion

As noted in Section 3.3, natural erosion is a long-term trend in Matagorda and Lavaca Bays, due primarily to persistent winds blowing across large, open sections of the Bays causing waves which erode the shorelines. Some areas, such as the narrow peninsula between Matagorda and Keller Bays, protect sensitive habitat areas and are particularly susceptible to continued erosion. In other areas, the shoreline is eroding, endangering property. The proposed project, through shoreline protection and beach nourishment, will alleviate some of these problems. The other projects included in this section either have no impacts on shoreline erosion or there is no available information, except for the GIWW Reroute by the USACE. Mitigative measures that are part of that project will also provide beach nourishment at Port O'Connor and/or Sundown Island.

5.4.11 Cultural Resources

Numerous side-scan sonar and close-order surveys have been conducted to identify potential cultural resources within the bay (see Figure 3.16-1). Cultural resources have been identified in Matagorda Bay, thus it is reasonable to expect that past projects may have resulted in the loss of resources. Potential PAs for the Proposed alternative have been designed to avoid impacts to potential resources to the extent practical. Several potential resources have also been identified adjacent to the MSC that could be impacted during construction. The significance of these resources is yet to be determined and coordination with THC is ongoing. The proposed GIWW reroute is not expected to impact cultural resources, nor is the proposed Calhoun LNG facility.

5.4.12 Commercial Fisheries

Past projects in the study area have resulted in impacts to fisheries in the Matagorda Bay system. As noted in Table 5.2-1, there have been consumption bans on certain finfish and shellfish because of the mercury spill in Lavaca Bay, and decreases in CPUE have been noted. Additionally, although the GIWW resulted in a benefit for navigation access to the area, the Colorado River diversion resulted in increased currents and navigational hazards where the diversion channel meets the GIWW. None of the proposed future projects are expected to impact commercial or recreational fisheries in the study area. However, it should be noted that the net increase in marsh habitat expected in the bay could result in increased productivity, providing a benefit to fisheries in the bay.

5.5 CONCLUSIONS

Cumulative impacts due to past, existing, and reasonably foreseeable future projects, along with the Proposed alternative are not expected to have significant adverse effects to resources in the study area. The majority of impacts associated with these projects would be temporary and some result in positive impacts for the area. Existing governmental regulations, in conjunction with the goals and coordination of community planning efforts, address the issues that influence local and ecosystem-level conditions. Resources in the area are provided some protection through the coordination of the numerous stakeholder

groups, local organizations, and State and Federal regulatory agencies, and through regulations such as the TCMP, the CWA, and the CAA. This coordination and regulation of resources should prevent or minimize negative impacts that could threaten the general health and sustainability of the region.

Several of the projects included in the analysis involve dredging operations, which result in temporary impacts such as increased turbidity and air emissions and long-term impacts such as impacts to bay bottom. As described above, there would be a net increase in the productivity in the bay system as a result of mitigation associated with many of the proposed or ongoing projects. Overall, this would benefit the bay. Perhaps the most substantial impact would be potential for increased salinity and tidal amplitude in the bay, which could affect shoreline habitat. However, as previously discussed, the expected salinity changes are not outside the normal ranges for the species present in the system and changes in tidal amplitude are fairly minor. Loss of cultural resources may be inevitable; however, coordination with THC would ensure potential losses are properly mitigated.

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6.0 MITIGATION

Potential impacts associated with the proposed MSCIP were avoided and minimized through project planning and coordination with State and Federal agencies. This coordination included interagency meetings such as the DMMP Workgroup, the Aquatic Species Impact Workgroup, and the Hydrodynamic/Salinity Modeling Workgroup (Section 7.0 provides additional discussion regarding these workgroups). The TPWD, FWS, NMFS, and GLO also coordinated regarding the Oyster Impact Assessment. The mitigation measures described in the Mitigation Plan (Appendix O) and discussed here are part of the DMMP. The DMMP described as part of the Proposed Alternative in this EIS is a result of input received from public meetings (both the EIS Public Scoping Meeting held by the Corps of Engineers and community meetings held by the applicant) and agency coordination.

6.1 UNAVOIDABLE IMPACTS AND PROPOSED MITIGATION MEASURES

Unavoidable impacts would occur to low and high marshes, wetlands in the footprint of PA P1, oyster reefs, and bay and offshore bottom. Potential impacts associated with each PA or aspect of the proposed MSCIP are presented in Table 6.1-1.

Table 6.1-1
Mitigation for Potential Impacts to Marsh and Oyster Reef

Impacts (acres):

	PA A2	PA D	PA ER1	PA ER2	PA ER3	PA OR1 & OR2	Ship Channel	Indirect Impacts	Total
Low Marsh		3.4		3.4	1.6				8.4
High Marsh		19			9.4				28
Oyster Reef	0.8	0.7		0.6	17		129.2	105.7	253.9

Mitigation (acres):

	PA A2	PA D	PA ER1	PA ER2	PA ER3	PA OR1 & OR2	Mitigation Ratio	Mitigation Provided
Low Marsh		7.1		10.2	7.9		3:1	25.2
High Marsh		7.1			16.1 high 22.2 low		*	23.2 high 22.2 low
Oyster Reef			63.0			190.9	1:1	253.9

* Since low marsh is more productive than high marsh, high marsh mitigation includes both low marsh and high marsh to mitigate loss of habitat and increase total functional value.

Low and high marsh would be impacted by PAs, resulting in impacts to approximately 8.4 ac of low marsh and 28 ac of high marsh. Placement of dredged material in the upland confined PA P1 would impact prior converted cropland, artificial wetlands, and farmed wetlands. Wetland delineations have not yet been conducted to determine the jurisdictional status and acreages of wetlands that would be impacted by the placement of materials in PA P1. Any necessary delineations will be complete prior to a decision on the permit for the proposed MSCIP.

Mitigation of low marsh will be at a ratio of 3:1 (25.2 ac created). Mitigation of high marsh will be at a ratio of approximately 1.5:1. Low marsh is a more productive habitat type than high marsh, therefore it is a more desirable mitigation alternative. A combination of low marsh and high marsh will be created to mitigate for losses of high marsh habitat, and to increase the overall functional value of the mitigation provided. Thus, mitigation of high marsh will include approximately 23.2 ac of high marsh and 22.2 ac of low marsh (45.4 ac), which exceeds the 1.5:1 ratio. Mitigation for potential impacts to wetlands from use of PA P1 will be determined by USACE and applicable resource agencies following a determination and, if necessary, delineation of waters of the U.S. on the site.

A total of 148.2 ac of oyster reef would be directly impacted from construction of the proposed MSCIP, primarily from widening the existing ship channel (129.2 ac), but also from placement of dredged material. Direct impacts to oyster reefs will be mitigated for with a 1:1 ratio, resulting in 148.2 ac of new oyster reef. Potential project-induced increases in salinity would result in indirect impacts to an additional estimated 105.7 ac from an increased level of infection by the parasite Dermo (Perkinsus marinus). To compensate for indirect impacts, 105.7 ac of additional reef will be created, for a total of 253.9 ac of reef for mitigation. Additional available stiff clay new work material would be used to create 44.1 ac of oyster reef in addition to the oyster reef required for mitigation, for a total of 298 ac.

A total of 7,062 ac of bay or offshore bottom would be impacted by the proposed MSCIP. This includes 1,398.6 ac of bay bottom and mercury-impacted bay bottom that would be enhanced by habitat creation (marsh, oyster reef, beach nourishment, or sand platform conducive to seagrass colonization). A total of 1,343.4 ac of bay bottom would be converted to in-bay uplands. Approximately 3,403 ac of bay bottom would be impacted by unconfined placement of dredged material, including placement of dredged material in ODMDSs (2,053 ac). However, the 1,600 acre new work ODMDS would only receive a single placement of new work material. An additional 917 ac of bay bottom (704 ac in-bay and 213 ac offshore) would be converted to ship channel. The conversion of bay bottom to other habitat types that would result from the proposed MSCIP is expected to result in a net increase in the functional value of the bay system.

To determine mitigation for loss of bay bottom, a HEA analysis (as described in Appendix J) was used to quantify the loss of functional value (over 50 years) of unvegetated bay and offshore bottom habitats that would be lost from construction of the proposed MSCIP. Creation of more productive habitats such as marsh and areas designed to be colonized by seagrass, as well as protection of marsh and seagrass habitat in and around Keller Bay are proposed to offset project impacts. These measures would provide additional benefits to habitat functional value beyond what is required for mitigation.

6.2 MARSH MITIGATION PLAN

Approximately 587.6 ac of low estuarine marsh and 23.2 ac of high estuarine marsh will be created as part of the MSCIP. The low marsh will be created by planting smooth cordgrass (*Spartina alterniflora*) on clay fill. High marsh will consist of marsh hay cordgrass (*Spartina patens*). Approximately 47.4 ac of low marsh and 23.2 ac of high marsh will be created for mitigating impacts to those plant communities in

Lavaca Bay. The remaining 540 ac of low marsh will be used to offset impacts to open bay bottom. All actions will be performed in coordination with the USACE and the appropriate resource agencies.

Elevation surveys will be performed before planting, to identify target elevations for each marsh type. If the elevations are outside of the target ranges, then remedial actions (e.g., additional site conditioning such as grading or test plantings) may be taken. Planting and monitoring will be performed as described in the Mitigation Plan (Appendix O).

Marsh grasses to be transplanted to the mitigation sites will be harvested from either an existing nursery that Alcoa utilizes for other mitigation plantings or adjacent shoreline (avoiding mercury-contaminated sediments), or purchased from commercial sources. The initial planting would be completed within 18 months of the beginning of construction. Plantings are planned to occur between mid-October and mid-June. The resource agencies will be consulted if this time window cannot be met. Transplanting techniques would be developed in coordination with the appropriate resource agencies during final engineering and design of the mitigation site.

Marsh mitigation would be considered successful if marsh vegetation covers 70 percent of the planted area within 3 years. Monitoring and coordination with the resource agencies will facilitate adaptive management. An initial transplant survival survey would be conducted approximately 90 days after completion of the initial planting (and re-plantings, if needed) and a written report submitted to the resource agencies. If there is less than 50 percent survival, the resource agencies would be consulted to determine appropriate actions prior to replanting.

Post-planting monitoring efforts (at 6 months, 1 year, 2 years, and 3 years) will consist of site surveys to determine transplant survival and colonization. A written report detailing the results of each survey will be submitted to the USACE.

6.3 OYSTER MITIGATION PLAN

Approximately 253.9 ac of oyster reef will be created to compensate for the loss of oyster production resulting from direct and indirect project-related impacts to natural oyster reef habitats. An additional 44.1 ac of oyster reef will be created for a total of 298 ac of reef. Lavaca Bay has been selected for reef construction because much of the potential project impacts are within this bay and it provides an environment suitable for oyster reef growth. All actions will be performed in coordination with the USACE and the appropriate resource agencies.

Prior to construction of the oyster reefs, a detailed bathymetric survey will be conducted. Constructed reefs will consist of parallel segments that will be constructed perpendicular or diagonal to the tidal currents. The base of the reef will be constructed using stiff clay. The upper part of the reefs will be constructed using materials (approved by USACE and resource agencies) that will provide appropriate attachment surfaces for oysters and other sessile mollusks. After settling, the top of the reef base shall be on average 1 foot higher than the surrounding bay bottom, with no area less than 6 inches above the

surrounding sediment, in order to prevent burial by natural sedimentation. A permanent elevation marker will be placed on the reef for monitoring.

The plan is to deposit surface reef material between mid-April and early June, in order to establish reef as soon as possible before spat set (colonization by young oysters) while preventing excessive siltation on the reef before anticipated spat set in June. If delayed, then spat set will be lower, resulting in a less productive oyster reef the first year. Within 21 days of construction completion, a notice will be provided to the USACE that construction has been completed in accordance with the criteria described in the Mitigation Plan (Appendix O).

The first post-construction survey will be conducted during the first October–December time period after the oyster reef has settled by 70% (70% Settling Date). A geotechnical assessment will be conducted to determine the 70% Settling Date. During the first post-construction monitoring event, a baseline survey will be conducted by a Registered Professional Land Surveyor to determine whether specified aerial size and surface elevations have been achieved. Following the baseline survey and within 60 days after the completion of the monitoring event, a Post-Construction Report will be submitted to the USACE, which will then determine whether the construction criteria have been met. If the criteria have not been met, a discussion will be held to decide if and which additional steps are needed to meet the construction criteria. The USACE has the option of requiring one additional monitoring event if the ecological performance criterion has not been met by the time of the 30-Month Post-Construction Monitoring Event.

Performance Criteria (both design-based and ecological), if met, provide reasonable assurance of project success in the long term. Reef monitoring will be conducted at scheduled intervals following reef construction. Compliance with performance criteria shall be documented during monitoring events or other inspections approved by the USACE. A written report following each monitoring event will be submitted to the USACE for review. If environmental conditions occur that prevent the establishment of reefs (e.g., severe flooding, drought, or tropical storms), then the timeline for the performance criteria for reef establishment will begin when conditions become favorable for oysters.

Adaptive management (i.e., actions in response to needs identified during construction or monitoring) is an integral part of the mitigation plan. If corrective actions are needed, approval from the USACE will be obtained before any action is taken. Corrective actions may include:

- Mobilization of heavy equipment for reworking existing base material to provide gaps, passes, or deflectors designed to improve circulation and/or reduce sedimentation.
- Reconstruction or augmentation of reef base to address excessive subsidence or settlement.
- Mechanical manipulation of the upper reef surface to increase surface attachment area if the spat set is not successful and is negatively colonized by algae.

Corrective actions are limited to corrections, amendments, or modifications of the existing reef and will not include construction of a new reef at a different location.

6.4 MAINTENANCE FOR MITIGATION PROJECTS

The Calhoun County Navigation District is committed to maintaining the mitigation sites, and will work to establish a reasonable maintenance program that is acceptable to the USACE, in coordination with the appropriate resource agencies. An inspection will be performed at least every 5 years or after hurricane/tropical storm/or public notice of degradation of the site to determine whether particular element(s) need maintenance to preserve the function of the mitigation site.

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7.0 ANY ADVERSE ENVIRONMENTAL IMPACTS THAT CANNOT BE AVOIDED SHOULD THE PREFERRED ALTERNATIVE BE IMPLEMENTED

The Preferred Alternative will result in minor adverse impacts to benthos and fish from dredging and placement of dredged material, but these impacts will be temporary. Approximately 36.4 ac of wetlands (8.4 ac of low marsh and 28 ac of high marsh) will be lost as a direct result of the project (i.e., placement of dredged material); however, restoration and mitigation efforts included in the DMMP will offset the direct loss of wetlands. Mitigation of low marsh lost will be at a ratio of 3:1 (25.2 ac). Mitigation of high marsh will be at a ratio of approximately 1.5:1; however, because high marsh is less productive than low marsh, extensive areas of created high marsh would be less desirable than a high marsh/low marsh mix. Thus, mitigation of high marsh lost will include approximately 23.2 ac of high marsh and 22.2 ac of low marsh (45.4 ac), which exceeds the 1.5:1 ratio. Approximately 253.9 ac of oyster reef would be lost because of the proposed project. This includes approximately 148.2 ac of oyster reef that would be directly affected by the construction of the proposed MSCIP, and an additional 105.7 ac indirectly affected by potential project-induced salinity changes. Mitigation of oyster reef impacts will be at a ratio of 1:1, resulting in 253.9 ac of new oyster reef and an additional 44.1 ac of oyster reef created by the beneficial use of new work dredged stiff clay.

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8.0 ANY IRREVERSIBLE OR IRRETRIEVABLE COMMITTMENTS OF RESOURCES INVOLVED IN THE IMPLEMENTATION OF THE RECOMMENDED PLAN

The labor, capital, and material resources expended in the planning and construction of this project are irreversible and irretrievable commitments of human, economic, and natural resources. The loss of approximately 36.4 ac of wetlands and 253.9 ac of oyster reef during construction is irreversible; however, as noted in Section 7.0 and demonstrated in Appendix O and Section 6.0, restoration and mitigation activities will more than offset direct losses of wetlands and complete compensation for loss of oyster reef. This includes approximately 70.6 ac (47.4 ac of low marsh and 23.2 ac of high marsh) of wetland restoration and enhancement and approximately 253.9 ac of new oyster reef and an additional 44.1 ac of oyster reef created by the beneficial use of dredged material. Deep-water bay bottom will be irretrievably lost from channel deepening and bend easings.

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9.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The construction of the Preferred Alternative would result in the loss of approximately 36.4 ac of wetlands and 253.9 ac of oyster reef. Productivity of the sites removed during construction would be permanently lost from the ecosystem. Much of the bay bottom buried during construction will recover or will transform into different habitats. The planned mitigation would address wetland losses with 70.6 ac of wetland restoration and mitigation. In addition, the planned mitigation would address oyster reef losses with 253.9 ac of new oyster reef and an additional 44.1 ac of oyster reef through the beneficial use of dredged material. Because the mitigation plan will more than compensate for worse-case wetland and oyster reef losses, it will enhance the long-term productivity of study area ecosystems; however, some lag time will be necessary before the created/enhanced marshes and oyster reefs become established and ecologically functional. These areas will experience a temporary loss of productivity during that interim period.

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10.0 PERMITS AND APPROVALS REQUIRED

A list of permits and approvals that may be required for the proposed project is presented in Table 10.0-1. This EIS was initiated as a result of Calhoun County Navigation District's application to the USACE for a DA permit for dredge and fill activities. This application also initiates the permitting process for Clean Water Act Section 401 Water Quality Certification by the TCEQ and a TCMP Consistency Determination (described below).

Table 10.0-1
Permits/Approvals Possibly Required

Activity Permitted	Permitting Authority	Name of Permit or Filing	When Required
AIR			
Air emissions for activities subject to USACE jurisdiction	USACE (consultation w/ TCEQ & EPA)	Conformity ruling as part of USACE permit	Prior to issuance of USACE permit
WATER			
Placement of fill or dredged material in waters of U.S.	USACE	Section 404 permit of CWA	Preconstruction
Navigable Waters	USACE	Section 10 of Rivers and Harbors Act	Preconstruction
Construction and operation in waters of U.S.	TCEQ	Section 401 certification (to show compliance with Texas surface water quality standards)	Prior to issuance of USACE permit
Placement of dredged material in ODMDS	EPA	Section 103 of Marine Protection, Research, and Sanctuaries Act-ODMDS designation	Prior to issuance of USACE permit
OTHER COMPLIANCE			
Threatened or endangered species impacts	FWS/NMFS	Section 7 of Endangered Species Act – Biological Assessment/ Biological Opinion	Prior to issuance of USACE permit
Essential fish habitat impacts	NMFS	Magnuson-Stevens Fishery Conservation and Management Act	Prior to issuance of USACE permit
Cultural resource impacts	THC	Section 106 of National Historic Preservation Act	Prior to issuance of USACE permit
Coastal Zone Consistency	Coastal Coordination Council	Coastal Zone Management Act-TCMP Consistency Statement	Prior to issuance of USACE permit

10.1 SECTION 401 OF CLEAN WATER ACT

The TCEQ is responsible for conducting Section 401 certification reviews of U.S. Army Corps of Engineers Section 404 permit applications for the discharge of dredged or fill material into waters of the U.S., including wetlands. The purpose of these certification reviews is to determine whether a proposed discharge will comply with state water quality standards. USACE and CCND are currently coordinating

with TCEQ regarding Clean Water Act Section 401 certification. Coordination will be complete prior to issuance of a Record of Decision (ROD) for the project.

10.2 SECTION 103 OF MARINE PROTECTION AND SANCTUARIES ACT

EPA is charged with developing ocean dumping criteria to be used in evaluating permit applications under Section 102(a) of the Marine Protection and Sanctuaries Act (MPRSA). EPA also is responsible for designating recommended sites for ocean dumping under Section 102(c) of the MPRSA. Modeling indicates the existing maintenance material ODMDS is large enough to accommodate maintenance material from the proposed widening and deepening of the Entrance Channel (see Appendix L). Therefore, redesignation by EPA of the existing maintenance ODMDS would not be required for placement of maintenance dredged material from the improved channel since no modification to the ODMDS would be required. Additionally, future maintenance material is expected to have the same properties as existing maintenance material (see Appendix D).

A new work ODMDS site will need to be designated to accommodate the one-time placement of approximately 11.9 mcy of new work dredged material originating from the Entrance and In-Bay Channels. The proposed new work ODMDS was modeled to minimize the size of the ODMDS, yet sufficiently sized to receive the 11.9 mcy of new work dredged material (see Appendix L). The proposed new work ODMDS location is outside of the Zone of Feasibility exclusionary areas, but in a location to allow the dispersal of the placement mound overtime. Material to be placed in the proposed new work ODMDS is suitable for unconfined ocean placement and will not have long-term impacts on the benthic community (see Appendix L).

Section 103 of the MPRSA authorizes the USACE to permit the placement of dredged material within an ODMDS, subject to EPA concurrence and use of EPA's dumping criteria. USACE would need to issue a Section 103 permit to allow for the placement of new work (virgin) dredged material at the one-time use ODMDS and for continued use of the existing maintenance material ODMDS. The new work site would be designated by USACE under Section 103 for one-time placement of new work material associated with the proposed channel improvement project.

10.3 SECTION 7 OF THE ESA

Interagency consultation procedures under Section 7 of the ESA have been undertaken. A draft BA was prepared describing the study area, Federally listed endangered and threatened species likely to occur in the area (as provided by the FWS and NMFS), and potential impacts on these listed species (attached as Appendix N). The USACE has determined that no significant impacts to Federally listed species or designated Critical Habitat will occur as a result of the project addressed in this DEIS. The NMFS has guidelines to protect sea turtles when hopper dredges are being used. These guidelines will be followed. Coordination with NMFS regarding Essential Fish Habitat has been initiated (Appendix F).

10.4 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265), as amended, establishes procedures for identifying Essential Fish Habitat (EFH) and required interagency coordination to further the conservation of Federally managed fisheries. Rules published by the NMFS (50 CFR Sections 600.805 – 600.930) specify that any Federal agency that authorizes, funds, or undertakes, or proposes to authorize, fund, or undertake, an activity that could adversely affect EFH is subject to the consultation provisions of the act and identifies consultation requirements. EFH consists of those habitats necessary for spawning, breeding, feeding, or growth to maturity of species managed by Regional Fishery Management Councils in a series of Fishery Management Plans.

NMFS was contacted in March 2006 regarding EFH in the project area (Appendix F). Section 3.14.2 and 4.14.8 of the EIS were prepared to address EFH in the project area and meet the requirements of the act. Submittal of this DEIS to NMFS will continue consultation.

10.5 SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT

Compliance with the National Historic Preservation Act of 1966, as amended, requires identification of all NRHP-listed or NRHP-eligible properties in the project area and development of mitigation measures for those adversely affected in coordination with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (ACHP). As indicated in Section 4.16, this project has been designed to avoid and minimize impact to potential NRHP-listed properties or State Archeological Landmarks (SALs). Coordination with the Texas SHPO regarding cultural resources is ongoing.

10.6 COASTAL ZONE MANAGEMENT ACT

The Coastal Zone Management Program (CZM) was created by the Coastal Zone Management Act of 1972. The TCMP is a State entity that participates in the Federal CZM. The TCMP coordinates local, State, and Federal programs for the management of Texas coastal resources. The Coastal Coordination Council (CCC), composed of several State agencies and local officials, administers the TCMP. The TCMP reviews all Federal actions that may affect any natural resource in the coastal zone for consistency with the Federal goals and objectives of the Federal CZM. Federal actions include direct Federal actions (i.e., performed by or for a Federal agency) and indirect Federal actions (i.e., activities requiring Federal permits, approval, or financial assistance). The responsibility for these reviews belongs to the lead agency—the GLO. A Section 404 or Section 10 permit application will automatically trigger a review by the GLO for consistency with TCMP. Based on an evaluation of the proposed project's compliance with Federal goals and policies (Appendix P), the proposed MSCIP is consistent with the Federal goals and objectives of the CZM. Any concerns expressed by the GLO will be addressed before the permit is granted. Additional information regarding the TCMP for the proposed MSCIP is provided in Appendix P (TCMP).

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11.0 PUBLIC INVOLVEMENT, REVIEW, AND CONSULTATION

11.1 PUBLIC INVOLVEMENT PROGRAM

The USACE and CCND involved the public through public meetings, and other outreach throughout the history of this project. A proactive approach was taken to inform and involve the public, resource agencies, industry, local government, and other interested parties about the project and to identify any public concerns.

On April 25, 2006, a public scoping meeting was held at the Bauer Community Center, Port Lavaca, Texas. The purpose of the meeting was to introduce the proposed project to the public, explain the NEPA process, and solicit public comment regarding the project. The meeting included an open house prior to the formal meeting, which included a presentation from USACE, CCND, URS, and PBS&J. Oral and written comments were collected at the meeting and written comments were collected throughout the scoping comment period, which ended May 25, 2006. Other various forms of outreach utilized during this project included early regulatory agency coordination, DMMP Workgroup meetings, Aquatic Species Impact Analysis Workgroup meetings, Hydrodynamic/Salinity Modeling Workgroup meeting, DMMP presentations to the public, individual contacts, press releases, and comment forms.

An overview of DMMP Workgroup meetings is provided in Section 2.3. A total of six meetings were held between February and October 2006. As described in Section 2.3, the DMMP Workgroup meetings provided a venue for CCND to obtain agency comments, concerns, and suggestions regarding DMMP alternatives.

In order to address concerns raised during DMMP Workgroup meetings, two additional workgroups were formed. The Aquatic Species Impact Workgroup meetings were held June 7, 2006, and July 11, 2006. The purpose of the meetings was to (1) discuss the appropriate models for assessing potential impacts from the proposed project on aquatic species, (2) identify appropriate species or habitats to evaluate, (3) identify a project area for the analysis, and 4) review proposed methodology for the analysis.

The Hydrodynamic/Salinity Modeling Workgroup meetings were held between June and November 2006. The purpose of the meetings were to review the hydrodynamic and salinity modeling work being done by a CCND consultant. Proposed simulation conditions for with and without project scenarios were discussed. The panel provided review and comments on the modeling effort.

The CCND presented the proposed DMMP alternatives to the public on July 20, 2006. The meeting was advertised in the Port Lavaca and Port O'Connor newspapers and a meeting notice was mailed to 185 individuals who had been identified as possible stakeholders. Approximately 120 people attended, 96 of which signed in. The meeting began with a description of the current proposed DMMP, which included figures showing the plan. A moderated comment session followed. Comments received during the meeting were taken into consideration when finalizing the DMMP.

The CCND conducted an additional Community Update Meeting on January 31, 2007, in Port Lavaca. Public notice in advance of the meeting included advertisements in the Port Lavaca and Port O'Connor newspapers. A mail notice was sent 2 weeks in advance to 247 individuals who had been identified or had asked to be placed on the stakeholder mailing list. Approximately 95 people attended with 76 actually signing in. The community update began with an overview of the DMMP and observations about the process utilized to develop the plan and integrate community input. An extended comment and question session followed. These comments were considered when finalizing the DMMP.

11.2 REQUIRED COORDINATION

The Draft EIS is being circulated to all known Federal, State, and local agencies. Interested organizations and individuals are also being sent notice of availability. A list of those who are being sent a copy of this document, along with a request to review and provide comments on the documents, is provided in Section 9.0.

11.3 PUBLIC VIEWS AND RESPONSES

Public views and concerns expressed during this study have been considered during the preparation of this DEIS. The views and concerns were used to develop planning objectives, identify significant resources, evaluate impacts of various alternatives, identify potential PAs, and identify a plan that is socially and environmentally acceptable. Important concerns expressed included the beneficial use of dredged material and recreational opportunities.

Development of alternatives is explained in the Section 2. The recommended plan takes into consideration the expressed objectives, views, and concerns of the resource agencies and public.

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Appendix A

Calhoun County Navigation District
Section 404/10 Permit Application

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT (33 CFR 325)	OMB APPROVAL NO. 0710-0003 Expires December 31, 2004

The Public burden for this collection of information is estimated to average 10 hours per response, although the majority of applications should require 5 hours or less. This includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Service Directorate of Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302; and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003), Washington, DC 20503. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research and Sanctuaries Act, 33 USC 1413, Section 103. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued.

One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETED
24071			

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME Calhoun County Navigation District; Responsible Officer- Paul Blasingim, Board Chairman	8. AUTHORIZED AGENT'S NAME AND TITLE *(an agent is not required)* Mark Mazoch, P.E.
6. APPLICANT'S ADDRESS Calhoun County Navigation District P.O. Box 397, Point Comfort, Texas 77978	9. AGENT'S ADDRESS 9801 Westheimer, Suite 500 Houston, TX 77042
7. APPLICANT'S PHONE NOS. W/AREA CODE	10. AGENT'S PHONE NOS. W/AREA CODE
a. Residence – NA b. Business - (361) 987-2813	a. Residence NA b. Business (713) 914-6699

11. STATEMENT OF AUTHORIZATION

I hereby authorize MARK E. MAZOCH to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

Paul B. Blasingim — 2-21-7

APPLICANT'S SIGNATURE — DATE

NAME, LOCATION AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE *(see instructions)*
Matagorda Ship Channel Improvement Project (MSCIP)

13. NAME OF WATERBODY, IF KNOWN *(if applicable)* Matagorda Bay, Lavaca Bay, Cox Bay, and the Gulf of Mexico.	14. PROJECT STREET ADDRESS *(if applicable)*
15. LOCATION OF PROJECT Calhoun and Matagorda (COUNTY) — Texas (STATE)	

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)
See **Block 16**

17. DIRECTIONS TO THE SITE
See **Block 17**

18. Nature of Activity *(Description of project, include all features)*

See **Block 18**

19. Project Purpose *(Describe the reason or purpose of the project, see instructions)*

See **Block 19**

USE BLOCKS 20-22 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

See **Block 20**

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards

See **Block 21**

22. Surface Area in Acres of Wetlands or Other Waters Filled *(see instructions)*

See **Block 22**

23. Is Any Portion of the Work Already Complete? Yes _____ No ___X___ IF YES, DESCRIBE THE COMPLETED WORK

24. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list).

See **Block 24**

25. List of Other Certifications or Approvals/Denials Received from other Federal, State, or Local Agencies for Work Described in This Application

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED
NA	NA	NA	NA	NA	NA

*Would include but is not restricted to zoning, building and flood plain permits

See **Block 25**

26. Application is hereby made for a permit or permits to authorize the work described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

Paul K [illegible] 2-21-7 Mark G. [illegible] 2-21-07

SIGNATURE OF APPLICANT DATE SIGNATURE OF AGENT DATE

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

BLOCK 16: OTHER LOCATION DESCRIPTIONS

The project extends approximately 27 miles from the Port of Port Lavaca – Point Comfort turning basin in Lavaca Bay (Sta. 118+502) through the southwest section of Matagorda Bay and offshore into the Gulf of Mexico (Sta. –23+000). The Calhoun County Navigation District (CCND) is also proposing multiple dredged material placement areas located throughout Matagorda and Lavaca Bays, in the Gulf of Mexico, and on land in the vicinity of the proposed dredging activities. Overview maps of the proposed project area and potential placement options are provided as **Figures 1** and **2**.

The project area is encompassed by the following U.S. Geological Survey 7.5-minute quadrangle maps: Decros Point, Port O'Connor, Seadrift NE, Carancahua Pass, Keller Bay, Port Lavaca East, Turtle Bay, Olivia, and Point Comfort, Texas.

The approximate Texas State Plane, South Central Zone (U.S. feet) for the western edge of the existing turning basin are Easting: 2,754,392.819; Northing: 13,426,070.550. Approximate Texas State Plane, South Central Zone (U.S. feet) for the project terminus in the Gulf of Mexico (at Sta. –23+000) are Easting: 2,843,483.357; Northing: 13,332,562.639.

BLOCK 17: DIRECTIONS TO THE SITE

Directions from Houston and Corpus Christi, Texas to the Port of Port Lavaca – Point Comfort turning basin are provided below:

> **From Houston:** proceed south on US 59 toward Victoria, Texas; exit on TX 172/Farm-to-Market (FM) 710 toward Ganado, Texas; exit on to TX 35 and continue west to Point Comfort, Texas; turn south on FM 1593 toward the Port of Port Lavaca – Point Comfort turning basin.
>
> **From Corpus Christi:** proceed north on US 181 toward Portland, Texas; US 181 north becomes TX 35 north near Gregory, Texas; continue on TX 35 north to Point Comfort; turn south on FM 1593 toward the Port of Port Lavaca – Point Comfort turning basin.

BLOCK 18: NATURE OF THE ACTIVITY

The CCND proposes to widen and deepen approximately 27 miles of the Matagorda Ship Channel (MSC) (**Figure 2**) from the CCND facilities and existing turning basin in Lavaca Bay (Sta. 118+502; **Figure 10**) through the southwest section of Matagorda Bay and offshore into the Gulf of Mexico (Sta. -23+000). CCND plans to deepen its existing facilities to match the proposed channel improvement as well as construct a new turning basin at the intersection of the Matagorda Ship Channel and Alcoa Channel. The project is divided into three reaches:

- Lavaca Bay Reach – Station 118+502 to 75+000 (Includes CCND Facilities and Proposed Turning Basin);
- Matagorda Bay Reach – Station 75+000 to 6+000; and
- Offshore Reach – Station 6+000 to –23+000.

Generally, the project plans provide for a channel 46 feet deep by 600 feet wide from the 46-foot depth in the Gulf of Mexico to the Bay side of the Matagorda Peninsula; 44 feet deep by 400 feet wide from the bay side of the Peninsula to the terminus at the Port of Port Lavaca-Point Comfort. The project also includes deepening of CCND facilities at the port and the addition of a 44-foot-deep turning basin at the intersection of the Alcoa Channel and the MSC. A detailed description of the channel dimensions are provided as follows:

Channel Station 118+502 to 8+774.78

- 3H:1V channel side slopes, 44-foot depth with 2-foot advanced maintenance requirement and 2-foot overdepth dredge tolerance; and 400-foot channel width. Channel width varies at the turns and transitions. See **Figures 3 through 8 and 10**.

Channel Station 8+774.78 to 3+506.54

- 3H:1V channel side slopes, 44-foot depth with 2-foot advanced maintenance requirement and 2-foot overdepth dredge tolerance; and width varies from 400 to 761.32 feet. **See Figure 8**.

Channel Station 3+506.54 to –5+000

- 5H:1V channel side slopes, 46-foot depth with 3-foot advanced maintenance requirement and 2-foot overdepth dredge tolerance; and 600-foot width. **See Figure 8 and 9**.

Channel Station -5+000 to -23+000

- 10H:1V channel side slopes; 46-foot depth; 3-foot advanced maintenance requirement; and 2-foot overdepth dredge tolerance; and 600-foot width. **See Figure 9**.

The initial dredging is referred to as “new work” dredging where previously undisturbed material is removed from the project area. Following construction, the area will require periodic “maintenance” dredging to remove sediments that accumulate above the depth required to navigate the area.

Approximately 46.5 million cubic yards of new work dredged material will be generated from the proposed widening and deepening project. Maintenance dredging of the proposed channel template will generate approximately 257.5 million cubic yards of material during the 50-year planning period. CCND may utilize various types of hydraulic and mechanical dredges (such as: pipeline, clamshell with dump scows, and hopper) to perform the new work and maintenance dredging.

Based on the location and type of new work and maintenance dredged material generated by the proposed project, material would be either: used to create or protect habitats, used to cap mercury-impacted sediments, placed in in-bay upland placement areas, placed in onshore placement areas, or placed in unconfined placement areas in Matagorda Bay or the Gulf of Mexico. Dredged material would be used to create marshes in Lavaca Bay and south of Sand Point in Matagorda Bay. Stiff clay would be used to create oyster reefs in Lavaca Bay between the MSC and TX Hwy 35; or used to create levees to construct in-bay uplands in Lavaca Bay and a habitat area in Matagorda Bay. Sand would be used to nourish beaches along the Magnolia Beach and Indianola shorelines and be used to create a habitat area in Matagorda Bay. Soft clay and silt would be placed in in-bay uplands in Lavaca Bay (located on existing placement areas or mercury-impacted sediments where possible); in an onshore placement area south of Alamo Beach; or placed in unconfined placement areas in Matagorda Bay and the Gulf of Mexico. The project would also feature an earthen levee constructed using materials mechanically excavated from along the Matagorda Bay shoreline south of Keller Bay to prevent a breach of the peninsula separating Keller Bay from Matagorda Bay. Locations and dimensions of habitat areas and placement areas to be built are shown in **Figures 12** to **46,** and acreages are given in **Table 21-1**.

BLOCK 19: PROJECT PURPOSE

The purpose of the proposed project is to improve the deep-draft transport of commerce on the MSC for the existing and planned users of the channel. The current channel is economically inefficient, with approximately 90% of vessels calling at the Port reported to be light-loaded due to draft limitations of the present channel configuration. By expanding the MSC dimensions and associated turning basin and marine slips, cargo vessels could reduce or eliminate light-loading measures and larger cargo vessels unable to transit the current channel configuration could call on the Port. The channel improvements would reduce transportation costs for existing commodities. Because the existing turning basin at 1,000 ft by 1,000 ft, may be deepened but cannot be expanded to accommodate the larger vessels, CCND proposes to construct a new turning basin at the intersection of the MSC and ALCOA Channel to accommodate larger vessels.

The project is expected to begin in January 2008 and continue until approximately February 2010.

BLOCK 20: REASONS FOR DISCHARGE

The overarching purpose of the proposed project is, as described in **Block 19**, to reduce transportation costs and increase operational efficiencies of maritime commerce movement through the Port. Widening and deepening the MSC and the discharge of dredged material are required to achieve this objective.

Figure 2 shows the location of the proposed placement areas and **Block 21** provides a description of the different types of dredged material placement types being used for this project. Generally, there are three proposed construction activities for the MSCIP that involve the placement of fill/dredge material into regulatory designated wetlands or water bodies:

- Channel dredging and placement of dredged material;
- Placement of stone in marine waters; and
- Navigation aids in marine waters.

Channel Dredging and Placement of Dredged Material

The MSCIP requires the widening and deepening of the MSC from outside the jetties to the Port of Port Lavaca/Point Comfort. The offshore area will be dredged to a depth of –46.0 Mean Low Tide (MLT) with 3.0 ft for advance maintenance and 2.0 ft of allowable overdepth. The Matagorda Bay and Lavaca Bay portions of the channel will be dredged to –44.0 MLT, with 2.0 ft for advance maintenance and 2.0 ft of allowable overdepth. The proposed dredging will generate 46.5 million cubic yards of dredged material for the initial widening and deepening, and 257.5 million cubic yards of material from the next 50 years of channel maintenance. This material would be placed in several types of placement areas, depending on the type of material and its location; detailed figures of placement areas are presented in **Figures 3 to 30**.

Additional dredging and placement of 400,000 cubic yards of dredged material would be done to create a levee designed to prevent a breach of the peninsula separating Keller Bay from Matagorda Bay.

Barge Access.

For some placement areas, barge access channels are required to access the levees where the water depth is less than 6.0 feet MLT. These channels are used for the placement of stone shore protection

and access for construction of the perimeter levees. These PA's include A1, A2, D, ER2, ER3, and G. The locations of these channels are shown on **Figures 15, 16, 20, 23, 24, and 25**. See block 21 for the type of material being discharged.

Placement of Stone in Marine Waters

Armoring of constructed placement areas with riprap is proposed for erosion protection. Approximately 375,000 cubic yards of stone riprap will be placed in Lavaca and Matagorda Bays. Stone groins will be created to stabilize the shorelines of the beach nourishment areas along the Magnolia-Indianola shoreline. Approximately 45,000 cubic yards of stone will be used to create the groins. Approximately 130,000 cubic yards of crushed limestone will be used in the construction of oyster reefs.

Navigation Aids in Marine Waters

Due to the widening of the ship channel, aids to navigation such as channel markers will need relocation along the Matagorda Ship Channel in order to correctly mark the new fairway for commercial and recreational boaters. These new navigational aids will be located primarily on the south side of the channel.

BLOCK 21: TYPE(S) OF MATERIAL BEING DISCHARGED AND THE AMOUNT OF EACH TYPE IN CUBIC YARDS

The proposed widening and deepening of the Matagorda Ship Channel will generate approximately 46.5 million cubic yards (mcy) of new work material. It is anticipated that maintenance of the proposed channel template will generate approximately 257.5 mcy of silt, soft clay, and sand during the 50-year planning period.

Table 21-1 provides a summary of the amount and type of new work and maintenance material that will be placed in each Reach (Lavaca Bay, Matagorda Bay, and Offshore).

- In **Lavaca Bay**, new work dredging will generate 21,300,000 cubic yards of material and maintenance dredging over the next 50 years is anticipated to generate 135,000,000 cubic yards of silt and soft clay. Of the new work material, 7,700,000 cubic yards will be stiff clay, 10,500,000 will be soft clay, and 3,100,000 will be sand.

- In **Matagorda Bay**, new work dredging will generate 22,100,000 cubic yards of material, and maintenance will generate 108,900,000 cubic yards of silt, soft clay and sand. Of the new work material, 2,300,000 cubic yards will be stiff clay, 9,100,000 will be soft clay, 10,600,000 will be sand. In addition, 400,000 cubic yards of stiff clay will be mined to create an earthen levee along the peninsula separating Matagorda Bay from Keller Bay.

- In the **Offshore** Reach, new work dredging will generate 3,200,000 cubic yards of silt and sand, and maintenance will generate 13,600,000 cubic yards of silt, soft clay, and sand.

- The **total** amount of new work material generated by the project by material type is: 10,000,000 cubic yards of stiff clay; 19,600,000 of soft clay; 13,700,000 of sand; and 3,200,000 of silt and sand. The total amount of maintenance material, by material type is: 135,000,000 of silt and soft clay; and 122,500,000 of silt, soft clay, and sand.

Table 21-2 provides a summary of the amount of material that would be placed in each placement area.

For PA's A1, A2, D, ER2, ER3, and G a barge access channel approximately 80 feet wide will be required in locations where the water is less than 6.0 feet MLT deep. The material dredged from the access corridors will be placed along the access channel alignment and pulled back into the channel upon completion. If the material is impacted with mercury above the Lavaca Bay Superfund site Remedial Action Objective for open water, then it will be managed in a manner consistent with the Lavaca Bay Superfund site requirements. **Table 21-3** provides a summary of the amount of material that would be excavated for the barge access channels for these PA's.

In addition to dredged material, stone will be brought in and placed in Lavaca and Matagorda Bays for erosion protection, and crushed limestone will be used in oyster reef creation. Approximately 420,000 cubic yards of stone will be used to armor levees and create groins to prevent shoreline erosion. Approximately 130,000 cubic yards of crushed limestone will be used in oyster reef creation.

Table 21-1. Amount and type of new work and maintenance material placed in each Reach.

	New Work Material (cubic yards)				Maintenance Material (cubic yards)	
	Stiff Clay	**Soft Clay**	**Sand**	**Silt and Sand**	**Silt and Soft Clay**	**Silt, Soft Clay and Sand**
Lavaca Bay	7,700,000	10,500,000	3,100,000		135,000,000	
	21,300,000				**135,000,000**	
Matagorda Bay	2,300,000*	9,100,000	10,600,000			108,900,000
	22,100,000				**108,900,000**	
Offshore				3,200,000		13,600,000
	3,200,000				**13,600,000**	
Total by Material	**10,000,000**	**19,600,000**	**13,700,000**	**3,200,000**	**135,000,000**	**122,500,000**
Total New Work and Maintenance	**46,500,000**				**257,500,000**	
*** Mined Material**	**400,000**					

Table 21-2. Amount and type of material in each placement area.

Matagorda Ship Channel Improvement Project
Dredged Material Management Plan (50 Year)

Placement Area		New Work Material Used at Site		Maintenance Material Used at Site		Description of Creation or Protection	
		Type	Amount	Type	Amount	Approximate Amount	Type
A1	In Bay Upland	Stiff Clay Soft Clay	2 1.3	Silt and Soft Clay	45.1	Creates 530 acres	In-Bay Uplands
A2	Combined Upland/Marsh	Stiff Clay Soft Clay	0.8 5.4			Creates 140 acres Creates 120 acres	In-Bay Uplands Marsh
OR1 & OR2	Clay Core Oyster Reefs	Stiff Clay	1			Creates 235 acres	Oyster Reef
BN1, BN2, & BN3	Beach Nourishment	Sand/Shell	1.9			Renourish 3 miles	Beach
D	In Bay Upland/Marsh	Stiff Clay Soft Clay	0.5 1.1	Silt and Soft Clay	14.8	Creates 260 acres Creates 14 acres	In-Bay Uplands Marsh
ER1	Submerged Enhanced Recovery Area	Stiff Clay	0.4			Caps 63 acres of impacted bay bottom Creates 63 acres	Submerged Cap Oyster Reef
ER2	Enhanced Recovery Area/Marsh	Stiff Clay Soft Clay	1.1 1	Silt and Soft Clay	6.9	Caps 168 acres of impacted bay bottom Creates 10 acres	Upland Cap Marsh
ER3	Enhanced Recovery Area/Marsh	Stiff Clay Soft Clay	1.2 1.1	Silt and Soft Clay	13.2	Caps 201 acres of impacted bay bottom Creates 46 acres	Upland Cap Marsh
G	Marsh and Sand Point Marsh and Keller Bay Protection	Stiff Clay Stiff Clay(Mechanically Excavated) Soft Clay	2.6 0.4 2.1			Creates 320 acres Protects 250 acres Protects 432 acres Protects 4 miles	Marsh Seagrass Marsh Shoreline
P	Terrestrial Upland	Soft Clay	1	Silt and Soft Clay	55	Elevates 700 acres	Terrestrial Uplands
PA 5, 6, 7, 8, 9, 10, 11,12	Existing Unconfined Placement Areas			Silt, Soft Clay, & Sand	108.9	Continued use 1350 acres	Bay Bottom
H4	Beneficial Use Site including Marsh, SAV Platform, and Bird Island	Stiff Clay Sand	1.5 8.5			Creates 20 acres Creates 325 acres Creates 100 acres Creates 25 acres	In-Bay Uplands SAV Platform Marsh Bird Island
O1*	Sundown Island	Sand	As Needed			Protects	Existing Bird Island
O2*	Port O'Connor Beach	Sand	As Needed			Renourish	Beach
PA1	Existing ODMDS**			Silt, Soft Clay & Sand	13.6	Continued use 453 acres	ODMDS
O5	Proposed ODMDS	Silt & Soft Clay Silt & Sand	4.5 7.5			1600 acres	ODMDS
	Placement Area Mechanical Excavation Channel Dredging Total		0.4 mcy 46.5 mcy		257.5 mcy	Creates 950 acres Creates 610 acres Creates 298 acres Creates 325 acres Creates 63 acres Creates 369 acres Nourish 3 miles Protects 250 acres Protects 432 acres Protects 4 miles Creates 25 acres Elevates 700 acres Protects Continued use 1350 acres Continued use 453 acres 1600 acres	In-Bay Uplands Marsh Oyster Reefs SAV Platform Submerged Cap Upland Cap Beach Seagrass Marsh Shoreline Bird Island Terrestrial Uplands Existing Bird Island Bay Bottom ODMDS ODMDS

*Maintenance dredged material may be used to augment areas if determined to be needed in the future and maintenance material available at the correct grain size.
**Ocean Dredge Material Disposal Site

Table 21-3. Barge access summary table.

Placement Area	Length of Channel	Current Depth	Quantity(CY)	Quantity(CY) Total	Type of Material
A1	1,800	-1	27,000	182,000	Soft to Stiff Clay
	8,200	-3	85,000		
	4,300	-1	70,000		
A2	2,300	-2	27,000	66,000	Soft to Stiff Clay
	4,400	-4	26,000		
	1,500	-3	13,000		
D	1,900	-2	23,000	35,000	Soft to Stiff Clay
	4,200	-5	12,000		
ER2	9,500	-2	113,000	113,000	Soft to Stiff Clay
ER3	6,400	-3	57,000	57,000	Soft to Stiff Clay
G	1,300	-3	12,000	26,000	Soft to Stiff Clay
	1,600	-3	14,000		
G-Levee	10,000	-3	89,000	89,000	Soft to Stiff Clay

BLOCK 22: SURFACE AREA IN ACRES OF WETLAND OR OTHER WATER FILLED

The proposed dredged material placement areas and channel improvements would impact approximately 7100 acres in Matagorda Bay, Lavaca Bay, Cox Bay, and the Gulf of Mexico. Total acreages and acreages of low marsh, high marsh, waterfowl habitat, oyster reef, and open bay bottom filled in each proposed placement area is provided in **Table 22-1**. The waterfowl habitat will require a wetland delineation to determine if wetlands are present, and if so, what type of wetlands will be impacted and their size. A proposed bird rookery, perimeter berms, in-bay upland placement sites, and beach nourishment will permanently convert open water to upland habitats. Several placement areas convert unvegetated bay bottom to marsh. Other placement area types (oyster reefs, submerged clay caps on mercury-impacted sediments, or sandy areas designed for seagrass colonization) would remain aquatic habitats. Open Bay Placement Areas will temporarily affect the bay bottom, but will not convert these areas to another habitat type. One proposed placement area is located on an upland site.

The proposed MSCIP would fill a total of: 8.4 acres of low marsh, 28 acres of high marsh, and 53 acres of waterfowl habitat (wetland area of waterfowl habitat to be determined). The project would impact 243.4 acres of oyster reef as follows: 129.2 acres converted to ship channel, 19.1 acres filled, and an equivalent of 95.1 acres of lost production from increased salinity. The project would impact a total of 4633.8 acres of unvegetated bay bottom as follows: 574.8 acres converted to ship channel, 2709 converted to marsh, oyster reef, sand platform, levees, and in-bay uplands, and 1350 acres of continued use of unconfined placement areas. The project would impact a total of 2266 acres of offshore bottom as follows: 213 acres converted to ship channel and 2053 acres used for open bay placement.

Barge access channels will temporarily affect 14 acres of bay bottom, which will be restored upon the completion of the work.

Table 22-1. Acreages of habitats impacted by MSCIP.

		Low Marsh	High Marsh	Waterfowl Habitat	Oyster Reef	Open Bay Bottom	Offshore Bottom	Total Acres
Proposed Ship Channel	**Convert to Channel**				129.2	574.8	213	**917**
A1[1]	**In-bay Upland**					530		**530**
A2	**In-bay Upland/Marsh**				0.8	259.2		**260**
BN1, BN2, and BN3	**Beach Nourishment**					125		**125**
D	**In-bay Upland/ Fringe Marsh**	3.4	18.6		0.7	251.5		**274.2**
ER1	**Oyster Reef**					126*		**63**
ER2	**In-bay Upland/ Fringe Marsh**	3.4			0.6	174*		**178**
ER3	**In-bay Upland/Marsh**	1.6	9.4		17	184.5*		**212.5**
G	**Marsh**					332		**332**
G Shoreline Protection	**Levee**					21.8		**21.8**
H4 Habitat Area	**Marsh/ Bird Island/ Sand Platform**					470		**470**
O5	**Unconfined Placement**						1600	**1600**
OR1 and OR2	**Oyster Reef**					235		**235**
P1	**Onshore Upland**			53				**53**
PA1	**Unconfined Placement**						453	**453**
PA5-12	**Unconfined Placement**					1350		**1350**
Indirect Impacts	**Salinity Impacts**				95.1			
Total		**8.4**	**28**	**53**	**243.4**	**4633.8**	**2266**	**7137.5**

* Mercury-impacted bay bottom.

A mitigation plan for impacts to low marsh and high marsh is provided in **Appendix A**. Low marsh impacts will be mitigated for in-kind at a 3:1 ratio (25.2 acres created). In order to provide a higher-quality habitat than pure high marsh habitat, mitigation for high marsh impacts will include a mix of low marsh and high marsh (23.2 acres of high marsh and 22.2 acres of low marsh created). The mitigation marshes will be created in Areas D, ER2, and ER3; in close proximity to the location of the impacted marshes.

Proposed onshore placement area P1 is located on agricultural land. The site contains an area of created waterfowl habitat that would be impacted by construction of the placement area. This area is not within the 100 year floodplain, but may have recently been farmed wetland. A wetland delineation will be done in order to determine jurisdictional status and acreages of wetlands that would be impacted by placement of materials. Appropriate mitigation will be provided on-site.

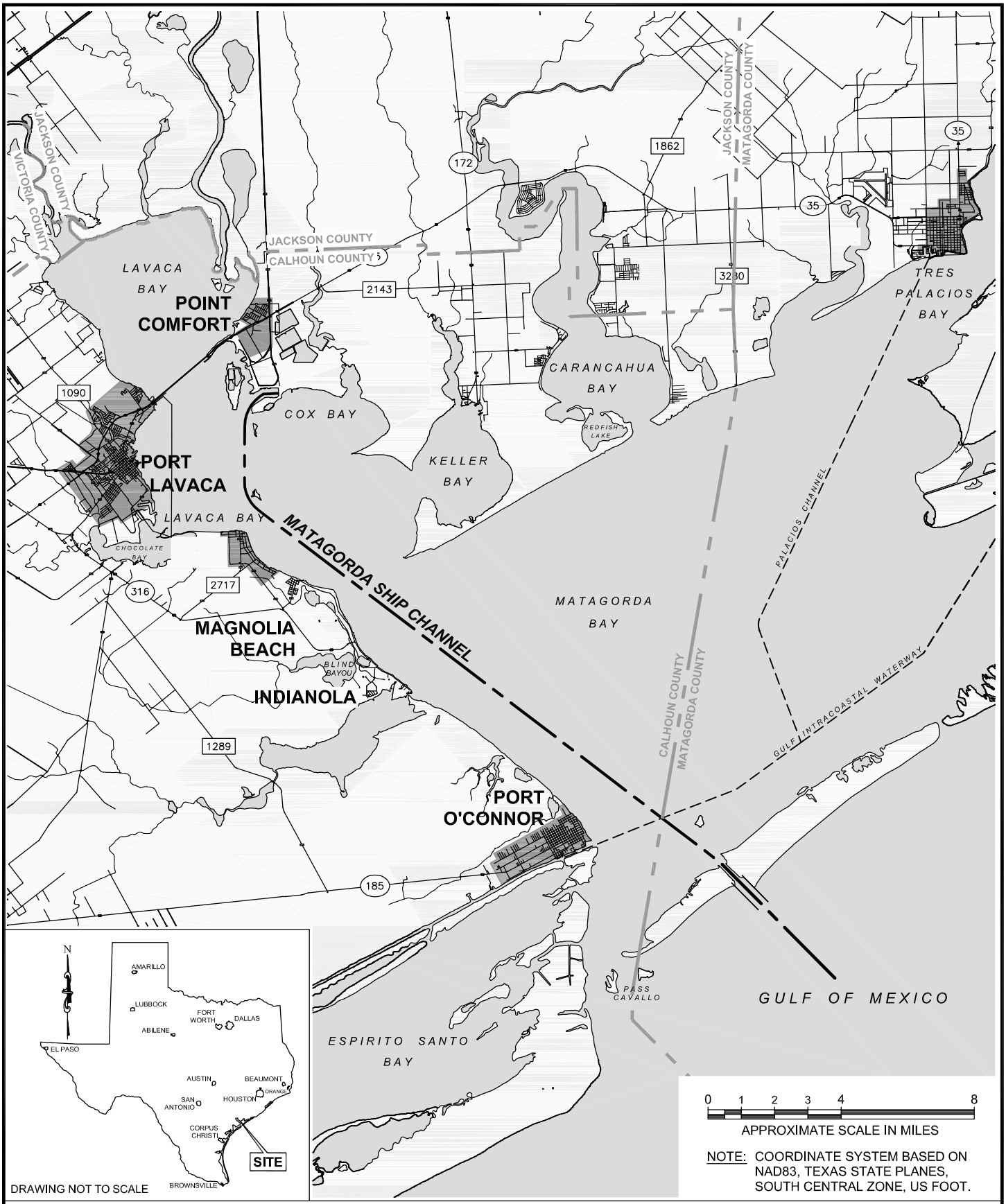
Oyster reefs will be mitigated for in-kind at a 1:1 ratio. Created oyster reefs will be located in Lavaca Bay, in Areas ER1, OR1, and OR2.

Mitigation for bay bottom impacts will be provided by the creation of 120 acres of marsh in area A2, 320 acres of marsh in area G, 100 acres of marsh and 325 acres of sand platform conducive to seagrass colonization in area H4, and protection of 432.1 acres of marsh and 250 acres of seagrass in Keller Bay by area G and G Shoreline Protection.

BLOCK 25: LIST OF CERTIFICATIONS OR APPROVALS/DENIALS RECEIVED FROM OTHER FEDERAL, STATE, OR LOCAL AGENCIES

Table 25-1. List of Certifications or Approvals/Denials Received from other Federal, State, or Local Agencies for the MSCIP

Agency	Type of Approval	Identification No.	Date Applied/ Anticipated Submittal	Date Approved	Date Denied
Calhoun County	Development Permit for Placement Area P1		Anticipated 3Q07		
Department of Army	Assumption of Maintenance of the Channel Improvements under Section 204(f), Operations and Maintenance of the water Resources Development Act(WRDA) 1986 as amended in WRDA 1990.		Anticipated 4Q07		



NOTE: COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

SITE VICINITY MAP

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 3-15-07

MATAGORDA AND CALHOUN COUNTIES, TEXAS

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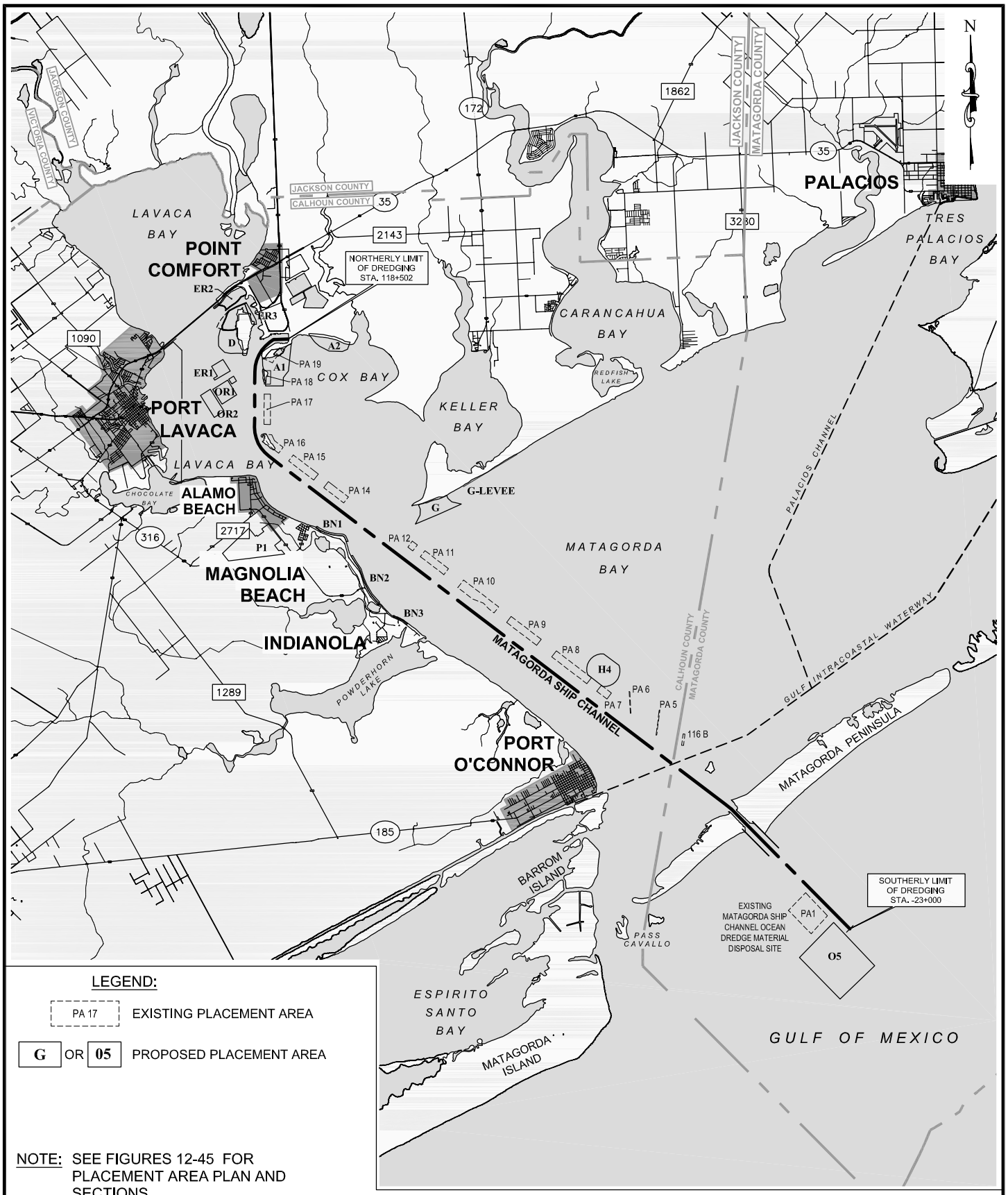
CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 1 OF 46



LEGEND:

PA 17 — EXISTING PLACEMENT AREA

G OR 05 — PROPOSED PLACEMENT AREA

NOTE: SEE FIGURES 12-45 FOR PLACEMENT AREA PLAN AND SECTIONS.

0 1 2 3 6

APPROXIMATE SCALE IN MILES

COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

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CHANNEL LAYOUT WITH EXISTING AND PROPOSED PLACEMENT AREAS

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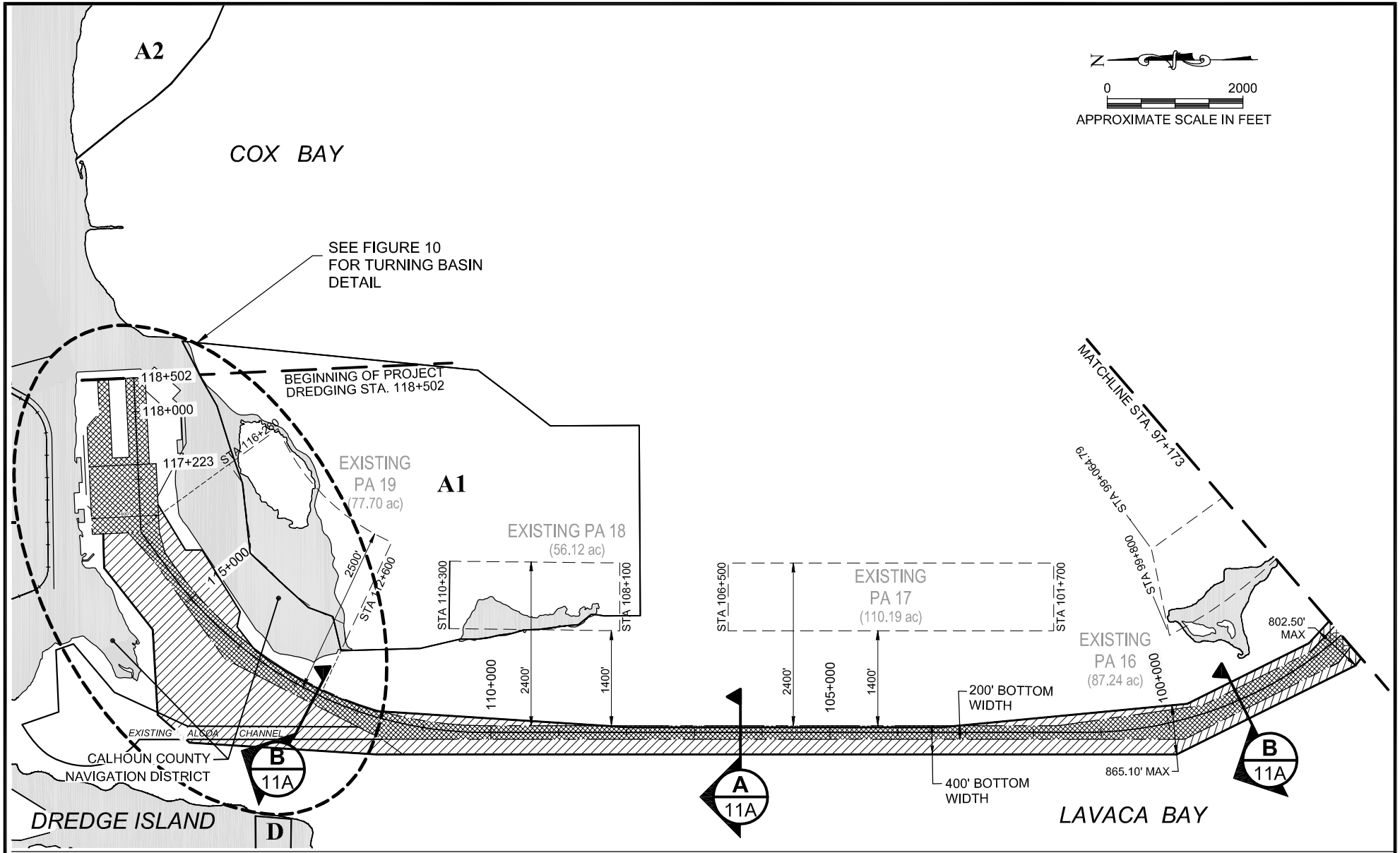
FIGURE 2 OF 46



NOTES:

1. COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.
2. SEE FIGURE 11 FOR THE CHANNEL CROSS SECTIONS.
3. THIS DOCUMENT IS RELEASED FOR PERMITTING ON MARCH 15, 2007 UNDER AUTHORITY OF MARK E. MAZOCH, P.E., #81099. IT IS NOT TO BE USED FOR CONSTRUCTION, OR BIDDING PURPOSES.

LEGEND:

- PROPOSED CHANNEL/ IMPROVEMENTS
- EXISTING CHANNEL/ MARINE FACILITIES
- PA 18 — EXISTING PLACEMENT AREA
- A1 OR 05 — PROPOSED PLACEMENT AREA

CHANNEL DREDGING PLAN
CHANNEL STA. 118+502 to STA. 97+173

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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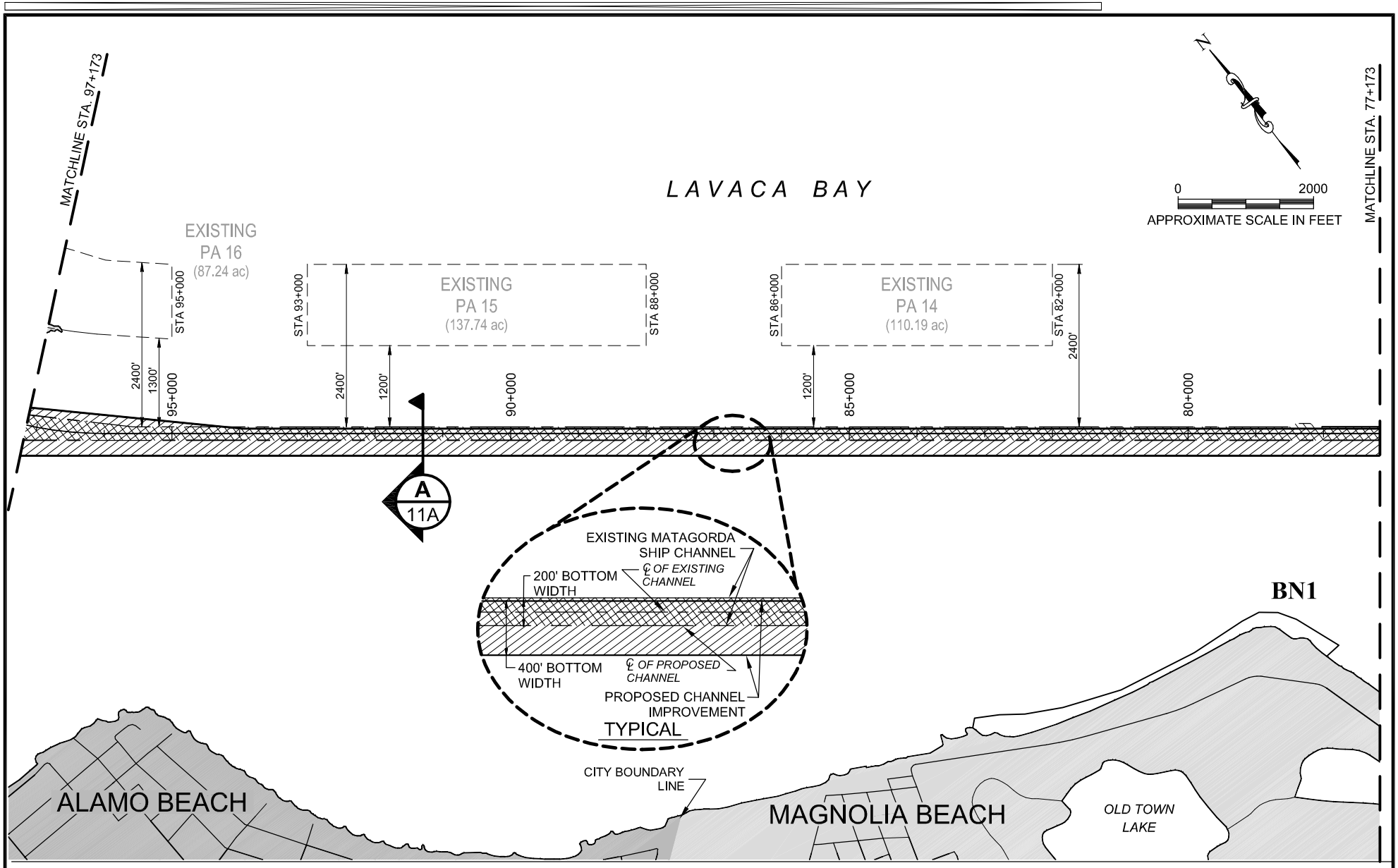
URS

PERMIT NO. 24071

FIGURE 3 OF 46



NOTES:

1. COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.
2. SEE FIGURE 11 FOR THE CHANNEL CROSS SECTIONS.
3. THIS DOCUMENT IS RELEASED FOR PERMITTING ON MARCH 15, 2007 UNDER AUTHORITY OF MARK E. MAZOCH, P.E., #81099. IT IS NOT TO BE USED FOR CONSTRUCTION, OR BIDDING PURPOSES.

LEGEND:

- PROPOSED CHANNEL/ IMPROVEMENTS
- EXISTING CHANNEL/ MARINE FACILITIES
- PA 18 — EXISTING PLACEMENT AREA
- A1 OR 05 — PROPOSED PLACEMENT AREA

CHANNEL DREDGING PLAN
CHANNEL STA. 97+173 to STA. 77+173

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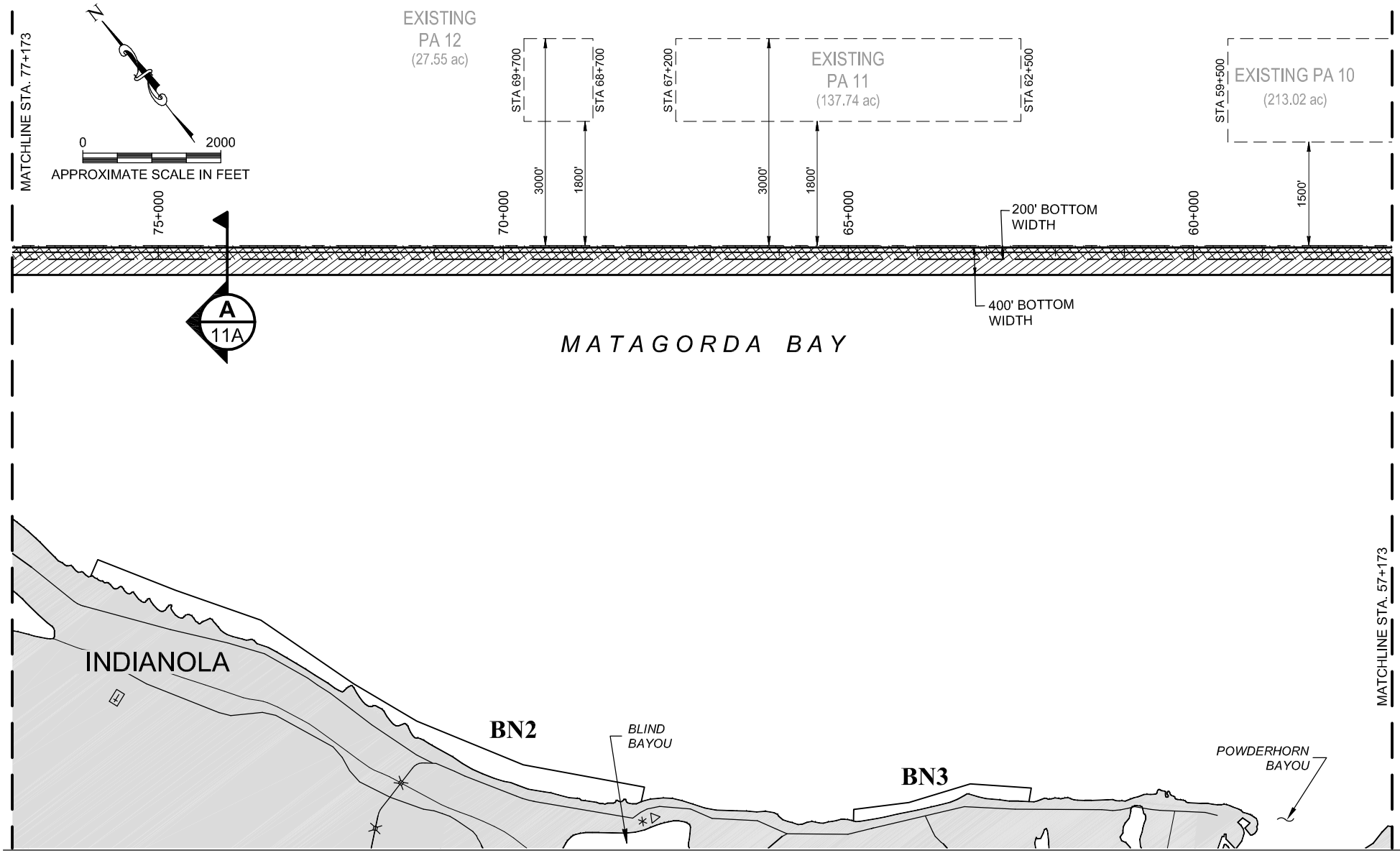
FIGURE 4 OF 46



NOTES:

1. COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.
2. SEE FIGURE 11 FOR THE CHANNEL CROSS SECTIONS.
3. THIS DOCUMENT IS RELEASED FOR PERMITTING ON MARCH 15, 2007 UNDER AUTHORITY OF MARK E. MAZOCH, P.E., #81099. IT IS NOT TO BE USED FOR CONSTRUCTION, OR BIDDING PURPOSES.

LEGEND:

- PROPOSED CHANNEL/ IMPROVEMENTS
- EXISTING CHANNEL/ MARINE FACILITIES
- PA 18 — EXISTING PLACEMENT AREA
- A1 OR 05 — PROPOSED PLACEMENT AREA

CHANNEL DREDGING PLAN
CHANNEL STA. 77+173 to STA. 57+173

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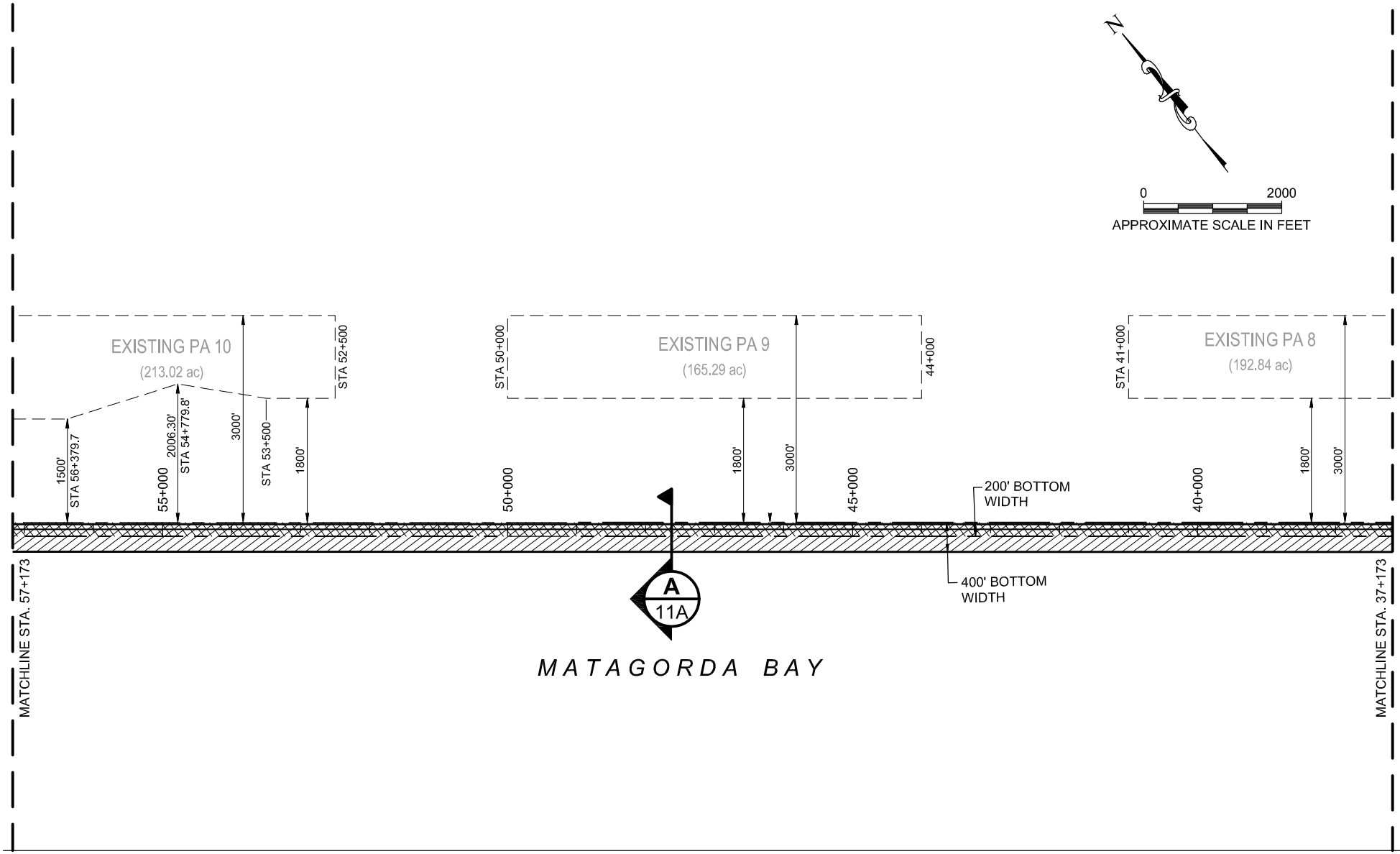
FIGURE 5 OF 46



NOTES:

1. COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.
2. SEE FIGURE 11 FOR THE CHANNEL CROSS SECTIONS.
3. THIS DOCUMENT IS RELEASED FOR PERMITTING ON MARCH 15, 2007 UNDER AUTHORITY OF MARK E. MAZOCH, P.E., #81099. IT IS NOT TO BE USED FOR CONSTRUCTION, OR BIDDING PURPOSES.

LEGEND:

- PROPOSED CHANNEL/ IMPROVEMENTS
- EXISTING CHANNEL/ MARINE FACILITIES
- PA 18 — EXISTING PLACEMENT AREA
- A1 OR 05 — PROPOSED PLACEMENT AREA

CHANNEL DREDGING PLAN
CHANNEL STA. 57+173 to STA. 37+173

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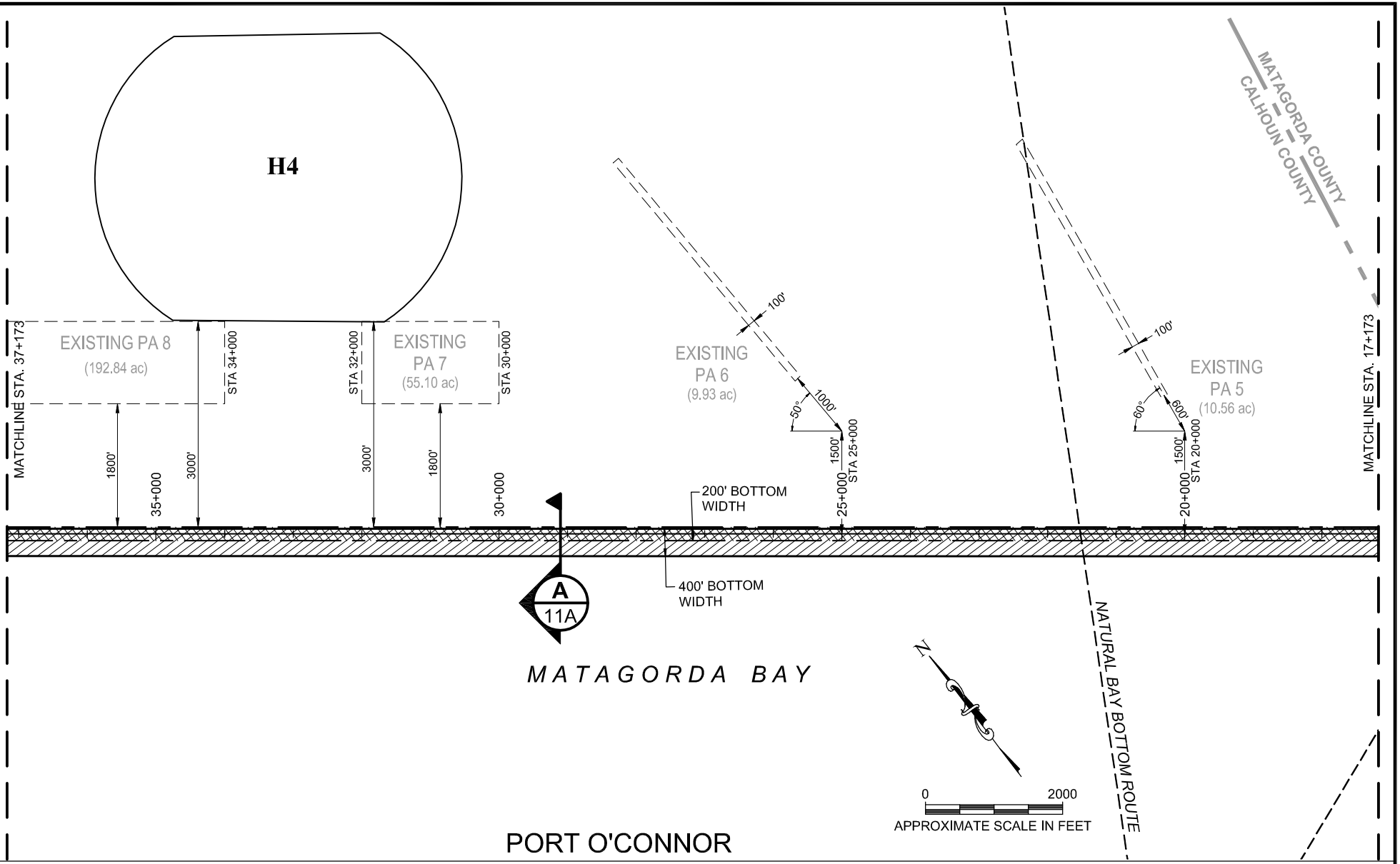
FIGURE 6 OF 46



NOTES:

1. COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.
2. SEE FIGURE 11 FOR THE CHANNEL CROSS SECTIONS.
3. THIS DOCUMENT IS RELEASED FOR PERMITTING ON MARCH 15, 2007 UNDER AUTHORITY OF MARK E. MAZOCH, P.E., #81099. IT IS NOT TO BE USED FOR CONSTRUCTION, OR BIDDING PURPOSES.

LEGEND:

- PROPOSED CHANNEL/ IMPROVEMENTS
- EXISTING CHANNEL/ MARINE FACILITIES
- PA 18 — EXISTING PLACEMENT AREA
- A1 OR 05 — PROPOSED PLACEMENT AREA

CHANNEL DREDGING PLAN
CHANNEL STA. 37+173 to STA. 17+173

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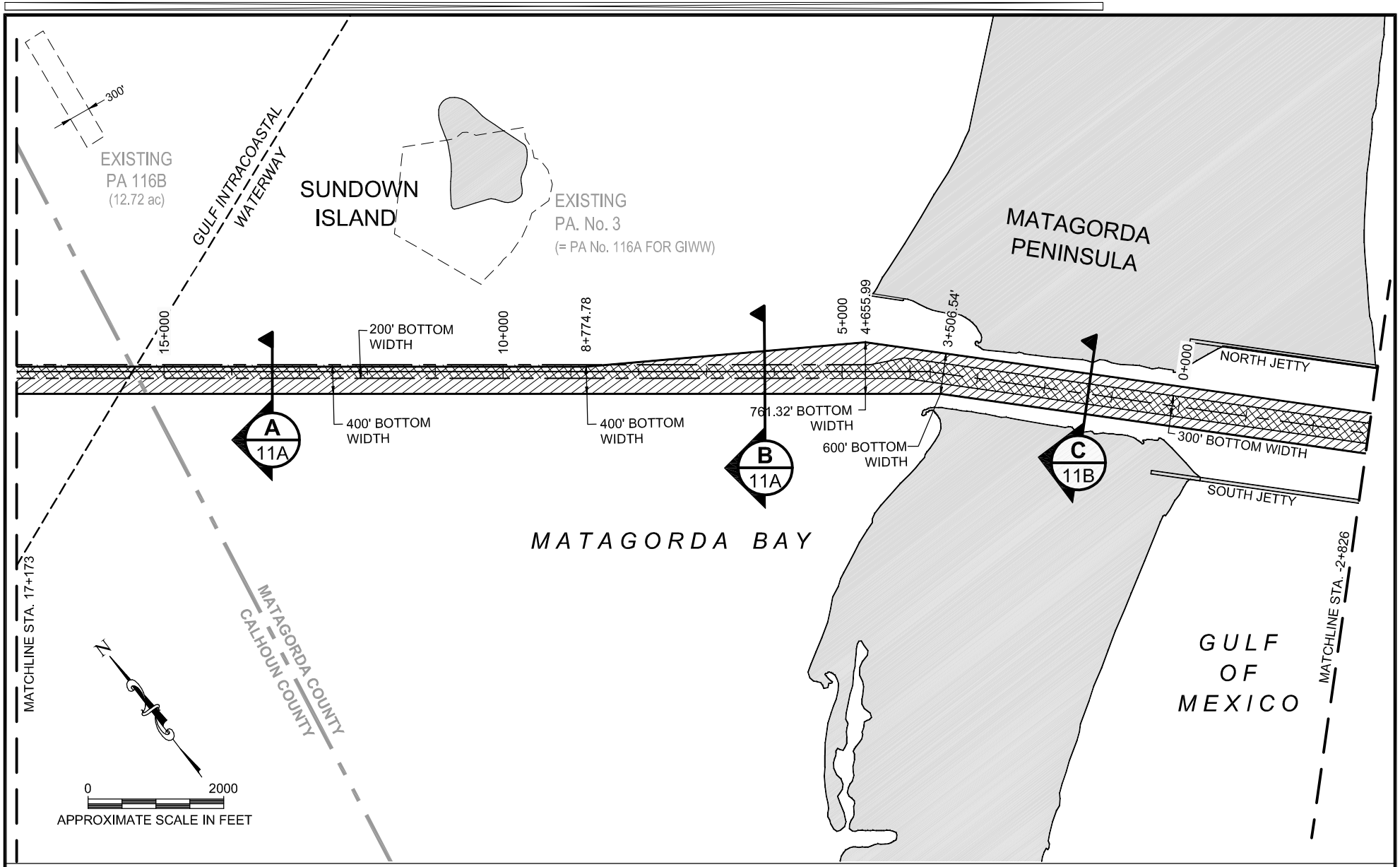
FIGURE 7 OF 46



NOTES:

1. COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.
2. SEE FIGURE 11A AND FIGURE 11B FOR THE CHANNEL CROSS SECTIONS.
3. THIS DOCUMENT IS RELEASED FOR PERMITTING ON MARCH 15, 2007 UNDER AUTHORITY OF MARK E. MAZOCH, P.E., #81099. IT IS NOT TO BE USED FOR CONSTRUCTION, OR BIDDING PURPOSES.

LEGEND:

- PROPOSED CHANNEL/ IMPROVEMENTS
- EXISTING CHANNEL/ MARINE FACILITIES
- PA 18 — EXISTING PLACEMENT AREA
- A1 OR 05 — PROPOSED PLACEMENT AREA

CHANNEL DREDGING PLAN
CHANNEL STA. 17+173 to STA. -2+826

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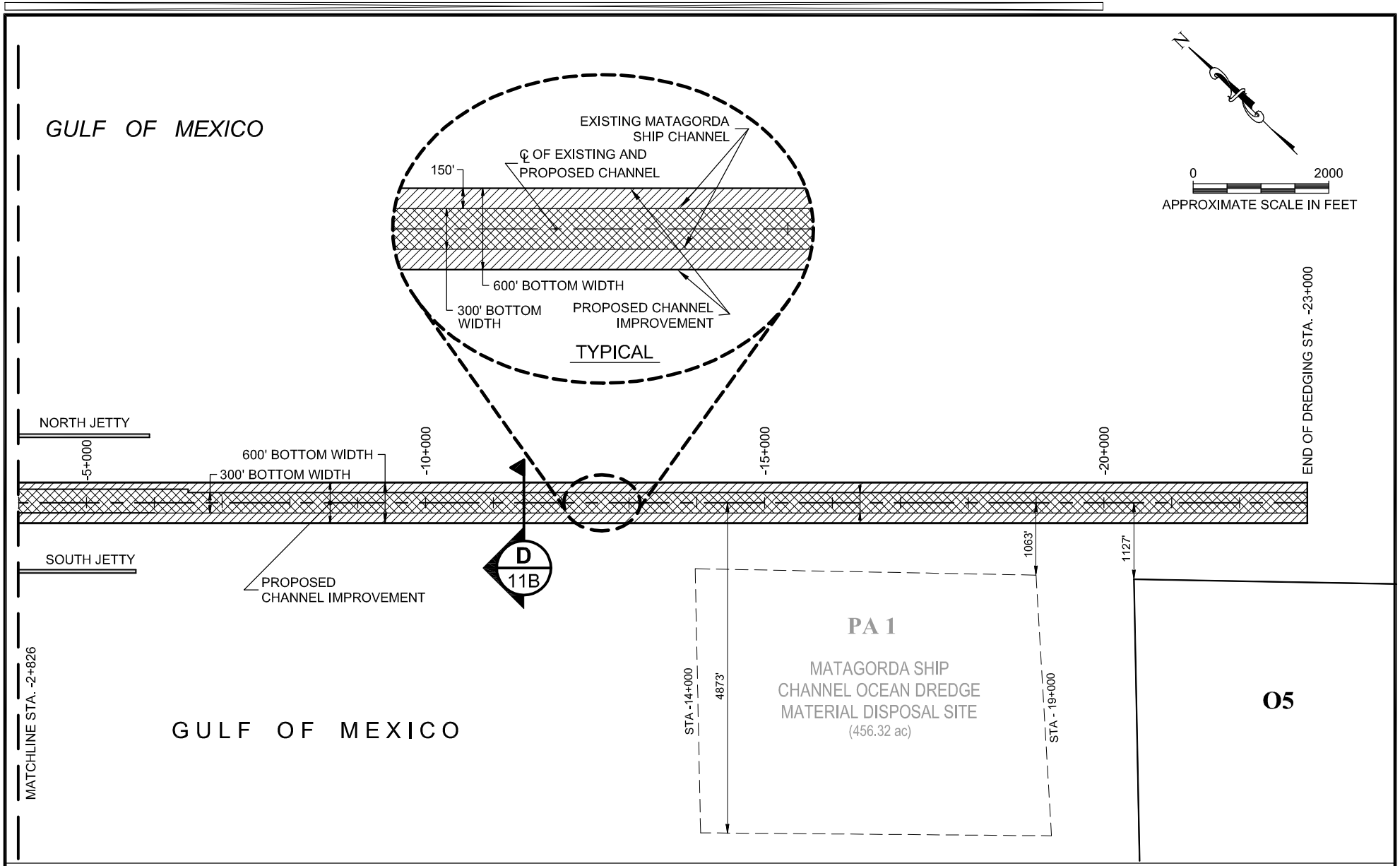
FIGURE 8 OF 46



NOTES:

1. COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.
2. SEE FIGURE 11B FOR THE CHANNEL CROSS SECTION.
3. THIS DOCUMENT IS RELEASED FOR PERMITTING ON MARCH 15, 2007 UNDER AUTHORITY OF MARK E. MAZOCH, P.E., #81099. IT IS NOT TO BE USED FOR CONSTRUCTION, OR BIDDING PURPOSES.

LEGEND:

- PROPOSED CHANNEL/ IMPROVEMENTS
- EXISTING CHANNEL/ MARINE FACILITIES
- PA 18 — EXISTING PLACEMENT AREA
- A1 OR 05 — PROPOSED PLACEMENT AREA

CHANNEL DREDGING PLAN
CHANNEL STA. -2+826 to STA. -23+000

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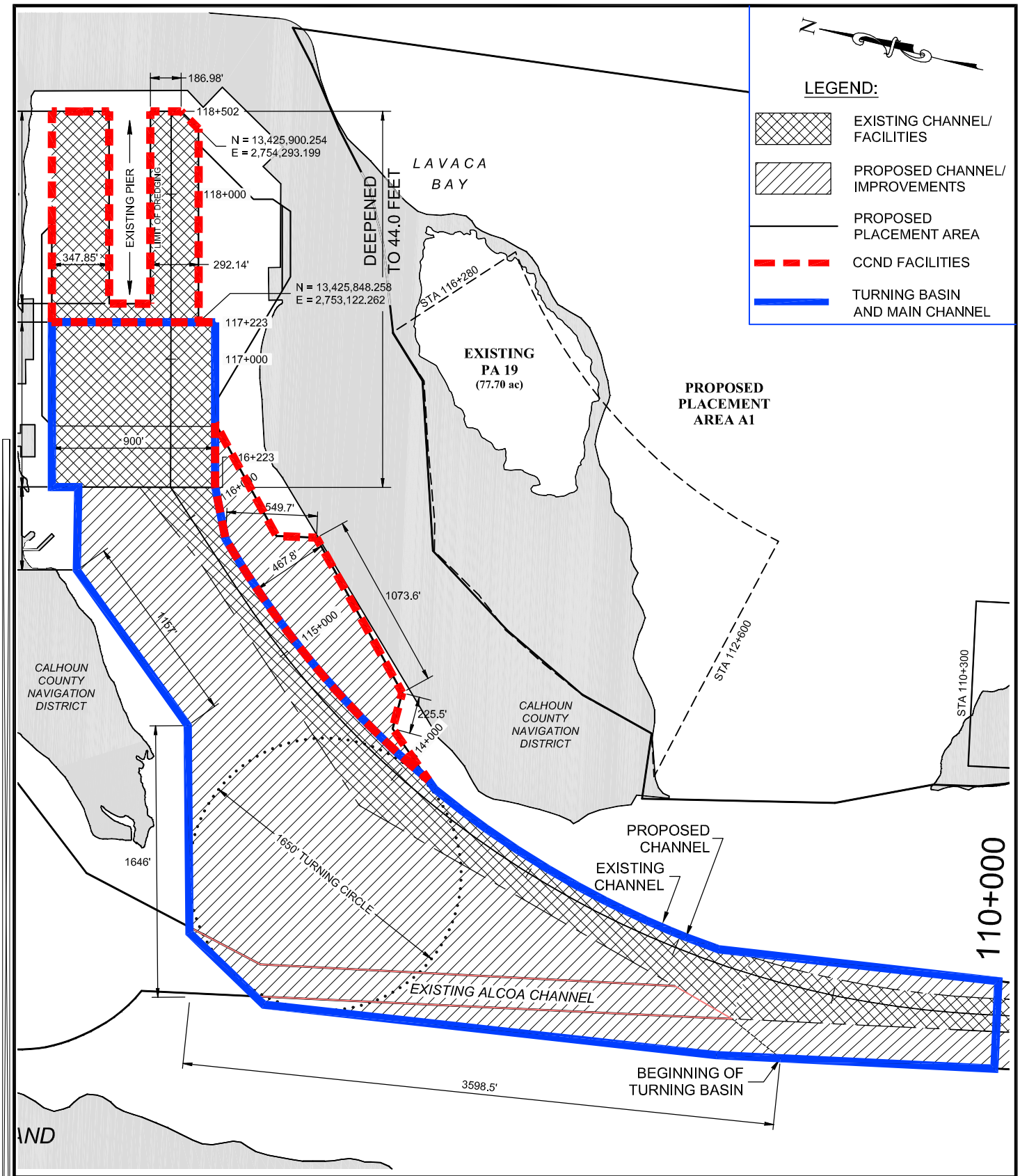
FIGURE 9 OF 46



0 800 1600

APPROXIMATE SCALE IN FEET

NOTE: NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT

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TURNING BASIN DETAIL

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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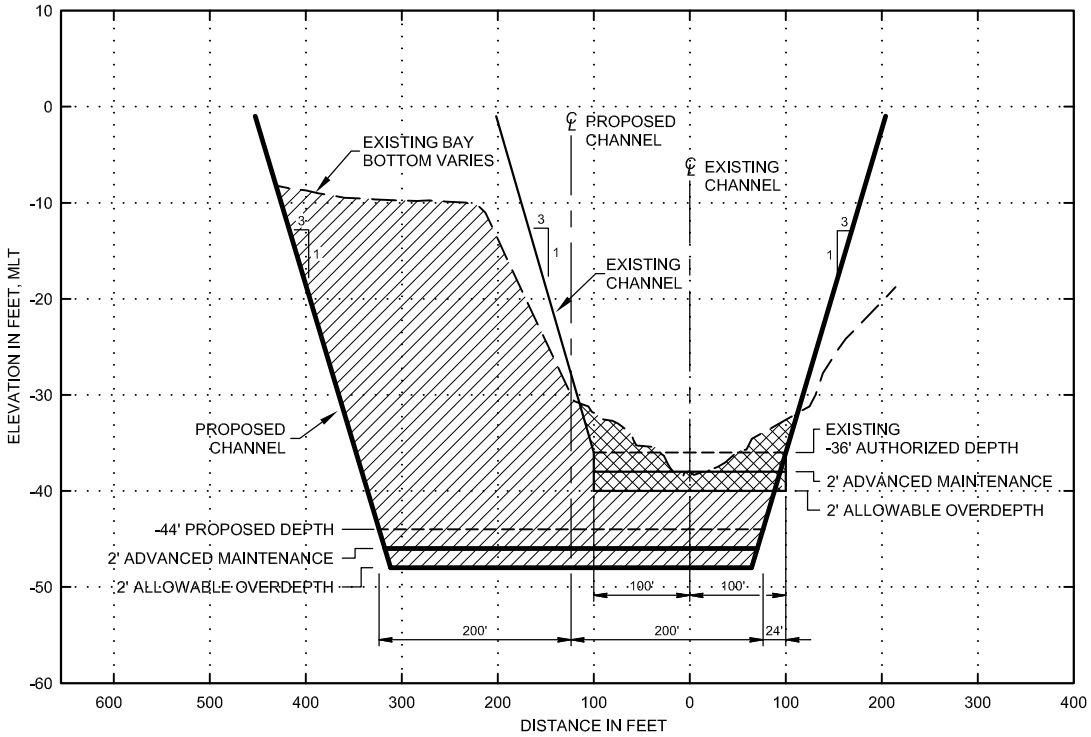
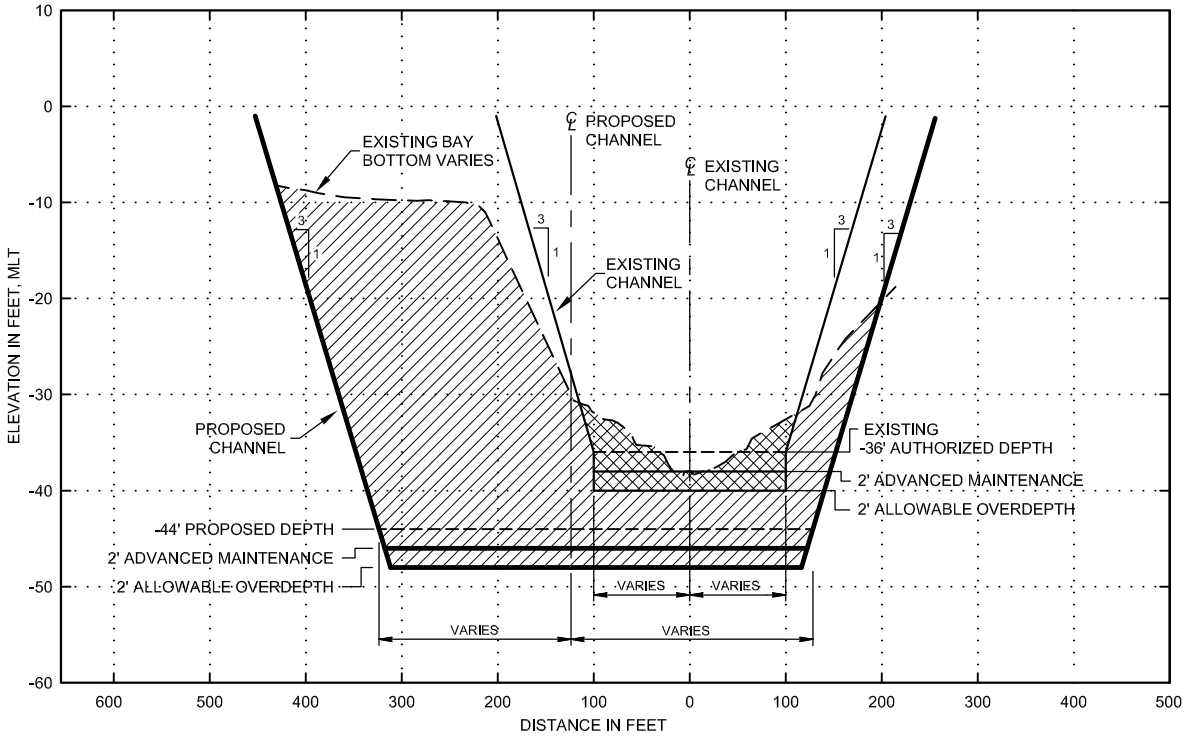
FIGURE 10 OF 46



A CROSS SECTION
BAY REACH



B CROSS SECTION
BAY REACH

LEGEND:

- AREA TO BE DREDGED FOR NEW WORK
- MAINTENANCE MATERIAL

NOTES:

1. CHANNEL SECTIONS ARE NOT TO SCALE.
2. CROSS SECTIONS VIEWED LOOKING TOWARDS INCREASING STATIONS.
3. ELEVATIONS ARE REFERENCED TO MEAN LOW TIDE DATUM.
4. SEE FIGURE 3 THROUGH FIGURE 8 FOR CROSS SECTION LOCATIONS.
5. THIS DOCUMENT IS RELEASED FOR PERMITTING ON MARCH 15, 2007 UNDER AUTHORITY OF MARK E. MAZOCH, P.E., #81099. IT IS NOT TO BE USED FOR CONSTRUCTION, OR BIDDING PURPOSES.

CHANNEL CROSS SECTIONS

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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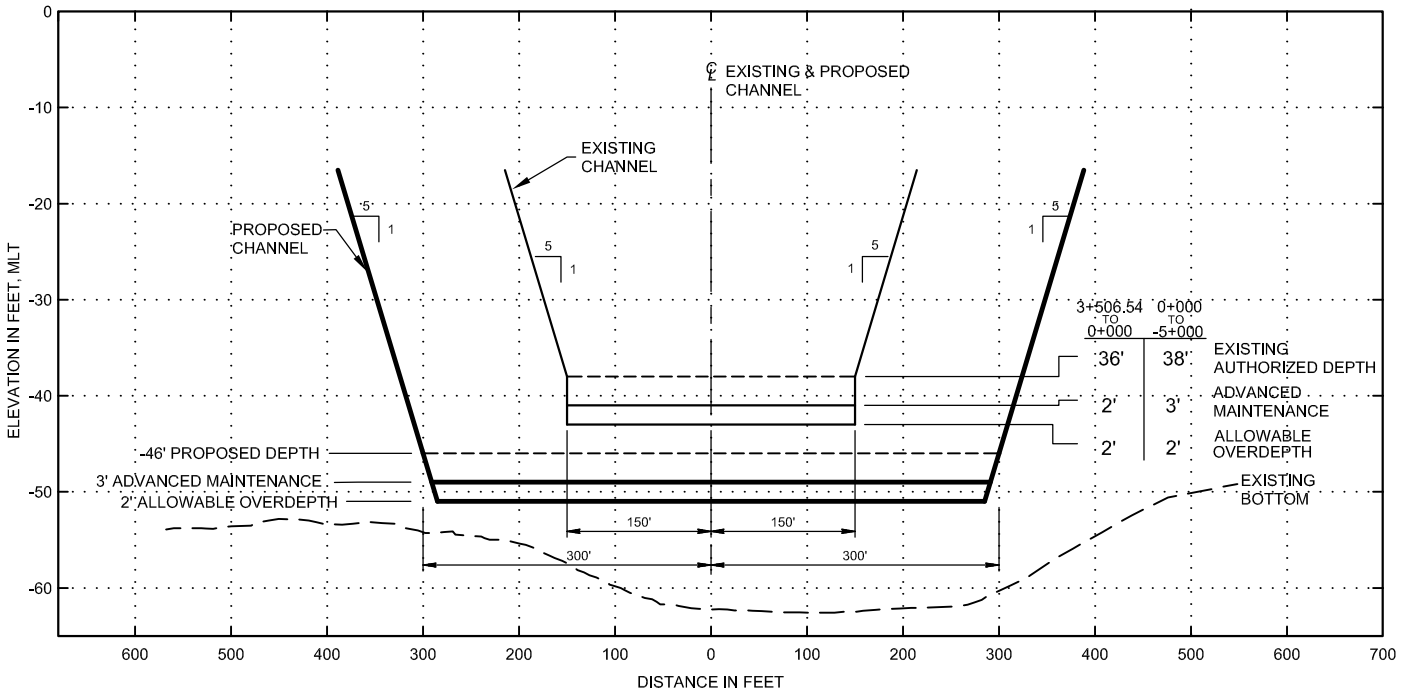
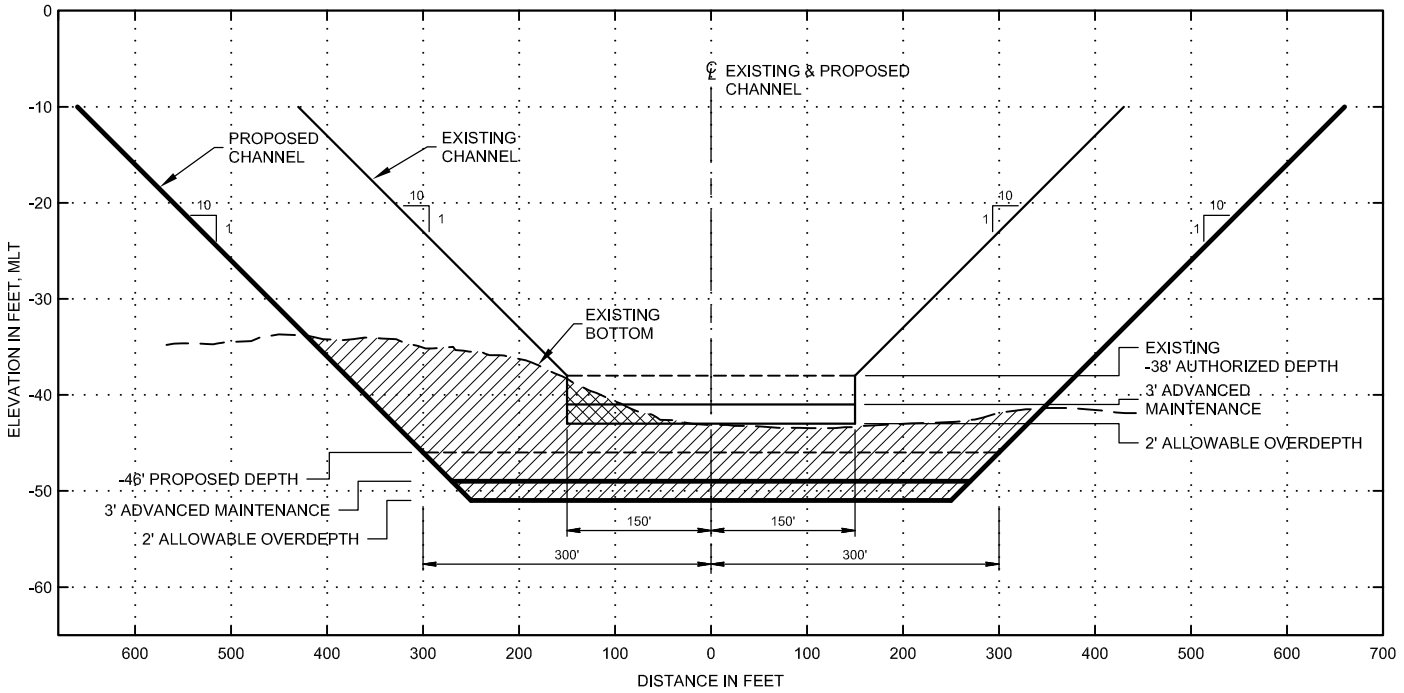
URS

PERMIT NO. 24071

FIGURE 11A OF 46



C - CROSS SECTION
OFFSHORE REACH
STATION 3+506.54 TO
STATION -5+000



D - CROSS SECTION
OFFSHORE REACH
STATION -5+000 TO
STATION -23+000

LEGEND:

AREA TO BE DREDGED FOR NEW WORK

MAINTENANCE MATERIAL

NOTES:

1. CHANNEL SECTIONS ARE NOT TO SCALE.
2. CROSS SECTIONS VIEWED LOOKING TOWARDS INCREASING STATIONS.
3. ELEVATIONS ARE REFERENCED TO MEAN LOW TIDE DATUM.
4. SEE FIGURE 8 AND FIGURE 9 FOR CROSS SECTION LOCATIONS.
5. THIS DOCUMENT IS RELEASED FOR PERMITTING ON MARCH 15, 2007 UNDER AUTHORITY OF MARK E. MAZOCH, P.E., #81099. IT IS NOT TO BE USED FOR CONSTRUCTION, OR BIDDING PURPOSES.

CHANNEL CROSS SECTIONS

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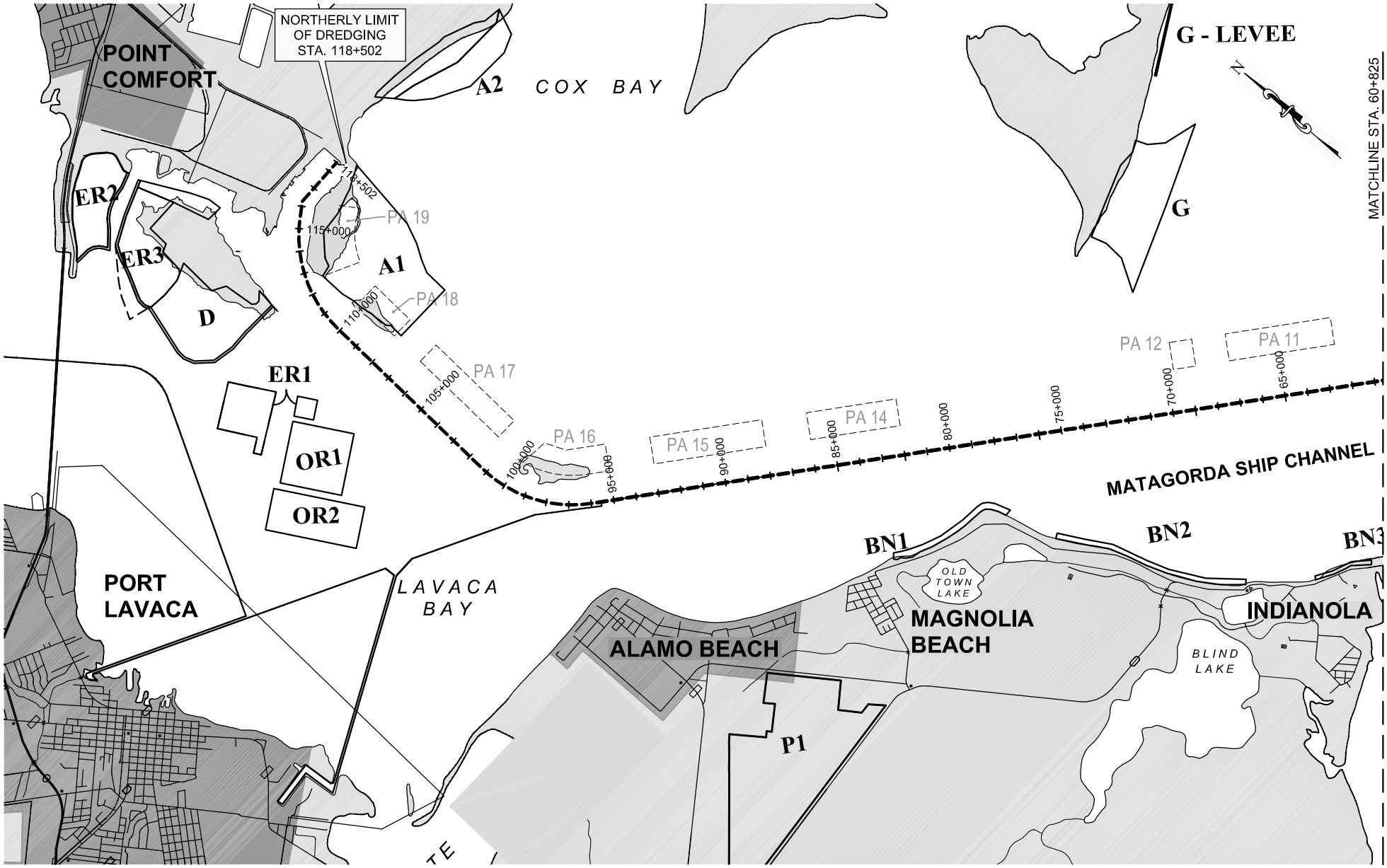
FIGURE 11B OF 46



0 6000 12000

APPROXIMATE SCALE IN FEET

NOTE: COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

LEGEND:

PA 17 EXISTING PLACEMENT AREA

G OR A1 PROPOSED PLACEMENT AREA

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PLACEMENT AREA PLAN STA. 118+502 TO STA. 60+825

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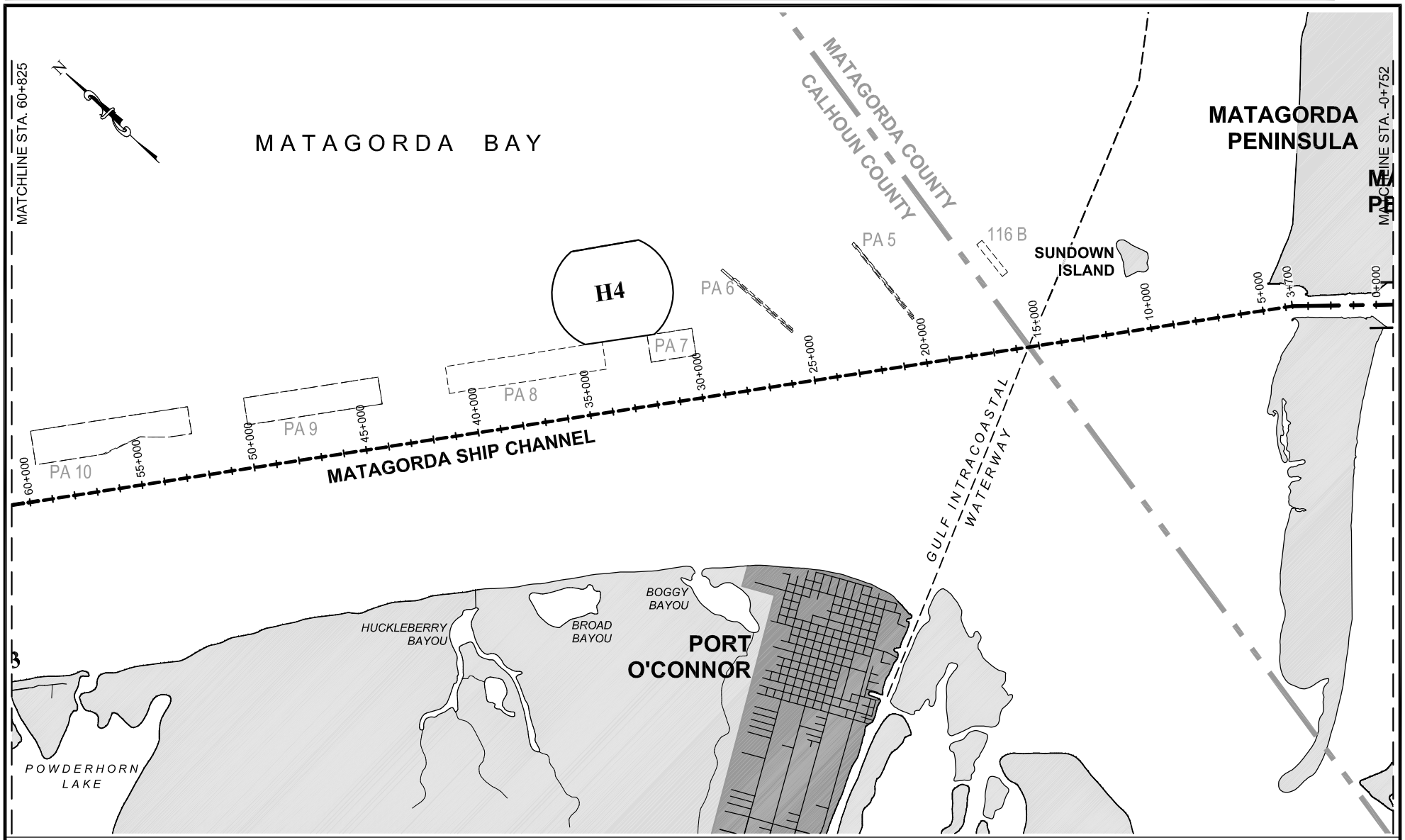
FIGURE 12 OF 46



0 6000 12000

APPROXIMATE SCALE IN FEET

NOTE: COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

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LEGEND:

PA 17 — EXISTING PLACEMENT AREA

G OR A1 — PROPOSED PLACEMENT AREA

PLACEMENT AREA PLAN
STA. 60+825 TO STA. -0+752

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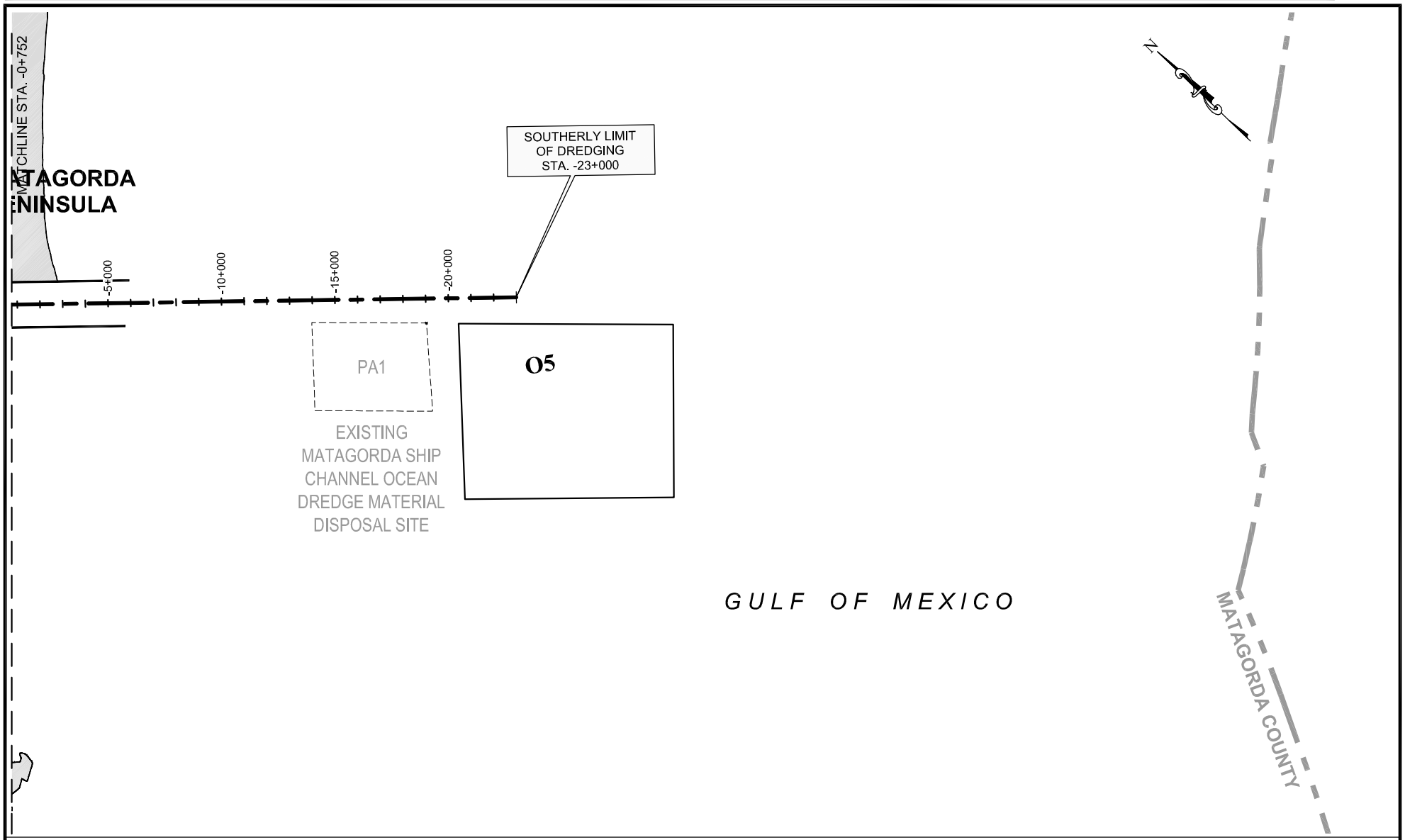
FIGURE 13 OF 46



0 6000 12000

APPROXIMATE SCALE IN FEET

NOTE: COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

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LEGEND:

PA 17 EXISTING PLACEMENT AREA

G OR A1 PROPOSED PLACEMENT AREA

PLACEMENT AREA PLAN
STA. -0+752 TO -23+000

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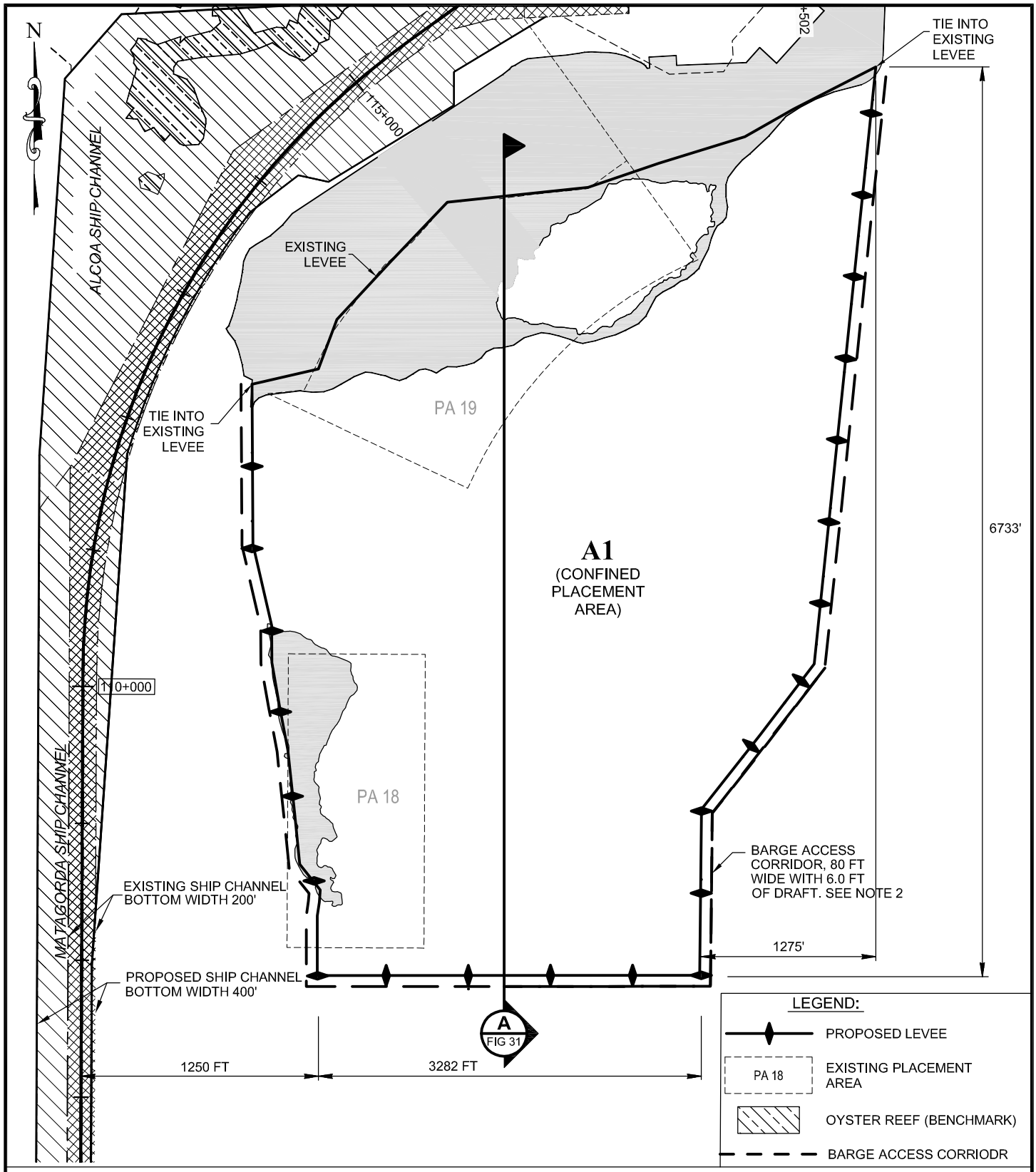
FIGURE 14 OF 46



NOTES:

1. COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.
2. MATERIAL DREDGED FROM ACCESS CORRIDOR WILL BE PLACED ALONG THE CHANNEL ALIGNMENT AND PULLED BACK INTO THE CHANNEL UPON COMPLETION IF MATERIAL IS IMPACTED BY MERCURY ABOVE THE LAVACA BAY SUPERFUND REMEDIAL ACTION OBJECTIVE FOR OPEN WATER THEN IT WILL BE MANAGED IN A MANNER CONSISTENT WITH THE LAVACA BAY SUPERFUND SITE REQUIREMENTS.
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0 1000 2000

APPROXIMATE SCALE IN FEET

PLACEMENT AREA PLAN AREA A1

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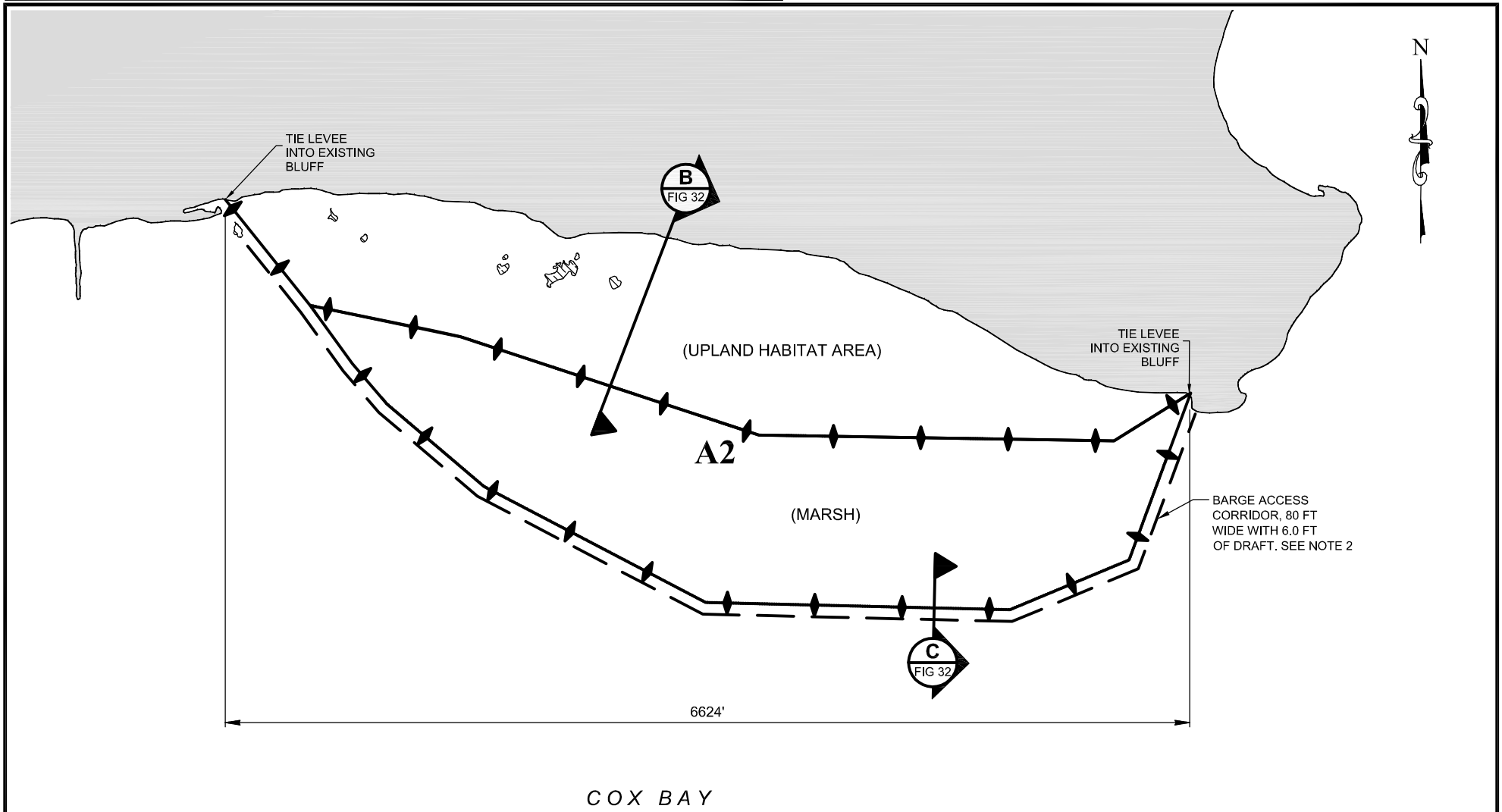
FIGURE 15 OF 46



NOTES:

1. COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.
2. MATERIAL DREDGED FROM ACCESS CORRIDOR WILL BE PLACED ALONG THE CHANNEL ALIGNMENT AND PULLED BACK INTO THE CHANNEL UPON COMPLETION. IF MATERIAL IS IMPACTED BY MERCURY ABOVE THE LAVACA BAY SUPERFUND REMEDIAL ACTION OBJECTIVE FOR OPEN WATER THEN IT WILL BE MANAGED IN A MANNER CONSISTENT WITH THE LAVACA BAY SUPERFUND SITE REQUIREMENTS
3. THIS DOCUMENT IS RELEASED FOR PERMITTING ON MARCH 15, 2007 UNDER AUTHORITY OF MARK E. MAZOCH, P.E., #81099. IT IS NOT TO BE USED FOR CONSTRUCTION, OR BIDDING PURPOSES.

0 1000 2000

APPROXIMATE SCALE IN FEET

LEGEND:

PROPOSED LEVEE

OYSTER REEF (BENCHMARK)

BARGE ACCESS CORRIDOR

PLACEMENT AREA PLAN
AREA A2

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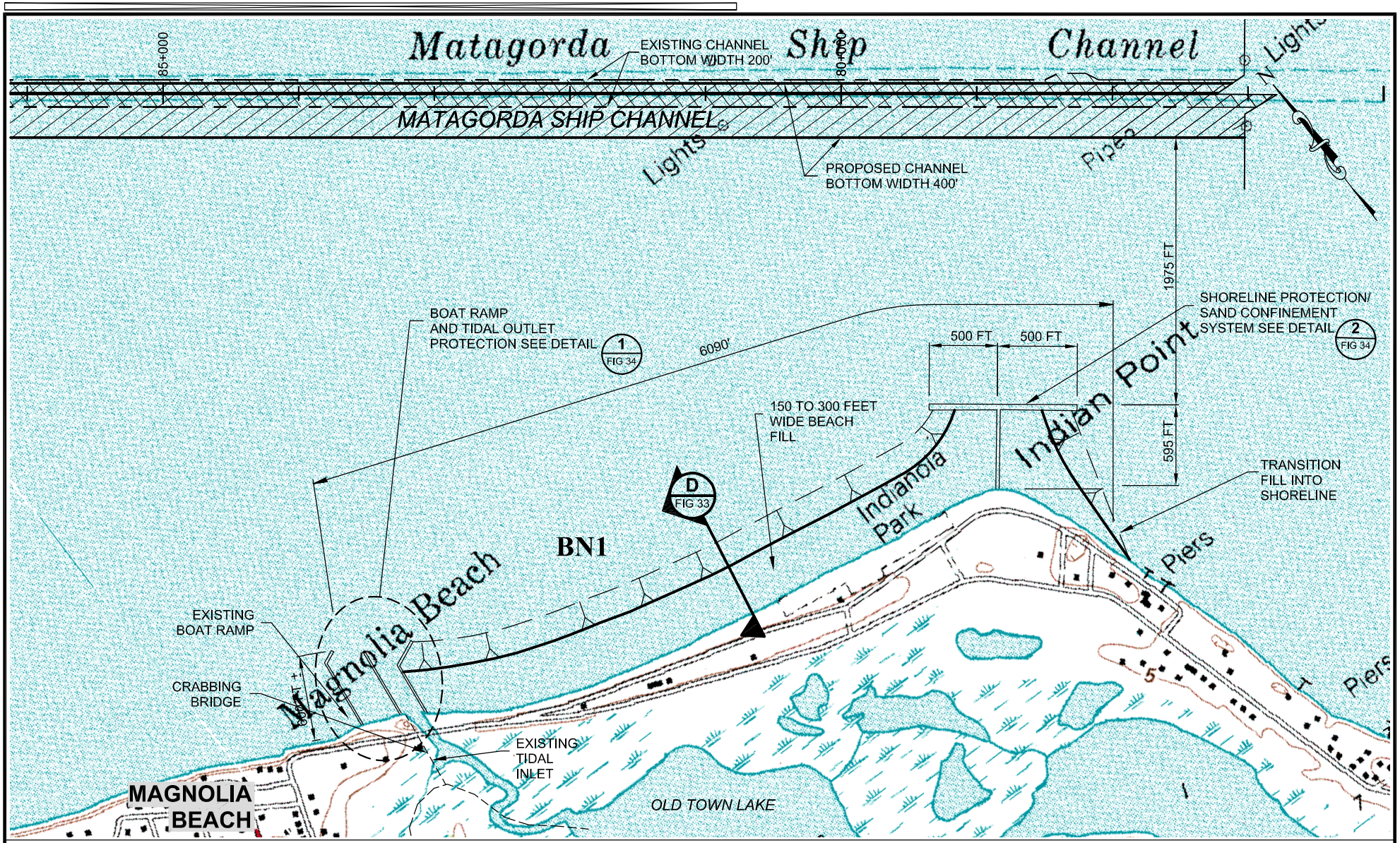
FIGURE 16 OF 46



NOTES:

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Source:

U.S.G.S. 7.5-minute Series Topographic Maps for Point Comfort (1995), Port Lavaca East (1995), Olivia (1995) and Keller Bay (1951) Texas Quadrangles.

0 1000 2000

APPROXIMATE SCALE IN FEET

LEGEND:

BEACH SLOPE

PLACEMENT AREA PLAN AREA BN1

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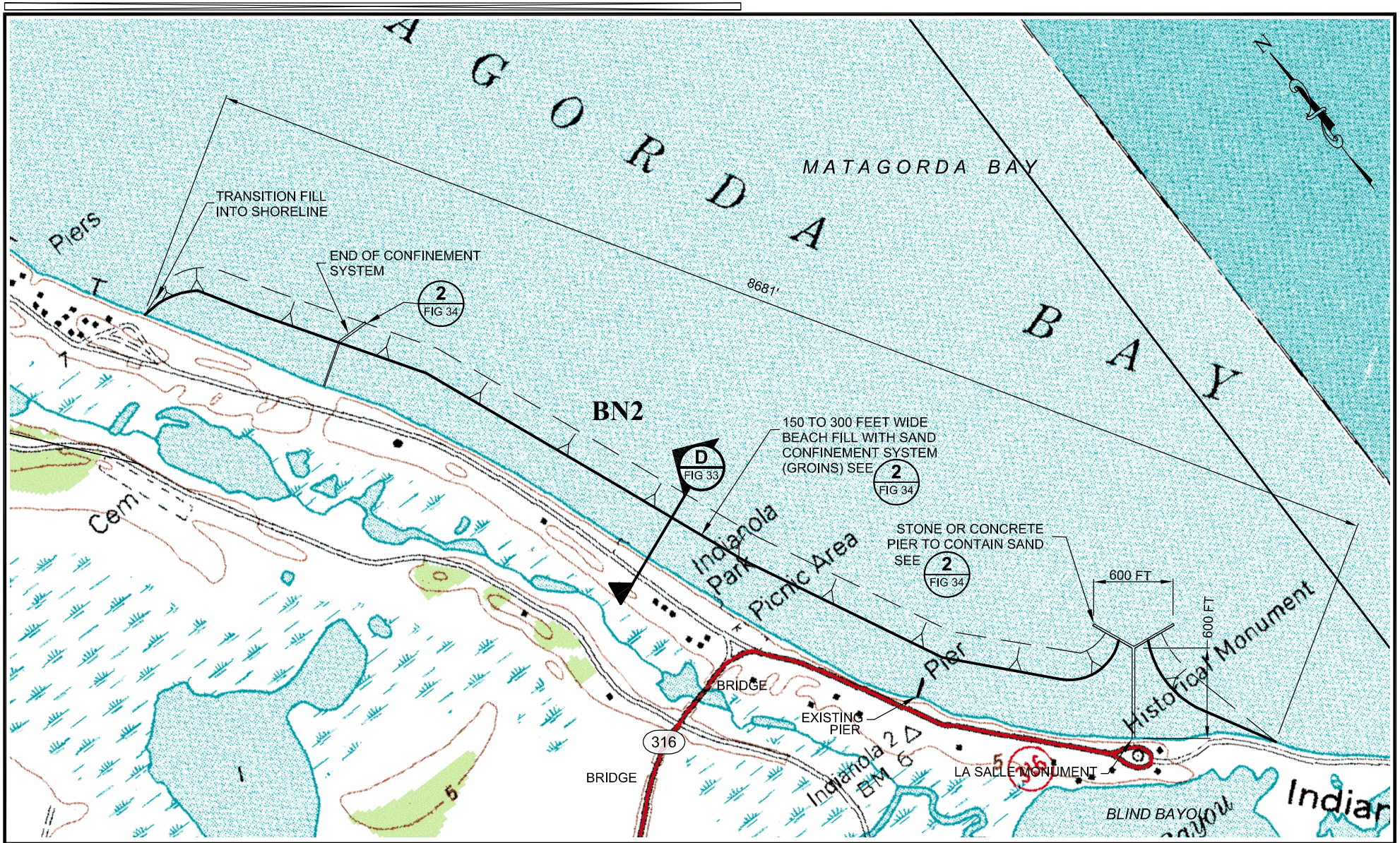
FIGURE 17 OF 46



NOTES:

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Source:

U.S.G.S. 7.5-minute Series Topographic Maps for Point Comfort (1995), Port Lavaca East (1995), Olivia (1995) and Keller Bay (1951) Texas Quadrangles.

0 1000 2000

APPROXIMATE SCALE IN FEET

LEGEND:

BEACH SLOPE

PLACEMENT AREA PLAN AREA BN2

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 3-15-07

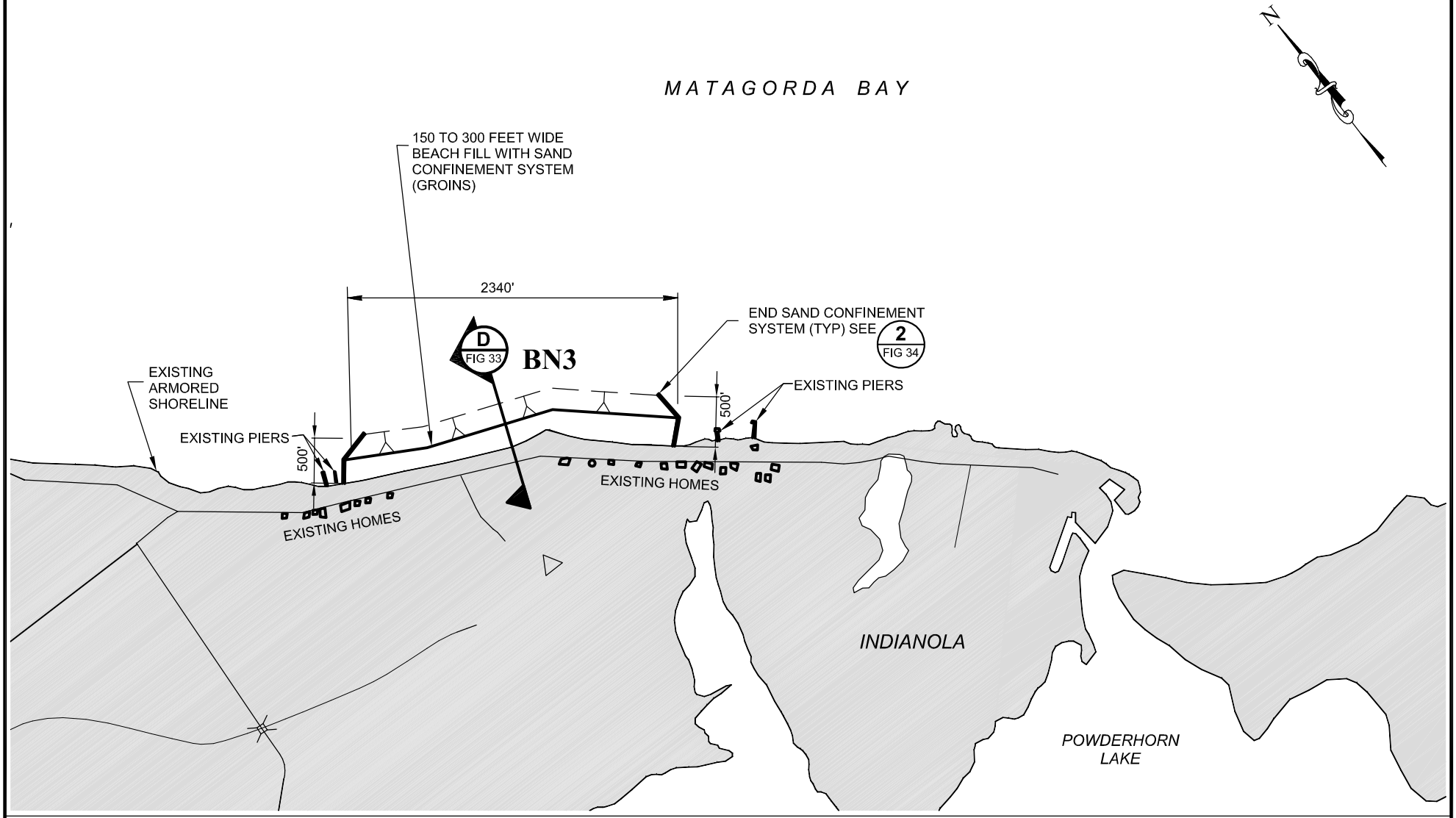
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 18 OF 46



0 1000 2000

APPROXIMATE SCALE IN FEET

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LEGEND:

BEACH SLOPE

PLACEMENT AREA PLAN
AREA BN3

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 3-15-07

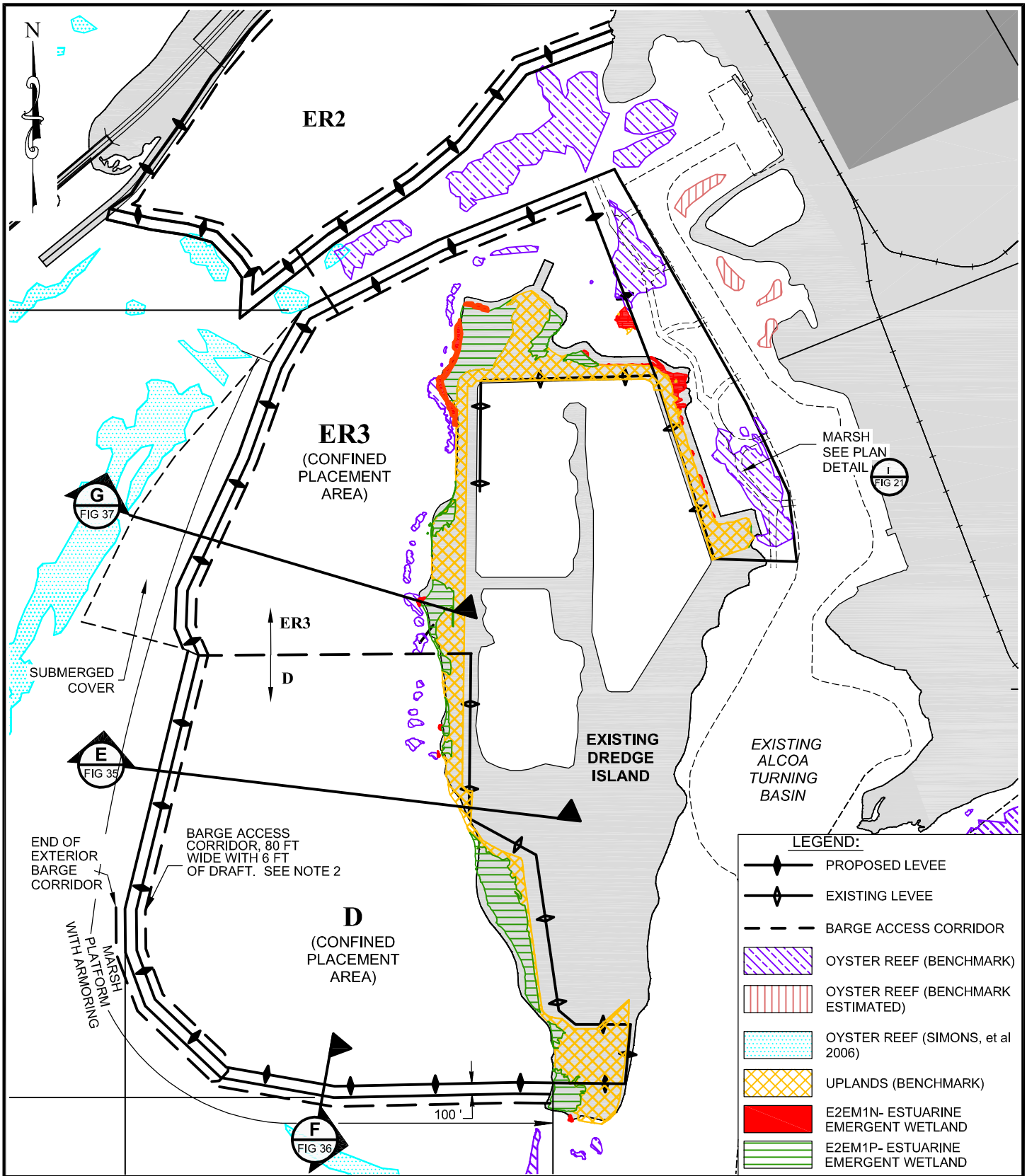
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 19 OF 46



NOTES:

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0 1200 2400

APPROXIMATE SCALE IN FEET

PLACEMENT AREA PLAN AREAS D and ER3

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 3-15-07

MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

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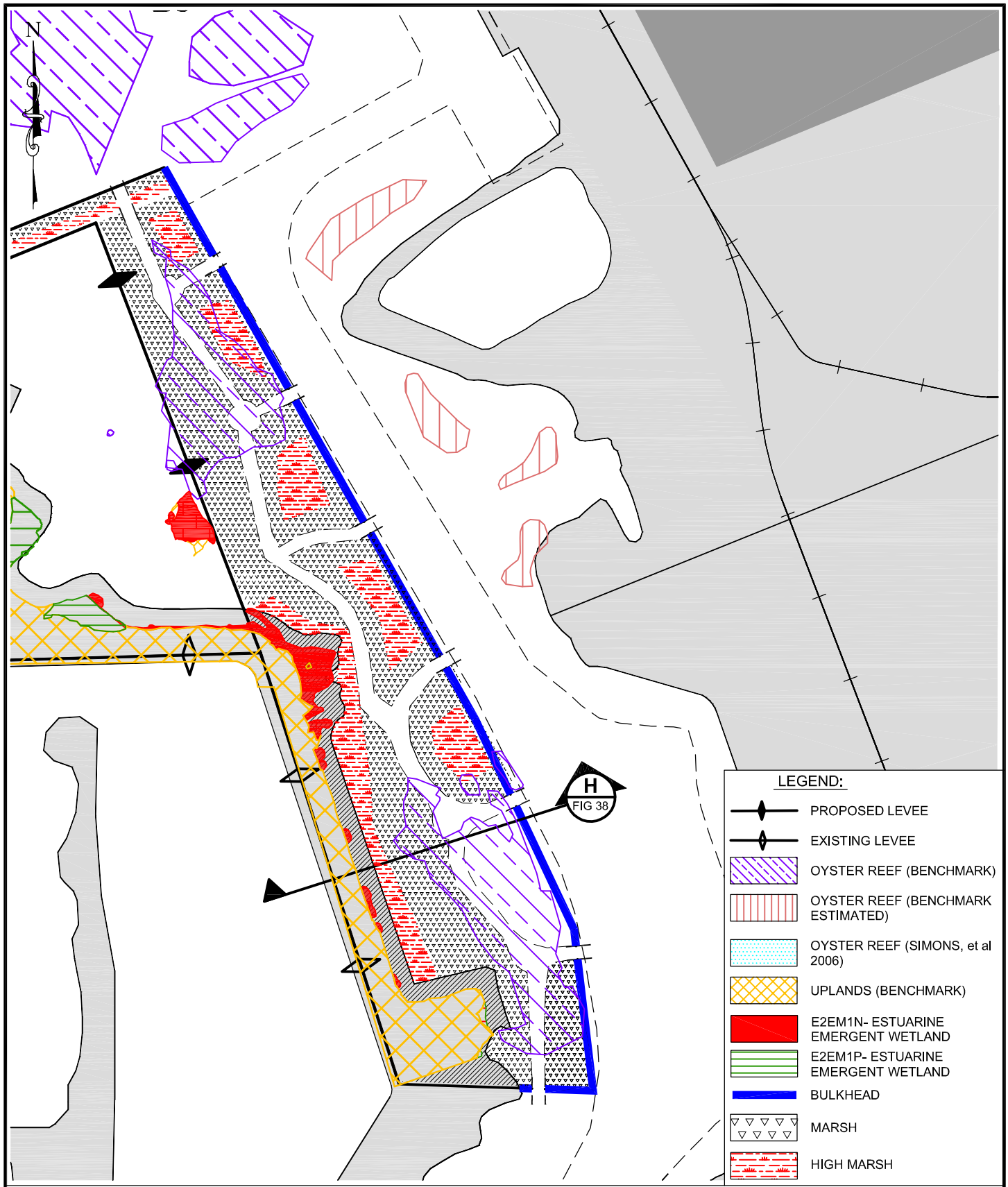
FIGURE 20 OF 46



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APPROXIMATE SCALE IN FEET

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PLACEMENT AREA PLAN
AREA ER3 MARSH

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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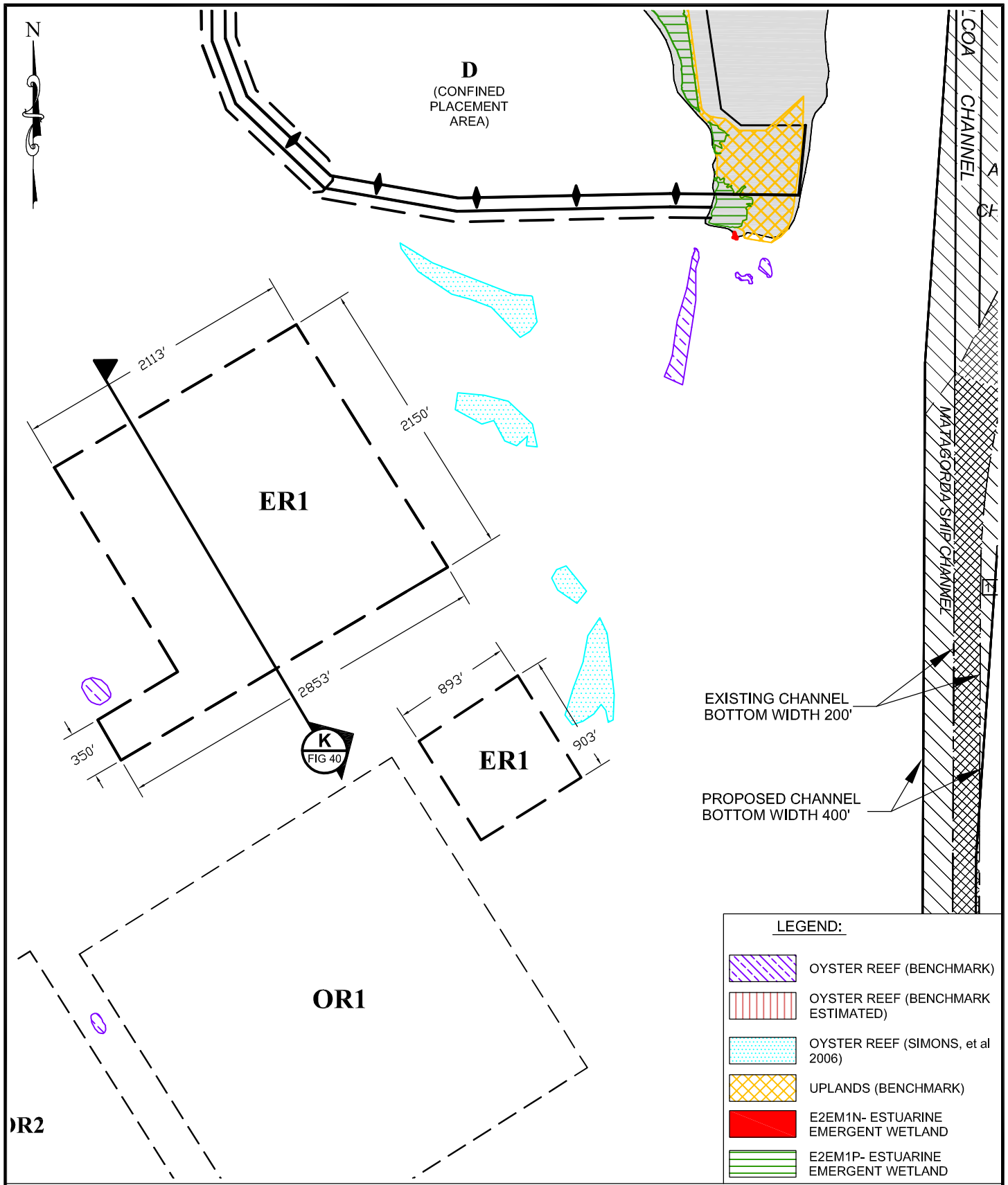
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 21 OF 46



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PLACEMENT AREA PLAN
AREA ER1

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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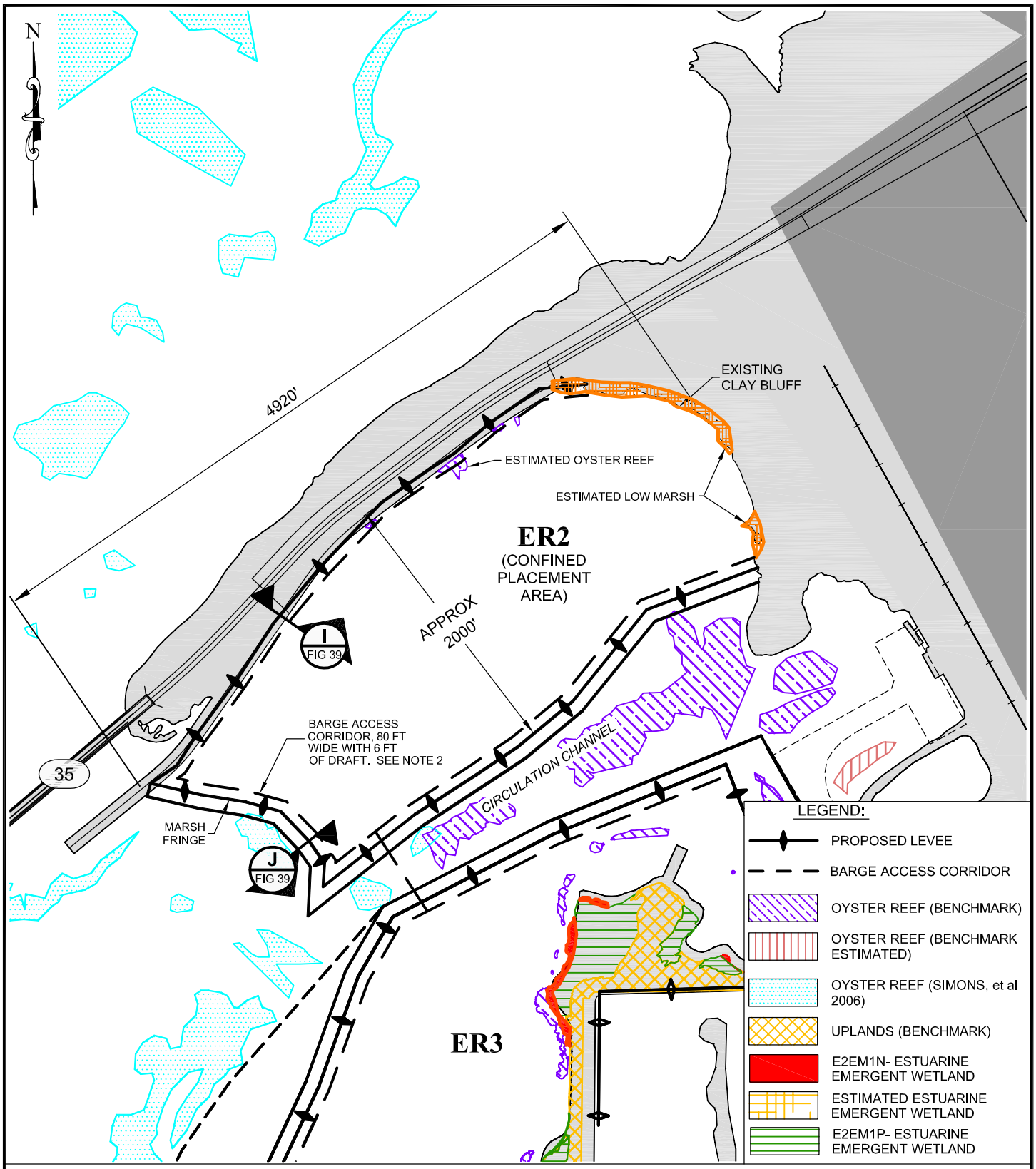
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 22 OF 46



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0 1000 2000

APPROXIMATE SCALE IN FEET

PLACEMENT AREA PLAN AREA ER2

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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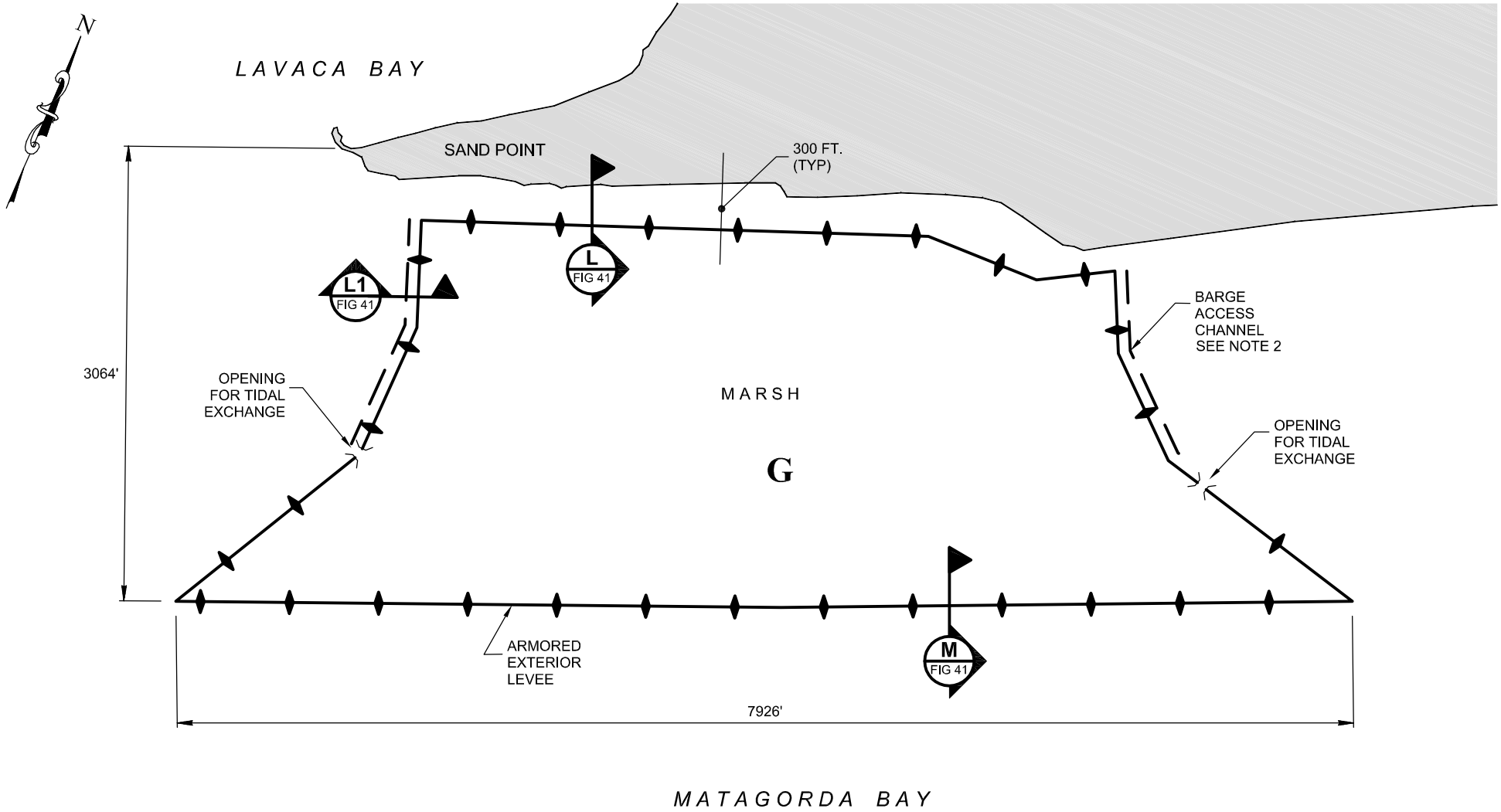
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 23 OF 46



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0 1000 2000

APPROXIMATE SCALE IN FEET

LEGEND:

PROPOSED LEVEE

BARGE ACCESS CORRIDOR

PLACEMENT AREA PLAN AREA G

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 3-15-07

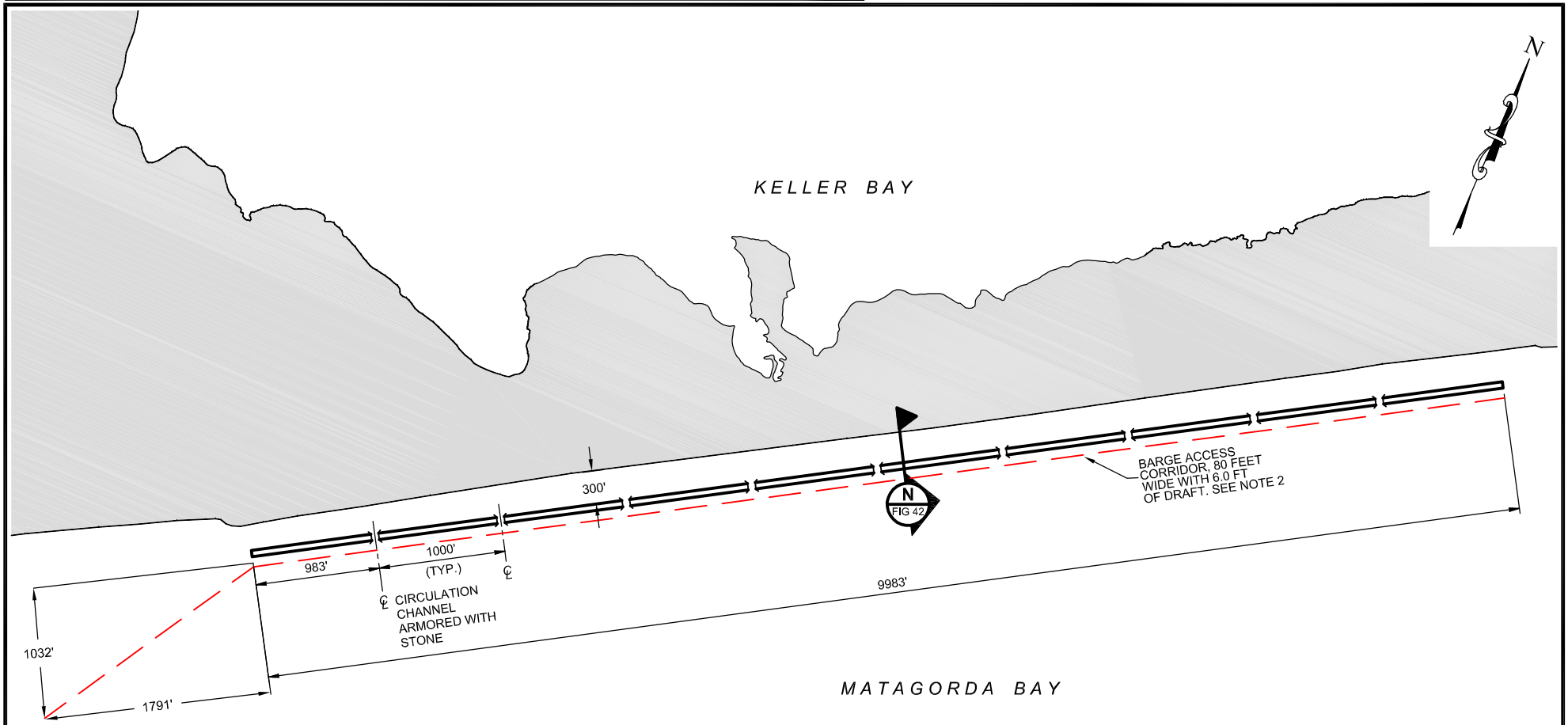
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 24 OF 46



G

NOTES:

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0 1200 2400

APPROXIMATE SCALE IN FEET

LEGEND:

CIRCULATION CHANNEL

BARGE ACCESS CORRIDOR

PLACEMENT AREA PLAN
AREA G LEVEE

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 3-15-07

MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

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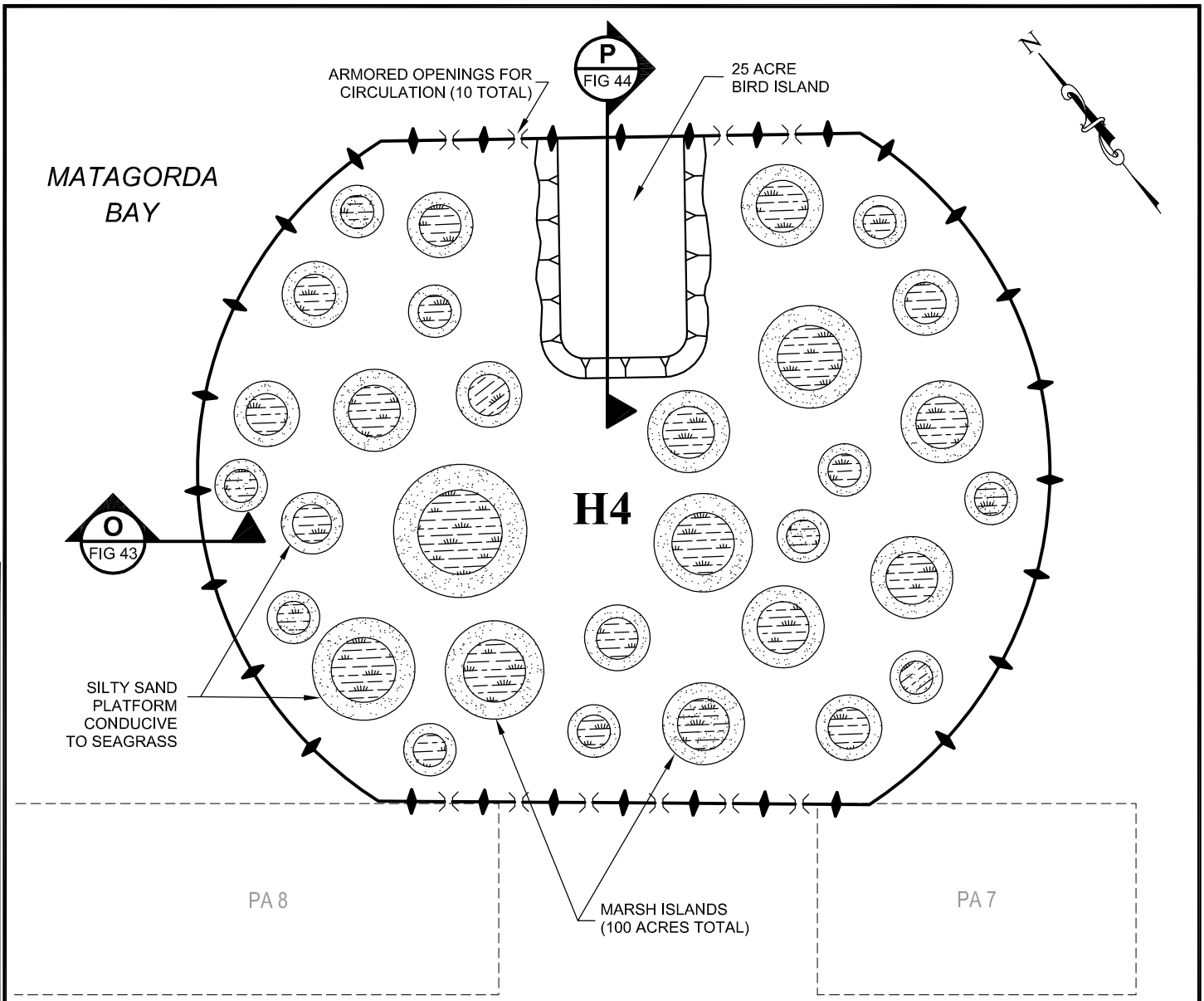
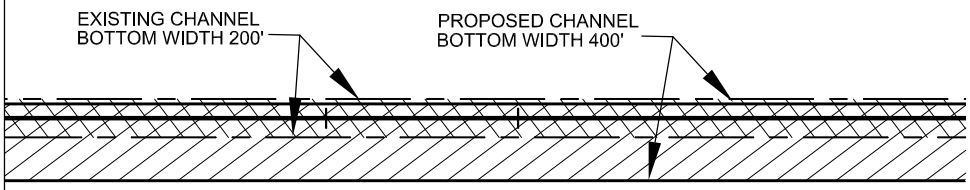
FIGURE 25 OF 46



LEGEND:

PROPOSED LEVEE

PA 18 — EXISTING PLACEMENT AREA



0 1000 2000

APPROXIMATE SCALE IN FEET

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PLACEMENT AREA PLAN AREA H4

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 3-15-07

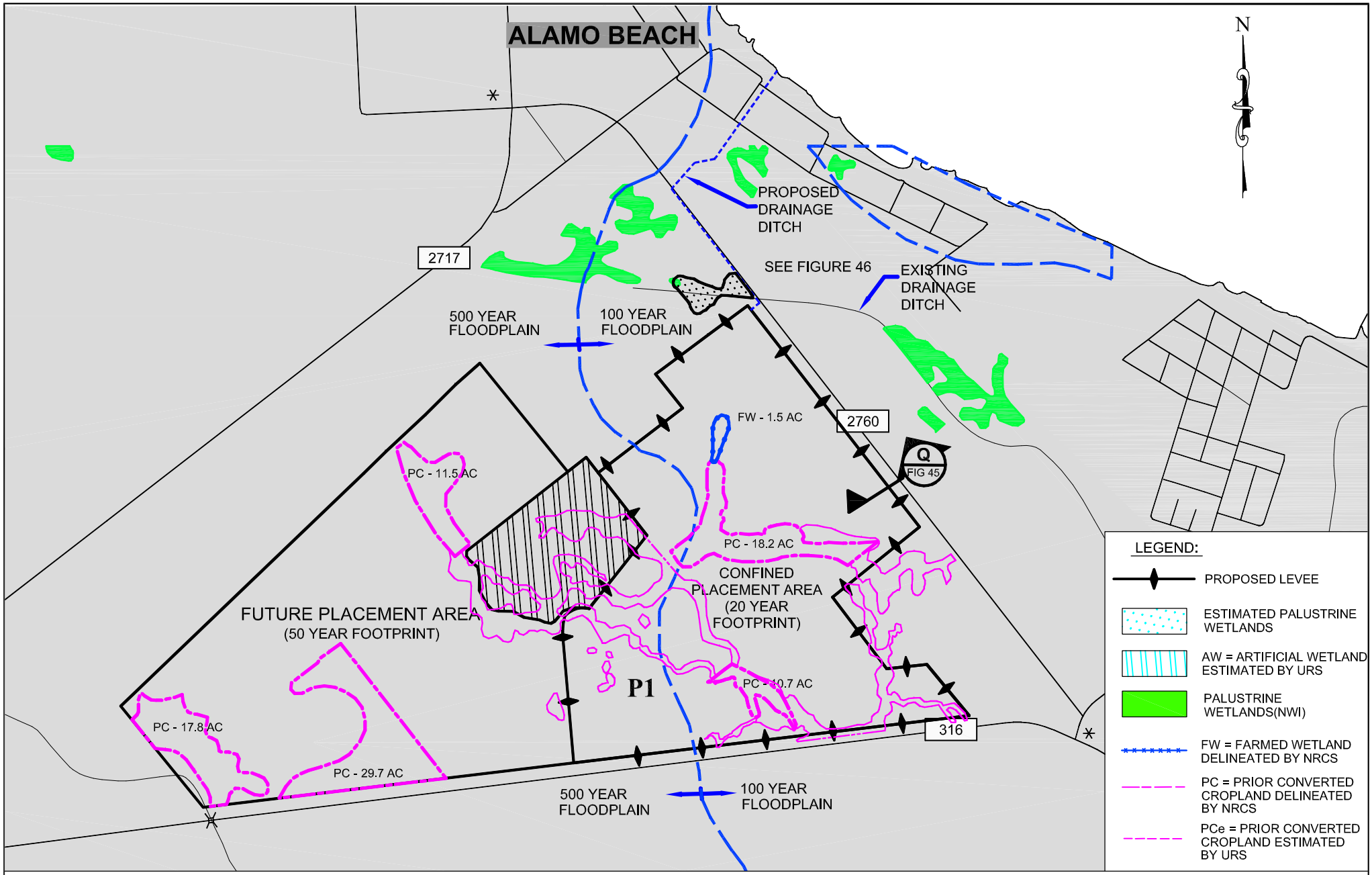
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 26 OF 46



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0 1500 3000

APPROXIMATE SCALE IN FEET

PLACEMENT AREA PLAN AREA P1

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 4-26-07

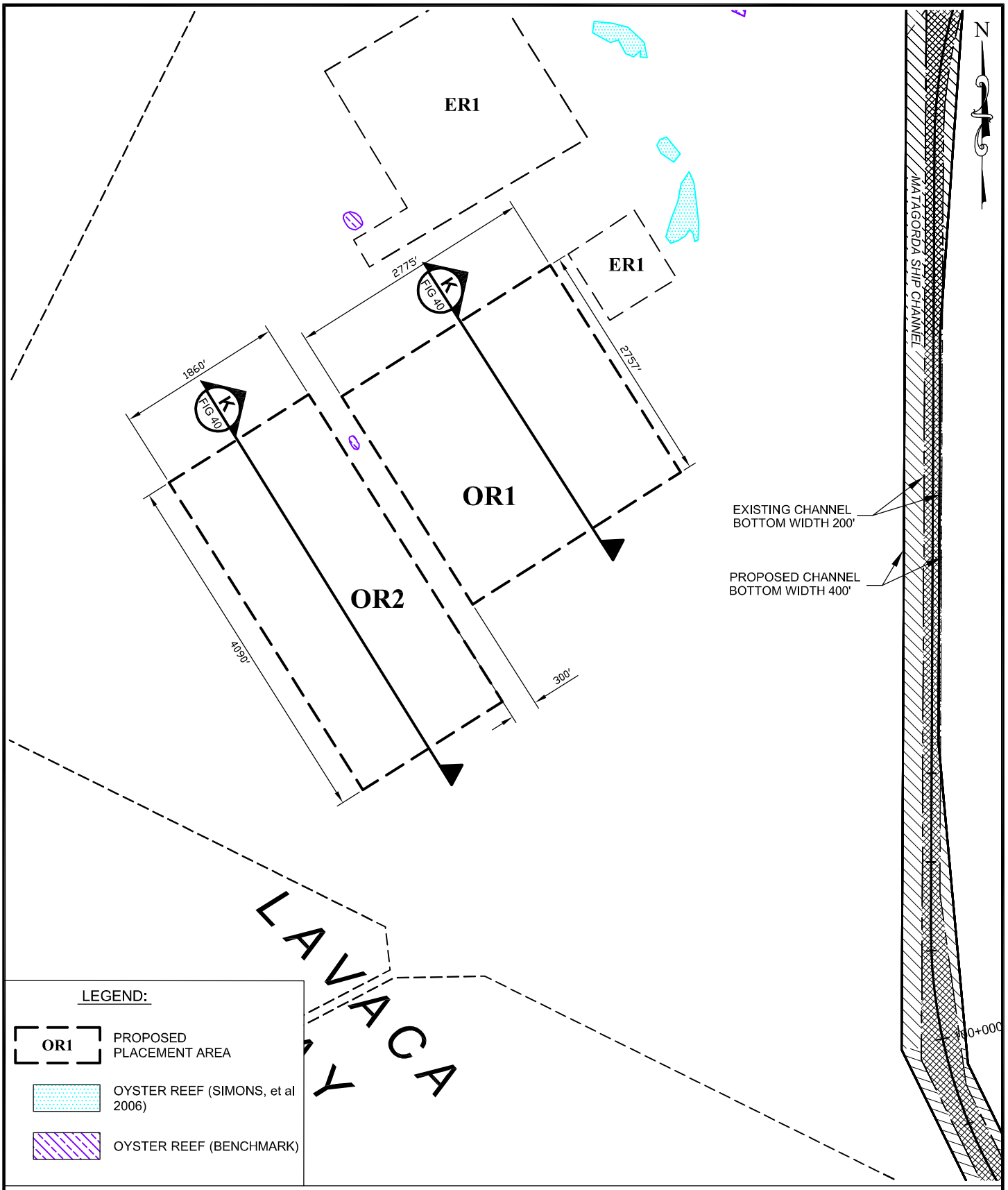
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 27 OF 46



0 1500 3000

APPROXIMATE SCALE IN FEET

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PLACEMENT AREA PLAN
AREAS OR1 AND OR2

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 3-15-07

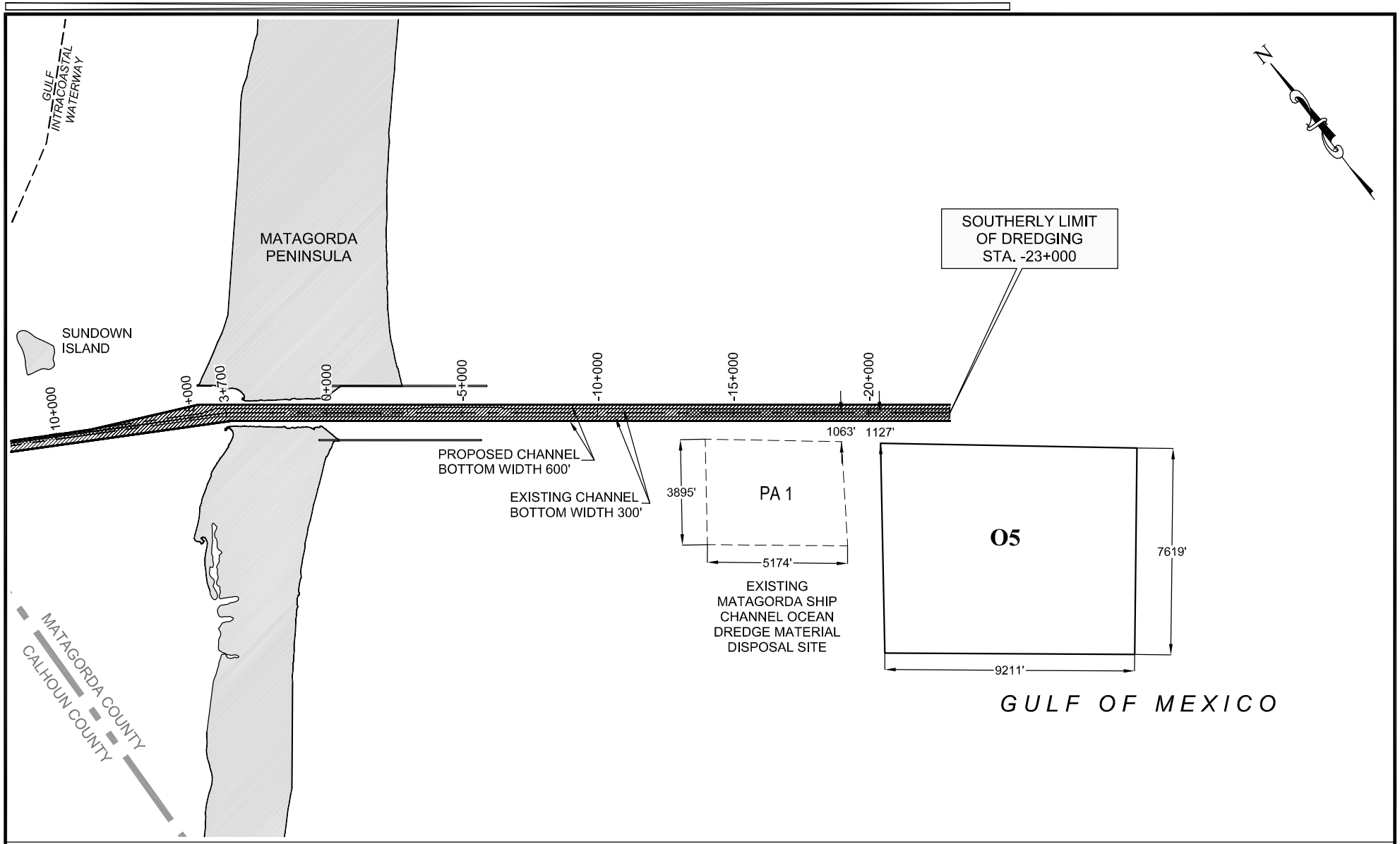
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 28 OF 46



0 5000 1000

APPROXIMATE SCALE IN FEET

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LEGEND:

04 EXISTING PLACEMENT AREA

05 PROPOSED PLACEMENT AREA

PLACEMENT AREA PLAN AREA 05 AND EXISTING PA 1

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 3-15-07

MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

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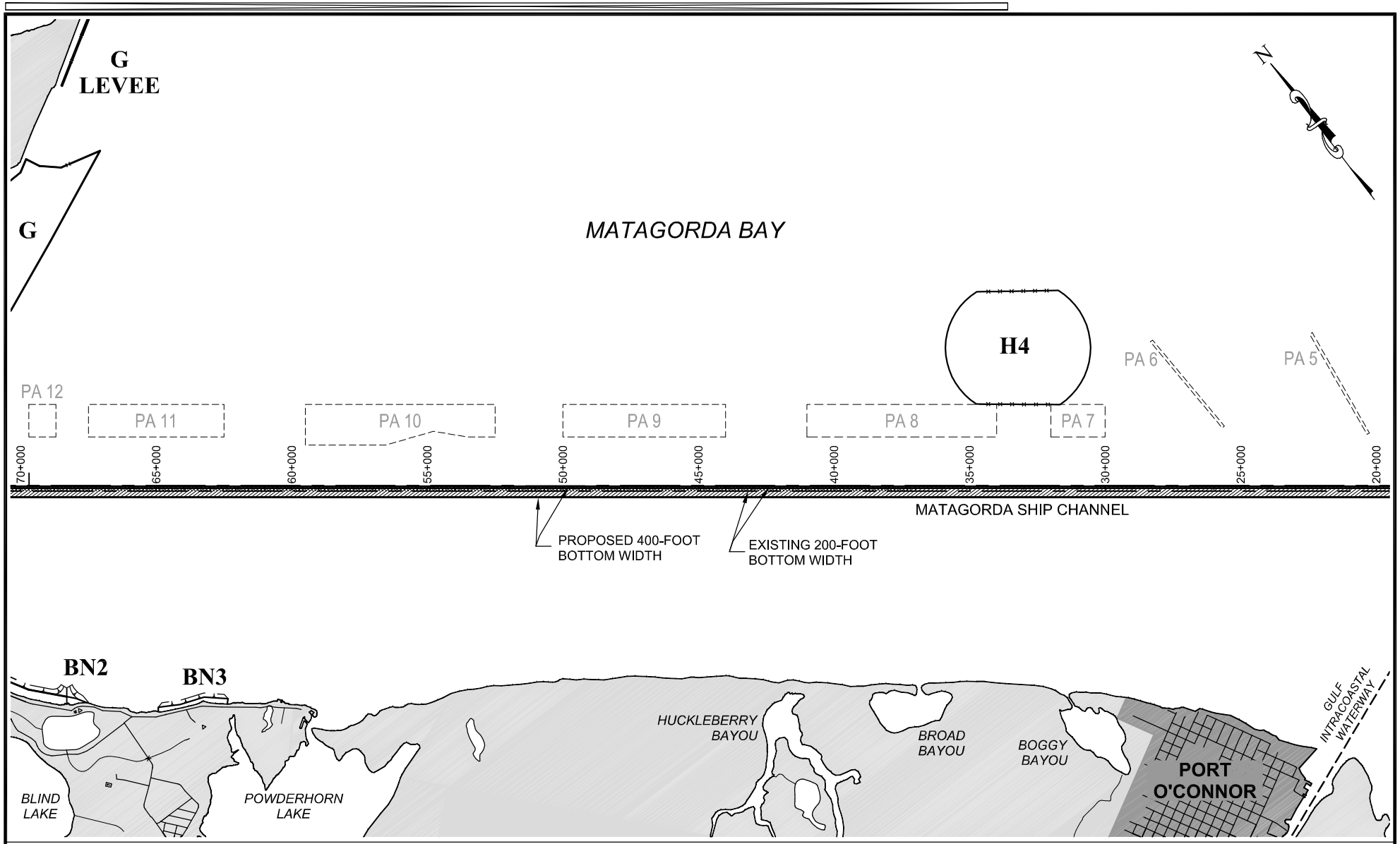
FIGURE 29 OF 46



0 5000 1000

APPROXIMATE SCALE IN FEET

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LEGEND:

PA 11 — EXISTING PLACEMENT AREA

H4 — PROPOSED PLACEMENT AREA

BEACH SLOPE

PLACEMENT AREA PLAN
EXISTING AREAS PA 5, 6, 7, 8, 9, 10, 11, 12

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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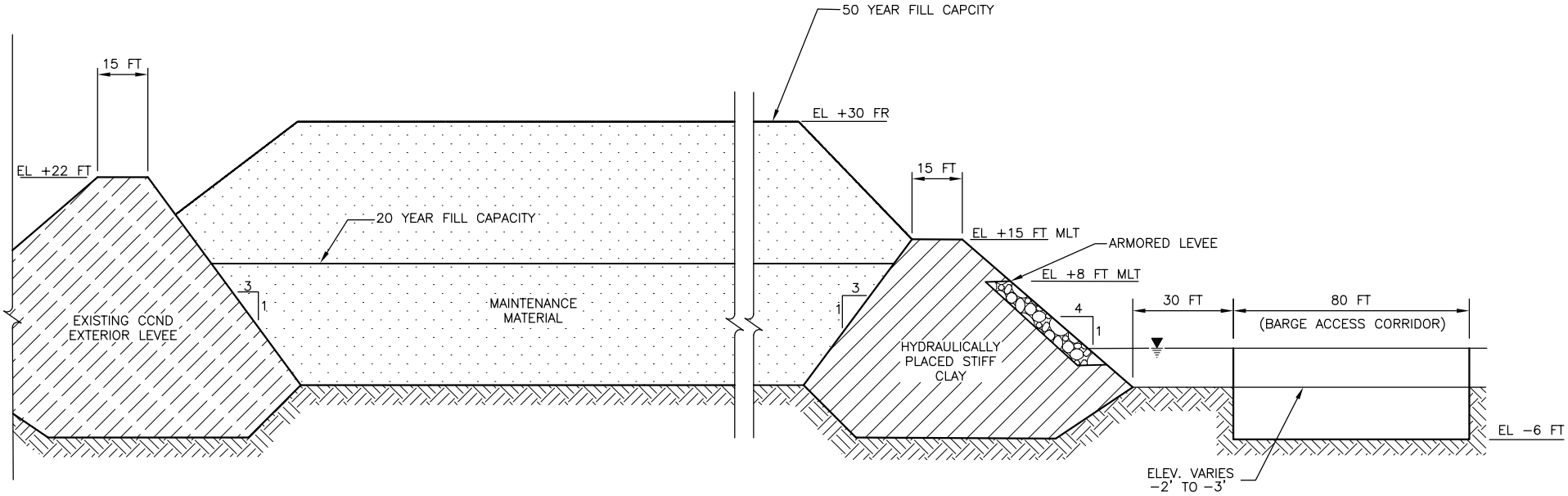
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 30 OF 46



A
15
SECTION
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PLACEMENT AREA SECTION
AREA A1

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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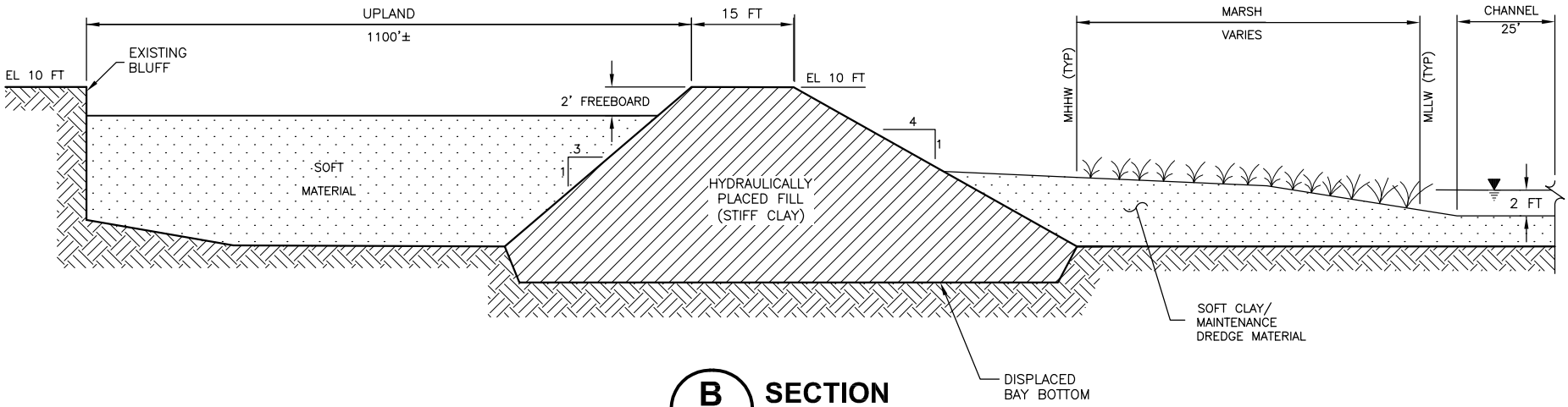
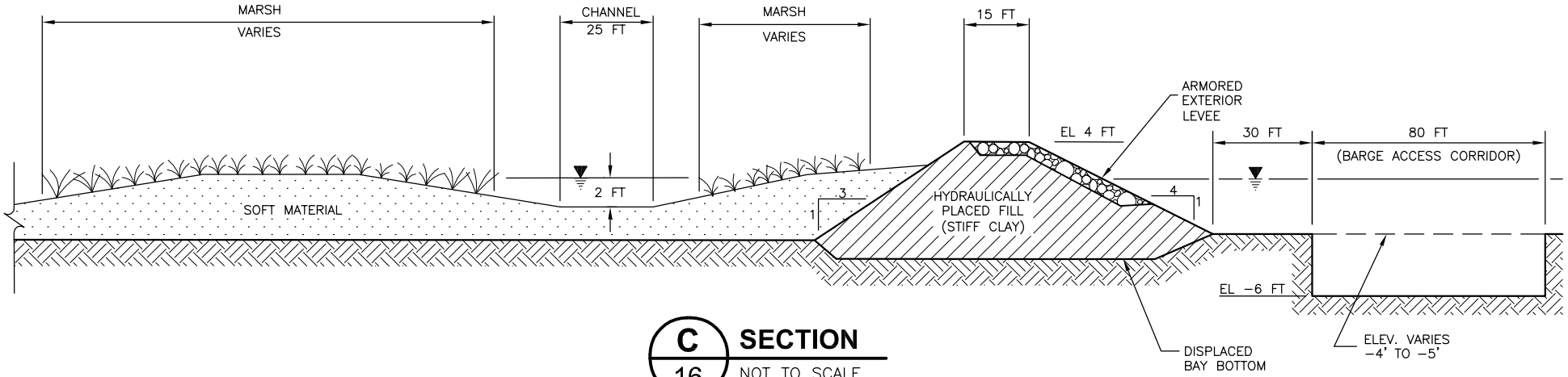
FIGURE 31 OF 46



B / 16 SECTION
NOT TO SCALE



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PLACEMENT AREA SECTION AREA A2

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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CALHOUN COUNTY NAVIGATION DISTRICT

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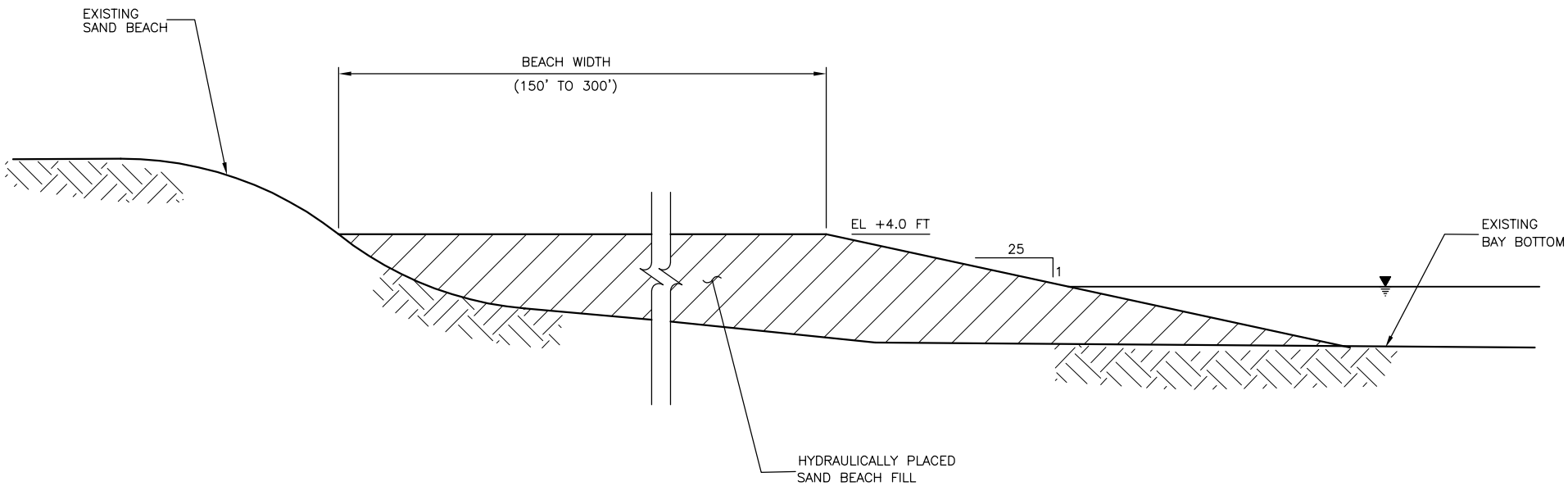
PERMIT NO. 24071

FIGURE 32 OF 46



D SECTION

17 18 19

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PLACEMENT AREA SECTION
BN1, BN2, BN3

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

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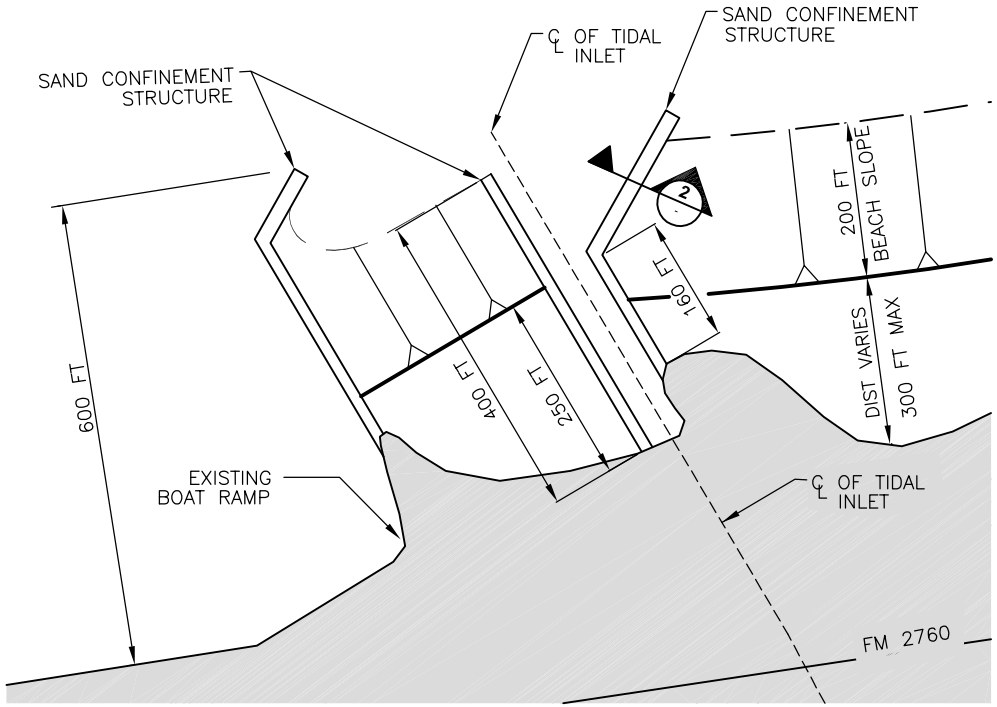
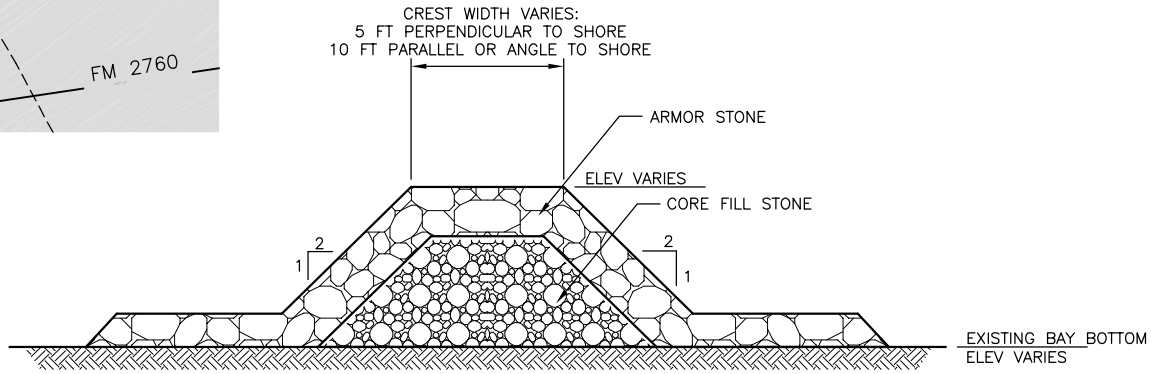
PERMIT NO. 24071

FIGURE 33 OF 46



1 DETAIL
17
NOT TO SCALE



2 DETAIL
17 18 19
NOT TO SCALE

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PLACEMENT AREA SECTION
BN1- BN3, CONFINEMENT STRUCTURES

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

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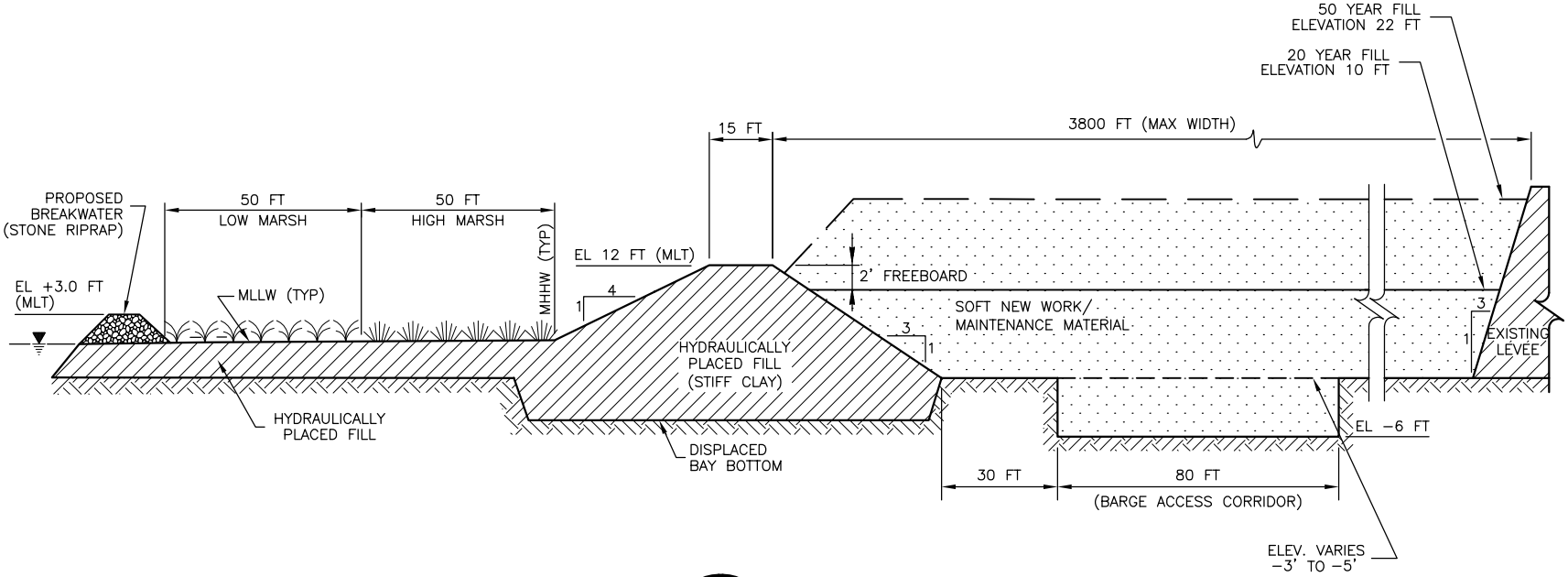
FIGURE 34 OF 46



E
20

SECTION

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PLACEMENT AREA SECTION
AREA D

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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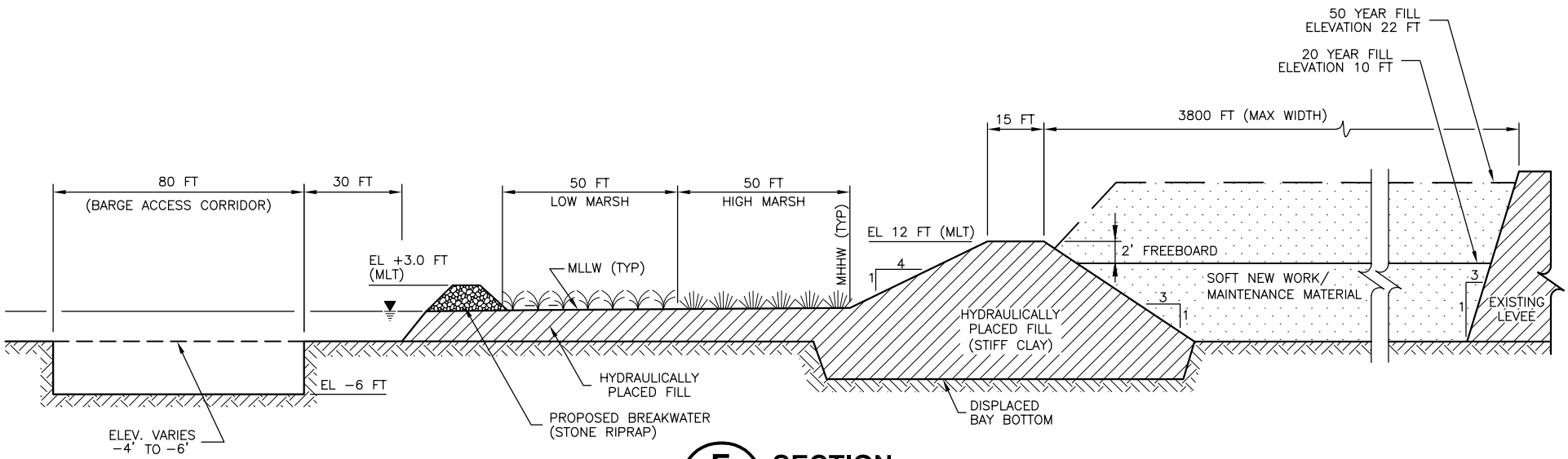
CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 35 OF 46



F 20 **SECTION**

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PLACEMENT AREA SECTION AREA D (WITH BREAKWATER)

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

Revised 3-15-07

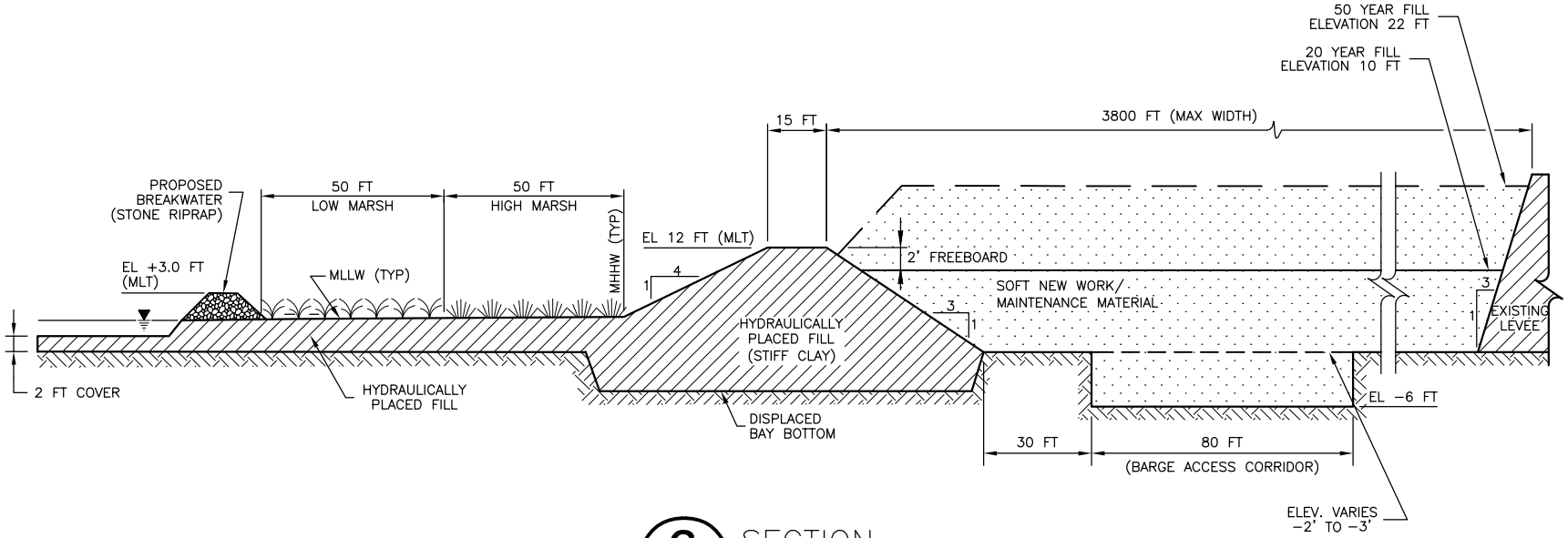
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 36 OF 46



G/20 SECTION
NOT TO SCALE

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PLACEMENT AREA SECTION
AREA ER3

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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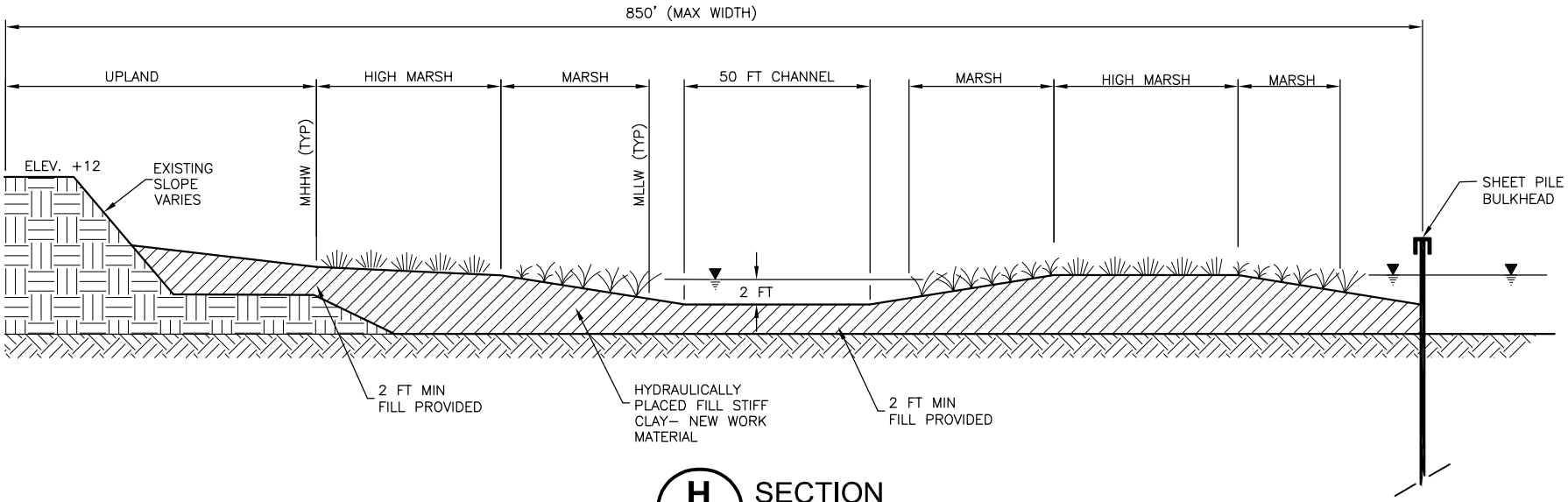
MATAGORDA AND CALHOUN COUNTIES, TEXAS

CALHOUN COUNTY NAVIGATION DISTRICT

URS

PERMIT NO. 24071

FIGURE 37 OF 46



H
21
SECTION
NOT TO SCALE

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PLACEMENT AREA SECTION
AREA ER3- MARSH AREA

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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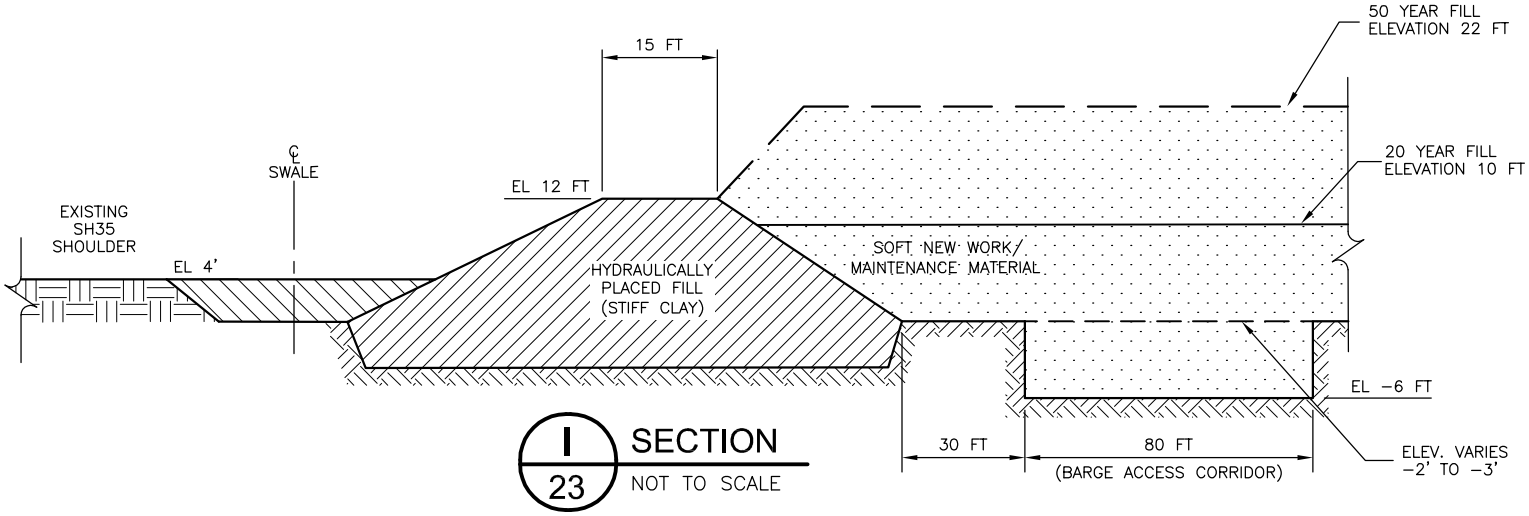
CALHOUN COUNTY NAVIGATION DISTRICT

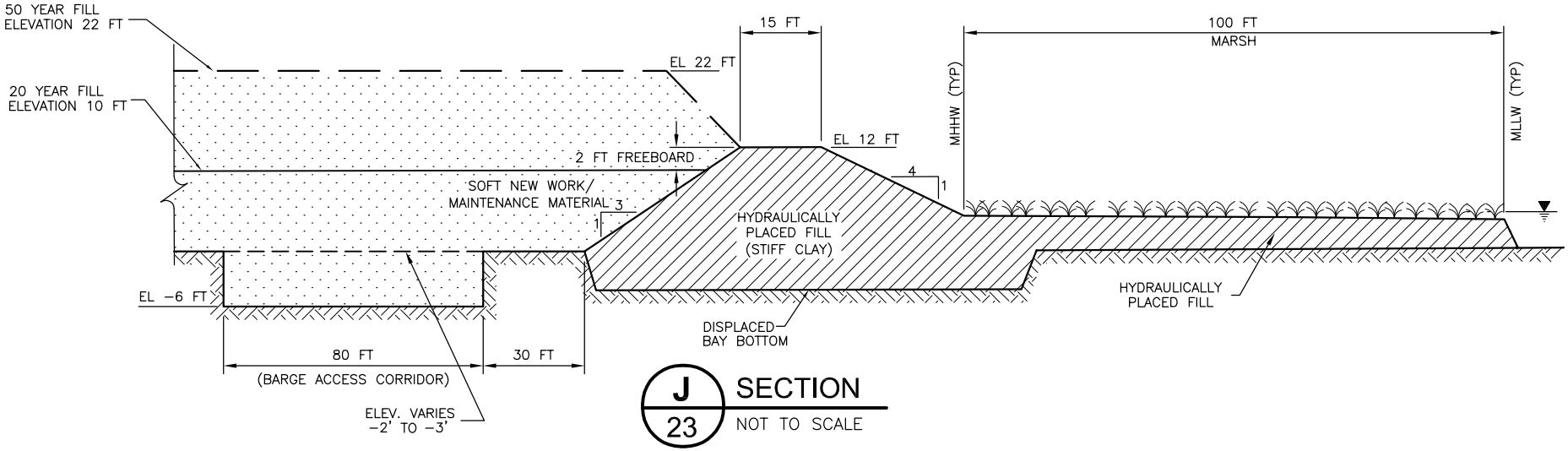
URS

PERMIT NO. 24071

FIGURE 38 OF 46



I
23
SECTION
NOT TO SCALE



J
23
SECTION
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PLACEMENT AREA SECTION
AREA ER2

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

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CALHOUN COUNTY NAVIGATION DISTRICT

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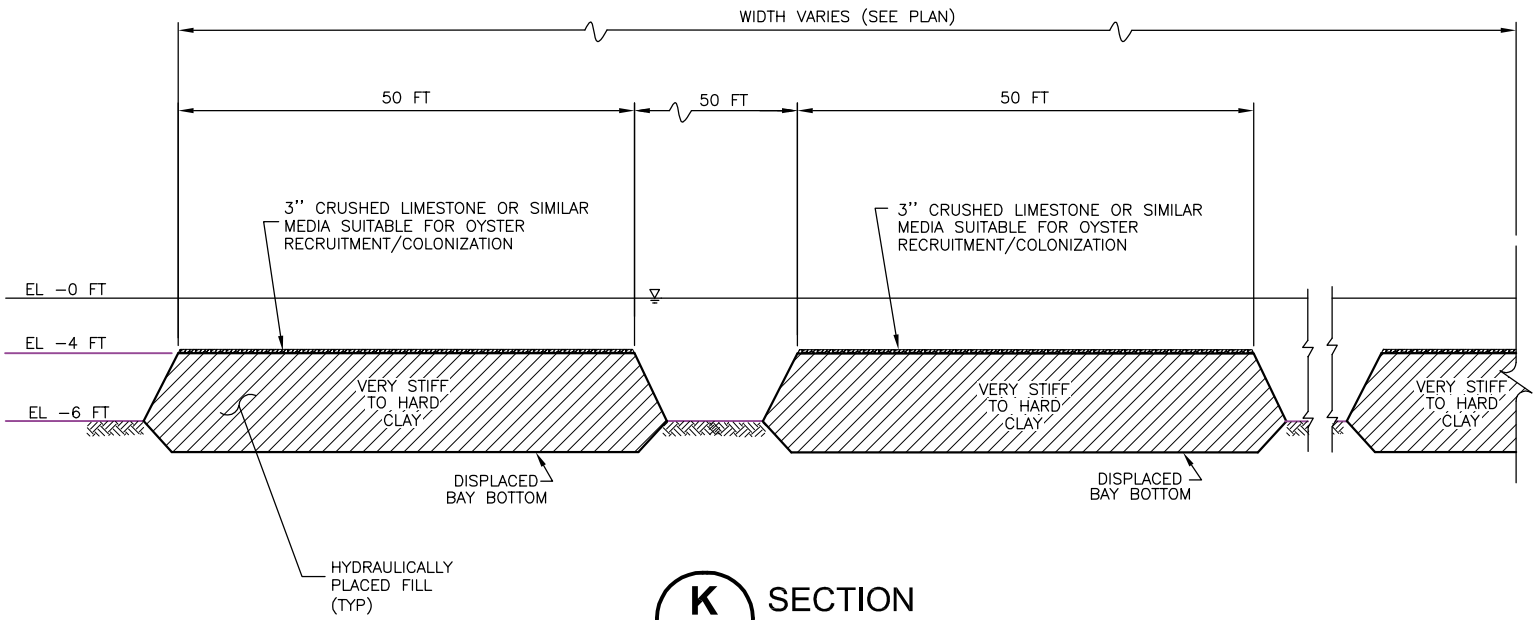
FIGURE 39 OF 46



K SECTION

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PLACEMENT AREA SECTIONS AREA ER1

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CALHOUN COUNTY NAVIGATION DISTRICT

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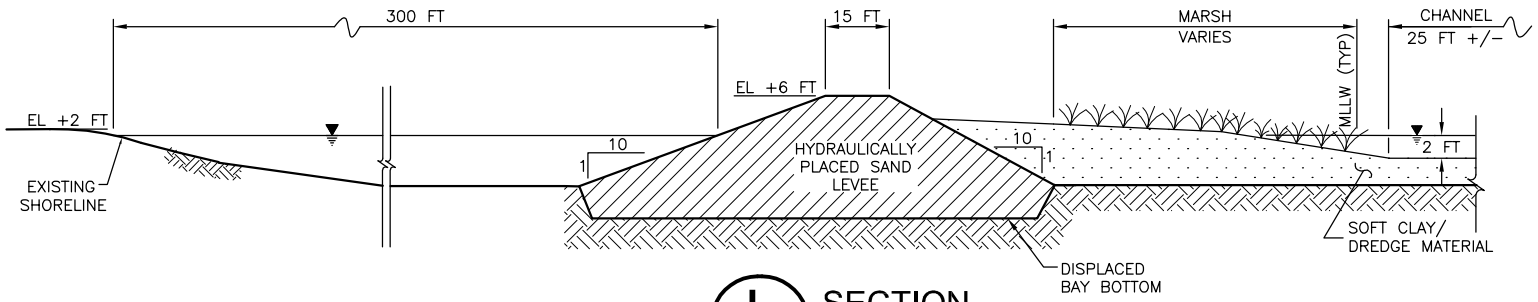
FIGURE 40 OF 46



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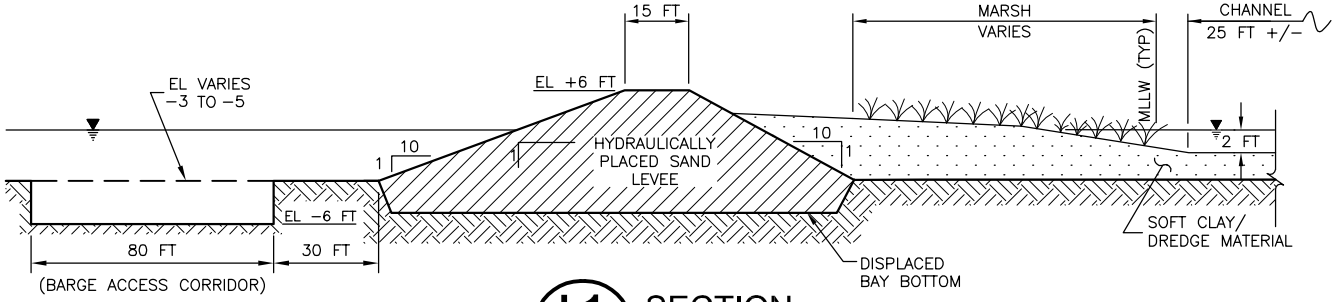

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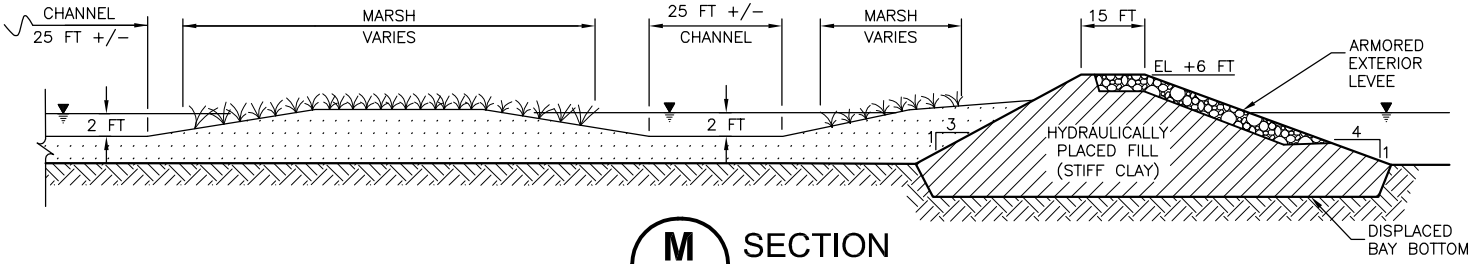

M / 24 SECTION
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PLACEMENT AREA SECTIONS
G MARSH

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FIGURE 41 OF 46

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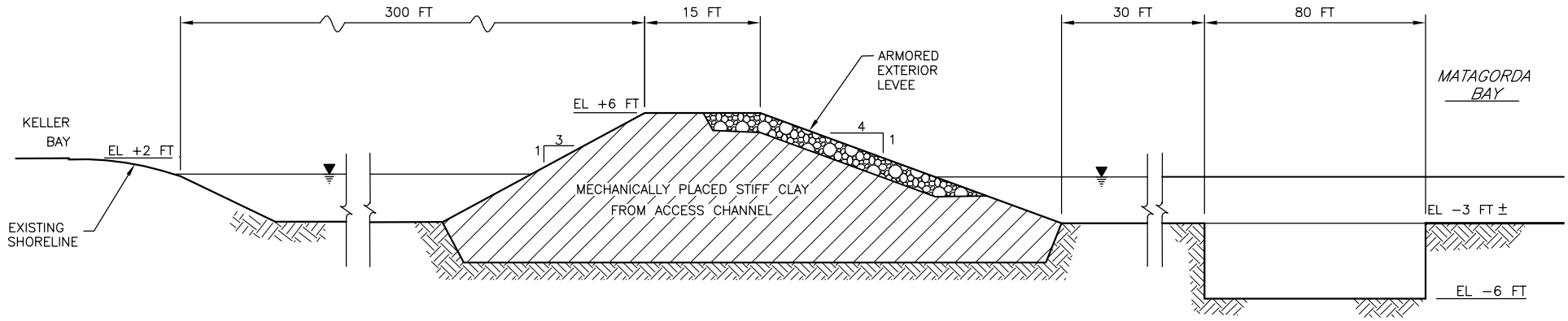

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PLACEMENT AREA SECTION
G LEVEE

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CALHOUN COUNTY NAVIGATION DISTRICT

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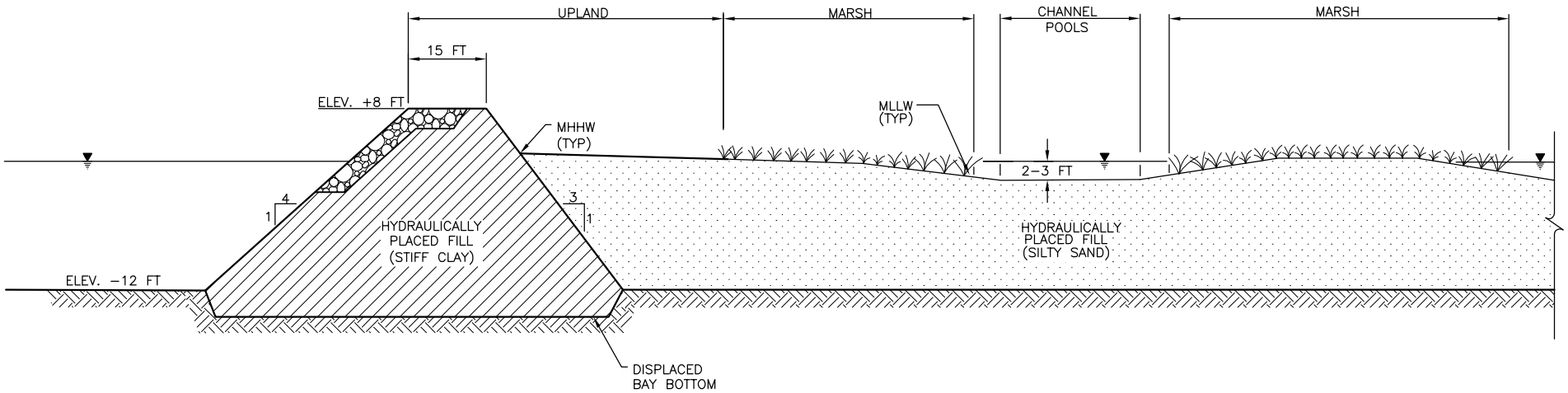
FIGURE 42 OF 46



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PLACEMENT AREA SECTION
AREA H4

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CALHOUN COUNTY NAVIGATION DISTRICT

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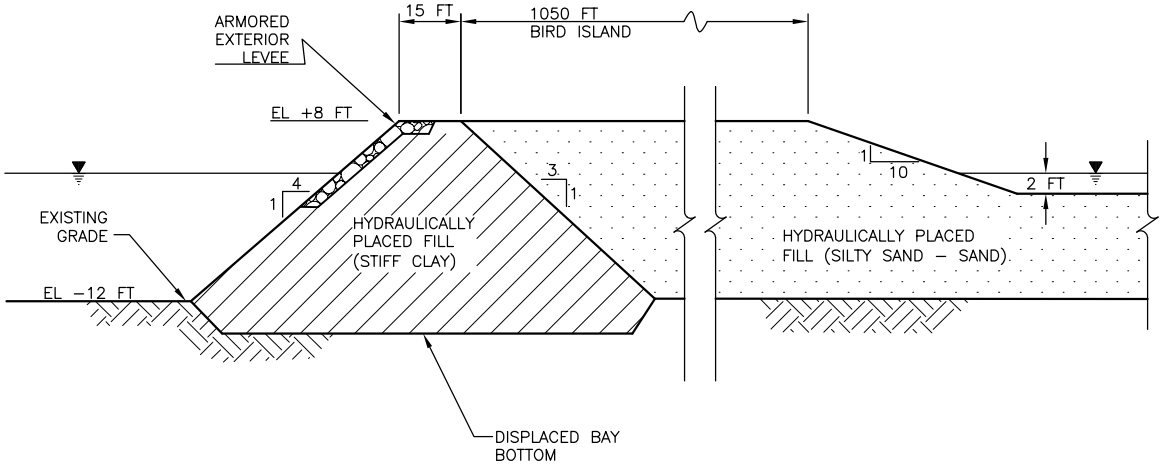
FIGURE 43 OF 46



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PLACEMENT AREA DETAIL
AREA H4 - BIRD ISLAND

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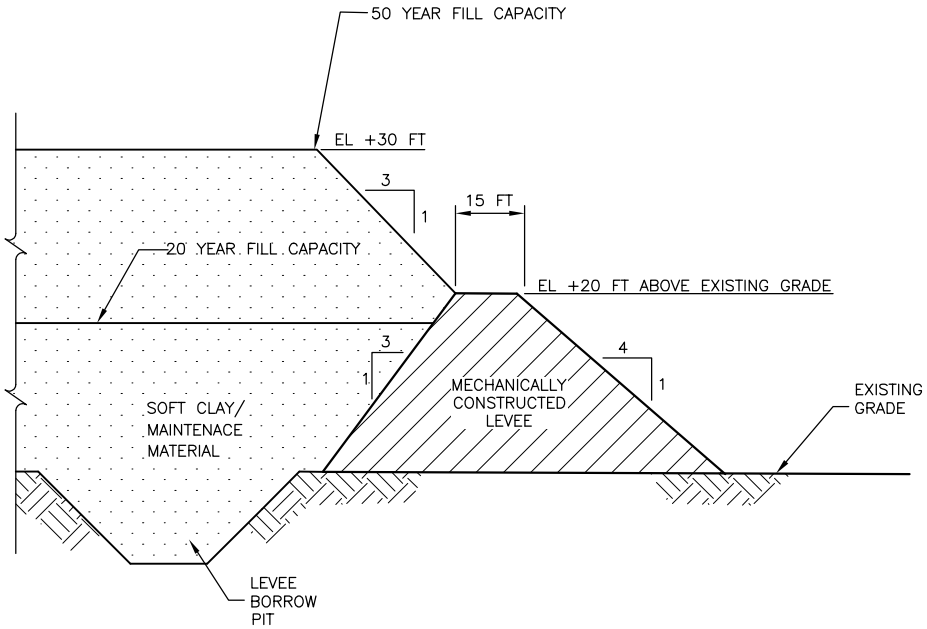

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PLACEMENT AREA PLAN
AREA P1

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CALHOUN COUNTY NAVIGATION DISTRICT

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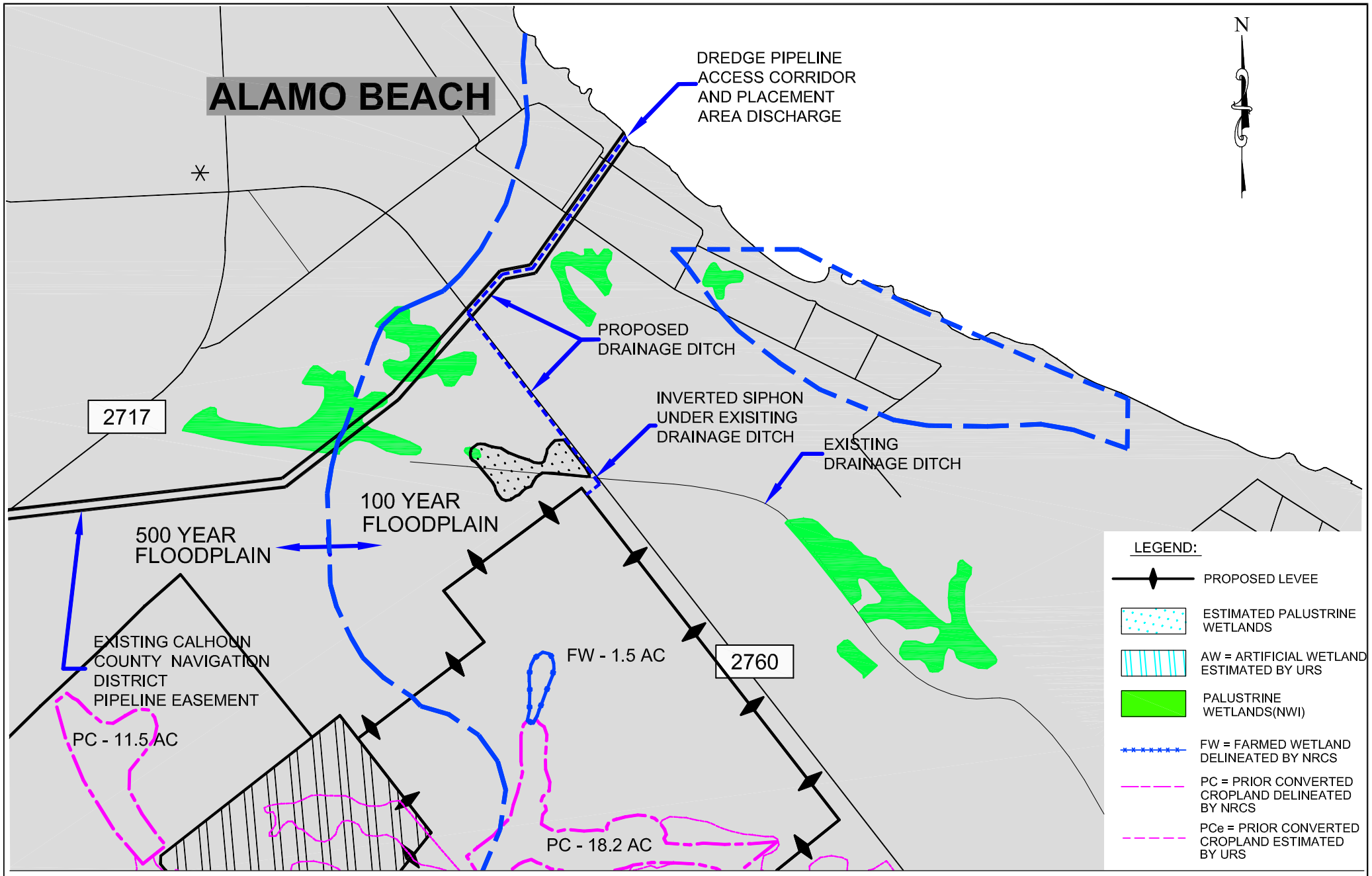
FIGURE 45 OF 46



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PLACEMENT AREA PLAN AREA P1

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CALHOUN COUNTY NAVIGATION DISTRICT

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FIGURE 46 OF 46

Appendix B

Dredged Material Management Plan

URS

Matagorda Ship Channel Improvement Project
Dredged Material Management Plan

Prepared for:
Calhoun County Navigation District
Date: March 15, 2007

URS Project No. 25008809

Rev No	**A**	**B**	**C**	**D**	**E**	**F**
Issue Purpose	Permit	Permit	Permit	Permit		
Date	10-31-06	11-20-06	2-16-07	3-15-07		
Prepared by	DMMP Team	DMMP Team	DMMP Team	DMMP Team		
Checked	MEM	MEM	MEM	MEM		
Approved	MEM	MEM	MEM	MEM		
Client Approval						

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1.0 INTRODUCTION

Calhoun County Navigation District (CCND) is proposing to improve the Matagorda Ship Channel (MSC) from its facilities in upper Lavaca Bay to the terminus in the Gulf of Mexico (**Figure 1**) as well as construct a new turning basin to accommodate the larger vessels, which would use the improved channel. The project extends approximately 27 miles from the Port of Port Lavaca – Point Comfort turning basin in Lavaca Bay (Channel Station 118+502) through the southwest section of Matagorda Bay and offshore into the Gulf of Mexico (Channel Station -23+000), in Matagorda and Calhoun Counties, Texas. The project can be located on the U.S.G.S. quadrangle maps entitled Point Comfort, Port Lavaca East, Keller Bay, Port O'Connor, and Decros Point, Tex. Approximate UTM Coordinates at the north end of the existing turning basin in NAD 27 (meters): Zone 14; Easting 739500; Northing 3170500.

Construction of the MSC improvements will yield a substantial volume of soil (new work material) as well as sediment (maintenance material) during the operations of the facility.

This Dredged Material Management Plan (DMMP) provides information regarding material characteristics, dredging activities and material placement related to the removal of material from the Matagorda Ship Channel Improvement Project (MSCIP). **Figure 2** shows the location of the MSCIP. The purpose of this plan is to develop environmentally acceptable placement areas for the material, which will be dredged over a fifty year planning horizon of the project. Specifically, the DMMP will:

- Discuss the purpose of dredging;
- Describe existing channel dredging frequency and volume, and existing ecological conditions;
- Present projections of future conditions without the proposed management plan;
- Discuss the MSCIP's proximity to the Lavaca Bay Superfund Site;
- Describe the geotechnical properties as well as contaminant assessment based on the existing data of both the material dredged for the initial construction, i.e., new work material, and the material requiring excavation as a result of continued sedimentation, i.e., maintenance material;
- Provide a summary of estimated dredged material volumes both for new work and maintenance materials;
- Identify beneficial use alternatives;
- Discuss the process of screening placement alternatives;
- Recommend a placement plan that meets the project requirements; and
- Identify potential impacts of the various dredging techniques and placement options, and the associated mitigation options.

This plan summarizes and evaluates placement alternatives and provides a recommend plan for dredged material placement. **Section 2.0** provides a discussion of the existing conditions, projection of future conditions without the channel improvement, as well as placement opportunities. **Section 3.0** provides specific information about the new work and maintenance dredged material. **Section 4.0** lists and analyzes dredged material placement alternatives. **Section 5.0** discusses the recommended plan based on the alternatives and criteria presented in Section 4.0. **Section 6.0** summarizes the potential impacts of dredging to water quality and habitats in the project area. **Section 7.0** lists the references used to develop this DMMP. **Appendix A** presents the soil boring results for the MSCIP. **Appendix B** presents a summary of the analytical results from previous investigations and ongoing monitoring. **Appendix C** presents a detailed analysis of cost estimates for the proposed alternatives.

1.1 PURPOSE OF DREDGING

The stated purpose of the project is to improve the deep-draft transport of commerce on the MSC for its existing and future users by:

- reducing or eliminating light loading measures;
- allowing larger cargo vessels to begin calls; and
- potentially allowing for two-way traffic of smaller vessels during periods of increased transits.

CCND's need for the project is to eliminate operational constraints and to avoid delays, thereby reducing shipping costs and avoiding logistical problems, which will allow its users to remain competitive in the global market place.

1.2 DREDGING TEMPLATE

The proposed MSCIP (**Figure 2** to **Figure 11B**) would create a channel with the following dimensions:

Channel Station 118+502 to 8+774.78

- 3H:1V channel side slopes, 44-foot depth with 2-foot advanced maintenance requirement and 2-foot overdepth dredge tolerance; and 400-foot width.

Channel Station 8+774.78 to 3+506.54

- 3H:1V channel side slopes, 44-foot depth with 2-foot advanced maintenance requirement and 2-foot overdepth dredge tolerance; and width varies from 400 to 761.32 feet.

Channel Station 3+506.54 to –5+000

- 5H:1V channel side slopes, 46-foot depth with 3-foot advanced maintenance requirement and 2-foot overdepth dredge tolerance; and 600-foot width.

Channel Station -5+000 to -23+000

- 10H:1V channel side slopes; 46-foot depth; 3-foot advanced maintenance requirement; and 2-foot overdepth dredge tolerance; and 600-foot width.

The initial dredging is referred to as “new work” dredging where previously undisturbed material is removed from the project area. Following construction, the area will require periodic “maintenance” dredging to remove sediments that accumulate above the depth required to navigate the area.

The channel from Station 8+774.78 to –5+000 does not require “new work” dredging because the existing grade is below the project depth as well as advanced maintenance and allowable dredge overdepth. It is also anticipated that no “maintenance” dredging will be required through these reaches because high channel velocities scour the channel and are expected to continue to do so after the improvements are made to the MSC (Moffatt and Nichol 2006).

2.0 PROJECT CONDITIONS

2.1 DESCRIPTION OF EXISTING CONDITIONS

2.1.1 Channel Maintenance

Maintenance dredging of the existing bay reach of the ship channel and the existing turning basin has occurred biannually, and the Gulf Reach and entrance channel has been maintained approximately every 2.5 years. Dredging records from 1963 to 1999 indicate an annual average volume of 2.6 million cubic yards (mcy) for the bay reach (**Table 2-1**). More recent records are available but they were not divided into channel stations dredge volumes, which limited their usefulness for detail analysis. However, they appeared to be consistent with the overall quantity and trend of increasing maintenance. Dredging records from 1970 to 2004 indicate an annual average volume of 0.26 mcy per year for the entrance channel (**Table 2-2**). The turning basin generates 0.2 mcy per year, and the area between the jetties requires no maintenance dredging due to scouring. The total average annual amount of dredged material is approximately 3.0 mcy. Maintenance dredging is usually performed with hydraulic pipeline dredging for the bay and hopper dredging equipment for the entrance channel. The United States Army Corps of Engineers (USACE) uses unconfined placement areas for disposal of all dredged material in a series of approved locations within the bay and offshore. The placement areas used for material dredged from each station of the channel might vary slightly, but generally material is taken to the closest placement area (**Exhibit 1**). Within Matagorda and Lavaca Bays, material is placed east of the channel in rectangular areas typically 1,000 feet wide and ranging from 1,000 to 7,000 feet in length. The total length of the existing Matagorda and Lavaca Bay unconfined placement areas is over 9.5 miles and the total area is over 1800 acres. Material dredged from the channel entrance is placed west of the channel in an existing Ocean Dredged Material Disposal Site (ODMDS) in the Gulf of Mexico.

Moffatt and Nichol (2006) analyzed the sedimentation rates along the channel for each 5,000 ft. section from 1963 to 1999. Despite large year-to-year variations, a significant decrease in sedimentation rates was found in the extreme lower end of the channel from Station 10+000 to 15+000 (near the jetty channel). A significant increase in sedimentation rates was found in the extreme upper end of the channel from Station 105+000 to 115+000 (near the turning basin). Sedimentation rates along the middle sections of the channel (from Station 15+000 to 105+000) showed no significant change in sedimentation rates during the study period.

These changes in sedimentation rates could be due to the influence of currents on the movement of material placed in unconfined placement areas. Near the jetty channel the high flow rate moves sediment out of the channel and contributes to low sedimentation rates. Moffatt and Nichol (2006) suggest that the placement of dredged material in unconfined placement areas in Lavaca Bay where cross channel currents exist is a likely cause of the elevated sedimentation rates from Stations 105+000 to 115+000, and could also explain the increase in the sedimentation rate in this area. At this location, where the channel turns to run north and south, currents are perpendicular to the channel and would tend to move material from the unconfined placement areas back into the channel (**Exhibit 2**). In the mid-channel section (approximately Station 15+000 to 105+000) currents run parallel to the channel, and would play a less significant role in transporting material into the channel.

Table 2-1. Dredged Material volumes in the Lavaca and Matagorda Bay Reach from 1963 to 1999 (Moffatt and Nichol 2006).

Begin date	End date	From range, ft	To range, ft	Dredged volume, CY
11/23/1963	02/04/1964	50+000	114+000	3,236,274
02/18/1965	08/02/1965	3+900	116+400	3,952,752
08/04/1966	10/18/1966	6+000	116+074	2,740,971
03/04/1968	06/16/1968	15+000	117+223	4,831,862
02/10/1970	05/26/1970	13+000	116+223	4,374,266
07/15/1972	10/14/1972	6+000	115+000	4,892,876
05/08/1974	08/16/1974	17+000	116+223	4,633,235
04/03/1977	10/14/1977	7+000	116+223	7,563,298
09/15/1979	02/19/1980	12+000	116+223	6,078,672
10/21/1981	03/24/1982	12+000	116+223	6,355,071
06/27/1983	02/15/1984	15+000	117+223	4,184,765
01/06/1986	01/01/1987	12+000	116+223	8,889,878
02/01/1988	06/01/1988	80+000	116+223	2,625,072
01/10/1989	03/24/1989	15+000	115+000	3,787,107
12/01/1989	01/23/1990	80+000	117+223	2,060,726
09/07/1991	03/17/1992	15+000	117+223	5,140,339
10/26/1993	07/07/1994	14+000	117+223	6,620,280
01/09/1996	10/24/1996	11+000	117+223	6,021,229
03/15/1998	06/12/1999	15+000	117+223	6,864,297
Total years	**36.7**	**Total dredged volume, CY**		**94,852,970**
		Average annually dredged volume, CY/year		**2,584,549**

Table 2.2. Dredged Material volumes in the Offshore Reach from 1970 to 2004 (Moffatt and Nichol 2006).

Date	Maintenance Quantity (cy)	Dredging Cycle (years)	Sedimentation Rate (cy/year)
10/11/1970	1,135,825	8.03	141,446
03/20/1972	484,560	1.44	336,474
03/261973	547,000	1.02	538,522
12/28/1974	1,463,473	1.76	832,607
01/21/1976	943,112	1.07	885,531
12/11/1977	290,000	1.89	153,511
08/02/1979	539,891	1.64	329,207
08/28/1980	1,790,548	1.07	1,668,361
01/26/1984	908,933	3.41	266,443
01/30/1989	498,040	5.01	99,350
08/11/1993	664,190	4.53	146,672
09/23/1996	488,383	3.12	156,613
07/16/1999	590,740	2.81	210,300
01/13/2004	365,226	4.50	81,242
Average	**764,994**	**2.56**	**259,403**

2.1.2 Environmental Setting

2.1.2.1 Community Types

The MSCIP transects Lavaca Bay and Matagorda Bay and terminates in the Gulf of Mexico. The bay system is comprised of various smaller bays (e.g., Keller, Cox Bay, Lavaca Bay, and Chocolate Bay), associated freshwater waterways (e.g., Lavaca River and Colorado River), adjacent marshes and wetlands, the Intracoastal Waterway and other shipping channels, and immediately adjacent upland features that include parts of Matagorda Island and Matagorda Peninsula. Major aquatic and coastal habitats types that occur within the MSCIP and proposed dredged material placement areas discussed in this plan include: open water (bay and offshore), oyster reef, and coastal marsh.

The following sections provide a brief description of these communities within the project area.

Open Water

The bay, open water habitat type includes both the estuarine water column and non-vegetated, soft-bottomed areas. The open water environment comprises the largest of the subtidal estuarine habitats in the Matagorda Bay system. Within the MSCIP, these habitats generally range from about 4 to 40 feet deep with sediments of mostly silt and clay.

Open water habitats within the project area support an abundance of vertebrate and invertebrate species. Benthic invertebrates play an important role in the estuarine food web, serving as decomposers, consumers and as prey for larger animals. Matagorda Bay, Lavaca Bay and Cox Bay also host numerous fish species; the most abundant are Atlantic croaker, black drum, gafftopsail catfish, red drum, sand seatrout, sheepshead, southern flounder, and

spotted seatrout, bay anchovy, and spot. Invertebrate species such as blue crab, eastern oyster, and shrimp also occur in the area.

Oyster Reefs

Oyster reefs are natural accumulations of oyster shell and living oysters that result from the successive growth of generations of oysters in the same place. Reefs along the Gulf of Mexico coast are comprised primarily of the eastern oyster (*Crassostrea virginica*). Whether they consist of live oysters or dead shell material, oyster reefs constitute an important estuarine habitat. In addition to sustaining oyster populations, oyster reefs often support diverse and complex biological communities. Oyster shells provide a substrate for a variety of sessile organisms, e.g., barnacles and mussels. These areas also support various grazing and scraping organisms (e.g., gastropods) that feed on the algal film that often form the oyster shells. When compared to open bay bottom habitats, and submerged aquatic vegetation habitat, the relatively complex physical structure of a reef provides cover and food for numerous other estuarine species.

Seagrass

Estuarine seagrass beds occur in shallow areas (generally <6 ft water depth depending on water clarity) in open bay and inlet interior marsh environments. Seagrass communities generate high primary productivity and provide refuge for numerous species including shrimp, fish, crabs and their prey. Animal abundances in seagrass beds can be 2–25 times greater than in adjacent unvegetated areas (TPWD 1999). Shoalgrass, widgeongrass, and turtlegrass have been documented in the Matagorda Bay estuary (Adair et al. 1994, TPWD 1999, White et al. 2002, Lower Colorado River Authority and San Antonio Water System 2006). Shoalgrass and widgeongrass have been mapped in Keller Bay and Carancahua Bay (Salt Lake and Redfish Lake) (Adair et al. 1994, Texas General Land Office [GLO], 2003). Shoalgrass is mapped along the southern shoreline of Keller Bay, in Boggy Bayou (north of Port O'Connor, near the bayside marshes of the barrier island (Matagorda Peninsula) north of the MSC cut (GLO 2003), and associated with the marshes west of Pass Cavallo at Bayuco and Matagorda Islands where turtlegrass is also noted (White et al. 2002, GLO 2003). The Seagrass Conservation Plan of Texas (TPWD 1999) lists shoalgrass, widgeongrass and clovergrass in the Matagorda Bay system. Nonvascular vegetation, such as freshwater algae and marine seaweed (*Sargassum* spp.) also occur in the study area. Sargassum is more common near the openings to the Gulf.

Coastal Marsh

Coastal marshes are characterized by emergent vegetation and regular tidal flooding. These habitats provide a variety of important functions such as nutrient cycling, flood control, and sediment stabilization. Coastal marsh also provides important fish and wildlife habitat.

2.1.3 Alcoa (Point Comfort)/Lavaca Bay Superfund Site

The following discussion of Alcoa (Point Comfort)/Lavaca Bay Superfund Site background, Record of Decision (ROD) and the Adaptive Sediment Management Framework was developed in conjunction with Alcoa.

2.1.3.1 Background

The MSCIP crosses the Alcoa (Point Comfort)/Lavaca Bay Superfund Site (Alcoa Superfund Site), which is significant to the project because of the potential for encountering mercury-impacted sediments during dredging activities and because it presents opportunities for beneficial use of dredged material. The following is a brief history of the Alcoa Superfund Site.

The Alcoa Point Comfort Operations facility (Alcoa) began operations in 1948 as an aluminum smelter and operated until 1980. Alumina refining operations began in 1959 and continue to operate today.

From 1966 to 1970, the Alcoa facility discharged mercury-containing wastewater into Lavaca Bay from its chlor-alkali processing operations. Alcoa terminated the direct discharge of this wastewater into the bay in 1970 after the Texas Water Quality Board notified Alcoa of potential adverse environmental impacts associated with mercury. In April of 1988, the Texas Department of Health (TDH) issued a closure order prohibiting the taking of finfish and crabs for consumption from a specific area of Lavaca Bay due to elevated mercury concentrations found in these species. The site was placed on the Comprehensive Environmental Response, Compensation, and Liability Act's (CERCLA) National Priority List (NPL) in 1994. The listing was primarily based on levels of mercury found in several species of finfish and crab in Lavaca Bay, the fisheries closure imposed by the TDH in 1988, and levels of mercury detected in bay sediments adjacent to the Alcoa facility. The Administrative Order on Consent (AOC), which was issued March 31, 1994 under the authority of the CERCLA required that a Remedial Investigation (RI), Baseline Risk Assessment (BLRA), and Feasibility Study (FS) be performed at the site. Additional regulatory background information can be found in the Preliminary Site Characterization Report, Alcoa (Point Comfort)/Lavaca Bay Superfund Site, (Alcoa 1995).

2.1.3.2 Record of Decision

A ROD (Alcoa 2001b) was signed on December 20, 2001 and proposed a remedy for the Site. The risk assessment indicated that only certain parts of Lavaca Bay and the Dredge Island required remediation. Remediation of the Site, as described in the ROD, consisted of actions that were initiated prior to the ROD (some of which were completed prior to the ROD and some of which are ongoing), and several proposed actions. The following remedial actions have been or will be completed at the Site pursuant to the ROD:

- Stabilization of the Dredge Island (completed as a non-time critical removal action prior to the ROD);
- Removal of Chlor-Alkali Process Area (CAPA) sediments via dredging (completed as a treatability study prior to the ROD);
- Extraction and treatment of groundwater at the CAPA (initiated as a treatability study prior to the ROD and continuing as an ongoing action under the Consent Decree);

- Dredging of the Witco Channel (completed as part of the routine planned maintenance prior to the ROD);
- Natural recovery of sediments (ongoing activity);
- Institutional controls to manage exposure to finfish/shellfish (ongoing activity);
- Dredging of the Witco Marsh;
- Enhanced natural recovery of the area north of Dredge Island;
- Monitoring of sediments, fish/shellfish, and surface water (ongoing activity).

A CERCLA Consent Decree/Statement of Work (CD/SOW) between Alcoa (Alcoa Inc. and Alcoa World Alumina Atlantic, L.L.C) and the United States of America and the State of Texas, was entered in the United States District Court, Southern District on the effective date of March 1, 2005. Alcoa submitted a Remedial Action Work Plan in August 2005 that proposed a schedule for completing the remaining remedial actions in Lavaca Bay.

The remedial action that is important to this DMMP is the natural recovery of sediments. Natural recovery of sediments throughout the Closed Area, in concert with the other elements of the remedy, is projected to allow fish tissue and shellfish mercury concentrations to recover to levels below the remedial action objective (RAO).

2.1.3.3 Adaptive Sediment Management Framework for Lavaca Bay Superfund Site

The following framework is adapted from a version contained in the Feasibility Study for the Superfund site (Alcoa 2001a) and is consistent with the target cleanup goals stated in the ROD (Alcoa 2001b). Based on extensive sampling done as part of the remedial investigation, a comprehensive understanding of the mercury distribution throughout the bay was developed. In general, the bay contained elevated mercury concentrations limited to the upper two feet of sediments; and the peak concentrations occurred at or about eight to 16 inches below the existing sediment surface. The burial of sediments with peak mercury concentrations is consistent with naturally high sedimentation rates in the bay depositing clean sediment on top of the contaminated sediments, which were the result of historical releases that occurred in about the 1960's time frame.

The selected remedy focuses on control, removal, and isolation of identified current and potential future sources of mercury input within the bay. Because most surficial sediment mercury concentrations were already below conservative ecological and human health risk levels developed specifically for the site, the remedial strategy for the majority of the bay was to rely on natural recovery to continue burying the sediments with elevated mercury levels.

The selection of a natural recovery strategy for most of the impacted area of the bay required that Alcoa develop and maintain a management and monitoring plan to ensure that sediment and fish tissue within the bay continue the trend of natural recovery. Additionally, Alcoa and EPA recognized that other development activities would be occurring in Lavaca Bay, and in anticipation of future activities developed an adaptive sediment management framework (the "framework) for the bay (Alcoa 2001a). Example activities include maintenance dredging, new channel dredging, pipeline or cable-line crossings, and bridge repair/construction.

The primary purpose of the framework is to facilitate development of project-specific plans for handling of mercury-contaminated sediments that potentially could be re-exposed as part of the development activity within the bay. While these future actions will be subject to project-specific permitting approvals, the framework was developed to help establish guidelines for how sediment management activities associated with those projects can occur in a manner that is supportive of, and possibly accelerates, the natural recovery component of the Superfund remedy. The goal of the plan is to provide a general approach for characterization of sediments proposed for excavation and a decision-making process for selecting responsible disposal alternatives consistent with the ROD.

A conceptual overview of an adaptive sediment management framework for Lavaca Bay is provided on (**Exhibit 3**). Any activities that occur in the bay in areas where sediments with elevated concentrations of mercury may be encountered should be managed using the decision-making process outlined in the (**Exhibit 3**). The end result of the decision-making process would be a designation for confined disposal or beneficial reuse of the targeted sediments.

The first step of the framework is designed to ensure there is adequate information to characterize the sediments targeted for the action. Significant data exists from the Lavaca Bay remedial investigation to document overall spatial and vertical distribution of mercury concentrations in sediments in the Bay, especially in those areas where concentrations are elevated. Using this data as a guide, sediment proposed for excavation should be characterized prior to construction by collecting and analyzing core samples throughout the proposed construction prism. To allow all possible management alternatives to be considered, sampling, and analysis activities should be designed to provide the appropriate resolution of mercury concentration data for each location where a sample is collected. This can be accomplished by sub-sampling each core sample at discrete intervals. Alcoa recommends using a compositing scheme that results in discrete two-foot intervals though the first four to six feet of the target prism. Information from these discrete intervals can then be evaluated for various sediment management actions.

The practical depths to which excavation will occur during dredging operations will serve as the primary guide for how to interpret the vertical distribution of sediment concentrations and disposition of the dredged material. This interpretation will consider to what extent dredged material will be homogenized throughout a vertical increment to determine what concentration would be representative of the material when it is placed at a given disposal location. Hydraulic maintenance dredging, for example, typically excavates sediments in lifts as great as four feet, and that interval would be an appropriate increment over which to composite or average concentrations to determine what type of disposal is suitable. A supplemental factor to consider in interpreting the vertical distribution of sediment concentrations is to determine if a thin veneer of highly concentrated sediments can be identified, and evaluate whether or not there is merit in handling that veneer differently (and if it is technically feasible) such that the mass of mercury represented by that veneer is isolated and removed from the system. Since Alcoa has obligations identified in the Superfund Consent Decree to ultimately meet fish tissue concentrations that relate back to exposure to bay sediments, it is within their discretion to evaluate sediment management options that may include removal and isolated disposal of such sediments, even if a compositing scheme which follows the planned development activity's dredging approach would suggest that open water disposal of the sediments is acceptable.

Once sufficient characterization information exists, and the mechanism by which to interpret that information has been determined, the framework provides for a threshold decision-making process whereby differing management actions are allowed depending on whether certain sediment concentration thresholds are met. Sediment concentrations that adequately characterize the targeted dredge prism or development action are determined. Again, the basis for determining a concentration value that is represented of the prism should take into account how material will be dredged and disposed of for that particular situation. Once the prism is characterized, its representative concentration(s) should be compared against two threshold values: 0.25 and 0.50 mg/Kg mercury (dry weight in bulk sediment), and decisions made consistent with the outcomes depicted in (**Exhibit 3**). A lower threshold value, 0.25 mg/Kg mercury, represents the remedial action objective for marshes, and is the threshold below which sediments can be used in any type of beneficial reuse scenario, including creation of aquatic habitats such as mudflat or marsh habitat. The higher threshold, 0.50 mg/Kg mercury, represents an upper end that is associated with limited use of dredged sediments. Between 0.25 and 0.50-mg/Kg mercury, sediments can potentially be applied to beneficial reuse; however, that reuse should not result in the sediments being directly linked to critical habitat types where the food chain uptake of mercury can potentially be exacerbated such as marsh habitats. Rather, they should be limited to applications such as the bottom layer of a reuse disposal area where they will be covered with cleaner sediments as the disposal area is completed or deposited in open water areas where mercury uptake is much less prevalent and the remedial action objective is 0.50 mg/Kg. Above the 0.50 mg/Kg concentration upper threshold, disposal options would be limited to a confined scenario, either in-water or upland.

2.2 PROJECTIONS OF FUTURE CONDITIONS WITHOUT MANAGEMENT PLAN

In general, future without-project environmental conditions in the MSC Study area are expected to reflect a continuation existing conditions. The trends in sedimentation rates identified by Moffatt and Nichol (2006) in the channel would be expected to continue. It is unlikely that any significant changes would occur to open bay bottom habitat, since there is no planned change in the MSC maintenance dredging placement practices. However, a continuation of the existing sedimentation and erosion rates in the bay system could impact more sensitive habitats, such as marshes, seagrass beds, oyster reefs and beaches.

2.2.1 Channel Sedimentation

If existing conditions continue without the MSCIP and dredged maintenance material continues to be placed in existing open bay unconfined placement areas the trends in sedimentation rates would be expected to continue. Under the existing channel maintenance plan the channel is dredged every two years in the Matagorda Bay and Lavaca Bay reaches. This dredged material is placed in unconfined placement areas to the east of the channel. An analysis of dredging records from 1963 to 1999 indicated that the sedimentation rate has decreased in some sections of the channel, increased in other areas, and not changed significantly over much of its length (Moffatt and Nichol 2006), changes in sedimentation rates are as follows:

- Station 10+000 to 15+000 – decrease
- Station 15+000 to 105+000 – no significant change
- Station 105+000 to 115+000 - increase

The observed decrease in sedimentation rate near the jetty channel at the lower end of the MSC is likely due to high flow conditions causing scouring, which would be expected to continue, so the sedimentation rate is expected to continue to decrease or remain similar to present levels. Sedimentation rates have not changed significantly in from Matagorda Bay above the jetty channel to Lavaca Bay where the channel turns to the north. The sedimentation rate in this middle segment of the channel would not be expected to change significantly. However, the sedimentation rate in upper Lavaca Bay has increased. In the upper Lavaca Bay area sedimentation rates would be expected to continue to increase if unconfined placement continues in areas where the current would carry sediment back into the channel. Increased sedimentation would lead to increased dredging costs. However, this increase in sedimentation rate was not projected into the future for any habitat impact assessment.

2.2.2 Marsh and Seagrass Impacts

Projected future conditions without the DMMP would include continued shoreline erosion along the Matagorda Bay shoreline which at this time is significant and creating steep bluffs all around the bay. Areas of marsh and seagrass that are highly vulnerable to future erosion have been identified in the vicinity of Keller Bay. The expected average erosion rate could cause a breach of the narrow peninsula separating Keller Bay from the larger Matagorda Bay within the 50-year project period of study. Wave erosion during tropical storms or hurricanes has been estimated to hasten this eventuality to within 10 years (a breach could occur at any time if a hurricane were to hit the area). Keller Bay is a shallow, protected body of water with lower-velocity currents than Matagorda Bay. If this peninsula is breached it is likely that in addition to the marshes lost to erosion, additional marshes and the seagrass in Keller Bay would be lost through habitat modification.

Based on recent aerial photography, there are 488 acres of marsh along the edge of Keller Bay, and 250 acres of seagrass within the Bay. It is anticipated that a Category 1 or larger hurricane would breach the peninsula separating Keller Bay from Matagorda Bay. The potential impacts of a breach are expected to replicate conditions that followed the breach from Matagorda Bay into nearby Redfish Lake in about 1986. Based on a review of habitat changes in Redfish Lake, most of the marsh and seagrass in Keller Bay is expected to be completely lost to erosion or habitat modification over the 50-year project analysis period.

2.2.3 Oyster Impacts

The majority of the Lavaca Bay oyster fishery is located near existing unconfined placement areas (**Exhibit 4**). The continued use of these unconfined placement areas would suspend silt during dredging operations and afterward until the disposal areas have stabilized. Sublethal impacts from high siltation are suspected to stress the oyster in several ways. Energy is required to consolidate silts and remove them from the mantle cavity while feeding. Heavy siltation causes the oyster to close and cease feeding until silts have settled out. Excess silt on oyster reefs might decrease the productivity of the reefs, reducing both their ecological function and commercial value. The high levels of total suspended solids found near placement areas 17, 18, and 19 (Moffatt and Nichol 2006) could also become detrimental to adjacent oyster reefs.

2.2.4 Beach Losses

Significant erosion has occurred located along the Matagorda Bay and southwestern Lavaca Bay shoreline. An area of particular concern is the public beaches on the Magnolia-Indianola shoreline, which have been eroding at an average rate of 3 to 4 feet per year (McGowen and Brewton 1975). The current rate of erosion would be expected to continue in the future without the DMMP, resulting in significant losses to the public beaches. The observed shoreline erosion could also pose a threat to the homes, roads, and marshes behind the beach.

2.3 PLACEMENT OPPORTUNITIES

2.3.1 Existing Placement Areas

Placing material in existing unconfined placement areas would minimize the impact to the bay system. Dredged material could be continued to be placed in these areas or they could be converted into a confined placement areas that may include habitat creation. Locating placement areas on existing unconfined placement areas would reduce the amount of undisturbed bay bottom converted to placement areas.

2.3.2 Shoreline Erosion

Beaches, marshes, and seagrass habitat is threatened by shoreline erosion. If sand is available, dredged material could be placed along beaches on the southwest shoreline of Matagorda and Lavaca Bays (from Indianola to Magnolia Beach), where beaches have been lost to erosion at a rate of 3 to 4 feet/year. Material could also be placed along the Sand Point shoreline and the peninsula separating Keller Bay from Matagorda Bay. Material placed along the Sand Point-Keller Bay shoreline would prevent erosion from destroying marshes and potentially causing a breach that would eliminate the seagrass in Keller Bay.

2.3.3 Coastal Texas 2020

Coastal Texas 2020 is a Texas General Land Office (GLO) initiative designed to promote the environmental and economic health of the Texas coast (GLO 2005). The GLO has identified areas along the Texas coast where shoreline erosion threatens ecologically sensitive areas or economically important resources. A goal of the Coastal Texas 2020 program is to increase available funding for projects to prevent and counteract erosion in identified areas. Several sites in Lavaca and Matagorda Bays have been identified as Coastal Texas 2020 priority areas.

The Peninsula at Sand Point, Indianola Beach, Sundown Island, and the Matagorda/Lavaca Bay shorelines have been identified as Coastal Texas 2020 critical project areas. As described in **Section 2.2.2** a breach of the peninsula at Sand Point would threaten seagrass habitat in Keller Bay, as well as a large wetland complex in the area. **Section 2.2.4** also describes threats to Indianola Beach from high erosion rates. Sundown Island is a created bird island near the jetty channel in Matagorda Bay. Strong currents in near Sundown Island contribute to high erosion rates. Coastal Texas 2020 suggests addressing threats to the Matagorda/Lavaca Bay shoreline on a site-by-site basis in areas where losses to erosion are high. Coastal Texas 2020 has suggested placement of dredged materials to create shoreline protection or nourish beaches as potential restoration/preservation activities for each of these areas in Matagorda and Lavaca Bay identified critical project areas.

2.3.4 Lavaca Bay Superfund Site

The Lavaca Bay Superfund Site is located near Point Comfort, from Texas State Highway 35 to south of Dredge Island. Elevated levels of mercury were identified in the sediments in the area, which triggered the Superfund designation. Mercury-impacted sediments are still present in the area, which presents the opportunity to use dredged material to cover the impacted sediments to prevent future disturbance. Covering the mercury-impacted sediments would minimize the potential for mercury to be released from sediments. See **Section 2.1.3** for a detailed discussion of the Lavaca Bay Superfund Site.

3.0 DREDGED MATERIAL

3.1 DREDGED MATERIAL VOLUMES

The deepening and widening of the MSC for the proposed MSCIP will generate approximately 46.5 million cubic yards (mcy) of new work material and 257.5 mcy of maintenance material over the 50-year life of the project. The project is divided into three reaches:

- Lavaca Bay Reach – Station 118+502 to 75+000 (Includes CCND Facilities and Proposed Turning Basin);
- Matagorda Bay Reach – Station 75+000 to 6+000; and
- Offshore Reach – Station 6+000 to –23+000.

The volume of new work dredged material from the MSCIP site, and the future maintenance dredging volumes, were determined based on the configuration of the MSCIP site as shown on **Figure 2** to **Figure 12**.

3.1.1 Initial Dredging (New Work)

The total volume of material within the MSCIP site was estimated using geometric analysis based on average elevations from existing topographic surveys and field data. The volume calculations were estimated using the average end area method. The calculation method does not account for potential variations within each project feature or changes since the topographic surveys were performed. The volume calculations are based on the channel dimensions provided in **Section 1.2**.

The volume calculations include both the overdepth and advanced maintenance requirements. **Table 3-1** provides the volumes of the new work dredge material:

Table 3-1. New Work Volumes

Reach	Station	to Station	Volume (CY)
Lavaca Bay	*Proposed CCND Facilities**		1,836,885
	*Proposed Turning Basin**		3,500,000
	116+593	107+000	3,312,115
	107+000	92+000	6,804,000
	92+000	88+000	1,443,000
	88+000	82+000	2,195,000
	82+000	75+000	2,170,000
Matagorda Bay	75+000	71+000	1,699,000
	71+000	67+000	1,505,000
	67+000	54+000	4,558,000
	54+000	46+000	2,664,000
	46+000	40+000	2,271,000
	40+000	6+000	9,366,000
Offshore	6+000	-5+000	0
	-5+000	-23+000	3,206,000
		Total	**46,530,000**

***Figure 10 provides the outlines of these two areas*.

3.1.2 Maintenance Dredging

The estimated annual maintenance dredging volume is based on a sedimentation analysis that calculated the volume using: historic dredging records, total suspended sediment concentrations, hydrodynamics of the proposed channel, and amount and location of material placed in unconfined placement areas (continued use of unconfined placement in Matagorda Bay and full confinement in Lavaca Bay; Moffatt & Nichol 2006). Projected annual maintenance volumes for each reach of the channel are provided in **Table 3-2.**

Table 3-2. Projected annual maintenance volumes with the proposed MSCIP, from Moffatt and Nichol (2006).

Reach	Station	To Station	CY/year	Total for 50 years, cy
Lavaca Bay	CCND Facilities		264,000	13,200,000
	Turning Basin		527,000	26,350,000
	110+000	75+000	1,909,000	95,450,000
Matagorda Bay	75+000	6+000	2,179,000	108,950,000
Offshore	6+000	-5+000	0	0
	-5+000	-23+000	272,000	13,600,000
		Total	**5,151,000**	**257,550,000**

3.2 QUALITY OF DREDGED MATERIAL

The subsurface soil conditions of the MSCIP site dictate the type of dredge that will be utilized to perform the excavation. The physical characteristics of the soil affect its placement options due to varying strength and compressibility. Contaminant levels within the soil/sediment also limit placement options. The following sections discuss the new work and maintenance material qualities and quantities.

3.2.1 Initial Dredging (New Work) Material

3.2.1.1 Physical

The subsurface soils in the turning basin and channel consist of soft clays, very stiff to hard clays and sand. The dredge prism soil classification in **Table 3-3** is based on available boring logs from the USACE – Galveston District's General Design Memorandum No. 3, finalized in January 1962 (USACE Design Memorandum No. 3).

Table 3-3. New Work Soil Classification

Station	to Station	Sand (CY)	Stiff to Hard Clay (CY)	Soft Clay or Silt (CY)
CCND Facilities		0	1,342,079	494,806
Proposed Turning Basin		0	2,453,451	1,046,549
116+593	107+000	0	2,667,470	644,645
107+000	92+000	1,164,000	324,000	5,316,000
92+000	88+000	297,000	671,000	475,000
88+000	82+000	1,113,000	251,000	831,000
82+000	75+000	471,000	0	1,699,000
75+000	71+000	0	0	1,699,000
71+000	67+000	687,000	454,000	364,000
67+000	54+000	1,434,000	320,000	2,804,000
54+000	46+000	1,779,000	0	885,000
46+000	40+000	780,000	1,338,000	153,000
40+000	6+000	5,933,000	207,000	3,226,000
6+00	-5+000	0	0	0
-5+000	-23+000	3,206,000	0	0
	Total	**16,864,000**	**10,028,000**	**19,638,000**

Information on these borings may be found in USACE Design Memorandum No. 3. (**Appendix A**).

3.2.1.2 Contaminant Assessment

Extensive sediment sampling was conducted as part of the Remedial Investigation (RI) to characterize and delineate the extent of contamination within the Alcoa/Lavaca Bay Superfund site area. The RI was conducted in two major phases, Phase 2A and Phase 2B (Alcoa 1999). The first phase, Phase 2A, was conducted to develop a list of constituents of potential concern (COPCs) at the site. Phase 2A of the RI consisted of collection of 111 sediment samples in the area nearest to the Alcoa facility and analysis of those samples for a range of constituents including metals/metalloids, volatile organic constituents, semivolatile organic constituents, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) (Alcoa 1999). As a follow-up to the Phase 2A investigation, Alcoa (1997b) conducted the Phase 2B study to further delineate COPCs identified in the Phase 2A study areas and to initially characterize sediment quality in areas that had not been previously sampled. A total of 367 sampling stations were installed in Lavaca Bay, Keller Bay, upper Matagorda Bay, Cox Marsh, and Cox Lake.

The vertical profile of mercury in the sediments was studied and reported in Phase 2C of the RI, the Mercury Reconnaissance Study (Alcoa 1996). This phase of the investigation focused on the basic fate and transport mechanisms related to methyl mercury. In this study, 15 sampling stations were selected in the vicinity of the Dredge Island, which is known to be the most heavily impacted area with respect to mercury releases to sediment.

Phase 3 of the RI process at Alcoa consisted of a sediment quality triad investigation (Alcoa 1997a) conducted in an area of Lavaca Bay known to have concentrations of mercury in sediment that ranged from 0.3 mg/kg to 4.6 mg/kg. The sediment quality triad evaluation included the determination of sediment chemistry, sediment physical parameters, survival and growth of a juvenile polychaete, survival of an adult infaunal amphipod, and benthic community

structure. Ten sampling stations in a north-south trending transect in Lavaca Bay (southwest of Dredge Island) and three reference stations were selected.

In November 2005, a sediment study was performed by Alcoa to obtain more recent and updated mercury data in Lavaca Bay (see **Appendix B**). As part of this study, 38 samples were collected from 23 sampling stations up to a depth of approximately 4.5 ft within the proposed turning basin and proposed channel improvements in Lavaca Bay.

The following statements summarize the results of the extensive surficial sediment assessments that were performed as part of the remedial investigation of the Alcoa (Point Comfort)/Lavaca Bay Superfund site:

The PSCR identified mercury detected above the minimum concentration of ecological concern and probable level of ecological concern in Lavaca Bay and Upper Matagorda Bay, and within the MSC adjacent to the Alcoa facility.

The results of the Phase 2A investigation identified mercury and PAH as the primary COPCs at the site.

Phase 2B of the RI, a follow-up investigation to Phase 2A, did not identify any new COPCs and concluded that PAHs were only a concern in the area closed to fishing (i.e., the area in proximity to Dredge Island), although the maximum concentration did not exceed the probable level of ecological concern (0.7 mg/kg), and mercury is the only COPC in Lavaca Bay (and presumably, Keller Bay and upper Matagorda Bay) outside the closed area.

Phase 2C (Mercury Reconnaissance Study) determined that maximum mercury concentrations typically occurred in the top 30 cm of sediment.

The Sediment Quality Triad Investigation (Phase 3) of the RI demonstrated that the concentration of mercury in sediment in the reference area (outside the vicinity of the Alcoa facility) was less than 0.2 mg/kg and presented evidence that total mercury in sediment ranging up to 4.6 mg/kg were not associated with any adverse effects in the benthic community in Lavaca Bay.

The concentrations of total mercury in sediment samples collected during the November 2005 sampling event ranged from 0.0024 mg/kg to a maximum concentration of 0.543 mg/kg (**Appendix B**). The total mercury concentrations in the sediment samples collected did not exceed the RAO of 0.5 mg/kg, with the exception of two sediment samples that were collected at the entrance of the proposed turning basin. The total mercury concentrations in these two samples were 0.543 mg/kg at a depth interval of 0-1.8 ft and 0.502 mg/kg at a depth interval of 0–2.7 ft.

3.2.2 Maintenance Dredging Material

3.2.2.1 Physical

Maintenance dredging of the existing bay reach of the ship channel and the existing turning basin has occurred biannually, and the Gulf reach and entrance channel has been maintained approximately every 2.5 years. Sampling of this dredged material within the existing ship channel provides analytical and grain size data for the maintenance dredged material. The

maintenance material is characterized as fine-grained, with both soft and sandy clays with the offshore material also containing fine-grained sand.

3.2.2.2 Contaminant Assessment

A considerable database of sediment quality information is available for maintenance material that was periodically removed from the existing MSC by the COE. Typically, the testing performed included toxicity testing and bioaccumulation studies. A reference location was selected and sediment collected from the reference location was subjected to the same testing protocol. In a 1994/1995 evaluation of sediment quality, dredged material to be removed from the entrance of the MSC on the Gulf of Mexico side of the Matagorda Peninsula (Espey, Huston & Associates 1996) was tested using solid-phase bioassays and a bioaccumulation study conducted in conformity with the EPA's/COE's Testing Manual in effect at that time (EPA/COE 1991). Three sampling stations were selected within the area to be dredged as well as a sampling station within a reference area. Survival of test organisms and bioaccumulation of metals in test organisms in contact with sediment subject to dredging relative to survival and bioaccumulation of organisms in contact with sediment collected from the reference area were the testing endpoints. No chemical analyses of sediment were conducted, although tissue samples obtained from organisms used in the bioaccumulation study were analyzed for a variety of constituents, including pesticides, PCBs, PAHs, phenols, and metals. Metals, to include arsenic, barium, cadmium, chromium, copper, lead, nickel, and zinc, were identified in tissue samples collected as part of the bioaccumulation study, but there was no statistically significant difference in the tissue metals content of test organisms exposed to sediment collected from the area subject to dredging and the reference area. The result of the toxicity analysis was that no toxic impacts on benthos would be expected if dredged material were disposed in the Gulf of Mexico. Therefore, it was the conclusion of the authors of the report that reasonable assurance was given by the results of the two types of tests that no significant undesirable effects would result from placement of the sediment in the Gulf of Mexico.

Two earlier evaluations (Espey, Huston & Associates 1980, Espey, Huston & Associates 1985) of sediment quality in the entrance to the MSC were conducted in 1980 and 1985. Metals, PCBs, and pesticides were analyzed in sediment samples collected from three sampling stations within the entrance to the MSC. In addition, toxicity and bioaccumulation testing was performed. The result of the testing in both studies was the same; sediment quality of material subject to dredging was considered acceptable for placement in the Gulf of Mexico.

Sediment within a section of the existing MSC from Indian Point to Point Comfort was evaluated for suitability of placement in other areas (Espey, Huston & Associates 1983a). A total of three sampling stations were placed in the portion of the MSC scheduled for dredging. A reference area was selected approximately 100 feet from the side of the channel to be dredged. Sediment samples were analyzed for metals, pesticides, and PCBs. Biological testing of sediment included toxicity testing and bioaccumulation studies. The conclusion of the 1983 study was that no sediment quality problem existed and that no significant undesirable effects would result if the dredged material were redistributed in other areas.

In a 1988 study of sediment quality within the existing MSC between Matagorda Peninsula and Point Comfort (Espey, Huston & Associates 1988), six sampling stations were established within the existing portion of the channel that was subject to dredging. A reference area also was sampled at four different locations. Toxicity and bioaccumulation testing was performed. Sediment samples were not analyzed for chemical constituents, but benthic tissue samples

were analyzed for metals, PAHs, pesticides, and PCBs. The conclusion drawn from the results of the study was that sediment dredged from this area could be redistributed without restriction.

A study conducted in 1983 pertaining to sediment quality in the MSC between Matagorda Peninsula and Indian Point (Espey, Huston & Associates 1983b) also resulted in the conclusion that sediment dredged from this area could be dredged and redistributed without restriction. This study included analysis of sediment samples for metals content and testing sediment for toxicity and bioaccumulation potential. A total of four stations were established in the area subject to dredging. Reference sediment was collected from three locations approximately 100 feet outside of the boundary of the existing channel and parallel to the four channel sampling stations.

Testing of maintenance material from a proposed extension of the Point Comfort Turning Basin was performed in 1999-2000 (PBS&J 2001a). Toxicity and bioaccumulation testing was performed on both sediment and suspended particulates in 23 samples collected from the existing turning basin. Toxicity and bioaccumulation testing was performed in conformity with the protocols contained in the EPA's/COE's Inland Testing Manual (EPA/COE 1998). Surface sediment samples were collected. Analytes for the sediment medium included metals, total petroleum hydrocarbons (TPH), and PAHs. A reference area was selected from the lower end of Lavaca Bay, and the same types of samples were collected from three locations within the reference area. The results of the study were that metals, TPH, and PAHs were detected but, according to the authors of the report, test sediment constituent concentrations were not noticeably different from constituent concentrations in the reference area. Toxicity characteristics of both solid phase and suspended sediments collected from the turning basin were comparable to that in the reference area. The conclusion reached from the toxicity testing of both suspended phase and solid phase sediment was that there would be no unacceptable impacts on benthic organisms from placement of dredged material elsewhere in the aquatic environment. There were several metals, notably chromium, copper, selenium, and zinc that bioaccumulated to a statistically significantly greater degree than the same metals present in sediment in the reference area. However, there were no available Food and Drug Administration (FDA) Action Levels for the metals that bioaccumulated to a significant degree, and the conclusion drawn from the results of the bioaccumulation study was that the COE and the EPA must make a case-specific decision whether dredged material from the Point Comfort Turning Basin would be suitable for open water placement or, alternatively, for upland confined placement. Note that the results of elutriate testing of this material indicated that the material would not cause water quality degradation if upland placement were used.

In a separate evaluation, the COE (2002) published an environmental assessment focused to Federal assumption of maintenance of an additional portion of the Point Comfort Turning Basin originally constructed by the Calhoun County Navigation District. Sediment quality was evaluated by analysis of samples for organic and inorganic constituents and by toxicity and bioaccumulation testing. While metals reportedly were detected in all samples collected and organic constituents were detected in a few samples, the results of the toxicity testing indicated that dredging and discharge of material would not be acutely toxic to benthic organisms and that the level of bioaccumulation of constituents in benthic organisms was not significant. The conclusion of the environmental assessment was that the risk associated with encountering sediments containing excessive concentrations of hazardous materials was remote. When sediment quality was considered with other factors associated with dredging, such as water quality, impacts to wildlife and fisheries, threatened and endangered species, social resources, and historic resources, the COE concluded that an environmental impact statement was not

required to support the assumption of maintenance of portions of the turning basin. The result of the evaluation was a finding of no significant impact (FONSI).

An evaluation of maintenance material to be taken from the MSC from the Point Comfort Turning Basin and adjacent segments of the Federally maintained MSC was conducted in 2000 (PBS&J 2001b). A total of 28 surface sediment samples were analyzed for metals, pesticides, PCBs, PAHs, and TPH. Both solid-phase and suspended sediments were tested for toxicity and bioaccumulation potential in conformity with the protocols contained in the EPA's/ACE's Inland Testing Manual (EPA/ACE 1998). A reference area was selected from the lower end of Lavaca Bay, and the same types of samples were collected from the reference area. The results of the analyses were that metals and TPH were detected in sediment but, according to the authors of the report, test sediment concentrations were not noticeably different from reference area sediment concentrations. Survival of test organisms in the toxicity test was not different from that noted in the reference control samples, and there was no bioaccumulation of any detected constituent. Therefore, the conclusion of the study was that there was reasonable assurance that no significant undesirable effects would occur upon open bay placement of the sediments tested.

Another analysis of sediment quality was performed prior to maintenance activities to take place in the entrance channel to the MSC (PBS&J 2001c). Sediment samples collected from nine locations within the area scheduled for dredging and three within a reference area. These were composited into three samples from the area subject to dredging and one sample from the reference area and analyzed for metals, pesticides and PCBs, and PAHs. The composite samples from the area subject to dredging and the reference area were tested for toxicity and bioaccumulation potential in benthic invertebrates. The result of the analysis was that detected metals in sediment subject to dredging were not noticeably different from the metals content of sediment collected from the reference area. Only four PAHs were detected in sediment, and it was the conclusion of the authors that because all PAH concentrations were near the detection limit and that there was no toxicity or bioaccumulation concerns identified from the biological testing, the presence of PAHs in sediment was not a cause for concern. A lack of toxicity and bioaccumulation potential and a lack of noticeably different constituent concentrations in the area subject to dredging and the reference area led the authors to conclude that dredging and placement of material would not cause unacceptable impacts to the water column or to benthic organisms.

4.0 PLACEMENT PLAN FORMULATION

4.1 IDENTIFICATION OF ALTERNATIVES

The MSCIP will require areas for placement of new work and maintenance dredged material. The mix of placement areas would primarily distinguish the placement alternative, along with the types of dredging equipment capable of constructing the improvements. Thus, a range of dredged material placement alternatives was considered, including confined upland placement, habitat creation/protection, unconfined open bay, and unconfined ocean placement.

In evaluating the alternatives for material placement, three feasible categories of placement alternatives were initially screened:

- Upland Confined Placement
- Gulf Unconfined Placement
- Multi-use Placement

Upland Confined Placement and Gulf Unconfined Placement alternatives focus on a single type of placement of the dredged material and do not allow for the habitat creation/protection. Multi-use Placement alternatives, as the name implies, includes a variety of placement types.

In the interest of meeting the project purpose and need while minimizing and mitigating for environmental impacts, CCND and USACE met with representatives of several State and Federal resource agencies to develop the DMMP. A preliminary DMMP was presented to the Agency Work Group (Work Group) on February 9, 2006, with subsequent revisions. Work Group participants included representatives from the following State and Federal agencies:

- Texas Commission on Environmental Quality (TCEQ);
- Texas General Land Office (GLO);
- Texas Parks and Wildlife Department (TPWD);
- National Marine Fisheries Service (NMFS); and
- U.S. Fish and Wildlife Service (FWS).

Five additional meetings were held with the agencies. Also, a Community Workshop in Port Lavaca, Texas was held on July 21, 2006 to solicit ideas on the placement of dredged material. Input from both the agencies and the community help form the DMMP, specifically the Multi-use Placement Alternatives.

The Recommended Plan was selected based on costs and ecological impacts. The plan must include sufficient quantities of material to be used for habitat creation or protection to ensure that any harmful ecological impacts over the 50 year project life are fully mitigated by the plan.

4.2 EVALUATION OF ALTERNATIVES

4.2.1 Upland Confined Placement Alternative

There are several potential and existing onshore upland confined sites that might be available for use throughout the bay system, in both the Lavaca Bay and Matagorda Bay areas. In this alternative all of the material from Station 118+502 in Lavaca Bay to Station -23+000 in the Gulf of Mexico would be placed in upland confined sites.

There are two existing dredged material placement areas in the Lavaca Bay area. Dredge Island is currently used by Alcoa and Calhoun County Navigation District (CCND) for placement of maintenance materials. A dredged material placement area designated as PA 19 is located on the Calhoun County Navigation District property in Lavaca Bay. These placement areas lack the capacity to hold the entire anticipated volume of materials. Several potential upland placement areas have been identified including: Alamo/Magnolia Beach area (P1), Rhodes Point (P2), Powderhorn Lake vicinity (P3), and the north side of the Matagorda Peninsula (P4) (**Exhibit 2**).

All of these potential sites would require land acquisition, estimated at approximately $3,000 per acre, and none of the potential placement areas would be capable of receiving all the dredged material (new work and maintenance) alone. Therefore multiple areas would be required to be purchased and constructed and any potential mitigation would need to be addressed. Approximately 3,888 acres of placement areas would need to be identified from the potential options listed above to manage the material generated by both new work dredging and subsequent maintenance operations. Materials from the Lavaca Bay, Matagorda Bay, and Offshore Reach of the MSC would need to be pumped from a distance of up to 9 miles in order to avoid placement of the material on high quality wetlands, marshes, oysters and/or seagrass habitat that would require extensive mitigation.

4.2.2 Gulf Unconfined Placement Alternative

The Gulf Unconfined Placement Alternative would entail the placement of dredged materials in an ODMDS for the Lavaca Bay, Matagorda Bay, and Offshore Reaches of the MSC. The materials would be transported by either a hopper dredge or dump scow to the ODMDS(s).

An EPA approved ODMDS (PA1) is located approximately two miles offshore and 1,000 feet south of the MSC jetties. A potential ODMDS (O5) has been considered adjacent to PA1 approximately three miles offshore and 1,000 feet south of the MSC centerline (**Figure 14**). PA1 and O5 are dispersive sites, so they have an unlimited capacity. In this alternative, all of the new work and maintenance material from the Lavaca Bay, Matagorda Bay, and Offshore Reaches of the MSC was evaluated for placement offshore.

4.2.3 Multi-use Placement Alternative

Preliminary results indicate that the Upland Confined and Gulf Unconfined Placement Alternatives would cost considerably more than the Multi-use Placement Alternative, even if there was no cost for the land acquisition. Therefore, several Multi-use Placement Alternatives were evaluated to determine the optimized plan that provides the least cost with net positive ecological impacts. Multi-use Placement Alternatives include a mixture of upland, offshore and in-bay placement areas. In these alternatives, placement areas are located close to the channel

to minimize pump distance and thereby minimize costs for placement of both new work and maintenance dredged material. The alternatives also propose the utilization of dredged material to create or protect habitat for mitigation of dredging and placement area impacts.

No placement option other than confined placement was considered for maintenance material in the Lavaca Bay Reach due to ecological concerns (oyster reefs) and a potential increase in shoaling in the channel.

Continued unconfined open bay placement of maintenance material in the Matagorda Bay Reach is considered a viable option for the project because of the following factors:

- No special aquatic resource such as oyster reef or seagrass is located in close proximity to the placement areas;
- Analysis of the Matagorda Bay sedimentation process indicates that use of these areas will not increase the amount of maintenance dredging required (URS 2006b);
- In-bay, unconfined placement areas have less of an ecological impact than in-bay confined placement areas of similar size because the confined areas result in a permanent loss of the aquatic habitat.

This option as well as confined placement areas are explored for the alternative analysis.

4.2.3.1 Lavaca Bay

A majority of the material to be removed during new work widening and deepening of the channel in the Lavaca Bay Reach will consist of stiff to hard clay (7.7 mcy). Because of the quality of the material, several in-bay confined placement areas, as well as sites that use material to create habitat were considered. Also, sandy material is available in the Lavaca Bay Reach that could be beneficially used for nourishment of beaches that are eroding along the Indianola-Magnolia shoreline.

Additional types of project opportunities include marshes, oyster reefs, and covers for mercury-impacted sediments. None of these alternatives would include any unconfined placement in Lavaca Bay.

4.2.3.2 Matagorda Bay

The Matagorda Bay Reach of the MSCIP has a limited amount of stiff and hard clay (2.3 mcy) for use in levees to confine softer new work and maintenance material. As a result, the amount of marsh, platforms for seagrass colonization, or in-bay confined placement areas that can be built from dredged material is limited. Stiff or hard clay would need to be mined from either within the channel, or within the footprint of the proposed placement areas to fully confine all material in Matagorda Bay. Mining material would result in a significant additional cost for the project.

Other options for placement of dredged material include using it to nourish beaches, protect shorelines, or create bird islands (**Figures 12** and **13**). In addition, material could be placed offshore, or in existing open bay unconfined placement areas. Input from public meetings indicated a desire for placement areas to be located away from the shoreline. Based on this

restriction, proposed placement areas are located on the northeast side of the ship channel (away from shore). Suitable locations for onshore uplands were not available along Matagorda Bay.

Sandy material is also available in the Matagorda Bay Reaches that could be used for nourishment of beaches that are eroding along the Indianola-Magnolia shoreline. Material could also be used for shoreline protection to prevent the loss of marsh and seagrass habitat in and around Keller Bay. Marsh, bird island, and sand platform habitat location restrictions are the same as for in-bay uplands, so these habitats could also be located northeast of the ship channel. The sand platforms would provide habitat suitable for seagrass colonization, and these areas would be allowed to vegetate naturally.

Material dredged from Matagorda Bay Reach that is not suitable for mitigation or habitat creation could be economically placed in an ODMDS. Unconfined placement in Matagorda Bay is being considered for some Multi-use Placement alternatives.

4.2.3.3 Offshore

The proposed Multi-use Placement Alternatives could use ODMDS PA1 and/or a proposed ODMDS O5 for placement of materials from the Offshore Reach. Sites PA1 and O5 are designed to be offshore unconfined dispersive placement sites, which is reflected in the size of the areas. Placing sand on the gulf beach was considered; however, sand placed on the north side might increase maintenance costs because the jetty fillet has built out and sand is more readily mobilized around the end of the jetties, which increases maintenance. Material placed on the south side of the island could be transported to the west and increase shoaling at Pass Cavallo. Additionally, the entrance channel work requires a hopper dredge, and placing material on a beach requires the material to be pumped out. Other uses of the sand were considered, but all other options would require pumping out of a hopper dredge which would cost considerably more than offshore placement.

4.2.4 Screening of Alternatives

The three Placement Alternative types were compared based on cost. **Appendix C** provides detailed cost estimates for the alternatives with the base assumptions for the estimates. These estimates provide comparisons among alternatives only, and do not include the following cost items:

- Engineering and Design;
- Construction Administration;
- Pipeline Relocations;
- Relocation of Aids for Navigation;
- Monitoring and Maintenance of the Habitat Areas; and
- Contingency or Escalation

The inclusion of these items would not influence the screening process because the costs are approximately the same for all the Alternatives. The Multi-use Placement Alternative had the lowest cost (**Table 4-1**).

Table 4-1. Costs for Placement Alternatives

	Upland Confined Placement	Gulf Unconfined Placement	Multi-use Placement
New Work Cost	$308,108,000	$313,472,000	$248,050,000 to $301,469,000
Maintenance Cost (50 years)	$749,310,000	$1,073,104,000	$496,572,000 to $590,190,000
Total Cost	$1,057,418,000	$1,386,576,000	$772,571,000 to $863,710,000

4.2.4.1 Upland Confined Placement Alternative

The new work construction cost for the Upland Confined Placement Alternative is $308,108,000. This value is high due to the high number of boosters required to pump the dredged materials up to 9 miles. This cost does not include the additional cost for mitigation that would be required for the impacts to bay bottom and oyster reef resulting from widening the channel. The project maintenance cost over the 50-year project life is $749,310,000; making the total cost $1,057,418,000; excluding costs for mitigation sites (**Table 4-1**).

Since all dredged material is removed and placed on shore, the Upland Confined Placement Alternative has the least conversion of open bay bottom and offshore habitats. However, this alternative includes no mitigation or habitat creation/protection sites to offset project negative impacts. Thus, it would have a negative ecological impact without additional mitigation. In addition, this alternative would require purchasing a large amount of land, which involves high costs and potential mitigation for impacts to wetlands and other terrestrial habitats. The Upland Confined Placement Alternative was removed from consideration due to the high costs and difficulties arising from large amounts of land acquisition.

4.2.4.2 Gulf Unconfined Placement Alternative

The new work construction cost for the Gulf Placement Alternative is $313,472,000 due to the travel distance required for dredged materials using hopper dredges or clam shell dredges with dump scows. This cost does not include the costs for additional mitigation that would be required for the impacts to bay bottom and oyster reef resulting from widening the channel. The project maintenance cost over the 50-year project life is $1,073,100,000 excluding costs for mitigation sites. The total project cost for Gulf Unconfined Placement is $1,386,576,000 (**Table 4-1**).

The Gulf Unconfined Placement Alternative minimizes conversion of Bay habitats by not having any in-bay placement areas, but results in placement of all of the dredged material into offshore unconfined placement. However, this alternative includes no mitigation or habitat creation/protection sites to offset project impacts. Thus, it would have a negative ecological impact without additional mitigation. Moving all dredged material offshore requires long distance transport of some of the materials. The costs for new work and maintenance for

moving material is higher than other alternatives. Due to the cost associated with offshore disposal for all dredged materials, the Gulf Unconfined Placement Alternative was removed from further consideration.

4.2.4.3 Multi-use Placement Alternative

Initial analysis indicated that Multi-use Placement Alternatives would result in a significantly lower cost than the other two alternatives. Four Multi-use Alternatives were developed in order to examine the costs and ecological impacts (positive or negative) of a range of scenarios for Multi-use Placement Alternatives with varying placement areas. Two alternatives were developed that had full confinement of maintenance and new work dredged materials in Matagorda Bay, and two that continued unconfined open bay placement. In each of these pairs of alternatives one utilized an onshore upland placement area, and the other called for placement of materials in an additional in-bay upland.

The new work construction costs for the Multi-use Placement Alternatives range from $248,050,000 to $301,469,000. A significant amount of the new work cost is in building levees for placement areas, with transportation costs for materials less than the other alternatives. This alternative includes mitigation and habitat creation/protection sites, so no additional costs are required. The project maintenance cost over the 50-year project life ranges from $496,572,000 to $590,190,000; making the total cost from $772,571,000 to $863,710,000 (**Table 4-1**).

The Multi-use Placement Alternatives have greater impacts to the Bay habitat than the other two alternatives. However, they provide for mitigation and habitat creation/protection sites, and alternatives could be designed to result in a net positive impact to the Bay system, whereas the others result in a net loss of function. Regardless of the alternative selected, Multi-use Placement Alternatives also have the lowest new work and maintenance costs of the three potential alternatives. Multi-use Placement was selected during the screening process as the most favorable alternative based on having the lowest cost and by providing net positive impact to the Bay system.

4.3 SELECTION OF RECOMMENDED PLAN

The Multi-use Placement Alternatives require the creation of numerous in-bay placement areas, and potentially an onshore placement area. In coordination with federal and state resource agencies, as well as the public, several different options using numerous placement area configurations were evaluated and narrowed down to 4 alternatives whose feasibility of implementation were found to be reasonable. Most of the placement areas are the same among all 4 alternatives, the main differences are in whether or not there is full confinement in Matagorda Bay, and whether or not material is placed in onshore upland PA P1. **Table 4-2** lists the placement areas that make up each alternative. Alternatives 1A and 1B have full confinement of all new work and maintenance material in Lavaca Bay and Matagorda Bay. Alternatives 2A and 2B have full confinement of new work and maintenance material in Lavaca Bay and no unconfined open bay placement of new work material in Matagorda Bay. Alternatives 2A and 2B have continued use of the existing unconfined open bay placement areas for maintenance of the Matagorda Reach. Alternatives 1A and 2A place material in PA P1. Alternatives 1B and 2B place material in in-bay upland site C2 instead of P1. **Exhibits 6, 7, 8 and 9** show the locations of the placement areas for Alternatives 1A, 1B, 2A, and 2B, respectively. Proposed placement areas for the Multi-use Placement Alternatives are described below.

Table 4-2. Placement Areas used in each Multi-use Placement Alternative

Placement Area	Type	Alternative			
		1A	1B	2A	2B
A1	In-Bay Upland	X	X	X	X
A2	In-Bay Upland/Marsh	X	X	X	X
BI	Bird Island	X	X	X	X
BN1, BN2, BN3	Beach Nourishment	X	X	X	X
C2	In-Bay Upland		X		X
D	In-Bay Upland	X	X	X	X
ER1	Oyster Reef on Mercury-Impacted sediment	X	X	X	X
ER2	In-Bay Upland on Mercury-Impacted sediment	X	X	X	X
ER3	In-Bay Upland/Marsh on Mercury-Impacted sediment	X	X	X	X
G	Marsh/Shoreline Protection	X	X	X	X
H2	In-Bay Upland	X	X		
H4	In-Bay Upland	X	X		
H4 Habitat Area	Marsh/Sand Platform/Bird Island			X	X
O5	Offshore Dispersive Site	X	X	X	X
OR1 and OR2	Oyster Reef	X		X	
P1	Onshore Upland	X		X	
PA1	Existing Offshore Dispersive Site	X	X	X	X
PA5 to PA12	Existing Unconfined Area in Matagorda Bay			X	X

4.3.1 Placement Areas (PA)

4.3.1.1 PA A1 – In-Bay Upland

Proposed PA A1 is a 530-acre, rectangular site located south of the Port of Port Lavaca-Point Comfort facilities on existing USACE PAs 18 and 19. The area is planned to be an upland confined placement area, located partially on land, but with the majority of the site in open water. Approximately 530 acres of bay bottom are expected to be covered during the filling of the placement area. PA A1 will be used to contain approximately 2.0 mcy of stiff clay and 1.3 mcy of soft clay new work material and 45.1 mcy of future maintenance material.

4.3.1.2 PA A2 - Combined Upland/Marsh

Proposed PA A2 is a 260-acre, rectangular site located along the northern shore of Cox Bay, which is an eroding clay bluff. The area is planned to include uplands as well as marsh in the open bay adjacent to the bluff, which should eliminate future erosion in this area. The upland part of the site is planned to extend from the bluffs to an interior levee. The site will have a marsh along the bay. PA A2 will contain 140 acres of uplands and 120 acres of marsh constructed from new work material. This area will be used to contain approximately 0.8 mcy of stiff clay and 5.4 mcy of soft clay new work material. A small amount of oyster reef (0.75 acres) will be impacted by construction of the site (BESI 2006a).

4.3.1.3 PA BN1, BN2, and BN3 – Beach Nourishment

Proposed PA BN1, BN2, and BN3 are located along the public beaches of the Magnolia-Indianola shoreline. These proposed areas would nourish the beaches in areas that have been eroding at an average rate of 3 to 4 feet per year. Confining structures of stone or a comparable system will be used at the end of the fills near the LaSalle monument to the south as well as along the beach fill and at the public boat ramp to the north to stabilize the sand. Additional structures would be provided at the Crabbing Bridge to protect the inlet to Old Towne Lake and at Indian Point to protect the fill. Depending on the composition of the sand, the beach may be built out between 150 feet to 300 feet after the initial construction. This area will be used to contain approximately 1.9 mcy of new work material. Since these beach nourishment areas will be restoring similar habitats to what has been lost to erosion, they would not be considered significant impacts to bay bottom habitat.

4.3.1.4 PA C2 – In-Bay Upland

PA C2 is a rectangular 886-acre in-bay upland placement area located to the north of the ship channel, north of Magnolia Beach in Lavaca Bay. Levees will be raised around the site during the initial construction of the channel and openings will be provided to allow circulation until the maintenance material is placed inside. Half of the area will be filled with new work material, and the other half of the area will remain open until 25 years later, when maintenance material will be placed there over the remaining project life. PA C2 will be used to contain approximately 2.2 mcy of new work material and 55.0 mcy of future maintenance material.

4.3.1.5 PA D – In-Bay Upland

Proposed PA D is a 274.2-acre, rectangular site located adjacent to the southwest side of the existing “Dredge Island“. The area is planned to be an upland site with part of the placement area on land and the majority of the site located in open water. Both marsh and high marsh will be created in a 100 ft. wide area along the perimeter of the upland; 7.1 acres marsh and 7.1 acres of high marsh will be created. PA D and ER3 are joined; PA ER3 is the part of the placement area that is on mercury-impacted sediments. The amount of existing oyster reef in the proposed placement area was estimated at 0.66 acres (BESI 2006a). A marsh delineation done by BESI (2006b) found 3.4 acres of marsh and 18.6 acres of high marsh along the edge of dredge island. The remainder of the existing habitat of the site is non-marsh Dredge Island shoreline and open bay bottom. PA D will be used to contain approximately 0.5 mcy of stiff clay and 1.1 mcy of soft clay new work material and 14.8 mcy of future maintenance material.

4.3.1.6 PA ER1 – Enhanced Recovery Area Oyster Reef

Proposed PA ER1 is located on sediments that are impacted by mercury, which was analyzed for the Lavaca Bay Superfund Site. The remedy in the Lavaca Bay Superfund Record of Decision (ROD) for this area is to allow natural sedimentation to cover the area. The area southwest of Dredge Island had levels of mercury above the remedial action objective (RAO) in the surface sediments and had been identified as an area of concern as a result of the remedial investigation. The Sediment Radiochemistry Study (Alcoa 1999) performed by Alcoa determined that the lowest sedimentation rates occurred southwest of Dredge Island, which has resulted in a slower recovery rate of the impacted sediments in these areas compared to the rest of the bay. Although not required by the ROD because these areas are undergoing natural sedimentation, an area southwest of Dredge Island has been identified as a potential area for beneficial use of available dredged materials to provide additional cover on the sediments, which have had mercury concentrations above the RAO. The footprint of this area was limited because of the available amount of stiff clay. This area was coordinated with Alcoa as the preferred location for the use of the material.

A report entitled *Damage Assessment and Restoration Plan and Environmental Assessment for the Point Comfort/Lavaca Bay NPL Site; Ecological Injuries and Service Losses* prepared by national resource trustees, recommended the area southwest of Dredge Island as one of the areas to be used as part of an oyster reef restoration project to compensate for ecological injuries at the Point Comfort/Lavaca Bay NPL site. The Trustees recommended the creation of an oyster reef that is constructed out of clay-rich spoil material that can be placed on top of the mercury-impacted sediments. This would require stiffer clay material for stability reasons. Stiffer dredged material from the turning basin or channel will be utilized for this purpose. A layer of non-erodable material such as crushed limestone will be placed on top of the dredged material. Although this area was not ultimately selected for oyster reef creation as part of the natural resource damage assessment, creating an oyster reef in this area is still beneficial and might serve to mitigate potential oyster reef losses of the project.

A cultural resources survey (PBS&J 2006) and oyster survey (BESI 2006a) were conducted in December 2005. A much larger area was surveyed during this field event because several additional placement areas were under consideration at the time the survey was performed. Conclusions from the cultural resources survey indicated a magnetic anomaly, which is indicative of a historical submerged cultural resource, in the vicinity of the placement area. The oyster survey also showed the presence of an oyster reef in the vicinity of ER1, but the reef was avoided during the planning process. Therefore, no impacts to oyster reefs are expected in this area. Because the area is within the middle of the bay, no wetlands are present within the boundaries of PA ER1. Creation of PA ER1 would also temporarily affect approximately 63 acres of unvegetated benthic habitat. However, permanently covering impacted sediments is believed to outweigh any negative effects to existing benthic habitats.

The extent of the area is approximately 126 acres and will consist of alternating 50-ft wide rows approximately 2-ft thick for oyster reef creation and 50-ft wide channels for access. The effective area for oyster reef creation is 63 acres. Crushed limestone or other suitable media may be placed on the clay to serve as a base for the recruitment of oysters. These may serve as mitigation for the project impacts. From discussions with Alcoa, methylation of mercury occurs in the top 1 to 2 cm of sediment. Therefore, the thickness of material of 2 ft provides substantial separation between impacted sediments and the created oyster reefs. Thus, there is not a

concern for the potential methylation of mercury within this created oyster reef. PA ER1 will utilize approximately 0.4 mcy of very stiff to hard clay material.

4.3.1.7 PA ER2 - Enhanced Recovery Area In-Bay Upland and Marsh

PA ER2 is a 178-acre in-bay upland area that will cover mercury-impacted sediments. ER2 is located northwest of Dredge Island, along State Highway 35. An analysis of aerial photos indicated that approximately 3.4 acres of marsh are present at the site, these impacts would be mitigated by creation of a 10.2-acre fringe marsh. In a similar manner oyster reef were estimated to be 0.6 acres. PA ER2 will be used to contain approximately 1.1 mcy of stiff clay and 1.0 mcy of soft clay new work material and 6.9 mcy of future maintenance material.

4.3.1.8 PA ER3 - Enhanced Recovery Area In-Bay Upland and Marsh

The northern part of the Dredge Island was excavated during initial remedial activities at Lavaca Bay Superfund Site prior to the establishment of the remedial action objectives. Sediments on the northern edge of Dredge Island are impacted by mercury with concentrations above the Lavaca Bay Superfund ROD sediment RAO. Dredged sediments will be placed over the area to cover impacted sediment.

PA ER3 is a confined placement area used to contain soft new work and maintenance material. A 100-ft wide marsh will be created along the perimeter to serve as both shoreline protection as well as mitigation for project impacts. This type of protection is adequate because the placement area is sheltered by existing landmasses and the water is relatively shallow in the adjoining bay. Existing marsh along Dredge Island in the area provides evidence that this measure should be adequate. The levee with adjoining marsh will be constructed of stiff to very stiff clay new work material. ER3 marsh and upland will store approximately 1.2 mcy of stiff clay and 1.1 mcy of soft clay new work material and 13.2 mcy of maintenance material. PA D adjoins PA ER3 on its southern edge, where mercury concentrations fall below RAO.

In addition to PA ER3 upland and fringe marsh, a marsh will be connected to the east side of Dredge Island. A low bulkhead will be installed along the eastern side to separate the area from the adjacent navigation channel. The bulkhead will confine the placed material and prevent it from entering the channel. Openings within the bulkhead will be provided for marsh circulation once the material is placed. Stiff clay will be placed within the area to create a platform at an intertidal level for marsh creation. The dredge pipe will be moved within the area to facilitate the creation of islands and creeks in the marsh. Along the shoreline and within the water, the clay cover will be a minimum of 2.0 feet thick. In the deeper water areas, the thickness will be greater in order to reach the target intertidal level. In discussions with Alcoa, 2.0 ft thick material provides adequate separation between impacted sediments and the created marsh. Thus, there is not a concern for the potential methylation of mercury within this created marsh.

Results from oyster reef (BESI 2006a) and marsh (BESI 2006b) delineations indicate that creation of PA ER3 will result in the loss of approximately 11 acres of coastal marsh (1.6 acre of fringe marsh and 9.4 acres of high marsh), 17 acres of oyster reefs, and 184.5 acres of mercury-impacted bay bottom.

4.3.1.9 PA G – Marsh with Sand Point & Keller Bay Protection

Erosion at Sand Point and the peninsula separating Keller Bay from Matagorda Bay threatens the adjacent marsh systems and seagrass habitat in Keller Bay. A breach of this peninsula would cause Keller Bay to be connected to Matagorda Bay and result in a loss of seagrass habitat and acceleration of the loss of marsh due to erosion. The combined resource agency work group has agreed that some measure of shoreline protection should be implemented in this area to prevent the breaching of the shoreline and the associated impacts to these areas. PA G and associated shoreline protection is proposed to provide the desired protection.

PA G is a 320-acre, rectangular marsh located 300 ft. offshore of Sand Point Marsh and continues as shoreline protection to the end of Keller Bay. The marsh area has a capacity of 2.6 mcy of stiff clay and 2.1 mcy of soft clay material, and will be constructed entirely from new work material. The shoreline protection proposed consists of an armored earthen levee to approximately elevation 6.0 feet above mean low tide (MLT) with an area of 12.6 acres. The levee will be constructed using 0.4 mcy of materials mechanically excavated from along the shoreline.

4.3.1.10 PA H2 – In-Bay Upland

PA H2 is only required in Alternatives 1A and 1B, which have full containment of dredged materials in Matagorda Bay, where in-bay uplands are used to contain the material. PA H2 is a 564-acre rectangular upland located north of Port O'Connor in Matagorda Bay northeast of the ship channel. The site has a capacity of 9.2 mcy of new work material and 42.4 mcy of maintenance material. Half of the area will be filled with new work material, and the other half will not begin to be filled until 25 years later.

4.3.1.11 PA H4 – Habitat Site Including Marsh, Sand Platform, and Bird Island

PA H4 is located north of Port O'Connor in Matagorda Bay along the northeast side of the ship channel. This area would only be constructed in Alternatives 2A and 2B, which do not require uplands to contain as much of the dredged material. The area will be a mosaic of habitat including 325 acres of sandy shallow-water habitat at a depth of –2 to –3 MLT, 100 acres of marsh islands/terraces, and a 25-acre bird island. Seagrass beds at the shoreline between Powderhorn Lake and Port O'Connor are expected to provide propagules to establish seagrass in the calm, shallow, sandy areas. A perimeter levee with gaps for water circulation will be installed and armored to an elevation of 8.0 MLT and silty/sandy material will be placed inside to create the variety of habitats. The site will be used to contain approximately 1.5 mcy of stiff clay and 8.5 mcy of silty sand new work material.

In alternatives that feature full containment of dredged material in Matagorda Bay, the PA H4 habitat area will be replaced by a PA H4 upland area. As an upland, PA H4 has a capacity to hold 10.7 mcy of new work material and 42.5 mcy of maintenance material in a 675-acre footprint. In such alternatives PA H4 will no longer contain a mosaic of habitats, but it will have 131 acres of shallow sandy areas that are conducive to seagrass colonization.

4.3.1.12 PA O1 and O2 – Sundown Island and Port O'Connor Beach

Sundown Island and the Port O'Connor Beach periodically receive material from maintenance dredging of the Gulf Intracoastal Waterway. Both will be considered as potential placement areas, but are not used to develop the 50-year DMMP.

4.3.1.13 PA O5 – New ODMDS

PA O5 is a 1600-acre rectangular open-water placement area located approximately 3 miles offshore and 1,000 feet south of the channel centerline. The ODMDS will be used for the placement of approximately 12.0 mcy of new work dredged material from Matagorda Bay and Offshore.

4.3.1.14 PA OR1 and OR2 – Clay Core Oyster Reefs

Proposed PA OR1 and OR2 together have 235 acres of clay-core oyster reefs located in upper Lavaca Bay. Sites were selected to maximize their potential to become productive oyster reef habitat, which is based on a number of factors, including appropriate salinity, orientation to currents, and temperature. The proposed reefs would be constructed from stiff clay from new work channel material to provide an elevation of a minimum of 1 ft. above surrounding bay bottom. The stiff clay serves as a base for the proposed oyster reefs. After the clay is placed the area will be covered with 3 inches of crushed limestone or similar media conducive to recruitment of oyster. This area will be used to contain approximately 1.0 mcy of new work material.

4.3.1.15 PA P1 – Terrestrial Upland

Proposed PA P1 is a 700-acre site located south of Alamo Beach on existing agricultural land. The area is planned to be an upland site and would be built out over the 50-year project life.

Levees will be raised around the site during the initial construction of the channel and provide capacity for new work and maintenance material. Fill will be placed in the area during the first maintenance cycle. It will be used to contain approximately 1.0 mcy of new work, and 55.0 mcy of future maintenance material.

4.3.1.16 PA 1 – Existing ODMDS

PA 1 is a 453-acre rectangular open-water placement area located approximately 2 miles offshore and 1,000 feet south of the channel centerline. PA 1 will be used for the placement of approximately 13.6 mcy of maintenance material from the Entrance Channel over a 50-year period.

4.3.1.17 Existing Unconfined Open-Water Placement Areas 5, 6, 7, 8, 9, 10, 11, and 12

The MSC is currently maintained by placing dredged material in unconfined placement areas along the length of the channel, both in the bay and offshore.

PAs PA 5 - 12 are located northeast of the ship channel in Matagorda Bay. The areas are separated from the channel by a ridge that is most likely a remnant of the initial construction of the channel. The tidal currents in this area are relatively small and are oriented parallel to the

channel and placement areas. The shoaling rates in this portion of Matagorda Bay have not changed significantly since the construction of the channel in the 1960's. This constant shoaling rate provides good evidence that the ridge acts as a barrier between the channel and placement areas, and that the currents do not recycle material into the channel. The areas will be used for the placement of 109 mcy of future maintenance material in Matagorda Bay. Modeling has indicated that the material is dispersed through wave action within a year of placement (URS 2006b).

4.3.2 Multi-use Placement Alternative Analysis

For each alternative, mitigation for marsh and oyster reef impacts will be done using standard ratios (1:1 for oyster reefs and 3:1 for marsh), and each of the 4 alternatives would affect the same amount of these habitats. Indirect impacts to oyster reefs due to increases in salinity are assessed (URS 2007b) and included in the mitigation plan (URS 2007a). Indirect impacts to oyster reefs would be the same under any of the alternatives. A Habitat Equivalency Analysis (HEA) was done to scale mitigation for bay bottom impacts (URS 2006a). The HEA quantifies the functional value of habitats impacted and habitats created for the proposed alternatives over the 50-year planning period. The HEA is used to compare the resulting habitat functional values of the proposed alternative to the No Action Alternative for the 50-year planning period, which is continued unconfined placement of all maintenance material from the existing ship channel and continued erosion near Keller Bay. The No Action Alternative is assigned a value of 0 and any increases in the functional value of habitats as a result of the project are given positive HEA values; whereas decreases in functional value result in negative HEA values. Alternatives with a negative total HEA value (having a net impact) would require additional mitigation for bay bottom impacts. Among alternatives with positive total HEA values, the alternative with the greatest total HEA value provides the greatest improvement to the aquatic ecosystem. **Table 4-3** to **Table 4-6** provide acreages and HEA values for each placement area, as well as total HEA values for Alternatives 1A, 1B, 2A, and 2B, respectively.

Each Multi-use Placement Alternative will modify the existing unconfined placement practice that is part of the No Action Alternative. To account for the change in bay bottom functional value compared to the No Action Alternative each Multi-Use Placement Alternative is credited with the benefit to functional value resulting from no longer having the existing amount of open bay placement (the "Stop Current Unconfined Placement" row in **Tables 4-3** to **4-6**). Alternatives 2A and 2B have unconfined placement in Matagorda Bay, which would use the existing placement areas PA 5-12. The amount of material planned to be placed in these areas is approximately double the existing annual amount. This increase has been accounted for in the HEA by doubling the amount of impact for these placement areas compared to their existing impact. All alternatives will stop all unconfined placement in Lavaca Bay, and are therefore credited with the increased habitat functional value.

Table 4-7 provides a cost/HEA Value comparison of the four Multi-use Placement Alternatives, including the new work and maintenance costs and HEA values. Alternative 2A has the highest HEA value at the lowest cost.

Table 4-3. Acreages and HEA values of placement sites for Alternative 1A

Site	Habitat Type	Impacts			
		Negative		Positive	
		Acres	HEA Value	Acres	HEA Value
Proposed Ship Channel	Bay Bottom	704.0	-3490.7		
	Offshore Bottom	213.0	-1056.1		
Stop Current Unconfined Placement	Bay Bottom			1879.0	2329.2
A1	Bay Bottom	530.0	-2627.9		
A2	Marsh			120.0	1230.3
	Bay Bottom	140.0	-694.2		
BN1, BN2, BN3	Beach	125.0	0.0		
C2	Bay Bottom 2010	0.0	0.0		
	Bay Bottom 2035	0.0	0.0		
D	Bay Bottom	260.0	-1289.2		
ER2	Mercury Bottom	167.8	-416.0		
ER3	Mercury Bottom	161.0	-399.2		
G	Bay Bottom	12.0	-59.5		
	Marsh			320.0	3280.9
G-Levee	Bay Bottom	12.6	-62.5		
	Marsh Protection			432.1	3976.5
	Seagrass Protection			250.0	3782.7
H4 Habitat Area	Bay Bottom	0.0	0.0		
	Bird Island	0.0	0.0		
	Marsh			0.0	0.0
	Sand Platform			0.0	0.0
H2	Bay Bottom 2010	294.0	-1457.8		
	Bay Bottom 2035	270.0	-426.2		
H4	Bay Bottom 2010	59.0	-292.5		
	Bay Bottom 2013	271.0	-1193.7		
	Bay Bottom 2035	273.0	-430.9		
	Sand Platform			131.0	780.8
O5 and PA1	Offshore Bottom New Work (O5)	428.4	-81.5		
	Offshore Bottom Maintenance (PA1)	453.0	-540.0		
PA5-12	Bay Bottom Unconfined	0.0	0.0		
P1	Terrestrial	700.0	--		
	Total		**-14517.8**		**15380.4**
Total HEA Value					**862.6**

Table 4-4. Acreages and HEA values of placement sites for Alternative 1B.

Site	Habitat Type	Impacts			
		Negative		Positive	
		Acres	HEA Value	Acres	HEA Value
Proposed Ship Channel	Bay Bottom	704.0	-3490.7		
	Offshore Bottom	213.0	-1056.1		
Stop Current Unconfined Placement	Bay Bottom			1879.0	2329.2
A1	Bay Bottom	530.0	-2627.9		
A2	Marsh			120.0	1230.3
	Bay Bottom	140.0	-694.2		
BN1, BN2, BN3	Beach	125.0	0.0		
C2	Bay Bottom 2010	446.0	-2211.4		
	Bay Bottom 2035	440.0	-694.5		
D	Bay Bottom	260.0	-1289.2		
ER2	Mercury Bottom	167.8	-416.0		
ER3	Mercury Bottom	161.0	-399.2		
G	Bay Bottom	12.0	-59.5		
	Marsh			320.0	3280.9
G-Levee	Bay Bottom	12.6	-62.5		
	Marsh Protection			432.1	3976.5
	Seagrass Protection			250.0	3782.7
H4 Habitat Area	Bay Bottom	0.0	0.0		
	Bird Island	0.0	0.0		
	Marsh			0.0	0.0
	Sand Platform			0.0	0.0
H2	Bay Bottom 2010	294.0	-1457.8		
	Bay Bottom 2035	270.0	-426.2		
H4	Bay Bottom 2010	59.0	-292.5		
	Bay Bottom 2013	271.0	-1193.7		
	Bay Bottom 2035	273.0	-430.9		
	Sand Platform			131.0	780.8
O5 and PA1	Offshore Bottom New Work (O5)	428.4	-81.5		
	Offshore Bottom Maintenance (PA1)	453.0	-540.0		
PA5-12	Bay Bottom Unconfined	0.0	0.0		
P1	Terrestrial	700.0	--		
	Total		**-17423.7**		**15380.4**
Total HEA Value					**-2043.3**

Table 4-5. Acreages and HEA values of placement sites for Alternative 2A.

Site	Habitat Type	Impacts			
		Negative		Positive	
		Acres	HEA Value	Acres	HEA Value
Proposed Ship Channel	Bay Bottom	704.0	-3490.7		
	Offshore Bottom	213.0	-1056.1		
Stop Current Unconfined Placement	Bay Bottom			1879.0	2329.2
A1	Bay Bottom	530.0	-2627.9		
A2	Marsh			120.0	1230.3
	Bay Bottom	140.0	-694.2		
BN1, BN2, BN3	Beach	125.0	0.0		
C2	Bay Bottom 2010	0.0	0.0		
	Bay Bottom 2035	0.0	0.0		
D	Bay Bottom	260.0	-1289.2		
ER2	Mercury Bottom	167.8	-416.0		
ER3	Mercury Bottom	161.0	-399.2		
G	Bay Bottom	12.0	-59.5		
	Marsh			320.0	3280.9
G-Levee	Bay Bottom	12.6	-62.5		
	Marsh Protection			432.1	3976.5
	Seagrass Protection			250.0	3782.7
H4 Habitat Area	Bay Bottom	20.0	-99.2		
	Bird Island	25.0	-124.0		
	Marsh			100.0	1025.3
	Sand Platform			325.0	1937.0
H2	Bay Bottom 2010	0.0	0.0		
	Bay Bottom 2035	0.0	0.0		
H4	Bay Bottom 2010	0.0	0.0		
	Bay Bottom 2013	0.0	0.0		
	Bay Bottom 2035	0.0	0.0		
	Sand Platform	0.0	0.0		
O5 and PA1	Offshore Bottom New Work (O5)	1600.0	-304.4		
	Offshore Bottom Maintenance (PA1)	453.0	-540.0		
PA5-12	Bay Bottom Unconfined	1350.0	-1609.3		
P1	Terrestrial	700.0	--		
	Total		**-12772.1**		**17561.9**
Total HEA Value					**4789.9**

Table 4-6. Acreages and HEA values of placement sites for Alternative 2B.

Site	Habitat Type	Impacts			
		Negative		Positive	
		Acres	HEA Value	Acres	HEA Value
Proposed Ship Channel	Bay Bottom	704.0	-3490.7		
	Offshore Bottom	213.0	-1056.1		
Stop Current Unconfined Placement	Bay Bottom			1879.0	2329.2
A1	Bay Bottom	530.0	-2627.9		
A2	Marsh			120.0	1230.3
	Bay Bottom	140.0	-694.2		
BN1, BN2, BN3	Beach	125.0	0.0		
C2	Bay Bottom 2010	446.0	-2211.4		
	Bay Bottom 2035	440.0	-694.5		
D	Bay Bottom	260.0	-1289.2		
ER2	Mercury Bottom	167.8	-416.0		
ER3	Mercury Bottom	161.0	-399.2		
G	Bay Bottom	12.0	-59.5		
	Marsh			320.0	3280.9
G-Levee	Bay Bottom	12.6	-62.5		
	Marsh Protection			432.1	3976.5
	Seagrass Protection			250.0	3782.7
H4 Habitat Area	Bay Bottom	20.0	-99.2		
	Bird Island	25.0	-124.0		
	Marsh			100.0	1025.3
	Sand Platform			325.0	1937.0
H2	Bay Bottom 2010	0.0	0.0		
	Bay Bottom 2035	0.0	0.0		
H4	Bay Bottom 2010	0.0	0.0		
	Bay Bottom 2013	0.0	0.0		
	Bay Bottom 2035	0.0	0.0		
	Sand Platform	0.0	0.0		
O5 and PA1	Offshore Bottom New Work (O5)	1600.0	-304.4		
	Offshore Bottom Maintenance (PA1)	453.0	-540.0		
PA5-12	Bay Bottom Unconfined	1350.0	-1609.3		
P1	Terrestrial	0.0	--		
	Total		**-15678.0**		**17561.9**
	Total HEA Value				**1883.9**

Table 4-7. Cost and HEA Values for each Multi-use Placement Plan Alternative.

	Alternatives			
	1A	**1B**	**2A**	**2B**
New Work Cost	$269,542,000	$301,469,000	$248,050,000	$279,977,000
Maintenance (50 Year)	$590,190,000	$562,241,000	$524,521,000	$496,572,000
HEA Value	862.6	-2043.3	**4789.9**	1883.9
Total	$859,732,000	$863,710,000	$772,571,000	$776,549,000
Equivalent Annual Costs	$26,580,000	$27,829,000	**$24,106,000**	$26,482,000

4.3.3 Recommended Plan

Multi-use Placement Plan Alternative 2A has been selected as the Recommended Plan. Alternative 2A is the lowest-cost alternative, and the HEA model demonstrates that it provides the highest net increase in aquatic habitat functional value (**Table 4-7**).

5.0 DESCRIPTION OF MANAGEMENT PLAN

5.1 PLAN DESCRIPTION

This DMMP describes a plan for placement of new work material and 50 years of maintenance material (**Table 5-1**). The 50-year maintenance plan identifies the maximum footprint (dimensions) of the dredged material placement areas and provides dredged material storage for the 50-year project life. A reasonable sequencing of the placement of maintenance dredged material is provided in the following sections. However, the sequencing may be modified during the operations of the improved channel to allow for managing the areas based on local conditions/requirements (dredged material consolidation rates and shoaling in unexpected locations, for example) over the 50-year project life.

Figure 2 to **Figure 46** detail the placement areas for the Recommended Plan. In general, the construction will utilize traditional dredging techniques. Equipment planned for dredging the channel includes:

- Hydraulic Pipeline Dredges in Lavaca Bay and Matagorda Bay Reaches;
- Hopper dredge or clamshell dredge with dump scows in portions of the Matagorda Bay Reach; and
- Hopper dredge in the Offshore Reach.

The implementation of the plan requires that the levees of the placement areas will be constructed first to confine the soft material within the dredging reaches. This requires the dredging of the stiff clay from the Lavaca Bay Reach. In the Matagorda Bay Reach, both stiff clay and sand will be used for levee construction. However, in both of the bay reaches, the dredging must be sequenced to uncover clay or sand deposits. Initially, there is enough clay available to construct the levees for several confined placement areas. These areas as well as the ODMDS will provide areas for placing the soft material that covers the remaining clay and sand deposits, which is needed for levee construction. The following sections describe the implementation plan for both the new work construction including maintenance during construction as well as maintenance of the improved channel.

5.2 CONSTRUCTION

5.2.1 Lavaca Bay Reach

The reach will be dredged with hydraulic pipeline dredges. The material will go toward the construction of marshes, upland habitats, oyster reefs, beach nourishment, cover for impacted bay sediments, as well as confined placement areas. The stiffer clays found in the reach will be utilized for hydraulically constructed levees and platforms for oyster reefs. These levees will form the perimeter of the placement areas, which will confine the new work fill material as well as the maintenance material expected for the first 20 years of the project life. The remaining capacity would be obtained through the vertical expansion of the confined placement areas.

Table 5-1
Matagorda Ship Channel Improvement Project
Dredged Material Management Plan (50 Year)

Placement Area		New Work Material Used at Site		Maintenance Material Used at Site		Description of Creation or Protection	
		Type	Amount	Type	Amount	Approximate Amount	Type
A1	In Bay Upland	Stiff Clay Soft Clay	2 1.3	Silt and Soft Clay	45.1	Creates 530 acres	In-Bay Uplands
A2	Combined Upland/Marsh	Stiff Clay Soft Clay	0.8 5.4			Creates 140 acres Creates 120 acres	In-Bay Uplands Marsh
OR1 & OR2	Clay Core Oyster Reefs	Stiff Clay	1			Creates 235 acres	Oyster Reef
BN1, BN2, & BN3	Beach Nourishment	Sand/Shell	1.9			Renourish 3 miles	Beach
D	In Bay Upland/Marsh	Stiff Clay Soft Clay	0.5 1.1	Silt and Soft Clay	14.8	Creates 260 acres Creates 14 acres	In-Bay Uplands Marsh
ER1	Submerged Enhanced Recovery Area	Stiff Clay	0.4			Caps 63 acres of impacted bay bottom Creates 63 acres	Submerged Cap Oyster Reef
ER2	Enhanced Recovery Area/Marsh	Stiff Clay Soft Clay	1.1 1	Silt and Soft Clay	6.9	Caps 168 acres of impacted bay bottom Creates 10 acres	Upland Cap Marsh
ER3	Enhanced Recovery Area/Marsh	Stiff Clay Soft Clay	1.2 1.1	Silt and Soft Clay	13.2	Caps 201 acres of impacted bay bottom Creates 46 acres	Upland Cap Marsh
G	Marsh and Sand Point Marsh and Keller Bay Protection	Stiff Clay Stiff Clay(Mechanically Excavated) Soft Clay	2.6 0.4 2.1			Creates 320 acres Protects 250 acres Protects 432 acres Protects 4 miles	Marsh Seagrass Marsh Shoreline
P	Terrestrial Upland	Soft Clay	1	Silt and Soft Clay	55	Elevates 700 acres	Terrestrial Uplands
PA 5, 6, 7, 8, 9, 10, 11,12	Existing Unconfined Placement Areas			Silt, Soft Clay, & Sand	108.9	Continued use 1350 acres	Bay Bottom
H4	Beneficial Use Site including Marsh, SAV Platform, and Bird Island	Stiff Clay Sand	1.5 8.5			Creates 20 acres Creates 325 acres Creates 100 acres Creates 25 acres	In-Bay Uplands SAV Platform Marsh Bird Island
O1*	Sundown Island	Sand	As Needed			Protects	Existing Bird Island
O2*	Port O'Connor Beach	Sand	As Needed			Renourish	Beach
PA1	Existing ODMDS**			Silt, Soft Clay & Sand	13.6	Continued use 453 acres	ODMDS
O5	Proposed ODMDS	Silt & Soft Clay Silt & Sand	4.5 7.5			1600 acres	ODMDS
	Placement Area Mechanical Excavation Channel Dredging Total		46.5 mcy	0.4 mcy	257.5 mcy	Creates 950 acres Creates 610 acres Creates 298 acres Creates 325 acres Creates 63 acres Creates 369 acres Nourish 3 miles Protects 250 acres Protects 432 acres Protects 4 miles Creates 25 acres Elevates 700 acres Protects Continued use 1350 acres Continued use 453 acres 1600 acres	In-Bay Uplands Marsh Oyster Reefs SAV Platform Submerged Cap Upland Cap Beach Seagrass Marsh Shoreline Bird Island Terrestrial Uplands Existing Bird Island Bay Bottom ODMDS ODMDS

*Maintenance dredged material may be used to augment areas if determined to be needed in the future and maintenance material available at the correct grain size.
**Ocean Dredge Material Disposal Site

Shore protection will be placed after the construction of the levees. The shore protection, consisting of stone for most of the placement areas, is designed for a 10-year storm return interval in accordance with the Coastal Engineering Manual (USACE 2002). In some areas, a 100-foot-wide bench planted with marsh grasses will be employed for shoreline protection. The marsh benches will have a stone breakwater in areas of higher wave energy for additional protection. Grass will be planted for erosion prevention on portions of the levees above the water influence.

PAs A1, D/ER3, ER2, and P1 are confined placement areas that will be used for both the initial construction of the channel and 50 years of maintenance for this reach. PA P1 is the only area that will be constructed on land. The levees for P1 will be created through on-site borrow/fill. Water quality will be maintained in P1 by spill boxes and weirs, with effluent being discharged back into Lavaca Bay. PA ER2 will have a 44 year life and once the fill is completed the area will be converted to an upland habitat area by CCND. PA A2 is a confined upland/marsh habitat with an interior levee separating it into cells. Both cells of A2 will be filled during initial construction. PA A2 marsh site may take 18 to 24 months to reach the target elevation due to shrinkage and consolidation of the fill material. Mechanical excavation may be required to provide circulation channels and ponds for the marsh prior to planting.

PA ER1, OR1, and OR2 are submerged fills that will be created by hydraulically placing stiff clay on the bay bottom to raise the grade above the bay bottom. Crushed limestone or other suitable material will be placed on top of the fill as substrate for oysters.

The PAs ER1, ER2, and D/ER3 are covering mercury impacted bay sediment and there is a potential for disturbing the impacted sediment during the construction of the placement areas. The potential impacts are addressed in **Section 6.2**. The following procedures have been developed to minimize the disturbance of the sediments. For PAs ER2, and D/ER3, the construction of the areas will proceed from the outside to the inside of the contaminated areas including barge access routes. Working from the outside to the inside, a 100-foot wide toe berm will be hydraulically placed to about the inter-tidal water level. The levee will then be hydraulically placed starting at the berm and working inward. This procedure allows for any disturbed area to be covered by the subsequent placement of clean dredged material.

5.2.2 Matagorda Bay Reach

This reach will be dredged with hydraulic pipeline dredge and clamshell or hopper dredge (clamshell/hopper). The clamshell/hopper dredge will be used to remove material that will be placed in the ODMDS. All other material will be removed by a hydraulic pipeline dredge and used to construct PAs: H4, G, BN2 and BN3. Clamshell/hopper dredging will proceed first to uncover deposits of stiff clay and sand. This material will be used to hydraulically construct the levees required for PA H4 and PA G while a portion of the material will be placed in PA BN2 and PA BN3 as beach nourishment. Softer material from the upper portion of the reach will be used as fill material for the marsh at PA G. Silty sand from the lower portion of the reach will be used to fill PA H4.

Shore protection will be placed after the construction of the levees. The shore protection, consisting of stone, is designed for a 10-year storm return interval in accordance with the Coastal Engineering Manual (USACE 2002). Grass will be planted on portions of the levees above water influence. PA G is a marsh site may take 18 to 24 months to reach the target elevation due to shrinkage and consolidation of the fill material. Mechanical excavation may be required to provide circulation channels and ponds for the marsh prior to planting.

PA G-Levee will protect Keller Bay and the sensitive habitats along it from being destroyed by erosion. The levee will be constructed through the mechanical excavation of on-site, stiff clay material and armored with stone. The levee will be approximately 300 feet offshore and armored gaps will allow circulation through the area.

PA H4 interior fill will consist mainly of silty sand. Marsh islands as well as a bird island will be constructed in the interior of the placement area. Because of the nature of the fill material, it will be placed at or near its target elevation. Although minor amount of grade manipulation may be required, marsh planting will occur immediately after the fill. Trees will be planted at the upper elevations of the bird island.

PA BN2 and PA BN3 are beach fills that will be confined by structures at the ends and along the length of the fill to increase the longevity of the beach nourishment. The structures may consist of stone or sheet piling with the preliminary design consisting of stone.

The existing unconfined open bay placement areas, PA5 to 12, located along the east side of the channel will be used for the 50 year maintenance of the Matagorda Bay Reach.

5.2.3 Offshore Reach

The Offshore Reach will be dredge by a clamshell/hopper dredge. Construction will begin at the outer edge of the channel and work inward. The material consists mostly of fine grained sand. All dredged material is proposed to be placed into an unconfined area approximately 4 miles offshore in a proposed ODMDS, PA O5. All maintenance material is proposed to be placed into an existing ODMDS.

5.2.4 Mitigation

Mitigation for oyster reef and marsh will be required in the Lavaca Bay Reach. Oyster reefs include both direct and indirect impacts (salinity related) and will be mitigated through the creation of reefs at ER1, OR1 and OR2. Marshes will be directly impacted by PA ER3/D and ER2. The marshes will be mitigated on-site adjacent to ER3/D and ER2. The construction of the channel and placement areas within the bay remove a significant amount of bay bottom. The bay bottom aquatic habitat function will be replaced by the creation and protection of higher value habitat. A2 marsh, G marsh and H4 marsh habitat created habitat while G-Levee provides protection of sensitive seagrass and marsh habitat located at Keller Bay. The placement areas are an integral part of the mitigation and; thus, no separate construction activity is required. However, CCND will provide monitoring, maintenance and management of these areas after the completion of the initial construction.

5.3 CONSTRUCTION SEQUENCE

Construction contracting strategy has not been finalized, but major activities will have to be sequenced in order to keep the construction time to a reasonable period. The intent is to build the levees first and/or uncover the material for levees so that the dredging of the channel can proceed unimpeded. An estimated, reasonable construction sequence is provided in (**Exhibit 10**). Actual construction sequence may vary depending on the contractor's sequencing of the work.

5.4 MAINTENANCE DURING CONSTRUCTION

It is not anticipated that the maintenance of the MSC will conflict with the construction of the improvements. The existing PA's, PA 1 to PA 19, will remain available for maintenance material during the construction of the project. Once the channel is complete the only existing areas that would continue to be used at PA 1 and PA 5 to PA 12.

Existing PA 18 and 19 will be incorporated into the much larger footprint of PA A1. Levee construction will not impede the placement of maintenance material during construction (if required) because the levees will remain open until maintenance activities are complete. If the maintenance filling of PA A1 is required after the completion of PA A1 then maintenance material would be incorporated into the placement area volume. Vertical expansion can accommodate this potential minor volume increase.

Construction of PA H4 will not impede the placement of maintenance material in PA 7 and 8 because it is located between the existing PA's.

5.5 OPERATIONS AND MAINTENANCE

This section covers the operations and maintenance requirements associated with the proposed project. A description of the operations and maintenance requirements for each project feature is addressed in the following sections. **Table 5-2** provides a summary of the sequencing of the filling of these areas; which may be modified to manage conditions (unexpected shoaling, PA consolidation, etc.) that may occur during the operations of the improved channel.

5.5.1 Lavaca Bay Reach

This reach is expected to require maintenance by hydraulic pipeline dredge every 2 years. All the material will be placed in confined PAs, A1, ER2, D/ER3, and P1, which are located along the Lavaca Bay Reach. Water quality will be maintained from these areas by spill boxes and weirs, with effluent being discharged back into Lavaca Bay. Each area is described in detail in the following sections.

5.5.1.1 PA A1

Proposed PA A1 is a 530-acre, rectangular site located south of the CCND's facilities on existing USACE PAs 18 and 19. PA A1 will be used to contain approximately 45.1 mcy of future maintenance material. Approximately 31.9 mcy will be associated with the MSC and related turning basin and 13.2 mcy will be from CCND's facilities.

During the MSCIP, the levees will be built to contain 20 years of maintenance capacity and shore protection will be provided. The initial levee height will be 15 feet MLT and will be raised to 30 feet by the end of the project life.

5.5.1.2 PA ER2

PA ER2 is a 178-acre in-bay upland area that will cover mercury-impacted sediments. PA ER2 is located northwest of Dredge Island, along State Highway 35. ER2 will be used to contain approximately 6.9 mcy of future maintenance material.

Table 5-2. Maintenance Sequencing (50 Years)

Reach	Sta. to Sta.	Total Quantity, CY	Placement per Cycle, CY	Placement Area	Placement Area Type	Placement Method	Cycle YRS
Lavaca Bay	CCND Facilities	13,200,000	528,000	A1	Confined	Pipeline Dredge	50
	Turning Basin and Channel	26,350,000	740,000	A1	Confined	Pipeline Dredge	44
			1,054,000	A1	Confined	Pipeline Dredge	44 - 50*
			314,000	ER2	Confined	Pipeline Dredge	44
	110+000 to 105+000	21,980,000	879,200	ER3/D	Confined	Pipeline Dredge	30
			879,200	A1			30 - 50**
	105+000 to 100+000	18,520,000	740,800	ER3/D	Confined	Pipeline Dredge	40
			740,800	A1			40 - 50**
	100+000 to 95+000	13,680,000	547,200	P1	Confined	Pipeline Dredge	50
	95+000 to 90+000	13,210,000	528,400	P1	Confined	Pipeline Dredge	50
	90+000 to 85+000	10,020,000	400,800	P1	Confined	Pipeline Dredge	50
	85+000 to 80+000	10,790,000	431,600	P1	Confined	Pipeline Dredge	50
	80+000 to 75+000	7,250,000	290,000	P1	Confined	Pipeline Dredge	50
Matagorda Bay	75+000 to 70+000	9,200,000	368,000	PA12	Open Bay	Pipeline Dredge	50
	70+000 to 65+000	9,350,000	374,000	PA11	Open Bay	Pipeline Dredge	50
	65+000 to 60+000	9,640,000	385,600	PA11	Open Bay	Pipeline Dredge	50
	60+000 to 55+000	8,620,000	344,800	PA10	Open Bay	Pipeline Dredge	50
	55+000 to 50+000	8,500,000	340,000	PA10	Open Bay	Pipeline Dredge	50
	50+000 to 45+000	9,140,000	365,600	PA9	Open Bay	Pipeline Dredge	50
	45+000 to 40+000	9,240,000	369,600	PA8	Open Bay	Pipeline Dredge	50
	40+000 to 35+000	9,300,000	372,000	PA8	Open Bay	Pipeline Dredge	50
	35+000 to 30+000	9,650,000	386,000	PA7	Open Bay	Pipeline Dredge	50
	30+000 to 25+000	9,990,000	399,600	PA6	Open Bay	Pipeline Dredge	50
	25+000 to 20+000	7,890,000	315,600	PA6	Open Bay	Pipeline Dredge	50
	20+000 to 15+000	6,680,000	267,200	PA5	Open Bay	Pipeline Dredge	50
	15+000 to 6+000	1,750,000	70,000	PA5	Open Bay	Pipeline Dredge	50
Offshore	6+000 to (5+000)	0	0	PA1	ODMDS	Hopper Dredge	50
	(5+000) to (23+000)	13,600,000	544,000	PA1	ODMDS	Hopper Dredge	50

*ER2 is filled up to capacity at year 44, A1 is then used the remaining 6 years.
**ER3/D is filled up to capacity at year 40, A1 is then used the remaining 10 years.

During the MSCIP, the levees will be built to contain 20 years of maintenance capacity and shore protection will be provided. The initial levee height will be 12 feet MLT and will be raised to 22 feet. This area will be completed 44 years after the completion of the channel. CCND will then convert the placement area into an upland habitat area.

5.5.1.3 PA D/ER3

PAs D and ER3 are a combined placement area encompassing 526.9 acres, which is located adjacent to the existing Dredge Island. PA D/ER3 will be used to contain approximately 28 mcy of future maintenance material.

During the MSCIP, the levees will be built to contain 20 years of maintenance capacity and shore protection will be provided. The initial levee height will be 12 feet MLT which will be raised to 22 feet. This area will be completed 40 years after the completion of the channel.

5.5.1.4 PA P1

PA P1 is a 700-acre site located south of Alamo Beach on existing agricultural land. The area is planned to be an upland site and would be built out over the 50-year project life.

Levees will be raised around the site during the initial construction of the channel and provide capacity for new work and 20 years of maintenance material. Fill will be placed in the area during the first maintenance cycle and will continue for the 50-year project life. The site will be used to contain approximately 55.0 mcy of future maintenance material.

5.5.2 Matagorda Bay Reach

This reach is expected to require maintenance by hydraulic pipeline dredge every 2 years. The material will be placed in existing PAs 5 to 12 that are located in Matagorda Bay northeast of the MSC.

5.5.3 Offshore Reach

This reach is expected to require maintenance by hopper dredge. This material will be placed in an existing ODMDS. The current maintenance cycle is 2.5 years; however, modeling has shown that the existing ODMDS can accommodate a lower frequency (up to 4 years) based on the accumulation rate of 0.26 mcy/year. The wider deeper channel may accommodate a dredging frequency up to 4 years.

5.6 PLACEMENT AREA MAINTENANCE RESPONSIBILITY

The current study effort is authorized and is being pursued under Section 204 of the Water Resources Development Act (WRDA). Under Section 204 of WRDA 1986 (ER 1165-2-124), any non-Federal interest is authorized to undertake navigational improvements in harbors or inland harbors of the United States, subject to obtaining any permits required pursuant to Federal and state laws in advance of the actual construction of such improvements.

Specifically, CCND is pursuing a Section 204(f) project, as amended in WRDA 1990 authorization. This authority requires the USACE to be responsible for the maintenance of navigation improvements made by the non-Federal interest if the following conditions are met:

a) the Secretary of the Army (Secretary) determines, before construction, that the improvements, or separable elements thereof, are economically justified, environmentally acceptable, and consistent with the purposes of this title.

b) the Secretary certifies that the project is constructed in accordance with applicable permits and the appropriate engineering and design standards; and

c) the Secretary does not find that the project, or separable elements thereof, is no longer economically justified or environmentally acceptable.

The Recommended Plan for the locally preferred channel configuration includes input from the USACE Galveston District, Resource Agencies, and the local community. **Exhibits 11, 12,** and **13** provide the overall plan, new work only plan, and maintenance only plan, respectively. The DMMP includes the following items:

- 50 years of maintenance capacity;
- 20 years of maintenance capacity built with new work material; and
- 100% of project impacts are mitigated during the initial construction of the channel.

Table 5-3 provides a breakdown of the placement areas and the maintenance responsibility for the recommended plan based on applicable regulations. The assessment is based upon the assumption that the USACE will assume the maintenance of the project in accordance with Section 204(f) project, as amended in WRDA 1990.

Table 5-3 . Placement Area Maintenance responsibilities.

Placement Area	Type	Acres	New Work (MCY)	Maintenance (MCY)	Maintained by USACE*	20-Year Capacity Provided	Maintained by CCND
A1	**In-Bay Upland Confined PA**	530	3.3	31.9 USACE 13.2 CCND	X	X	X
A2	**In-Bay Upland Confined PA/ Marsh**	260	6.2				X
BN1, BN2, and BN3	**Beach Nourishment**	125	1.9				X
D	**In-Bay Upland Confined PA with Perimeter Marsh**	274.2	1.6	14.8	X	X	Perimeter Marsh Only
ER1	**Oyster Reef**	126	0.4				X
ER2	**In-Bay Upland Confined PA with Perimeter Marsh**	178	2.1	6.9	X	X	Perimeter Marsh Only
ER3	**In-Bay Upland Confined PA with Perimeter Marsh**	252.5	2.3	13.2	X	X	Perimeter Marsh Only
G	**Marsh**	332	5.1				X
H4 Habitat Area	**Marsh/ Sand Platform/ Bird Island**	470	10				X
O5	**New ODMDS**	1600	12				
OR1 and OR2	**Oyster Reef**	235	1				X

Placement Area	Type	Acres	New Work (MCY)	Maintenance (MCY)	Maintained by USACE*	20-Year Capacity Provided	Maintained by CCND
P1	**Terrestrial Upland Confined PA**	700	1	55	X	X	
PA1**	**Existing ODMDS**	453		13.6	X	X	
PA5-12**	**Existing unconfined PA**	1350		108.9	X	X	

*Pending 204(f) approval

** No maintenance required

6.0 POTENTIAL IMPACTS

6.1 WATER COLUMN

Potential effects on water quality from dredging and dredged material placement include: 1) the re-suspension of sediments, increasing total suspended solid (TSS) concentrations in the water column; and 2) toxic effects from the re-suspension of impacted sediments. These potential effects are addressed in the following sections.

6.1.1 Total Suspended Solids

Dredging of the MSCIP will result in a temporary and localized increase in TSS concentrations, which will temporarily increase turbidity in the water column. TSS at the placement location is highly dependent on the configuration and type of the placement area. For this project, the Texas Commission on Environmental Quality provides water quality certification for the discharge of decant water from upland confined placement areas and generally limits the TSS concentrations of these discharges to 300 mg/L. In bay confined and unconfined placement areas are typically related to beneficial use of dredged material projects such as marsh creation or subaqueous capping of impacted sediments. These projects do temporarily elevate TSS concentration above the 300 mg/L limit for upland confined placement areas. Siting of the placement area and placement controls reduce the potential affect of elevated TSS concentrations. The potential for habitat impacts exist from elevated TSS; however, control measures beginning with avoidance of critical habitats are available to reduce the potential effects of elevated TSS. During the selection process, CCND will avoid unconfined placement of dredged materials near critical habitats such as oysters and beds of submerged aquatic vegetation that could be affected by increases in TSS. Where these sensitive areas cannot be avoided, CCND will implement control measures such as turbidity curtains and discharge controls to direct the flow of material away from these habitats.

6.2 IMPACTED SEDIMENTS

6.2.1 Initial Dredging (New Work) Material

The primary concern with regard to sediment quality in the project area is mercury. Activities performed as part of the MSCIP that may potentially disturb and cause the re-suspension of mercury-impacted sediments include direct dredging, placement of dredged material to build levees, and building access channels for moving equipment. The specific impacts are further discussed in the following sections.

6.2.1.1 Direct Dredging

The MSCIP will result in the dredging of approximately 46.5 mcy of new construction dredged material. The quality of the dredged material may be of concern if dredged from areas historically impacted by mercury from the Superfund Site. An evaluation of the end-of-dredge-pipe mercury concentration was performed. According to the Inland Testing Manual (EPA/COE 1998), dredge material may be classified using vertical subdivisions which, “should reflect the actual removal precision to be employed during the dredging operation.” Using this guidance, it was estimated that given the soil boring data along the channel alignment, a six-foot dredge cut

is the minimum economical dredge cut. This determination is based on the conditions that there are 1 to 3 feet of maintenance or soft mud overlying new work clay, a large cutter suction dredge (30-inch diameter discharge and 1,500 hp cutterhead), and more than 20 feet of material to dredge.

Utilizing the most recent data obtained from Alcoa (**Appendix B**) and following procedures outlined in the Inland Testing Manual, mercury concentrations were averaged over a six-foot dredge cut. Samples were collected approximately every two feet from the mudline, through the unconsolidated sediment and stopped once consolidated material was encountered. The mercury concentration in the material underlying unconsolidated sediment is assumed to be negligible, or for these purposes 0.0 mg/Kg. Using the described sample depths and corresponding concentrations, as well as the thickness of the consolidated material with a mercury concentration of 0.0 mg/kg, a weighted mercury concentration was calculated. The tables below shows the depth/concentration intervals, as well as provides the concentrations derived for a six-foot dredge cut for the turning basin and ship channel, respectively.

Average Concentrations Over Dredge Cut for Turning Basin Sample Locations

Sample Station	Interval I - Thickness	Interval I - Conc	Interval II - Thickness	Interval II - Conc	Interval III - Thickness	Interval III - Conc	Interval IV - Thickness	Interval IV - Conc	Total Depth	Average Conc
LNG0001	1.4	0.0142	4.6	0	n/a	n/a	n/a	n/a	6	**0.003**
LNG0002	2	0.0206	0.5	0.0083	3.5	0	n/a	n/a	6	**0.008**
LNG0003	2	0.121	1.2	0.014	2.8	0	n/a	n/a	6	**0.043**
LNG0004	1.1	0.0086	4.9	0	n/a	n/a	n/a	n/a	6	**0.002**
LNG0005	1.2	0.0399	4.8	0	n/a	n/a	n/a	n/a	6	**0.008**
LNG0015	2	0.26	1.2	0.0378	2.8	0	n/a	n/a	6	**0.094**
LNG0016	2.7	0.502	3.3	0	n/a	n/a	n/a	n/a	6	**0.226**
LNG0017	2	0.055	0.8	0.0205	3.2	0	n/a	n/a	6	**0.021**
LNG0018	1.8	0.543	4.2	0	n/a	n/a	n/a	n/a	6	**0.163**
LNG0020	2	0.0571	1.9	0.0164	2.1	0	n/a	n/a	6	**0.024**
LNG0021	2	0.0658	0.4	0.0136	3.6	0	n/a	n/a	6	**0.023**
LNG0023	1.9	0.0487	4.1	0	n/a	n/a	n/a	n/a	6	**0.015**
LNG0024	2	0.0525	1.3	0.0209	2.7	0	n/a	n/a	6	**0.022**
LNG0025	2	0.0404	0.8	0.0319	3.2	0	n/a	n/a	6	**0.018**

Average Concentrations Over Dredge Cut for Ship Channel Sample Locations

Sample Station	Interval I - Thickness	Interval I - Conc	Interval II - Thickness	Interval II - Conc	Interval III - Thickness	Interval III - Conc	Interval IV - Thickness	Interval IV - Conc	Total Depth	Average Conc
LNG0006	2	0.0982	0.7	0.0057	3.3	0	n/a	n/a	6	**0.033**
LNG0007	1.5	0.0883	4.5	0	n/a	n/a	n/a	n/a	6	**0.022**
LNG0008	2	0.165	2.3	0.0052	1.7	0	n/a	n/a	6	**0.057**
LNG0009	2	0.215	2	0.009	1.3	0.0042	0.7	0	6	**0.076**
LNG0010	2	0.109	0.7	0.0024	3.3	0	n/a	n/a	6	**0.037**
LNG0011	0.8	0.0709	5.2	0	n/a	n/a	n/a	n/a	6	**0.009**
LNG0012	2	0.147	1.8	0.0197	2.2	0	n/a	n/a	6	**0.055**
LNG0013	2.3	0.175	3.7	0	n/a	n/a	n/a	n/a	6	**0.067**
LNG0014	2	0.324	2	0.0183	2	0	n/a	n/a	6	**0.114**

Based on the analyses, all average mercury concentrations were below the RAO of 0.25 mg/kg for critical habitats (marsh-type) and therefore, there should be no restrictions on the use of the dredged material.

6.2.1.2 Placement of Dredged Material

Potential placement alternatives for the dredged material include upland placement, habitat creation/protection, unconfined in-water, and ocean placement. The potential dredged material placement areas are shown on **Figure 2**. The areas southwest (ER1) and north (ER2 and ER3) of Dredge Island are potential enhanced recovery placement areas for the dredged material. These areas were identified as areas of concern following the remedial investigation at the Alcoa (Point Comfort)/Lavaca Bay Superfund Site. These areas are currently undergoing natural recovery by sedimentation, which buries the mercury-impacted surficial sediment (0 – 5 cm). However, the sedimentation rates in the area southwest of Dredge Island (ER1) are lower than the rates in the rest of the area. Recent sampling data from 2005 obtained from Alcoa confirms elevated mercury-surface concentrations (0 – 5 cm) in PAs ER2 and ER3. PAs ER2 and ER3 cover approximately 88 acres where the mercury-surface concentrations (0 – 5 cm) exceed the remedial action objective (RAO) of 0.5 mg/kg for open water areas as set forth in the Superfund Record of Decision (ROD). They also cover over 300 acres of buried mercury impacted sediments. The natural recovery effort will be enhanced by the placement of dredged material over the impacted sediments and will prevent disturbance of the buried mercury.

In addition to impacts due to the location of the placement areas, disturbance of bay sediments can also result from building levees to contain the dredged material within the placement areas. There is a concern with regard to the placement of dredged material to build the levees because there may be potential to displace sediments from underneath the levees. This is referred to as a mud wave. Mud waves occur when excessive dredged material is rapidly placed on top of soft, weak sediments exceeding the sediment's bearing capacity. This is a concern in areas where soft sediment is present and where mercury concentrations are elevated because of the potential for the exposure of buried mercury, i.e. D, ER1, ER2, ER3, and A1. The levees are in areas where the current mercury surface concentrations (0 – 5 cm) are at or below the RAO of 0.5 mg/kg for open water areas. In most cases the surface concentrations in these areas are below 0.25 mg/kg, which is the ROA for marshes. In these areas, as sediment is displaced it would likely be moved in conjunction with the clean material that has covered it. This action would likely promote mixing clean sediment with impacted sediment and thus reduce the mercury concentration. Also, the toe area would be covered with mudflow (dredged material that becomes part of the slurry) from the construction of a toe berm and/or levee, which would aid in covering sediments that contain mercury.

Historical data also indicate elevated mercury concentrations at depth for a portion of PA D within Lavaca Bay (Alcoa 1999). Current analytical data show mercury concentrations above 0.5 mg/kg along the shoreline of Dredge Island within PA D (**Exhibit 14**). PAs ER2 and ER3 have residual elevated mercury concentrations at the surface and at depth according to the recent 2005 sampling results from Alcoa (**Appendix B**). Recent analytical data is not available for placement area ER1, but historical data indicate that mercury-impacted sediment may exist at-depth (**Exhibit 15**). In areas where very soft sediment exists, it may be difficult to avoid creating mud waves during construction of the levees. The issue of exposing sediments with elevated mercury concentrations in these areas has been recognized. Work in these areas is planned to progress from the outside to the inside of contaminated areas including barge access routes, which provides for any disturbed area to be covered by the subsequent

placement of clean dredged material. For PAs D, ER2, and ER3 (**Figure 20**), a 100-ft wide bench will be created first, prior to levee creation. The bench will be placed to just below the water line and will cover the area that may mudwave during the raising of the perimeter levee. Mudwaves at the toe of the bench are possible but would occur at a much lesser extent and the toe area would be covered with mudflow (dredged material that becomes part of the slurry) from the construction of the levee.

According to sediment probing performed in June 2006, PAs D, ER2, ER3, and A1 have soft sediments with depths ranging from 19 inches to 62 inches with the largest depths from placement area A1, which is indicative of its current use as a placement area. No recent analytical data are available for Cox Bay where PA A1 is located, but historical data show mercury concentrations above 0.5 mg/kg in Cox Bay (Alcoa 1995). Due to the fact that Cox Bay has deeper waters, the potential for mercury-impacted sediments to be displaced by a mud wave onto emergent marsh is unlikely. Therefore, the RAO of 0.5 mg/kg for open water habitat is used as the basis for comparison. When compared to the RAO for open water habitats, there is a possibility for mercury-impacted sediments to be exposed in the event of a mud wave occurring in placement area A1 within Cox Bay. However, the area has been periodically covered with maintenance material that has not been impacted by mercury as a result of the area being used as existing placement areas (PA 18 and 19) for the MSC. In addition, the mixing associated with the mudwave and covering the sediment with mudflow from the levee construction alleviated the need for a 100-foot wide bench for PA A1.

Post-construction sampling and analysis will be performed to determine if the surficial sediments exceed the RAO of 0.5 mg/kg for open water habitats and if so, the sediments will be managed in a manner consistent with the Lavaca Bay Superfund Site requirements.

6.2.1.3 Construction of Barge Access Channel

Equipment barges that would support the construction operations of the MSC improvement can work in 6 feet of water, which is the deepest portion of Lavaca Bay outside of the navigation channels. These barges will be light loaded to access the work areas but in some areas within the bay where the water is shallower, barge flotation channels may be required to be constructed to provide access to the placement areas. The construction of the access channels has the potential for disturbing mercury-impacted sediment.

As discussed, the concern over mercury-impacted sediments is limited to areas in the vicinity of Dredge Island within Lavaca Bay and Cox Bay. According to the RI performed in 1999, surficial mercury concentrations north of Lavaca Bay, Cox Bay and near Matagorda Bay have recovered to the point where surface concentrations of mercury range from 0.1 to 0.3 mg/kg (Alcoa 1999). Recent data obtained from Alcoa's sampling program in 2005 show that sediments within placement area ER2 and ER3 still have residual surface and at-depth mercury concentrations above the RAO (**Exhibit 14**). The recent data show that placement area D was not impacted, with the exception of a few locations along the western shoreline of Dredge Island (**Exhibit 14**). However, barge access channels are not expected to be required in placement area D where residual mercury-impacted sediments exist.

No current data exists for Cox Bay. As discussed, historical data indicate that at-depth mercury concentrations above the RAO of 0.5 mg/kg exist in Cox Bay (**Exhibit 13**). Historical water depths in Cox Bay taken during sampling efforts from the RI ranged from approximately 1 ft to approximately 8 ft. Recent probing results in the area indicate that water depth in Cox Bay is currently shallower (by approximately 1.5 ft) compared to historical water depths. Efforts will be made to avoid constructing barge access channels through areas in Cox Bay with known at-depth mercury-impacted sediments.

Post-construction sampling and analysis will be performed to determine if the surficial sediments exceed the RAO of 0.5 mg/kg for open water habitats and if so, the sediments will be managed in a manner consistent with the Lavaca Bay Superfund Site requirements.

6.2.2 Maintenance Material

As discussed in **Section 3.2.2**, the conclusions from the studies performed on the maintenance material in the MSC do not restrict the dredging placement options available to this project. However, within CCND's facilities, pre-dredging sediment sampling will be performed to confirm that mercury, ethylene dichloride, or PAH levels will not adversely affect the placement areas. The Adaptive Sediment Management Framework discussed in **Section 2.1.3.3** and shown on **Exhibit 3** will be followed for decision-making with regard to sediment disposal or reuse.

6.3 BIOLOGICAL COMMUNITIES

Dredging and dredged material placement would have a variety of direct and indirect effects on biological communities in the project area. Dredging will defaunate and permanently alter the benthic habitats located within the MSCIP site. Habitats affected by the proposed dredging activities include unvegetated 'bay bottom' and oyster reef. **Table 6-1** provides the area of these habitats affected at the MSCIP site. Impacts to open bay bottom habitats are expected to be temporary, as benthic communities are known to quickly re-colonize areas disturbed by dredging activities. However, shallow-water benthic communities will likely experience a measurable decrease in species diversity after the change in depth. A draft mitigation plan is provided separately (URS 2007a).

Potential indirect effects might include those related to increased TSS concentrations such as interference with the filter feeding of live oysters and sedimentation on oyster reefs. TSS concentrations generated by the pipeline dredge are not expected to be much higher than background levels this far from the dredging operations.

6.3.1 Oyster Impacts

In December 2005, NCS Subsea, Benchmark Ecological Services (BESI 2006a), and PBS&J (PBS&J 2006) delineated oyster reefs within the MSCIP and proposed dredged material placement areas. As the DMMP has gone through several iterations, and originally included a larger MSCIP site and more placement areas, the oyster reef delineation was performed over a more extensive area than what was required for this DMMP. **Exhibit 4** shows the location of reefs identified and delineated during this study; **Table 6-1** provides the area of oyster reef that would be impacted by the proposed project. A draft mitigation plan was prepared from coordination efforts between CCND appropriate resource agencies.

6.3.2 Marsh Impacts

Benchmark Ecological Services, Inc. (2006b) delineated and characterized coastal marshes on and around portions of Dredge Island in March 2006. **Figure 20** shows the location of marshes delineated during this study; **Table 6-1** provides the area of marsh that would be impacted by the proposed project.

Dredge Island supports two sub-communities of coastal marsh: low marsh and high marsh. These communities are described below:

Low marsh included mostly intertidal areas supporting near pure stands of smooth cordgrass (*Spartina alterniflora*) that sometimes transitioned to less frequently flooded zones populated primarily by saltgrass (*Distichlis spicata*), saltwort (*Batis maritima*), and annual glasswort (*Salicornia bigelovii*).

High marsh communities were found at higher elevations subject to infrequent tidal flooding and/or received runoff and groundwater flow from site levees and riprap areas. The density of vegetation in the high marshes of Dredge Island varied from moderate to sparse. These communities typically were dominated by following plant species: saltgrass, sea-ox-eye daisy (*Borrichia frutescens*), sea purslane (*Sesuvium maritimum*), annual glasswort, and less frequently with marsh elder (*Iva frutescens*) and saltmeadow cordgrass (*Spartina patens*).

6.3.3 Open Bay Impacts

Open bay bottom impacts were estimated based on the footprint of the proposed MSC improvements and associated placement areas. **Table 6-1** provided the area of open-bay bottom that would be impacted or converted by the proposed project.

Table 6-1. Pre- and Post-Construction Acreages of Habitats for Placement Areas in Alternative 2A.

Alternative 2A		Open Bay Bottom	Mercury Impacted Bottom	Offshore Bottom	Upland	Marsh[1]	Oyster Reef	Sand Platform	Beach	Bird Island	Unconfined Placement	Ship Channel Bottom	High Marsh[2]	Agricultural land	Onshore Placement Area	Total Area (acres)
Proposed Ship Channel	Pre-Construction	574.8		213			129.2									917
	Post-Construction											917				
A1[3]	Pre-Construction	530														530
	Post-Construction				530											
A2	Pre-Construction	259.3					0.75									260
	Post-Construction				140	120										
BN1, BN2, and BN3	Pre-Construction	125														125
	Post-Construction								125							
D[4]	Pre-Construction	251.5				3.4	0.66						18.6			274.2
	Post-Construction				260	7.1							7.1			
ER1	Pre-Construction		126													126
	Post-Construction	63					63									
ER2[4]	Pre-Construction		174			3.4	0.6									178
	Post-Construction				167.8	10.2										
ER3	Pre-Construction		184.5		40	1.6	17						9.4			252.5

Table 6-1. Pre- and Post-Construction Acreages of Habitats for Placement Areas in Alternative 2A.

Alternative 2A		Open Bay Bottom	Mercury Impacted Bottom	Offshore Bottom	Upland	Marsh[1]	Oyster Reef	Sand Platform	Beach	Bird Island	Unconfined Placement	Ship Channel Bottom	High Marsh[2]	Agricultural land	Onshore Placement Area	Total Area (acres)
	Post-Construction	5.2			201	30.25							16.05			
G	Pre-Construction	332														332
	Post-Construction				12	320										
G Shoreline Protection	Pre-Construction	21.8														21.8
	Post-Construction	9.2			12.6											
H4 Habitat Area	Pre-Construction	470														470
	Post-Construction				20	100		325		25						
O5	Pre-Construction			1600												1600
	Post-Construction										1600					
OR1 and OR2	Pre-Construction	235														235
	Post-Construction						235									
P1	Pre-Construction													700		700
	Post-Construction														700	
PA1	Pre-Construction			453												453
	Post-Construction										453					

Table 6-1. Pre- and Post-Construction Acreages of Habitats for Placement Areas in Alternative 2A.

Alternative 2A		Open Bay Bottom	Mercury Impacted Bottom	Offshore Bottom	Upland	Marsh[1]	Oyster Reef	Sand Platform	Beach	Bird Island	Unconfined Placement	Ship Channel Bottom	High Marsh[2]	Agricultural land	Onshore Placement Area	Total Area (acres)
PA5-12	Pre-Construction	1350														1350
	Post-Construction										1350					
Total	**Pre-Construction**	4149.4	484.5	2266.0	40.0	8.4	148.2	0.0	0.0	0.0	0.0	0.0	28.0	700.0	0.0	7824.5
	Post-Construction	77.4	0.0	0.0	1343.4	587.6	298.0	325.0	125.0	25.0	3403.0	917.0	23.2	0.0	700.0	

[1] Marsh habitat post-construction will be *Spartina alterniflora* near mean sea level

[2] High marsh areas have infrequent tidal flooding, post construction they will be dominated by *Spartina patens*.

[3] Includes active placement areas PA18 and PA19

[4] Area D oyster reef area and Area ER2 marsh and oyster reef areas estimated using aerial photos

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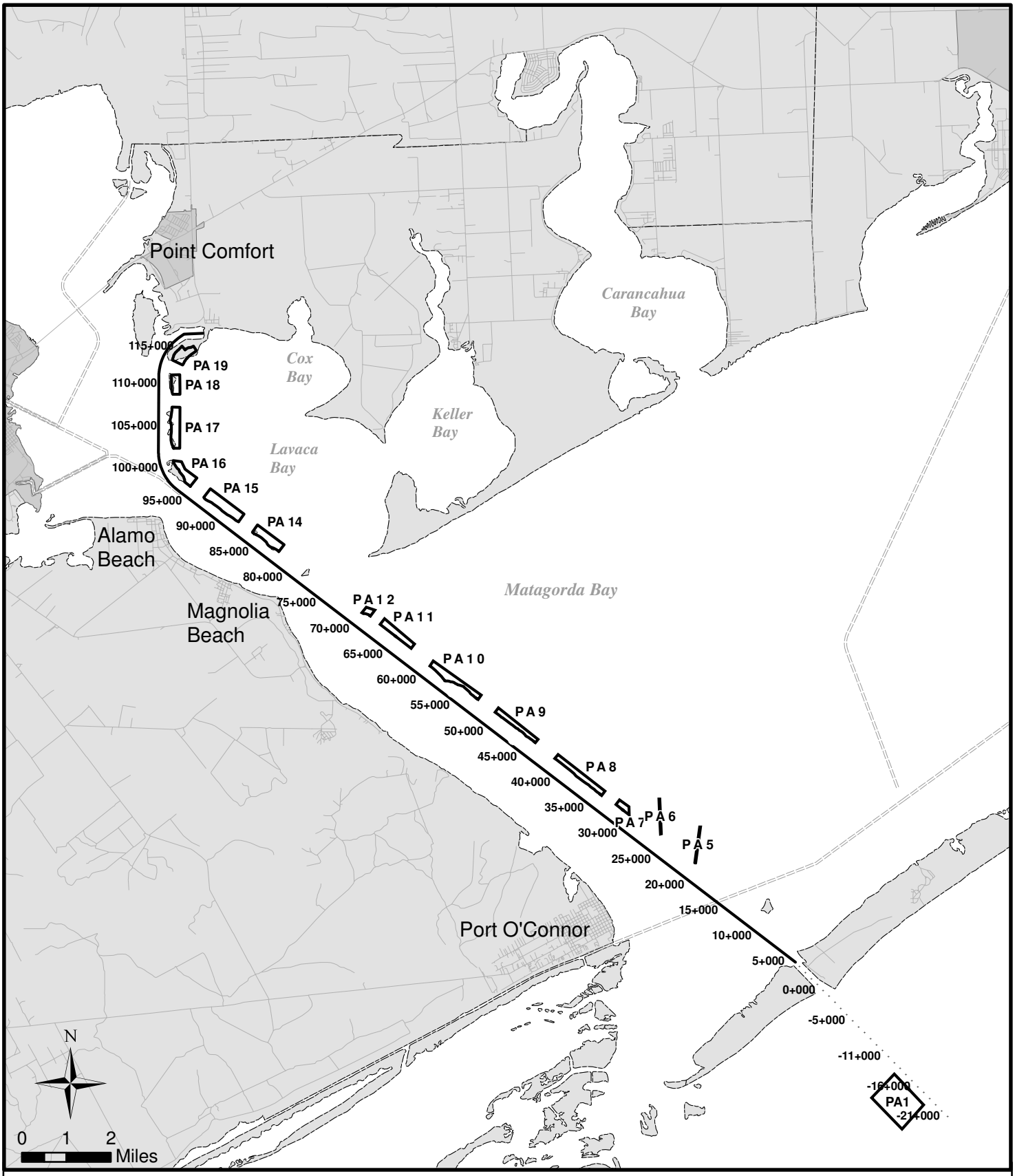
FIGURES

REFER TO PERMIT APPLICATION FOR FIGURES
(SEE APPENDIX A OF THE MSCIP DEIS)

EXHIBITS



Legend

Placement Area

Ship Channel

Existing Unconfined Placement Areas and Channel Stations

Matagorda Ship Channel Improvement Project

Matagorda and Calhoun Counties, Texas

Calhoun County Navigation District

URS

Exhibit 1

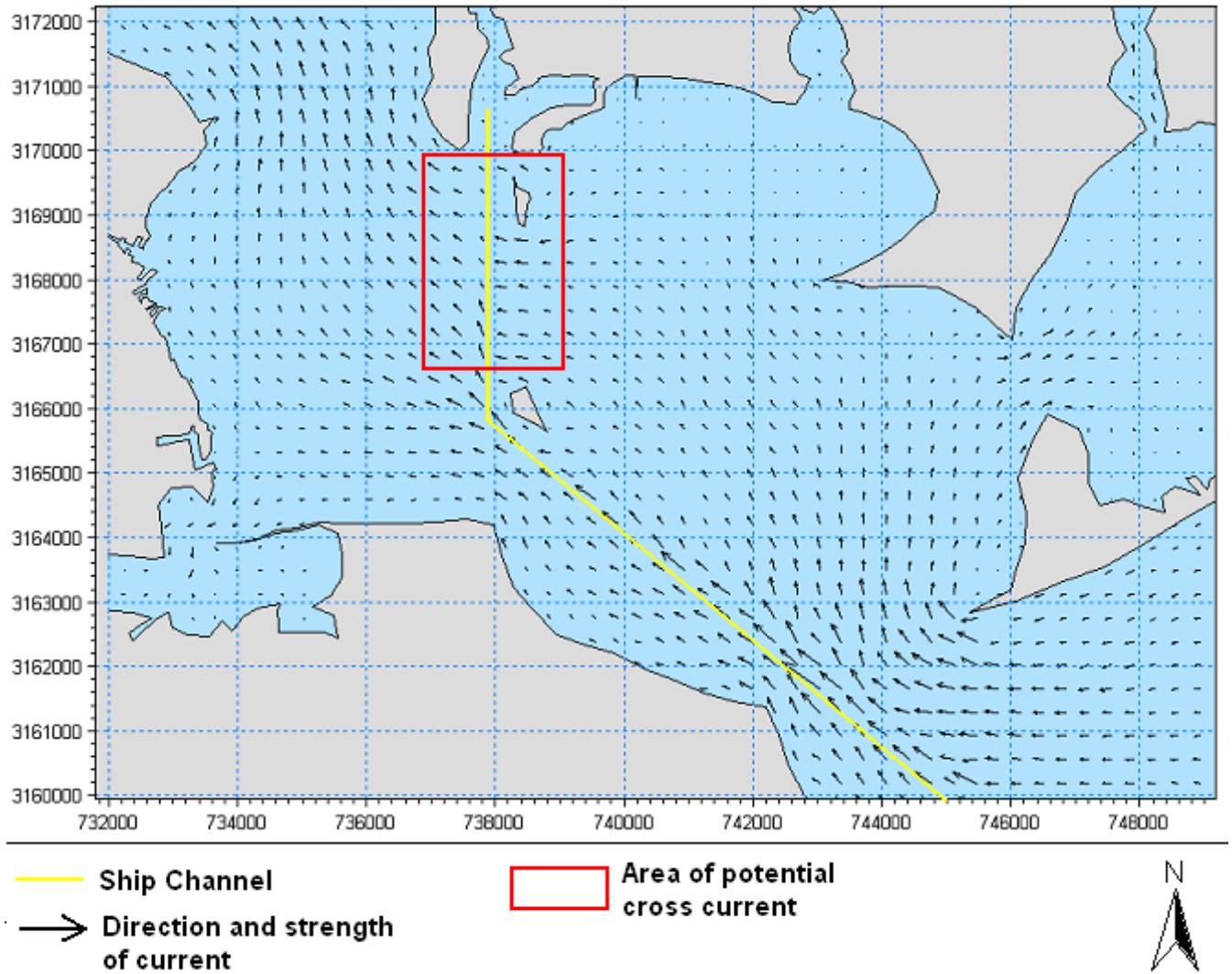
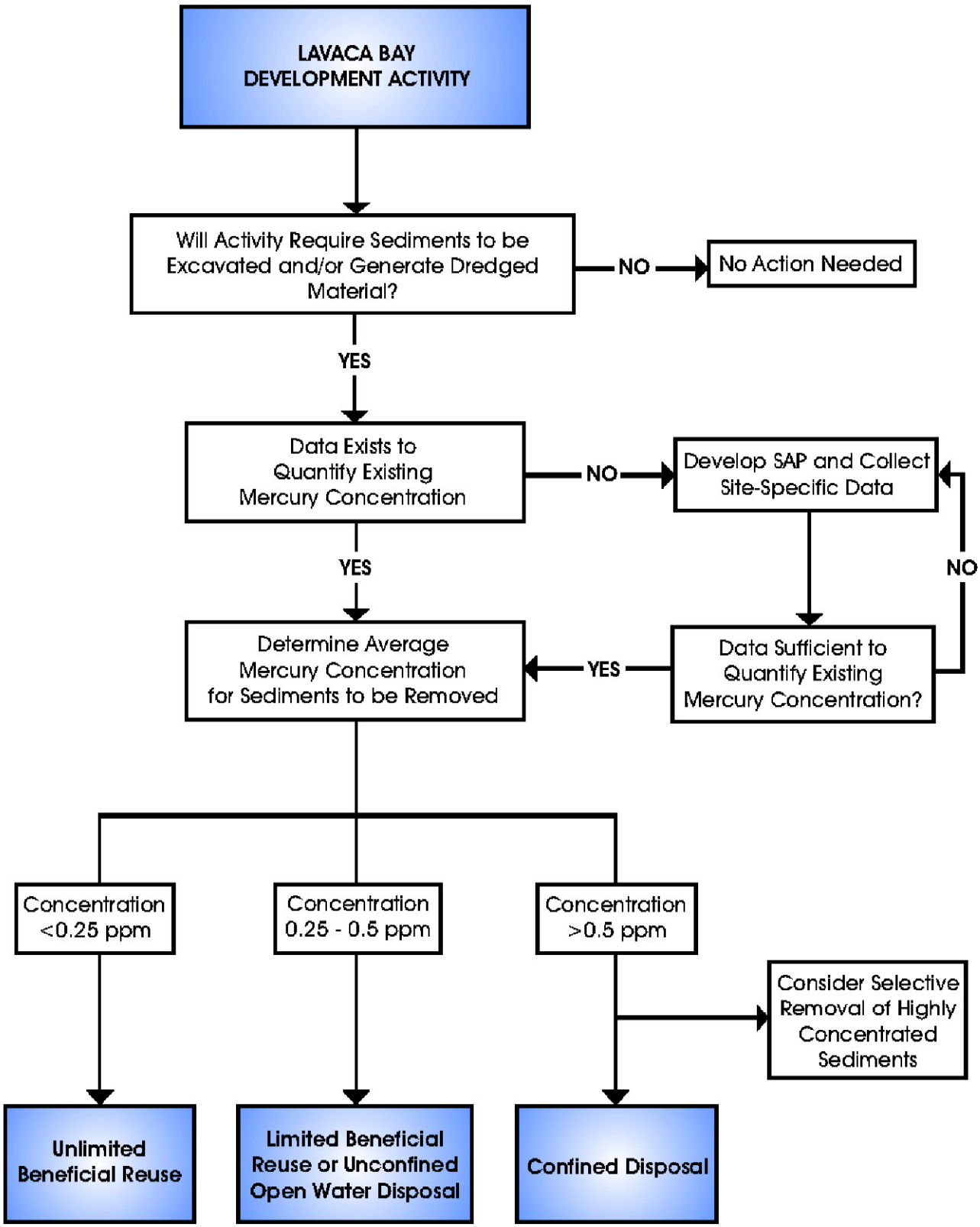


Exhibit 2. Tidal Flood flow currents in Lavaca Bay. Adapted from Moffatt and Nichol (2006).



Legend:

SAP Sampling and Analysis Plan

URS
9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 914-6699
FAX: (713) 789-8404

Scale:	Drawn by:	Date:
As Shown	DAN	02-15-07
	Chk'd by: MEM	Date: 02-15-07

Title: **Lavaca Bay Sediment Management Framework Conceptual Overview**

Project: Matagorda Ship Channel Improvement Project
Dredged Material Management Plan
Matagorda and Calhoun Counties, Texas

Client: **CALHOUN COUNTY NAVIGATION DISTRICT**

Project No.:	File Name:	Exhibit:
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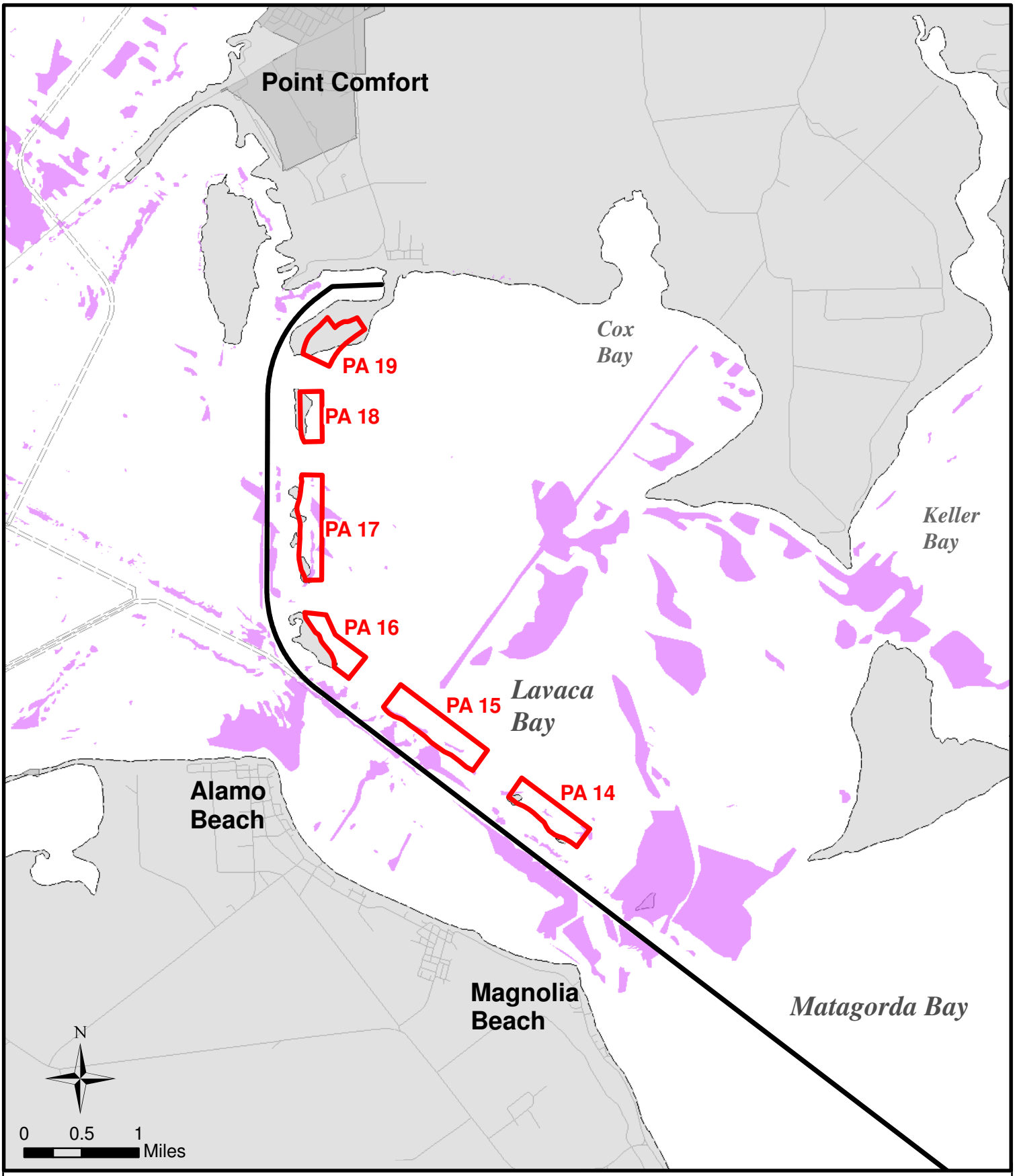


Legend

- Placement Area
- Oyster Reef
- Ship Channel

Existing Unconfined Placement Areas and Oyster Reefs in Lavaca Bay

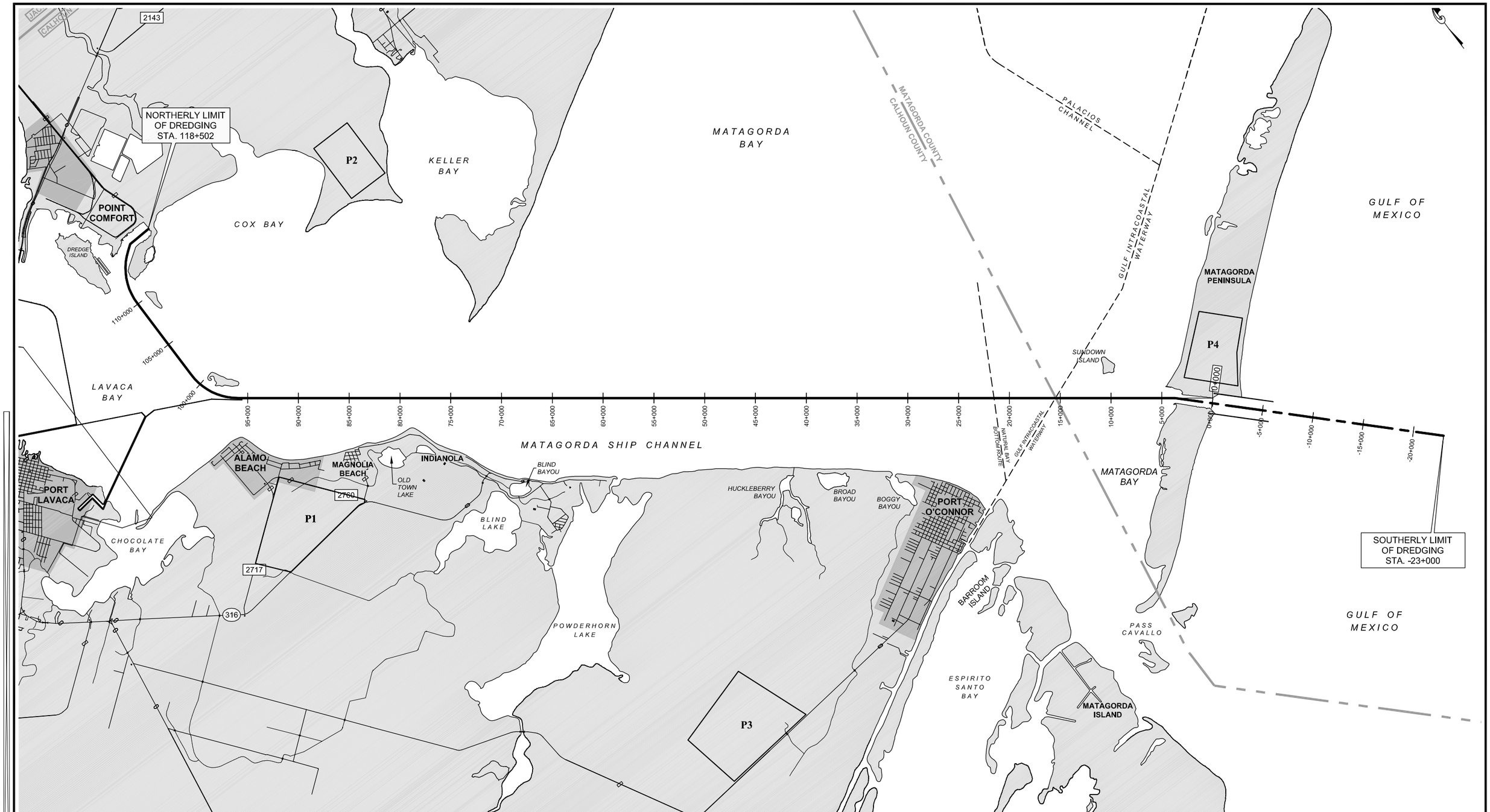
Matagorda Ship Channel Improvement Project

Matagorda and Calhoun Counties, Texas

Calhoun County Navigation District

URS

Exhibit 4



LEGEND:

P — POTENTIAL PLACEMENT AREA

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APPROXIMATE SCALE IN FEET

COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

EXISTING AND PROPOSED PLACEMENT AREAS UPLAND ALTERNATIVE

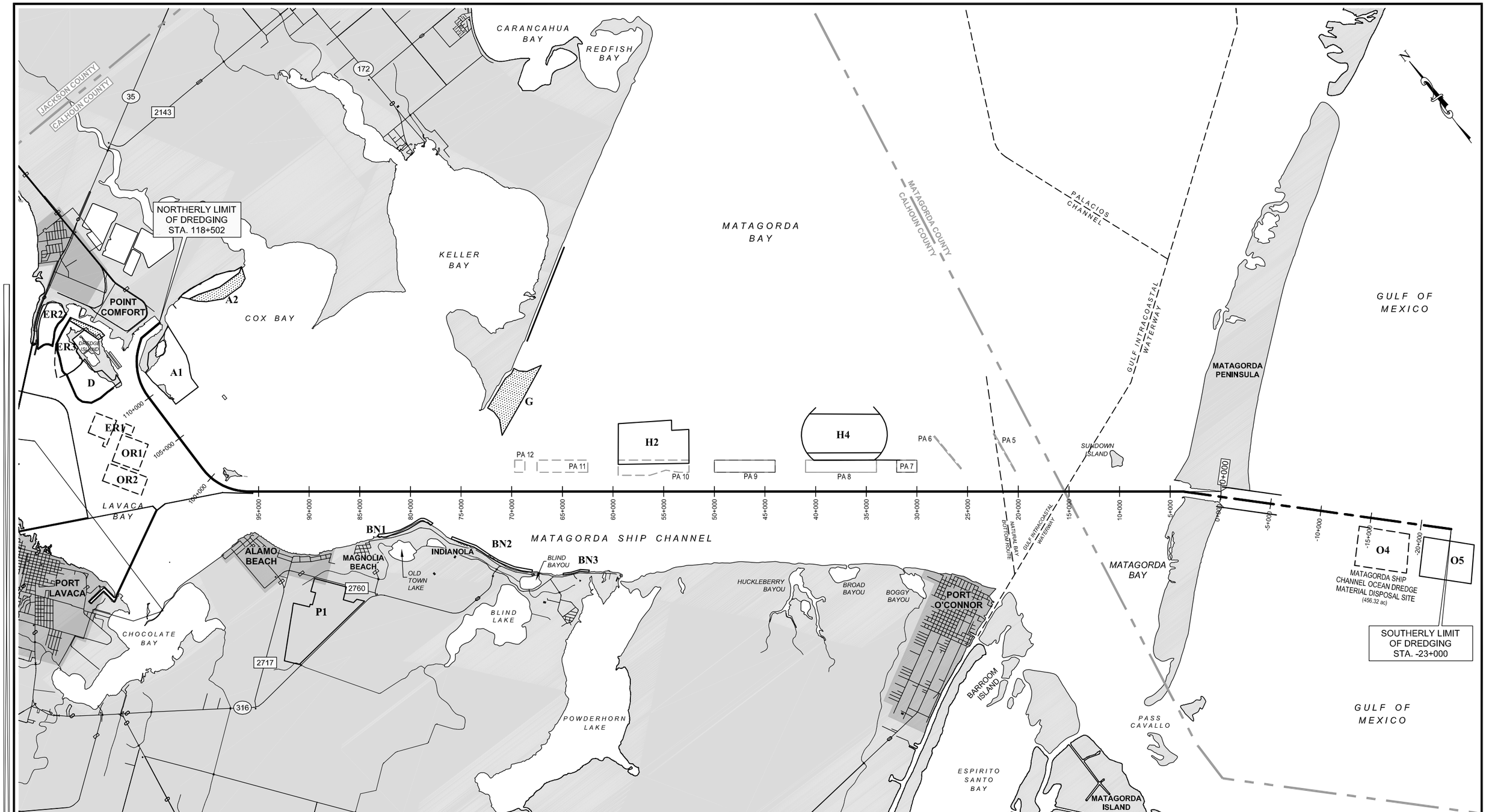
MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

MATAGORDA AND CALHOUN COUNTIES, TEXAS

URS

PERMIT NO. 24071

EXHIBIT 5



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- MARSH PLACEMENT AREA
- MARSH/AQUATIC PLACEMENT AREA
- PA 17 — EXISTING PLACEMENT AREA
- G OR D — POTENTIAL PLACEMENT AREA

0 3000 6000 9000 18000

APPROXIMATE SCALE IN FEET

COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

EXISTING AND PROPOSED PLACEMENT AREAS ALTERNATIVE 1A

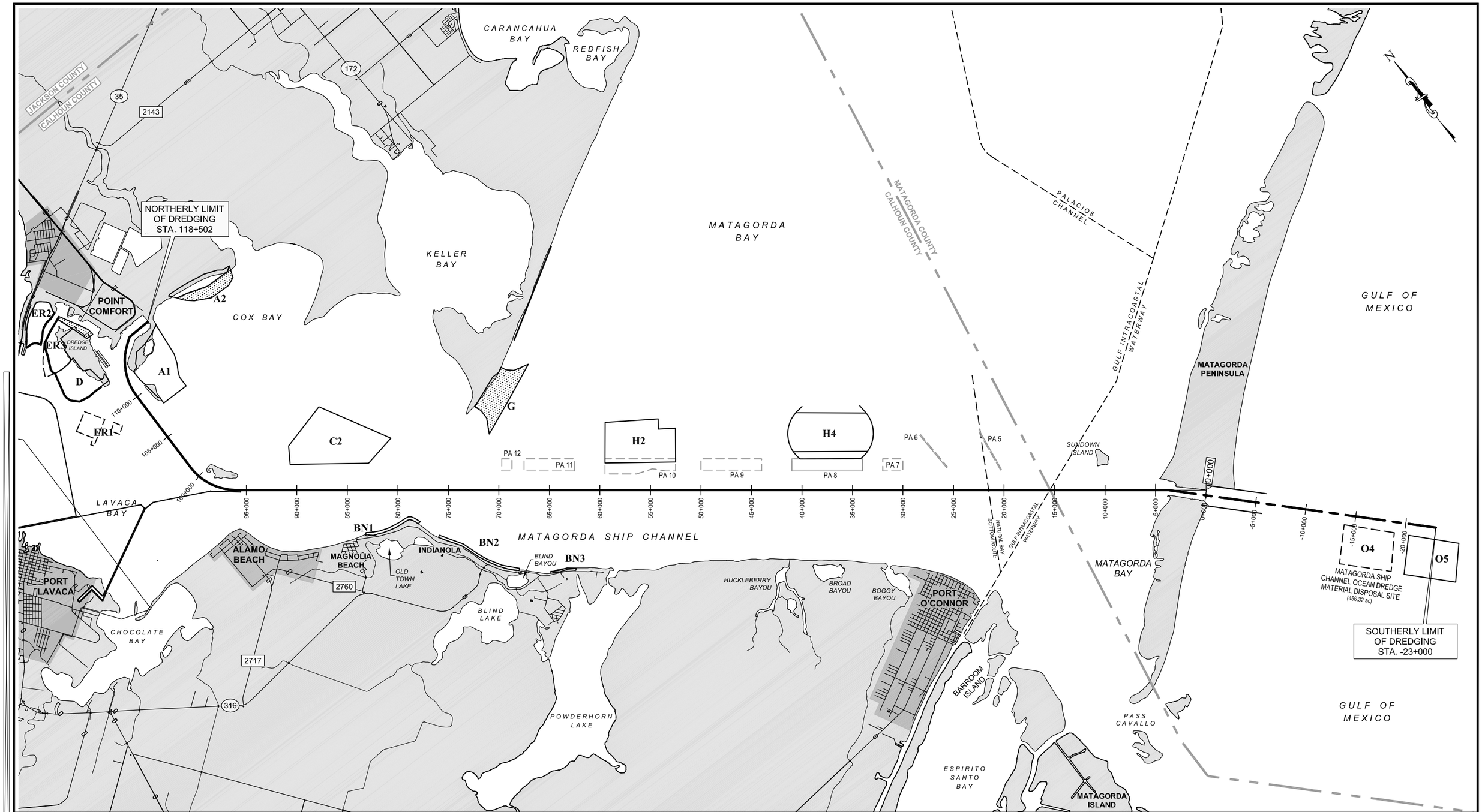
MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

MATAGORDA AND CALHOUN COUNTIES, TEXAS

URS

PERMIT NO. 24071

EXHIBIT 6



LEGEND:

MARSH PLACEMENT AREA

MARSH/AQUATIC PLACEMENT AREA

PA 17 EXISTING PLACEMENT AREA

G OR D POTENTIAL PLACEMENT AREA

0 3000 6000 9000 18000

APPROXIMATE SCALE IN FEET

COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

EXISTING AND PROPOSED PLACEMENT AREAS ALTERNATIVE 1B

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

MATAGORDA AND CALHOUN COUNTIES, TEXAS

URS

PERMIT NO. 24071

EXHIBIT 7

LEGEND:

- MARSH PLACEMENT AREA
- PA 17 — EXISTING PLACEMENT AREA
- G OR D — POTENTIAL PLACEMENT AREA
- MARSH/AQUATIC PLACEMENT AREA

0 3333 6666 10000 20000

APPROXIMATE SCALE IN FEET
COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

EXISTING AND PROPOSED PLACEMENT AREAS ALTERNATIVE 2A

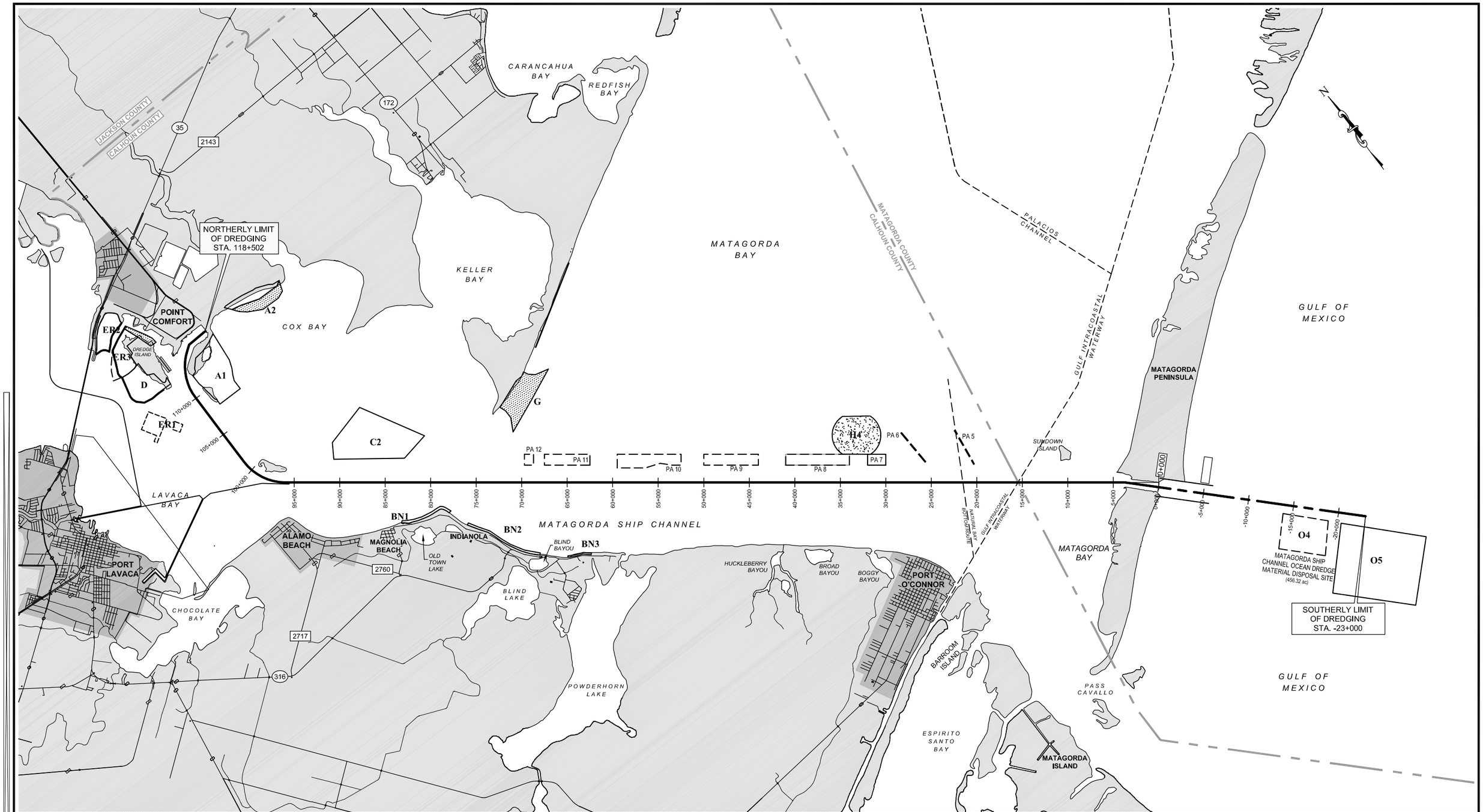
MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

MATAGORDA AND CALHOUN COUNTIES, TEXAS

URS

PERMIT NO. 24071

EXHIBIT 8



LEGEND:

- MARSH PLACEMENT AREA
- MARSH/AQUATIC PLACEMENT AREA
- PA 17 — EXISTING PLACEMENT AREA
- G OR D — POTENTIAL PLACEMENT AREA

0 3333 6666 10000 20000

APPROXIMATE SCALE IN FEET

COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

EXISTING AND PROPOSED PLACEMENT AREAS ALTERNATIVE 2B

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

MATAGORDA AND CALHOUN COUNTIES, TEXAS

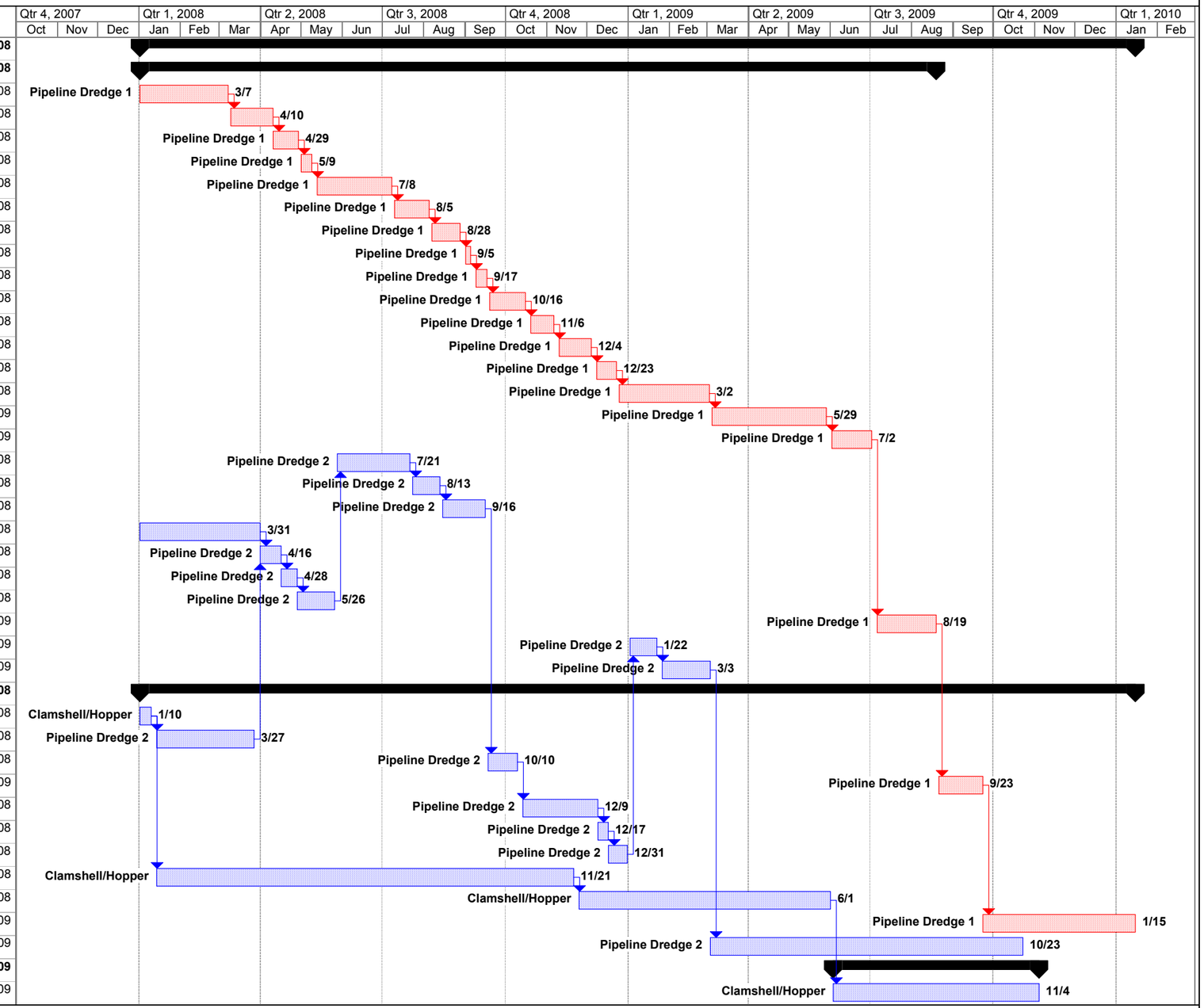
URS

PERMIT NO. 24071

EXHIBIT 9.

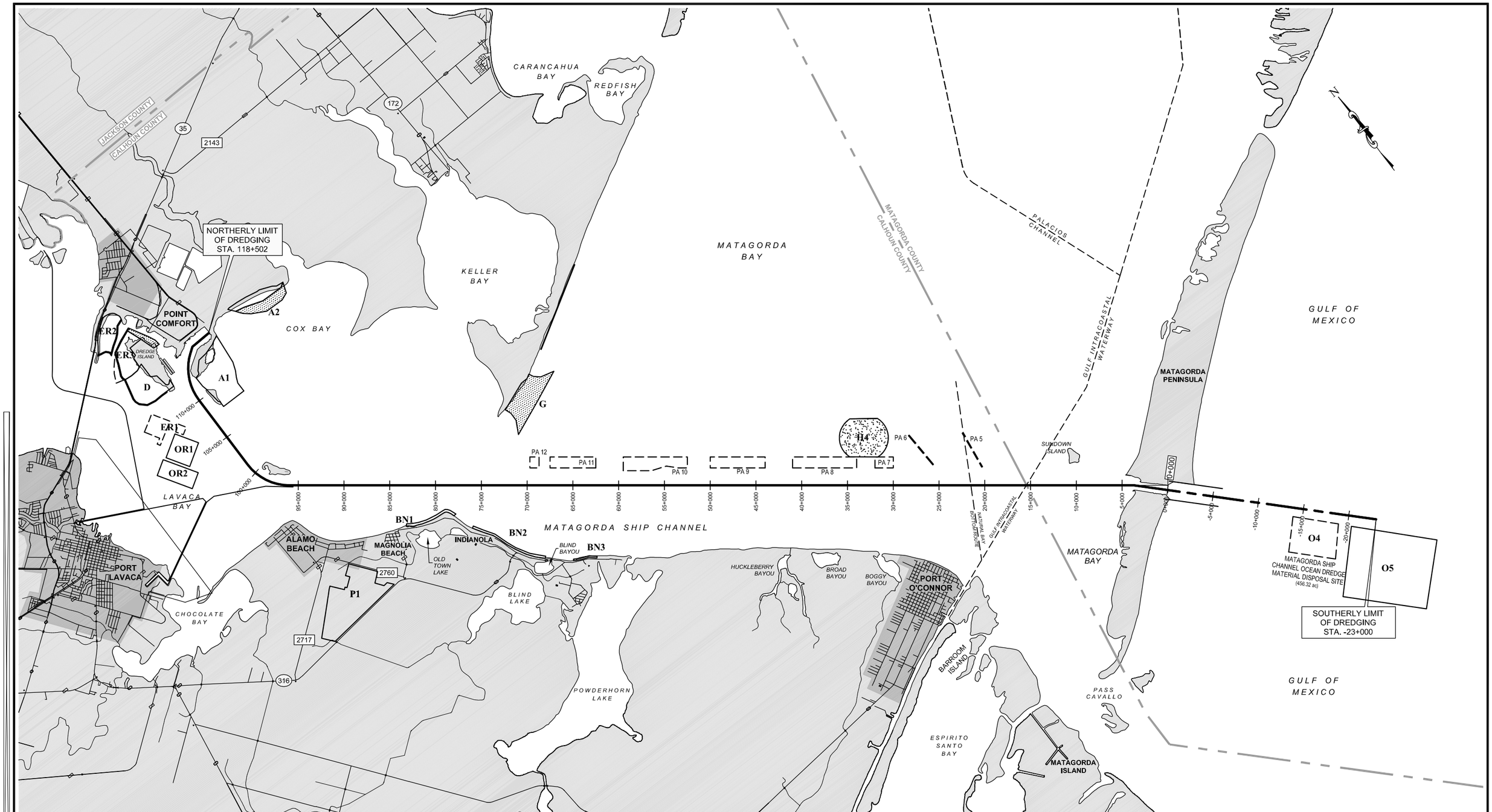
Exhibit 10
Matagorda Ship Channel Improvement Project
Estimated Dredge Construction Sequence

ID	Placement Type	From Station	To Station	Volume, CY	Duration	Start
1	**Matagorda Ship Channel Improvement Project**				**532.8 days**	**Wed 1/2/08**
2	**Lavaca Bay Reach**				**425.8 days**	**Wed 1/2/08**
3	A1 - Up Levee	CCND	CCND	1,342,082	2.4 mons	Wed 1/2/08
4	A1 - Up Levee	116+593	107+000	657,918	1.18 mons	Mon 3/10/08
5	A1 - Up Fill	CCND	CCND	855,530	0.65 mons	Thu 4/10/08
6	A1 - Up Fill	TB	TB	404,470	0.3 mons	Thu 5/1/08
7	ER3 - Up Levee	TB	TB	1,100,000	1.98 mons	Tue 5/13/08
8	D - Up Levee	116+593	107+000	500,000	0.9 mons	Thu 7/10/08
9	ER3 - Up Fill	116+593	107+000	926,000	0.77 mons	Thu 8/7/08
10	ER3 - Marsh Levee	116+593	107+000	100,000	0.18 mons	Mon 9/1/08
11	ER3 - Marsh Fill	116+593	107+000	200,000	0.33 mons	Tue 9/9/08
12	D - Up Fill	107+000	92+000	1,116,000	0.92 mons	Fri 9/19/08
13	OR1/OR2 Platform	116+593	107+000	300,000	0.68 mons	Mon 10/20/08
14	A2 - Up Levee	TB	TB	500,000	0.9 mons	Mon 11/10/08
15	A2 - Marsh Levee	TB	TB	300,000	0.54 mons	Mon 12/8/08
16	A2 - Marsh Fill (Sand)	107+000	88+000	1,461,000	2.37 mons	Thu 12/25/08
17	A2 - Up Fill	107+000	92+000	3,675,000	3.08 mons	Thu 3/5/09
18	A2 - Marsh Fill (Clay)	107+000	92+000	329,000	1.09 mons	Tue 6/2/09
19	ER2 - Up Levee	TB	TB	1,063,000	1.91 mons	Wed 5/28/08
20	ER1 - Platform	TB	TB	400,000	0.72 mons	Thu 7/24/08
21	ER2 - Up Fill	107+000	92+000	1,000,000	1.09 mons	Fri 8/15/08
22	P1 Levee				3.2 mons	Wed 1/2/08
23	P1 - Up Fill (Clay)	88+000	82+000	831,000	0.59 mons	Tue 4/1/08
24	P1 - UP Fill (Sand)	88+000	82+000	251,000	0.4 mons	Wed 4/16/08
25	OR1/OR2 Platform	92+000	88+000	671,000	1 mon	Mon 4/28/08
26	BN 1, BN2 Beach Fill	88+000	82+000	1,113,000	1.62 mons	Mon 7/6/09
27	G - Marsh Levee (Sand)	82+000	76+000	471,000	0.7 mons	Fri 1/2/09
28	G - Marsh Fill	82+000	76+000	1,699,000	1.3 mons	Mon 1/26/09
29	**Matagorda Bay Reach**				**532.8 days**	**Wed 1/2/08**
30	ODMDS	46+000	40+000	153,000	0.32 mons	Wed 1/2/08
31	H4 - Sand Platforms Levee	46+000	38+000	1,545,000	2.64 mons	Mon 1/14/08
32	G - Marsh Levee (Clay from Exist Channel)	71+000	54+000	464,400	0.8 mons	Thu 9/18/08
33	BN2,BN3 Beach Fill	67+000	54+000	771,000	1.14 mons	Fri 8/21/09
34	G - Marsh Levee (Sand)	71+000	54+000	1,350,000	2.02 mons	Tue 10/14/08
35	G - Marsh Fill	71+000	67+000	364,000	0.28 mons	Tue 12/9/08
36	G - Marsh Levee (Clay from New Channel)	71+000	54+000	309,600	0.53 mons	Wed 12/17/08
37	ODMDS	67+000	46+000	5,388,000	11.2 mons	Mon 1/14/08
38	ODMDS	40+000	6+000	3,226,000	6.71 mons	Tue 11/25/08
39	H4 - Sand Platforms Fill	54+000	40+000	2,559,000	4.11 mons	Wed 9/23/09
40	H4 - Sand Platforms Fill	40+000	6+000	5,933,000	8.38 mons	Tue 3/3/09
41	**Offshore Reach**				**110 days**	**Wed 6/3/09**
42	New ODMDS	-5+000	-23+000	3,206,000	5.5 mons	Wed 6/3/09



Project: Schedulerev
Date: Mon 2/19/07

Task		Milestone		Rolled Up Critical Task		Split	Group By Summary
Critical Task		Summary		Rolled Up Milestone		External Tasks	
Progress		Rolled Up Task		Rolled Up Progress		Project Summary	



LEGEND:

- MARSH PLACEMENT AREA
- PA 17 — EXISTING PLACEMENT AREA
- G OR D — POTENTIAL PLACEMENT AREA
- MARSH/AQUATIC PLACEMENT AREA

0 3333 6666 10000 20000

APPROXIMATE SCALE IN FEET
COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

RECOMMENDED PLAN

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

MATAGORDA AND CALHOUN COUNTIES, TEXAS

URS

PERMIT NO. 24071

EXHIBIT 11

LEGEND:

- MARSH PLACEMENT AREA
- PA 17 — EXISTING PLACEMENT AREA
- G OR D — POTENTIAL PLACEMENT AREA
- MARSH/AQUATIC PLACEMENT AREA

0 3333 6666 10000 20000

APPROXIMATE SCALE IN FEET
COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

RECOMMENDED- NEW WORK PLAN

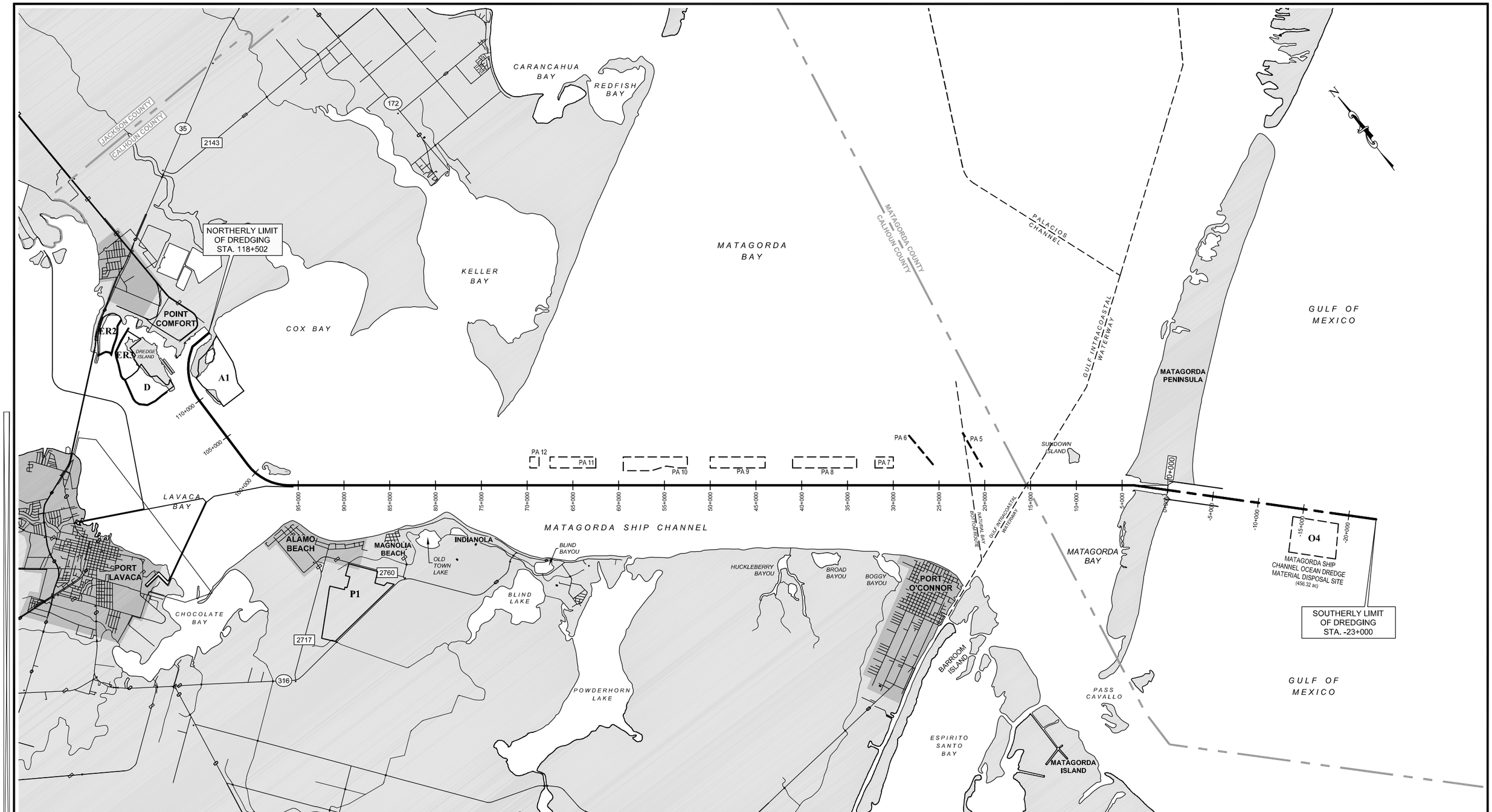
MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

MATAGORDA AND CALHOUN COUNTIES, TEXAS

URS

PERMIT NO. 24071

EXHIBIT 12



LEGEND:

MARSH PLACEMENT AREA

PA 17 EXISTING PLACEMENT AREA

G OR D POTENTIAL PLACEMENT AREA

MARSH/AQUATIC PLACEMENT AREA

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APPROXIMATE SCALE IN FEET
COORDINATE SYSTEM BASED ON NAD83, TEXAS STATE PLANES, SOUTH CENTRAL ZONE, US FOOT.

RECOMMENDED- MAINTENANCE PLAN

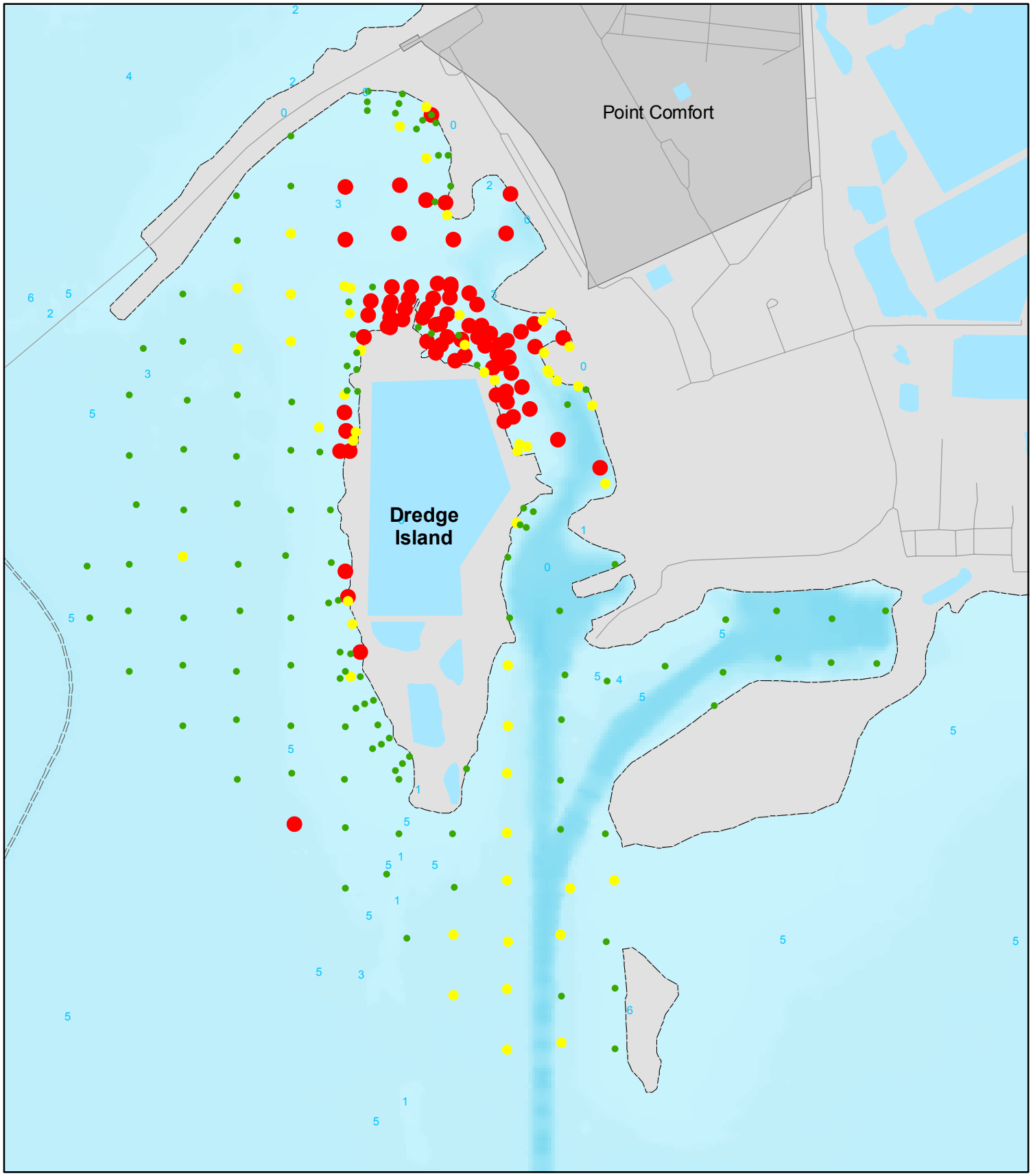
MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

MATAGORDA AND CALHOUN COUNTIES, TEXAS

URS

PERMIT NO. 24071

EXHIBIT 13



Mercury Concentrations

- < 0.25 mg/Kg
- 0.25 - 0.50 mg/Kg
- >0.50 mg/Kg

N

1,000 500 0 1,000
Feet

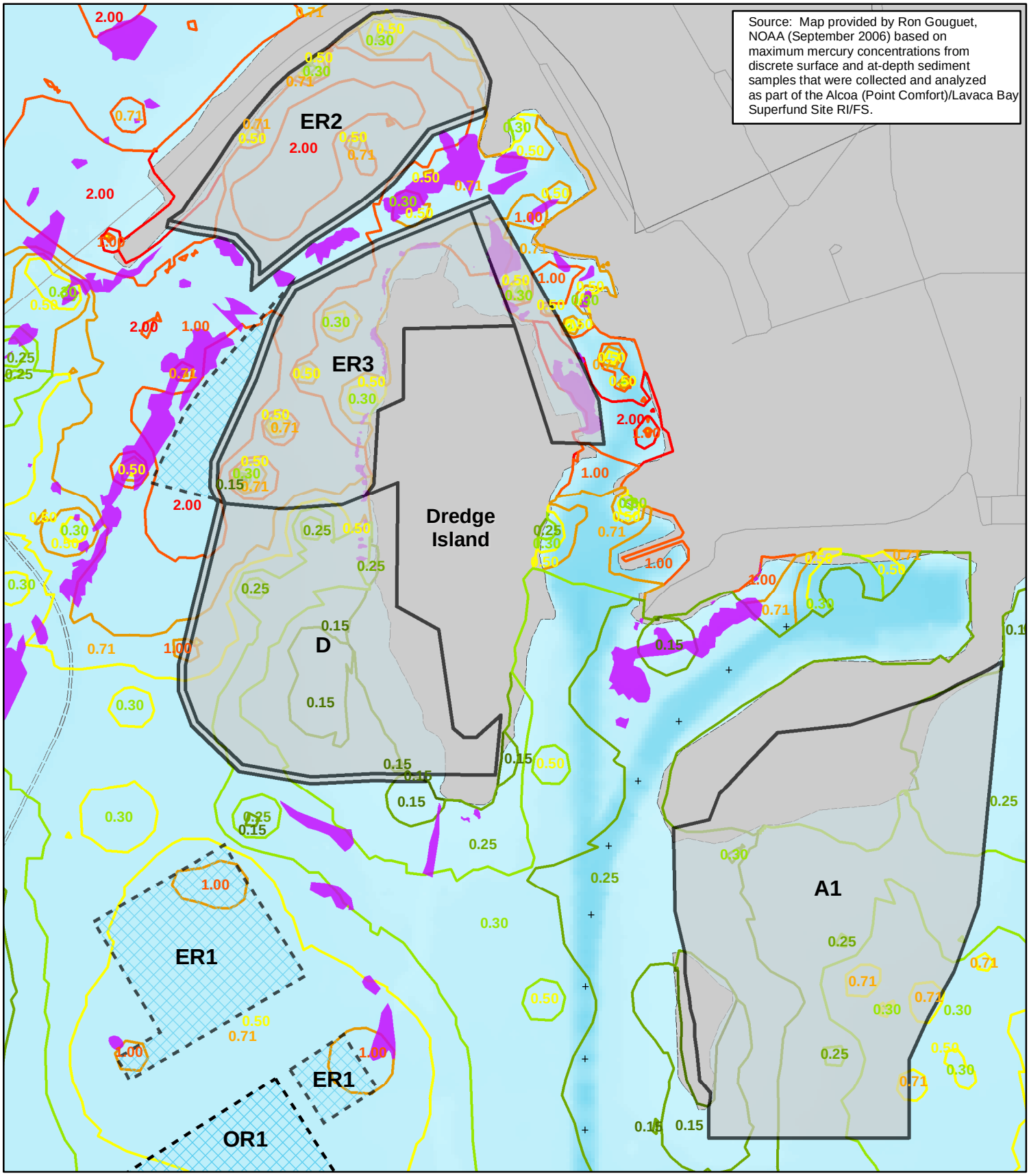
URS
9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 789-9801
FAX: (713) 789-8404

Title: **Mercury Concentrations in Surface Sediment Alcoa 2005**

Project: Matagorda Ship Channel Improvement Project
Dredged Material Management Plan
Matagorda and Calhoun Counties, Texas

Drawn by: GP	Date: 08/18/06	Client: Calhoun County Navigation District		
Chk'd by: SH	Date: 08/18/06	Project No.: 25008809	File Name:	Exhibit: 14

Compilation Wednesday, November 1, 2006 4:59:50 PMK:\ENG\25008809.Matagorda Ship Channel.Improvement Project.05\Dwgs\GIS\MXD\11012006\fig7.mxd Author: Geoff Price



Mercury Concentrations Mg/Kg dw

0.0 0.15 0.25 0.30 0.50 0.71 1.00 2.00

Oysters

Proposed Placement Area

1,000 500 0 1,000
Feet

URS
9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 789-9801
FAX: (713) 789-8404

Title: Historical Mercury Concentrations in Surface/Buried Sediment at Placement Area D, ER1, ER2, & A1

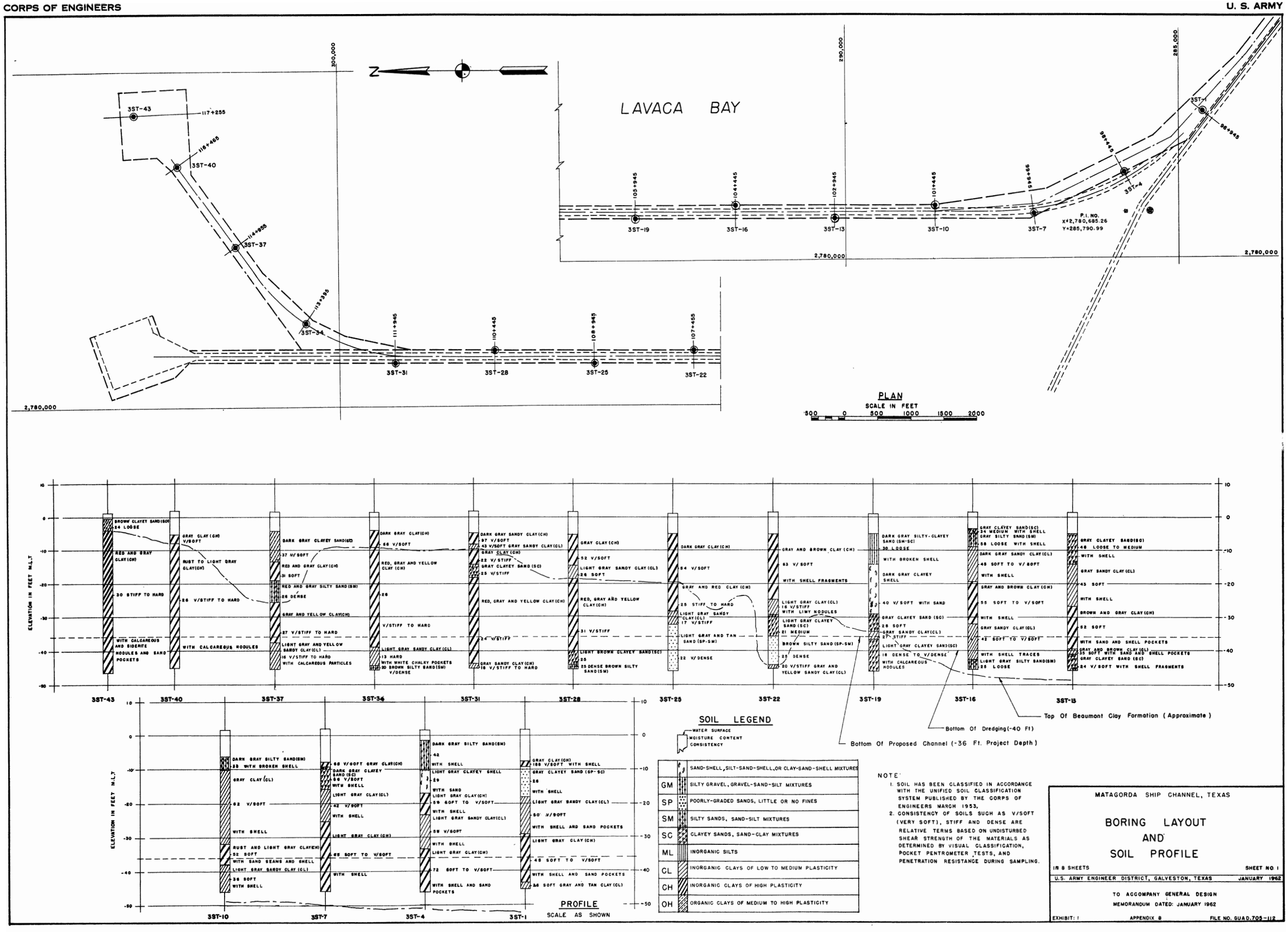
Project: Matagorda Ship Channel Improvement Project
Dredged Material Management Plan
Matagorda and Calhoun Counties, Texas

Drawn by:	Date:	Client:	
GP	08/18/06	Calhoun County Navigation District	
Chk'd by:	Date:	Project No.:	File Name:	Exhibit:
SH	08/18/06	25008809		15

Compilation Wednesday, November 1, 2006 2:42:51 PMK:\ENG\25009147.DMMP LNG\Dwgs\MXD\Figures\110106\Figue_11.mxd Author: Geoff Price

APPENDICES

APPENDIX A
SOIL BORING RESULTS



NOTE:

1. SOIL HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM PUBLISHED BY THE CORPS OF ENGINEERS MARCH 1953.
2. CONSISTENCY OF SOILS SUCH AS V/SOFT (VERY SOFT), STIFF AND DENSE ARE RELATIVE TERMS BASED ON UNDISTURBED SHEAR STRENGTH OF THE MATERIALS AS DETERMINED BY VISUAL CLASSIFICATION, POCKET PENTROMETER TESTS, AND PENETRATION RESISTANCE DURING SAMPLING.

MATAGORDA SHIP CHANNEL, TEXAS

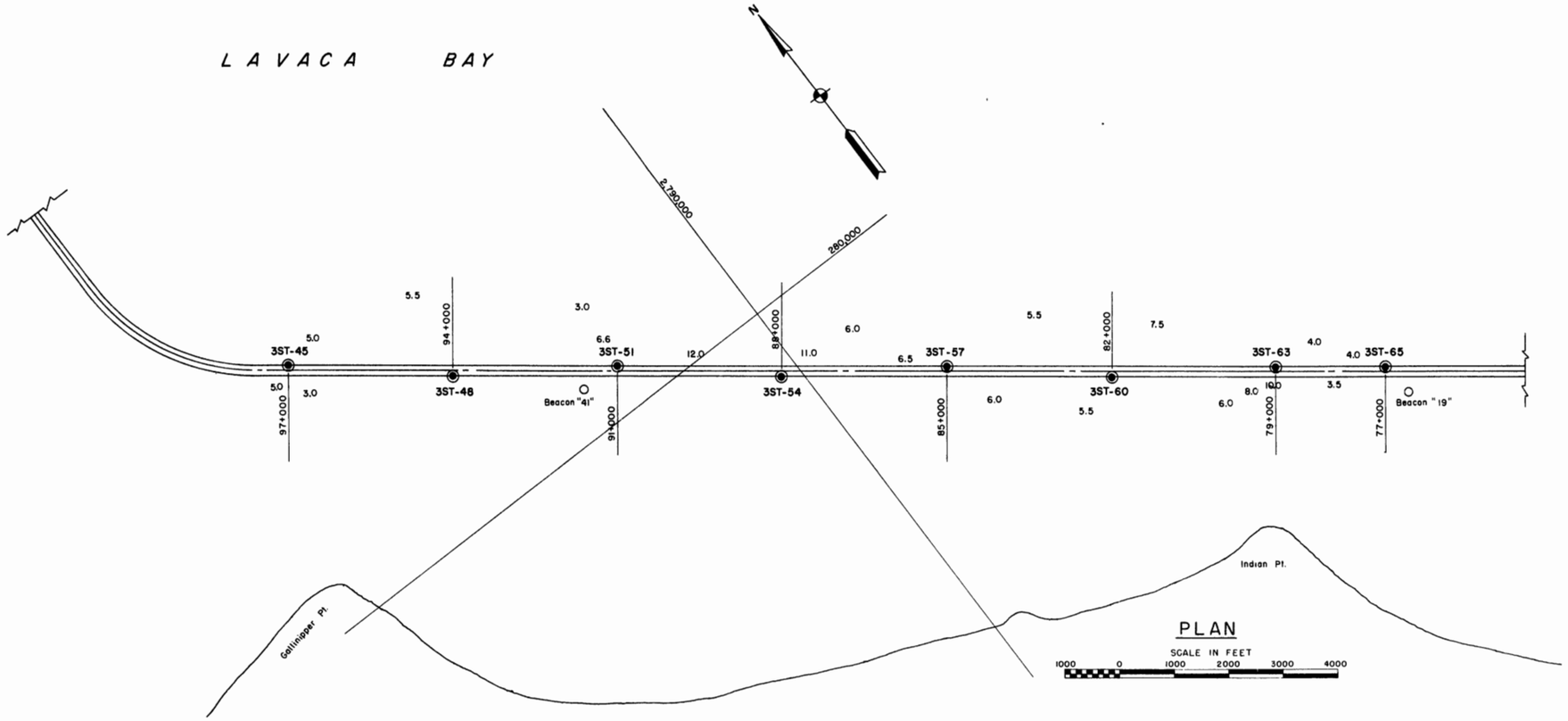
BORING LAYOUT AND SOIL PROFILE

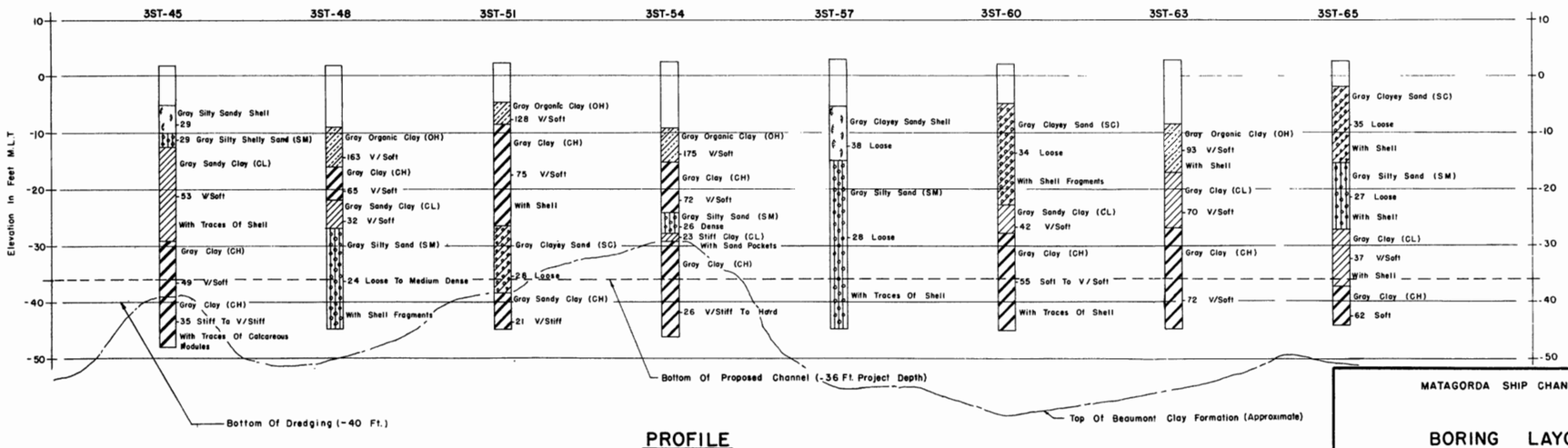
IN 8 SHEETS — SHEET NO. 1

U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS — JANUARY 1962

TO ACCOMPANY GENERAL DESIGN MEMORANDUM DATED: JANUARY 1962

EXHIBIT: 1 — APPENDIX 8 — FILE NO. GUAD.705-112





PROFILE

SCALE AS SHOWN

NOTE:
See Sheet No. 1 of 8
For Soil Legend
And Soil Note

MATAGORDA SHIP CHANNEL, TEXAS

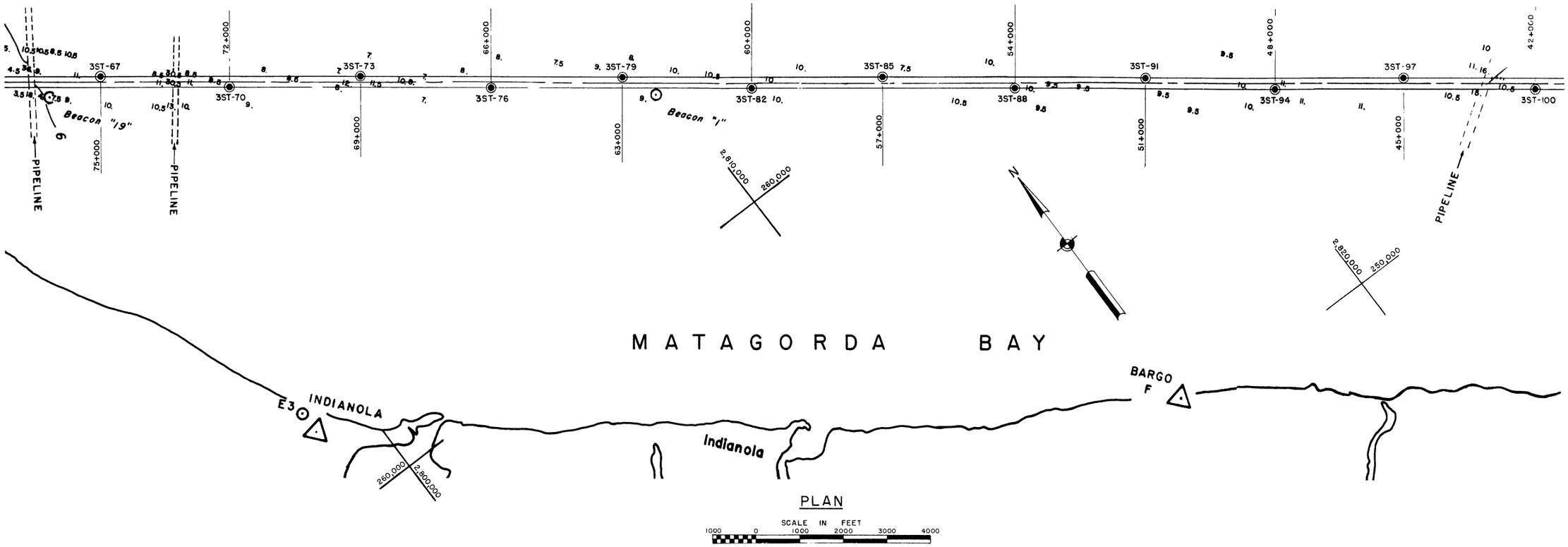
BORING LAYOUT AND SOIL PROFILE

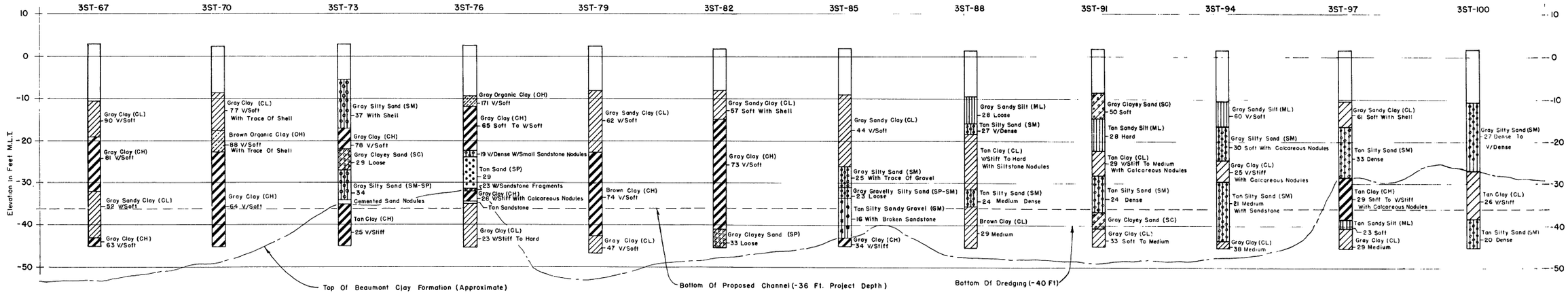
IN 8 SHEETS — SHEET NO. 2

U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS — JANUARY, 1962

TO ACCOMPANY GENERAL DESIGN MEMORANDUM
DATED: JANUARY 1962

EXHIBIT: 1 APPENDIX: B FILE NO. GUAD 705-112





PROFILE

SCALE AS SHOWN

NOTE:
See Sheet 1 of 8 for Soil Legend and Soil Note.

MATAGORDA SHIP CHANNEL, TEXAS

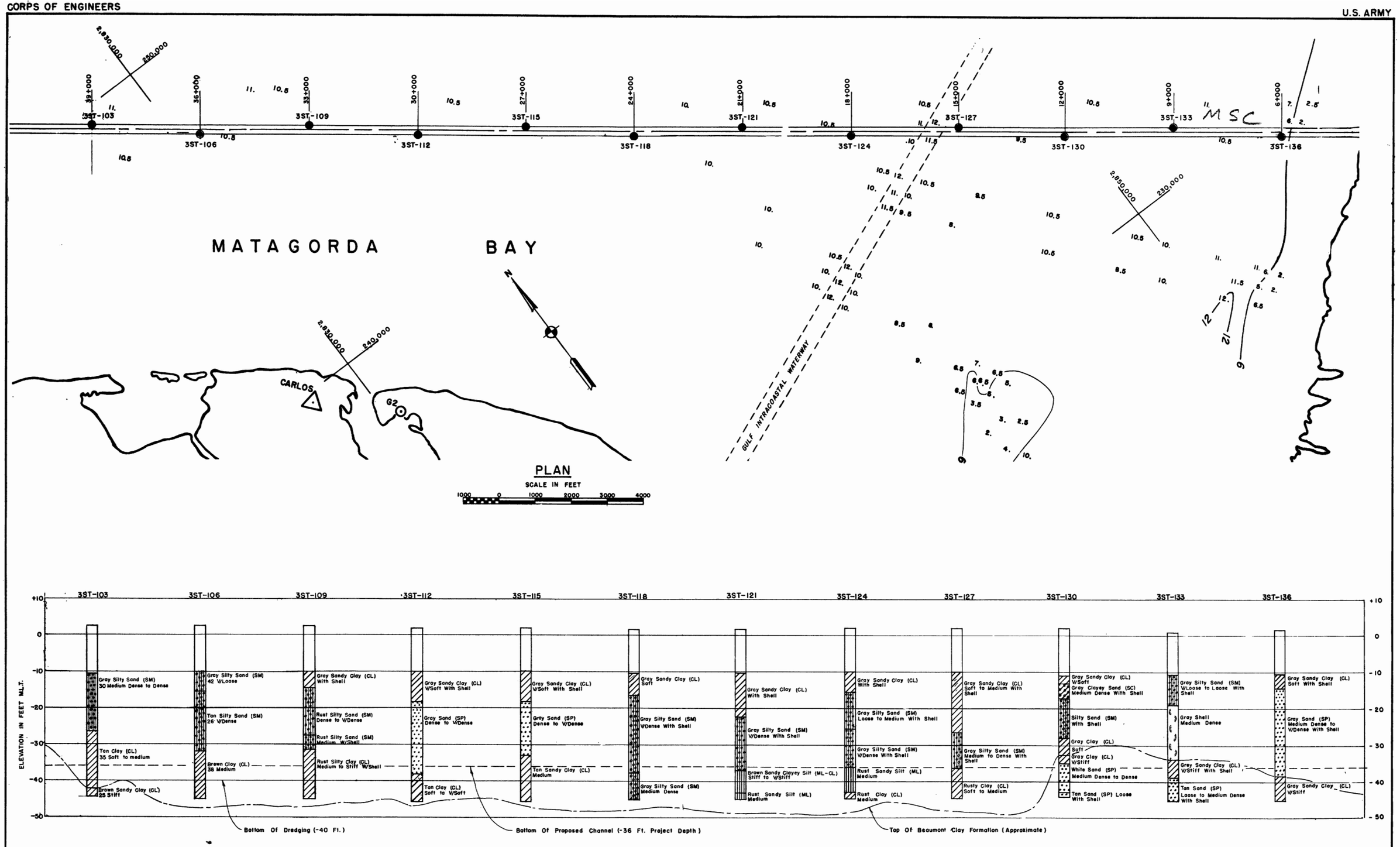
BORING LAYOUT AND SOIL PROFILE

IN 8 Sheets — Sheet No 3

U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS — JANUARY, 1962

TO ACCOMPANY GENERAL DESIGN MEMORANDUM
JANUARY 1962

EXHIBIT 1 — APPENDIX "B" — FILE NO. GUAD 705-112



PROFILE

SCALE AS SHOWN

Note:
See Sheet 1 of 8 for Soil Legend and Soil Note.

MATAGORDA SHIP CHANNEL, TEXAS

BORING LAYOUT AND SOIL PROFILE

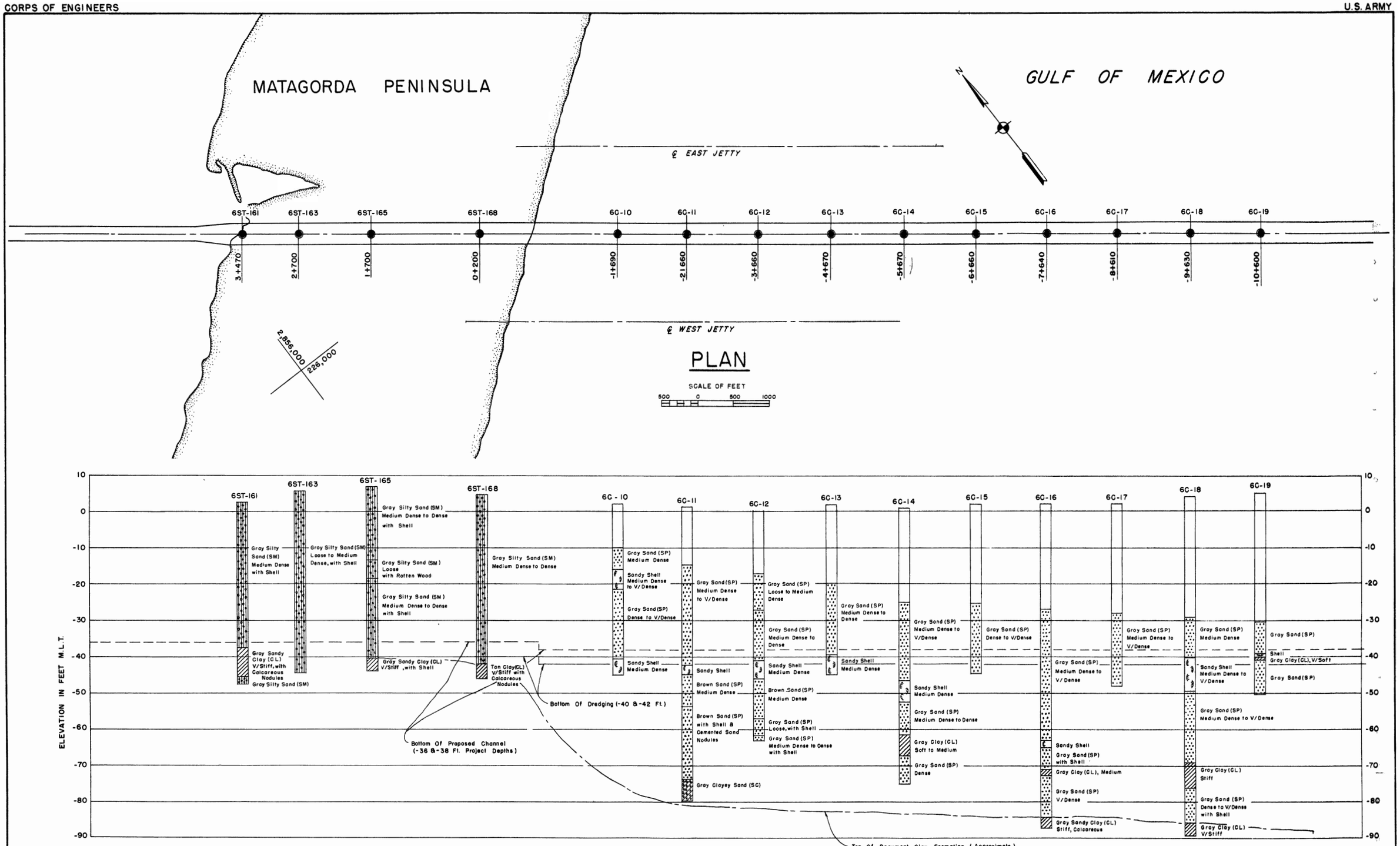
IN 8 SHEETS — SHEET NO. 4

U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS — JANUARY 1962

TO ACCOMPANY GENERAL DESIGN MEMORANDUM

DATED: JANUARY 1962

EXHIBIT: 1 — APPENDIX: B — FILE: GUAD. 705-112



PROFILE

SCALE AS SHOWN

Note:
See Sheet 1 of 8 for Soil Legend and Soil Note.

MATAGORDA SHIP CHANNEL, TEXAS

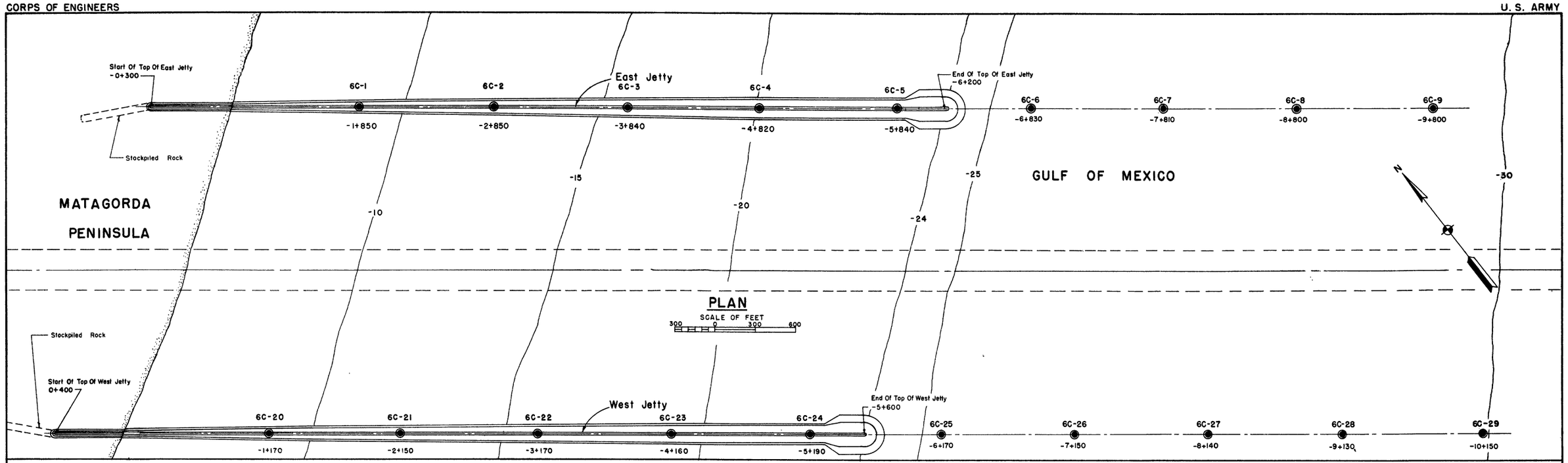
BORING LAYOUT AND SOIL PROFILE

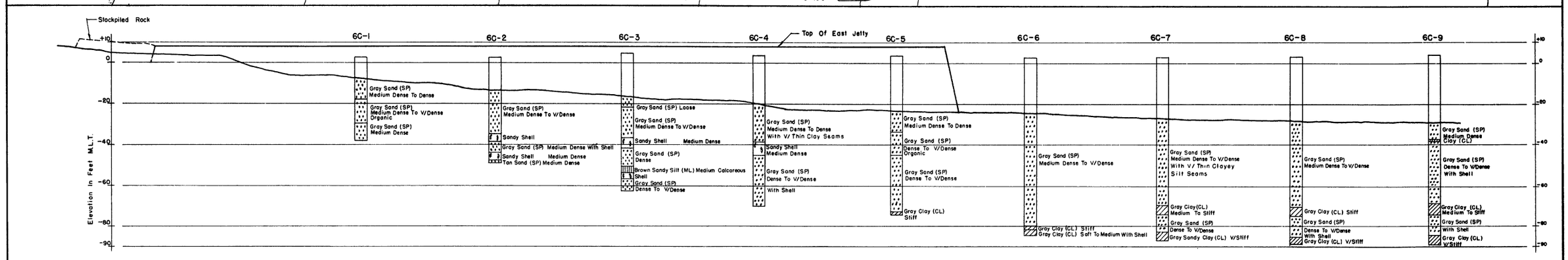
IN 8 SHEETS SHEET NO. 5

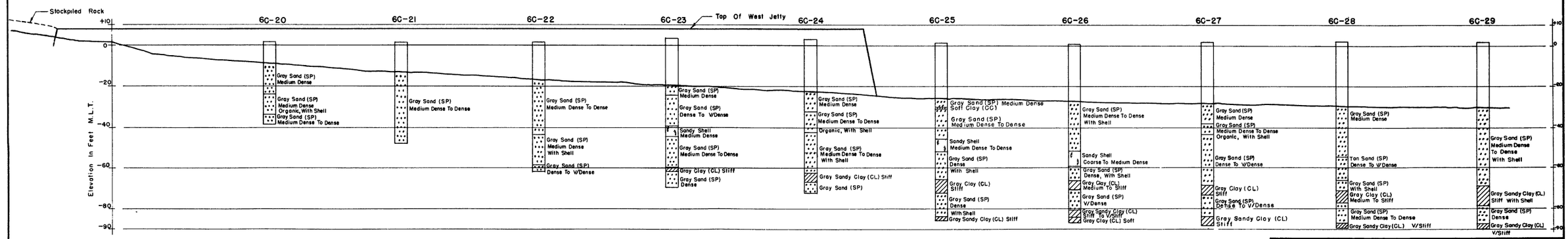
U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS JANUARY 1962

TO ACCOMPANY GENERAL DESIGN MEMORANDUM
DATED: JANUARY 1962

EXHIBIT: 1 APPENDIX: B FILE: GUAD. 705-112







PROFILE

SCALE AS SHOWN

NOTE:
See Sheet No. 1 of 8
For Soil Legend

MATAGORDA SHIP CHANNEL, TEXAS

BORING LAYOUT AND SOIL PROFILE

IN 8 SHEETS SHEET NO. 6

U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS JANUARY, 1962

TO ACCOMPANY GENERAL DESIGN MEMORANDUM
DATED: JANUARY 1962

EXHIBIT 1 APPENDIX B FILE NO. GUAD. 705-112

APPENDIX B
SEDIMENT ANALYTICAL RESULTS FROM ALCOA, 2005

Table 1 - Sample Stations and Sediment Descriptions

Station	Sample Id	Sample Interval (ft.)	Coordinates Easting[1]	Coordinates Northing[1]	Water Depth (ft.)[2]	Date	Time	Depth of Core (cm)	Comments/Descriptions
LNG0001	LNG-SE-08180	0-2	2751787.266	13426165.04	4.2	11/01/2005	13:46	40	0-5cm brown silty sand 5-35cm brown clayey sand 35-40cm orange brown clay Shell hash present in sample
LNG0002	LNG-SE-08181 LNG-SE-08182	0-2 2-4	2751187.481	13425639.26	7.2	11/01/2005	14:01	77	0-5cm brown sandy silt 5-18cm brown black silty sand 18-57cm brown gray sandy silt 57-77cm white orange clay Shell hash present in sample
LNG0003	LNG-SE-08183 LNG-SE-08184	0-2 2-4	2750383.241	13425059.11	6.4	11/01/2005	14:21	98	0-15cm brown silty sand 15-98cm gray silty clay
LNG0004	LNG-SE-08185	0-2	2749820.491	13424257.35	8.2	11/01/2005	14:42	35	0-2cm brown sandy silt 2-21cm gray silt 21-35cm gray white clay
LNG0005	LNG-SE-08188	0-2	2749380.310	13423395.294	8.3	11/02/2005	8:49	37	0-14cm brown sandy silt 14-37cm gray silty clay
LNG0006	LNG-SE-08189 LNG-SE-08190	0-2 2-4	2748892.326	13422308.528	7.7	11/02/2005	9:07	81	0-14cm brown sandy silt 14-61cm gray silt 61-81cm dark gray silty clay
LNG0007	LNG-SE-08191	0-2	2748896.715	13421466.660	6.8	11/02/2005	9:23	46	0-7cm brown sandy silt 7-40cm gray silt 40-46cm dark gray silty clay
LNG0008	LNG-SE-08192 LNG-SE-08193	0-2 2-4	2748899.864	13420479.786	7.1	11/02/2005	9:35	130	0-22cm brown sandy silt 22-114cm gray silt 114-130cm dark gray silty clay
LNG0009	LNG-SE-08194 LNG-SE-08195 LNG-SE-08196	0-2 2-4 4-6	2748908.469	13419459.832	6.9	11/02/2005	9:57	162	0-139cm gray silt 139-162cm dark gray silty clay
LNG0010	LNG-SE-08197 LNG-SE-08198	0-2 2-4	2748899.369	13418471.402	7.8	11/02/2005	10:12	81	0-47cm gray silt 47-81cm dark gray silty clay
LNG0011	LNG-SE-08199	0-2	2748881.285	13417136.202	6.7	11/02/2005	11:02	25	0-9cm gray sandy silt 9-25cm gray silty clay Station on reef, moved station 650ft North

[1]Coordinates reported in Nad 1983 Texas South Central Survey Feet
[2] Water depths are not related to MLT

Table 1 (Continued)- Sample Stations and Sediment Descriptions

Station	Sample Id	Sample Interval (ft.)	Coordinates Easting[1]	Coordinates Northing[1]	Water Depth (ft.)[2]	Date	Time	Depth of Core (cm)	Comments/Descriptions
LNG0012	LNG-SE-08200 LNG-SE-08201	0-2 2-4	2748868.066	13413410.853	7.0	11/02/2005	11:42	115	0-83cm gray silty sand with shell 83-115cm dark gray silty clay Station on reef, moved station 1000ft South
LNG0013	LNG-SE-08202	0-2	2748879.483	13412463.333	9.5	11/03/2005	11:30	71	0-4cm brown silt 4-66cm gray silt with shell hash 66-71cm gray silty clay
LNG0014	LNG-SE-08203 LNG-SE-08204	0-2 2-4	2748883.552	13410622.182	10.2	11/03/2005	11:55	121	0-4cm brown silt 4-117cm gray silt with shell hash 117-121cm gray silty clay Station on reef, moved station 128ft North Strong H2S odor in LNg-SE-08203
LNG0015	LNG-SE-08219 LNG-SE-08220	0-2 2-4	2749519.688	13424137.819	6.7	11/09/2005	10:12	97	0-5cm brown silt 5-34cm brown silty sand with shell hash 34-97cm gray silt
LNG0016	LNG-SE-08218	0-2	2749547.784	13424657.191	5.5	11/09/2005	10:01	83	0-3cm brown silt 3-21cm brown silty sand with shell 21-83cm gray silt
LNG0017	LNG-SE-08216 LNG-SE-08217	0-2 2-4	2749480.553	13425141.040	5.0	11/09/2005	9:52	84	0-5cm brown silt 5-23cm brown silty sand with shell hash 23-84cm brown gray silt
LNG0018	LNG-SE-08215	0-2	2749545.763	13425632.977	8.5	11/09/2005	9:44	55	0-11cm fine brown silt 11-32cm brown silty sand with shell hash 32-55cm brown silt
LNG0020	LNG-SE-08213 LNG-SE-08214	0-2 2-4	2750294.358	13425644.415	3.0	11/09/2005	9:21	120	0-2cm brown silt 2-18cm brown silty sand with shell hash 18-112cm brown silt 112-120cm brown gray silty clay
LNG0021	LNG-SE-08211 LNG-SE-08212	0-2 2-4	2750290.348	13425281.111	6.3	11/09/2005	9:31	73	0-5cm brown silt 5-73cm brown gray silt
LNG0023	LNG-SE-08210	0-2	2751021.907	13425888.714	3.1	11/09/2005	9:10	58	0-10cm brown silty sand with shell hash 10-58cm brown gray silt

[1]Coordinates reported in Nad 1983 Texas South Central Survey Feet
[2] Water depths are not related to MLT

Table 1 (Continued)- Sample Stations and Sediment Descriptions

Station	Sample Id	Sample Interval (ft.)	Coordinates Easting[1]	Coordinates Northing[1]	Water Depth (ft.)[2]	Date	Time	Depth of Core (cm)	Comments/Descriptions
LNG0024	LNG-SE-08208 LNG-SE-08209	0-2 2-4	2751431.139	13426127.140	3.1	11/09/2005	9:02	99	0-3cm brown silt 3-17cm brown silty sand with shell hash 17-99cm brown gray silt Station on reef, moved station North
LNG0025	LNG-SE-08206 LNG-SE-08207	0-2 2-4	2751786.289	13426411.312	2.0	11/09/2005	8:45	86	0-82cm brown silty sand with shell hash 82-86cm orange clay

[1]Coordinates reported in Nad 1983 Texas South Central Survey Feet
[2] Water depths are not related to MLT

Table 2- Total Mercury Analytical Results

Sample Station	Sample ID	Date	Time	Sample Matrix	Sample Interval (ft)	Total Hg (mg/kg) Dry Weight	% Moisture	Report Limit (mg/kg)	Flags
LNG0001	LNG-SE-08180	11/01/2005	13:46	Sediment	0.0 - 1.4	0.0142	28.2	0.0674	J[2,3]
LNG0002	LNG-SE-08181	11/01/2005	14:01	Sediment	0.0 - 2.0	0.0206	30.6	0.0674	J[2,3]
LNG0002	LNG-SE-08182	11/01/2005	14:01	Sediment	2.0 - 2.5	0.0083	25.5	0.0639	J[2,3]
LNG0003	LNG-SE-08183	11/01/2005	14:21	Sediment	0.0 - 2.0	0.1210	36.7	0.0741	J[2]
LNG0003	LNG-SE-08184	11/01/2005	14:21	Sediment	2.0 - 3.2	0.0140	42.0	0.0772	J[2,3]
LNG0004	LNG-SE-08185	11/01/2005	14:42	Sediment	0.0 - 1.1	0.0086	29.7	0.0677	J[2,3]
LNG0005	LNG-SE-08188	11/02/2005	8:49	Sediment	0.0 - 1.2	0.0399	32.6	0.0706	J[2,3]
LNG0006	LNG-SE-08189	11/02/2005	9:07	Sediment	0.0 - 2.0	0.0982	43.4	0.0841	J[2]
LNG0006	LNG-SE-08190	11/02/2005	9:07	Sediment	2.0 - 2.7	0.0057	30.3	0.0662	J[2,3]
LNG0007	LNG-SE-08191	11/02/2005	9:23	Sediment	0.0 - 1.5	0.0883	47.3	0.0933	J[2,3]
LNG0008	LNG-SE-08192	11/02/2005	9:35	Sediment	0.0 - 2.0	0.1650	48.8	0.0945	J[2]
LNG0008	LNG-SE-08193	11/02/2005	9:35	Sediment	2.0 - 4.3	0.0052	32.7	0.0743	J[2,3]
LNG0009	LNG-SE-08194	11/02/2005	9:57	Sediment	0.0 - 2.0	0.215	55.4	0.1080	J[2]
LNG0009	LNG-SE-08195	11/02/2005	9:57	Sediment	2.0 - 4.0	0.0090	33.3	0.0725	J[2,3]
LNG0009	LNG-SE-08196	11/02/2005	9:57	Sediment	4.0 - 5.3	0.0042	27.5	0.0627	J[2,3]
LNG0010	LNG-SE-08197	11/02/2005	10:12	Sediment	0.0 - 2.0	0.109	49.6	0.0976	J[2]
LNG0010	LNG-SE-08198	11/02/2005	10:12	Sediment	2.0 - 2.7	0.0024	27.9	0.0694	J[2,3]
LNG0011	LNG-SE-08199	11/02/2005	11:02	Sediment	0.0 - 0.8	0.0709	36.4	0.0761	J[2,3]
LNG0012	LNG-SE-08200	11/02/2005	11:42	Sediment	0.0 - 2.0	0.147	53.3	0.0959	J[2]
LNG0012	LNG-SE-08200[4]	11/02/2005	11:42	Sediment	0.0 - 2.0	0.118	53.7	0.1060	J[2]
LNG0012	LNG-SE-08201	11/02/2005	11:42	Sediment	2.0 - 3.8	0.0197	51.9	0.1040	J[2,3]
LNG0013	LNG-SE-08202	11/03/2005	11:30	Sediment	0.0 - 2.3	0.175	55.4	0.1050	J[2]
LNG0014	LNG-SE-08203	11/03/2005	11:55	Sediment	0.0 - 2.0	0.324	57.9	0.1130	J[1]
LNG0014	LNG-SE-08203[4]	11/03/2005	11:55	Sediment	0.0 - 2.0	0.223	56.6	0.1150	J[1]
LNG0014	LNG-SE-08204	11/03/2005	11:55	Sediment	2.0 - 4.0	0.0183	46.7	0.0922	J[3]
LNG0025	LNG-SE-08206	11/09/2005	08:45	Sediment	0.0 - 2.0	0.0404	18.9	0.0560	J[3]
LNG0025	LNG-SE-08207	11/09/2005	08:45	Sediment	2.0 - 2.8	0.0319	20.2	0.0627	J[3]

Table 2- Total Mercury Analytical Results

Sample Station	Sample ID	Date	Time	Sample Matrix	Sample Interval (ft)	Total Hg (ug/kg) Dry Weight	% Moisture	Report Limit (ug/kg)	Flags
LNG0024	LNG-SE-08208	11/09/2005	09:02	Sediment	0.0 - 2.0	0.0525	33.0	0.0688	J[3]
LNG0024	LNG-SE-08209	11/09/2005	09:02	Sediment	2.0 - 3.2	0.0209	30.7	0.0677	U,J[3]
LNG0023	LNG-SE-08210	11/09/2005	09:10	Sediment	0.0 - 1.9	0.0487	42.2	0.0838	J[3]
LNG0021	LNG-SE-08211	11/09/2005	09:31	Sediment	0.0 - 2.0	0.0658	34.2	0.0724	J[3]
LNG0021	LNG-SE-08212	11/09/2005	09:31	Sediment	2.0 - 2.4	0.0136	24.8	0.0643	U,J[3]
LNG0020	LNG-SE-08213	11/09/2005	09:21	Sediment	0.0 - 2.0	0.0571	35.5	0.0750	J[3]
LNG0020	LNG-SE-08213	11/09/2005	09:21	Sediment	2.0 - 3.9	0.0164	38.6	0.0801	J[3]
LNG0018	LNG-SE-08214	11/09/2005	09:44	Sediment	0.0 - 1.8	0.543	32.2	0.0726	U
LNG0017	LNG-SE-08216	11/09/2005	09:52	Sediment	0.0 - 2.0	0.0550	33.0	0.0746	J[3]
LNG0017	LNG-SE-08217	11/09/2005	09:52	Sediment	2.0 - 2.8	0.0205	35.1	0.0734	J[3]
LNG0016	LNG-SE-08218	11/09/2005	10:01	Sediment	0.0 - 2.7	0.502	38.5	0.0762	
LNG0015	LNG-SE-08219	11/09/2005	10:12	Sediment	0.0 - 2.0	0.260	46.9	0.0856	
LNG0015	LNG-SE-08220	11/09/2005	10:12	Sediment	2.0 - 3.2	0.0378	33.8	0.0686	J[3]

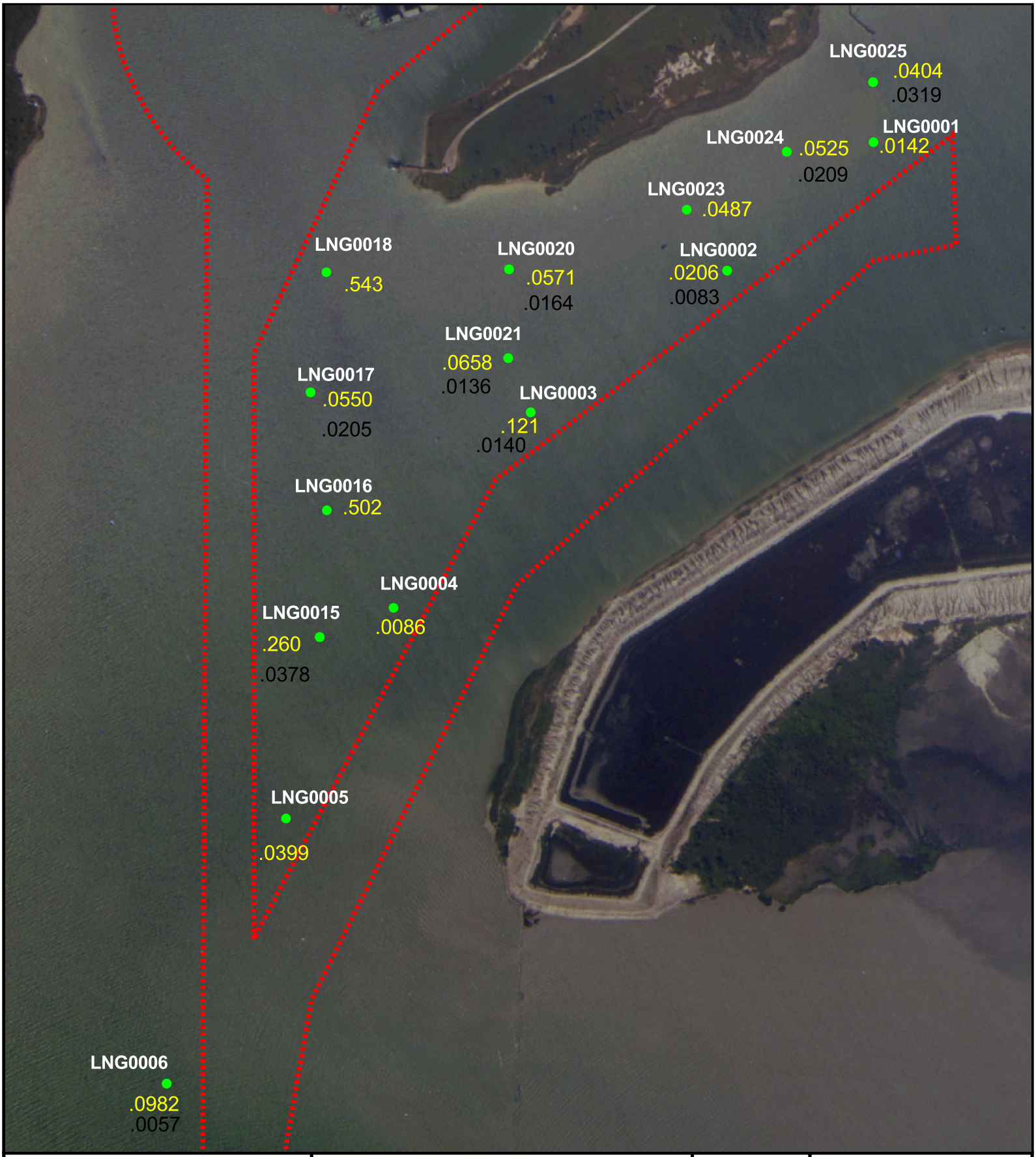
J[1] - Serial Dilution % Difference for Batch Was >10% (16%)

J[2] - Field Duplicate RPD >20%

J[3] - Analyte detected below Report Limit

U - Associated blank contained mercury

[4] - Duplicate Sample



N

400 0 400 Feet

Legend

- Sample Stations
- ### Sample Station IDs
- ### Total Hg Concentration (mg/kg) for 0-2' cut
- ### Total Hg Concentration (mg/kg) for 2'-4' cut
- ### Total Hg Concentration (mg/kg) for 4'-6' cut
- Matagorda Ship Channel

Notes

Alcoa 2005 Aerial Photograph

Turning Basin and Matagorda Ship Channel Widening and Deepening Sediment Study

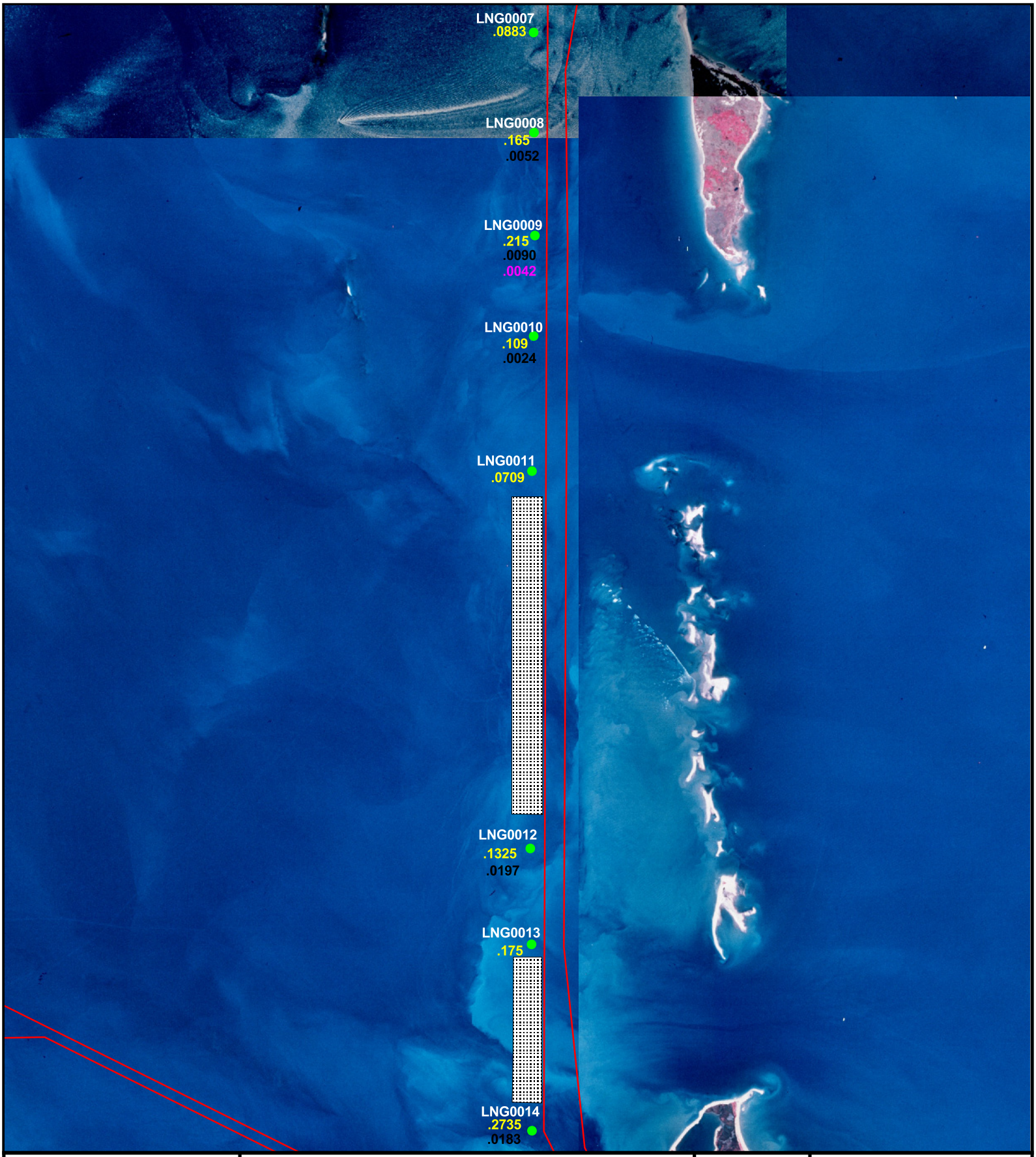
ALCOA Point Comfort Operations

BESI Benchmark Ecological Services, Inc.

Project Name: lng_terminal_2.apr

Date: 01/07/2006

Figure 1



N

500 0 500 1000 Feet

Legend

- Sample Stations
- ### Sample Station IDs
- ### Total Hg Concentration (mg/kg) for 0-2' cut
- ### Total Hg Concentration (mg/kg) for 2'-4' cut
- ### Total Hg Concentration (mg/kg) for 4'-6' cut
- Matagorda Ship Channel
- Shell/Oyster Reef on the Surface of the Sediment

Notes

TNRIS 1995 DOQQs
2896281a.sid,
2896282a.sid,
2896203a.sid,
2896204a.sid

Turning Basin and Matagorda Ship Channel Widening and Deepening Sediment Study

ALCOA Point Comfort Operations

BESI Benchmark Ecological Services, Inc.

Project Name: lng_terminal_2.apr

Date: 01/07/2006

Figure 2

APPENDIX C
COST ESTIMATES

URS

Matagorda Ship Channel Improvement Project
Cost Estimate Basis and Assumptions

A. General
- No engineering or construction management costs are included in the estimates. They should be approximately the same for all the alternatives.
- No associated costs were included because they were included because they would be the same for all the alternatives

B. Upland Confined Placement Alternative
- Cost for Land Acquisition: $3000/acre
- Total Acres: 3,888
- Dredging costs alone are significantly higher than other options. Thus, estimate did not include related costs of levee construction or dredge pipelines.

C. Gulf Unconfined Placement Alternative
- Costs were based on type of material to be dredged (sand, soft clay, or stiff clay), equipment, and distance to offshore placement area. A clamshell supported with dump scow was used for the soft clay, while a hopper dredge was used for the remainder of the material.

D. Muli-use Placement Alternatives
- Mobilization, dredge pipeline, and environmental protection cost we assumed to be equivalent for all the projects because they are similar in nature.

Matagorda Ship Channel Improvement Project
New Work Cost Estimates

Matagorda Ship Channel Improvement Project
New Work Costs for Upland and Offshore Alternative

Upland Costs		Costs
Land Acquisition		
Cost/Acre		$3,000
Acres		3888
Subtotal		**$11,664,000**
Dredging		
Quantity (CY)		46,500,000
Average Dredging Cost	$	6.38
Subtotal	**$**	**296,516,000.00**
Total	**$**	**308,180,000.00**

Offshore Costs		Costs
Sand		
Quantity (CY)		16,900,000
Average Dredging Cost	$	3.20
Subtotal	**$**	**54,118,000.00**
Stiff Clay		
Quantity (CY)		10,000,000
Average Dredging Cost	$	16.12
Subtotal	**$**	**161,164,000.00**
Soft Clay		
Quantity (CY)		19,600,000
Average Dredging Cost	$	5.01
Subtotal	**$**	**98,190,000.00**
Total		**$313,472,000.00**

MSCIP - Alternative 1A Summary	
Placement Area	**Cost**
A1	$24,279,920
A2	$21,962,368
BN1, BN2, BN3	$12,048,480
C2	
D	$9,886,535
ER1	$3,241,837
ER2	$11,919,891
ER3	$15,229,598
G w/Levee	$30,192,361
H4 Habitat Area	
H2	$37,576,076
H4	$65,305,467
O5	$12,663,700
OR1 and OR2	$9,437,523
P1	$6,171,136
Subtotal	**$259,914,890**
Other Related Costs	
Mob & Demob(Includes Dredge Pipeline Costs)	$9,127,000
Oyster Mitigation	see OR1, OR2 & ER1
Environmental Protection	$500,000
Subtotal	**$9,627,000**
Total	**$269,541,890**

MSCIP NEW WORK COSTS - ALTERNATIVE 1A

MSCIP NEW WORK COSTS - Other Related Costs

ITEM NO.	Placement Area	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
1	Environmental Protection	1.00	LS	*$500,000.00* $500,000	$0	$0	$0	$500,000
MOB/DEMOB(Includes Dredge Pipeline Costs)								
1	Cutter Head Pipline Dredge Mob/Demob	2.00	LS	*$2,504,000.00* $5,008,000	$0	$0	$0	$5,008,000
2	Hopper Dredge Mob/Demob	1.00	LS	*$1,220,440* $1,220,440	$0	$0	$0	$1,220,440
3	Clamshell Dredge Mob/Demob	1.00	LS	*$2,898,560* $2,898,560	$0	$0	$0	$2,898,560
	SUBTOTAL							**$9,627,000**

MSCIP NEW WORK COSTS - LAVACA BAY

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	OYSTER REEF AREA (OR1 and OR2)							
1	Dredging for Oyster Fill	971,000.00	CY	*$4.58* $4,447,180	$0	$0	$0	$4,447,180
2	Crushed Limestone	124,759	TON	*$40.00* $4,990,343	$0	$0	$0	$4,990,343
	SUBTOTAL OYSTER							**$9,437,523**
	"A1" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,260,000.00	CY	*$1.92* $2,419,200	$0	$0	$0	$2,419,200
3	Dredging for Exterior Levee Construction	2,000,000.00	CY	*$4.81* $9,620,000	$0	$0	$0	$9,620,000
4	Mechanical Levee Construction	0.00	CY	*$4.74* $0	$0	$0	$0	$0
5	Hydraulically Constructed Exterior Levees	14,759	LF	*$373.51* $5,512,634	$0	$0	$0	$5,512,634
6	Stone Shore Protection	107,040.00	TONS	*$60.00* $6,422,400	$0	$0	$0	$6,422,400
7	Seeding	23.00	ACRE	*$200.00* $4,600	$0	$0	$0	$4,600
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "A1"							**$24,279,920**
	"A2" AREA							
1	Dredging for Marsh Fill	1,461,000.00	CY	*$4.37* $6,384,570	$0	$0	$0	$6,384,570
2	Dredging for Upland Fill	3,999,000.00	CY	*$1.93* $7,718,070	$0	$0	$0	$7,718,070
3	Dredging for Exterior Levee Construction	800,000.00	CY	*$3.79* $3,032,000	$0	$0	$0	$3,032,000
4	Hydraulically Constructed Exterior Levees	14,789	LF	*$92.88* $1,373,602	$0	$0	$0	$1,373,602
5	Stone Shore Protection	47,460.66	TONS	*$60.00* $2,847,640	$0	$0	$0	$2,847,640
6	Seeding	27.00	ACRE	*$200* $5,400	$0	$0	$0	$5,400
7	Planting (Marsh)	60.00	ACRE	*$5,000.00* $300,000	$0	$0	$0	$300,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "A2"							**$21,962,368**
	"ER1" AREA							
1	Dredging for Oyster Fill	400,000.00	CY	*$4.76* $1,904,000	$0	$0	$0	$1,904,000
7	Crushed Limestone	33,445.91	TON	*$40* $1,337,837	$0	$0	$0	$1,337,837
	SUBTOTAL "ER1"							**$3,241,837**

MSCIP NEW WORK COSTS - LAVACA BAY (continued)

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	"ER2" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* 0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,000,000.00	CY	*$2.83* $2,830,000	$0	$0	$0	$2,830,000
3	Dredging for Exterior Levee Construction	1,063,000.00	CY	*$4.77* $5,070,510	$0	$0	$0	$5,070,510
4	Hydraulically Constructed Exterior Levees	9,520	LF	*$242.88* $2,312,218	$0	$0	$0	$2,312,218
5	Stone Shore Protection	25,027.00	TONS	*$60.00* $1,501,620	$0	$0	$0	$1,501,620
6	Seeding	20.00	ACRE	*$200.00* $4,000	$0	$0	$0	$4,000
7	Planting (Marsh)	10.20	ACRE	*$5,000.00* $51,000	$0	$0	$0	$51,000
8	Drop Outlet Structures	1.00	EA	*$150,543.00* $150,543	$0	$0	$0	$150,543
	SUBTOTAL "ER2"							**$11,919,891**
	"ER3" AREA							
1	Dredging for Marsh Fill	200,000.00	CY	*$4.32* $864,000	$0	$0	$0	$864,000
2	Dredging for Upland Fill	926,000.00	CY	*$2.15* $1,990,900	$0	$0	$0	$1,990,900
3	Dredging for Exterior Levee Construction	1,200,000.00	CY	*$4.64* $5,568,000	$0	$0	$0	$5,568,000
4	Hydraulically Constructed Exterior Levees	12,511	LF	*$242.88* $3,038,672	$0	$0	$0	$3,038,672
5	Bulkhead	4,000.00	LF	*$500.00* $2,000,000.00				$2,000,000
6	Stone Shore Protection	20,554.00	TONS	*$60.00* $1,233,240	$0	$0	$0	$1,233,240
7	Seeding	11.00	ACRE	*$200.00* $2,200	$0	$0	$0	$2,200
8	Planting (Marsh)	46.30	ACRE	*$5,000.00* $231,500	$0	$0	$0	$231,500
9	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "ER3"							**$15,229,598**
	"D" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,116,000.00	CY	*$2.09* $2,332,440	$0	$0	$0	$2,332,440
3	Dredging for Exterior Levee Construction	500,000.00	CY	*$4.94* $2,470,000	$0	$0	$0	$2,470,000
4	Hydraulically Constructed Exterior Levees	6,967	LF	*$217.01* $1,511,909	$0	$0	$0	$1,511,909
5	Stone Shore Protection	53,315.00	TONS	*$60.00* $3,198,900	$0	$0	$0	$3,198,900
6	Seeding	6.00	ACRE	*$200.00* $1,200	$0	$0	$0	$1,200
7	Planting (Marsh)	14.20	ACRE	*$5,000.00* $71,000	$0	$0	$0	$71,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "D"							**$9,886,535**
	"P1" Area							
1	Dredging for Upland Fill	1,082,000.00	CY	*$2.35* $2,542,700	$0	$0	$0	$2,542,700
2	Land Acquisition	700.00	ACRE	*$3,000.00* $2,100,000.00	$0	$0	$0	$2,100,000
3	Mechanical Levee Construction (Inland)	300,000	CY	*$4.00* $1,200,000	$0	$0	$0	$1,200,000
4	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
5	Ditch Drainage Improvements	19,500.00	LF	$0.50 $9,750	$0	$0	$0	$9,750
6	Seeding	88.00	ACRE	$200.00 $17,600.00	$0	$0	$0	$17,600
	SUBTOTAL "P1"							**$6,171,136**
TOTAL "LAVACA BAY"								**$102,128,806**

MSCIP NEW WORK COSTS - MATAGORDA BAY

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	Beach Nourishment "BN1, BN2, BN3"							
1	Dredging for Beach Nourishment	1,884,000.00	CY	*$3.47* $6,537,480	$0	$0	$0	$6,537,480
2	Grading and Shaping	1,884,000.00	CY	*$1.00* $1,884,000	$0	$0	$0	$1,884,000
3	Rock Groins	6,000.00	LF	$604.50 $3,627,000	$0	$0	$0	$3,627,000
	SUBTOTAL "BN"							**$12,048,480**
	"G" Area							
1	Dredging for Marsh Fill	2,063,000.00	CY	*$1.92* $3,960,960	$0	$0	$0	$3,960,960
2	Dredging for Upland Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
3	Dredging for Exterior Levee Construction	2,595,000.00	CY	*$3.89* $10,094,550	$0	$0	$0	$10,094,550
4	Hydraulically Constructed Exterior Levees	18,081	LF	*$173.39* $3,135,065	$0	$0	$0	$3,135,065
5	Mechanical Levee Construction	0.00	CY	*$4.74* $0	$0	$0	$0	$0
6	Stone Shore Protection	88,707.00	TONS	*$60.00* $5,322,420	$0	$0	$0	$5,322,420
7	Planting (Marsh)	160.00	ACRE	*$5,000.00* $800,000	$0	$0	$0	$800,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "G"							**$23,614,081**
	G Levee							
1	Mechanical Levee Construction	450,000.00	CY	*$4.74* $2,133,000	$0	$0	$0	$2,133,000
2	Stone Shore Protection	74,088.00	TONS	*$60.00* $4,445,280	$0	$0	$0	$4,445,280
	SUBTOTAL "G-BN"							**$6,578,280**
	"H2" Area							
1	Dredging for Sand Platform	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	2,804,000.00	CY	*$2.54* $7,122,160	$0	$0	$0	$7,122,160
3	Dredging for Exterior Levee Construction	1,338,000.00	CY	*$4.68* $6,261,840	$0	$0	$0	$6,261,840
4	Hydraulically Constructed Exterior Levees	22,320	LF	*$98.95* $2,208,564	$0	$0	$0	$2,208,564
5	Mechanical Levee Construction	1,800,000.00	CY	*$4.74* $8,532,000	$0	$0	$0	$8,532,000
6	Stone Shore Protection	214,089.00	TONS	*$60.00* $12,845,340	$0	$0	$0	$12,845,340
7	Seeding	20.00	ACRE	$200.00 $4,000	$0	$0	$0	$4,000
8	Drop Outlet Structures	4.00	EA	*$150,543.00* $602,172	$0	$0	$0	$602,172
	SUBTOTAL "H"							**$37,576,076**
	"H4" Area							
1	Dredging for Sand Platform	2,559,000.00	CY	*$2.90* $7,421,100	$0	$0	$0	$7,421,100
2	Dredging for Upland Fill	5,963,000.00	CY	*$2.23* $13,317,500	$0	$0	$0	$13,317,500
3	Dredging for Exterior Levee Construction	6,140,526.00	CY	*$4.68* $28,749,415	$0	$0	$0	$28,749,415
4	Hydraulically Constructed Exterior Levees	24,381	LF	*$98.95* $2,412,500	$0	$0	$0	$2,412,500
5	Mechanical Levee Construction	300,000.00	CY	*$4.74* $1,422,000	$0	$0	$0	$1,422,000
6	Stone Shore Protection	137,338.00	TONS	*$60.00* $8,240,280	$0	$0	$0	$8,240,280
7	Seeding	59.00	ACRE	$2,000.00 $118,000	$0	$0	$0	$118,000
8	Rock Groins and Breakwaters	6,000.00	LF	$503.75 $3,022,500	$0	$0	$0	$3,022,500
9	Drop Outlet Structures	4.00	EA	*$150,543.00* $602,172	$0	$0	$0	$602,172
	SUBTOTAL "H"							**$65,305,467**
TOTAL "MATAGORDA BAY"								**$145,122,384**

MSCIP NEW WORK COSTS - OFFSHORE

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	"O5" Area							
				$3.95				
2	Offshore (Hopper)	3,206,000.00	CY	$12,663,700.00	$0	$0	$0	$12,663,700
	SUBTOTAL "O5"							**$12,663,700**
TOTAL "OFFSHORE"								**$12,663,700**

MSCIP - Alternative 1B Summary	
Placement Area	**Cost**
A1	$24,279,920
A2	$21,962,368
BN1, BN2, BN3	$12,048,480
C2	$28,735,590
D	$9,886,535
ER1	$3,241,837
ER2	$11,919,891
ER3	$15,229,598
G w/Levee	$30,192,361
H4 Habitat Area	
H2	$37,576,076
H4	$65,305,467
O5	$12,663,700
Oyster Mitigation	$18,800,000
P1	
Subtotal	**$291,841,821**
Other Related Costs	
Mob & Demob(Includes Dredge Pipeline Costs)	$9,127,000
Environmental Protection	$500,000
Subtotal	**$9,627,000**
Total	**$301,468,821**

MSCIP NEW WORK COSTS - ALTERNATIVE 1B

MSCIP NEW WORK COSTS - Other Related Costs

ITEM NO.	Placement Area	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
1	Environmental Protection	1.00	LS	*$500,000.00* $500,000	$0	$0	$0	$500,000
MOB/DEMOB(Includes Dredge Pipeline Costs)								
1	Cutter Head Pipeline Dredge Mob/Demob	2.00	LS	*$2,504,000.00* $5,008,000	$0	$0	$0	$5,008,000
2	Hopper Dredge Mob/Demob	1.00	LS	*$1,220,440* $1,220,440	$0	$0	$0	$1,220,440
3	Clamshell Dredge Mob/Demob	1.00	LS	*$2,898,560* $2,898,560	$0	$0	$0	$2,898,560
	SUBTOTAL							**$9,627,000**

MSCIP NEW WORK COSTS - LAVACA BAY

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	OYSTER MITIGATION							
1	Dredging for Oyster Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Gravel	470,000	TON	*$40.00* $18,800,000	$0	$0	$0	$18,800,000
	SUBTOTAL OYSTER							**$18,800,000**
	"A1" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,260,000.00	CY	*$1.92* $2,419,200	$0	$0	$0	$2,419,200
3	Dredging for Exterior Levee Construction	2,000,000.00	CY	*$4.81* $9,620,000	$0	$0	$0	$9,620,000
4	Mechanical Levee Construction	0.00	CY	*$4.74* $0	$0	$0	$0	$0
5	Hydraulically Constructed Exterior Levees	14,759	LF	*$373.51* $5,512,634	$0	$0	$0	$5,512,634
6	Stone Shore Protection	107,040.00	TONS	*$60.00* $6,422,400	$0	$0	$0	$6,422,400
7	Seeding	23.00	ACRE	*$200.00* $4,600	$0	$0	$0	$4,600
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "A1"							**$24,279,920**
	"A2" AREA							
1	Dredging for Marsh Fill	1,461,000.00	CY	*$4.37* $6,384,570	$0	$0	$0	$6,384,570
2	Dredging for Upland Fill	3,999,000.00	CY	*$1.93* $7,718,070	$0	$0	$0	$7,718,070
3	Dredging for Exterior Levee Construction	800,000.00	CY	*$3.79* $3,032,000	$0	$0	$0	$3,032,000
4	Hydraulically Constructed Exterior Levees	14,789	LF	*$92.88* $1,373,602	$0	$0	$0	$1,373,602
5	Stone Shore Protection	47,460.66	TONS	*$60.00* $2,847,640	$0	$0	$0	$2,847,640
6	Seeding	27.00	ACRE	*$200* $5,400	$0	$0	$0	$5,400
7	Planting (Marsh)	60.00	ACRE	*$5,000.00* $300,000	$0	$0	$0	$300,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "A2"							**$21,962,368**
	"ER1" AREA							
1	Dredging for Oyster Fill	400,000.00	CY	*$4.76* $1,904,000	$0	$0	$0	$1,904,000
7	Gravel	33,445.91	TON	*$40* $1,337,837	$0	$0	$0	$1,337,837
	SUBTOTAL "ER1"							**$3,241,837**

MSCIP NEW WORK COSTS - LAVACA BAY (continued)

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	"ER2" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,000,000.00	CY	*$2.83* $2,830,000	$0	$0	$0	$2,830,000
3	Dredging for Exterior Levee Construction	1,063,000.00	CY	*$4.77* $5,070,510	$0	$0	$0	$5,070,510
4	Hydraulically Constructed Exterior Levees	9,520	LF	*$242.88* $2,312,218	$0	$0	$0	$2,312,218
5	Stone Shore Protection	25,027.00	TONS	*$60.00* $1,501,620	$0	$0	$0	$1,501,620
6	Seeding	20.00	ACRE	*$200.00* $4,000	$0	$0	$0	$4,000
7	Planting (Marsh)	10.20	ACRE	*$5,000.00* $51,000	$0	$0	$0	$51,000
8	Drop Outlet Structures	1.00	EA	*$150,543.00* $150,543	$0	$0	$0	$150,543
	SUBTOTAL "ER2"							**$11,919,891**
	"ER3" AREA							
1	Dredging for Marsh Fill	200,000.00	CY	*$4.32* $864,000	$0	$0	$0	$864,000
2	Dredging for Upland Fill	926,000.00	CY	*$2.15* $1,990,900	$0	$0	$0	$1,990,900
3	Dredging for Exterior Levee Construction	1,200,000.00	CY	*$4.64* $5,568,000	$0	$0	$0	$5,568,000
4	Hydraulically Constructed Exterior Levees	12,511	LF	*$242.88* $3,038,672	$0	$0	$0	$3,038,672
5	Bulkhead	4,000.00	LF	*$500.00* $2,000,000.00				$2,000,000
6	Stone Shore Protection	20,554.00	TONS	*$60.00* $1,233,240	$0	$0	$0	$1,233,240
7	Seeding	11.00	ACRE	*$200.00* $2,200	$0	$0	$0	$2,200
8	Planting (Marsh)	46.30	ACRE	*$5,000.00* $231,500	$0	$0	$0	$231,500
9	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "ER3"							**$15,229,598**
	"D" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,116,000.00	CY	*$2.09* $2,332,440	$0	$0	$0	$2,332,440
3	Dredging for Exterior Levee Construction	500,000.00	CY	*$4.94* $2,470,000	$0	$0	$0	$2,470,000
4	Hydraulically Constructed Exterior Levees	6,967	LF	*$217.01* $1,511,909	$0	$0	$0	$1,511,909
5	Stone Shore Protection	53,315.00	TONS	*$60.00* $3,198,900	$0	$0	$0	$3,198,900
6	Seeding	6.00	ACRE	*$200.00* $1,200	$0	$0	$0	$1,200
7	Planting (Marsh)	14.20	ACRE	*$5,000.00* $71,000	$0	$0	$0	$71,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "D"							**$9,886,535**
	"C2" Area							
1	Dredging for Upland Fill	1,082,000.00	CY	*$3.19* $3,451,580	$0	$0	$0	$3,451,580
2	Dredging for Exterior Levee Construction	971,000.00	CY	*$3.89* $3,777,190	$0	$0	$0	$3,777,190
3	Hydraulically Constructed Exterior Levees	25,584	LF	*$242.88* $6,213,842	$0	$0	$0	$6,213,842
4	Stone Shore Protection	91,571.53	TONS	*$60.00* $5,494,292	$0	$0	$0	$5,494,292
5	Mechanical Levee Construction	2,000,000.00	CY	*$4.74* $9,480,000	$0	$0	$0	$9,480,000
6	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086.00	$0	$0	$0	$301,086
7	Seeding	88.00	ACRE	$200.00 $17,600.00	$0	$0	$0	$17,600
	SUBTOTAL "P1"							**$28,735,590**
TOTAL "LAVACA BAY"								**$134,055,737**

MSCIP NEW WORK COSTS - MATAGORDA BAY

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	Beach Nourishment "BN1, BN2, BN3"							
1	Dredging for Beach Nourishment	1,884,000.00	CY	*$3.47* $6,537,480	$0	$0	$0	$6,537,480
2	Grading and Shaping	1,884,000.00	CY	*$1.00* $1,884,000	$0	$0	$0	$1,884,000
3	Rock Groins	6,000.00	LF	$604.50 $3,627,000	$0	$0	$0	$3,627,000
	SUBTOTAL "BN"							**$12,048,480**
	"G" Area							
1	Dredging for Marsh Fill	2,063,000.00	CY	*$1.92* $3,960,960	$0	$0	$0	$3,960,960
2	Dredging for Upland Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
3	Dredging for Exterior Levee Construction	2,595,000.00	CY	*$3.89* $10,094,550	$0	$0	$0	$10,094,550
4	Hydraulically Constructed Exterior Levees	18,081	LF	*$173.39* $3,135,065	$0	$0	$0	$3,135,065
5	Mechanical Levee Construction	0.00	CY	*$4.74* $0	$0	$0	$0	$0
6	Stone Shore Protection	88,707.00	TONS	*$60.00* $5,322,420	$0	$0	$0	$5,322,420
7	Planting (Marsh)	160.00	ACRE	*$5,000.00* $800,000	$0	$0	$0	$800,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "G"							**$23,614,081**
	G Levee							
1	Mechanical Levee Construction	450,000.00	CY	*$4.74* $2,133,000	$0	$0	$0	$2,133,000
2	Stone Shore Protection	74,088.00	TONS	*$60.00* $4,445,280	$0	$0	$0	$4,445,280
	SUBTOTAL "G-BN"							**$6,578,280**
	"H2" Area							
1	Dredging for Sand Platform	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	2,804,000.00	CY	*$2.54* $7,122,160	$0	$0	$0	$7,122,160
3	Dredging for Exterior Levee Construction	1,338,000.00	CY	*$4.68* $6,261,840	$0	$0	$0	$6,261,840
4	Hydraulically Constructed Exterior Levees	22,320	LF	*$98.95* $2,208,564	$0	$0	$0	$2,208,564
5	Mechanical Levee Construction	1,800,000.00	CY	*$4.74* $8,532,000	$0	$0	$0	$8,532,000
6	Stone Shore Protection	214,089.00	TONS	*$60.00* $12,845,340	$0	$0	$0	$12,845,340
7	Seeding	20.00	ACRE	$200.00 $4,000	$0	$0	$0	$4,000
8	Drop Outlet Structures	4.00	EA	*$150,543.00* $602,172	$0	$0	$0	$602,172
	SUBTOTAL "H"							**$37,576,076**
	"H4" Area							
1	Dredging for Sand Platform	2,559,000.00	CY	*$2.90* $7,421,100	$0	$0	$0	$7,421,100
2	Dredging for Upland Fill	5,963,000.00	CY	*$2.23* $13,317,500	$0	$0	$0	$13,317,500
3	Dredging for Exterior Levee Construction	6,140,526.00	CY	*$4.68* $28,749,415	$0	$0	$0	$28,749,415
4	Hydraulically Constructed Exterior Levees	24,381	LF	*$98.95* $2,412,500	$0	$0	$0	$2,412,500
5	Mechanical Levee Construction	300,000.00	CY	*$4.74* $1,422,000	$0	$0	$0	$1,422,000
6	Stone Shore Protection	137,338.00	TONS	*$60.00* $8,240,280	$0	$0	$0	$8,240,280
7	Seeding	59.00	ACRE	$2,000.00 $118,000	$0	$0	$0	$118,000
8	Rock Groins and Breakwaters	6,000.00	LF	$503.75 $3,022,500	$0	$0	$0	$3,022,500
9	Drop Outlet Structures	4.00	EA	*$150,543.00* $602,172	$0	$0	$0	$602,172
	SUBTOTAL "H"							**$65,305,467**
TOTAL "MATAGORDA BAY"								**$145,122,384**

MSCIP NEW WORK COSTS - OFFSHORE

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	"O5" Area							
				$3.95				
2	Offshore (Hopper)	3,206,000.00	CY	$12,663,700.00	$0	$0	$0	$12,663,700
	SUBTOTAL "O5"							**$12,663,700**
TOTAL "OFFSHORE"								**$12,663,700**

MSCIP - Alternative 2A Summary	
Placement Area	**Cost**
A1	$24,279,920
A2	$21,962,368
BN1, BN2, BN3	$12,048,480
C2	
D	$9,886,535
ER1	$3,241,837
ER2	$11,919,891
ER3	$15,229,598
G w/Levee	$30,192,361
H4 Habitat Area	$47,899,693
H2	
H4	
O5	$46,153,640
OR1 and OR2	$9,437,523
P1	$6,171,136
Subtotal	**$238,422,980**
Other Related Costs	
Mob & Demob(Includes Dredge Pipeline Cost)	$9,127,000
Oyster Mitigation	see OR1, OR2 & ER1
Environmental Protection	$500,000
Subtotal	**$9,627,000**
Total	**$248,049,980**

MSCIP NEW WORK COSTS - ALTERNATIVE 2A

MSCIP NEW WORK COSTS - Other Related Costs

ITEM NO.	Placement Area	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
1	Environmental Protection	1.00	LS	*$500,000.00* $500,000	$0	$0	$0	$500,000
MOB/DEMOB(Includes Dredge Pipeline Costs)								
4	Cutter Head Pipline Dredge Mob/Demob	2.00	LS	*$2,504,000.00* $5,008,000	$0	$0	$0	$5,008,000
5	Hopper Dredge Mob/Demob	1.00	LS	*$1,220,440* $1,220,440	$0	$0	$0	$1,220,440
6	Clamshell Dredge Mob/Demob	1.00	LS	*$2,898,560* $2,898,560	$0	$0	$0	$2,898,560
	SUBTOTAL							**$9,627,000**

MSCIP NEW WORK COSTS - LAVACA BAY

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	OYSTER REEF AREA (OR1 and OR2)							
1	Dredging for Oyster Fill	971,000.00	CY	*$4.58* $4,447,180	$0	$0	$0	$4,447,180
2	Crushed Limestone	124,759	TON	*$40.00* $4,990,343	$0	$0	$0	$4,990,343
	SUBTOTAL OYSTER							**$9,437,523**
	"A1" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,260,000.00	CY	*$1.92* $2,419,200	$0	$0	$0	$2,419,200
3	Dredging for Exterior Levee Construction	2,000,000.00	CY	*$4.81* $9,620,000	$0	$0	$0	$9,620,000
4	Mechanical Levee Construction	0.00	CY	*$4.74* $0	$0	$0	$0	$0
5	Hydraulically Constructed Exterior Levees	14,759	LF	*$373.51* $5,512,634	$0	$0	$0	$5,512,634
6	Stone Shore Protection	107,040.00	TONS	*$60.00* $6,422,400	$0	$0	$0	$6,422,400
7	Seeding	23.00	ACRE	*$200.00* $4,600	$0	$0	$0	$4,600
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "A1"							**$24,279,920**
	"A2" AREA							
1	Dredging for Marsh Fill	1,461,000.00	CY	*$4.37* $6,384,570	$0	$0	$0	$6,384,570
2	Dredging for Upland Fill	3,999,000.00	CY	*$1.93* $7,718,070	$0	$0	$0	$7,718,070
3	Dredging for Exterior Levee Construction	800,000.00	CY	*$3.79* $3,032,000	$0	$0	$0	$3,032,000
4	Hydraulically Constructed Exterior Levees	14,789	LF	*$92.88* $1,373,602	$0	$0	$0	$1,373,602
5	Stone Shore Protection	47,460.66	TONS	*$60.00* $2,847,640	$0	$0	$0	$2,847,640
6	Seeding	27.00	ACRE	*$200* $5,400	$0	$0	$0	$5,400
7	Planting (Marsh)	60.00	ACRE	*$5,000.00* $300,000	$0	$0	$0	$300,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "A2"							**$21,962,368**
	"ER1" AREA							
1	Dredging for Oyster Fill	400,000.00	CY	*$4.76* $1,904,000	$0	$0	$0	$1,904,000
7	Crushed Limestone	33,445.91	TON	*$40* $1,337,837	$0	$0	$0	$1,337,837
	SUBTOTAL "ER1"							**$3,241,837**

MSCIP NEW WORK COSTS - LAVACA BAY (continued)

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	"ER2" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* 0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,000,000.00	CY	*$2.83* $2,830,000	$0	$0	$0	$2,830,000
3	Dredging for Exterior Levee Construction	1,063,000.00	CY	*$4.77* $5,070,510	$0	$0	$0	$5,070,510
4	Hydraulically Constructed Exterior Levees	9,520	LF	*$242.88* $2,312,218	$0	$0	$0	$2,312,218
5	Stone Shore Protection	25,027.00	TONS	*$60.00* $1,501,620	$0	$0	$0	$1,501,620
6	Seeding	20.00	ACRE	*$200.00* $4,000	$0	$0	$0	$4,000
7	Planting (Marsh)	10.20	ACRE	*$5,000.00* $51,000	$0	$0	$0	$51,000
8	Drop Outlet Structures	1.00	EA	*$150,543.00* $150,543	$0	$0	$0	$150,543
	SUBTOTAL "ER2"							**$11,919,891**
	"ER3" AREA							
1	Dredging for Marsh Fill	200,000.00	CY	*$4.32* $864,000	$0	$0	$0	$864,000
2	Dredging for Upland Fill	926,000.00	CY	*$2.15* $1,990,900	$0	$0	$0	$1,990,900
3	Dredging for Exterior Levee Construction	1,200,000.00	CY	*$4.64* $5,568,000	$0	$0	$0	$5,568,000
4	Hydraulically Constructed Exterior Levees	12,511	LF	*$242.88* $3,038,672	$0	$0	$0	$3,038,672
5	Bulkhead	4,000.00	LF	*$500.00* $2,000,000.00				$2,000,000
6	Stone Shore Protection	20,554.00	TONS	*$60.00* $1,233,240	$0	$0	$0	$1,233,240
7	Seeding	11.00	ACRE	*$200.00* $2,200	$0	$0	$0	$2,200
8	Planting (Marsh)	46.30	ACRE	*$5,000.00* $231,500	$0	$0	$0	$231,500
9	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "ER3"							**$15,229,598**
	"D" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,116,000.00	CY	*$2.09* $2,332,440	$0	$0	$0	$2,332,440
3	Dredging for Exterior Levee Construction	500,000.00	CY	*$4.94* $2,470,000	$0	$0	$0	$2,470,000
4	Hydraulically Constructed Exterior Levees	6,967	LF	*$217.01* $1,511,909	$0	$0	$0	$1,511,909
5	Stone Shore Protection	53,315.00	TONS	*$60.00* $3,198,900	$0	$0	$0	$3,198,900
6	Seeding	6.00	ACRE	*$200.00* $1,200	$0	$0	$0	$1,200
7	Planting (Marsh)	14.20	ACRE	*$5,000.00* $71,000	$0	$0	$0	$71,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "D"							**$9,886,535**
	"P1" Area							
1	Dredging for Upland Fill	1,082,000.00	CY	*$2.35* $2,542,700	$0	$0	$0	$2,542,700
2	Land Acquisition	700.00	ACRE	*$3,000.00* $2,100,000.00	$0	$0	$0	$2,100,000
3	Mechanical Levee Construction (Inland)	300,000	CY	*$4.00* $1,200,000	$0	$0	$0	$1,200,000
4	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
5	Ditch Drainage Improvements	19,500.00	LF	$0.50 $9,750	$0	$0	$0	$9,750
6	Seeding	88.00	ACRE	$200.00 $17,600.00	$0	$0	$0	$17,600
	SUBTOTAL "P1"							**$6,171,136**
TOTAL "LAVACA BAY"								**$102,128,806**

MSCIP NEW WORK COSTS - MATAGORDA BAY

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	Beach Nourishment "BN1, BN2, BN3"							
1	Dredging for Beach Nourishment	1,884,000.00	CY	*$3.47* $6,537,480	$0	$0	$0	$6,537,480
2	Grading and Shaping	1,884,000.00	CY	*$1.00* $1,884,000	$0	$0	$0	$1,884,000
3	Stone Groins	6,000.00	LF	$604.50 $3,627,000	$0	$0	$0	$3,627,000
	SUBTOTAL "BN"							**$12,048,480**
	"G" Area							
1	Dredging for Marsh Fill	2,063,000.00	CY	*$1.92* $3,960,960	$0	$0	$0	$3,960,960
2	Dredging for Upland Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
3	Dredging for Exterior Levee Construction	2,595,000.00	CY	*$3.89* $10,094,550	$0	$0	$0	$10,094,550
4	Hydraulically Constructed Exterior Levees	18,081	LF	*$173.39* $3,135,065	$0	$0	$0	$3,135,065
5	Mechanical Levee Construction	0.00	CY	*$4.74* $0	$0	$0	$0	$0
6	Stone Shore Protection	88,707.00	TONS	*$60.00* $5,322,420	$0	$0	$0	$5,322,420
7	Planting (Marsh)	160.00	ACRE	*$5,000.00* $800,000	$0	$0	$0	$800,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "G"							**$23,614,081**
	G Levee							
1	Mechanical Levee Construction	450,000.00	CY	*$4.74* $2,133,000	$0	$0	$0	$2,133,000
2	Stone Shore Protection	74,088.00	TONS	*$60.00* $4,445,280	$0	$0	$0	$4,445,280
	SUBTOTAL "G-BN"							**$6,578,280**
	"H" Area							
1	Dredging for Sand Platform	8,492,526.00	CY	*$3.55* $30,148,467	$0	$0	$0	$30,148,467
2	Dredging for Upland Fill	0.00	CY	*Varies per reach* $0	$0	$0	$0	$0
3	Dredging for Exterior Levee Construction	1,545,000.00	CY	*$4.39* $6,782,550	$0	$0	$0	$6,782,550
4	Hydraulically Constructed Exterior Levees	14,981	LF	*$98.95* $1,482,370	$0	$0	$0	$1,482,370
5	Mechanical Levee Construction	0.00	CY	*$4.74* $0	$0	$0	$0	$0
6	Stone Shore Protection	144,687.00	TONS	*$60.00* $8,681,220	$0	$0	$0	$8,681,220
7	Seeding	20.00	ACRE	$200.00 $4,000	$0	$0	$0	$4,000
8	Planting (Marsh)	100.00	ACRE	*$5,000.00* $500,000	$0	$0	$0	$500,000
9	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "H"							**$47,899,693**
TOTAL "MATAGORDA BAY"								**$90,140,534**

MSCIP NEW WORK COSTS - OFFSHORE

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	"O5" Area							
1	Dredging for Offshore Placement (Clamshell)	8,767,000.00	CY	*$3.82* $33,489,940	$0	$0	$0	$33,489,940
2	Offshore (Hopper)	3,206,000.00	CY	$3.95 $12,663,700.00	$0	$0	$0	$12,663,700
	SUBTOTAL "O5"							**$46,153,640**
TOTAL "OFFSHORE"								**$46,153,640**

MSCIP - Alternative 2B Summary	
Placement Area	**Cost**
A1	$24,279,920
A2	$21,962,368
BN1, BN2, BN3	$12,048,480
C2	$28,735,590
D	$9,886,535
ER1	$3,241,837
ER2	$11,919,891
ER3	$15,229,598
G w/Levee	$30,192,361
H4 Habitat Area	$47,899,693
H2	
H4	
O5	$46,153,640
Oyster Mitigation	$18,800,000
P1	
Subtotal	**$270,349,911**
Other Related Costs	
Mob & Demob (Includes Dredge Pipeline Costs)	$9,127,000
Environmental Protection	$500,000
Subtotal	**$9,627,000**
Total	**$279,976,911**

MSCIP NEW WORK COSTS - ALTERNATIVE 2B

MSCIP NEW WORK COSTS - Other Related Costs

ITEM NO.	Placement Area	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
1	Environmental Protection	1.00	LS	*$500,000.00* $500,000	$0	$0	$0	$500,000
MOB/DEMOB(Includes Dredge Pipeline Costs)								
				$2,504,000.00				
1	Cutter Head Pipeline Dredge Mob/Demob	2.00	LS	$5,008,000	$0	$0	$0	$5,008,000
				$1,220,440				
2	Hopper Dredge Mob/Demob	1.00	LS	$1,220,440	$0	$0	$0	$1,220,440
				$2,898,560				
3	Clamshell Dredge Mob/Demob	1.00	LS	$2,898,560	$0	$0	$0	$2,898,560
	SUBTOTAL							**$9,627,000**

MSCIP NEW WORK COSTS - LAVACA BAY

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	OYSTER MITIGATION							
1	Dredging for Oyster Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Crushed Limestone	470,000	TON	*$40.00* $18,800,000	$0	$0	$0	$18,800,000
	SUBTOTAL OYSTER							**$18,800,000**
	"A1" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,260,000.00	CY	*$1.92* $2,419,200	$0	$0	$0	$2,419,200
3	Dredging for Exterior Levee Construction	2,000,000.00	CY	*$4.81* $9,620,000	$0	$0	$0	$9,620,000
4	Mechanical Levee Construction	0.00	CY	*$4.74* $0	$0	$0	$0	$0
5	Hydraulically Constructed Exterior Levees	14,759	LF	*$373.51* $5,512,634	$0	$0	$0	$5,512,634
6	Stone Shore Protection	107,040.00	TONS	*$60.00* $6,422,400	$0	$0	$0	$6,422,400
7	Seeding	23.00	ACRE	*$200.00* $4,600	$0	$0	$0	$4,600
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "A1"							**$24,279,920**
	"A2" AREA							
1	Dredging for Marsh Fill	1,461,000.00	CY	*$4.37* $6,384,570	$0	$0	$0	$6,384,570
2	Dredging for Upland Fill	3,999,000.00	CY	*$1.93* $7,718,070	$0	$0	$0	$7,718,070
3	Dredging for Exterior Levee Construction	800,000.00	CY	*$3.79* $3,032,000	$0	$0	$0	$3,032,000
4	Hydraulically Constructed Exterior Levees	14,789	LF	*$92.88* $1,373,602	$0	$0	$0	$1,373,602
5	Stone Shore Protection	47,460.66	TONS	*$60.00* $2,847,640	$0	$0	$0	$2,847,640
6	Seeding	27.00	ACRE	*$200* $5,400	$0	$0	$0	$5,400
7	Planting (Marsh)	60.00	ACRE	*$5,000.00* $300,000	$0	$0	$0	$300,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "A2"							**$21,962,368**
	"ER1" AREA							
1	Dredging for Oyster Fill	400,000.00	CY	*$4.76* $1,904,000	$0	$0	$0	$1,904,000
7	Crushed Limestone	33,445.91	TON	*$40* $1,337,837	$0	$0	$0	$1,337,837
	SUBTOTAL "ER1"							**$3,241,837**

MSCIP NEW WORK COSTS - LAVACA BAY (continued)

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	"ER2" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* 0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,000,000.00	CY	*$2.83* $2,830,000	$0	$0	$0	$2,830,000
3	Dredging for Exterior Levee Construction	1,063,000.00	CY	*$4.77* $5,070,510	$0	$0	$0	$5,070,510
4	Hydraulically Constructed Exterior Levees	9,520	LF	*$242.88* $2,312,218	$0	$0	$0	$2,312,218
5	Stone Shore Protection	25,027.00	TONS	*$60.00* $1,501,620	$0	$0	$0	$1,501,620
6	Seeding	20.00	ACRE	*$200.00* $4,000	$0	$0	$0	$4,000
7	Planting (Marsh)	10.20	ACRE	*$5,000.00* $51,000	$0	$0	$0	$51,000
8	Drop Outlet Structures	1.00	EA	*$150,543.00* $150,543	$0	$0	$0	$150,543
	SUBTOTAL "ER2"							**$11,919,891**
	"ER3" AREA							
1	Dredging for Marsh Fill	200,000.00	CY	*$4.32* $864,000	$0	$0	$0	$864,000
2	Dredging for Upland Fill	926,000.00	CY	*$2.15* $1,990,900	$0	$0	$0	$1,990,900
3	Dredging for Exterior Levee Construction	1,200,000.00	CY	*$4.64* $5,568,000	$0	$0	$0	$5,568,000
4	Hydraulically Constructed Exterior Levees	12,511	LF	*$242.88* $3,038,672	$0	$0	$0	$3,038,672
5	Bulkhead	4,000.00	LF	*$500.00* $2,000,000.00				$2,000,000
6	Stone Shore Protection	20,554.00	TONS	*$60.00* $1,233,240	$0	$0	$0	$1,233,240
7	Seeding	11.00	ACRE	*$200.00* $2,200	$0	$0	$0	$2,200
8	Planting (Marsh)	46.30	ACRE	*$5,000.00* $231,500	$0	$0	$0	$231,500
9	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "ER3"							**$15,229,598**
	"D" AREA							
1	Dredging for Marsh Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
2	Dredging for Upland Fill	1,116,000.00	CY	*$2.09* $2,332,440	$0	$0	$0	$2,332,440
3	Dredging for Exterior Levee Construction	500,000.00	CY	*$4.94* $2,470,000	$0	$0	$0	$2,470,000
4	Hydraulically Constructed Exterior Levees	6,967	LF	*$217.01* $1,511,909	$0	$0	$0	$1,511,909
5	Stone Shore Protection	53,315.00	TONS	*$60.00* $3,198,900	$0	$0	$0	$3,198,900
6	Seeding	6.00	ACRE	*$200.00* $1,200	$0	$0	$0	$1,200
7	Planting (Marsh)	14.20	ACRE	*$5,000.00* $71,000	$0	$0	$0	$71,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "D"							**$9,886,535**
	"C2" Area							
1	Dredging for Upland Fill	1,082,000.00	CY	*$3.19* $3,451,580	$0	$0	$0	$3,451,580
2	Dredging for Exterior Levee Construction	971,000.00	CY	*$3.89* $3,777,190.00	$0	$0	$0	$3,777,190
3	Hydraulically Constructed Exterior Levees	25,584	LF	*$242.88* $6,213,842	$0	$0	$0	$6,213,842
4	Stone Shore Protection	91,571.53	TONS	*$60.00* $5,494,292	$0	$0	$0	$5,494,292
5	Mechanical Levee Construction	2,000,000.00	CY	*$4.74* $9,480,000	$0	$0	$0	$9,480,000
6	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086.00	$0	$0	$0	$301,086
7	Seeding	88.00	ACRE	$200.00 $17,600.00	$0	$0	$0	$17,600
	SUBTOTAL "C2"							**$28,735,590**
TOTAL "LAVACA BAY"								**$134,055,737**

MSCIP NEW WORK COSTS - MATAGORDA BAY

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	Beach Nourishment "BN1, BN2, BN3"							
1	Dredging for Beach Nourishment	1,884,000.00	CY	*$3.47* $6,537,480	$0	$0	$0	$6,537,480
2	Grading and Shaping	1,884,000.00	CY	*$1.00* $1,884,000	$0	$0	$0	$1,884,000
3	Rock Groins	6,000.00	LF	$604.50 $3,627,000	$0	$0	$0	$3,627,000
	SUBTOTAL "BN"							**$12,048,480**
	"G" Area							
1	Dredging for Marsh Fill	2,063,000.00	CY	*$1.92* $3,960,960	$0	$0	$0	$3,960,960
2	Dredging for Upland Fill	0.00	CY	*$0.00* $0	$0	$0	$0	$0
3	Dredging for Exterior Levee Construction	2,595,000.00	CY	*$3.89* $10,094,550	$0	$0	$0	$10,094,550
4	Hydraulically Constructed Exterior Levees	18,081	LF	*$173.39* $3,135,065	$0	$0	$0	$3,135,065
5	Mechanical Levee Construction	0.00	CY	*$4.74* $0	$0	$0	$0	$0
6	Stone Shore Protection	88,707.00	TONS	*$60.00* $5,322,420	$0	$0	$0	$5,322,420
7	Planting (Marsh)	160.00	ACRE	*$5,000.00* $800,000	$0	$0	$0	$800,000
8	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "G"							**$23,614,081**
	G Levee							
1	Mechanical Levee Construction	450,000.00	CY	*$4.74* $2,133,000	$0	$0	$0	$2,133,000
2	Stone Shore Protection	74,088.00	TONS	*$60.00* $4,445,280	$0	$0	$0	$4,445,280
	SUBTOTAL "G-BN"							**$6,578,280**
	"H" Area							
1	Dredging for Sand Platform	8,492,526.00	CY	*$3.55* $30,148,467	$0	$0	$0	$30,148,467
2	Dredging for Upland Fill	0.00	CY	*Varies per reach* $0	$0	$0	$0	$0
3	Dredging for Exterior Levee Construction	1,545,000.00	CY	*$4.39* $6,782,550	$0	$0	$0	$6,782,550
4	Hydraulically Constructed Exterior Levees	14,981	LF	*$98.95* $1,482,370	$0	$0	$0	$1,482,370
5	Mechanical Levee Construction	0.00	CY	*$4.74* $0	$0	$0	$0	$0
6	Stone Shore Protection	144,687.00	TONS	*$60.00* $8,681,220	$0	$0	$0	$8,681,220
7	Seeding	20.00	ACRE	$200.00 $4,000	$0	$0	$0	$4,000
8	Planting (Marsh)	100.00	ACRE	*$5,000.00* $500,000	$0	$0	$0	$500,000
9	Drop Outlet Structures	2.00	EA	*$150,543.00* $301,086	$0	$0	$0	$301,086
	SUBTOTAL "H"							**$47,899,693**
TOTAL "MATAGORDA BAY"								**$90,140,534**

MSCIP NEW WORK COSTS - OFFSHORE

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	CONTRACT COST	ESCALATION	CONTINGENCY	SIOH	PROJECT COST
	"O5" Area							
1	Dredging for Offshore Placement (Clamshell)	8,767,000.00	CY	*$3.82* $33,489,940	$0	$0	$0	$33,489,940
2	Offshore (Hopper)	3,206,000.00	CY	*$3.95* $12,663,700.00	$0	$0	$0	$12,663,700
	SUBTOTAL "O5"							**$46,153,640**
TOTAL "OFFSHORE"								**$46,153,640**

Matagorda Ship Channel Improvement Project
Maintenance Cost Estimates

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

50 YEAR MAINTENANCE COSTS

	Placement Area	CY	Cost/CY	Cost/Cycle	Cost
Upland Alternative*	P1	61,530,000	$ 3.28	$ 8,078,831	$ 201,970,766
	P2	55,440,000	$ 2.46	$ 5,451,342	$ 136,283,558
	P3	100,670,000	$ 3.34	$ 13,465,118	$ 336,627,944
	P4	39,910,000	$ 1.86	$ 2,977,211	$ 74,430,268
	Total	**257,550,000**	**$ 2.91**	**$ 29,972,501**	**$ 749,312,536**
Offshore Alternative*	O6	257,550,000	$ 4.17	$ 42,924,169	$ 1,073,104,217
	Total	**257,550,000**	**$ 4.17**	**$ 42,924,169**	**$ 1,073,104,217**

*Costs are for dredging only. Raising of levees, E&D, contingencies, construction administration, and pipeline relocation costs are not included in this estimate.

Alternative	Cost/Cycle	50 Year Cost
Alternative 1A	$ 23,607,596	$ 590,189,894
Alternative 1B	$ 22,489,634	$ 562,240,848
Alternative 2A	$ 20,980,840	$ 524,520,996
Alternative 2B	$ 19,862,878	$ 496,571,950

**Costs include raising of the levees, and mob/demob. See 50 year maintenance alternatives for a more detailed estimate.

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

50 YEAR MAINTENANCE COST

Alternative 2A

Area	CY per cycle	Dredging Cost/CY	Dredging Cost/Cycle	Years of Placement	Cost per Levee Construction**	Mob/Demob per Cycle*	Total CY Maint	Mob/Demob*	Total Cost of Levee Construction	Dredging Cost	Total Cost
A1	1,268,636	$ 1.45	$ 1,839,522	0-30	$ 82,605	$ 762,440	19,029,540	$ 19,061,000	$ 247,815	$ 27,592,833	$ 46,901,648
	2,147,807	$ 1.69	$ 3,629,794	30-40	$ 165,211	$ -	10,739,035	$ -	$ 495,633	$ 18,148,969	$ 18,644,602
	2,888,696	$ 1.75	$ 5,055,218	40-44	$ 330,442		5,777,392	$ -	$ 330,442	$ 10,110,436	$ 10,440,878
	3,202,060	$ 1.78	$ 5,699,667	44-50	$ 330,442		9,606,180	$ -	$ 330,442	$ 17,099,000	$ 17,429,442
ER2	313,364	$ 2.08	$ 651,797	0-44	$ 84,497		6,894,008	$ -	$ 506,981	$ 14,339,537	$ 14,846,517
ER3/D	1,620,060	$ 1.88	$ 3,037,628	0-30	$ 364,027		24,300,900	$ -	$ 1,092,081	$ 45,564,422	$ 46,656,503
	740,889	$ 1.88	$ 1,390,167	30-40	$ 182,013		3,704,445	$ -	$ 364,026	$ 6,950,834	$ 7,314,860
P1	2,198,057	$ 2.63	$ 5,780,890	0-50	$ 156,424		54,951,425	$ -	$ 1,251,390	$ 144,522,248	$ 145,773,638
Open Bay Existing PA5-12	4,357,684	$ 1.32	$ 5,752,143	0-50	$ -	$ 375,966	108,942,100	$ 9,399,150	$ -	$ 143,803,572	$ 153,202,722
ODMDS	1,088,000	$ 3.86	$ 4,200,986	0-50	$ -	$ 830,605	13,600,000	$ 10,797,865	$ -	$ 52,512,320	$ 63,310,185
Total							257,545,025	$ 39,258,015	$ 4,618,810	$ 480,644,171	$ 524,520,996

*Mob/Demob includes dredge pipeline cost and it is divided amongst the PA's

**Levee Construction done every 4 years beginning on year 20.

Alternative 2B

Area	CY/cycle	Dredging Cost/CY	Dredging Cost/Cycle	Years of Placement	Cost per Levee Construction**	Mob/Demob per Cycle*	Total CY Maint	Mob/Demob*	Levee Construction	Dredging Cost	Total Cost
A1	1,268,636	$ 1.45	$ 1,839,522	0-30	$ 82,605	$ 762,440	19,029,540	$ 19,061,000	$ 247,815	$ 27,592,833	$ 46,901,648
	2,147,807	$ 1.69	$ 3,629,794	32-40	$ 165,211	$ -	10,739,035	$ -	$ 495,633	$ 18,148,969	$ 18,644,602
	2,888,696	$ 1.75	$ 5,055,218	42-44	$ 330,442		5,777,392	$ -	$ 330,442	$ 10,110,436	$ 10,440,878
	3,202,060	$ 1.78	$ 5,699,667	46-50	$ 330,442		9,606,180	$ -	$ 330,442	$ 17,099,000	$ 17,429,442
ER2	313,364	$ 2.08	$ 651,797	0-44	$ 84,497		6,894,008	$ -	$ 506,981	$ 14,339,537	$ 14,846,517
ER3/D	1,620,060	$ 1.88	$ 3,037,628	0-30	$ 364,027		24,300,900	$ -	$ 1,092,081	$ 45,564,422	$ 46,656,503
	740,889	$ 1.88	$ 1,390,167	32-40	$ 182,013		3,704,445	$ -	$ 364,026	$ 6,950,834	$ 7,314,860
C2	2,198,057	$ 2.11	$ 4,637,900	0-50	$ 234,636		54,951,425	$ -	$ 1,877,085	$ 115,947,507	$ 117,824,592
Open Bay Existing PA5-12	4,357,684	$ 1.32	$ 5,752,143	0-50	$ -	$ 375,966	108,942,100	$ 9,399,150	$ -	$ 143,803,572	$ 153,202,722
ODMDS	1,088,000	$ 3.86	$ 4,200,986	0-50	$ -	$ 830,605	13,600,000	$ 10,797,865	$ -	$ 52,512,320	$ 63,310,185
Total	18,737,253						257,545,025	$ 39,258,015	$ 5,244,505	$ 452,069,430	$ 496,571,950

*Mob/Demob includes dredge pipeline cost and it is divided amongst the PA's

**Levee Construction done every 4 years beginning on year 20.

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT

50 YEAR MAINTENANCE COST

Alternative 1A

Area	CY/cycle	Dredging Cost/CY	Dredging Cost/Cycle	Years of Placement	Cost per Levee Construction**	Mob/Demob per Cycle*	Total CY Maint	Mob/Demob*	Levee Construction	Dredging Cost	Total Cost
A1	1,268,636	$ 1.45	$ 1,839,522	0-30	$ 82,605	$ 762,440	19,029,540	$ 19,061,000	$ 247,815	$ 27,592,833	$ 46,901,648
	2,147,807	$ 1.69	$ 3,629,794	32-40	$ 165,211	$ -	10,739,035	$ -	$ 495,633	$ 18,148,969	$ 18,644,602
	2,888,696	$ 1.75	$ 5,055,218	42-44	$ 330,442	$ -	5,777,392	$ -	$ 330,442	$ 10,110,436	$ 10,440,878
	3,202,060	$ 1.78	$ 5,699,667	46-50	$ 330,442	$ -	9,606,180	$ -	$ 330,442	$ 17,099,000	$ 17,429,442
ER2	313,364	$ 2.08	$ 651,797	0-44	$ 84,497	$ -	6,894,008	$ -	$ 506,981	$ 14,339,537	$ 14,846,517
ER3/D	1,620,060	$ 1.88	$ 3,037,628	0-30	$ 364,027	$ -	24,300,900	$ -	$ 1,092,081	$ 45,564,422	$ 46,656,503
	740,889	$ 1.88	$ 1,390,167	32-40	$ 182,013	$ -	3,704,445	$ -	$ 364,026	$ 6,950,834	$ 7,314,860
P1	2,198,057	$ 2.63	$ 5,780,890	0-50	$ 156,424	$ -	54,951,425	$ -	$ 1,251,390	$ 144,522,248	$ 145,773,638
H2	2,178,056	$ 1.79	$ 3,898,720	0-50	$ 165,211	$ 187,983	54,451,400	$ 4,699,575	$ 1,321,684	$ 97,468,006	$ 103,489,265
H4	2,179,628	$ 2.01	$ 4,381,052	0-50	$ 144,559	$ 187,983	54,490,700	$ 4,699,575	$ 1,156,474	$ 109,526,307	$ 115,382,356
ODMDS	1,088,000	$ 3.86	$ 4,200,986	0-50	$ -	$ 830,605	13,600,000	$ 10,797,865	$ -	$ 52,512,320	$ 63,310,185
Total	16,557,625						257,545,025	$ 39,258,015	$ 7,096,967	$ 543,834,912	$ 590,189,894

*Mob/Demob includes dredge pipeline cost and it is divided amongst the PA's
**Levee Construction done every 4 years beginning on year 20.

Alternative 1B

Area	CY/cycle	Dredging Cost/CY	Dredging Cost/Cycle	Years Placed	Cost per Levee Construction**	Mob/Demob per Cycle*	Total CY Maint	Mob/Demob*	Levee Construction	Dredging Cost	Total Cost
A1	1,268,636	$ 1.45	$ 1,839,522	0-30	$ 82,605	$ 762,440	19,029,540	$ 19,061,000	$ 247,815	$ 27,592,833	$ 46,901,648
	2,147,807	$ 1.69	$ 3,629,794	32-40	$ 165,211	$ -	10,739,035	$ -	$ 495,633	$ 18,148,969	$ 18,644,602
	2,888,696	$ 1.75	$ 5,055,218	42-44	$ 330,442	$ -	5,777,392	$ -	$ 330,442	$ 10,110,436	$ 10,440,878
	3,202,060	$ 1.78	$ 5,699,667	46-50	$ 330,442	$ -	9,606,180	$ -	$ 330,442	$ 17,099,000	$ 17,429,442
ER2	313,364	$ 2.08	$ 651,797	0-44	$ 84,497	$ -	6,894,008	$ -	$ 506,981	$ 14,339,537	$ 14,846,517
ER3/D	1,620,060	$ 1.88	$ 3,037,628	0-30	$ 364,027	$ -	24,300,900	$ -	$ 1,092,081	$ 45,564,422	$ 46,656,503
	740,889	$ 1.88	$ 1,390,167	32-40	$ 182,013	$ -	3,704,445	$ -	$ 364,026	$ 6,950,834	$ 7,314,860
C2	2,198,057	$ 2.11	$ 4,637,900	0-50	$ 234,636	$ -	54,951,425	$ -	$ 1,877,085	$ 115,947,507	$ 117,824,592
H2	2,178,056	$ 1.79	$ 3,898,720	0-50	$ 165,211	$ 187,983	54,451,400	$ 4,699,575	$ 1,321,684	$ 97,468,006	$ 103,489,265
H4	2,179,628	$ 2.01	$ 4,381,052	0-50	$ 144,559	$ 187,983	54,490,700	$ 4,699,575	$ 1,156,474	$ 109,526,307	$ 115,382,356
ODMDS	1,088,000	$ 3.86	$ 4,200,986	0-50	$ -	$ 830,605	13,600,000	$ 10,797,865	$ -	$ 52,512,320	$ 63,310,185
Total	16,557,625						257,545,025	$ 39,258,015	$ 7,722,662	$ 515,260,171	$ 562,240,848

*Mob/Demob includes dredge pipeline cost and it is divided amongst the PA's
**Levee Construction done every 4 years beginning on year 20.

Matagorda Ship Channel Improvement Project
Equivalent Annual Costs

Matagorda Ship Channel 44 ft x 400 ft
Preliminary Annual Cost Worksheet
DMMP Alternative 1A

Price Level 2006

Federal Discount Rate 4.875%

Base yr 2009 Proj Life 50

Annual Cost Summary		
Construction Present Worth	$	269,541,890
+ Interest During Construction	$	13,220,229
Investment Cost	$	282,762,119
x Capital Recovery Factor		0.0537
= Interest & Amortization	$	15,190,626
+ Annual O&M	$	11,389,804
Total Annual Costs	$	26,580,431

Total Costs		2006
Construction	$	269,541,890
Total O&M	$	590,189,884
Total	$	859,731,774

Total Costs	Present Value at Base Year	
Construction	$	269,541,890
IDC	$	13,220,229
Total O&M	$	212,012,669
Total PW	$	494,774,788

This is spreadsheet is intended for the comparison of preliminary alternatives only.
Base yr is year facilities become operational. All Present Worths adjusted to Base Year.
Assume Interest During Construction (IDC) from midpoint of year to end of base year
Other initial costs may include Aids to Navigation, Monitoring of Beneficial use areas, etc.
Costs do not include: Engineering & Design
Construction Administration
Pipeline Relocations
Contingency

Project		<-------- Construction Costs ---------->					Years of			Operation & Maintenance Costs			Present Worth		
Year	Year	GNF Dredging/ Containment	Associated Cost	Monitiring/ Other	E&D/SI&A	Total	Interest	Interest During Construction		Dredging	Levee	Total	Present Worth Factor	Construction	O&M
-3	2006	$ -	$ -		$ -	$ -	3.50	$ -		$ -	$ -	$ -	1.0000	$ -	$ -
-2	2007				$ -	$ -	2.50	$ -				$ -	1.0000	$ -	$ -
-1	2008	$ 134,770,945	$ -		$ -	$ 134,770,945	1.50	$ 9,974,276				$ -	1.0000	$ 134,770,945.00	$ -
0	2009	$ 134,770,945	$ -		$ -	$ 134,770,945	0.50	$ 3,245,952				$ -	1.0000	$ 134,770,945.00	$ -
1	2010	$ -	$ -	$ -	$ -	$ -	-	$ -		$ -	$ -	$ -	0.9535	$ -	$ -
2	2011			$ -	$ -	$ -	-	$ -		$ 20,728,015	$ -	$ 20,728,015	0.9092	$ -	$ 18,845,764.79
3	2012			$ -	$ -	$ -	-	$ -		$ -	$ -	$ -	0.8669	$ -	$ -
4	2013					$ -	-	$ -		$ 25,759,606	$ -	$ 25,759,606	0.8266	$ -	$ 21,293,709.30
5	2014					$ -	-	$ -		$ -	$ -	$ -	0.7882	$ -	$ -
6	2015					$ -	-	$ -		$ 20,728,015	$ -	$ 20,728,015	0.7516	$ -	$ 15,578,508.34
7	2016					$ -	-	$ -		$ -	$ -	$ -	0.7166	$ -	$ -
8	2017					$ -	-	$ -		$ 25,759,606	$ -	$ 25,759,606	0.6833	$ -	$ 17,602,057.10
9	2018					$ -	-	$ -		$ -	$ -	$ -	0.6516	$ -	$ -
10	2019					$ -	-	$ -		$ 20,728,015	$ -	$ 20,728,015	0.6213	$ -	$ 12,877,690.29
11	2020					$ -	-	$ -		$ -	$ -	$ -	0.5924	$ -	$ -
12	2021					$ -	-	$ -		$ 25,759,606	$ -	$ 25,759,606	0.5649	$ -	$ 14,550,420.02
13	2022					$ -	-	$ -		$ -	$ -	$ -	0.5386	$ -	$ -
14	2023					$ -	-	$ -		$ 20,728,015	$ -	$ 20,728,015	0.5136	$ -	$ 10,645,108.21
15	2024					$ -	-	$ -		$ -	$ -	$ -	0.4897	$ -	$ -
16	2025					$ -	-	$ -		$ 25,759,606	$ -	$ 25,759,606	0.4669	$ -	$ 12,027,839.79
17	2026					$ -	-	$ -		$ -	$ -	$ -	0.4452	$ -	$ -
18	2027					$ -	-	$ -		$ 20,728,015	$ -	$ 20,728,015	0.4245	$ -	$ 8,799,584.89
19	2028					$ -	-	$ -		$ -	$ -	$ -	0.4048	$ -	$ -
20	2029					$ -	-	$ -		$ 25,759,606	$ 997,323	$ 26,756,929	0.3860	$ -	$ 10,327,537.71
21	2030					$ -	-	$ -		$ -	$ -	$ -	0.3680	$ -	$ -
22	2031					$ -	-	$ -		$ 20,728,015	$ -	$ 20,728,015	0.3509	$ -	$ 7,274,016.63
23	2032					$ -	-	$ -		$ -	$ -	$ -	0.3346	$ -	$ -
24	2033					$ -	-	$ -		$ 25,759,606	$ 997,323	$ 26,756,929	0.3191	$ -	$ 8,537,071.02
25	2034					$ -	-	$ -		$ -	$ -	$ -	0.3042	$ -	$ -
26	2035					$ -	-	$ -		$ 20,728,015	$ -	$ 20,728,015	0.2901	$ -	$ 6,012,933.41
27	2036					$ -	-	$ -		$ -	$ -	$ -	0.2766	$ -	$ -
28	2037					$ -	-	$ -		$ 25,759,606	$ 997,323	$ 26,756,929	0.2637	$ -	$ 7,057,014.32
29	2038					$ -	-	$ -		$ -	$ -	$ -	0.2515	$ -	$ -
30	2039					$ -	-	$ -		$ 20,728,015	$ -	$ 20,728,015	0.2398	$ -	$ 4,970,481.93
31	2040					$ -	-	$ -		$ -	$ -	$ -	0.2286	$ -	$ -
32	2041					$ -	-	$ -		$ 25,902,417	$ 897,915	$ 26,800,332	0.2180	$ -	$ 5,843,015.14
33	2042					$ -	-	$ -		$ -	$ -	$ -	0.2079	$ -	$ -
34	2043					$ -	-	$ -		$ 20,870,826	$ -	$ 20,870,826	0.1982	$ -	$ 4,137,066.74
35	2044					$ -	-	$ -		$ -	$ -	$ -	0.1890	$ -	$ -
36	2045					$ -	-	$ -		$ 25,902,417	$ 897,915	$ 26,800,332	0.1802	$ -	$ 4,830,022.08
37	2046					$ -	-	$ -		$ -	$ -	$ -	0.1718	$ -	$ -
38	2047					$ -	-	$ -		$ 20,870,826	$ -	$ 20,870,826	0.1639	$ -	$ 3,419,830.90
39	2048					$ -	-	$ -		$ -	$ -	$ -	0.1562	$ -	$ -
40	2049					$ -	-	$ -		$ 25,902,417	$ 715,902	$ 26,618,319	0.1490	$ -	$ 3,965,533.95
41	2050					$ -	-	$ -		$ -	$ -	$ -	0.1421	$ -	$ -
42	2051					$ -	-	$ -		$ 20,906,083	$ -	$ 20,906,083	0.1354	$ -	$ 2,831,716.49
43	2052					$ -	-	$ -		$ -	$ -	$ -	0.1292	$ -	$ -
44	2053					$ -	-	$ -		$ 25,937,674	$ 796,636	$ 26,734,310	0.1231	$ -	$ 3,292,320.69
45	2054					$ -	-	$ -		$ -	$ -	$ -	0.1174	$ -	$ -
46	2055					$ -	-	$ -		$ 20,898,735	$ -	$ 20,898,735	0.1120	$ -	$ 2,339,964.14
47	2056					$ -	-	$ -		$ -	$ -	$ -	0.1068	$ -	$ -
48	2057					$ -	-	$ -		$ 28,861,419	$ 796,636	$ 29,658,055	0.1018	$ -	$ 3,019,172.47
49	2058					$ -	-	$ -		$ -	$ -	$ -	0.0971	$ -	$ -
50	2059					$ -	-	$ -		$ 20,898,735	$ -	$ 20,898,735	0.0926	$ -	$ 1,934,288.76
51	2060					$ -	-	$ -		$ -	$ -	$ -	after		
52	2061					$ -	-	$ -		$ -	$ -	$ -	after		
53	2062					$ -	-	$ -		$ -	$ -	$ -	after		
54	2063					$ -	-	$ -		$ -	$ -	$ -	after		
55	2064					$ -	-	$ -		$ -	$ -	$ -	after		
56	2065					$ -	-	$ -		$ -	$ -	$ -	after		
57	2066					$ -	-	$ -		$ -	$ -	$ -	after		
58	2067					$ -	-	$ -		$ -	$ -	$ -	after		
59	2068					$ -	-	$ -				$ -	after		
					Total Construction =	$ 269,541,890	Total IDC =	$ 13,220,229			Total O&M =	$ 590,189,884	Total PW =	$ 269,541,890	$ 212,012,669
													CRF		0.05372
													Annual O&M		$ 11,389,804

Matagorda Ship Channel 44 ft x 400 ft
Preliminary Annual Cost Worksheet
DMMP Alternative 1B

Price Level 2006
Federal Discount Rate 4.875%

Base yr 2009 Proj Life 50

This is spreadsheet is intended for the comparison of preliminary alternatives only.
Base yr is year facilities become operational. All Present Worths adjusted to Base Year.
Assume Interest During Construction (IDC) from midpoint of year to end of base year
Other initial costs may include Aids to Navigation, Monitoring of Beneficial use areas, etc.
Costs do not include: Engineering & Design
Construction Administration
Pipeline Relocations
Contingency

Annual Cost Summary		
Construction Present Worth	$	301,468,821
+ Interest During Construction	$	14,786,150
Investment Cost	$	316,254,971
x Capital Recovery Factor		0.0537
= Interest & Amortization	$	16,989,939
+ Annual O&M	$	10,839,223
Total Annual Costs	$	27,829,162

Total Costs		2006
Construction	$	301,468,821
Total O&M	$	562,240,835
Total	$	863,709,656

Total Costs	Present Value at Base Year	
Construction	$	301,468,821
IDC	$	14,786,150
Total O&M	$	201,764,012
Total PW	$	518,018,983

Project		<-------- Construction Costs ---------->						Years of		Operation & Maintenance Costs			Present Worth		
Year	Year	GNF Dredging/ Containment	Associated Cost	Monitiring/ Other	E&D/SI&A	Total	Interest	Interest During Construction	Dredging	Levee	Total	Present Worth Factor	Construction	O&M
-3	2006	$ -	$ -		$ -	$ -	3.50	$ -	$ -	$ -	$ -	1.0000	$ -	$ -
-2	2007				$ -	$ -	2.50	$ -			$ -	1.0000	$ -	$ -
-1	2008	$ 150,734,411	$ -		$ -	$ 150,734,411	1.50	$ 11,155,718			$ -	1.0000	$ 150,734,410.50	$ -
0	2009	$ 150,734,411	$ -		$ -	$ 150,734,411	0.50	$ 3,630,432			$ -	1.0000	$ 150,734,410.50	$ -
1	2010	$ -	$ -	$ -	$ -	$ -	-	$ -	$ -	$ -	$ -	0.9535	$ -	$ -
2	2011			$ -	$ -	$ -	-	$ -	$ 19,585,025	$ -	$ 19,585,025	0.9092	$ -	$ 17,806,566.36
3	2012			$ -	$ -	$ -	-	$ -	$ -	$ -	$ -	0.8669	$ -	$ -
4	2013					$ -	-	$ -	$ 24,616,616	$ -	$ 24,616,616	0.8266	$ -	$ 20,348,877.42
5	2014					$ -	-	$ -	$ -	$ -	$ -	0.7882	$ -	$ -
6	2015					$ -	-	$ -	$ 19,585,025	$ -	$ 19,585,025	0.7516	$ -	$ 14,719,473.88
7	2016					$ -	-	$ -	$ -	$ -	$ -	0.7166	$ -	$ -
8	2017					$ -	-	$ -	$ 24,616,616	$ -	$ 24,616,616	0.6833	$ -	$ 16,821,029.03
9	2018					$ -	-	$ -	$ -	$ -	$ -	0.6516	$ -	$ -
10	2019					$ -	-	$ -	$ 19,585,025	$ -	$ 19,585,025	0.6213	$ -	$ 12,167,585.09
11	2020					$ -	-	$ -	$ -	$ -	$ -	0.5924	$ -	$ -
12	2021					$ -	-	$ -	$ 24,616,616	$ -	$ 24,616,616	0.5649	$ -	$ 13,904,797.39
13	2022					$ -	-	$ -	$ -	$ -	$ -	0.5386	$ -	$ -
14	2023					$ -	-	$ -	$ 19,585,025	$ -	$ 19,585,025	0.5136	$ -	$ 10,058,112.68
15	2024					$ -	-	$ -	$ -	$ -	$ -	0.4897	$ -	$ -
16	2025					$ -	-	$ -	$ 24,616,616	$ -	$ 24,616,616	0.4669	$ -	$ 11,494,147.60
17	2026					$ -	-	$ -	$ -	$ -	$ -	0.4452	$ -	$ -
18	2027					$ -	-	$ -	$ 19,585,025	$ -	$ 19,585,025	0.4245	$ -	$ 8,314,355.72
19	2028					$ -	-	$ -	$ -	$ -	$ -	0.4048	$ -	$ -
20	2029					$ -	-	$ -	$ 24,616,616	$ 1,075,535	$ 25,692,151	0.3860	$ -	$ 9,916,558.75
21	2030					$ -	-	$ -	$ -	$ -	$ -	0.3680	$ -	$ -
22	2031					$ -	-	$ -	$ 19,585,025	$ -	$ 19,585,025	0.3509	$ -	$ 6,872,910.77
23	2032					$ -	-	$ -	$ -	$ -	$ -	0.3346	$ -	$ -
24	2033					$ -	-	$ -	$ 24,616,616	$ 1,075,535	$ 25,692,151	0.3191	$ -	$ 8,197,342.74
25	2034					$ -	-	$ -	$ -	$ -	$ -	0.3042	$ -	$ -
26	2035					$ -	-	$ -	$ 19,585,025	$ -	$ 19,585,025	0.2901	$ -	$ 5,681,366.56
27	2036					$ -	-	$ -	$ -	$ -	$ -	0.2766	$ -	$ -
28	2037					$ -	-	$ -	$ 24,616,616	$ 1,075,535	$ 25,692,151	0.2637	$ -	$ 6,776,184.13
29	2038					$ -	-	$ -	$ -	$ -	$ -	0.2515	$ -	$ -
30	2039					$ -	-	$ -	$ 19,585,025	$ -	$ 19,585,025	0.2398	$ -	$ 4,696,398.22
31	2040					$ -	-	$ -	$ -	$ -	$ -	0.2286	$ -	$ -
32	2041					$ -	-	$ -	$ 24,759,427	$ 976,127	$ 25,735,554	0.2180	$ -	$ 5,610,871.97
33	2042					$ -	-	$ -	$ -	$ -	$ -	0.2079	$ -	$ -
34	2043					$ -	-	$ -	$ 19,727,836	$ -	$ 19,727,836	0.1982	$ -	$ 3,910,500.43
35	2044					$ -	-	$ -	$ -	$ -	$ -	0.1890	$ -	$ -
36	2045					$ -	-	$ -	$ 24,759,427	$ 976,127	$ 25,735,554	0.1802	$ -	$ 4,638,125.16
37	2046					$ -	-	$ -	$ -	$ -	$ -	0.1718	$ -	$ -
38	2047					$ -	-	$ -	$ 19,727,836	$ -	$ 19,727,836	0.1639	$ -	$ 3,232,543.99
39	2048					$ -	-	$ -	$ -	$ -	$ -	0.1562	$ -	$ -
40	2049					$ -	-	$ -	$ 24,759,427	$ 794,114	$ 25,553,541	0.1490	$ -	$ 3,806,905.85
41	2050					$ -	-	$ -	$ -	$ -	$ -	0.1421	$ -	$ -
42	2051					$ -	-	$ -	$ 19,763,093	$ -	$ 19,763,093	0.1354	$ -	$ 2,676,899.17
43	2052					$ -	-	$ -	$ -	$ -	$ -	0.1292	$ -	$ -
44	2053					$ -	-	$ -	$ 24,794,684	$ 874,848	$ 25,669,532	0.1231	$ -	$ 3,161,193.66
45	2054					$ -	-	$ -	$ -	$ -	$ -	0.1174	$ -	$ -
46	2055					$ -	-	$ -	$ 19,755,745	$ -	$ 19,755,745	0.1120	$ -	$ 2,211,987.23
47	2056					$ -	-	$ -	$ -	$ -	$ -	0.1068	$ -	$ -
48	2057					$ -	-	$ -	$ 27,718,434	$ 874,848	$ 28,593,282	0.1018	$ -	$ 2,910,779.20
49	2058					$ -	-	$ -	$ -	$ -	$ -	0.0971	$ -	$ -
50	2059					$ -	-	$ -	$ 19,755,745	$ -	$ 19,755,745	0.0926	$ -	$ 1,828,498.97
51	2060					$ -	-	$ -	$ -	$ -	$ -	after		
52	2061					$ -	-	$ -	$ -	$ -	$ -	after		
53	2062					$ -	-	$ -	$ -	$ -	$ -	after		
54	2063					$ -	-	$ -	$ -	$ -	$ -	after		
55	2064					$ -	-	$ -	$ -	$ -	$ -	after		
56	2065					$ -	-	$ -	$ -	$ -	$ -	after		
57	2066					$ -	-	$ -	$ -	$ -	$ -	after		
58	2067					$ -	-	$ -	$ -	$ -	$ -	after		
59	2068					$ -	-	$ -			$ -	after		
					Total Construction =	$ 301,468,821	Total IDC =	$ 14,786,150		Total O&M =	$ 562,240,835	Total PW =	$ 301,468,821	$ 201,764,012
												CRF		0.05372
												Annual O&M		$ 10,839,223

Matagorda Ship Channel 44 ft x 400 ft
Preliminary Annual Cost Worksheet
DMMP Alternative 2A

Price Level 2006
Federal Discount Rate 4.875%

Base yr 2009 Proj Life 50

This is spreadsheet is intended for the comparison of preliminary alternatives only.
Base yr is year facilities become operational. All Present Worths adjusted to Base Year.
Assume Interest During Construction (IDC) from midpoint of year to end of base year
Other initial costs may include Aids to Navigation, Monitoring of Beneficial use areas, etc.
Costs do not include: Engineering & Design
Construction Administration
Pipeline Relocations
Contingency

Annual Cost Summary		
Construction Present Worth	$	248,049,980
+ Interest During Construction	$	12,166,114
Investment Cost	$	260,216,094
x Capital Recovery Factor		0.0537
= Interest & Amortization	$	13,979,402
+ Annual O&M	$	10,127,090
Total Annual Costs	$	24,106,493

Total Costs		2006
Construction	$	248,049,980
Total O&M	$	524,521,004
Total	$	772,570,984

Total Costs	Present Value at Base Year	
Construction	$	248,049,980
IDC	$	12,166,114
Total O&M	$	188,508,192
Total PW	$	448,724,287

Project		<-------- Construction Costs ---------->					Years of		Operation & Maintenance Costs			Present Worth		
Year	Year	GNF Dredging/ Containment	Associated Cost	Monitiring/ Other	E&D/SI&A	Total	Interest	Interest During Construction	Dredging	Levee	Total	Present Worth Factor	Construction	O&M
-3	2006	$ -	$ -		$ -	$ -	3.50	$ -	$ -	$ -	$ -	1.0000	$ -	$ -
-2	2007				$ -	$ -	2.50	$ -			$ -	1.0000	$ -	$ -
-1	2008	$ 124,024,990	$ -		$ -	$ 124,024,990	1.50	$ 9,178,978			$ -	1.0000	$ 124,024,990.00	$ -
0	2009	$ 124,024,990	$ -		$ -	$ 124,024,990	0.50	$ 2,987,137			$ -	1.0000	$ 124,024,990.00	$ -
1	2010	$ -	$ -	$ -	$ -	$ -	-	$ -	$ -	$ -	$ -	0.9535	$ -	$ -
2	2011			$ -	$ -	$ -	-	$ -	$ 18,200,386	$ -	$ 18,200,386	0.9092	$ -	$ 16,547,662.37
3	2012			$ -	$ -	$ -	-	$ -	$ -	$ -	$ -	0.8669	$ -	$ -
4	2013					$ -	-	$ -	$ 23,231,977	$ -	$ 23,231,977	0.8266	$ -	$ 19,204,290.80
5	2014					$ -	-	$ -	$ -	$ -	$ -	0.7882	$ -	$ -
6	2015					$ -	-	$ -	$ 18,200,386	$ -	$ 18,200,386	0.7516	$ -	$ 13,678,823.81
7	2016					$ -	-	$ -	$ -	$ -	$ -	0.7166	$ -	$ -
8	2017					$ -	-	$ -	$ 23,231,977	$ -	$ 23,231,977	0.6833	$ -	$ 15,874,877.34
9	2018					$ -	-	$ -	$ -	$ -	$ -	0.6516	$ -	$ -
10	2019					$ -	-	$ -	$ 18,200,386	$ -	$ 18,200,386	0.6213	$ -	$ 11,307,350.65
11	2020					$ -	-	$ -	$ -	$ -	$ -	0.5924	$ -	$ -
12	2021					$ -	-	$ -	$ 23,231,977	$ -	$ 23,231,977	0.5649	$ -	$ 13,122,678.32
13	2022					$ -	-	$ -	$ -	$ -	$ -	0.5386	$ -	$ -
14	2023					$ -	-	$ -	$ 18,200,386	$ -	$ 18,200,386	0.5136	$ -	$ 9,347,015.55
15	2024					$ -	-	$ -	$ -	$ -	$ -	0.4897	$ -	$ -
16	2025					$ -	-	$ -	$ 23,231,977	$ -	$ 23,231,977	0.4669	$ -	$ 10,847,623.11
17	2026					$ -	-	$ -	$ -	$ -	$ -	0.4452	$ -	$ -
18	2027					$ -	-	$ -	$ 18,200,386	$ -	$ 18,200,386	0.4245	$ -	$ 7,726,540.22
19	2028					$ -	-	$ -	$ -	$ -	$ -	0.4048	$ -	$ -
20	2029					$ -	-	$ -	$ 23,231,977	$ 687,553	$ 23,919,530	0.3860	$ -	$ 9,232,369.23
21	2030					$ -	-	$ -	$ -	$ -	$ -	0.3680	$ -	$ -
22	2031					$ -	-	$ -	$ 18,200,386	$ -	$ 18,200,386	0.3509	$ -	$ 6,387,003.80
23	2032					$ -	-	$ -	$ -	$ -	$ -	0.3346	$ -	$ -
24	2033					$ -	-	$ -	$ 23,231,977	$ 687,553	$ 23,919,530	0.3191	$ -	$ 7,631,769.93
25	2034					$ -	-	$ -	$ -	$ -	$ -	0.3042	$ -	$ -
26	2035					$ -	-	$ -	$ 18,200,386	$ -	$ 18,200,386	0.2901	$ -	$ 5,279,700.40
27	2036					$ -	-	$ -	$ -	$ -	$ -	0.2766	$ -	$ -
28	2037					$ -	-	$ -	$ 23,231,977	$ 687,553	$ 23,919,530	0.2637	$ -	$ 6,308,663.67
29	2038					$ -	-	$ -	$ -	$ -	$ -	0.2515	$ -	$ -
30	2039					$ -	-	$ -	$ 18,200,386	$ -	$ 18,200,386	0.2398	$ -	$ 4,364,368.21
31	2040					$ -	-	$ -	$ -	$ -	$ -	0.2286	$ -	$ -
32	2041					$ -	-	$ -	$ 23,374,788	$ 588,145	$ 23,962,933	0.2180	$ -	$ 5,224,404.69
33	2042					$ -	-	$ -	$ -	$ -	$ -	0.2079	$ -	$ -
34	2043					$ -	-	$ -	$ 18,343,197	$ -	$ 18,343,197	0.1982	$ -	$ 3,636,033.87
35	2044					$ -	-	$ -	$ -	$ -	$ -	0.1890	$ -	$ -
36	2045					$ -	-	$ -	$ 23,374,788	$ 588,145	$ 23,962,933	0.1802	$ -	$ 4,318,659.02
37	2046					$ -	-	$ -	$ -	$ -	$ -	0.1718	$ -	$ -
38	2047					$ -	-	$ -	$ 18,343,197	$ -	$ 18,343,197	0.1639	$ -	$ 3,005,661.20
39	2048					$ -	-	$ -	$ -	$ -	$ -	0.1562	$ -	$ -
40	2049					$ -	-	$ -	$ 23,374,788	$ 406,132	$ 23,780,920	0.1490	$ -	$ 3,542,824.98
41	2050					$ -	-	$ -	$ -	$ -	$ -	0.1421	$ -	$ -
42	2051					$ -	-	$ -	$ 18,378,454	$ -	$ 18,378,454	0.1354	$ -	$ 2,489,350.64
43	2052					$ -	-	$ -	$ -	$ -	$ -	0.1292	$ -	$ -
44	2053					$ -	-	$ -	$ 23,410,045	$ 486,866	$ 23,896,911	0.1231	$ -	$ 2,942,896.02
45	2054					$ -	-	$ -	$ -	$ -	$ -	0.1174	$ -	$ -
46	2055					$ -	-	$ -	$ 18,371,106	$ -	$ 18,371,106	0.1120	$ -	$ 2,056,953.65
47	2056					$ -	-	$ -	$ -	$ -	$ -	0.1068	$ -	$ -
48	2057					$ -	-	$ -	$ 26,333,795	$ 486,866	$ 26,820,661	0.1018	$ -	$ 2,730,327.43
49	2058					$ -	-	$ -	$ -	$ -	$ -	0.0971	$ -	$ -
50	2059					$ -	-	$ -	$ 18,371,106	$ -	$ 18,371,106	0.0926	$ -	$ 1,700,343.29
51	2060					$ -	-	$ -	$ -	$ -	$ -	after		
52	2061					$ -	-	$ -	$ -	$ -	$ -	after		
53	2062					$ -	-	$ -	$ -	$ -	$ -	after		
54	2063					$ -	-	$ -	$ -	$ -	$ -	after		
55	2064					$ -	-	$ -	$ -	$ -	$ -	after		
56	2065					$ -	-	$ -	$ -	$ -	$ -	after		
57	2066					$ -	-	$ -	$ -	$ -	$ -	after		
58	2067					$ -	-	$ -	$ -	$ -	$ -	after		
59	2068					$ -	-	$ -			$ -	after		
					Total Construction =	$ 248,049,980	Total IDC =	$ 12,166,114		Total O&M =	$ 524,521,004	Total PW =	$ 248,049,980	$ 188,508,192
													CRF	0.05372
													Annual O&M	$ 10,127,090

Matagorda Ship Channel 44 ft x 400 ft
Preliminary Annual Cost Worksheet
DMMP Alternative 2B

Price Level 2006

Federal Discount Rate 4.875%

Base yr 2009 Proj Life 50

This is spreadsheet is intended for the comparison of preliminary alternatives only.
Base yr is year facilities become operational. All Present Worths adjusted to Base Year.
Assume Interest During Construction (IDC) from midpoint of year to end of base year
Other initial costs may include Aids to Navigation, Monitoring of Beneficial use areas, etc.
Costs do not include: Engineering & Design
Construction Administration
Pipeline Relocations
Contingency

Annual Cost Summary		
Construction Present Worth	$	279,976,911
+ Interest During Construction	$	13,732,035
Investment Cost	$	293,708,946
x Capital Recovery Factor		0.0537
= Interest & Amortization	$	15,778,715
+ Annual O&M	$	9,703,645
Total Annual Costs	$	25,482,360

Total Costs		2006
Construction	$	279,976,911
Total O&M	$	496,571,950
Total	$	776,548,861

Total Costs		Present Value at Base Year
Construction	$	279,976,911
IDC	$	13,732,035
Total O&M	$	180,626,084
Total PW	$	474,335,031

Project		<-------- Construction Costs ---------->					Years of		Operation & Maintenance Costs			Present Worth		
Year	Year	GNF Dredging/ Containment	Associated Cost	Monitiring/ Other	E&D/SI&A	Total	Interest	Interest During Construction	Dredging	Levee	Total	Present Worth Factor	Construction	O&M
-3	2006	$ -	$ -		$ -	$ -	3.50	$ -	$ -	$ -	$ -	1.0000	$ -	$ -
-2	2007				$ -	$ -	2.50	$ -			$ -	1.0000	$ -	$ -
-1	2008	$ 139,988,456	$ -		$ -	$ 139,988,456	1.50	$ 10,360,419			$ -	1.0000	$ 139,988,455.50	$ -
0	2009	$ 139,988,456	$ -		$ -	$ 139,988,456	0.50	$ 3,371,616			$ -	1.0000	$ 139,988,455.50	$ -
1	2010	$ -	$ -	$ -	$ -	$ -	-	$ -	$ -	$ -	$ -	0.9535	$ -	$ -
2	2011			$ -	$ -	$ -	-	$ -	$ 19,988,494	$ -	$ 19,988,494	0.9092	$ -	$ 18,173,397.53
3	2012			$ -	$ -	$ -	-	$ -	$ -	$ -	$ -	0.8669	$ -	$ -
4	2013					$ -	-	$ -	$ 22,088,987	$ -	$ 22,088,987	0.8266	$ -	$ 18,259,458.93
5	2014					$ -	-	$ -	$ -	$ -	$ -	0.7882	$ -	$ -
6	2015					$ -	-	$ -	$ 17,057,396	$ -	$ 17,057,396	0.7516	$ -	$ 12,819,789.35
7	2016					$ -	-	$ -	$ -	$ -	$ -	0.7166	$ -	$ -
8	2017					$ -	-	$ -	$ 22,088,987	$ -	$ 22,088,987	0.6833	$ -	$ 15,093,849.28
9	2018					$ -	-	$ -	$ -	$ -	$ -	0.6516	$ -	$ -
10	2019					$ -	-	$ -	$ 17,057,396	$ -	$ 17,057,396	0.6213	$ -	$ 10,597,245.46
11	2020					$ -	-	$ -	$ -	$ -	$ -	0.5924	$ -	$ -
12	2021					$ -	-	$ -	$ 22,088,987	$ -	$ 22,088,987	0.5649	$ -	$ 12,477,055.69
13	2022					$ -	-	$ -	$ -	$ -	$ -	0.5386	$ -	$ -
14	2023					$ -	-	$ -	$ 17,057,396	$ -	$ 17,057,396	0.5136	$ -	$ 8,760,020.01
15	2024					$ -	-	$ -	$ -	$ -	$ -	0.4897	$ -	$ -
16	2025					$ -	-	$ -	$ 22,088,987	$ -	$ 22,088,987	0.4669	$ -	$ 10,313,930.92
17	2026					$ -	-	$ -	$ -	$ -	$ -	0.4452	$ -	$ -
18	2027					$ -	-	$ -	$ 17,057,396	$ -	$ 17,057,396	0.4245	$ -	$ 7,241,311.05
19	2028					$ -	-	$ -	$ -	$ -	$ -	0.4048	$ -	$ -
20	2029					$ -	-	$ -	$ 22,088,987	$ 765,765	$ 22,854,752	0.3860	$ -	$ 8,821,390.27
21	2030					$ -	-	$ -	$ -	$ -	$ -	0.3680	$ -	$ -
22	2031					$ -	-	$ -	$ 17,057,396	$ -	$ 17,057,396	0.3509	$ -	$ 5,985,897.94
23	2032					$ -	-	$ -	$ -	$ -	$ -	0.3346	$ -	$ -
24	2033					$ -	-	$ -	$ 22,088,987	$ 765,765	$ 22,854,752	0.3191	$ -	$ 7,292,041.66
25	2034					$ -	-	$ -	$ -	$ -	$ -	0.3042	$ -	$ -
26	2035					$ -	-	$ -	$ 17,057,396	$ -	$ 17,057,396	0.2901	$ -	$ 4,948,133.55
27	2036					$ -	-	$ -	$ -	$ -	$ -	0.2766	$ -	$ -
28	2037					$ -	-	$ -	$ 22,088,987	$ 765,765	$ 22,854,752	0.2637	$ -	$ 6,027,833.47
29	2038					$ -	-	$ -	$ -	$ -	$ -	0.2515	$ -	$ -
30	2039					$ -	-	$ -	$ 17,057,396	$ -	$ 17,057,396	0.2398	$ -	$ 4,090,284.50
31	2040					$ -	-	$ -	$ -	$ -	$ -	0.2286	$ -	$ -
32	2041					$ -	-	$ -	$ 22,231,798	$ 666,357	$ 22,898,155	0.2180	$ -	$ 4,992,261.52
33	2042					$ -	-	$ -	$ -	$ -	$ -	0.2079	$ -	$ -
34	2043					$ -	-	$ -	$ 17,200,207	$ -	$ 17,200,207	0.1982	$ -	$ 3,409,467.56
35	2044					$ -	-	$ -	$ -	$ -	$ -	0.1890	$ -	$ -
36	2045					$ -	-	$ -	$ 22,231,798	$ 666,357	$ 22,898,155	0.1802	$ -	$ 4,126,762.09
37	2046					$ -	-	$ -	$ -	$ -	$ -	0.1718	$ -	$ -
38	2047					$ -	-	$ -	$ 17,200,207	$ -	$ 17,200,207	0.1639	$ -	$ 2,818,374.29
39	2048					$ -	-	$ -	$ -	$ -	$ -	0.1562	$ -	$ -
40	2049					$ -	-	$ -	$ 22,231,798	$ 484,344	$ 22,716,142	0.1490	$ -	$ 3,384,196.88
41	2050					$ -	-	$ -	$ -	$ -	$ -	0.1421	$ -	$ -
42	2051					$ -	-	$ -	$ 17,235,464	$ -	$ 17,235,464	0.1354	$ -	$ 2,334,533.33
43	2052					$ -	-	$ -	$ -	$ -	$ -	0.1292	$ -	$ -
44	2053					$ -	-	$ -	$ 22,267,055	$ 565,078	$ 22,832,133	0.1231	$ -	$ 2,811,768.99
45	2054					$ -	-	$ -	$ -	$ -	$ -	0.1174	$ -	$ -
46	2055					$ -	-	$ -	$ 17,228,116	$ -	$ 17,228,116	0.1120	$ -	$ 1,928,976.74
47	2056					$ -	-	$ -	$ -	$ -	$ -	0.1068	$ -	$ -
48	2057					$ -	-	$ -	$ 22,259,707	$ 565,078	$ 22,824,785	0.1018	$ -	$ 2,323,549.62
49	2058					$ -	-	$ -	$ -	$ -	$ -	0.0971	$ -	$ -
50	2059					$ -	-	$ -	$ 17,228,116	$ -	$ 17,228,116	0.0926	$ -	$ 1,594,553.50
51	2060					$ -	-	$ -	$ -	$ -	$ -	after		
52	2061					$ -	-	$ -	$ -	$ -	$ -	after		
53	2062					$ -	-	$ -	$ -	$ -	$ -	after		
54	2063					$ -	-	$ -	$ -	$ -	$ -	after		
55	2064					$ -	-	$ -	$ -	$ -	$ -	after		
56	2065					$ -	-	$ -	$ -	$ -	$ -	after		
57	2066					$ -	-	$ -	$ -	$ -	$ -	after		
58	2067					$ -	-	$ -	$ -	$ -	$ -	after		
59	2068					$ -	-	$ -			$ -	after		
					Total Construction =	$ 279,976,911	Total IDC =	$ 13,732,035		Total O&M =	$ 496,571,950	Total PW =	$ 279,976,911	$ 180,626,084
													CRF	0.05372
													Annual O&M	$ 9,703,645