Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

Freeport LNG Liquefaction Project Phase II Modification Project

Draft Environmental Impact Statement

Freeport LNG Development, L.P
FLNG Liquefaction, LLC
FLNG Liquefaction 2, LLC
FLNG Liquefaction 3, LLC

Docket Nos. CP12-509-000
CP12-29-000
PF11-2-000
FERC/EIS-0250D
DOE/EIS-0487

Cooperating Agencies:

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OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas 3
Freeport LNG Development, L.P.
FLNG Liquefaction LLC
FLNG Liquefaction 2, LLC
FLNG Liquefaction 3, LLC
Docket Nos. CP12-509-000
CP12-29-000

TO THE PARTY ADDRESSED:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared a draft environmental impact statement (EIS) for the Freeport LNG Phase II Modification Project and the Liquefaction Project (Projects) proposed by Freeport LNG Development, L.P., FLNG Liquefaction LLC, FLNG Liquefaction 2, LLC, and FLNG Liquefaction 3, LLC (collectively referred to as Freeport LNG) in the above-referenced dockets. Freeport LNG requests authorization to export up to 13.2 million tons of liquefied natural gas (LNG) per year from its proposed Liquefaction Plant and associated facilities in Brazoria County, Texas and modify its previously approved Phase II Project facilities within the town of Quintana.

The draft EIS assesses the potential environmental effects of the construction and operation of the Liquefaction Project and Phase II Modification Project in accordance with the requirements of the National Environmental Policy Act (NEPA). The FERC staff concludes that approval of the Projects would have some adverse impacts; however, most of these impacts would be reduced to less than significant levels with the implementation of Freeport LNG's proposed mitigation and the additional measures recommended by the FERC staff in the draft EIS.

The United States Department of Energy (USDOE), United States Environmental Protection Agency (USEPA), United States Department of Transportation (USDOT), the United States Army Corps of Engineers (USACE), and the National Oceanic Atmospheric Administration (NOAA) Fisheries participated as cooperating agencies in the preparation of the draft EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and participate in the NEPA analysis. The USACE, USEPA, and USDOE can adopt and use the EIS to support their respective permit decisions after an independent review of the document. The USDOT and NOAA Fisheries cooperated in the preparation of this draft EIS because of their special expertise with respect to resources potentially affected by the proposal. Although the cooperating agencies provided input on the conclusions and recommendations presented in the draft EIS, the agencies will present their own conclusions and recommendations in their respective Records of Decision or other determinations for the Projects.

The proposed Phase II Modification Project includes modification to the previously authorized LNG vessel berthing dock, LNG transfer pipelines, LNG unloading arms; and the access road system. In addition, Freeport LNG would either eliminate or modify components of the previously authorized facility.

The Liquefaction Project consists of multiple components, including facilities at and adjacent to the existing LNG terminal and facilities located beyond Quintana Island. The Liquefaction Plant, located at and adjacent to the existing LNG terminal, would consist of three propane pre-cooled mixed refrigerant liquefaction trains, each capable of producing a nominal 4.4 million metric tons per annum of LNG for export, which equates to a total liquefaction capacity of approximately 1.8 billion cubic feet per day of natural gas.

To support the Liquefaction Plant, Freeport LNG proposes to construct a natural gas Pretreatment Plant located about 2.5 miles north of the existing Quintana Island Terminal. The Pretreatment Plant would process the gas for liquefaction. In addition several interconnecting pipelines and utility lines including a five-mile-long, 12-inch diameter boil-off gas feed pipeline from the Quintana Island terminal to the Pretreatment Plant (referred together as the Pipeline/Utility Line System). The Liquefaction Plant, the Pretreatment Plant, and the Pipeline/Utility Line System, together with the associated appurtenant structures, are collectively referred to as the Liquefaction Project.

The FERC staff mailed copies of the draft EIS to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Native American tribes; potentially affected landowners and other interested individuals and non-governmental organizations; newspapers and libraries in the project area; and parties to this proceeding. Individuals who requested a paper copy, and those who filed a comment will receive hard copy of the draft EIS, and others on our environmental mailing list will receive a CD version of the draft EIS. In addition, the draft EIS is available for public viewing on the FERC's website (www.ferc.gov) using the eLibrary link. A limited number of copies are available for distribution and public inspection at:

Federal Energy Regulatory Commission
Public Reference Room
888 First Street NE, Room 2A
Washington, DC 20426
(202) 502-8371

Any person wishing to comment on the draft EIS may do so. To ensure consideration of your comments on the proposal in the final EIS, it is important that the Commission receive your comments before **May 5, 2014.**

For your convenience, there are four methods you can use to submit your comments to the Commission. In all instances, please reference the Projects' docket numbers (CP12-509-000, or CP12-29-000) with your submission. The Commission encourages electronic filing of comments and has expert staff available to assist you at (202) 502-8258 or efiling@ferc.gov. Please carefully follow these instructions so that your comments are properly recorded.

1) You can file your comments electronically using the eComment feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. This is an easy method for submitting brief, text-only comments on a project.

2) You can file your comments electronically by using the eFiling feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. With eFiling, you can provide comments in a variety of formats by attaching them as a file with your submission. New eFiling users must first create an account by clicking on "eRegister." If you are filing a comment on a particular project, please select "Comment on a Filing" as the filing type.

3) You can file a paper copy of your comments by mailing them to the following address:

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

4) In lieu of sending written or electronic comments, the Commission invites you to attend the public comment meeting its staff will conduct in the project area to receive comments on the draft EIS. We encourage interested groups and individuals to attend and present oral comments on the draft EIS. Transcripts of the meetings will be available for review in eLibrary under the Projects' docket numbers.

Date	**Location**
Wednesday, April 16, 2014 6:30 PM	Lake Jackson Civic Center 333 Highway 332 E Lake Jackson, TX 77566 (979) 415-2600

After the comments are reviewed, any significant new issues will be investigated and a final EIS will be published. The final EIS will contain FERC staff's responses to timely comments received on the draft EIS.

Any person seeking to become a party to the proceeding must file a motion to intervene pursuant to Rule 214 of the Commission's Rules of Practice and Procedures (18 CFR Part 385.214).[1] Only intervenors have the right to seek rehearing of the Commission's decision. The Commission grants affected landowners and others with environmental concerns intervenor status upon showing good cause by stating that they have a clear and direct interest in this

[1] See the previous discussion on the methods for filing comments.

proceeding which no other party can adequately represent. **Simply filing environmental comments will not give you intervenor status, but you do not need intervenor status to have your comments considered.**

Questions?

Additional information about the Projects is available from the Commission's Office of External Affairs, at **(866) 208-FERC,** or on the FERC (www.ferc.gov) using the eLibrary link. Click on the eLibrary link, click on "General Search," and enter the docket number excluding the last three digits in the Docket Number field (i.e., CP12-509, CP12-29). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FERConlinesupport@ferc.gov or toll free (866) 208-3676; for TTY, contact (202) 502-8659. The eLibrary link also provides access to the texts of formal documents issued by the Commission, such as orders, notices, and rulemakings.

In addition, the Commission offers a free service called eSubscription that allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. Go to http://www.ferc.gov/docs-filing/esubscription.asp.

Kimberly D. Bose

Secretary

ENVIRONMENTAL IMPACT STATEMENT
FREEPORT LNG
LIQUEFACTION PROJECT AND PHASE II MODIFICATION

TABLE OF CONTENTS

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

AAQS	ambient air quality standards
ACHP	Advisory Council on Historic Preservation
AEGLs	Acute Exposure Guideline Level
AirData	USEPA AirData database
amsl	above mean sea level
ANSI	American National Standards Institute
APE	Area of Potential Effect
AQCRs	Air quality control regions
ATWS	additional temporary workspace
BA	Biological Assessment
BACT	Best Available Control Technology
BCC	Birds of Conservation Concern
Bcf	billion cubic feet
Bcf/d	billion cubic feet per day
BCGCD	Brazoria County Groundwater Conservation District
BCR 37	Bird Conservation Region 37
bgs	below ground surface
BIA	Bureau of Indian Affairs
BLEVE	boiling-liquid-expanding-vapor explosion
BOG	boil-off gas
Brazos Pilots	Brazos Pilots Association
BWA	Brazosport Water Authority
BWE	Ballast Water Exchange
CAA	Clean Air Act
CAER	Community Awareness & Emergency Response
CCC	Coastal Coordination Council
CCMA	Center for Coastal Monitoring and Assessment
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CMP	Coastal Management Program
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
COTP	Captain of the Port
CR	County Road
CWA	Clean Water Act
CWS	Construction workspace
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
dBA	decibels on the A-weighted scale
DMPA	Dredged Material Placement Area
DO	dissolved oxygen
Dow	Dow Chemical Company
EA	Environmental Assessment
EAP-EA	Export Authorization Project Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EI	Environmental Inspector

EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESD	emergency shutdown
F	Fahrenheit
FEED	Front-End Engineering Design
FEMA	Federal Emergency Management Agency
FERC or Commission	Federal Energy Regulatory Commission
FHC	Freeport Harbor Channel
FIRM	Flood Insurance Rate Map
FLDP	Facility Lighting Design Plan
FLNG	Freeport LNG
FM	Farm-to-Market
FMP	Fishery Management Plans
FOC	Freeport Oil Company
Freeport LNG's Procedures	Refers collectively to Freeport Plan that includes FERC's Upland Erosion Control, Revegetation, and Maintenance Plan and Wetland and Waterbody Construction and Mitigation Procedures and Freeport LNG's two variances to these procedures
FWS	U.S. Fish and Wildlife Service
g	Acceleration due to gravity
GCBO	Gulf Coast Bird Observatory
GHG	greenhouse gas
GMFMC	Gulf of Mexico Fishery Management Council
gpd	gallons per day
gpm	gallons per minute
H_2S	hydrogen sulfide
H2SO4	sulfuric acid mist
HAPs	Hazardous Air Pollutants
HAZID	hazard identification
HAZOP	hazard and operability
HDD	Horizontal directional drill
HG-AQCR	Metropolitan Houston-Galveston Intrastate AQCR
HGB	Houston-Galveston-Brazoria
hp	Horsepower
ICW	Intracoastal Waterway
INEOS	INEOS Group Limited
IPCC	Intergovernmental Panel on Climate Change
ISDs	Independent School Districts
km	kilometers
kV	kilovolt
LAER	Lowest Achievable Emission Rate
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
LFL	lower flammability limit
Liquefaction Plant	Liquefaction trains and their support facilities
LNG	Liquefied Natural Gas
L_{Night}	night sound level
L_{max}	maximum impact noise level
LOI	Letter of Intent
LOS	Level of Service
LPG	liquefied propane gas

LULC	Land Use/Land Cover
m^3	cubic meter
m^3/hr	cubic meters per hour
MACT	Maximum Achievable Control Technology
MARPOL	International Convention for the Prevention of Pollution from Ships
MBTA	Migratory Bird Treaty Act
mph	miles per hour
MLV	mainline valve
MMPA	Marine Mammal Protection Act
MMscfd	million standard cubic feet per day
MOU	Memorandum of Understanding
MP	milepost
MSA	Magnuson-Stevens Fishery Conservation and Management Act
msl	mean sea level
mtpa	million metric tons per annum
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAISA	National Aquatic Invasive Species Act of 2003
NANPCA	Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990
NCA	National Climate Assessment
NAVD 88	North American Vertical Datum 1988
NBS	Neotropical Bird Sanctuary
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NGA	Natural Gas Act
NGL	Natural Gas Liquid
NHPA	National Historic Preservation Act
NISA	National Invasive Species Act of 1996 (NISA)
NNSR	Nonattainment New Source Review
NO_2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	NOAA's National Marine Fisheries Service
NOAA/NOS	National Oceanic and Atmospheric Administration/National Oceanic Survey
NOI	Notice of Intent
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSA	Noise Sensitive Area
NSPS	New Source Performance Standards
NSR	New Source Review
NWR	National Wildlife Refuge
O_3	ozone
ODMDS	Ocean Dredged Material Disposal Site
OEP	Commission’s Office of Energy Projects
OPF	New operational footprint
Pb	lead
PHMSA	Pipeline and Hazardous Materials Safety Administration
P&IDs	Piping and Instrument Diagrams
PJD	Preliminary Jurisdictional Determination
PM_{10}	Respirable Particulate

$PM_{2.5}$	Fine Particulate
ppm	parts per million
ppmv	parts per million on a volume basis
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
psig	pounds per square inch gauge
PSM	Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents
PUC	Public Utility Commission
RFP	Reasonable Further Progress
RHA	Rivers and Harbors Act of 1899
RRC	Railroad Commission of Texas
SAFMC	South Atlantic Management Fishery Council
SAV	submerged aquatic vegetation
SEP	surface emissive power
SH	State Highway
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO_2	sulfur dioxide
SPCC Plan	Spill Prevention, Control and Countermeasure Plan
Supplemental NOI	Supplemental Notice of Intent to Prepare an Environmental Impact Statement for the Planned Liquefaction Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting
SWPPP	Stormwater Pollution Prevention Plan
TAC	Texas Administrative Code
TBBA	Texas Bird Breeding Atlas
TCEQ	Texas Commission for Environmental Quality
TCMP	Texas Coastal Management Program
TDCJ	Texas Department of Criminal Justice
TPWD	Texas Parks and Wildlife Department
tpd	tons per day
TRRP	Texas Risk Reduction Program
TxDOT	Texas Department of Transportation
tpy	tons per year
UFL	upper flammability limit
ug/m^3	Micrograms per Cubic Meter
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USDOE	U.S. Department of Energy
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey
UTC	Upper Texas Coast
VOC	volatile organic compound
WMA	Wildlife Management Area
WSA	Waterway Suitability Assessment
yd^3	cubic yards

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Introduction

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared this draft Environmental Impact Statement (EIS) to assess the environmental impact associated with the construction of facilities proposed by Freeport LNG.[1] in accordance with the requirements of the National Environmental Policy Act (NEPA) and the Commission's implementing regulations under Title 18 Code of Federal Regulations (CFR) Part 380.

Freeport LNG has submitted separate proposals to the Commission for authorization to: (1) to modify previously authorized facilities at Freeport LNG's existing Quintana Island terminal known as the Phase II Modification Project in Docket No. CP12-29-000 for support of liquefied natural gas (LNG) export or import and (2) develop new liquefaction facilities and LNG export capacity known as the Liquefaction Project in Docket No. CP12-509-000 (collectively referred to as the Projects).

The purpose of the EIS is to inform the FERC decision-makers, the public, and the permitting agencies about the potential adverse and beneficial environmental impacts of the proposed Projects and its alternatives, and recommend mitigation measures that would reduce adverse impacts to the extent practicable. The FERC prepared this analysis based on information provided by Freeport LNG and further developed from data requests, field investigations, scoping, literature research, and contacts with or comments from federal, state, and local agencies, individual members of the public, and Commission staff analysis.

The U.S. Department of Energy (USDOE) has exclusive jurisdiction over the export of natural gas as a commodity. USDOE has delegated to the Commission authority to approve or disapprove the construction and operation of particular facilities, the site at which such facilities will be located, and with respect to natural gas that involves the construction of new domestic facilities, the place of entry for imports or exit for exports. Therefore, the FERC is the lead federal agency for the preparation of this draft EIS in compliance with the requirements of NEPA. The USDOE, U.S. Environmental Protection Agency (USEPA), U.S. Department of Transportation (USDOT), the U.S. Army Corps of Engineers (USACE), and the National Oceanic and Atmospheric Administration (NOAA) - Office of Protected Resources, are cooperating agencies for the development of the draft EIS consistent with 40 CFR 1501.6(b). A cooperating agency has jurisdiction by law or has special expertise with respect to environmental resource issues associated with the Projects.

Proposed Action

The proposed Phase II Modification Project includes modification to the previously authorized LNG vessel berthing dock, LNG transfer pipelines, LNG unloading arms, and the access road system. In addition, Freeport LNG would not construct components of the previously authorized

[1] Freeport LNG Development, L.P., FLNG Liquefaction, LLC, FLNG Liquefaction 2, LLC, and FLNG Liquefaction 3, LLC.

facility, including vaporization equipment that was approved to increase the LNG Terminal's sendout capacity.

The Liquefaction Project consists of multiple components, including facilities at and adjacent to the existing Quintana Island LNG terminal and facilities located beyond Quintana Island. The Liquefaction Plant, located at and adjacent to the existing LNG terminal, would consist of three propane pre-cooled mixed refrigerant liquefaction trains, each capable of producing a nominal 4.4 million metric tons per annum (mtpa) of LNG (13.2 mtpa total) for export, which equates to a total liquefaction capacity of approximately 1.8 billion cubic feet per day of natural gas.

In support of the Liquefaction Plant, Freeport LNG proposes to construct a natural gas Pretreatment Plant located about 2.5 miles north of the existing Quintana Island terminal. The Pretreatment Plant would process the gas for liquefaction. In addition, several interconnecting pipelines and utility lines including a 5.0-mile-long, 12-inch diameter boil-off gas (BOG) feed gas line from the terminal to the Pretreatment Plant (Referred together as the Pipeline/Utility Line System). The Liquefaction Plant, the Pretreatment Plant, and the Pipeline/Utility Line System, together with the associated appurtenant structures, are collectively referred to as the Liquefaction Project.

Public Outreach and Comments

On January 5, 2011, the Director of the Office of Energy Projects granted Freeport LNG's request to utilize our Pre-Filing Process for the Liquefaction Project. On August 11, 2011, we issued a *Notice of Intent to Prepare an Environmental Assessment for the Planned Liquefaction Project and Request for Comments on Environmental Issues and Notice of Public Scoping Meeting* (NOI). The NOI was mailed to interested parties, including federal, state, and local officials; agency representatives; conservation organizations; Native American tribes; local libraries and newspapers; and property owners in the project area. On September 8, 2011, we[2] conducted a scoping meeting in Lake Jackson, Texas to provide the public an opportunity to learn about the Liquefaction Project, FERC's process, and provide comments on the record. Four, out of the approximately 20 members of the public attending the scoping meeting provided comments.

After Freeport LNG filed the application for the Phase II Modification Project on December 9, 2011 we determined the need to analyze both projects in this draft EIS. On July 19, 2012, we issued a *Supplemental Notice of Intent to Prepare an Environmental Impact Statement for the Planned Liquefaction Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting* (Supplemental NOI). The Supplemental NOI included both the Liquefaction Project and the Phase II Modification Project and was mailed to interested parties.

On August 9, 2012, we conducted a second public scoping meeting in Lake Jackson, Texas to provide an opportunity for the public to learn more about the newly proposed modifications to the proposed export terminal and Pretreatment Plant and to provide comments on environmental issues to be addressed in the draft EIS. At this scoping meeting, we received 24 comments from

[2] We; us; our; equals FERC Staff

the approximately 80 members of the public attending the scoping meeting. As of February 28, 2014, we have received a total of 186 comment letters and two petitions (a petition in opposition signed by 323 people associated with the Liquefaction Project, and a second letter disavowing the petition signed by 57 landowners from Quintana Island).

Issues identified during the public comment process and public meetings included: alternatives to the various locations of the Projects; concerns about safety such as the potential for fires, explosions, and spills, concerns about emergency response capability; the ability of the facility to withstand hurricanes and their associated storm surges; climate change; traffic impacts during construction, visual impacts, lighting impacts, noise and vibration during construction and operation, air emissions and concerns about air quality impacts to residents and wildlife.

Alternatives Considered

We conducted an alternatives analysis for the Liquefaction Project and Phase II Modification Project and found no other practicable alternative that would result in less environmental impact that would still address the purpose and need of the Projects. Alternatives considered included the no action alternative, system alternatives, and site alternatives.

With respect to the no action alternative, we concluded this alternative is not viable as the purpose of the proposed Projects would not be met and Freeport LNG would not be able to provide U.S. natural gas producers with new access to global gas suppliers and meet Freeport LNG's contractual obligations.

For the Phase II Modification Project, we determined that the location, design, and purpose is wholly dependent on the existing plant facilities and operations at the Quintana Island terminal; therefore, other geographically separate sites beyond the terminal were not evaluated and no system alternatives exist that could achieve the same level of functional integration or optimize the terminal's operational flexibility and capabilities.

With respect to system alternatives for the Liquefaction Project, we analyzed other proposed LNG export facilities on the West Coast, Gulf Coast, and East Coast of the United States and whether these could be considered system alternatives. In all cases we found that these alternatives would not address the Liquefaction Project's purpose and would not offer any significant environmental advantage.

We considered the possibility of expanding the size of another proposed LNG export terminal to address Freeport LNG's desired export capacity. However, this alternative would involve further impacts such as: construction of additional liquefaction infrastructure plus the potential need for expanded docking facilities. Hence, the environmental impacts would not be significantly different than those that would occur as a result of Freeport LNG's proposals.

We evaluated site alternatives for the components of the Liquefaction Project, but did not find any viable alternatives. Siting of the Liquefaction Plant was dictated by the need to be close to the existing offloading areas, LNG storage tanks, docking area, and other existing LNG infrastructure at the Quintana Island terminal. The proposed siting makes maximum use of the available areas within the existing Quintana Island terminal.

We also evaluated the feasibility of lowering the pad elevation of the Liquefaction Plant to determine whether this would lessen impacts on visibility, noise, safety, stormwater, and site engineering. We concluded that this would not provide substantial improvements in visibility and noise attenuation, and would result in significant safety, engineering, traffic and soil disposal issues.

With respect to the siting of the Pretreatment Plant, we assessed six alternative sites, all of which were deemed unsuitable due to site constraints and or environmental impacts, except for two sites, Site E and Site F. However, based on comments from residents regarding the lack of a suitable evacuation route in case of emergency at Site E, and concerns about noise, air emissions, water discharges, materials storage, and flood protection, we determined Site F is the preferred site. As a result of concerns expressed by people living near Site F, we evaluated four additional alternative sites. However, these sites were not preferable to the proposed site.

With respect to siting of the Pipeline/Utility Line System, the main criteria were the functional interdependency and geographic locations of the proposed process facilities (Liquefaction Plant and Pretreatment Plant), Freeport LNG's existing natural gas sendout pipeline, and the existing sendout pipeline meter station at Stratton Ridge. The Liquefaction Plant, Pretreatment Plant, and Stratton Ridge Meter Station represent fixed receipt or delivery points for the natural gas transported by the sendout pipeline and utilized in the liquefaction process. The existing sendout pipeline route constitutes the preferred route as it follows an area already disturbed right-of-way and minimizes environmental impacts.

Environmental Impacts and Mitigations

We evaluated the construction and operation impacts of the proposed Liquefaction Project and Phase II Modification Project, as minimized by Freeport LNG's proposed mitigation measures, on geology, soils, water resources, vegetation, wildlife, fisheries, special status species, land use, visual resources, socioeconomics, cultural resources, air quality, noise, and safety. Where necessary, we recommended additional mitigation measures to minimize or avoid impacts on the above resources. Section 5.15 of this draft EIS contains the mitigation measures that we recommend be attached as conditions to any authorization issued by the Commission.

We are requesting that the U.S. Fish and Wildlife Service (USFWS) and NOAA's National Marine Fisheries Service (NOAA) Fisheries consider the draft EIS as the official Biological Assessment (BA) for the Projects. As consultation with each agency is ongoing, we are recommending that Freeport LNG not begin construction activities until we complete our consultations with the USFWS and NOAA Fisheries.

To ensure that our responsibilities under Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations are met, we are recommending that Freeport LNG not begin construction until all outstanding survey and evaluation reports have been reviewed and we provide written notification to proceed.

Also, to ensure consistency with the requirements of the Coastal Zone Management Act (CZMA), we are recommending that Freeport LNG not begin construction until it files Texas' determination of the consistency with the applicable provisions of the CZMA for the Projects.

The Projects would predominantly result in direct impacts on waterbodies, wetlands, socioeconomics (construction traffic and housing of construction workers), noise, safety, and air quality. We also considered the cumulative impacts of the proposed Projects with other past, present, and reasonably foreseeable actions in the Brazoria County region. These affected resources are described below along with mitigation to minimize such impacts.

Waterbodies

Along the Freeport Harbor Channel and Intracoastal Highway (ICW), dredging of approximately 1,333,000 cubic yards of material would be required to expand the existing berthing dock, construction docks, firewater intake, and to modify the previously approved Phase II dock. To minimize impacts associated with dredging, Freeport LNG has developed a Dredging Plan that outlines procedures to minimize the spread of turbidity in surface waters. The construction of the Projects would involve crossing and or work within 28 waterbodies. To minimize impacts on surface waters, Freeport LNG would adhere to FERC's Upland Erosion Control, Revegetation, and Maintenance Plan, and Wetland and Waterbody Construction and Mitigation Procedures with two alternative measures, herein referred to as Freeport LNG's Procedures. In addition, Freeport LNG would adhere to its Spill Prevention, Control and Countermeasure Plan (SPCC Plan), and would use horizontal directional drilling (HDD) technology to entirely avoid construction impacts on six waterbody crossings along the Pipeline/Utility Line System route.

Potentially, discharge of ballast water in the terminal's berthing area could provide a pathway for the introduction of exotic aquatic nuisance species into U.S. coastal waters. However, operation of the Liquefaction Project would not result in any increase in the maximum number of vessel visits (400 per year) that were previously authorized by the Commission and Freeport LNG would be required to comply with strict U.S. Coast Guard (USCG) regulations over the discharge of ballast water designed to prevent introduction of exotic species into U.S. waters. Given the above mitigation, we concluded that impacts on waterbodies would not be significant.

Wetlands

The Projects would result in the temporary impacts on 25.6 acres and permanents impact on 19.0 acres of wetlands. Additional wetlands would have temporary impacts from sedimentation due to turbidity from dredging activities. The implementation of the Freeport LNG's Procedures would minimize impacts on wetlands. Freeport LNG would also adhere to requirements of a Stormwater Pollution and Prevention Plan (SWPPP Plan) and its SPCC Plan to ensure the avoidance of indirect impacts from stormwater runoff and or accidental spills on the wetlands. Freeport LNG would also provide compensatory mitigation for wetlands in accordance with the USACE regulatory requirements. We have included a condition requiring that Freeport LNG provide the Compensatory Wetland Mitigation Plan prior to the end of the draft comment period to confirm the wetland mitigation. Therefore, with the avoidance measures identified and our recommended condition, we concluded that the impacts on wetlands due to construction and operation of the Projects would not be significant.

Socioeconomics

The Liquefaction Project would require, during the peak construction period, greater than 3,000 temporary construction workers and operation of the Liquefaction Project facilities would require the addition of about 163 permanent workers, significantly greater than that required for the original terminal construction. While there may be temporary and minor reductions of the supply of temporary housing and increased congestion of roadways near the Projects, there are sufficient resources (*i.e.*, housing, emergency services, roadway capacity, school system and other municipal services) to address both the temporary influx of workers who may want to move to the area, and the permanent workers to fill the 163 job openings. We recommended that Freeport LNG provide a Transportation Management Plan prior to construction to mitigate the traffic associated with the additional construction and worker traffic.

Nearby residents, especially those of the Town of Quintana would be affected by the large increase in construction and worker vehicle traffic. This would be minimized to the extent practicable by the Transportation Management Plan. However we concluded that construction traffic would result in significant and unavoidable impacts on the residents of the Town of Quintana during construction of the Liquefaction Plant and Phase II Modification Projects. For the wider Brazoria County, our recommendations and Freeport LNG's construction plans would mitigate these impacts and they would not be significant.

For other socioeconomic factors, we concluded that the construction and operation of the Projects and the Phase II Modification Project would not have a significant adverse impact on local public services, property values, and disadvantaged communities.

Safety and Reliability

We evaluated the safety of the proposed pipeline and LNG facilities associated with the Projects, including a review of the cryogenic design of the facilities proposed for liquefaction, related facilities, and safety systems. Based on our technical review of the preliminary engineering designs, we conclude that sufficient safeguards would be included in the facility designs to mitigate the potential for an incident that could damage the facility, injure operating staff, or impact the safety of the off-site public.

As part of our review, we also assessed the potential for public safety impacts using the information which Freeport LNG supplies to comply with the federal siting standards in 49 CFR 193. To ensure this we recommended that prior to the end of the Draft EIS comment period Freeport LNG identify how the portion of the vapor cloud extending onto the ExxonMobil facility would comply with the exclusion zone requirements of 49 CFR 193. This small area of the ExxonMobil property that the vapor dispersion extends over is an adjacent industrial property and is not publicly accessed.

To ensure safety and reliability, we identified specific recommendations for the Projects to be addressed by Freeport LNG prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, and prior to commencement of service (see section 5.15). Based on our review of Freeport LNG's siting analyses, we concluded that potential hazards from the Projects would also not have a significant impact on public safety and would only represent a slight increase in risk to the nearby public.

Air Quality

Air emissions during the construction of the proposed Projects would consist of tailpipe emissions (due to fossil fuel combustion from equipment and vehicles) and fugitive dust (ground and roadway dust).

These emissions would be temporary and may vary in intensity and composition over the 4.5 years of construction. While the construction emissions would significantly affect air quality in the region, they may cause elevated dust and pollutant levels in close proximity to residents of the Town of Quintana Island and near to the Pretreatment Plant. Freeport LNG must comply with General Conformity; thus we recommended that Freeport LNG offset the emissions of nitrogen oxides (NO_x) and volatile organic compounds (VOC) from construction, obtain a specific commitment from the Texas Commission on Environmental Quality (TCEQ) to account for emissions of NO_x and VOC in the region's State Implementation Plan (SIP), or otherwise comply with a General Conformity demonstration under the Clean Air Act (CAA).

Air emissions from the operation of the Liquefaction Plant, and Pretreatment Plant stationary sources would be minimized by using electric-powered equipment, high-efficiency equipment, state of the art emission controls, burning natural gas, and using proper maintenance and operating procedures. In addition, Freeport LNG would obtain air quality permits from the USEPA and the TCEQ for the Liquefaction Plant and the Pretreatment Plant.

The ship emissions associated with the proposed Projects would be minimized by the use of BOG as the primary fuel in the LNG boilers and engines, and the use of low-sulfur marine diesel in the tug vessels.

As part of the TCEQ permitting process, Freeport LNG used an air quality model to estimate the air quality impacts from the facility. The model demonstrated that air quality impacts from the facilities and surrounding industrial facilities would not exceed the National Ambient Air Quality Standards (NAAQS). We updated this air quality model using revised emissions from the LNG vessels and escort vessels. We confirmed that, although cumulative impacts from all the industrial facilities in the area combined with operation of the Projects would exceed the NAAQS for particulate matter less than 2.5 micrometers, Freeport LNG's facilities are not the cause of the exceedance. Thus, we conclude that impacts on air quality would not be significant.

Noise

Residents in the immediate vicinity of construction activities at the Pretreatment and Liquefaction Plant would experience an increase in noise during the 48-54 months of construction but this would vary in intensity during the construction period and be confined to daytime hours. Certain construction activities at the Liquefaction Plant, such as HDD work, dredging, and pile driving, would have 24-hour, or impulse noise impacts and result in greater annoyance of the residents on Quintana Island. Based upon Freeport LNG's noise estimates, noise from pile driving at the Liquefaction Plant would be indistinctly heard by Quintana Island residents with noise increases up to 21 decibels on the A-weighted scale (dBA) over background noise levels and above 55 dBA for up to 3 years. Dredging activities have the potential for 24-hour per day elevated noise impacts sustained over approximately 120 days. Freeport LNG has estimated that the noise from dredging would be greater than 55 dBA day-night average sound level (L_{dn}) at one residence. To address noise concerns associated with both pile driving and dredging, we have recommended that Freeport LNG submit a Construction Noise Mitigation Plan that outlines measures to reduce dredging noise to no greater than 55 dBA L_{dn} at all Noise Sensitive Areas (NSA), and includes mitigation measures to reduce pile driving noise to no greater than 10 dBA over background levels. However, this would represent a doubling of existing ambient noise and would be a significant and unavoidable adverse impact on the residents of the Town of Quintana during construction.

HDD noise for the pipeline construction would elevate noise levels at several NSAs from the multiple HDDs; however, at locations where noise would be above 55 dBA L_{dn}, Freeport LNG committed to install mitigation to reduce noise to below 55 dBA L_{dn} where technically feasible.

Operation of the Pretreatment Plant would increase overall noise for nearby residents; however, the noise attributable to the facility would remain below 55 dBA L_{dn}. As well, operational noise at the Liquefaction Plant would remain below 55 dBA L_{dn}, except in some locations, where Freeport LNG has purchased the properties to address this issue. We recommended that Freeport LNG conduct a noise survey to confirm compliance with operational noise level requirements at both the Pretreatment and Liquefaction Plants.

The Liquefaction Plant, ship loading, and LNG vessel movement would be another source of operational noise for residents on Quintana Island. LNG vessel movement may cause short-term noise elevation above 55 dBA L_{dn}. In addition, Freeport LNG’s analysis revealed that during LNG vessel backing, moderately perceptible vibration would occur at an NSA. As a result, we recommended that Freeport prepare a Ship Noise & Vibration Monitoring Plan that details how Freeport LNG would monitor noise and vibration from LNG ship movement and loading operations to ensure that noise would not exceed 55 dBA L_{dn}, and would not cause vibration in excess of the Clearly Perceptible Vibration Threshold under American National Standards Institute (ANSI) S12.2-2008.

In summary, construction of the Projects would result in significant and unavoidable noise impacts to the residents of the Town of Quintana. However with the recommendations discussed above, operational noise and vibration would be minimized and not result in a significant impact on residents.

Cumulative Impacts

As detailed in each section of the draft EIS, we determined that the most impacts on each resource from the Projects would not be significant. However, the large number of workers at the Quintana Island terminal, the extended construction period, and large area of construction would result in aggregate significant adverse impacts from significant noise and traffic impacts as well as adverse dust and air pollutants during construction. Although individual members of the Town of Quintana would be affected to a greater or lesser extent, for many individuals, the impacts on the residents would be significant and unavoidable.

Freeport LNG's Projects would not have any significant and readily identifiable cumulative impacts with other projects in the area. While some additive effects would occur, no compounding effects have been identified. Many such effects would be precluded by the degree of geographic separation between the various projects, which is also the case with visual impacts. Similarly, construction and operation of the Projects along with other facilities would produce impacts additive to the existing air quality problems in Brazoria County, however we concluded that the Projects would not be the primary cause of any violation of the NAAQS.

With respect to socioeconomic factors other than visual impacts, Freeport LNG's Projects would contribute to cumulative impacts in so much as the demand for housing and jobs would increase and there would be associated additional burdens on road usage and public services. However, these impacts would essentially be additive rather than compounding. Some socioeconomic impacts on the Town of Quintana would be positive such as additional tax base. However, overall cumulative impacts associated with Freeport LNG's Projects should not result in significant additional burdens on public services, housing or other socioeconomic factors in Freeport, Brazosport, and across Brazoria County.

Conclusions

Construction and operation of Freeport LNG's Liquefaction Project and the Phase II Modification Project would result in mostly temporary and short-term environmental impacts. Based upon the mitigation that Freeport LNG has identified, and our conditions, we conclude that the Projects would be in compliance with the Endangered Species Act (ESA), the NHPA, the CAA, and the CZMA.

We concluded that if the Liquefaction Project and the Phase II Modification Project are constructed and operated in accordance with Freeport LNG's application, proposed mitigation, and our recommendations presented in section 5.15 of the draft EIS, the Projects would result in some adverse environmental impacts. The impacts would not be significant except for traffic, noise and aggregate impacts on the residents of the Town of Quintana during construction. The principal reasons for our decision include:

- the site of the Liquefaction Facility would be an expansion of an existing, operating LNG import terminal with existing LNG storage tanks and berthing and loading/unloading facilities;

- Freeport LNG would implement its dredging plan to minimize impacts of in-water dredging, implement the use of Freeport's Procedures to minimize construction impacts on soils, wetlands, and waterbodies, and use HDD to minimize impacts to wetlands and waterways;

- adequate safety features would be incorporated into the design and operation of the Projects;

- the Pipeline/Utility Line System follows the existing sendout pipeline and would be contained within the already disturbed right-of-way;

- the Projects would have no effect or would be not likely to adversely affect any federally or state-listed threatened or endangered species;

- air emissions from the Projects would not exceed of the NAAQS, and noise and vibration impacts would be minimized; and

- the FERC's environmental and engineering inspection and mitigation monitoring program for this Project would ensure compliance with all mitigation measures and conditions of any FERC Authorization.

1.0 INTRODUCTION

The staff of the Federal Energy Regulatory Commission (FERC or Commission) prepared this draft Environmental Impact Statement (EIS) to assess the environmental impacts associated with the construction and operation of facilities proposed by Freeport LNG[3] in accordance with the requirements of the National Environmental Policy Act (NEPA). The proposed liquefied natural gas (LNG) facilities would be located in Brazoria County, Texas.

Freeport LNG submitted two applications to the Commission for authorization to (1) modify previously authorized facilities on Quintana Island known as the Phase II Modification Project in Docket No. CP12-29-000, and (2) develop new liquefaction and LNG export facilities known as the Liquefaction Project in Docket No. CP12-509-000 (collectively called Projects). This draft EIS analyzes the effects of these two interconnected projects. A final EIS will be prepared to respond to comments received on this draft EIS. The Commission will use the final EIS in its decision-making process to determine whether to authorize Projects.

The FERC is the federal agency responsible for evaluating applications to construct and operate interstate natural gas facilities. We[4] prepared this draft EIS in compliance with the requirements of NEPA and the Council on Environmental Quality (CEQ) regulations for implementing NEPA (Title 40 Code of Federal Regulations [CFR] Parts 1500-1508), and the Commission's regulations for implementing the NEPA (Title 18 CFR Part 380).

The U.S. Department of Energy (USDOE), U.S. Environmental Protection Agency (USEPA), U.S. Department of Transportation (USDOT), the U.S. Army Corps of Engineers (USACE), and the National Oceanic and Atmospheric Administration (NOAA) - Office of Protected Resources are cooperating agencies for the development of the draft EIS. A cooperating agency has jurisdiction by law or special expertise with respect to environmental impacts involved with the proposal, and is involved in the NEPA analysis.

1.1 REGULATORY BACKGROUND

The proposal involves the construction of facilities necessary to export LNG to foreign countries, and amending the operation of the previously authorized facilities, which requires Commission approval under Natural Gas Act (NGA) Section 3.[5] While Section 3(a) provides that an application shall be approved if the proposal "will not be inconsistent with the public interest," Section 3 also provides that an application may be approved "in whole or in part, with such modification and upon such terms and conditions as the Commission may find necessary or appropriate." Section 3(a) also provides that for good cause shown, the Commission may make supplemental orders as it may find "necessary or appropriate."

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[3] Refers to the collective applicants: Freeport LNG Development L.P., FLNG Liquefaction, LLC, FLNG Liquefaction 2, LLC, and FLNG Liquefaction 3, LLC

[4] "We," "us," and "our" refer to the environmental staff of the Office of Energy Projects.

[5] The regulatory functions of section 3 of the Natural Gas Act were transferred to the Secretary of Energy in 1977 pursuant to section 301(b) of the Department of Energy Organization Act. 42 U.S.C. § 7151(b) (2006).

The USDOE has exclusive jurisdiction over the export of natural gas as a commodity. USDOE delegated to the Commission authority to approve or disapprove the construction and operation of particular facilities, the site at which such facilities would be located, and the place of entry for imports or exit for exports. However, the USDOE Secretary has not delegated to the Commission any authority to approve or disapprove the import or export of the commodity itself as part of the Commission's public interest determination.

Freeport LNG filed an application for the Phase II Modification Project on December 9, 2011 in Docket No. CP12-29-000 proposing to modify the following previously approved facilities:

- the LNG vessel berthing dock;
- the LNG transfer pipelines;
- the LNG unloading arms; and
- the access road system.

The Phase II Modification Project would enable Freeport LNG to import and export LNG at the Quintana Island terminal. Freeport LNG also proposes to eliminate the vaporization equipment that was proposed to increase the sendout capacity of its existing Quintana Island terminal. This action would eliminate the need for some of the associated support equipment, interdependent infrastructure, and appurtenant facilities that were previously authorized.

On January 5, 2011, the Commission staff granted Freeport LNG's request to use the FERC's pre-filing environmental review process and assigned the Liquefaction Project pre-filing Docket No. PF11-2-000. Subsequently, staff determined that the Phase II Modification Project was an interconnected action and would be analyzed in a single EIS with the Liquefaction Project.

On August 31, 2012, Freeport LNG filed an application under Section 3 of the NGA for the Liquefaction Project in Docket No. CP12-509-000, which would consist of multiple components, including facilities at and adjacent to the existing LNG terminal and facilities located beyond Quintana Island. The main liquefaction components, located at and adjacent to the existing LNG terminal, would consist of three propane pre-cooled mixed refrigerant liquefaction trains, each capable of producing a nominal 4.4 million metric tons per annum (mtpa) of LNG (13.2 mtpa in aggregate) for export, which equates to a total liquefaction capacity of approximately 1.8 billion cubic feet per day (Bcf/d) of natural gas.[6] These trains and their support facilities are collectively referred to as the Liquefaction Plant. In addition to the Liquefaction Plant, Freeport LNG proposes to construct various facilities, both at and adjacent to the terminal and beyond Quintana Island, to support the liquefaction and export operation. These facilities include a proposed natural gas pretreatment plant (Pretreatment Plant) located about 2.5 miles north of the existing Quintana Island terminal, several interconnecting pipelines and utility lines including a 5-mile long, 12-inch-diameter boil-off-gas (BOG) feed gas line from the terminal to the Pretreatment Plant (Referred together as the Pipeline/Utility Line System), and appurtenant structures. The Liquefaction Plant, the Pretreatment Plant, and the Pipeline/Utility Line System,

[6] Each train is capable of producing 4.48 mtpa of LNG; beyond the 4.4 mtpa that would be available for export, the remaining 0.08 mtpa would become BOG to be used as fuel gas for the Pretreatment Plant or would constitute "unaccounted-for" gas in the liquefaction process.

together with the associated appurtenant structures, are collectively referred to as the Liquefaction Project. Figure 1-1 shows the location of the existing and proposed Freeport LNG Liquefaction Project facilities and regional setting. Figures 1-2 and 1-3 show the Liquefaction Project proposed facility layout at the Quintana Island terminal and at the Pretreatment Plant, respectively. The layout for the Phase II Modification Project is shown in figure 1-4.

1.2 PROJECT PURPOSE

Freeport LNG indicates in its application that the proposed Liquefaction Project would allow for exportation of domestic natural gas to the global market and meet its contractual obligations.

The existing Freeport LNG facility was approved by the Commission for the sole purpose of importing foreign-sourced LNG, storing and re-vaporizing that LNG, and delivering natural gas to United States markets. The Phase II Modification Project would modify the existing terminal to meet Freeport LNG's plans for exportation of LNG under the Liquefaction Project.

1.2.1 U.S. Army Corps of Engineers

The Projects have a water-dependency purpose as it relates to the liquefaction and subsequent exportation of domestic natural gas. LNG vessels would be utilized to transport LNG to worldwide markets. The Projects requires marine berths for loading and unloading of LNG vessels for waterborne transport of LNG. A portion of the marine facilities required for the export of LNG are already operational and additional facilities would be constructed to support import or export of LNG.

1.2.2 U.S. Department of Energy

The USDOE's Office of Fossil Energy must meet its obligation under Section 3 of the NGA to authorize the import and export of natural gas, including LNG, unless it finds that the import or export is not consistent with the public interest. The purpose and need for USDOE action is to respond to the Freeport LNG's application for authority to export LNG from the Quintana Island terminal under Dockets FE10-160-LNG, FE10-161-LNG, FE12-06-LNG, and FE11-161-LNG.

The USDOE is conducting its review under Section 3 of the NGA to evaluate the application for long-term, multi-contract authorization to export up to 2.8 Bcf/d of domestic natural gas as LNG for a 20-year period, commencing the earlier of the date of first export or five years from the date of issuance of the requested authorization. Freeport LNG seeks to export the LNG to any country: (1) with which the United States does not have a free trade agreement requiring the national treatment for trade in natural gas and LNG; (2) that has, or in the future develops, the capacity to import LNG; and (3) with which trade is not prohibited by U.S. law or policy.

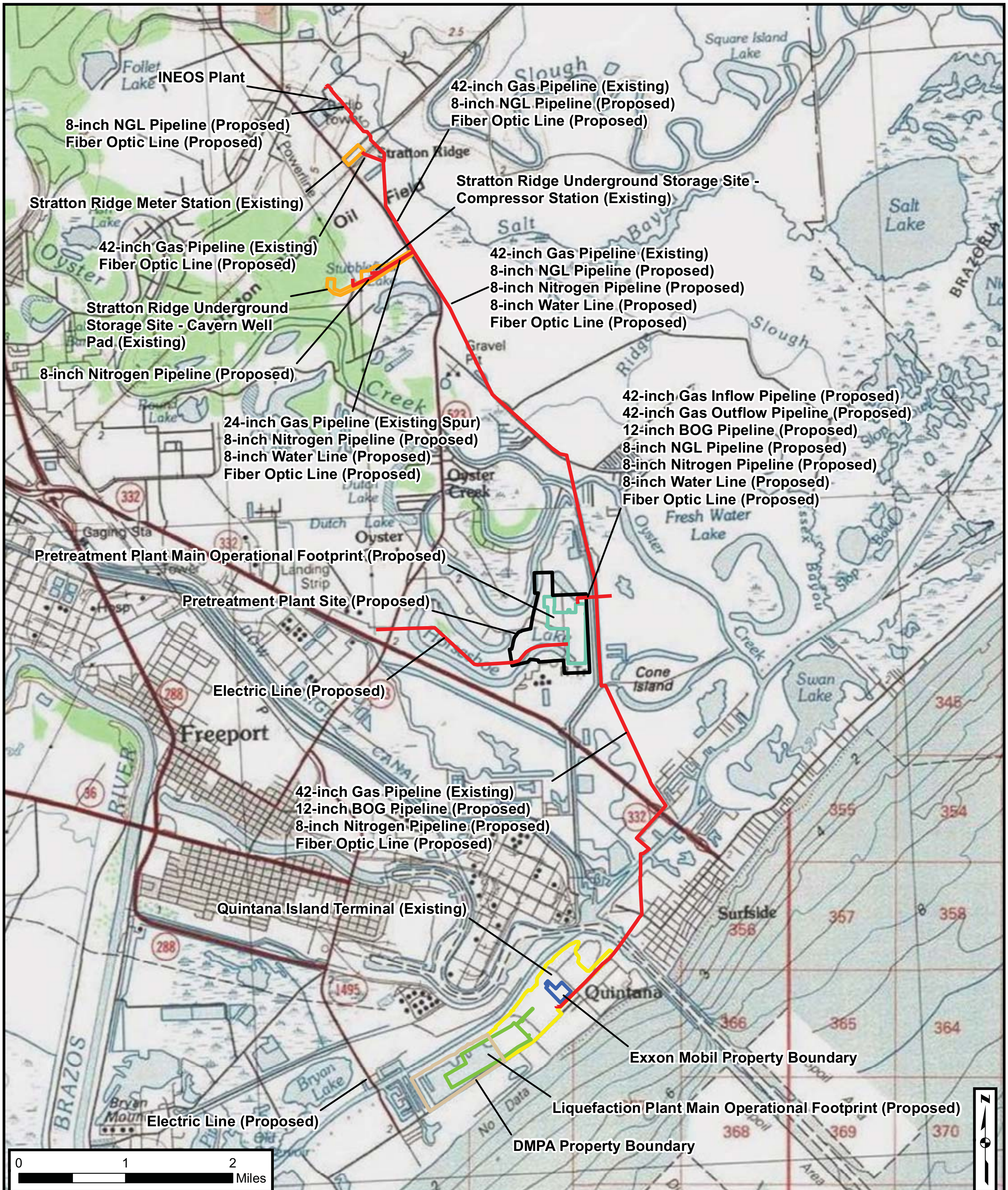

Figure 1-1
Freeport LNG - Liquefaction Project
Project Facilities - Regional Setting
Brazoria County, Texas

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Figure 1-2

Freeport LNG - Liquefaction Project

Proposed Liquefaction Facilities and Workspace Layout at and Adjacent to Quintana Island Terminal

Brazoria County, Texas

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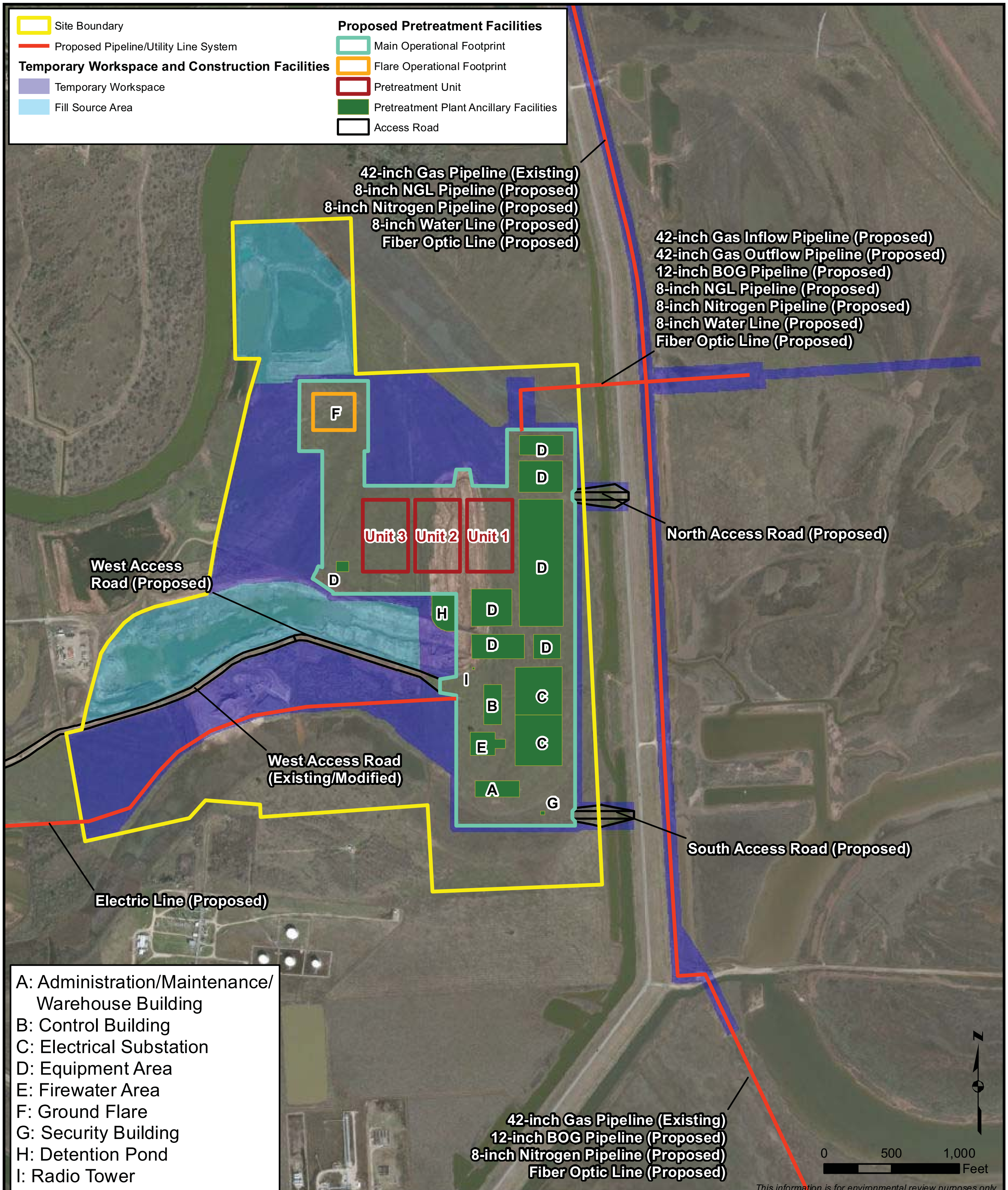

Figure 1-3

Freeport LNG - Liquefaction Project
Proposed Facilities and Workspace Layout at the Pretreatment Plant Site
Brazoria County, Texas

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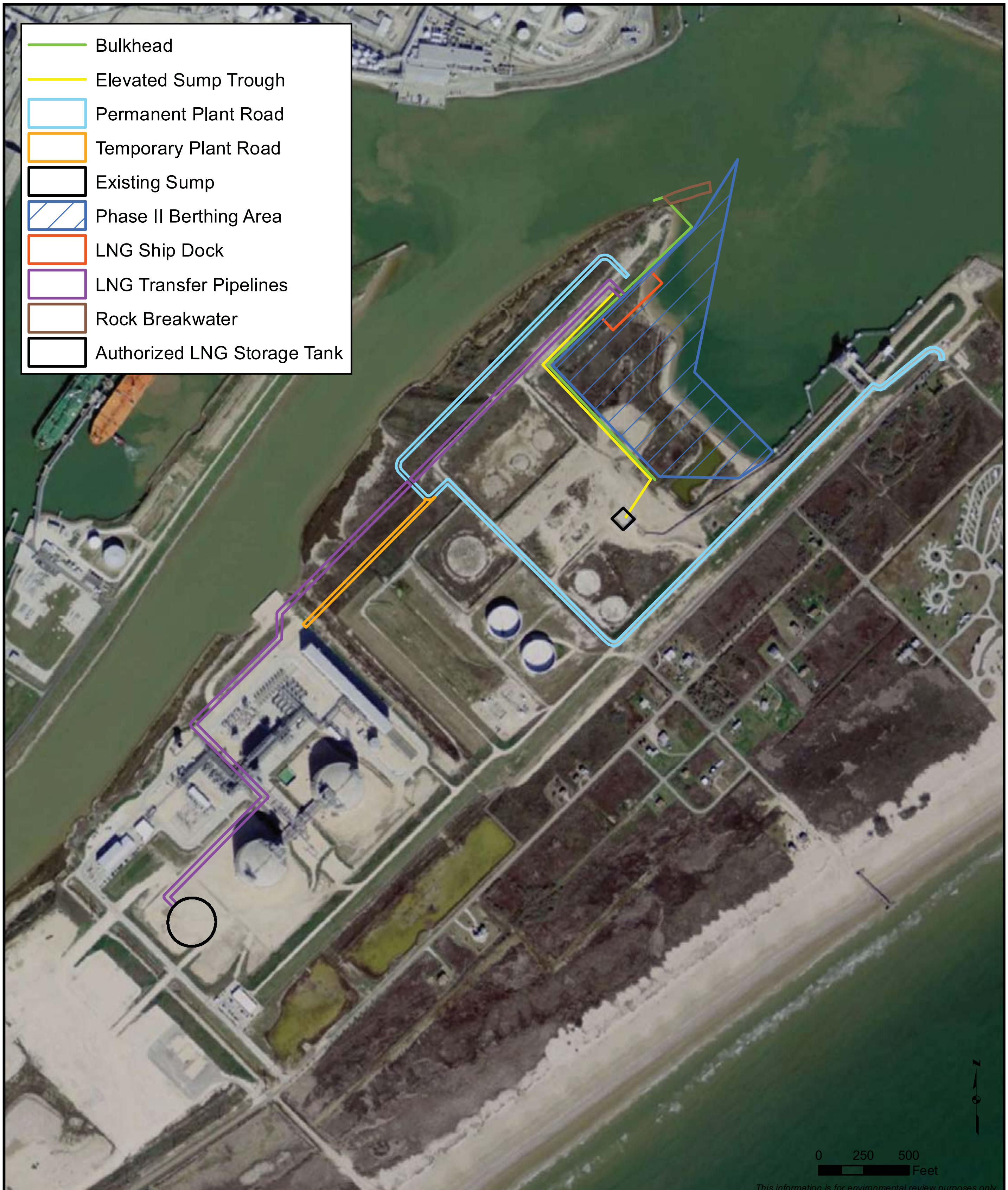

Figure 1-4

Freeport LNG - Phase II Modification Project

Proposed Facilities and Components at the Quintana Island Terminal

Brazoria County, Texas

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The USDOE has approved Freeport LNG's application under Docket Nos. FE10-160-LNG, and FE12-06-LNG to allow up to 2.8 Bcf/d of natural gas to U.S. free-trade countries. In Order 3282 on May 17, 2013, contingent on FERC siting approval, the USDOE approved export of up to 1.4 Bcf/d of natural gas to non free-trade countries. Application FE11-161-LNG, for the export of an additional 1.4 Bcf/d of natural gas to non free-trade countries received conditional approval by USDOE on November 15, 2013 for 0.4 Bcf/d, which in total would allow Freeport LNG to export 1.8 Bcf/d to non free-trade countries (and 2.8 Bcf/d to free-trade countries). Freeport LNG's FERC application is for 1.8 Bcf/d, and if Freeport LNG proposed to export more than this amount, it would be required to submit an additional application to the FERC.

1.3 PURPOSE AND SCOPE OF THE EIS

Under Section 3 of the NGA, the FERC considers as part of its decision to authorize natural gas facilities, all factors bearing on the public interest. Specifically, regarding whether to authorize natural gas facilities used for importation or exportation, the FERC shall authorize the proposal unless it finds that the proposed facilities would not be consistent with the public interest.

This draft EIS is prepared for public review and comment, after which a final EIS would be prepared to respond to comments received on this draft EIS. The distribution list for this draft EIS is provided in appendix A.

Our principal objectives in preparing this draft EIS are to:

- identify and assess potential impacts on the natural and human environment that would result from the implementation of the proposed actions;
- describe and evaluate reasonable alternatives to the proposed actions that would avoid or minimize adverse effects on the environment;
- identify and recommend specific mitigation measures, as necessary, to minimize the environmental impacts; and
- facilitate public involvement in identifying the significant environmental impacts.

The Commission will consider the findings of the draft EIS as well as non-environmental issues in its review of these proposals to determine whether to authorize the Liquefaction Project and the Phase II Modification Project. Environmental impact assessment and mitigation development are important factors in the overall public interest determination.

Under Section 3 of the NGA, the FERC considers as part of its decision to authorize natural gas facilities, all factors bearing on the public interest. Specifically, regarding whether to authorize natural gas facilities used for importation or exportation, the FERC shall authorize the proposal unless it finds that the proposed facilities would not be consistent with the public interest.

1.3.1 U.S. Environmental Protection Agency Role

The USEPA is tasked with implementation of the Clean Air Act (CAA). USEPA's greenhouse gas (GHG) Tailoring Rule, issued in May 2010, established thresholds for permitting GHG emissions under the CAA. Additional detail can be found in section 4.11 of this EIS. Freeport LNG, on December 21, 2011, filed an application with the USEPA Region VI office for a GHG Prevention of Significant Deterioration (PSD) Permit and USEPA issued the draft Permit on December 2, 2013. The USEPA is required to ensure that its GHG Permit (appendix B) would not violate the Endangered Species Act (ESA), Clean Water Act (CWA), and the National Historic Protection Act (NHPA). To ensure this, the USEPA has agreed to be a cooperating agency and will use this draft EIS to document its compliance with the aforementioned laws.

1.3.2 U.S. Army Corps of Engineers Role

The Projects would impact areas within the Galveston District of the USACE. Wetlands in the area of the Projects are regulated at the federal and state levels. The USACE elected to cooperate in preparing this draft EIS because it has jurisdictional authority pursuant to Section 404 of the CWA (33 United States Code [USC] 1344), which governs the discharge of dredged or fill material into water of the United States, and Section 10 of the Rivers and Harbors Act of 1899 (RHA) (33 USC 403), which regulates any work or structures that potentially affect the navigable capacity of a waterbody.

The USACE must comply with the requirements of the NEPA before issuing permits under these statutes. In addition, when a Section 404 discharge is proposed and a standard permit is required, the USACE must consider whether the proposed Section 404 discharge represents the least environmentally damaging, practicable alternative pursuant to the CWA Section 404(b)(1) guidelines. The USACE must also carry out its public interest review process before a standard permit can be issued. Although this draft EIS addresses environmental impacts associated with the Projects as they relate the USACE's jurisdictional permitting authority, it does not serve as a public notice for any USACE permits or take the place of the USACE's permit review process.

1.3.3 U.S. Department of Transportation Role

Under 49 USC 60101, the USDOT has prescribed the minimum federal safety standards for LNG facilities. Those standards are codified in 49 CFR Part 193 and apply to the siting, design, construction, operation, maintenance, and security of LNG facilities. A portion of the National Fire Protection Association (NFPA) Standard 59A, "Standard for the Production, Storage, and Handling of Liquefied Natural Gas," is incorporated into these requirements by reference, with regulatory preemption in the event of conflict. In accordance with the 1985 Memorandum of Understanding (MOU) on LNG facilities and the 2004 Interagency Agreement on the safety and security review of waterfront import/export LNG facilities, the USDOT participates as a cooperating agency and assists in assessing any mitigation measures that may become conditions of approval for any project. USDOT staff has reviewed FERC staff's analysis and provided comments on our conclusions regarding compliance with the Part 193 regulations.

1.3.4 National Oceanic and Atmospheric Administration Role

The NOAA Office of Protected Resources (OPR) is a headquarters program office of NOAA's National Marine Fisheries Service (NOAA Fisheries), under the U.S. Department of Commerce, with responsibility for protecting marine mammals and threatened/endangered marine life. NOAA's OPR works to conserve, protect, and recover species under the ESA and the Marine Mammal Protection Act (MMPA).

To ensure that impacts on threatened/endangered species are minimized, the NOAA's OPR has agreed to be a cooperating agency and assist the FERC in ensuring that this draft EIS documents compliance with the aforementioned laws.

1.4 PUBLIC REVIEW AND COMMENT

1.4.1 Liquefaction Project

As previous stated, on January 5, 2011, the FERC's Director of the Office of Energy Projects (OEP) granted Freeport LNG’s request to utilize our Pre-Filing Process. This review process was established to facilitate and encourage early involvement by citizens, governmental entities, non-governmental organizations, and other interested parties. As part of this process, the FERC assigned the Liquefaction Project an individual Pre-Filing Docket No. PF11-2-000. During the Pre-Filing Process, we worked with Freeport LNG and interested stakeholders to identify and resolve issues, where possible, prior to Freeport LNG’s filing of a formal application with the FERC.

As part of the Pre-Filing Process, Freeport LNG sent notification letters to landowners, government officials and the general public informing them about the Liquefaction Project and inviting them to attend Freeport LNG-sponsored open houses to acquire information, ask questions, and to express their comments and concerns. Notifications of the open houses were also published in local newspapers. Table 1.4.1-1 provides a list of public open houses held for the Liquefaction Project.

Table 1.4.1-1

List of Public Open Houses Held for the Freeport LNG Liquefaction Project

Date of Meeting	Meeting Location
February 23, 2011	Quintana Island terminal
February 24, 2011	Clute, TX
July 28, 2011	Quintana Island terminal
February 2, 2012	Lake Jackson, TX

1.4.2 Phase II Modification Project

Prior to filing its application for the Phase II Modification Project, Freeport LNG submitted to the Commission, on November 18, 2011, a request for a determination by the Director of the OEP that the Phase II Modification Project would not be subject to the Commission's otherwise mandatory Pre-Filing Process. On December 6, 2011, the Director of OEP issued a Letter Order finding that the proposal to modify the authorization granted by the September 26, 2006 Order would be exempt from the Commission's Pre-Filing Process because the number of LNG vessels ship-calls would not change and it would remain within the existing Quintana Island terminal.

Freeport LNG filed its application for the Phase II Modification Project on December 9, 2011, in Docket No. CP12-29-000. We issued a Notice of Application on December 21, 2011 indicating that the public comment period would close on January 11, 2012. We continued to receive and accept comments after the close of the comment period. After Freeport LNG filed the application, it was determined that the Phase II Modification Project may be used for both import and export activities and would be constructed concurrently with the Liquefaction Project. Thus, we are analyzing the Projects in this draft EIS.

1.4.3 Public Scoping Period for Liquefaction Project and Phase II Modification Project

On August 11, 2011, we issued a *Notice of Intent to Prepare an Environmental Assessment for the Planned Liquefaction Project and Request for Comments on Environmental Issues and Notice of Public Scoping Meeting* (NOI). The NOI was mailed to interested parties, including federal, state, and local officials; agency representatives; conservation organizations; Native American tribes; local libraries and newspapers; and property owners in the area. On September 8, 2011, we conducted a scoping meeting in Lake Jackson, Texas to provide the public an opportunity for the public to learn about the Liquefaction Project, FERC's process, and provide comments on the record. Four members of the public provided comments at the scoping meeting.

Since the issuance of the August 11, 2011 NOI, Freeport LNG proposed changes to the facilities and the scope of our review has changed such that the staff determined that review of the Liquefaction Project would require an EIS. On July 19, 2012, we issued a *Supplemental Notice of Intent to Prepare an Environmental Impact Statement for the Planned Liquefaction Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting* (Supplemental NOI). This Supplemental NOI included both the Liquefaction Project and the Phase II Modification Project and was mailed to interested parties, including federal, state, and local officials; agency representatives; conservation organizations; Native American tribes; local libraries and newspapers; and property owners in the area.

On August 9, 2012, we conducted a second public scoping meeting in Lake Jackson, Texas to provide an opportunity for the public to learn more about the newly proposed modifications to the proposed export terminal and Pretreatment Plant and to provide comments on environmental issues to be addressed in the EIS. Twenty four people commented at the meeting.

Issuance of the Supplemental NOI also opened the time period for receiving written comments and established a scoping closing date of August 20, 2012. The FERC continued to receive and accept comments after the close of the comment period. As of February 28, 2014, we have received a total of 186 comment letters and two petitions (a petition in opposition signed by 323 people associated with the Liquefaction Project, and a second letter disavowing the petition signed by 57 landowners from Quintana Island).

Issues identified during the public comment process and public meetings included: alternatives to the various project locations; concerns about safety such as the potential for fires, explosions, and spills, concerns about emergency response capability; the ability of the facility to withstand hurricanes and their associated storm surges; climate change; traffic impacts during construction, visual impacts, lighting impacts, noise and vibration during construction and operation, air emissions and concerns about air quality impacts to residents and wildlife.

Issues identified during the public comment process that are within the scope of the environmental analysis are summarized in table 1.4.3-1 and addressed in the applicable sections of this draft EIS.

Table 1.4.3-1

Issues Identified During the Public Comment Period

Issue	Specific Comments	draft EIS Section Where Comments are Addressed
Alternatives	Consideration of alternatives that reduce impacts on fish and wildlife resources, relocate facilities to Freeport-owned industrial parcels (including Site A) and away from residential areas, consideration for alternative location adjacent to salt dome storage facility on Farm-to-Market (FM) Route 523.	3.0
Water Use and Quality	Impacts of increased vessel traffic on water quality; impacts on water quality as a result of air pollution; placement of proposed pipelines in proximity to one of Quintana's public water systems.	4.3
Surface Waters	Surface and groundwater contamination; effects of hurricane/storm surge and the washing of wastes/contaminated materials into surrounding community.	4.3.2
Wetlands	Wetland mitigation plan (*i.e.,* mitigation should benefit as many species as possible); loss of wetlands, contamination of wetlands as a result of hurricane/storm surge.	4.3.5
Vegetation	Impacts on native coastal prairie vegetation and submerged aquatic vegetation (SAV), invasive species control measures/plan.	4.4
Fish and Wildlife	Loss of important habitat; effects of habitat loss on survival of migratory birds; effects of habitat loss on productivity and diversity of bird species; effects to avian resources as a result of bird strikes on LNG storage tanks and other tall structures; impacts on aquatic resources (including discharge of ballast water); impacts on Brazoria County National Wildlife Refuge (NWR); consideration of construction windows to reduce impacts on migratory birds; donation of land to the City of Quintana in the amount Freeport LNG would be using to mitigate wildlife impacts.	4.5
Threatened, Endangered, and Special-Status Species	State threatened/endangered bird species use of Quintana Island habitats; impacts on federally and state-listed rare, threatened, and endangered species and their habitats within five miles of the Projects.	4.6

Table 1.4.3-1

Issues Identified During the Public Comment Period

Issue	Specific Comments	draft EIS Section Where Comments are Addressed
Land Use, Recreation, and Visual Resources	Loss of eco-tourism attractions (hot spot for neotropical migratory birds); interaction of recreational boat traffic and LNG vessels; relocation of boat ramp; loss of important farmland (soils); visual impacts on nearby residents (including light pollution); impacts on estuarine recreation (including businesses: Kirby Marina and Tempest Marine).	4.7
Socioeconomics	Effects of construction truck traffic on traffic levels, and on Quintana Island bridge traffic; loss of property values; lower quality of life for nearby residents/environmental justice issues, increased gas production/climate change issues; tax abatements would not benefit Freeport residents; few permanent jobs in facilities for local citizens; effects of increased shipping and marine traffic; economic effect of exporting resources that could be used domestically	4.8
Cultural Resources	Effects of the Projects on historic cemetery maintenance, and restoration efforts; availability and access to an existing cemetery given Freeport LNG's security concerns.	4.9
Reliability and Safety	Proximity of homes to proposed terminal site location; potential terrorism issues, public safety concerns (island does not have adequate evacuation route for residents, limited access for first responders, air pollution; fail safe valves on pipeline); increased demands on the United States Coast Guard for protection of shoreline security; hurricane/storm surge poses threat to facility.	4.10
Air Quality and Noise	Noise and air pollution from influx of construction workers; impacts on air quality both locally and cumulatively from Project facilities, air impacts from shipping and construction traffic; air and noise pollution effects on wildlife (especially birds); and construction and operational noise, vibration, and air pollution impacts on nearby residents.	4.11

1.5 NONJURISDICTIONAL FACILITIES

The facilities for the Liquefaction Project and the Phase II Modification Project that are under the FERC's jurisdiction are described in detail in section 2.0 of this draft EIS. Occasionally, proposed projects have associated facilities not under the jurisdiction of the FERC. Nonjurisdictional facilities may be integral to the need for a proposed project or they may merely be associated as a minor, non-integral component of the jurisdictional facilities.

Our review of associated facilities for the Liquefaction Project identified the following nonjurisdictional components: a Natural Gas Liquid (NGL) pipeline, nitrogen pipeline, utility lines (electric, water, and fiber optic), and associated appurtenant facilities. The electric lines, including a 2.93-mile-long 138 kilovolt (kV) line that would serve the new Liquefaction Plant, would be installed on the same poles as the Quintana Island terminal's existing 69 kV electric transmission line.

The new 138 kV line supplying the Liquefaction Plant would connect with the Cortez substation on the south side of the Liquefaction Plant and would provide approximately 600 to 700 megawatts of power. Beyond this line installation, no substantial system upgrades would be required to supply the anticipated electric load. A proposed 2-mile-long, 138 kV electric line would connect the Pretreatment Plant with the existing electric transmission corridor and would be located about 1.6 miles west of the plant's operational footprint. The design, construction, and operation of the electric lines would be done by CenterPoint Energy.

The nonjurisdictional facilities may be authorized and regulated by federal, state, and local agencies other than the FERC. For example, the electric transmission lines at the terminal and the Pretreatment Plant would require approval from various authorities, including the Town of Quintana, the City of Oyster Creek, the Texas Public Utility Commission (PUC), and, if waters of the U.S. are affected, the USACE. However, to facilitate a complete and thorough environmental review, we have identified the environmental impacts for the associated nonjurisdictional facilities, and these are discussed throughout section 4.0.

1.6 PERMITS, APPROVALS, AND REGULATORY REQUIREMENTS

As the lead federal agency for the Projects, the FERC is required to comply with Section 7 of the ESA, the Magnuson-Stevens Fishery Conservation and Management Act (MSA), Section 106 of the NHPA, General Conformity under the CAA, and the Coastal Zone Management Act (CZMA). Each of these statutes has been taken into account in the preparation of this document.

Section 7 of the ESA, as amended, states that any project authorized, funded, or conducted by any federal agency (*e.g.*, FERC) should not pose "… adverse modification of habitat of an endangered or threatened species that is determined to be critical habitat." (16 USC Section 1536(a)(2)(1988)). The FERC, or Freeport LNG as a non-federal party, is required to consult with the U.S. Fish and Wildlife Service (FWS) and NOAA Fisheries to determine whether any federally-listed or proposed threatened/endangered species or their designated critical habitat occur in the vicinity of the proposed Project. Formal consultation is required if an action is likely to "adversely affect" listed species and designated critical habitat. The FERC is then required to prepare a Biological Assessment (BA) to identify the nature and extent of adverse impact, and to recommend measures that would avoid the habitat and/or species, or would reduce potential impacts to acceptable levels. If, however, the FERC determines that no federally-listed or proposed threatened/endangered species, or their designated critical habitat, would be affected by the proposed Project, no further action is necessary under the ESA. We request that the FWS and NOAA accept the information provided in this EIS as the BA for the Projects. See section 4.6 of this draft EIS for the status of this review.

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under federal Fishery Management Plans (FMPs). The MSA requires federal agencies to consult with NOAA Fisheries on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH (MSA Section 305(b)(2)). Although absolute criteria have not been established for conducting EFH consultations, NOAA Fisheries recommends consolidating EFH consultations with interagency coordination procedures required by other statutes, such as the NEPA, or the ESA (50 CFR 600.920(e)) in order to reduce duplication and improve efficiency. As part of the consultation process, we prepared an EFH Assessment included in section 4.5.5 of this draft EIS.

Section 106 of the NHPA requires the FERC to take into account the effects of its undertakings on properties listed in or eligible for listing in the National Register of Historic Places (NRHP) and to afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on the undertaking. The FERC has requested that Freeport LNG, as a non-federal party, assist in meeting the FERC's obligation under Section 106 by preparing the necessary information and analyses as required by the ACHP regulations at 36 CFR 800. See section 4.9.4 of this draft EIS for the status of this review.

The CZMA calls for the "effective management, beneficial use, protection, and development" of the nation's coastal zone and promotes active state involvement in achieving those goals. As a means to reach those goals, the CZMA requires participating states to develop management programs that demonstrate how these states would meet their obligations and responsibilities in managing their coastal areas. In the state of Texas, the Texas Coastal Zone Management Program (CZMP)is responsible for administering the CZMA. The CZMA provides that states have the authority to review federal projects to determine whether activities are consistent with their coastal management program. If a state finds that the activity is not consistent, the federal agency may not authorize the activity. Freeport LNG is responsible for preparing and submitting an application that establishes the Liquefaction Project's consistency with the enforceable policies contained in the CZMP. See section 4.7.4 of this draft EIS for additional discussion of the Texas CZMP.

At the federal level, required permits and approval authority outside of the FERC's jurisdiction include compliance with the CWA, the RHA, the CAA, and U.S. Coast Guard (USCG) regulations relating to LNG waterfront facilities. All major permits, approvals, and consultations that may be required for the proposed actions are identified in table 1.6-1. The FERC encourages cooperation between applicants and state and local authorities, but this does not mean that state and local agencies, through application of state and local laws, may prohibit or unreasonably delay the construction or operation of facilities approved by the FERC. Any state or local permits issued with respect to jurisdictional facilities must be consistent with the conditions of any authorization issued by the FERC.[7]

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[7] See, *e.g.*, Schneidewind v. ANR Pipeline Co., 485 U.S. 293 (1988); National Fuel Gas Supply v. Public Service Commission, 894 F.2d 571 (2d Cir. 1990); and Iroquois Gas Transmission System, L.P., *et al*., 52 FERC 61,091 (1990) and 59 FERC 61,094 (1992).

Table 1.6-1

Permits, Approvals, and Clearances for Liquefaction Project and Phase II Modification Project

Agency	Permit/Approval - Regulatory Scope	Project / Facility Applicability	Authorization/ Interaction Required	Status
FEDERAL				
USDOE, Office of Fossil Energy	Section 3 – Natural Gas Act (NGA) Export Authorization	Liquefaction Project	Authorization	Filing Date: December 17, 2010 Free Trade Agreement (FTA) Countries Export Order Issuance Date: February 10. 2011 1st Non-FTA Countries Anticipated Authorization Issuance Date: May 17, 2013 2nd Non-FTA Countries Authorization Issuance Date: November 15, 2013
FERC	Section 3 - NGA	Liquefaction Project	Authorization	Filing Date: August 31, 2012 FERC Review in Process
		Modification Project	Authorization	Filing Date: December, 9, 2011 FERC Review in Process
USACE – Galveston District Regulatory Branch	Section 404 – Clean Water Act Section 10 Rivers and Harbors Act	Liquefaction & Phase II Modification Projects	New permit for Liquefaction Project; amendment to existing permit for Phase II Modification Project	Filing Date: June 14, 2013 Anticipated Authorization Date: February 2014
USACE - Galveston District Real Estate Division and Office Counsel		Liquefaction & Phase II Modification Projects	Approval/ Coordination for Dredge Spoil Disposal (For new LNG berthing dock, new construction dock, and new firewater intake structure)	Anticipated Filing Date: December 20, 2013 Anticipated Authorization Date: April 2014
NOAA Fisheries – Habitat Conservation Division	Section 7 – Endangered Species Act Magnuson- Stevens Fishery Conservation and Management Act Marine Mammal Protection Act	Liquefaction & Phase II Modification Projects	Consultation	Consultation Process ongoing
NOAA Fisheries - Protected Resources Division		Liquefaction & Phase II Modification Projects	Consultation	Consultation Process ongoing

Table 1.6-1

Permits, Approvals, and Clearances for Liquefaction Project and Phase II Modification Project

Agency	Permit/Approval - Regulatory Scope	Project / Facility Applicability	Authorization/ Interaction Required	Status
FWS	Section 7 – Endangered Species Act Migratory Bird Treaty Act	Liquefaction & Phase II Modification Projects	Consultation	Consultation Process ongoing
USEPA - Region VI	Section 402 – Clean Water Act – National Pollutant Discharge Elimination System	Liquefaction & Phase II Modification Projects	Industrial Storm Water Permit	Coordinating with USEPA on renewal of existing National Pollutant Discharge Elimination System (NPDES) permits and permitting of Liquefaction Plant
		Liquefaction Project	Process Waste Water Discharge Permit	Anticipated Filing Date: May 2014 Anticipated Authorization Date: December 2014
		Liquefaction & Phase II Modification Projects	Storm Water Construction Permit	Anticipated Filing Date (Notice of Intent): May 2014 Anticipated Authorization Date: June 2014 (Amended permit and Stormwater Pollution Prevention Plan (SWPPP) to cover all project facilities)
	40 CFR 52 GHG Tailoring Rule – Federal Implementation Plan	Liquefaction Project	Prevention of Significant Deterioration (PSD) Permit for GHG Emissions	Filing Date (Original Application): December 16, 2011 Draft PSD Permit Issues: December 2013 Anticipated Authorization Date: April 2014
U.S. Department of Homeland Security – U.S. Coast Guard	33 CFR 127, Waterfront Facilities Handling Liquefied Natural Gas and Liquefied Hazardous Gas	Liquefaction & Phase II Modification Projects	Letter of Recommendation	Not required - authorization complete
STATE				
Railroad Commission of Texas (RRC) with notification to EPA	NPDES Storm Water Construction Permit	Liquefaction & Phase II Modification Projects	Permit	Anticipated Filing Date (Notice of Intent): May 2014 Anticipated Authorization Date: June 2014 (Amended permit and SWPPP to cover all project facilities)

Table 1.6-1

Permits, Approvals, and Clearances for Liquefaction Project and Phase II Modification Project

Agency	Permit/Approval - Regulatory Scope	Project / Facility Applicability	Authorization/ Interaction Required	Status
Railroad Commission of Texas	Coastal Management Plan Consistency Determination	Liquefaction & Phase II Modification Projects	Review	Filing Date: June 14, 2013 Anticipated Authorization Date: February 2014
	Section 401 Water Quality Certification	Liquefaction & Phase II Modification Projects	Certification (concurrent with Section 404 Permit)	Filing Date: June 14, 2013 Anticipated Authorization Date: February 2014
	Hydrostatic Discharge Permit	Liquefaction Project	Permit	Anticipated Filing Date: July 2015 Anticipated Authorization Date: October 2015
	Organization Report and Operator Number (P-5)	Liquefaction Project	Registration	Anticipated Filing Date: July 2015 Anticipated Authorization Date: October 2015
	Permit to Operate a Pipeline (T-4)	Liquefaction Project	Permit	Anticipated Filing Date: July 2015 Anticipated Authorization Date: October 2015
	New Construction Report (PS-48)	Liquefaction Project	Permit	Anticipated Filing Date: July 2015 Anticipated Authorization Date: October 2015
	Texas Intrastate Pipeline Questionnaire (PS-8000A)	Liquefaction Project	Questionnaire	Anticipated Filing Date: July 2015 Anticipated Authorization Date: October 2015
Texas Commission for Environmental Quality (TCEQ) - Air Permits Division	30 Texas Administrative Code (TAC) Chapter 116 - Permit to Construct	Liquefaction Plant	New Source Review (NSR) Pre-construction Air Permit	Filing Date: December 20, 2011 Anticipated Authorization Date: April 2014
	30TAC Chapter 116 - Permit to Construct	Pretreatment Plant	NSR Pre-construction Air Permit	Filing Date (Amended Application): July 18, 2012 Anticipated Authorization Date: April 2014
	30 TAC Chapter 122 – Operating Permit	Liquefaction Plant	Title V Site Operating Permit	Filing Date: August 29, 2011 Authorization Date: November 8, 2011
	30 TAC Chapter 122 – Operating Permit	Pretreatment Plant	Title V Site Operating Permit	Anticipated Filing Date: November 2015 Anticipated Authorization Date: September 2016
Texas TCEQ	Temporary Water Use Appropriation Permit	Liquefaction Project	Permit	Anticipated Filing Date: August 2014 Anticipated Authorization Date: December 2014

Table 1.6-1

Permits, Approvals, and Clearances for Liquefaction Project and Phase II Modification Project

Agency	Permit/Approval - Regulatory Scope	Project / Facility Applicability	Authorization/ Interaction Required	Status
Texas Parks and Wildlife Department (TPWD)	Listed Species Clearance	Liquefaction & Phase II Modification Projects	Clearance	Consultation ongoing Anticipated authorization date concurrent with draft EIS issuance
Texas Historical Commission - State Historic Preservation Office	Section 106 National Historic Preservation Act Consultation	Phase II Modification Project	Consultation	Consultation Letter sent: December 9, 2011 Receipt of Comment: December 14, 2011
		Liquefaction/ Pipelines & Utilities	Consultation	Informational Update Letter and Request for Clearance sent: April 20, 2012 Receipt of Comment: May 8, 2012
		Pretreatment	Consultation	Request for Clearance sent: June 18, 2012 Receipt of Comment: July 3, 2012
Public Utility Commission of Texas	Certificate of Convenience and Necessity	Liquefaction Project	Authorization	Filing Date (by CenterPoint): October 2012 Anticipated Authorization Date: January 2014
LOCAL				
Brazoria County	Building Permits	Liquefaction & Phase II Modification Projects	Permit	Anticipated Filing Date: January 2014 Anticipated Authorization Date: May 2014
Brazoria County Floodplain Administrator	Permit for Construction in a Zone "VE" or Variance as: functionally dependent use"	Liquefaction & Phase II Modification Projects	Permit or Variance	Anticipated Filing Date: January 2014 Anticipated Authorization Date: May 2014
Velasco Drainage District	Levee/Ditch Crossing Permit Section 408 Clearance for CR 690 Levee from COE through Velasco Drainage District as a precursor to Levee/Ditch Crossing Permit	Liquefaction Project	Permit	Filing Date: August 2013 Anticipated Authorization Date: January 2014

Table 1.6-1

Permits, Approvals, and Clearances for Liquefaction Project and Phase II Modification Project

Agency	Permit/Approval - Regulatory Scope	Project / Facility Applicability	Authorization/ Interaction Required	Status
NATIVE AMERICAN TRIBES				
Caddo Indian Nation of Oklahoma	Consultation	Liquefaction & Phase II Modification Projects	Project Notification and Comments	Informational Letter sent: December 3, 2010 FERC Request for Comments sent: September 26, 2011 Informational Update Letter sent: April 20, 2012
Alabama-Coushatta Nation of Texas	Consultation	Liquefaction & Phase II Modification Projects	Project Notification and Comments	Informational Letter sent: December 3, 2010 FERC Request for Comments sent: September 26, 2011 Informational Update Letter sent: April 20, 2012
Tonkawa Tribe of Oklahoma	Consultation	Liquefaction & Phase II Modification Projects	Project Notification and Comments	Informational Letter sent: December 3, 2010 FERC Request for Comments sent: September 26, 2011 Informational Update Letter sent: 04-20-12
Wichita and Affiliated Tribes of Oklahoma	Consultation	Liquefaction & Phase II Modification Projects	Project Notification and Comments	Informational Letter sent: December 3, 2010 FERC Request for Comments sent: September 26, 2011 Informational Update Letter sent: April 20, 2012

2.0 DESCRIPTION OF THE PROPOSED ACTION

The Liquefaction Project and Phase II Modification Project would involve the construction and operation of the Liquefaction Plant, Pretreatment Plant, other aboveground facilities and associated pipeline and utilities. The environmental analysis contained in this draft EIS evaluates the facilities proposed for both the Liquefaction Project and the Phase II Modification Project.

2.1 LIQUEFACTION PROJECT

2.1.1 Liquefaction Plant

As indicated in figure 1-2, the Liquefaction Plant would be located on Quintana Island near Freeport, Texas, on the west end of the existing terminal and on adjacent industrial-zoned property that was formerly a dredged material placement area (DMPA).

The Liquefaction Plant consists of three liquefaction trains (Trains 1, 2, and 3) positioned in parallel and occupying a 2,140-foot-long by 860-foot-wide rectangular footprint west of the existing process area. Most of the Train 1 footprint, along with various ancillary facilities (utility area, maintenance/warehouse building, reception building, control room, security building, electric substations, fire suppression foam system, LNG containment sump, standby generator, trucking unloading area, car parking areas), would be located on the existing terminal property, in an area where more than two thirds of the acreage constituted temporary construction workspace during Phase I facility construction.

The remainder of the Train 1 footprint and the entire Train 2 and Train 3 footprints, along with various ancillary facilities (electric substations, propane and mixed refrigerant storage area, liquefaction ground flare, truck unloading area, guard house), would be located adjacent to and beyond the western boundary of the existing terminal property. Construction and start-up of the initial liquefaction train (Train 1) and the first pretreatment train at the Pretreatment Plant is expected to be completed in approximately 48 months. Completion and start-up of each additional liquefaction and pretreatment train (Trains 2 and 3) is expected to sequentially follow Train 1 at approximately 6-9 month intervals.

In addition to the three liquefaction trains, aboveground infrastructure would include chemical and utility storage units, pipe racks and pipes, LNG troughs and an associated sump, a ground flare, a control room, a guard house, a security building, a reception building, a maintenance building, a warehouse/office building, a fire suppression unit, three electric substations, plant roads, and a ground flare.

Process cooling for the liquefaction trains would be provided by conventional air coolers (fin fans), arranged in longitudinal rows alongside each train. Each train would have independent electric motor-driven refrigeration compressors and other compressors. Refrigerant storage would be common for all three trains.

New process equipment and structures outside of the Liquefaction Plant would include two blowers (one at each LNG berthing dock [existing Phase I and proposed Phase II]) and four BOG compressors (one regular compressor and three booster compressors in tandem in the Phase I process area), together with natural gas piping, nitrogen piping, LNG piping/troughs, and fiber optic cabling between the Liquefaction Plant and process area facilities (existing Phase I and proposed Phase II) to the east. A narrow walkway would be constructed over the existing drainage channel that would otherwise separate the Phase I administration building from the Liquefaction Plant's administration building to the east. The driveway would facilitate pedestrian and cart access between the two buildings.

The Liquefaction Project would include a new permanent construction dock located on the south shore of the Intracoastal Waterway (ICW), near the northwest corner of the Liquefaction Plant site. The existing shoreline would be recessed to accommodate the 300-foot-long by 60-foot-wide concrete dock platform, which would be mounted on piles. Land access would be provided by a new permanent plant road between the dock and the Liquefaction Plant. A new permanent firewater intake structure would be located on the south shore of the ICW also. The structure would consist of a 50-foot-long by 20-foot-wide concrete platform mounted on piles. The platform would support two diesel-driven pumps to withdraw water at the 5,000 gallons per minute (gpm) rate required for fire suppression.

A stormwater collection basin approximately 1,130 feet long by 945 feet wide would be constructed in the northwest corner of the former DMPA. This basin would receive stormwater from the western sector of the Liquefaction Plant site during construction and operation. Stormwater would be discharged to the ICW through an outfall located at the north end of the basin.

The major components associated with the new Liquefaction Plant would include three propane pre-cooled mixed refrigerant LNG trains (Trains 1, 2, and 3), capable of liquefying a total of 1.8 Bcf/d of natural gas, producing up to 4.48 mtpa of LNG and including or sharing the following:

- multi-stage mixed refrigerant compressors with electric motor drivers;
- multi-stage propane compressors with electric motor drivers;
- heat exchangers;
- storage for propane refrigerant, and make-up ethylene;
- nitrogen utility unit;
- plant air utility unit;
- stormwater system;
- firewater system;
- fire and gas detection and safety systems;
- control systems and electrical infrastructure;
- utilities and distribution systems;
- metering facilities for gas and LNG;
- piping, pipe racks, LNG troughs, foundations, and ancillary structures;
- LNG sump;
- refrigerant sump;

- control room;
- maintenance building;
- warehouse/office building;
- security building;
- reception building;
- utility area;
- flare; and
- electric substations (3).

The new Liquefaction Plant site modifications would include:

- augmentation of soils;
- addition of new piles and paving;
- addition of new plant roads;
- addition of a temporary concrete batch plant;
- addition of new truck unloading and turning areas; and
- addition of a stormwater collection basin.

In addition, other supporting facilities would be necessary, including:

- two blowers, one at the existing Phase I marine berthing dock and one at the authorized (but yet to be constructed) Phase II marine berthing dock;
- replacement installation of higher capacity in-tank pumps;
- an aggregate barge dock on the ICW;
- a construction dock and fire water intake structure on the ICW;
- one BOG compressor at Phase I process area;
- three BOG booster compressors at Phase I process area;
- the expansion and integration of electrical systems, lighting systems, security systems, emergency shutdown (ESD) system, telecom, information technology, closed-circuit television, potable and service water systems;
- the integration with LNG transfer lines; and
- modifications and expansion of plant roads.

2.1.2 Pretreatment Plant Facilities

The proposed Pretreatment Plant site is located about 2.5 miles northeast of Freeport, Texas and 2.5 miles north of Quintana Island. The is located west of County Road (CR) 690, about 0.7 mile north of the intersection of CR 690 and State Highway (SH) 332. (See figure 1-3).

The proposed Pretreatment Plant would occupy an operational footprint of approximately 113.4 acres in the eastern sector of a 276.3-acre property for which Freeport LNG has secured a purchase option. The main plant footprint would include three natural gas pretreatment units (Units 1, 2, and 3) located in parallel in the northwest section and various support facilities. The ground elevation of the main plant footprint would be raised from an average of three feet above mean sea level (amsl) to approximately eight feet amsl.

The only facilities outside of the Pretreatment Plant's elevated main footprint would be a ground flare system consisting of a flare for the pressure relief vent (with associated aboveground piping) and the emergency NGL flare (with associated aboveground piping). The ground flare system would be located approximately 400 feet to the north of Unit 3. One new approximately 400-foot-long access road and one new approximately 450-foot-long access road would respectively connect the northern and southern sectors of the plant to CR 690 directly to the east. An existing private road extending north and east from SH 332 to the property would be modified and extended through the property to provide site access from the west.

The Pretreatment Plant would be connected to Freeport LNG's existing 42-inch-diameter natural gas sendout pipeline, which extends from the Stratton Ridge meter station to the Quintana Island terminal and runs about 630 feet east of the plant fence line, in the eastern Velasco Ditch. This borrow ditch fringes the eastern side of the Velasco Levee and CR 690. CR 690 is situated atop of the Velasco Levee; both the road and the levee would be crossed at one location by the various pipelines and utility lines (excluding the electric line) that would connect the Pretreatment Plant with the Liquefaction Plant and other facilities. These latter facilities include the sendout pipeline itself, a new gas inflow pipeline that would deliver gas from the sendout pipeline to the Pretreatment Plant and a new gas outflow pipeline that would deliver treated gas back to the sendout pipeline for transportation to the Liquefaction Plant.

The following is a detailed list of the major components associated with the proposed Pretreatment Plant:

- natural gas pretreatment units (Units 1, 2, and 3) each containing;
  - amine sweetening system to remove carbon dioxide (CO_2) and sulfur compounds;
  - mercury removal unit (in-line unit);
  - molecular sieve dehydration system to remove water;
  - electric compression units; and
  - miscellaneous storage vessels;
- storage for amine solution, aqueous ammonia, liquid nitrogen, heating medium, slop, and treated (demineralized) water;
- NGL removal unit;
- ground flare (combined emergency NGL and pressure relief vent flares);
- combustion turbine/heat recovery system;
- two emergency electric generators;
- firewater pump system;
- control room;
- maintenance building;
- administration building;
- security building;
- two electric substations;
- utility areas; and
- three access roads.

2.1.3 Pipeline/Utility Line System

The Pretreatment Plant would receive gas via a 0.51-mile-long, 42-inch-diameter inflow pipeline that would tie in with the existing 42-inch-diameter sendout pipeline and run east for 0.16-mile, then west and south for 0.35-mile, crossing the Velasco Levee and the northern fence line of the Pretreatment Plant. This looped configuration is necessary for all the pipelines and utility lines that cross the levee, to maintain a 300-foot separation (stipulated by the Velasco Drainage District) between the centerline of the levee and the exit points for the horizontal directional drills (HDDs) that would be used to cross the levee. The standard operating pressure of the incoming gas would be 700 pounds per square inch gauge (psig).

After treatment, the gas would be run through an on-site compressor to increase its pressure to approximately 1,100 psig and would then be delivered back into the sendout pipeline via a 42-inch-diameter outflow. Feed gas to provide power for the pretreatment turbine would be derived from the BOG that originates at the LNG storage tanks at the terminal. The BOG would be transported from the terminal to the Pretreatment Plant via the proposed 12-inch-diameter, 5.1-mile-long BOG pipeline.

In addition to the removal of trace constituents, the liquefaction process requires that the heavier hydrocarbon components of the source gas be removed. These NGLs (butanes, pentanes, and ethane) would be removed at the Pretreatment Plant and transported north to the INEOS Group Limited (INEOS) Plant for commercial use via the proposed 8-inch-diameter, 6.2-mile-long NGL pipeline.

Both the Pretreatment Plant and the terminal would require nitrogen for purging. Of the total 3.4 million standard cubic feet per day (MMscfd) of nitrogen required, 2.8 MMscfd (82 percent) would be supplied to the terminal and 0.6 MMscfd (18 percent) would be supplied to the Pretreatment Plant.

The nitrogen would be obtained from an interconnection with the existing Air Liquide nitrogen pipeline that is located in the multi-pipeline corridor running north-south about 750 feet west of the compressor station at Freeport LNG's Stratton Ridge underground storage site. This interconnect would involve a hot tap on Air Liquide's distribution header, which is located on the west side of the multi-pipeline corridor, about 920 feet from the compressor station. A meter station would be constructed within the compressor station fence line. The meter station and the approximately 0.35-mile-long section of new pipe between the meter station and the tie-in location on the existing nitrogen pipeline would be constructed and operated by Air Liquide. The remaining 9.2 miles of nitrogen pipeline between the meter station, the Pretreatment Plant, and the terminal would be constructed by Freeport LNG.

To enable integrated and synchronized control of the Liquefaction Project's proposed process facilities (pretreatment and liquefaction) and other facilities at the terminal, the Stratton Ridge underground storage site, the Stratton Ridge meter station, and the INEOS Plant, an 11.33-mile-long interconnecting network of fiber optic cabling would be installed, following the same route system as the existing 42-inch-diameter sendout pipeline and the various proposed pipelines described above.

Freeport LNG is currently evaluating source options for the estimated 38,400 gallons per day (gpd) of process water that would be required at the Pretreatment Plant. Fire water and potable water would also be needed. Assuming all this water cannot be obtained from an existing on-site well, Freeport LNG would construct an 8-inch-diameter, 4.7-mile-long water line from a tie-in with an existing 16-inch-diameter water line at Freeport LNG's Stratton Ridge underground storage site. The existing water line originates at Dow Chemical Company's (Dow) brine mining and production facility, located about 0.9 mile to the north, and was used previously to supply fresh water for solution mining of the underground cavern at the storage site.

Table 2.1.3-1 provides a summary of proposed pipelines associated with the Liquefaction Project.

Table 2.1.3-1

Proposed Pipelines Associated with the Liquefaction Project

Pipeline	Location	Diameter (inches)	Length (Miles)	Standard Operating Pressure (PSI)
BOG	Quintana Island terminal to Pretreatment Plant	12	5.1	1,100
Natural Gas Interconnect Inflow Pipeline	From Freeport LNG's existing 42-inch-diameter sendout pipeline to Pretreatment Plant	42	0.51	700
Natural Gas Interconnect Outflow Pipeline	From Pretreatment Plant to Freeport LNG's existing 42-inch-diameter sendout pipeline	42	0.51	1,100
Nitrogen Pipeline	From hot tap on existing Air Liquide nitrogen pipeline just west of compressor station at Freeport LNG's Stratton Ridge underground storage site to Quintana Island terminal	8	9.6	145
NGL Pipeline	Pretreatment Plant to INEOS Plant located approximately 0.4 mile north of Freeport LNG's Stratton Ridge meter station	8	6.2	NA
Water Line	Compressor station at Freeport LNG's Stratton Ridge underground storage site to Pretreatment Plant	8	4.7	NA

Other related facilities include:

Stratton Ridge Meter Station - Modifications to meter station to allow bidirectional flow in existing 42-inch-diameter gas pipeline.

Appurtenances for the Natural Gas Pipeline System

- 42-inch mainline valve (MLV) located near terminus of gas inflow/outflow pipelines;
- 42-inch ESD side valve located on 42-inch-diameter gas inflow pipeline;
- 42-inch ESD side valve located on 42-inch-diameter gas outflow pipeline; and
- MLV and ESD side valves located within the Pretreatment Plant fence line.

Appuntenances for the BOG Pipeline

- Pig[8] launcher/receiver located at each end of BOG pipeline;
- ESD valve located with pig receiver at each end of BOG pipeline; and
- Pig launchers/receivers and ESD valves located within the terminal and Pretreatment Plant fence lines.

2.2 PHASE II MODIFICATION PROJECT

The Phase II Modification Project is proposed to modify the authorized, but not yet constructed, Phase II Project. The Phase II Project, as modified by this proposal, would serve Freeport LNG's existing import and re-export operations, and the proposed Liquefaction Project.

The Phase II Modification Project would be located entirely within Freeport LNG's existing leased area and would be adjacent to or within the boundaries of the existing Phase I facilities at the Quintana Island terminal. The proposed Phase II Modification Project is shown on previously referenced figure 1-4. The major components of the Phase II Modification Project are:

- reorientation of the Phase II dock based on recommendations from the Brazos Pilots Association (Brazos Pilots);
- decreasing the diameter of the two LNG transfer pipelines from 32 inches to 26 inches;
- reducing the number of LNG unloading arms from four to three; and
- modifying the access roads at the terminal.

These facilities are described below in table 2.2-1.

Table 2.2-1

Phase II Modification Project

Equipment Type	No. of Units	Description
Phase II Dock	1	88,000 m^3 to 180,000 m^3 vessel capacity
LNG Transfer Arm	3	16-inch-outside diameter
Vapor Return Arm	1	16-inch-outside diameter
LNG Transfer Pipeline	2	26-inch-diameter pipe-in-pipe
Access Road System	1	23-feet-wide, 7,000-feet-long

2.2.1 Phase II Dock

LNG vessels would use two single berthing docks for cargo transfers at the Quintana Island terminal. One dock was constructed as part of Freeport LNG's Phase I Project; the other is one of the modified facilities associated with the proposed Phase II Modification Project. Specifically, the orientation of the Phase II dock would be modified to accommodate

[8] Pigs is a device used to used to internally inspect and/or clean gas pipelines.

maneuvering preferences of the Brazos Pilots, but would remain principally located north of and opposite the Phase I dock at the east end of the terminal.

The proposed berthing area for the Phase II dock would be approximately 1,340 feet wide at its entrance and approximately 830 feet wide at its base. Freeport LNG would install a bulkhead, consisting of approximately 2,255 feet of corrugated steel piling, installed vertically along the western and northern edges of the berthing area and extending around the terminal's northeastern land extremity to the south shore of the ICW at the confluence with the Freeport Harbor Channel (FHC). In addition, an approximately 300-foot-long by 50-foot-wide rock breakwater would be installed peripheral to the dock, extending east from the same northeastern land extremity. This breakwater was requested by the Brazos Pilots to assist with safe vessel maneuvering into and out of the dock basin.

The berthing area for the Phase II dock would be dredged roughly perpendicular to the FHC to a depth of -46.5 feet (North American Vertical Datum 1988 [NAVD 88]) with an allowable over-depth of 2.0 feet. This would match the adjacent channel depth. Prior to dredging, approximately 60,000 cubic yards (yd^3) of surface material within the berth area but outside of the originally proposed Phase I dock footprint would be excavated with onshore equipment to a depth of -5.0 feet (NAVD 88) and used elsewhere as fill material during site preparation.

Following shore-based excavation, construction of the Phase II dock would involve the hydraulic dredging of approximately 1,188,000 yd^3 of material to expand the existing berth area. The dredged material would be pumped to an existing DMPA that is currently being used by Port Freeport and has been authorized by the USACE.

The Phase II dock would be sized to accommodate vessels with a maximum length of 980 feet and a cargo capacity of up to 180,000 cubic meters (m^3). The jetty platform would be a single-level reinforced concrete beam and slab structure supported on piles and measuring approximately 100 feet long by 90 feet wide. It would have a nominal maximum elevation of 25 feet (NAVD 88). An approximately 30-foot-wide by 45-foot-long extension would support affiliated dock structures such as the shore-mounted gangway and the jetty control building. The surface of the jetty platform would slope landward to drain away rainwater and potential LNG discharges from the waterway.

The Phase II Modification Project would not result in any additional LNG vessel transits to or from the terminal beyond the level accommodated by current authorizations.

2.2.2 Transfer Facilities

Freeport LNG would modify the transfer facilities in two ways: by (1) reducing the number of LNG transfer arms from four to three; and (2) decreasing the diameter of the two LNG transfer pipelines from 32 inches to 26 inches.

2.2.3 Access Road System

Land access within the Phase II Modification Project site during construction and operation would require development of an approximately 7,000-foot-long plant road system. Approximately 3,820 feet of the plant road system is currently operational but may require some improvement; the remaining 3,180 feet would require new construction. The road system would provide access both to the new marine berthing dock and to the Liquefaction Project's temporary construction workspace located on the east side of the terminal.

2.3 LAND REQUIREMENTS

The Liquefaction Project would require an overall construction workspace of 599.3 acres, of which 269.1 acres would constitute the operational footprint of the proposed facilities.

Construction and operation of the Phase II Modification Project facilities would involve both permanent and temporary land impacts at the Quintana Island terminal. A total of 38.5 acres of land would be required for the Phase II Modification Project, including 14.6 acres that would be temporarily disturbed during construction and 23.9 acres that would be affected on a permanent basis for operation as seen below in table 2.3-1.

A breakdown of land requirements for the Projects is provided in table 2.3-1.

Table 2.3-1

Freeport LNG Liquefaction and Phase II Modification Projects
Summary of Land Requirements for Proposed Liquefaction Project (acres)

Facilities	Permanent Facility Footprint	Temporary Workspace	Total
FERC JURISDICTIONAL FACILITIES			
Liquefaction Plant and Associated Facilities	144.6	97.4	242.0
Pretreatment Plant and Associated Facilities	113.4	104.9	218.3
Pretreatment Plant – Off-site Access Road Segments	1.7	1.2	2.9
Pipeline/Utility Line System (FERC Jurisdictional Facilities and Nonjurisdictional Pipelines/Utility Lines) – South of PTP	0.0	44.6	44.6
LIQUFACTION PROJECT TOTAL:	**259.7**	**248.1**	**507.8**
FERC NONJURISDICTIONAL FACILITIES			
Pipeline/Utility Line System (FERC Nonjurisdictional Facilities without Electric Line) – North of PTP	3.3	74.7	78.0
Electric Line at Pretreatment Plant	6.0	7.3	13.3
Appurtenant Facilities beyond Terminal Site and Pretreatment Plant site and not included in Pipeline/Utility Line System Footprint Totals	0.1	0.1	0.2
NONJURISDICTIONAL TOTAL:	**9.4**	**82.1**	**91.5**
LIQUEFACTION PROJECT TOTAL AFFECTED LAND AREA:	**269.1**	**330.2**	**599.3**

Table 2.3-1

Freeport LNG Liquefaction and Phase II Modification Projects
Summary of Land Requirements for Proposed Liquefaction Project (acres)

Facilities	Permanent Facility Footprint	Temporary Workspace	Total
PHASE II MODIFICATION			
Phase II Dock and Berthing Area	17.4 a/	6.0 b/	23.4
LNG Transfer Pipelines	3.3	6.3	9.6
Access Road System	3.2	2.3	5.5
PHASE II MODIFICATION TOTAL:	**14.6**	**23.9**	**38.5**
TOTAL LAND REQUIREMENTS FOR LIQUEFACTION PROJECT AND PHASE II MODIFICATION PROJECT:	**283.7**	**354.1**	**637.8**

a/ Includes 12.6 acres of land and 4.8 acres of open water
b/ Includes 4.1 acres of land and 1.9 acres of open water

2.4 CONSTRUCTION, OPERATION, AND MAINTENANCE PROCEDURES

All Freeport LNG facilities would be designed, installed, tested, operated, and maintained in accordance with federal safety standards and regulations that are intended to ensure adequate protection for the public and to prevent facility accidents and failures. Additional information on these measures can be found in section 4.10.

2.4.1 Liquefaction Project

2.4.1.1 Construction of Liquefaction Plant

Grading, Site Preparation, and Site Fill Requirements

The proposed Liquefaction Plant footprint and adjacent laydown areas would require significant site improvements including clearing, grubbing, soil stabilization, backfilling, and grading activities, which must be performed prior to mobilization for construction of plant infrastructure. Prior to clearing of the construction workspace, appropriate temporary erosion controls would be installed. Typically, silt fences, check dams, fiber rolls, and sediment traps are positioned along the limits of disturbance. We are recommending Freeport LNG use at least one Environmental Inspsctor (EI) for the Liquefaction and Phase II Modification Projects, and at least one inspector for the Pretreatment Plant and Pipeline/Utility Line System. Each EI would monitor field conditions daily to ensure that appropriate erosion and sedimentation control measures are maintained until the construction workspace is fully stabilized. In addition, we are recommending that Freeport LNG develop and implement an environmental complaint resolution procedure which would provide affected landowners (typically within ½ mile of the aboveground facility) with clear and simple directions for identifying and solving their environmental concerns during construction and restoration.

The Liquefaction Plant would be located in the former DMPA west of the existing Phase I process facilities. The existing ground elevation in this area ranges from 25 feet to 31 feet amsl, except for a large stockpile of dredge material that rises to 40 feet amsl in the north central portion of the site. The final site grade for the Liquefaction Plant would be established at 28 feet amsl. Some cutting and filling would be required to smooth out topographic irregularities and an average two-foot depth or 528,000 yd^3 of additional fill material (clay top soil) would be needed which would require many truck or barge trips for fill material.

The section of the former DMPA outside of the existing terminal site would require considerable improvement and stabilization to provide a load bearing surface for crane access and construction. The techniques used to improve the soils would be similar to those adopted during Phase I facility construction. Various stabilizers may be added, including hydrated lime, Portland cement, fly ash, and other admixtures. Where needed, appropriate geotextiles and aggregate materials (*e.g.*, gravel and crushed stone) would be used to level and finish laydown and operational areas.

Prior to construction at any particular location, Freeport LNG would prepare such temporary workspaces (primarily laydown and support/satellite areas) as needed outside the proposed operational footprints of the various process units. Temporary support facilities (*e.g.*, construction offices, warehouses, mess halls, parking lots, and portable toilets) would be installed. Site preparation for all construction workspace (both temporary and within operational footprints) would involve cutting and filling to rough grade and soil stabilization/improvement as described above, followed by erection of temporary fencing to isolate construction activities from operational areas where possible.

Permanent site grading would be directed towards perimeter outfalls and would be completed during initial site preparation to ensure proper drainage during construction and operation. Stormwater controls (including placement of gravel or other suitable material to provide a stable, well-drained surface) would be installed. The stormwater collection basin in the northwest corner of the former DMPA would be developed at this time and would receive stormwater channeled from perimeter outfalls in the western sector of the former DMPA; stormwater in the eastern sector would be conveyed to an existing drainage channel, which connects to a wetland mitigation pond and the ICW.

Much of the major equipment for the Liquefaction Plant would be delivered by barge, using the new aggregate barge and construction docks. Upgrading and extending existing plant roads would be performed as necessary to support the hauling of heavy equipment and supplies to the new construction areas.

To produce the large amounts of concrete required for the Liquefaction Project, a concrete batch plant would be brought to the site, as was the case during construction of the Phase I facilities. However, the infrastructure to support a concrete batch plant remains at the Quintana Island terminal site in the former batch plant and construction laydown area, which is now within the proposed permanent footprint of the Liquefaction Plant. This infrastructure would be removed during initial site preparation and new infrastructure to support the new concrete batch plant would be installed near the western end of the defined laydown area (See figure 1-2).

Liquefaction Trains and Ancillary Facilities

Following site grading and soil stabilization, foundation construction would initially involve the installation of pre-cast concrete piles to provide a firm base for the concrete pads on which buildings, pipe racks, and the heavy equipment components of the liquefaction trains would be set.

Dredging Requirements

The new aggregate barge dock slip would require dredging to a depth of -14 feet resulting in removal of approximately 28,000 yd^3 of material. The dredging activities would need authorization from the USACE.

The new construction dock would be recessed into the south shore of the ICW, a design that would require excavation of bank-side material to install the 300-foot-long by 60-foot-wide dock platform and off-shore dredging to create the dock slip. The extent to which dredging is required would depend primarily on the existing water depth and its ability to accommodate barges, which have a relatively shallow draft. Freeport LNG estimates that 85,000 yd^3 of material would be removed over 6.5 acres. The existing construction dock at the terminal site would also have to be dredged of approximately 32,000 yd^3.

<u>Dredging and Dredged Material Disposal</u>

Vessel access to the Phase II dock would be provided from the FHC by deepening and widening the existing 30-acre berthing area on the east side of the terminal site to about 50 acres. Freeport LNG proposes to use conventional barge-mounted cutter/suction dredging or a combination of shore-based dragline and barge-mounted cutter/suction dredging during development of the dock and berthing area. The total amount of material to be removed for the Phase II dock work is estimated at 1,188,000 yd^3. Pre- and post-dredge surveys would be conducted to determine actual quantities. It is expected that dredging would be done prior to pile driving of the jetty structures.

As with the material dredged for the Liquefaction Project, material dredged for the Phase II dock and berthing area would be placed in Port Freeport's DMPA No. 1 and/or in one or more pre-approved DMPAs elsewhere. Adequate levee height would be maintained for proper containment and effluent quality.

Where it crosses an active shipping lane, such as the ICW, the pipeline used to convey the dredged material to the DMPA would be either floating or submerged. In the event that a floating pipeline is used, the pipeline would be equipped with quick connect joints and blank flanges that allow a section to be uncoupled quickly and moved out of the way to enable vessel passage. A small volume of sediment laden water would be released into the water channel during the uncoupling process, however, it is not anticipated that this amount would compromise water quality.

2.4.1.2 Construction of Pretreatment Plant

Grading, Site Preparation, and Site Fill Requirements

In general, Freeport LNG would adhere to the requirements set forth in the FERC's *2013 Upland Erosion Control, Revegetation, and Maintenance Plan (Plan)* and *Wetland and Waterbody Construction and Mitigation Procedures (Procedures).*[9] The Pretreatment Plant site is currently actively grazed coastal upland pasture, with some peripheral and interspersed emergent wetland and waterbody features. However, the location has an extensive excavation pit representing the site of commercial sand extraction that was undertaken by the previous landowner. The central excavation pit covers approximately 26.5 acres and is approximately 20 feet to 40 feet deep in the western sector and approximately 10 feet to 20 feet deep in the eastern sector. Freeport LNG intends to modify the western sector of the central pit to form a retention pond for receipt of stormwater discharges during facility construction and operation. Construction discharges would be channeled to the retention pond.

Approximately 9.8 acres of the central pit's eastern sector are located in the proposed operational footprint of the Pretreatment Plant and would require significant fill deposition during the initial stages of site preparation to provide a level, stable surface for foundation placement and subsequent infrastructure development. Freeport LNG estimates that 253,000 yd^3 of fill would be necessary to bring this previously excavated area up to the existing base elevation (average 3.0 feet amsl found elsewhere on the site and to provide a suitably sloped [4H:1V gradient] perimeter).

Preparatory tasks include soil stabilization, cutting and filling to rough grade beyond the extraction area and installation of stormwater controls. Two new access roads between the Pretreatment Plant site and CR 690 would be installed and the existing private access road from SH 332 would be upgraded and extended as necessary to provide site access from the west. The roads would be permanent and utilized during both construction and operation. After the necessary temporary workspaces, support facilities, and access roads have been installed, the Pretreatment Plant's main operational footprint would be elevated and graded.

As previously mentioned, the existing base elevation outside of the sand extraction area is relatively level, with an average and maximum height of approximately 3.0 feet and 5.0 feet amsl, respectively. To ensure flood protection, the ground elevation of the equipment area would be raised to 8.0 feet amsl; concrete foundation pads would add another 1.6 feet, bringing the base elevation of the equipment itself to 9.6 feet amsl.

Pretreatment Units and Ancillary Facilities

Following site preparation, foundation construction would involve the installation of concrete foundations for the pretreatment units and ancillary structures (buildings, electric substations,

[9] For Upland Erosion Control, Revegetation and Maintenance Plan see: http://www.ferc.gov/industries/gas/enviro/plan.pdf and for Wetland and Waterbody Construction Mitigation procedures see: http://www.ferc.gov/industries/gas/enviro/procedures.pdf.

storage areas, etc.). The concrete foundations would be designed following recommendations received from the geotechnical engineering evaluation report.

The three pretreatment trains would be connected to Freeport LNG's existing natural gas pipeline system by underground pipeline interconnects between the existing sendout pipeline and the Pretreatment Plant, and by aboveground piping at the plant itself.

2.4.1.3 Construction of Pipeline/Utility Line System

As previously stated, Freeport LNG would use conventional construction techniques for buried pipelines and would follow the requirements set forth in the Freeport LNG's Procedures, but with the following two exceptions noted in table 2.4.1-1 to accommodate the installation of multiple pipelines/utility lines within the same right-of-way and HDDs across large waterbodies and wetland expanses. In table 2.4.1-1 the relevant section of the FERC's Plan and Procedures is paraphrased, followed by Freeport LNG's proposed modification and justification. Based on the justifications noted, we find Freeport's proposed modification acceptable. FERC's Plan and Procedures and Freeport LNG's two modifications to these are referred to collectively herein as Freeport LNG's Procedures.

Table 2.4.1-1

Requested Modifications to FERC's Upland Erosion Control, Revegetation, and Maintenance Plan and Waterbody Construction and Mitigation Procedures

FERC Procedure No.	FERC Requirement	Requested Modifications	Justification
VI.A.3	Item VI.A.3 of the FERC's Upland Erosion Control, Revegetation, and Maintenance Plan and Wetland and Waterbody Construction and Mitigation Procedures requires that the construction right-of-way width in wetlands be limited to 75 feet, unless prior written approval is obtained from the Director for a right-of-way width greater than 75 feet based on topographic conditions or soil limitations.	In wetlands and open water, Freeport LNG would require an 85-foot- to 100-foot-wide construction right-of-way for open-cut sections to accommodate multiple new pipelines. Between two and seven pipelines and/or utility lines would be installed in parallel at any given location. At the HDD crossing on the east side of the Velasco Levee in the vicinity of the Pretreatment Plant, a 200-foot-wide right-of-way lateral segment would be required to accommodate trench installation of the seven Pipeline/Utility Line System turnaround sections.	Right-of-way widths beyond 75 feet are required to ensure safe working conditions and to maintain safe separation distances between the individual lines in locations where there are multiple lines. For the most part multiple lines must be installed in separate trenches.
VI.B.1.a	Item VI.B.1.a of the FERC's Upland Erosion Control, Revegetation, and Maintenance Plan and Wetland and Waterbody Construction and Mitigation Procedures requires that all extra work areas (such as staging areas and additional spoil storage areas) be located at least 50 feet away from wetland boundaries, except where the adjacent upland consists of actively cultivated or rotated cropland or other disturbed land.	Several additional temporary workspaces (ATWSs) are necessarily located in wetlands due to their intended use. These include the HDD ATWSs on either side of the Freeport Harbor Channel (milepost [MP] 0.67 and 1.14, on the south side of the Intracoastal Waterway (MP 1.55), and on either side of the extensive wetland south of the County Road (CR) 891 Ditch (MP 2.70 and 3.62).	Based on ground reconnaissance and map review, Freeport LNG stated that there are no feasible location alternatives for these ATWSs that would cause less significant environmental impacts. Moreover, the ATWSs are required for HDD, a method that has been selected in part to minimize or avoid greater environmental impacts on wetlands as a whole.

Construction specifications would also require adherence to Freeport LNG's *Stormwater Pollution Prevention Plan* (SWPPP) for construction stormwater discharges, *Spill Prevention, Control and Countermeasure Plan*[10] (SPCC Plan), and Freeport LNG's *HDD Monitoring and Contingency Plan* (see appendix C).

As described in the following paragraphs, conventional pipeline construction typically involves the following sequential activities:

- right-of-way surveying;
- clearing and grading;
- trenching;
- stringing, welding, and installation;
- backfilling and grade restoration;
- hydrostatic testing and tie-ins; and
- cleanup and restoration.

The pipeline alignment would be identified and surveyed prior to construction. This would include staking the proposed pipeline centerlines, foreign line crossings, and workspace limits, along with wetland boundaries and other environmentally sensitive areas.

Prior to clearing of the construction workspace, appropriate temporary erosion controls would be installed. The EI would monitor field conditions daily to ensure that appropriate erosion and sedimentation control measures are maintained until the construction workspace is fully stabilized.

Prior to trench excavation in upland areas, vegetation would be cut and removed from the construction workspace. Chipped material would be spread across the work area during revegetation. No cleared material would be placed within wetlands unless approved by the appropriate agencies.

After clearing, the upland portions of the construction right-of-way would be graded to create a safe and level work surface. However, given the relatively uniform topography of the area landscape, the need for extensive grading is not expected. Generally, machinery would operate on one side of the trench and excavated materials would be stockpiled on the other. Grading activities would be scheduled to minimize the time between initial clearing operations and pipe installation.

Trenching

Trenching would involve excavating a pipeline ditch and would be accomplished with backhoes and/or similar excavation machinery. Spoil would be deposited within the construction workspace, adjacent to the trench on the opposite side from the excavation equipment. The trench would be excavated to a minimum depth that allows at least four feet of cover over the

[10] The SPCC Plan is included as appendix 2-C of Freeport LNG Liquefaction Project Resource Report 2 available at: http://elibrary.ferc.gov:0/idmws/file_list.asp?document_id=14048942.

pipe. The bottom width of the trench would be cut to accommodate the specific diameter of pipe to be installed. The top width of the trench would vary depending on local soil conditions at the time of construction. The need for special bedding or blasting is not anticipated.

Based on concurrent construction of the multiple proposed pipelines and utility lines, and the generally narrow (nominally five feet) separation distance between the lines, Freeport LNG anticipates that the closely collocated lines would be laid together in one trench. The fiber optic cable would be installed directly adjacent to (within one foot of) the nearest pipeline. Typical cross-section drawings showing the arrangement of the pipelines and utility lines at specific milepost (MP) intervals along the route system are shown in figures 2.4.1-1, 2.4.1-2 and 2.4.1-3.

Crossing of foreign pipelines would generally require the new pipelines to be buried at a greater depth than the existing pipelines. These would be identified and flagged during the pre-construction phase. Trenching operations in the vicinity of an existing pipeline would proceed only after appropriate field testing has been undertaken to determine the existing pipeline's exact location. No temporary pipeyards or laydown areas are proposed outside of the temporary work area for the Liquefaction Plant and Pretreatment Plant sites and Phase II Modification work area.

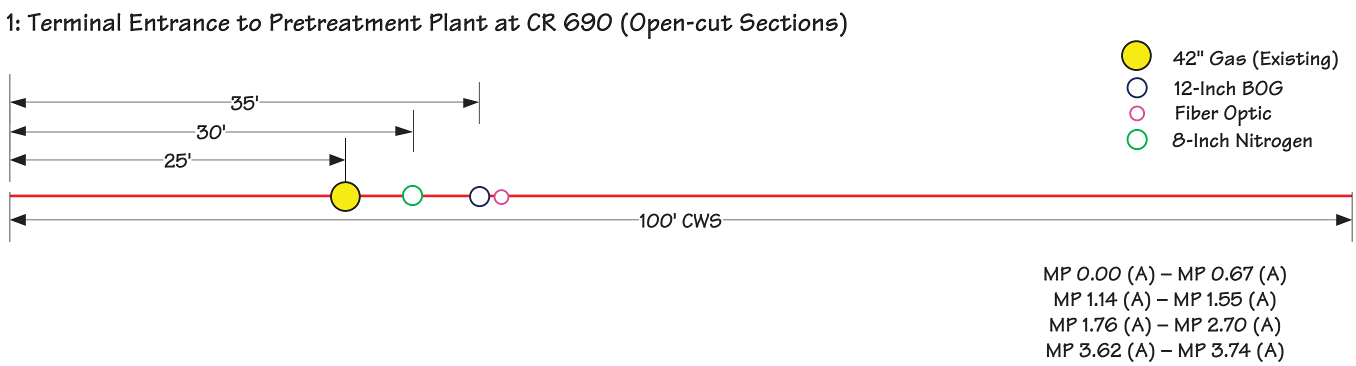
In cropland, residential areas, or at the landowner's discretion, topsoil would be segregated from subsoil during trenching and remain segregated during storage to avoid loss though mixing with stockpiled subsoil.

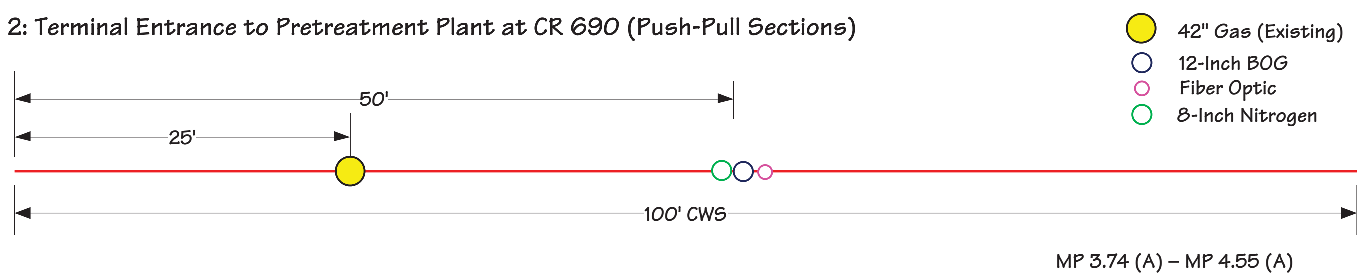
Freeport LNG would use conventional measures to minimize erosion and sedimentation during trenching and would follow the requirements set forth in the Freeport LNG's Procedures. These would include measures to minimize the free flow of surface water into the trench and through the trench from upland areas into waterbodies. Erosion control measures would also be implemented as necessary for bank stabilization at waterbody crossing locations.

If trench dewatering is necessary, discharge to the ground generally is permitted where there is adequate vegetation along the right-of-way to function effectively as a filter medium. In areas adjacent to waterways, or where there is minimal vegetation, bale filters, filtration bags, or other appropriate measures would be used to limit sedimentation.

Stringing, Welding, and Installation

Stringing involves moving pipe joints into position along the prepared construction right-of-way. The joints would be moved by truck and loaders from the source areas and placed along the construction right-of-way, parallel to the trench line, for subsequent line-up and welding. Stringing activities would be coordinated with the trenching and pipe laying crews. Certain pipe joints may be bent to conform to changes in the direction of the pipeline alignment and natural ground contours. Individual pipe joints would be bent to the desired angle in the field and/or prefabricated fittings may be used.





Acronyms for Figures 2.3.1-1 and 2.3.1-2

BOG = boil-off gas
CR = County Road
CWS = construction workspace
INEOS = INEOS Group Limited
MLV = mainline valve
MP = milepost
ROW = right-of-way

Figure 2.4.1-1

For environmental review purposes only.

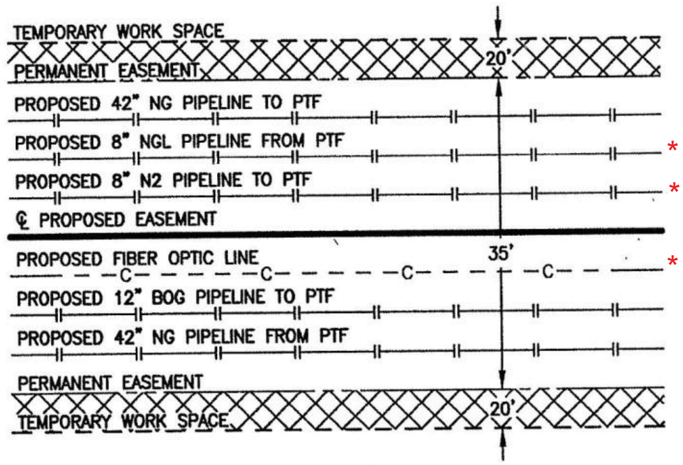
Freeport LNG – Liquefaction Project
Construction Right-of-Way Cross-Sections for Jurisdictional Pipelines and Non-Jurisdictional Pipelines/Utility Lines MP 0.00(A) – MP 4.55(A)
South of Pretreatment Plant

_FRE_RR_1_4_4A_CONSTRUCTION_ROW_CROSS_SECTIONS_SORRELL_1TO3.VSD	SCALE: NTS	REVISED: 6/28/2012	DRAWN BY: JPBOENTJE

For environmental review purposes only.

Figure 2.4.1-2
Freeport LNG – Liquefaction Project
Construction Right-of-Way Cross-Sections
for Non-Jurisdictional Pipelines/Utility Lines
North of Pretreatment Plant

_FRE_RR_1_4_4B_CONSTRUCTION_ROW_CROSS_SECTIONS_SORRELL_4TO9.VSD	SCALE: NTS		REVISED: 8/1/2012	DRAWN BY: JPBOENTJE



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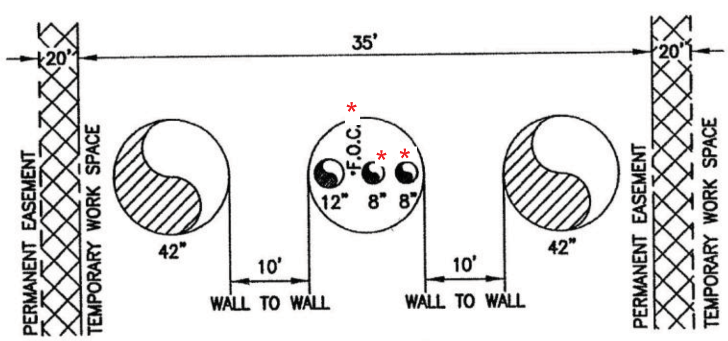
N.T.S.



DETAIL "B"
N.T.S.

Acronyms for Figure 2.3.1-3

BOG = boil-off gas
F.O.C. = fiber optic cable
N2 = Nitrogen
NG = Natural Gas
NGL = Natural Gas Liquid
PTF = Pretreatment Facility

*Indicates nonjurisdictional pipeline/utility line

Note: Water line is not depicted on these plans pending final determination of drill arrangement

Figure 2.4.1-3

For environmental review purposes only.

Freeport LNG – Liquefaction Project

Construction Right-of-Way Cross-Sections for Lateral Jurisdictional Pipelines and Non-Jurisdictional Pipelines/Utility Lines MP 0.00(B) – MP 0.35(B)

At Pretreatment Plant

_FRE_RR_1_4_4C_CONSTRUCTION_ROW_CROSS_SECTIONS_LATERALS.VSD	SCALE: NTS		REVISED: 6/28/2012	DRAWN BY: JPBOENTJE

Welding would be performed in accordance with 49 CFR, Part 192, Subpart E *Welding of Steel in Pipelines* and American Petroleum Institute Standard 1104. Completed welds would be inspected to determine integrity. If a weld does not meet defined requirements, it would be marked for repair or replacement. The weld joint areas would be coated and the entire pipe coating would be inspected for defects and repaired as needed. Following integrity inspections, the pipe would be lowered into the trench using sideboom tractors or similar equipment and bedded with padding material prior to backfilling.

After the pipe is lowered into the trench and bedded with padding material, the trench would be backfilled with the previously excavated material using dozers, loaders, and compactors. Any excess excavated materials or materials unsuitable for backfill would be disposed of in accordance with applicable regulations.

In areas where topsoil has been segregated, the backfilling operation would involve the replacement of subsoil in the bottom of the trench, followed by the replacement of topsoil over the subsoil layer. In upland areas, a soil mound would be left over the trench to allow for soil settlement, unless the land owner requires otherwise. During backfilling, special care would be taken to minimize erosion, restore the natural ground contours, and restore surface drainage patterns as close to pre-construction conditions as practicable. Upon completion of trench backfilling, topsoil would be replaced as necessary and the pre-construction soil profile restored across the wider construction workspace.

After the completion of backfilling and topsoil replacement across the construction workspace, all disturbed areas would be final graded and any remaining trash, debris, or unsuitable backfill would be properly disposed of. After construction is completed, the workspace area would be protected by the implementation of appropriate erosion control measures as necessary, including site-specific contouring and reseeding with an approved seed mix.

Road/Railroad Crossing Construction Procedures

Table 2.4.1-2 lists the road and railroad crossings identified on the proposed pipeline and utility line routes. For most road and railroad crossings, conventional bores are anticipated. In all cases, applicable state and local regulations would be followed and traffic interruption would be minimized. The minimum pipeline clearance for both unsurfaced and paved public roads would be five feet under the roadbed and four feet under any side borrow/drainage ditches. Pipeline warning signs/markers would be installed at each crossing location.

Waterbody and Wetland Crossing Construction Procedures

Open cut construction methods at waterbody crossings would vary according to the physical and environmental characteristics of the crossing. Minor waterways (water channel width less than or equal to 10 feet) and intermediate waterways (water channel width greater than 10 feet but less than or equal to 100 feet) would generally be crossed by open trench excavation with equipment operating from the banks as the width of the waterbody allows. During these operations, any existing water flow would be maintained. All open cut crossings would be "wet" crossings without the need for trench isolation techniques such as dam and pump or fluming.

Table 2.4.1-2

Road/Railroad Crossing Locations and Methods for Pipeline/Utility Line System

Road Name	Milepost	Proposed Crossing Method	Pipelines/Utility Lines
FERC JURISDICTIONAL AND NONJURISDICTIONAL FACILITIES			
Entrance to ExxonMobil Facility	0.23(A)	Bore	BOG, Nitrogen, Fiber Optic
Entrance to Terminal Site	0.68(A)	HDD	BOG, Nitrogen, Fiber Optic
Thunder Road	1.18(A)	Bore	BOG, Nitrogen, Fiber Optic
Canal Drive	1.54(A)	Bore	BOG, Nitrogen, Fiber Optic
SH 332 (Ramp)	2.30(A)	Bore	BOG, Nitrogen, Fiber Optic
SH 332	2.33(A)	Bore	BOG, Nitrogen, Fiber Optic
SH 332 (Ramp)	2.35(A)	Bore	BOG, Nitrogen, Fiber Optic
CR 891 (Cone Island Road)	3.67(A)	Bore	BOG, Nitrogen, Fiber Optic
FERC NONJURISDICTIONAL FACILITIES			
Galleywax Way	5.41(A)	Bore	NGL, Nitrogen, Water, Fiber Optic
CR 792 (Suggs Road)	5.85(A)	HDD	NGL, Nitrogen, Water, Fiber Optic
Private Driveway	6.24(A)	Open Cut	NGL, Nitrogen, Water, Fiber Optic
Private Road	6.76(A)	Open Cut	NGL, Nitrogen, Water, Fiber Optic
Private Driveway	7.95(A)	Open Cut	NGL, Nitrogen, Water, Fiber Optic
Abandoned Railroad	9.46(A)	Bore	Fiber Optic
Abandoned Railroad	0.22(D)	Bore	NGL, Fiber Optic
CR 227	0.33(D)	Bore	NGL, Fiber Optic
CR 690 (Levee Road)	0.15(B)	HDD	Gas Inflow, Gas Outflow, BOG, NGL, Nitrogen, Water, Fiber Optic
FM Route 523	0.04(C)	Bore	Nitrogen, Water, Fiber Optic
FM Route 523	0.15(E)	Overhead	Electric Line
Private Road (West Access Road to Pretreatment Plant)	1.07(E)	Overhead	Electric Line

Notes
CR County Road
FM Farm-to-Market
HDD Horizontal Directional Drill
SH State Highway

Trench spoil would be placed bank-side above the high water mark for use as backfill. The pipeline would be installed below scour depth. Any federal and state backfill cover requirements would be met. The pipe would be weight coated, as needed, to provide negative buoyancy. Once the trench is backfilled, the banks would be stabilized through seeding, sodding, riprap deposition, or other techniques. Excavated material not required for backfill would be removed to an upland disposal site.

Other waterbody crossing methods that would be utilized for specific circumstances include conventional boring and HDD. Where a waterbody lies adjacent to a road, a bore is often used to avoid surface impacts on both the road and the waterbody. HDD crossings are generally over longer distances than bores and also avoid surface impacts, including in-stream and riparian disturbance.

A bore is implemented by excavating a bore pit to the proposed pipeline depth on both sides of the feature being crossed, boring a hole under the feature from one side to the other, and installing a prefabricated segment of pipeline through the borehole.

In the first stage of each HDD crossing, electric grid wire guides would be hand laid along the pipeline right-of-way between the proposed drill entry and exit locations. Only minimum ground and vegetation disturbance would result from this procedure. Following guide wire installation, a slant drill unit would be set up and a small diameter pilot hole would be drilled under the waterbody along a prescribed profile. Electromagnetic sensors would be used to guide the drill bit.

Once the pilot hole is completed, it would be enlarged using reaming tools to accept the pipeline. The reaming tools are attached to the drill string at the exit point of the pilot hole and are rotated and drawn back to the drilling rig, thus enlarging the pilot hole with each pass. During this process, drilling mud consisting of bentonite clay and water would be continuously pumped into the hole to remove cuttings and to maintain the integrity of the hole. Once the hole has been sufficiently enlarged, a prefabricated segment of pipe would be attached behind the reaming tool on the exit side of the crossing and pulled back through the drill hole toward the drill rig, completing the crossing.

As indicated in table 2.4.1-3 the FHC, ICW, and Oyster Creek, all of which are major waterbodies (water channel width greater than 100 feet), would be crossed by HDD for the underground Pipeline/Utility Line System. In addition, HDD would be used to cross an extensive emergent wetland, together with the Velasco Levee and its side ditches (eastern and western) in the vicinity of the Pretreatment Plant site. The three proposed lines (BOG, nitrogen, fiber optic) at three of the five HDD locations (FHC, ICW, emergent wetland) would be installed in one bore hole. At Oyster Creek, the four proposed lines (NGL, nitrogen, water, fiber optic) would likely require two bore holes, drilled in close proximity, but with sufficient separation (at least 10 feet) to ensure borehole integrity. At the Velasco Levee, four boreholes would be required, one for the gas inflow pipeline, one for the gas out flow pipeline, one for the BOG, NGL, nitrogen, and fiber optic lines together, and one for the water line.

Freeport LNG's *Draft HDD Monitoring and Contingency Plan* (see appendix C) outlines the procedures that would be followed to minimize the potential for an inadvertent release of drilling mud and to undertake effective cleanup should a release occur.

Table 2.4.1-3

HDD Waterbody Crossing Locations for Underground Pipeline/Utility Line System

Feature Name	Milepost Start	Milepost End	Crossing Length (Feet)	Pipelines/Utility Lines
FERC JURISDICTIONAL AND NONJURISDICTIONAL FACILITIES				
FHC	0.67(A)	1.14(A)	2,448	BOG, Nitrogen, Fiber Optic
ICW	1.55(A)	1.76(A)	1,108	BOG, Nitrogen, Fiber Optic
Emergent Wetland	2.70(A)	3.62(A)	4,837	BOG, Nitrogen, Fiber Optic
Velasco Levee Eastern Velasco Ditch Western Velasco Ditch CR 690	0.00(B)	0.33(B)	1,725	Gas Inflow, Gas Outflow, BOG, NGL, Nitrogen, Water, Fiber Optic
FERC NONJURISDICTIONAL FACILITIES				
Galleywax Way Oyster Creek CR 792	5.34(A)	5.90(A)	2,990	NGL, Nitrogen, Water, Fiber Optic
Total:			**13,108**	

Notes
CR County Road
FHC Freeport Harbor Channel
ICW Intracoastal Waterway

The push-pull method would be used to install the BOG pipeline, nitrogen pipeline, and fiber optic cabling along approximately 8,507 feet of the eastern Velasco Ditch between MP 3.74(A) and MP 5.34(A). The trench would be excavated in the bed of the water channel with a barge-mounted backhoe working from the center of the channel.

Spoil from the trench would be placed adjacent to the excavation within the channel. Pipe joints would be welded, inspected, and coated one at a time and, as the pipelines are fabricated into continuous floating strings, they would be pushed or pulled through the channel, weighted as necessary, and lowered into the trench.

Hydrostatic Testing and Tie-ins

After construction and prior to placing the pipelines and associated appurtenances in service, the completed pipelines would be hydrostatically tested to ensure that the systems are leak proof and to provide the necessary safety margin for high pressure operation. Testing would be conducted in accordance with the requirements of 49 CFR Part 192, Freeport LNG testing specifications, and applicable permits.

The in-place pipeline would be filled with water and kept at the requisite operating pressure throughout the test. After the completion of a satisfactory test, the water would be discharged over land into containment structures. Valves and appropriate energy-dissipation devices, containment structures, or other measures would be used to regulate discharge rates and to minimize erosion and sedimentation. No chemical agents would be added to the test water. Hydrostatic testing impacts and water requirements are detailed in section 4.3.3.

Aboveground Appurtenant Facilities

At the sites for the meter stations, MLVs and ESD valves, and pig launchers/receivers, both within and beyond the fencelines of other facilities (Terminal, Pretreatment Plant, INEOS Plant), the principal sequential construction steps would be clearing and grading, placement of a concrete pad foundation, installation of equipment, erection of equipment housing, installation of perimeter fencing, and surface cleanup during which open areas would be covered with gravel, limestone or similar material. Where pigging equipment is installed, a concrete containment area sump would be constructed below the barrel of the pig launcher/receiver.

Temporary Construction Facilities

Temporary construction facilities required by the major contractors or subcontractors include shop, welding, storage, laydown, office facilities and construction of a temporary concrete batch plant. At this time, beyond the identification of workspace locations and configurations, a final layout plan for the temporary facilities is not available as it would depend on the preferences and needs of the contractors and subcontractors. The locations of proposed temporary construction workspaces for the Liquefaction Project are illustrated in figure 1-2.

Transportation

Construction workers at the Quintana Island terminal would leave their vehicles at off-site parking lots and would be transported by bus to and from Quintana Island. Construction access routes and traffic issues are discussed in section 4.8.5.

2.4.1.4 Construction Schedule

Freeport LNG has indicated a preferred construction start date of August 1, 2014. Construction and start-up of the initial liquefaction train (Train 1) and the first pretreatment train at the Pretreatment Plant is expected to be completed in approximately 48 months. Completion and start-up of each additional liquefaction and pretreatment train (Trains 2 and 3) is expected to sequentially follow Train 1 at approximately 6-9 month intervals. Based on this schedule, construction at the Quintana Island terminal would take up to 4.5 years. Freeport LNG indicated that anticipated commercial operation of Train 1 would commence in December 2018, and that full commercial operation of all three trains may be reached as early as December 2019.

2.4.1.5 Operation and Maintenance

The Pretreatment Plant, Liquefaction Plant, and pipelines would be sited, designed, constructed, operated, and maintained in compliance with federal safety standards. Federal siting and design requirements for LNG facilities and the pipelines are identified in section 4.10, Reliability and Safety.

2.4.2 Phase II Modification Project

2.4.2.1 Construction of Berthing Dock

Construction would be initiated with the installation of piles for the dock platform, approach way, and pipe supports, after which pile-driving equipment and crews would be redeployed to install the piles for mooring and breasting structures while concrete placement is performed at the dock platform. Concrete placement for all other structures would follow the completion of the dock platform. Work on the dock superstructure would also involve the erection of pre-cast concrete elements and structural steel components. Completion of the dock platform, approach way, and pipe supports would allow subsequent installation of equipment and piping.

Heavy lifting equipment would be used to lift the piles into position, support pile-driving equipment and lift various formwork, concrete, and steel materials. Diesel powered pile-driving hammers would be used to install all piles for the dock facility structures. These hammers are internal combustion, open top hammers typically used in this type of construction. Other equipment would include smaller hydraulic lifting cranes, gas and diesel powered air compressors, gas powered welding machines, small hand tools, and gas powered generators.

Excavation and Dredging Operations for Dock Construction

Upland excavation would encompass all soils above -5.0 feet (NAVD 88) that can be handled by conventional, land-based construction equipment in the Phase II dock area.

Following upland excavation, the Phase II berthing area would be dredged roughly perpendicular to the FHC to a depth of -46.5 feet (NAVD 88) with a two-foot allowable overdepth, which would match the adjacent channel depth. Dredging specifications for the Phase II dock and berthing area would be similar to those for the Phase I dock. The width of the berthing area would be approximately 1,340 feet at the entrance to 830 feet at the west end. The easternmost mooring dolphin at the dock would be at least 250 feet from the near bottom edge of the ship channel that is maintained and periodically dredged by the USACE.

Portions of the Phase II dock would be excavated from within an existing dredged slip, which has depths ranging from about -8 feet to -12 feet (NAVD 88). It is estimated that about 1,188,000 yd^3 of material would be hydraulically dredged and pumped to an existing DMPA in the vicinity of the terminal.

Construction of the LNG Transfer Pipelines

The Phase II dock would be connected to the storage tank area by the LNG transfer pipelines. These two pipelines would run aboveground and adjacent to each other on steel-framed support racks. The individual frame members for the support racks would arrive at the terminal prefabricated, after which the racks would be assembled on-site. At the dock site, the pipe racks would be installed after the dock superstructure has been erected. Pipe installation on the racks would be implemented from multiple directions.

Construction of Access Road

Land access for the Phase II Modification Project construction and operation work would require development of an approximately 7,000-foot-long plant access road. Approximately 3,820 feet of the plant road is currently operational but may require some improvement, and the remaining 3,180 feet would require new construction within the existing fenced facility. The road would be constructed using earth moving/grading equipment and the road would meet applicable USDOT requirements. Freeport LNG would use fill on-site for grading to the extent possible.

Transportation

Construction workers would leave their vehicles at off-site parking lots and would be transported by bus to and from Quintana Island. Construction access routes and traffic issues are discussed in section 4.8.5.

2.4.2.2 Construction Schedule

The construction schedule of the Phase II Modification Project is expected to commence at the same time as the Liquefaction Project, though may differ in length of time required because of the smaller scope of construction work.

2.4.2.3 Operation and Maintenance Procedures

The Phase II Modification Project would be operated and maintained in accordance with federal safety standards and regulations as identified in section 4.10 Reliability and Safety.

2.5 FUTURE PLANS AND ABANDONMENT

Freeport LNG currently has no plans for abandonment of the Freeport LNG terminal, Pretreatment Plant or pipeline facilities. As noted in section 1.2, Freeport LNG had previously requested LNG non-FTA country export capacity in excess of that requested in the Application to FERC. This was not granted by the USDOE. Any Freeport expansion of non-FTA country export capacity would require an additional USDOE authorization as well as a FERC authorization. In addition, an appropriate environmental analysis would be conducted. The expansion or abandonment would be subject to appropriate federal, state, and local regulations in effect at that time.

3.0 ALTERNATIVES

We evaluated a number of alternatives to the Freeport LNG Liquefaction Project and Phase II Modification Project to determine whether an alternative would be reasonable or environmentally preferable to the proposed actions. These alternatives included the No Action Alternative, system alternatives, route alternatives, and aboveground facility site alternatives.

The evaluation criteria for selecting potentially reasonable and environmentally preferable alternatives include whether they:

- are technically and economically feasible and practical;
- offer significant environmental advantage over the proposed Project or segments of it; and
- meet the stated purpose and need for the proposed action: to allow Freeport LNG to export domestic natural gas to the world market.

3.1 NO ACTION ALTERNATIVE

If the Commission selects the No Action Alternative (*i.e.*, denies the applications), the objectives of the proposed Projects would not be met and Freeport LNG would not be able to provide U.S. natural gas producers with new access to global gas markets, however, the environmental impacts described in this EIS would not occur. It is speculative to predict the actions that would be taken by natural gas producers and end users as a result of the No Action Alternative. Similarly, the associated direct and indirect environmental impacts are also speculative. It is possible that natural gas infrastructure supplying natural gas to the global market area could be developed in other ways unforeseen at this point, including the construction of other associated LNG export projects to serve global markets. These other LNG export projects would have their own environmental impacts, which could be less than, equal to, or greater than the Freeport LNG Projects.

3.2 SYSTEM ALTERNATIVES

System alternatives are alternatives to the proposed action that would make use of other existing, modified or proposed facilities that would meet the stated purpose of the proposed actions. A system alternative would make it unnecessary to construct part or all of the proposed actions, though additions or modifications to existing facilities may result in environmental impacts that are less than, equal to, or greater than the environmental impacts of the proposed facility.

On the East, West, and Gulf coasts of the United States, there are several proposed LNG export terminals that could be expanded or modified to export additional LNG. Any of these facilities would need additional liquefaction infrastructure plus the potential need for expanded docking facilities. Freeport LNG is an existing facility, and although the Pretreatment Plant would be built on a new site, the Liquefaction Plant, docks, tanks, etc. are existing. Any new LNG terminal would have large impacts from development of the facility. In addition, any of the system alternatives would not meet Freeport LNG's development goals or meet Freeport LNG's contractual obligations. As a result, any of the proposed export terminals do not offer significant environmental advantage over the proposed Project which would partially utilize an existing facility.

3.3 SITE ALTERNATIVES

Site Alternatives include different locations for Freeport LNG's facilities that could reduce environmental impacts and still allow the Projects to meet the objectives. We evaluated site alternatives for the components of the Liquefaction Project (*i.e.*, the Liquefaction Plant, Pretreatment Plant, and Utility Line/Pipeline) and we considered site alternatives to the Phase II Modification Project. It should be noted that unlike a pipeline under Section 7 of the NGA, an authorization granted under Section 3 of the NGA does not grant the applicant eminent domain and thus we have limited ability to ensure that a recommended alternative site would be available unless the landowner would make it available for purchase or lease.

3.3.1 Liquefaction Plant

The site for the Liquefaction Plant adjacent to the existing Quintana Island terminal was selected on the basis of compatibility with the existing plant layout and yet-to-be constructed Phase II facilities, ease of functional integration, compliance with the siting and design requirements set forth in the CFR 49 Part 193 Subparts B and C and NFPA Standard 59, and availability of open space. The Liquefaction Plant also needs to be sited close to the existing offloading areas, LNG storage tanks, docking area, and other existing LNG infrastructure to avoid the construction of duplicative and significantly costly infrastructure at another location with added environmental impacts. The liquefaction trains and supporting equipment would be constructed within the existing terminal property and on adjacent Port Freeport property to the west, which was used previously as a DMPA.

The original Liquefaction Plant layout involved three trains located east of the Phase I process area and one train on the north edge of the Phase I process area (see figure 3.3.1-1). Freeport LNG revised the layout scenario for the current filing so that the three trains are on the former DMPA and located west of the Phase I process area (see figure 3.3.1-2). This location is expected to have relatively lower potential operational noise impacts as it is further away from a greater number of Quintana Island residents than the original location. As no other reasonable alternative site exists without significant increases in environmental impacts, constructing the Liquefaction Plant adjacent to the existing facility is the environmentally preferred location.

0 500 1,000
Feet

N

Figure 3.3.1-1
Freeport LNG - Liquefaction Project
Original Liquefaction Facility Configuration at Quintana Island Terminal
Brazoria County, Texas

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Figure 3.3.1-2

Freeport LNG - Liquefaction Project

Proposed Liquefaction Facilities at and Adjacent to Quintana Island Terminal

Brazoria County, Texas

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At the request of local landowners and FERC staff, Freeport LNG evaluated the feasibility of lowering the pad elevation of the Liquefaction Plant and examined the difference this would have on impacts on visibility, noise, safety, stormwater, and site engineering. Specifically, Freeport LNG evaluated lowering the ground elevation of the Liquefaction Plant by excavating 20 feet from the elevation currently proposed (*i.e.*, changing elevation from 28 feet amsl to 8 feet amsl). The results of the work showed that this alternative would not provide substantial improvements in visibility, noise attenuation or safety. Furthermore, this alternative would result in other impacts including significant traffic vehicle or barge traffic associated with having to transport 5.7 million yd^3 of excavated material that would require disposal and reduce the capacity of the Port Freeport dredge material placement system. Transport of the 5.7 million yd^3 would require an estimated 570,000 tandem dump truck round trips to transport the material, much of it saturated with water. As a result of these impacts, this alternative would not provide a significant environmental advantage.

3.3.2 Pretreatment Plant

The proposed Pretreatment Plant site is located about 2.5 miles north of Quintana Island and would be situated primarily on grazing land. It would require an operational footprint of approximately 113.4 acres within a 276.3-acre property. The purpose of the Pretreatment Plant is to remove impurities in the natural gas prior to its liquefaction. The facility includes three natural gas pretreatment units (Units 1, 2, and 3) located in parallel in the northwest section and various support facilities. During Project planning and design, several site alternatives for the Pretreatment Plant were evaluated by Freeport.

The main criteria for site selection were:

- location between common source gas receipt point at Stratton Ridge meter station and the proposed Liquefaction Plant at the Quintana Island terminal;
- close proximity to the existing 42-inch-diameter sendout pipeline to minimize length of lateral pipeline interconnects;
- sufficient contiguous land acreage (approximately 40.0+ acres) to install Pretreatment Plant equipment with sufficient buffer to avoid disturbance (*i.e.*, noise and visual impacts) of neighboring property occupants;
- sufficient contiguous land acreage to provide topographic compensation (stormwater detention pond) for the loss of floodplain retention volume, as required;
- proposed industrial use compatible with existing surrounding land use(s);
- suitable road access; and
- land available for purchase or long-term lease.

To minimize impact, site alternatives were first assessed near or adjacent to the existing Quintana Island terminal. However there was a lack of a suitably configured (rectangle-based) area of sufficient size. The terminal site and the adjacent DMPA comprise an overall contiguous land area of 427 acres. Of this area, the operational footprints of the existing Phase I facilities (*i.e.*, unloading facilitates, two 160,000 m^3 LNG storage tanks, LNG vaporization systems, and associated utilities), proposed Phase II facilities, and proposed Liquefaction Plant collectively account for 221 acres. Much of the remaining 206 acres is peripheral fragmented land bordering the existing and proposed facilities, with 106 acres designated as construction workspace for the proposed Phase II and/or Liquefaction Plant.

The largest unfragmented block of land beyond the existing and proposed operational facility footprints is the 21-acre section located east of the ExxonMobil property and designated as "temporary workspace" for the Liquefaction Plant (see previously referenced figure 1-2). This area is insufficient to support the proposed Pretreatment Plant.

Since no suitable location was available at or adjacent to the terminal site, alternatives beyond the terminal were evaluated. The locations of eight alternative sites are illustrated in figure 3.3.2-1 along with Freeport LNG's proposed location of the Pretreatment Plant (Site F). A comparison of these site alternatives is provided in table 3.3.2-1.

Site A is a 1,500-foot-long by 800-foot-wide (27.5-acre) rectangle located adjacent to Freeport LNG's existing compressor station at the Stratton Ridge underground storage site. As the Pretreatment Plant design evolved, a lack of sufficient space for the pretreatment equipment at Site A became evident (only 27.5 acres was available in comparison with the anticipated 40 acres required). The presence of peripheral industrial infrastructure and wetlands constrain the extent to which Site A could be expanded and would increase the area of affected wetlands over the proposed action. Freeport LNG's preliminary discussions with current land owners indicated that Site A is not likely to be available for purchase or long-term lease within a timeframe that meets the schedule or regulatory filing requirements.

Site B, which is located on the opposite side of Farm-to-Market (FM) Route 523 to Site A and the Stratton Ridge underground storage site, did not exhibit the same expansion constraints as Site A. Site B is a 2,000-foot-long by 1,000-foot-wide (45.9-acre) rectangle with sufficient additional peripheral space for a stormwater detention pond. Freeport LNG's preliminary discussions with current land owners indicated that Site B is not likely to be available for purchase or long-term lease within a timeframe that meets the schedule or regulatory filing requirements.

Site C is located on the same side of FM Route 523 as Site B, but is approximately one mile north of Site B. Site C consists of a parcel that is approximately 27.5 acres in size and exhibits the same expansion constraints as Site A. Freeport LNG's preliminary discussions with current land owners indicated that Site C is not likely to be available for purchase or long-term lease within a timeframe that meets the schedule or regulatory filing requirements.

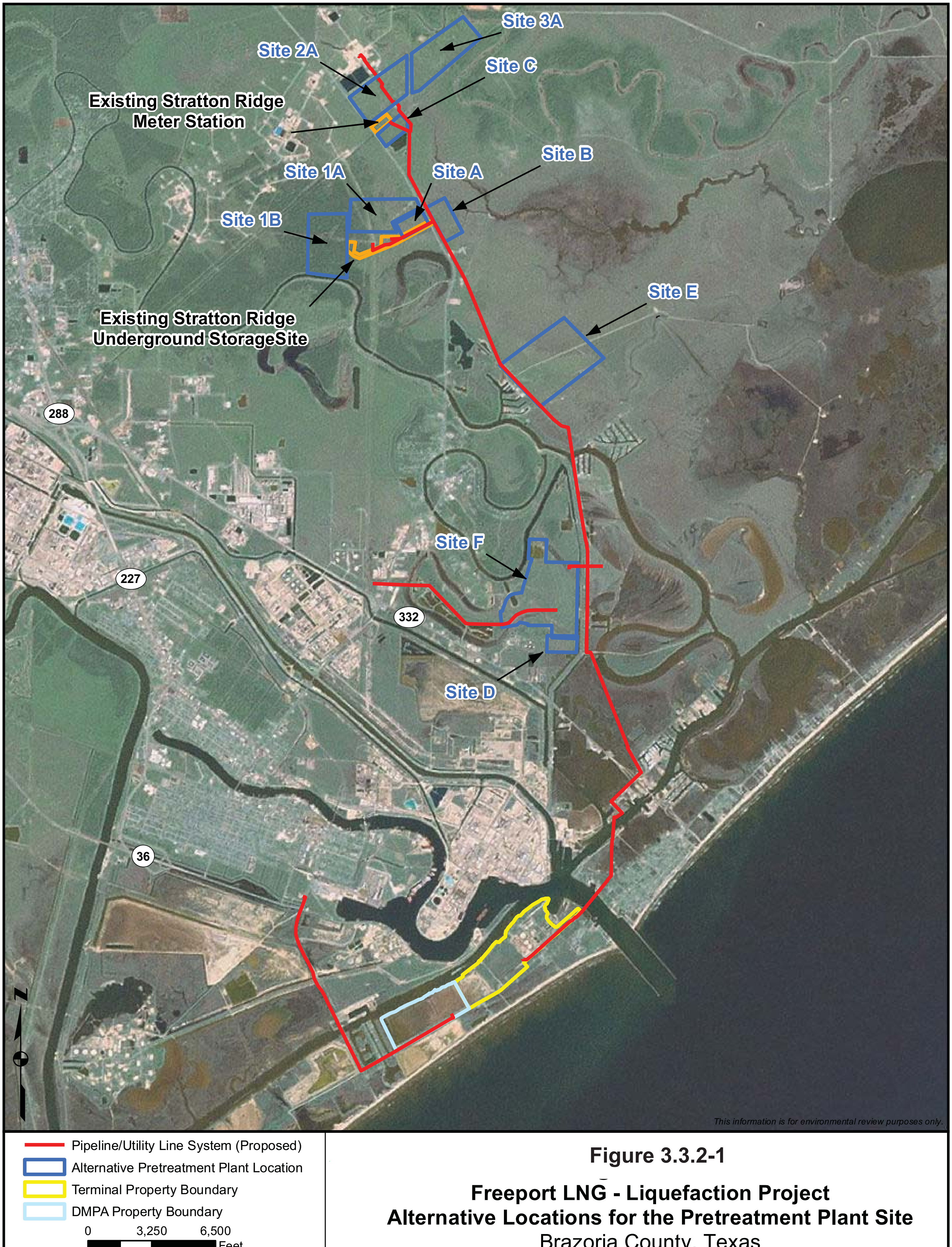

Figure 3.3.2-1

Freeport LNG - Liquefaction Project
Alternative Locations for the Pretreatment Plant Site
Brazoria County, Texas

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Table 3.3.2-1

Selection Criteria Summary for Pretreatment Plant Site Alternatives

Selection Criteria	Site									
	A	**B**	**C**	**D**	**E**	**F**	**1A**	**1B**	**2A**	**3A**
Location between Stratton Ridge meter station and Quintana Island terminal	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Close proximity to existing 42-inch-diameter send-out pipeline	yes	yes	yes	yes	yes	yes	yes	no	no	yes
Sufficient contiguous land acreage for pretreatment equipment, temporary workspace, and buffer	no	yes	no	no	yes	yes	no	yes	yes	yes
Sufficient contiguous land acreage for pond to offset loss of floodplain retention volume, as required	no	yes	no	no	yes	yes	no	yes	yes	yes
Proposed industrial use compatible with existing surrounding land use(s)	yes	yes	yes	yes	yes	Yes	no	no	yes	no
Suitable road access	yes	yes	yes	yes	yes	Yes	yes	yes	yes	yes
Land available for purchase or long-term lease within timeframe that meets Project schedule and regulatory filing requirements	no	no	no	no	yes	Yes	no	no	no	No

Note
Site F is the Proposed site

Site D is a small rectangular parcel, approximately 27.5 acres in size and is located adjacent to the southeast corner of Site F off FM Route 523. Like Site A, this Site turned out to be too small and Freeport LNG's preliminary discussions with current land owners indicated that Site D is not likely to be available for purchase or long-term lease within a timeframe that meets the schedule or regulatory filing requirements.

Site E is located on one part of a contiguous 500-acre property that Freeport LNG purchased in November 2011. Of the original five alternative sites considered, Site E was the only one that offered sufficient construction and operational space, while being readily available on the real estate market for purchase or lease. Site E was consequently originally chosen as Freeport LNG's "preferred site" for the Pretreatment Plant and was identified as such in draft Environmental Report (ER) materials filed with the FERC in Docket No. PF11-2 in December 2011.

The operational footprint for the Pretreatment Plant at Site E would occupy 100.1 acres and adjoining temporary workspace would occupy 85.6 acres, constituting an overall site footprint of 185.7 acres. This footprint was located in the western sector of the 500-acre property adjacent to CR 792 and the existing sendout pipeline, which runs along and within the site's western boundary.

The location and configuration of the construction footprint for Site E in the western sector of the overall 500-acre property minimized wetland and waterbody impacts to the extent possible. Of the 188.6 acres of planned site disturbance (which included 2.9 acres relating to the permanent relocation of an existing site access road north of the proposed Pretreatment Plant), only seven acres (based on delineation during July and August of 2011) involved either temporary or permanent impacts on wetlands or waterbodies.

Public review of the development plans for Site E, as filed with the FERC and as presented at several public meetings, raised significant concerns and opposition from residents in the nearby communities of Hide Away on the Gulf, Turtle Cove, and Oyster Creek Estates. In particular, residents of Hide Away on the Gulf and Oyster Creek Estates were concerned that Site E was located on CR 690, the single means of road access for the two communities, and an emergency or accident at the Pretreatment Plant could block that access. Concerns were also expressed in comment letters from residents in the area about noise levels, air emissions, water discharges, materials storage, flood protection, and other construction and operation-related issues with the potential to negatively impact local residents and natural resources.

As a result of public concerns with Site E, Freeport LNG evaluated and selected Site F as its proposed site. Site F consists of 400 acres of land that recently became available for purchase. The acreage consists of multiple contiguous land parcels with one property owner and is located about one mile southeast of the City of Oyster Creek, on the west side of CR 690 between Turtle Cove and SH 332. The Pretreatment Plant site (Site F) is evaluated in section 4.0 of this EIS.

Freeport LNG entered into an option agreement to purchase the above-described 400 acres of land, of which an approximately 276-acre area constitutes the newly proposed site for the Pretreatment Plant (see previous figure 3.3.2-1). Site F fulfills all the relevant site selection criteria[11] identified in table 3.3.2-1; in addition, it can be accessed by multiple road routes and is located in a sparsely populated semi-rural area currently or historically supporting several industrial and commercial operations such as sand extraction and oil/gas storage. The communities that are in closest proximity to Site E are at least 0.7 mile from Site F. This buffer minimizes noise and visual impacts. In addition Site F has a means of access that does not involve travel in close proximity to the proposed plant and thus addresses concerns about public safety and use of road in the event of an emergency. From an environmental impact perspective, development of Site F would involve approximately 15.1 acres of temporary and permanent wetland/waterbody impacts, in comparison with approximately 7.0 acres of temporary and permanent wetland/waterbody impacts for Site E.

We evaluated additional alternative sites as a result of concerns expressed by persons living in residential areas in proximity of the proposed Pretreatment Plant site to ensure the site chosen by Freeport LNG minimizes land use and environmental impacts on the greatest extent possible. These other sites included Sites 1A, 1B, 2A, and 3A (see figure 3.3.2-1). None of the sites proved to be viable due to land availability issues and site constraints as discussed below.

Alternative Sites 1A and 1B are located in undeveloped areas north and west, respectively, of the existing Stratton Ridge underground storage site. These properties rest atop the Stratton Ridge Salt Dome, an economically important salt diapir used by Dow and others for salt mining, gas, and petroleum products storage. The property owner of these sites is planning to use them for the development of future storage capacity and is not interested in selling or leasing the property for non-salt dome oriented activities. In addition, Site 1A is too small for the Pretreatment Plant, and Site 1B is too far from the existing 42-inch diameter send-out pipeline and would not be compatible with surrounding land uses.

Site 2A and 3A are located north and east, respectively, of the Stratton Ridge meter station. The property owner of Site 2A is not willing to sell or lease property for uses that are incompatible with salt dome oriented activities. Additionally, Site 2A lacks the required close proximity to the existing 42-inch-diameter sendout pipeline. Alternative Site 3A is not available for purchase at this time, and is not compatible with existing adjacent land uses.

In conclusion, Sites A, B, C, D, 1A, 1B, 2A, and 3A are not viable alternatives for siting of the Pretreatment Plant. The proposed site (Site F) provides a suitable location without the safety issues regarding access to homes during an emergency at the facility that were of concern with Site E. Site F minimizes environmental impacts associated with noise and other operational issues, and thus we conclude that no alternative site offers significant environmental advantages over the proposed site.

[11] The criterion referring to an offset of stormwater retention volume is inapplicable because Site F is not located in a flood zone.

3.3.3 Pipeline/Utility Line System

In evaluating alternatives to the Pipeline/Utility Line System, the main criteria were the functional interdependency; and proximity to the proposed process facilities (Liquefaction Plant and Pretreatment Plant), Freeport LNG's existing natural gas sendout pipeline, and the existing sendout pipeline meter station at Stratton Ridge. The Liquefaction Plant, Pretreatment Plant, and Stratton Ridge meter station represent fixed receipt or delivery points for the natural gas transported by the sendout pipeline and utilized in the liquefaction process. The existing sendout pipeline route is the proposed route identified through Freeport LNG's routing analysis.

Freeport LNG would use existing pipeline corridor for its other pipelines and utility lines (nitrogen, NGL, BOG, water, and fiber optic) and would install utilities within a shared trench to the extent practicable. This would help to avoid segmentation of wooded areas, and minimize the impact on additional land owners.

For those new pipelines for which the contents are received from or delivered to locations other than the Terminal, Pretreatment Plant, or Stratton Ridge meter station, certain route sections deviate from the sendout pipeline and would be dependent on the geographic locations of the receipt and delivery points. Specifically, the water line and nitrogen pipeline originate from foreign pipeline connections (Dow [via an existing Freeport LNG water line] and Air Liquide, respectively) at the Stratton Ridge underground storage site, while the NGL pipeline would deliver to the INEOS Plant, about 0.4 mile north of the Stratton Ridge meter station (see figure 1-1).

At the Stratton Ridge underground storage site, the proposed routes for the nitrogen pipeline and water line are largely located on land owned or leased by Freeport LNG, and the two facilities are partially collocated along the right-of-way for the existing 24-inch-diameter gas pipeline that would be extended to connect the storage facility with the 42-inch-diameter sendout pipeline.[12] The section of the proposed NGL pipeline route that leaves the sendout pipeline south of the Stratton Ridge meter station and runs north to the INEOS Plant fence line, collocated along existing pipeline rights-of-way (approximately 60 percent of the proposed route section is collocated in this way). Alternatives to these direct and relatively short route sections (less than one mile in each case) would involve less collocation and thus would increase impacts on environmental resources. Therefore, the proposed routes are environmentally preferable.

[12] The proposed extension of the 24-inch-diameter gas pipeline is for Freeport LNG's Stratton Ridge underground storage operation and was identified as a nonjurisdictional facility under the previously authorized Phase II Project – it is not part of the Liquefaction Project.

3.4 PHASE II MODIFICATION PROJECT

3.4.1 System Alternatives

The purpose of Freeport LNG's Phase II Modification Project is to provide enhanced LNG storage and vessel handling options to allow Freeport LNG to respond to import, re-export, and export opportunities with optimum market positioning and service flexibility. Such enhanced options cannot be achieved through new or modified LNG terminal facilities elsewhere in the U.S., given that the location, design, and purpose of the Phase II Modification Project facilities are predicated on and inextricably linked to the existing plant facilities and operations at Freeport LNG's terminal. As such, no system alternatives exist that could achieve the same level of functional integration or optimize the terminal's operational flexibility and capabilities without causing greater environmental impacts.

3.4.2 Site and Facility Placement Alternatives

The location, design, and purpose of the Phase II Modification Project facilities are wholly dependent on the existing plant facilities and operations at the Quintana Island terminal; therefore, other geographically separate sites beyond the terminal were not evaluated.

The location and configuration of the proposed Phase II facilities (both for the Phase II Project and the Phase II Modification Project) at the terminal site are essentially dictated by technological considerations and the need for compatible design integration into the existing Phase I layout, and thus relocating these structures elsewhere onsite is not a viable alternative.

4.0 ENVIRONMENTAL ANALYSIS

The Projects would be located in Brazoria County Texas, along the Gulf Coast. The Liquefaction Plant and terminal is located on Quintana Island in the Town of Quintana, and the Pretreatment Plant would be located just outside the City of Freeport approximately 3.5 miles to the northeast.

The Town of Quintana is on the west side of the mouth of the Brazos River and on Farm Roads 1495 and 723, directly across the Brazos River Harbor channel from the Village of Surfside Beach. Quintana has long been a major seaport and varied industries have come and gone including a cattle hide and tallow operation, a pickled-beef factory, an elevator that loaded coal onto ships, a cottonseed oil and cake mill, a shipyard, and a cork plantation (Texas State Historical Association, 2013). In the Galveston hurricane of 1900, the coastline of Brazoria County was destroyed and most of the families then living at Quintana moved farther inland or left entirely. The current population of Quintana is approximately 58 persons (Texas State Data Center, 2012). Today Quintana is a popular destination for beachgoers, the site of a Brazoria County Park, and on the western end of Quintana Island, the location of Freeport LNG's existing LNG import terminal, which includes docking facilities, a storm levee, LNG storage tanks, LNG offloading equipment, vaporization facilities, and an approximately 10-mile-long 36–inch-diameter gas pipeline to deliver imported gas to the Stratton Ridge Meter Station.

The City of Freeport is approximately 16 miles south of Angleton in southern Brazoria County. The City itself was founded by the Freeport Sulphur Company in 1912 and was the site of the world's largest sulfur mines. In 1957 Velasco, one of the oldest towns in Texas, was incorporated into Freeport. Today Freeport is home to one of the Gulf's largest commercial shrimp trawler fleets, and has over 600 businesses and approximately 12,049 inhabitants (Texas State Historical Association, 2013). The location of the proposed Pretreatment Plant is just outside of Freeport on a 218-acre parcel. Cattle grazing is the predominant land use at and in the vicinity of the site, but the surrounding area also supports several residential communities, commercial developments concentrated along arterial roads (SH 332 and FM Route 523), and infrastructure associated with oil and gas production and storage. (See further details on land use in section 4.7).

The Freeport region has a predominantly maritime climate, characterized by periods of modified continental influence during the colder months when cold fronts from the northwest may reach the area. Because of its coastal location and latitude, cold fronts that reach the Freeport region seldom have severe temperatures. Below freezing temperatures are generally recorded only a few times per year. Normal monthly high temperatures range from about 63 degrees Fahrenheit (ºF) in January to 90 ºF in July and August; and lows range from 45 ºF in January to 77 ºF in July.

High humidity prevails throughout the year. The average annual precipitation is approximately 51 inches, varying from approximately 2.8 inches per month in February, March, and April, to 7.8 inches per month in September. Winter precipitation comes mainly as slow, steady rain. Excessive rainfall may occur in any season and on occasion there have been months with rainfall totals amounting to a trace, followed by months with totals in excess of 15 inches. Hail is rare and summer rains can be strong due to local thunderstorms and storms originating in the Gulf. Tropical disturbances, such as hurricanes and tropical storms, are infrequent but can be major storm events when they occur.

Local air mass movements are strongly influenced by onshore-offshore flows. As the land surface heats up on a warm day, the air near the land surface warms and rises, causing atmospheric pressure to decrease relative to the cooler ocean water. The result is an onshore flow or “sea breeze”. Onshore flows are common on spring, summer, and fall days, and typically penetrate less than 40 kilometers (km) inland from shore. When the land cools relative to the ocean, the pattern reverses and an offshore flow or “land breeze” results. Onshore flow is common on nights during the winter. The area is prone to fog, particularly in winter months when warm, humid ocean air is transported over cooler land surface and moisture in the air condenses.

Brazoria County has undergone significant subsidence since the early 1900s due mainly to groundwater extraction. Subsidence in the county ranged up to approximately 1.5 to 2 feet in northern portions of the county, closer to Houston.

The existing Freeport LNG import terminal was placed into service on July 1, 2008. The facility was authorized to operate with a vaporization capacity of 1.5 Bcf/d on Quintana Island. The Commission’s NEPA analysis and impact determination for the Phase I facilities was contained in the final EIS issued on May 28, 2004 (FERC/EIS – 0164).

Freeport LNG’s existing Quintana Island terminal is comprised of the following facilities: one marine berthing dock authorized for up to 200 LNG carrier visits annually, two 160,000 m^3 full containment LNG storage tanks, LNG vaporization systems, and associated utilities. The terminal is connected to the regional natural gas pipeline system by Freeport LNG’s 9.6-mile-long 42-inch-diameter natural gas sendout pipeline.

Freeport LNG submitted an application to the Commission in Docket No. CP05-361-000 for authorization to site, construct, and operate the Phase II Project facilities, the construction and operation of which would expand the import capacity of the Quintana Island terminal. As originally proposed, the Phase II Project at the Quintana Island terminal included an additional marine berthing dock and associated transfer facilities for LNG vessels, new and expanded vaporization systems to increase the vaporization capacity to 4.0 Bcf/d, and an additional LNG storage tank.

The Commission’s NEPA analysis and impact determination for the Phase II Project was contained in an Environmental Assessment (EA) issued on June 21, 2006 and on September 26, 2006, the Commission issued an Order approving the Phase II Project facilities. These facilities have not been constructed and a portion of this draft EIS will review the application for modifications to this authorization called the Phase II Modification Project.

Freeport LNG submitted an application to the Commission for authorization to operate its Quintana Island terminal for the additional purpose of exporting foreign-sourced LNG. Subsequently, on December 9, 2008, Freeport LNG filed an application with the Commission for authorization to construct and operate a BOG liquefaction system and an LNG truck delivery system to provide an alternative source of LNG at its Quintana Island terminal. The Commission's NEPA analysis and impact determination for the export, BOG liquefaction, and LNG truck delivery system facilities was contained in an EA issued on March 13, 2009. On March 25, 2010, the Commission authorized Freeport LNG to commence construction of the LNG truck delivery system, which was completed in November 2010.

4.1 GEOLOGY

4.1.1 Geology, Foundation Conditions and Natural Hazards

The Projects are located in the West Gulf Coast subdivision of the Coastal Plain geomorphic province. This region is characterized by seaward-dipping sedimentary rocks overlain by Quaternary deposits containing thick layers of clay, silt, sand, and gravel (United States Geological Survey [USGS], 2000). The area consists of Holocene barrier ridge/barrier flat deposits, alluvium, and fill and spoil deposits overlying the Pleistocene Beaumont Formation (USGS, 2005). The Beaumont and subsequent underlying formations represent unconsolidated deposits (sand, silt, clay, and gravel) up to several thousand feet thick. The proposed Liquefaction Plant would be located on beach-ridge and barrier-flat sand and shell sand deposits derived from coastal processes and fill and spoil material dredged for raising land along waterways. The proposed Pretreatment Plant and Pipeline/Utility Line System route are largely underlain by alluvium associated with historical deposition from the Brazos River and Oyster Creek. The Beaumont Formation underlies a small portion of the northern extent of the Pipeline/Utility Line System route.

The predominant structural feature under the northern portion of the pipeline route is the Stratton Ridge Salt Dome. The salt dome is oriented southwest to northeast with a caprock approximately 850 feet below ground. It is used as an underground gas storage facility with a capacity of 4.5 billion cubic feet (Bcf) in a cavern approximately 3,400 to 4,300 feet below ground (http://www.freeportlng.com/Underground_Cavern.asp).

The Old Brazos River, the Dow Barge Canal system, and the ICW come together at the FHC and the Gulf. The land and waterways in this area have been significantly altered by industrial development.

4.1.1.1 Mineral Resources

Underground mineral resources in proximity to the proposed Projects consist of salt (formerly exploited for brine production) and oil and gas resources. The Stratton Ridge Salt Dome was discovered in 1913 and has a salt ore body that extends from approximately 1,250 to 10,560 feet below ground. It is located approximately 2.8 miles northwest of the Pretreatment Plant. In the past, the salt dome was solution mined for brine production. The margins of the salt dome have been explored for oil and gas development (USGS, 2012). A small oil and gas field associated with the salt dome, the Stratton Ridge Oil Field, is now inactive. Another salt dome, the Bryan Mound, is located about 3.1 miles southwest of the Liquefaction Plant and serves as a storage site of the U.S. Strategic Petroleum Reserve. A commercial sand extraction operation existed at the proposed Pretreatment Plant site up to 2005. This has since been closed and the associated equipment and structures removed. The Pretreatment Plant site footprint overlies the eastern section of the central abandoned borrow pit. Freeport LNG plans to backfill this borrow pit to planned final grade which is estimated to require a maximum of approximately 20 feet of fill. There are no identified active surface mining operations within one mile of the Projects.

The Railroad Commission of Texas (RRC) Public GIS Map Viewer shows several oil and gas wells within 0.1 miles of the Pipeline/Utility Line System route; however, these are identified as dry holes or bore holes that were drilled and plugged. There are storage wells near the northern portion of the Pipeline/Utility Line System route, including the storage well associated with this Project – the Stratton Ridge underground storage site.

Existing mineral resources near in the area are located significantly deeper than the depth of disturbance associated with facility and utility line construction. The salt dome is about 1,250 feet below ground surface (bgs) and the oil and gas reserves are about 1,300 feet bgs. These resources would not be affected by the generally shallow nature of Project construction. The natural gas storage well drilled into the Stratton Ridge Salt Dome is already complete. Therefore, none of the activities associated with the construction and operation of the proposed Project would be expected to affect mineral resources in the area.

4.1.1.2 Foundation Conditions

Freeport LNG has divided the proposed Liquefaction Plant into five project areas which have somewhat different subsurface soil conditions. Area 5 is defined as in the vicinity of the LNG tank location. Ground surface elevation is +5 feet. Areas 1 and 2 are located to the northeast of Area 5 with ground elevation at +5 feet. No structures are located in Area 1 in the current plot plan while shallow subsurface utilities are located in Area 2. Areas 3 and 4 are located to the west of Area 5 on the previous DMPA dredge spoils area. The three liquefaction trains and additional process structures would be located in Area 3. The elevation of the ground surface of Areas 3 and 4 is approximately +28 feet due the previous placement of dredge fill.

Freeport LNG has performed a geotechnical investigation of the Liquefaction Plant site areas. The soil investigations at Area 5 indicate that subsurface conditions comprise approximately 3 feet of clayey fill directly underlain by soft to firm plastic clays. A layer of loose to medium silty sand was encountered to depths of 35 feet and was underlain by layers of stiff to very stiff clays and sandy clays to depths of about 80 feet. These deposits overlie alternate layers of dense to very dense sands and stiff to very stiff hard clays to a depth of 225 feet where a very dense sand layer was encountered. The subsurface soil properties of Areas 1 and 2 are generally similar to those of Area 5 except for differences in the depths of layers in the top 80 feet. In Areas 3 and 4, dredged fill was placed and the ground surface elevation ranges between +25 and +30 feet. The soil investigations for Areas 3 and 4 indicate that the overall stratigraphic layers are very similar to those indicated in Areas 1, 2 and 5 with the exception of the shallowest fill stratum, which has an increased thickness of up to 30 feet.

The average shear wave velocity for the Liquefaction Plant site for the top 100 feet range between 520 and 705 feet per second for Areas 1, 2 and 5 while for Areas 3 and 4 the velocities range between 525 and 800 feet per second. For all areas, the subsurface soils as characterized in accordance with Chapter 20 of ASCE 7-05 as Site Class D if the upper bound shear velocities are used and as Site Class E if the lower bound shear velocities are used. The foundations for all areas would be reinforced with concrete footings supported by deep driven piles.

The soil investigation at the Pretreatment Plant identified the surface conditions to consist of approximately 12 to 15 feet of firm to very stiff sandy to silty clay intermixed with sandy to clayey silt. This is underlain by about 15 feet of loose to medium dense sand and silty sand. Underlying this unit is approximately 70 feet of firm to stiff clay. Within this same 70-foot-thick zone, a dense to very dense silty sand layer was occasionally encountered.

The average shear wave velocity for the Pretreatment Plant site for the top 100 feet range is between 599 and 606 feet per second. Site classes as defined by ASCE 7-10, Chapter 20 refer to the soil and rock types in terms of shear wave velocity, standard penetration resistance, and undrained shear strength. The site classes are referred to by letter designations A through E. With A being hardest (hard rock) and E (soft clay soil) being the softest material type. Site Class D refers to stiff soil. The site class is important in seismic design because structures respond to ground shaking differently based on the soil or rock type that the building is founded upon. Structures founded upon softer soils experience more ground shaking than when on hard rock. The shear wave velocities for the Pretreatment Plant are in the upper range for Site Class E and the upper range for Site Class D site. Freeport LNG's geotechnical consultant Fugro has recommended that Site Class E be used for the Pretreatment Plant site. We concur.

The final grade proposed for the Pretreatment Plant is at an approximate elevation of +8 feet, which would be with two to five feet of the existing natural grade in areas outside of the borrow pits. Approximately 3 to 20 feet of fill is proposed across the Pretreatment Plant site which would require a large amount of deliveries. Because of anticipated on-site soil settlement, all settlement sensitive structures at the Pretreatment Plant site would be founded on deep pile foundations and lightly loaded structures would be supported on shallow foundations. However, shallow foundations are not recommended in the borrow pit areas that would be backfilled.

4.1.1.3 Natural and Geological Hazards

Geologic and other natural hazards that could potentially affect the proposed Liquefaction Plant, Pretreatment Plant, and pipelines consist of earthquake ground motions and faulting, soil liquefaction, subsidence, hurricane winds and flooding/storm/tsunami damage, and shoreline erosion.

Earthquake Ground Motions and Faulting

The Gulf Coastal Plain geomorphic province is characterized by a low seismic hazard potential. Freeport LNG conducted a site-specific hazard evaluation of the Liquefaction Plant site. The site specific evaluation determined that the peak ground acceleration including site effects is 0.021 g (where g is the acceleration due to gravity) with a 10 percent probability of exceedance in 50 years and 0.065 g with a 2 percent probability in 50 years. Significant earthquakes in the region are rare. Through 1989, only two earthquakes Modified Mercali Intensity VI had been recorded for east Texas – 1891 and 1932 (USGS, 1999). The Advanced National Seismic System Comprehensive Catalog (USGS, 2014) has no record of significant seismic activity in the region of southeast Texas since the inception of the database in 1973. The sediments do not have the capacity to store large amounts of energy and rupture, so natural movements are more slow slides than sudden lurches. Most of the ground subsidence and earthquake activity that does exist in the region is thought to be the result of human activity (*e.g.,* oil and gas or groundwater extraction). As groundwater extraction was decreased in Brazoria County in the 1970s, subsidence also decreased (see subsidence below).

There are several faults near the Projects, including normal, listric, growth faults that generally dip Gulfward along the Texas gulf coast and faults around salt domes associated with diapirism. Slip rates along the normal growth faults is anticipated to be less than 0.2 millimeters per year. Faults associated with salt diapirism occur locally around the Stratton Ridge Salt Dome and the Bryan Mound Salt Dome. A site-specific fault study was conducted for the Liquefaction Plant. No faults were identified that could impact the areas east and west of the existing terminal in areas of the proposed expansion so no further fault investigation is required. However, a fault has been identified in the northwestern corner of a possible future expansion area. If additional plant expansion is planned along the northern side of the future expansion area, then additional investigation would be required.

Freeport LNG conducted a fault study for the Pretreatment Plant to identify previously mapped faults in the area with the potential to impact the site. Three such faults (the Horseshoe Fault, the East Union Bayou Fault, and the Salt Lake Fault) were identified based on geologic maps, surface projection of subsurface faults, and literature review of the area. Topographic maps, aerial photographs, and LIDAR imagery were also used; however Freeport LNG's consultant did not identify surface fault traces crossing the Pretreatment Plant site. Fugro also conducted surface reconnaissance across the site and no evidence of surface offset was observed. Fugro concluded that the there is no evidence of a surface fault affecting the Pretreatment Plant site, however, Fugro recommended that a detailed fault study be conducted at the proposed Pretreatment Plant location. This detailed fault investigation has not been performed. Therefore, to confirm the absence of surface faulting at the Pretreatment Plant, **we recommend that:**

> **Prior to the end of the draft EIS comment period, Freeport LNG should file a detailed fault investigation for the Pretreatment Plant site for review and written approval by the Director of OEP. This investigation should provide sufficient information to document the absence of active faulting that may affect the Pretreatment Plant.**

Soil Liquefaction

Soil liquefaction is the transformation of loosely packed sediment, or cohesionless soil, from a solid to a liquid state as a result of increased pore pressure and reduced effective stress, such as intense and prolonged ground shaking from seismic events. Though there are sediments underlying the Liquefaction Plant that fit this category, the low risk of seismic activity in this area minimizes the potential hazard to the Liquefaction Plant from soil liquefaction. Freeport LNG identified a layer of loose to medium dense sand approximately 10 to 35 feet bgs at the proposed Liquefaction Plant that was potentially susceptible to liquefaction (Fugro, 2011). A similar loose sand/silty sand layer was also identified from approximately five to 20 feet bgs at the Pretreatment Plant (Fugro, 2012b). Freeport LNG evaluated the potential for liquefaction of this layer for the Liquefaction Project by performing soil borings and cone penetration tests. Based on the results of this investigation, Freeport LNG concluded that liquefaction of the identified continuous layers of silty sand and sand beneath the Liquefaction Project area is unlikely and that liquefaction of thin silt layers in the dredge fill would be sporadic, contained, and discontinuous (Fugro, 2011). Although Freeport LNG's geotechnical consultant Fugro recommended that a liquefaction study be performed for the Pretreatment Plant (Fugro, 2012c), and no such evaluation has yet been conducted, we deem that the extremely low risk of seismic activity, combined with the low liquefaction potential of the soils result in a low risk to the Pretreatment Plant from soil liquefaction.

Subsidence

Subsidence is defined as sudden sinking or gradual downward settling of land with little or no horizontal motion, caused by surface faults and intensified or accelerated by the extraction of subsurface mineral resources, groundwater, or hydrocarbons. Large-scale subsidence has occurred in Brazoria County, starting around the turn of the last century. By the 1970s the area around Freeport had subsided approximately 1.5 feet and up to 2 feet in northern portions of the county, near Houston (Sandeen and Wesselman, 1973). The Brazoria County Groundwater Conservation District (BCGCD) was created in 2005 to, among other things, control and prevent subsidence. BCGCD has a map of projected subsidence through 2050 on their website (http://bcgroundwater.org/maps/feet2050.htm). The risk of subsidence in the Freeport area has been reduced greatly due to a reduction in groundwater pumping and the associated rise in the water levels in the Chilot aquifer. Estimated subsidence in the area of the Liquefaction Project is estimated up to one foot when projected through 2050 according to the BCGCD. The subsidence would not affect improved facilities such as the Liquefaction or Pretreatment Plants, although it may have minor affects on appurtenant structures attaching to the plants such as roads, stairs, etc. Mitigation for minor, ongoing settlement of these appurtenant facilities would require continued maintenance by Freeport LNG.

Hurricane Winds

The proposed Liquefaction Plant site would be subject to hurricane winds. As required in 49 CFR 193.2067, the LNG facility including both the LNG tanks and liquefaction process areas would be designed for a sustained wind speed of 150 miles per hour (mph), which converts to a 3-second gust wind speed of 183 mph. The Pretreatment Plant would also be designed for a 3-second gust wind speed of 150 mph.

Flooding/Storm Damage/Tsunami

The Liquefaction Project would be located along the Gulf shoreline and would be subject to coastal storms, hurricanes, flooding, and other coastal processes. According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), the Liquefaction Project would lie within Coastal Flood Zone VE and 100-year Flood Zone AE. VE indicates that the area is susceptible to coastal flooding with wave action. The base 100-year flood elevation for the Liquefaction Project is 13 feet (FEMA, 1993). Therefore, the Liquefaction Project must be designed to withstand severe weather and flooding events.

The Pretreatment Plant would be located in an area designated as Zone X, indicating that it is an area protected by levees from a 100-year flood (FEMA, 1992). The majority of the Pipeline/Utility Line System route is located within the 100-year flood plain, with coastal areas also in Zone VE. The northern end of the Pipeline/Utility Line System route is outside of the 100-year floodplain.

The Liquefaction Project includes design elements to address potential flooding and storm damage. These elements include storm surge levees around the Liquefaction Project and elevated fill platforms or racks to raise operational facilities (28 feet amsl for the Liquefaction Plant, and 8 feet amsl for the Pretreatment Plant). The critical storm surge elevation used for the Liquefaction Project levee design criteria is elevation 13 feet amsl developed after Hurricane Carla in 1961. To dissipate the direct wave action of incoming waves and to prevent damage to inland installations, three levees are in place: the Velasco Drainage District's sacrificial levee extends around the ExxonMobil property to the east side of Quintana Island; the Freeport LNG levee surrounds the south and west sides of the LNG storage and vaporization area; and Port Freeport's levee around the former DMPA. The Liquefaction Project would be located within the Port Freeport DMPA levee. Both of non-sacrificial levees have crest elevations 21-feet amsl. The Freeport LNG levee was constructed of stabilized clay, but the levee around the DMPA is assumed to be constructed of the same dredged material found in the DMPA. Freeport LNG proposes to make structural improvements to the DMPA levee, as required.

As identified in section 4.12.4, Climate Change in the region would have two effects which may cause increased storm surges; increase temperatures of Gulf Waters which would increase storm intensity, and a rising sea level. Even with the increased sea levels due to climate change, and increased storm surge, the non-sacrificial levees elevations of 21-feet-amsl at the Liquefaction Plant would provide a significant barrier to even a 100-year climate-change-enhanced storm surge. The Pretreatment Plant, while inland, has a lower 8-feet-amsl pad that would be more vulnerable to storm surge, but would be afforded more protection due to its location 2.5 miles inland.

The Liquefaction Plant's shoreline location also makes it susceptible to potential inundation of tsunamis. The Pretreatment Plant is located approximately 2.5 miles from the coast and is not susceptible to inundation from tsunamis. Tsunamis are generated by submarine movements such as landslides and earthquakes. Freeport LNG conducted a tsunami hazard assessment as part of their seismic evaluation of the Liquefaction Plant (Freeport, 2011). It was concluded that a tsunami with a 500 year recurrence rate would reach less than 13 feet amsl. Horrillo *et al.*, (2010) identified three historical and potential future locations of submarine landslide occurrences and modeled the coastal impacts of the recurrence of similar slides. It was determined that the 21-feet-amsl levee elevation of the Liquefaction Plant would be sufficient for protection from storm surge and we agree.

Shoreline Erosion

Beach erosion along the seaward side of Quintana Island (south of the FHC mouth) has historically been rapid, but was reported to be stabilizing in recent years (Morton, 1997). However, according to the Texas Shoreline Change Project, a regional shoreline-monitoring and shoreline-change analysis program (Gibeaut *et al.*, 2000), the average annual rate of shoreline change in the Liquefaction Project vicinity is negative (*i.e.*, an erosional environment). Based on recent topographic profile mapping of the Quintana Island shoreline, and comparison to historic shoreline locations, mapping for the Liquefaction Project area indicates that the annual rate of beach erosion is about 11 feet per year. In 2005, 72,000 tons of sand were dumped along the Gulf side of Quintana Island to replace beach lost to erosion. In recent years, Brazoria County has instituted a dune restoration planting project. Since beach erosion is occurring from the Gulf inward, toward the main land, the presence of the Liquefaction Project, which would be located on the backside of the island, should not have any effect on the rate of erosion on the island. The Pretreatment Plant is inland and would not be affected by shoreline erosion.

The slope stability analysis has not been properly identified for the north side of the Liquefaction Plant. This is necessary because the slope in question is 27 feet high with 25 feet below water. Freeport LNG has only analyzed the above water portion and states that the slope is stable. This is not adequate. The below water portion of the slope should to be analyzed to complete the analysis and ensure proper stability.

Mitigation Measures

Although the geological hazards to construction and operation of the Liquefaction Plant are slight, additional information on the geology, seismology, and design of the proposed Quintana Island terminal site is required to ensure that Freeport LNG's Liquefaction Plant is designed to withstand potential geologic hazards, **we recommend that:**

Prior to construction, Freeport LNG should file the following design and construction details:

- **a. an updated slope stability analysis of the north side of Liquefaction Plant area including the slope below the water level early in the design phase. This analysis should include an updated bathymetry along the waterway channel that defines the underwater continuation of the slope included in the stability analysis;**
- **b. design details of structures and foundations of the Liquefaction Plant. These design and construction details should be stamped and sealed by the professional engineer-of-record, registered in the state where the facility where the facility is being constructed, responsible for the design; and**
- **c. seismic specifications used in conjunction with procuring Liquefaction Plant equipment prior to the issuing of requests for quotations.**

In conclusion, the Liquefaction Project is located in an area that presents several potential challenges, relative to geology, foundation conditions, and natural hazards; however, these conditions can be effectively managed through proper engineering design or shown to be minimal through additional evaluation. The recommendations included in this section ensure Freeport LNG would be required to mitigate and or manage associated geologic impacts on the proposed Projects, and thus geological impacts would be minor and not result in significant impacts.

4.1.2 Phase II Modification Geology, Foundation Conditions and Natural Hazards

Geologic issues and impacts associated with the Phase II Modification Project are the same as those described above for the Liquefaction Plant due to the geographic overlap of the two projects. Refer to discussion above with respect to, seismicity and faulting, soil liquefaction, subsidence, hurricane winds, flooding/storm damage/tsunami, and shoreline erosion.

4.2 SOIL RESOURCES

4.2.1 Liquefaction Project

4.2.1.1 Liquefaction Plant

There are three mapped soils that are potentially affected by the work at the proposed Liquefaction Plant on Quintana Island: Galveston fine sand, undulating; Ijam clay; and Velasco clay. Galveston fine sand, undulating is a partially hydric soil that accounts for approximately 3.1 percent of the area. Ijam and Velasco clays are hydric soils that are approximately 3.7 percent and 29 percent of the area, respectively. The remaining 64 percent of the Quintana Island site is classified as “water”; however, this is the location of the DMPA, where dredge spoils have been used as fill. The soil in the DMPA is likely heterogeneous.

Table 4.2.1-1 presents a descriptive profile, including construction limitations, of the three mapped soils.

Table 4.2.1-1

Characteristics of Soil Types at the Quintana Island Terminal Site

Map Unit Name	Drainage Class	Hydric	Prime Farmland	Erosion Concerns	Revegetation Potential	Compaction Prone
Galveston fine sand, undulating	Somewhat excessively drained	Partially	No	Very High	High	No
Ijam Clay	Very poorly drained	Yes	No	Moderate	Low	Yes
Velasco Clay	Very poorly drained	Yes	No	Moderate	Low	Yes

Impacts on Soils

Construction of the proposed Liquefaction Plant at and adjacent to the Quintana Island terminal would impact each of the three soil types (Ijam clay, Velasco clay, and Galveston fine sand, undulating) and the dredge spoil area. In total, approximately 97.3 acres would be temporarily affected as construction workspace and approximately 132.5 acres would be permanently affected by aboveground facility placement and operation. Table 4.2.1-2 summarizes the acreage impacts for each soil type.

Table 4.2.1-2

Soil Acreage Impacts at the Quintana Island Terminal Site

Soil Series	Temporary Workspace (acres)	Permanent Facility Footprint (acres)	Total
Galveston Fine Sand, Undulating	2.44	6.08	8.52
Ijam Clay	5.90	4.00	9.90
Velasco Clay	30.90	34.68	65.58
Water a/	58.10	87.72	145.82
Total	97.34	132.48	229.82

a/ Designation for former DMPA-impact acreages relate more appropriately to underlying dredge spoil material.

Permanent aboveground facilities associated with the Liquefaction Project would be designed to control and manage stormwater runoff, thus minimizing potential long-term erosive effects. The primary concern for erosive impacts of the Liquefaction Project would be the construction phase and temporary work areas during the post-construction phase.

The three soil types mapped at the Liquefaction Plant on Quintana Island are at least moderately erosive, and Galveston fine sand, undulating has a high erosive potential. Factors that influence the degree of erosion include soil texture, structure, length and percent of slope, vegetative cover, and rainfall or wind intensity. Soils most susceptible to erosion by water are typified by bare or sparse vegetative cover, noncohesive soil particles with low infiltration rates, and moderate to steep slopes. Clearing, grading, and equipment movement could accelerate the erosion process and, without adequate protection, result in discharge of sediment to waterbodies and wetlands. Soil loss due to erosion could also reduce soil fertility and impair revegetation.

In order to minimize erosion during construction and immediately thereafter Freeport LNG's Procedures and SWPPP would be followed, which include measures such as minimizing the amount and length of soil exposure; slowing and/or diverting runoff; installing and maintaining erosion and sedimentation control measures; and reintroducing vegetative cover as early as possible. Proper application of these measures would be required to minimize erosive effects, as would immediate revegetation of the work areas, in particular areas of Galveston fine sand, undulating.

Two soil types are identified as having poor revegetation potential at the terminal site. Soils with poor revegetation potential include those that have a high clay content, low fertility, and are saturated for most of the year (*i.e.,* hydric soils). Much of the soils affected by construction of the aboveground facilities would be permanently developed and would not require revegetation (58 percent at the Liquefaction Plant area) and Freeport LNG would make efforts to revegetate where necessary in accordance with Freeport LNG's Procedures.

With the exception of Galveston fine sand, undulating all soils that would be disturbed for development of the Liquefaction Plant have the potential to experience some level of soil compaction. This includes the dredge spoils in the DMPA, which are likely compactible. Soil compaction modifies the structure and reduces the porosity and moisture-holding capacity of the soil. The degree of compaction is dependent on moisture content and soil texture. Fine-textured soils with poor internal drainage are the most susceptible to compaction. Construction equipment traveling over wet soils could disrupt soil structure, reduce pore space, increase runoff potential, and cause rutting. Compaction and rutting impacts would be more likely to occur when soils are moist or saturated. To minimize soil compaction potential, the size of the construction work that requires the passage of heavy equipment would be limited to that required for construction and minimized to the extent practicable.

Freeport LNG plans to introduce an average 2 feet of clay soil fill beneath the operational footprint of the proposed Liquefaction Plant. This would also involve grading of piles and mounds, particularly material in the DMPA. This fill and grading would have little impact on the DMPA since this area already contains fill taken from nearby past dredging activities but would require large numbers of trucks or barge deliveries. Based on the plans to raise the grade on site, current plans for soil management during construction do not involve significant removals of soils for disposal off-site. If this is changed to include off-site disposal, reuse, or recycling, all soils would be tested in accordance with the requirements of the receiving facility as well as all appropriate federal and state laws.

Freeport LNG would additionally be amending soil on the property to make it more suitable for foundations. This would involve the addition of hydrated lime, Portland cement, fly ash, or other amendments. Geotextiles and/or aggregate material would be added to laydown and operational areas to mitigate potential soil erosion and compaction.

No prime farmland soils exist at the site of the Liquefaction Plant on the Quintana Island and investigations did not find any contaminated soils at the site.

Overall impacts on soils at the Liquefaction Plant would be minor given the vast majority of the area is a dredged disposal site and or contains disturbed soils. As noted above, work would be performed in accordance with Freeport LNG's Procedures and SWPPP to minimize impacts.

4.2.1.2 Pretreatment Plant Site

The soil types at the Pretreatment Plant are Brazoria clay; Clemville silty clay loam; Pledger clay; and Surfside clay. Approximately 76 percent of the 218-acre construction workspace is mapped as Surfside clay, which is a hydric soil. Pledger clay and Brazoria clay, are also hydric soils and account for 4 percent and 1 percent of the site acreage, respectively. Clemville silty clay loam is an upland soil confined to the upper northwest section of the site and accounts for 10 percent of areal coverage. The remaining 9 percent of the site is mapped as "water".

Table 4.2.1-3 presents a descriptive profile, including construction limitations, of the four mapped soils.

Table 4.2.1-3

Characteristics of Soil Types at the Pretreatment Plant Site

Map Unit Name	Drainage Class	Hydric	Prime Farmland	Erosion Concerns	Revegetation Potential	Compaction Prone
Brazoria clay 0 to 1 percent slopes	Somewhat poorly drained	Partially	Yes	Moderate	Moderate	Moderate
Clemville silty clay loam	Well drained	No	Yes	Moderate	Moderate	Moderate
Pledger clay	Somewhat poorly drained	Partially	Yes	Moderate	High	Moderate
Surfside clay	Poorly drained	Yes	No	Moderate	Low	Moderate

A portion of the Pretreatment Plant property was utilized for commercial clay and sand extraction from 2005 to 2012. Two pits remain – an approximate 29 acre pit in the west-central portion of the property and a smaller pit in the northwest corner of the property.

Impacts on Soils

Construction of the Pretreatment Plant would impact Brazoria clay, Clemville sand clay loam, Pledger clay, and Surfside clay. In total, approximately 104.9 acres would be temporarily affected as construction workspace and approximately 113.4 acres would be permanently affected by facility placement and operation. Table 4.2.1-4 summarizes the acreage impacts for each soil type.

Table 4.2.1-4

Freeport LNG Liquefaction Project Summary of Soil Acreage Impacts at the Pretreatment Plant Site

Soil Series	Temporary Workspace (acres)	Permanent Facility Footprint (acres)	Total
Brazoria clay, 0 to 1 percent slopes	0.14	2.68	2.82
Clemville silty clay loam	16.37	5.58	21.95
Pledger Clay	9.11	0	9.11
Surfside Clay	64.59	99.39	163.98
Water	14.65	5.75	20.40
Total	**104.86**	**113.4**	**218.26**

The proposed footprint of the Pretreatment Plant would extend over a portion of the existing 29 acre pit in the west-center portion of the site. Freeport LNG plans to fill in this portion of the pit with approximately 253,000 yd^3 of fill material that would be taken from the smaller pit in the northwest corner of the site. Soil stabilization additives including hydrated lime, Portland cement, and fly ash would also be added, as required. Geotextiles and/or aggregate material would be added to laydown and operational areas.

Permanent aboveground facilities associated with the Pretreatment Plant would be designed to control and manage stormwater runoff, thus minimizing potential long-term erosive effects. The primary concern for erosive impacts of the Pretreatment Plant would be the construction phase and temporary work areas during the post-construction phase.

The soil types mapped at the Pretreatment Plant are moderately erosive. In order to minimize erosion during construction and immediately thereafter, Freeport LNG would follow Freeport LNG's Procedures, and the SWPPP as outlined above for work at the Quintana Island terminal.

Freeport LNG would raise the grade of the operational footprint of the Pretreatment Plant by approximately 3 to 5 feet (to 8 feet amsl). Freeport LNG plans to source this material from the smaller pit in the northwest corner of the site. Based on the plans to raise the grade on site, current plans for soil management during construction do not involve significant removals of soils for disposal off-site.

Three of the four mapped soils at the Pretreatment Plant site are classified as prime farmland (Brazoria, Clemville, and Pledger). Approximately 8.26 acres of prime farmland would be lost due to filling and construction of the Pretreatment Plant. The remaining 25.62 acres of prime farmland would be temporarily disturbed during construction. Prime farmland is identified based on the ability of the soil to facilitate crop production. Potential impacts on prime farmland include interference with agricultural drainage, mixing of topsoil and subsoil, and compaction/rutting. Such impacts would result primarily from excavation, grading, backfilling, and vehicular traffic on the work site and along the construction right-of-way. Most impacts that could occur in temporary workspaces would be short-term and would not affect the potential use of prime farmland for agricultural purposes.

Freeport LNG proposes to minimize impacts on prime farmland by conforming to Freeport LNG's Procedures. These mitigation measures would include restoration of agricultural drainage systems, topsoil segregation, decompaction, and removal of rocks greater than 4 inches in diameter from surface soils.

Investigations did not find any contaminated soils at the site. Overall impacts on soils at the Pretreatment Plant site would be minor, limited to areas necessary for construction, and minimized through the use of the Freeport LNG's Procedures, and SWPPP.

4.2.1.3 Pipeline/Utility Line System

Thirteen soil types are represented in construction work space for the proposed pipelines and utility lines. Table 4.2.1-5 presents a descriptive profile of these soils, including construction limitations.

Table 4.2.1-5

Characteristics of Soil Types for the Pipeline/Utility Line System

Map Unit Name	Drainage Class	Hydric Soil	Prime Farmland	Erosion Potential	Revegetation Potential	Compaction Prone
Route Segment A						
Asa silty clay loam	Well drained	No	Yes	Moderate	High	Moderate
Edna fine sandy loam, 0-1 percent slopes	Poorly drained	Partially	No	High	High	Moderate
Francitas clay	Poorly drained	Partially	No	Moderate	Low	Yes
Galveston fine sand, undulating	Somewhat excessively drained	Partially	No	Very High	High	Moderate
Harris clay	Very poorly drained	Yes	No	Very Low	Low	Yes
Ijam clay	Very poorly drained	Yes	No	Moderate	Low	Moderate
Narta fine sandy loam	Somewhat poorly drained	Yes	No	High	Low	Yes
Norwood silt loam, 0-1 percent slopes	Well drained	Partially	Yes	Moderate	Moderate	Moderate
Pledger clay	Somewhat poorly drained	Partially	Yes	Moderate	High	Moderate
Surfside clay	Poorly drained	Yes	No	Moderate	Low	Moderate
Tracosa mucky clay	Very Poorly Drained	Yes	No	Very Low	Low	Yes
Velasco clay	Poorly Drained	Yes	No	Moderate	Low	Yes
Veston silty clay loam	Poorly Drained	Yes	No	Low	Low	Yes

Impacts on Soils

Table 4.2.1-6 shows the 13 soil types that would be affected by the construction of the pipelines and utility lines: Asa silty clay loam; Edna fine sandy loam with 0 to 1 percent slopes; Francitas clay; Galveston fine sand, undulating; Harris clay; Ijam clay; Narta fine sandy loam; Norwood silt loam with 0 to 1 percent slopes; Pledger clay; Surfside clay; Tracosa mucky clay; Velasco clay; and Veston silty clay loam. For each soil type, the aggregate system crossing length and temporary impact acreage is shown, the latter being divided between construction right-of-way and additional temporary workspace (ATWS).

Table 4.2.1-6

Freeport LNG Liquefaction Project
Summary of Soil Acreage Impacts for the Pipeline/Utility Line System

Soil Series	Crossing Length		Temporary Impact (acres)		
	Feet	Miles	Construction Right-of-Way	ATWS	Total
Asa silty clay loam	4,000	0.76	8.0	0	8.0
Edna fine sandy loam, 0 to 1 percent slopes	4,425	0.84	10.1	0	10.1
Francitas clay	2,120	0.40	5.0	0.1	5.1
Galveston fine sand, undulating	6,055	1.15	5.9	0	5.9
Harris clay	1,385	0.26	2.9	0	2.9
Ijam clay	7,255	1.38	3.8	0.2	4.0
Narta fine sandy loam	5,450	1.03	12.5	0	12.5
Norwood silt loam, 0 to 1 percent slopes	735	0.14	1.7	0	1.7
Pledger clay	9,030	1.71	6.1	0	6.1
Surfside clay	23,230	4.40	36.7	7.3	44.0
Tracosa mucky clay	45	0.01	0.1	0	0.1
Velasco clay	11,660	2.21	7.0	0	7.0
Veston silty clay loam	845	0.16	1.7	0	1.7
Water	10,515	1.98	9.6	0.6	10.2
TOTAL:	**86,750**	**16.43**	**111.1**	**8.2**	**119.3**

Construction of underground pipelines and utility lines would have no permanent impacts on soil types, in so much as soil types would remain unchanged and pre-construction soil conditions would be restored to the extent practicable following construction. In total, approximately 119.3 acres would be located within the construction workspace (nominal 100-foot-wide construction right-of-way and five ATWS') for the pipelines and non-electric utility lines. Tower placement for the new electric line between the Pretreatment Plant and an existing transmission corridor farther west would have minor temporary and permanent impacts. However, at this preliminary routing and design stage, the number and location of towers has not been determined; thus, the impact acreages with respect to soils have yet to be calculated. The electric line for the Liquefaction Project is not included in the acreage impact calculations presented in this section as the proposed line would utilize existing aerial infrastructure (poles) and would have no material effect on soils.

All of the soil types mapped for the Pipeline/Utility Line System route are at least moderately erosive, and the fine sandy soils (Galveston, Narta, and Edna) have a high erosive potential. In order to minimize erosion during construction and immediately thereafter, Freeport LNG would follow the Freeport LNG's Procedures and SWPPP for work at the Quintana Island Site. All of the soils that would be disturbed by pipeline construction activities have the potential to experience some level of soil compaction. Freeport LNG proposes to follow the Freeport LNG's Procedures during construction work to minimize the potential of this impact.

Approximately 84 percent of the soils that would be affected by construction of the Pipeline/Utility Line System have a poor revegetation potential. Freeport LNG has proposed to reseed disturbed areas using agency-approved seed mixes, consistent with the Freeport LNG's Procedures.

Three of the soil types crossed by the Pipeline/Utility Line System route are classified as prime farm land (Asa, Norwood, and Pledger). Freeport LNG proposes to minimize impacts on prime farmland by constructing the pipeline in accordance with the Freeport LNG's Procedures and following mitigation measures which include restoration of agricultural drainage systems, topsoil segregation, decompaction, and removal of rocks greater than 4 inches in diameter from surface soils.

About 93 percent of the proposed Pipeline/Utility Line System route and temporary construction area is underlain by hydric soils. Hydric soils are prone to compaction and rutting due to extended periods of saturation and high clay content. If construction of the Pipeline/Utility Line System occurs when these soils are saturated, heavy equipment operation would be impaired, and compaction and rutting could occur. Further, high groundwater levels that accompany hydric soils could create a buoyancy hazard for the Pipeline/Utility Line System. Special construction techniques such as concrete coating and other weighting methods would be used to overcome buoyancy hazards during operation of the Pipeline/Utility Line System. Construction of the proposed Projects would implement the Freeport LNG's Procedures, which include provisions for wetland crossings and special construction techniques in areas of saturated soils. Implementation of these measures would minimize impacts on hydric soils.

Freeport LNG does not anticipate encountering contaminated soils along the Pipeline/Utility Line System route because approximately 82 percent of the route is located in the same location as an existing pipeline for which no contaminated soils were identified during construction or during pre-planning. Overall soil impacts on the Pipeline/Utility Line System would be minor, take place at or adjacent to areas where soils have already been disturbed through previous work, and would be minimized through adherence to Freeport LNG's Procedures.

4.2.1.4 Summary of Impacts on Soils

In summary, the Liquefaction Project would result in a total of approximately 317.9 acres of temporary impact associated with construction of the Liquefaction Plant, the Pretreatment Plant, and the Pipeline/Utility Line System. Permanent impacts on soils would total 245.9 acres associated with construction of the Liquefaction Plant and the Pretreatment Plant, with no permanent impacts associated with the Pipeline/Utility Line System. Construction impacts on soils would be minor in the area of Quintana Island given the vast majority of the site is a dredge disposal area and or contains disturbed soils. The overall impacts on soils at the Pretreatment Plant site and for the Pipeline/Utility Line system would be minor, limited to areas necessary for construction, and minimized through the use of Freeport LNG's Procedures and SWPPP.

4.2.2 Phase II Modification Project

Soils potentially affected by the Phase II Modification Project are the same as those for the proposed Quintana Island Liquefaction Plant: Galveston fine sand, undulating; Ijam clay; and Velasco clay, which account for 1.8 percent, 35.2 percent, and 52.2 percent, respectively. The characteristics of these soils are summarized in table 4.2.1-1.

Construction of the Phase II Modification Project facilities at the terminal would impact each of the three soil types (Ijam clay, Velasco clay, and Galveston fine sand, undulating) and the portion of the berthing area depicted as "water" on soil survey maps. In total, approximately 14.6 acres would be temporarily affected as construction workspace and approximately 23.9 acres would be permanently affected. Table 4.2.2-1 summarizes the acreage impacts for each soil type.

Table 4.2.2-1

Summary of Soil Acreage Impacts For the Phase II Modification Project

Soil Series	Temporary Workspace (acres)	Permanent Facility Footprint (acres)	Total
Galveston Fine Sand, Undulating	0.0	0.7	0.7
Ijam Clay	10.0	3.8	13.8
Velasco Clay	3.2	116.9	20.1
Water a/	1.4	2.5	3.9
Total	14.6	23.9	38.5

a/ Designation for part of the berthing area

Upland soils would be excavated at the outset of the Phase II Modification Project. Approximately 60,000 yd^3 would be removed to a level of -5 feet mean sea level (msl). This material would be used as fill to raise the level of the adjacent Liquefaction Plant. Therefore, a significant surplus of soils is unlikely, and off-site disposal is not proposed.

The soil types mapped for the Phase II Modification Project are at least moderately erosive, and Galveston fine sand, undulating has a high erosive potential. In order to minimize erosion during construction and immediately thereafter, Freeport LNG would follow the Freeport LNG's Procedures and SWPPP.

Overall impacts on soils as result of the Phase II Modification work would be similar to that described for the Liquefaction Plant work. Specifically, soil impacts at the Phase II Modification Project would be minor given the vast majority of the area is a dredged disposal site and or contains disturbed soils.

4.2.3 Sediments

Several construction areas would occur in the ICW on the northwest side of Quintana Island. Planned sediment dredging activities to facilitate construction include:

- approximately 85,000 yd^3 for the new construction dock and firewater intake structure;
- 28,000 yd^3 for the new aggregate dock;
- 32,000 yd^3 for the existing construction dock; and
- 1,188,000 yd^3 for the modified LNG berthing dock expanded berthing area.

The first three areas are associated with the Liquefaction Project, and the last is associated with the Phase II Modification Project. Sediment dredged from the ICW is anticipated to be Velasco Clay and Ijam Clay. This material would be removed and deposited in an existing DMPA.

4.2.3.1 Impacts and Mitigation

Freeport LNG proposes to use hydraulic cutterhead-suction to dredge areas for the new construction docks and firewater intake structure. Dredged material, which is predominantly stiff virgin clays with pockets of beach sand, would be placed in Port Freeport's DMPA No. 1, approximately 2.1 miles northwest of the terminal site and/or in one or more pre-approved DMPAs elsewhere. Freeport LNG states that adequate levee height would be maintained for proper containment.

In the case of sediments dredged for the Projects, the material is expected to be a stiff clay with little likelihood of re-suspension during dredging. The Velasco Clay was deposited naturally in the existing tidal environment, and, as such, is well suited to it. If sediments exposed by dredging of the Velasco clay are less cohesive, increased erosion or scour of these areas could occur, particularly during storms, floods, and large tides. Overall, dredging would result in minor, localized and short term impacts on water quality through increased turbidity during the time of dredging, which already occurs periodically during the USACE and other maintenance dredging of the FHC.

In summary, construction of the proposed Projects would affect soils, including hydric soils. Since the LNG terminal site is currently well vegetated and is nearly level, the potential for erosion of soils and discharge of sediments off the site would be relatively low during construction. Freeport LNG would minimize impacts by implementing the mitigative measures specified in the Freeport LNG's Procedures. Further, Freeport LNG would minimize potential soil contamination by implementing the preventative and mitigative measures specified in its SPCC Plan. Accordingly, soil impacts associated with erosion and soil contamination would be minor.

With the proposed construction schedule, as well as the compaction minimization measures contained in the Freeport LNG's Procedures and Freeport LNG's ECP&P, impacts due to soil compaction would be minimized to the extent possible and associated impacts would be minor.

Our analysis indicates that potential hazards associated with soft sediments, ground subsidence, and hydric soils underlying areas that would be developed by Freeport LNG for the Liquefaction Plant and Pretreatment Plant would be adequately addressed with its engineering design. Due to the relatively shallow construction depth of the pipeline, we conclude that the pipeline would not have an effect on deep sediment loading or stability, and impacts on ground subsidence would be minor.

4.3 WATER RESOURCES

4.3.1 Groundwater Resources

The coastal lowlands aquifer system in southeastern Texas is the principal source of groundwater in the Liquefaction Project and Phase II Modification Project areas and is used for public, agricultural and industrial needs. Within the coastal lowlands aquifer system, the Chicot Aquifer is the uppermost aquifer, and all public and private water supply wells in the Liquefaction Project and Phase II Modification Project areas are supplied by this aquifer (TWDB, 2012b). 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 geological profile of these three aquifers is illustrated in figure 4.3.1-1.

In the vicinity of the terminal, the Upper Chicot Aquifer extends from ground surface to about 300 feet bgs and the Lower Chicot Aquifer extends from 300 feet bgs to at least 1,200 feet bgs. In the Stratton Ridge area, about 3.2 miles north-northwest of the proposed Pretreatment Plant site, the top of the Upper Chicot Aquifer is at 10 feet bgs, the top of the Lower Chicot Aquifer is at 300 feet bgs, and the top of the Evangeline aquifer is at 1,100 feet bgs.

Previous studies at the Quintana Island terminal indicated that two metals (arsenic and manganese) and one volatile compound (benzene) exist in some areas on the centrally located property formerly owned by Freeport Oil Company (FOC) at groundwater concentrations above Texas Risk Reduction Program (TRRP) Tier I protective concentration levels (Entrix, 2004). However, the study concluded that constituent concentrations did not appear to be indicative of significant contamination and case closure was obtained through the TRRP in 2008.

Analysis of data from the Texas Groundwater Protection Committee (2010) indicates that, of the 77 listed agency cases involving industrial contamination of groundwater in Brazoria County since 1989 or earlier, eight have been in the Freeport area; however, none are in close proximity of the proposed Projects.

The Town of Quintana operates two municipal water wells located approximately 125 feet from the temporary workspace for the nitrogen pipeline, BOG pipeline, and fiber optic utility line at MP 0.20(A). Each well is drilled to 265 feet and the total sendout into the municipal system is 500 gpm. In addition, two on-site 8-inch-diameter water wells, each producing approximately 1,300 gpm, have been installed on the terminal site as part of the Phase I Project. No known active water wells are located within 150 feet of the construction workspace for the Pretreatment Plant or Pipeline/Utility Line System beyond Quintana Island. See figures 4.3.1-2 to 4.3.1-4 for well locations, type, (industrial, domestic, government, public), and operation status (active, unused, plugged or destroyed) within 1 mile of the Liquefaction Plant, Pretreatment Plant, or Pipeline/Utility Line System.

The USEPA has not designated any sole source aquifers within the Liquefaction Project or Phase II Modification Project areas. In addition, no protected watersheds, specially designated aquifer withdrawal areas, wellhead protection areas, or springs occur within 150 feet of the construction workspace for the proposed Liquefaction Project and Phase II Modification Project facilities.

Era	System	Series	Stratigraphic Unit Modified from Baker, 1979	Lithology	Hydrogeologic Unit Commonly Used in Texas Modified from Baker, 1979
Cenozoic	Quaternary	Holocene	Alluvium	Sand, Silt & Clay	Chicot Aquifer
		Pleistocene	Beaumont Formation Montgomery Formation Bentley Formation Willis Sand	Sand, Silt & Clay	
	Tertiary	Pliocene	Goliad Sand	Sand, Silt & Clay	Evangeline Aquifer
		Miocene	Fleming Formation	Clay, Silt & Sand	Burkeville Confining Unit
			Oakville Sandstone	Sand, Silt & Clay	Jasper Aquifer
			Catahoula Sandstone or Tuff Anahuac Formation	Clay, Silt & Sand	Catahoula Confining Unit (restricted)
		Oligocene	Frio Formation	Sand, Silt & Clay	
			Frio Clay Vicksburg Formation	Clay & Silt	Vicksburg-Jackson Confining Unit
		Eocene	Jackson Group: Whitsett Formation Manning clay Wellborn Sandstone Caddell Formation		

Gulf Coast Aquifer

Source: Adapted from Figure 55 (Hydrogeology-Correlation) in Ground Water Atlas of the United States, Oklahoma-Texas, HA 730-E. (http://pubs.usgs.gov/ha/ha730/ch_e/gif/E055.gif)

For environmental review purposes only.

Figure 4.3.1-1
Freeport LNG - Liquefaction Project
Hydrogeological Units of Gulf Coast Aquifer

DATE: 5/6/2011
REVISED: 5/9/2011
SCALE: NTS
DRAWN BY: JPBOENTJE
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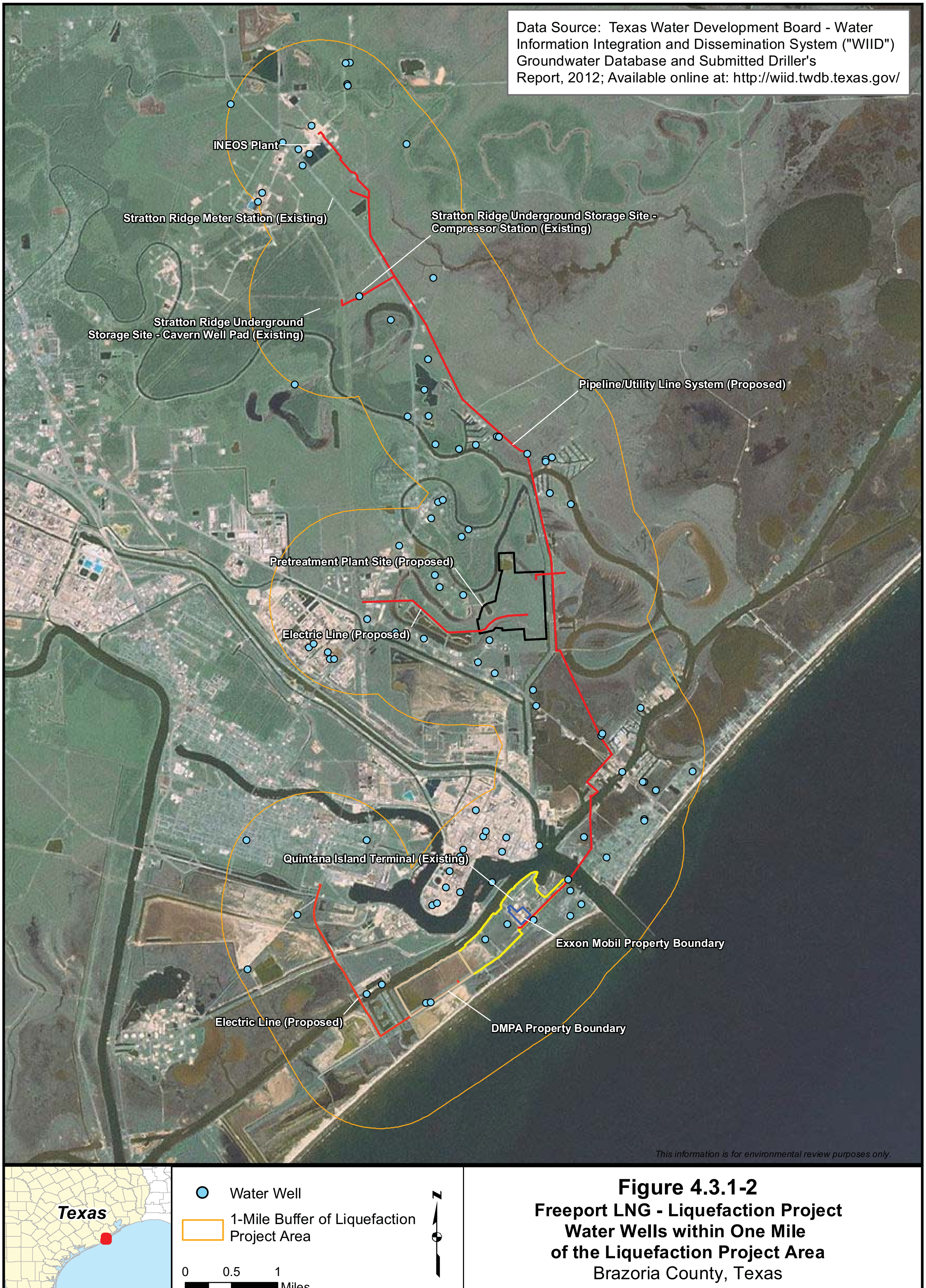

Figure 4.3.1-2
Freeport LNG - Liquefaction Project
Water Wells within One Mile
of the Liquefaction Project Area
Brazoria County, Texas

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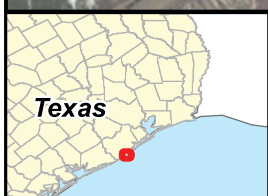

Well Type (Status)

- Domestic (Active)
- Domestic (Assumed Active)
- Federal Government Well (Unused)
- Industrial (Active)
- Industrial (Assumed Active)
- Industrial (No Data)
- Industrial (Plugged or Destroyed)
- Industrial (Unused)
- Public (Active)
- Public (Unused)

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Figure 4.3.1-3
Freeport LNG - Liquefaction Project
Water Wells Within One Mile of the Quintana Island Terminal Site
Brazoria County, Texas

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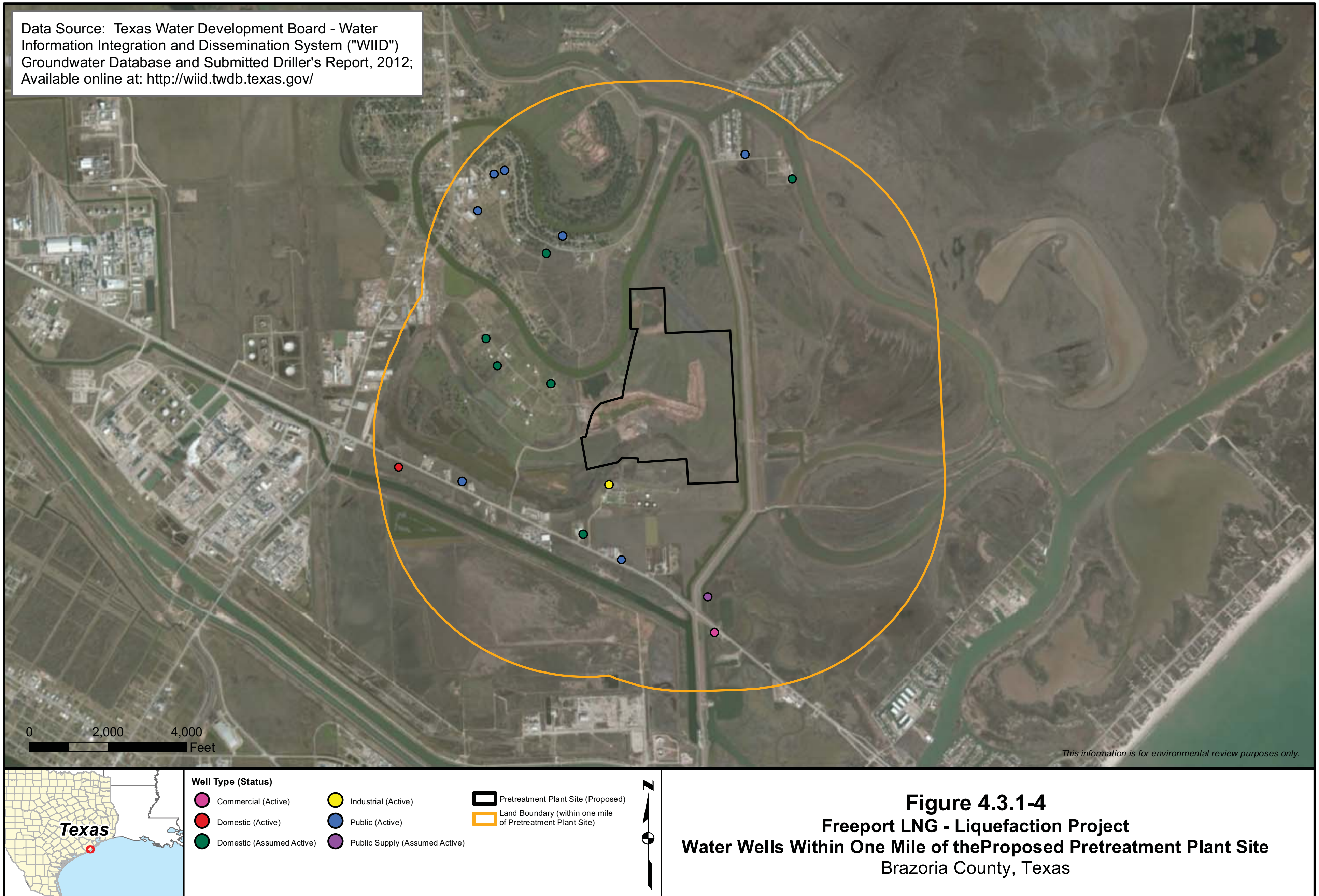

Figure 4.3.1-4
Freeport LNG - Liquefaction Project
Water Wells Within One Mile of theProposed Pretreatment Plant Site
Brazoria County, Texas

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4.3.1.1 Impacts and Mitigation

Liquefaction Project

Existing conditions including a high groundwater table, structurally soft and weak sediments, and shallow ground faulting and subsidence associated with the sedimentary environment are potential concerns for construction at and adjacent to the Quintana Island terminal. However, no construction issues were encountered during the development of the Phase I Project due to these conditions. The Liquefaction Project would be constructed using similar foundation design, construction procedures, and mitigation measures. Therefore, no significant construction-related groundwater impacts are anticipated. Deep-driven, pre-cast, concrete pile foundations would be installed to support concrete pads for the buildings, pipe racks, and the heavy equipment components of the liquefaction trains and pretreatment units. The impact associated with the installation of these pilings could potentially cause contamination of aquifer layers through seepage from one layer to another. In addition, deep foundations may act as a transport mechanism for surficial contamination into deep, previously uncontaminated water bearing zones. However, when installed, the pilings would not extend beyond the Upper Chicot Aquifer. Because the pilings would be confined to this uppermost layer of the aquifer system, we conclude that the potential for cross-contamination is low.

In areas of shallow groundwater, it may be necessary to dewater pipeline trenches, resulting in a temporary lowering of the groundwater in the immediate vicinity of construction. Because of the relatively small volume of water removed, the short duration of the activity, and the local discharge of the water, the water levels would recover quickly. Effects on groundwater from trench dewatering would be localized and insignificant. Shallow groundwater is not expected to affect construction of aboveground facilities because the land elevation for the Liquefaction Project would be raised with fill material, as necessary, to avoid or minimize flood damage.

The greatest potential for impact on groundwater during construction would be through an accidental release of hazardous substances, such as lubricants or fuel. Freeport LNG would follow the SPCC Plan that was developed for Phase I Project construction and would modify the plan to address any Project-specific changes. The SPCC Plan addresses personnel training, secondary containment design, hazardous substance storage and disposal procedures, refueling areas, spill response procedures, mitigation measures, and other measures designed to reduce or eliminate potential adverse impacts on groundwater resources. We find the SPCC Plan adequate.

Potential impacts on the nearby Town of Quintana water supply wells would be minimized by restricting refueling and storage of hazardous substances within a 400-foot radius of community and public supply wells. Freeport LNG's erosion and sedimentation control measures set forth in its SPCC Plan and SWPPP would be implemented to avoid or minimize stormwater runoff from the Liquefaction Project. To the extent there are concerns over groundwater quality and quantity, Freeport LNG would monitor groundwater quality and yield for public supply wells that could be affected before and after construction to determine whether these sources are being affected. Freeport LNG also proposes that in the event of damage to water supplies during construction, temporary water sources would be provided and the damage repaired.

Groundwater withdrawals from the two on-site wells may be required during construction as a source of concrete mixing water. These withdrawals would be made at a rate low enough to avoid short- and long-term groundwater depletion. Groundwater withdrawal could also be necessary for fire protection, but this would occur only during an emergency. Firewater tank capacity would be maintained with water from the Town of Quintana's two existing water supply wells, two existing on-site water wells, and/or condensate water from air tower operation.

Since natural gas would be cooled with air rather than water during the liquefaction process, only potable and service water would be required for the new Liquefaction Plant. The supply systems for these new facilities would be integrated with and would represent an expansion of the existing supply systems for the Phase I Project. Except for the fire water system, the same sources would be used for the Liquefaction Plant. During operation of the fire water system, water would be drawn from the ICW. Assuming 106 new full-time employees would work at the Liquefaction Plant. It is estimated that an additional 243.8 gpd (0.17 gpm) of potable water would be required at the terminal. The proposed supply sources should have more than enough capacity to accommodate this increase.

Pretreatment Plant operation would require process water, potable water, and service water. Freeport LNG has not yet determined a water source for the Pretreatment Plant, but is currently evaluating both installation of an on-site well and obtaining water from Dow through construction of an 8-inch diameter water line. Freeport LNG estimates that approximately 28,800 gpd (20.0 gpm) of de-ionized water would be needed for process use. An estimated 57 new full-time employees would work at the Pretreatment Plant, requiring a total of 131.1 gpd (0.09 gpm) of potable water. The water supply sources for the Pretreatment Plant would be determined based on these water rate requirements. If well water is used, the withdrawals would be at a low rate which would avoid short- and long-term groundwater depletion.

Based on the proposed construction methods and mitigation measures that Freeport LNG has identified, we conclude that Liquefaction Project would not have a significant impact on groundwater.

Phase II Modification Project

Potential impacts on existing groundwater resources as a result of construction and operation of the Phase II Modification Project and proposed mitigation measures are similar to those discussed above for the Liquefaction Project at the Quintana Island terminal site.

4.3.2 Surface Water Resources

The Freeport LNG Liquefaction Project and Phase II Modification Project lie within the Austin-Oyster Creek Watershed (USGS cataloging number 12040205). The major waterbodies in this watershed include Austin Bayou, Bastrop Bayou, Oyster Creek, the ICW, and the Old Brazos River Channel or FHC. All major waterways within the Liquefaction Project and Phase II Modification Project areas are considered tidally influenced because of their close proximity to the Gulf. The relatively low relief of the watershed promotes slow water movement, which is typical of coastal zone areas. There are no protected or sensitive public watershed areas within the Liquefaction Project and Phase II Modification Project areas.

The Liquefaction Project and the Phase II Modification Project are located within the San Jacinto-Brazos Coastal Basin (Basin 11) and fall within the boundaries of two classified stream segments: Old Brazos River Channel Tidal (Segment 1111) and Oyster Creek Tidal (Segment 1109). The Old Brazos River Channel Tidal segment includes the eastern section of the terminal site together with the adjoining Pipeline/Utility Line System in the area of the LNG berthing docks and the FHC/ICW confluence; the Oyster Creek Tidal segment includes most of the Pretreatment Plant site and an approximately 4.3-mile-long section of the Pipeline/Utility Line System between MP 3.2(A) and MP 7.5(A). The 2010 Texas Integrated Report for CWA Sections 305(b) and 303(d), states that the Oyster Creek Tidal segment has no impairments or concerns (TCEQ, 2011), while the Old Brazos River Channel Tidal segment is listed as containing elevated levels of chlorophyll-a and iron. Neither of these two segments appears on the CWA Section 303(d) lists of impaired waters (TCEQ, 2008a, 2011). However, four waterbodies within the Austin-Oyster Creek Watershed appear on these lists, including the Gulf in the Freeport area for containing “mercury in edible tissue”. The closest of the other three listed waterbodies is over 10 miles away from the Liquefaction Project and Phase II Modification Project.

The Quintana Island terminal site lies adjacent to the intersection of the FHC and the tidally influenced ICW (see figure D-1 in appendix D). The FHC provides access from Freeport LNG’s berthing area to the Gulf. Both the FHC and ICW are major shipping routes through this highly industrialized area and are used for barge traffic as well as commercial/recreational fishing and boating. Five waterbodies are located on the terminal site: two perennial manmade ponds (1 and 2) and three intermittent drainage channels (A, B, and C). Stormwater runoff from the maintained areas around the existing facilities is directed through a system of shallowly sloped peripheral troughs, which is connected to the drainage channel system by a series of culverts.

Seven waterbodies (A through G) are wholly or partially located on the Pretreatment Plant site (see figure D-2 in appendix D). One named waterbody, Horseshoe Lake (Waterbody A), is located partially within the Pretreatment Plant site to the south and is characterized by open water areas and peripheral emergent wetland, and connects with the western Velasco Ditch (Waterbody G). The western Velasco Ditch represents a continuation of the oxbow feature constituting Waterbody B located in the northwest corner of the Pretreatment Plant site. Waterbodies C and D are associated with the two large pits that have been excavated since 2004-2005 for the commercial extraction of sand and clay. One pit is centrally located on the site; the other is located in the northwest corner. A narrow drainage ditch (Waterbody F) and a small pond (Waterbody E) are also associated with pit operation. Stormwater from the northwestern portion of the Pretreatment Plant site is carried in three man-made intermittent drainage ditches (MS-WL-002, MS-WL-004, and MS-WL-005) that are channeled south to the central pit. Two similar ditches (MS-WM-006 and MS-WM-008) carry stormwater from the eastern portion of the site into the western Velasco Ditch. Based on field delineations conducted in March and April, 2012, and a subsequent Preliminary Jurisdictional Determination (PJD) issued by the USACE on August 9, 2012 (USACE, 2012), all five man-made intermittent drainage ditches are classified as wetlands and are discussed further in section 4.3.5.

The Pipeline/Utility Line System crosses twelve waterbodies, of which eight are perennial (the FHC, the ICW, Oyster Creek, Horseshoe Lake, the eastern Velasco Ditch, the western Velasco Ditch, the CR 891 Ditch, and an unnamed pond) and four are intermittent (two tributaries to Salt Bayou and two unnamed drainage channels) (see figure D-3 (a-h) in appendix D). Oyster Creek is a shallow, narrow, tidally influenced waterbody that is used by pleasure craft and recreational fishing boats. The eastern Velasco Ditch is a man-made, tidally influenced waterbody that was created during the construction of the adjacent levee. The western Velasco Ditch has a similar origin and physical profile, although it is not tidally influenced due to the fact that it lies inside the Velasco Levee and its drainage connection to tidally influenced waters involves a one way flow south through a box culvert under SH 332 that is maintained by five large capacity pumps at the Velasco Drainage District pumping station. The two tributaries to Salt Bayou are shallow, intermittent waterbodies that are not tidally influenced where they are crossed by the proposed Pipeline/Utility Line System. The two unnamed drainage channels are located further north and fringe the embankment of an abandoned railroad just east of Freeport LNG's Stratton Ridge Meter Station.

The FHC, the ICW, and Oyster Creek are designated as federally navigable waterbodies and federal navigation projects regulated by the USACE under the Section 10 of the RHA. Under Section 404 of the CWA, several waterbodies were confirmed as waters of the U.S. during previous Section 404/Section 10 permitting for the Phase I, Phase II, and NGL Extraction Projects and/or the PJD issued by the USACE on August 9, 2012 (USACE, 2012). These include: five other waterbodies, in addition to the FHC and ICW, at or adjacent to the Quintana Island terminal site (Pond 1, Pond 2, and Drainage Channels A, B, and C); the western Velasco Ditch, Horseshoe Lake, and unnamed drainage channel associated with WL-1 (Waterbody B) at the Pretreatment Plant site; and the twelve waterbodies crossed by the proposed Pipeline/Utility Line System. The remaining four waterbodies (C through F) at the Pretreatment Plant site are not regulated under Section 404 of the CWA, given their man-made origin in upland areas.

Under the Texas Commission for Environmental Quality (TCEQ) statewide water quality assessment program, the closest monitoring station to the terminal site is located in the Old Brazos River Channel approximately 3.5 miles upstream from the confluence of the FHC and the ICW. The most recent data sets for this station (TCEQ, 2008b, 2010) indicate that the only water quality or sediment concerns were an elevated level of nitrates in 2008 and elevated levels of chlorophyll-a and sediment-borne iron in 2010. The closest monitored waterbody to the proposed facilities beyond Quintana Island is the tidal portion of Oyster Creek, which runs within 0.2 mile east of the Pretreatment Plant site and is crossed by the proposed Pipeline/Utility Line System. The most recent data sets for this waterbody (TCEQ, 2008b, 2010) indicate that the only water quality or sediment concerns were elevated levels of bacteria and chlorophyll-a.

Of the use categories defined in the surface water quality standards in the state of Texas (aquatic life, contact recreation, fish consumption, general use, and public water supply), aquatic life, contact recreation, and general use apply to all waterbodies crossed by the proposed Liquefaction and Phase II Modification Project facilities. For those waterbodies within the Oyster Creek Tidal Segment (Segment 1109), including Oyster Creek, Horseshoe Lake, the western Velasco Ditch, and the eastern Velasco Ditch, all three use categories are considered "fully supported". For those waterbodies within the Old Brazos River Channel Tidal segment (Segment 1111), namely the FHC and ICW, the recreation use is fully supported but the aquatic life and general uses are listed as water quality concerns in the 2010 Texas Integrated Report for CWA Sections 305(b) and 303(d) (TCEQ, 2011), based on elevated levels of chlorophyll-a and sediment-borne iron, as previously described.

4.3.2.1 Impacts and Mitigation

Liquefaction Project

To avoid or minimize adverse impacts on water quality from construction and operation of the Liquefaction Project, protective measures similar to those described and approved for the Phase I and Phase II Projects would be implemented. These include conformance with applicable federal, state, and local permit conditions, the Freeport LNG's Procedures, and the additional measures described below. The following sections discuss the potential impacts and mitigation measures.

<u>Quintana Island Terminal</u>

Table 4.3.2-1 lists the jurisdictional waterbodies at or adjacent to the terminal site and provides, for each waterbody, a quantitative and qualitative summary of anticipated impacts (if any) associated with construction and operation of the Liquefaction Plant. Impacts are considered direct if the waterbody is located within the proposed construction workspace, is temporarily or permanently disturbed, and consequent impact acreages can be calculated. Indirect impacts, such as potential changes in flow regime, which occur beyond the construction workspace, are secondary in nature, and do not involve actual temporary or permanent impact acreages.

The most significant direct impacts on surface waters are associated with new structures on the ICW, namely the proposed construction dock, the proposed aggregate barge dock, and the proposed fire water intake structure. Direct impacts on surface waters associated with onshore plant infrastructure are negligible and associated with construction of a driveway over Drainage Channel A.

<u>Proposed Construction Dock and Proposed Aggregate Barge Dock</u>

A construction dock would be installed on the south shore of the ICW north of the Terminal Maintenance Building, and an aggregate barge dock would be installed on the south shore of the ICW at the northwest corner of the proposed site for the Liquefaction Plant (see figure D-1 in appendix D). These 300-foot-long by 75-foot-wide dock platforms would extend over both shoreline and open water, each covering an area of 0.52 acre.

Table 4.3.2-1

Freeport LNG Liquefaction Project
Waterbodies and Associated Impacts at the Quintana Island Terminal Site

Waterbody Name	Waterbody Type	Temporary Impact Acreage	Permanent Disturbance Acreage	Impact Profile
Pond 1	Perennial	0.00	0.00	Indirect- stormwater and hydrostatic test discharges during construction
Pond 2	Perennial	0.00	0.00	No direct or indirect impacts
Drainage Channel A	Intermittent	0.1	0.07	Plant road and walkway crossing requiring in-stream culvert (accounts for temporary impact and permanent disturbance acreages)
				Overhead crossing for LNG pipeline and trough- no in-stream impact Bore or drill crossing for natural gas pipeline, nitrogen pipeline, and fiber optic cable between Phase I process area and Liquefaction Plant- no in- stream impact
				Indirect - stormwater discharges during construction and operation
Drainage Channel B	Intermittent	0.00	0.00	Indirect - stormwater discharges during construction and operation
Drainage Channel C	Intermittent	0.00	0.00	Indirect - stormwater discharges during construction and operation
Freeport Harbor Channel (FHC) and Dow Barge Canal	Perennial	a/	0.00	Indirect impact due to turbidity plume
ICW	Perennial	a/	6.72	New Construction Dock and dredging
		a/	2.53	Aggregate Dock Dredging
		a/	0.08	Fire Water Intake Structure & Dredging
		a/	3.2	Dredging at Existing Construction Dock
	Total:	**0.1**	**12.6**	

a/ Impact area of estimated dredging plume within Freeport Harbor Channel, ICW, and Dow Barge Canal is approximately 428.1 acres, assuming 1000 meter plume.

Some shoreline disturbance and off-shore dredging would be necessary to install the platforms, which would be supported on piles. The amount of dredging required would depend on the water depth at the time of construction and its ability to accommodate barges, which have a relatively shallow draft. The fire water intake structure would be installed in the vicinity of a former boat ramp on the south shore of the ICW at the northwest corner of the Phase I process area. The structure would consist of a 50-foot-long by 20-foot-wide concrete platform mounted on piles and supporting two diesel-driven pumps to withdraw water at the 5,000 gpm flow rate required for fire suppression. Material removed for construction of the fire water intake structure would occur over 0.08 acres. Freeport LNG has estimated that the new construction dock and fire water intake structure would require 85,000 yd^3 of dredging and the aggregate barge dock would require 28,000 yd^3 of dredging. In addition, the existing construction dock would require 32,000 yd^3 of dredging. The docks would be permanent structures.

Dredging and Dredge Spoil Disposal

The USACE and several large petrochemical companies have performed periodic maintenance dredging of the FHC on a two to three year basis since the mid-1990s. This longstanding commercial activity coupled with typically high sediment flows into the ICW from the Brazos River have resulted in sustained high and variable turbidity levels over a long period of time. In addition, storms, floods, and large tides can result in high-energy or turbulent flow fields that increase suspended sediments over much larger areas and for longer periods than dredging operations, making it very difficult to distinguish between dredging-induced turbidity and the background levels generated by natural processes or normal navigation activities (Higgins *et al.*, 2004).

As outlined in Freeport LNG's Dredging Plan dated June 2013,[13] Freeport LNG proposes to use hydraulic cutterhead-suction dredging techniques during construction of the new construction docks and firewater intake structure. According to Reine *et al*., (2002), hydraulic cutterhead dredges generally produce small plumes that decay rapidly. Thus, turbidity effects from the use of a cutterhead-suction dredge are expected to be localized and of short duration, spreading less than a thousand meters from their sources and dissipating to ambient water quality within several hours after dredging is completed (Higgins *et al.*, 2004). In almost all cases, the vast majority of resuspended sediments resettle close to the dredge within an hour (Anchor Environmental CA L.P., 2003). The effects of sediment resuspension and increased turbidity would be limited to the period during and immediately following dredging. Figure 4.3.2-1 shows the worst-case scenario turbidity impacts up to 1000 meters from the dredging locations.

Dredged material, which is predominantly stiff virgin clays, would be placed in Port Freeport's DMPA No. 1, approximately 2.1 miles northwest of the terminal site and/or in one or more pre-approved DMPAs elsewhere. Freeport LNG states that adequate levee height would be maintained for proper containment and effluent quality would meet the requirements of the USACE permits and TCEQ water quality certification. Based on the relatively low volume of dredged material likely to be generated, the dredged material would be transported by a dredge pipeline to the disposal point. The dredge discharge pipe would cross the ICW to a booster pump. The booster pump would pump the dredged material slurry into a 704-acre DMPA. The sediment in the slurry would be allowed to settle before the decanted water exits the DMPA through a weir structure and is discharged into the Brazos River, far from the dredging site.

[13] The June 2013 Dredging Plan can be acquired at: http://elibrary.ferc.gov:0/idmws/File_List.asp?document_id=14126940

- Quintana Island Terminal (Existing)
- DMPA Property Boundary
- Proposed Phase II Berthing Area
- Proposed Construction Dock
- Proposed Aggregate Dock
- 1000-Meter Turbidity Plume

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Figure 4.3.2-1
Freeport LNG - Liquefaction Project
1000-Meter Extent of Turbidity Plume from Dredging
Brazoria County, Texas

FILE: R:\Projects\GIS_2013\181462 Freeport LNG liquefaction\mxd\Fig 4.3.2-1 Turbidity Plume 2014-02-19.mxd | REVISED: 2/20/2014 | SCALE: 1:45,000 DRAWN BY: GSTUDWELL

Onshore Plant Infrastructure

The only waterbody that would be directly affected by construction and operation of the onshore Liquefaction Plant at the terminal site is Drainage Channel A. Drainage Channel A would be crossed by a new LNG pipeline, LNG trough, natural gas pipeline, nitrogen pipeline, and fiber optic cable that would run between the Liquefaction Plant and the Phase I/Phase II LNG storage area to the east. The LNG pipeline and associated trough would span the channel via an overhead crossing at one location, while the natural gas pipeline, nitrogen pipeline, and fiber optic cable would be installed under the channel by bore or drill at a second location farther south. Therefore, in-stream impacts would be avoided at both crossing locations.

In addition, Freeport LNG would construct a narrow walkway across Drainage Channel A for pedestrian and cart access. Construction of the walkway would require installation of a permanent concrete culvert and some bank-side disturbance (see table 4.3.2-1). No redirection of drainage flow would occur to Drainage Channel A.

Indirect impacts may occur on drainage channels A, B, and C and Pond 1 at the terminal site due to minor variations in stormwater flow regimes, caused by construction-related changes in topography and surface permeability during construction and operation. None of these indirect impacts would have any significant environmental implications as all of the waterbodies were originally designed and built as drainage structures to convey stormwater to the ICW. Pond 2 would not be disturbed during facility construction or operation. Impacts and mitigation measures for stormwater runoff are discussed in more detail in section 4.3.4.

No process water discharges would be associated with the Liquefaction Plant; therefore, other than spilled or leaked material entering waterbodies directly or through stormwater runoff, the most likely potential pathway for process-related chemicals to enter local waterbodies is air deposition. As discussed above, the Gulf appears on the most recent Section 303(d) list of impaired waterbodies (TCEQ, 2011), due to the amount of mercury detected in edible fish tissue. Most of the mercury in fish in the Gulf is thought to originate from atmospheric deposition (Wallace and Swann, 2002) and is not attributable to surface runoff from adjacent industrial sites such as the terminal. Mercury in the feed gas for Freeport LNG's Liquefaction Plant at the Quintana Island terminal would be removed at the upstream Pretreatment Plant, resulting in natural gas containing very low levels of mercury (no more than one part per trillion) at the Liquefaction Plant. Therefore, the Liquefaction Project is not expected to have any measurable impact on mercury levels in the Gulf or adjacent surface waters.

Ballast Water

LNG exports through the Liquefaction Project would not result in any increase in the maximum number of vessel visits (400 per year) that corresponds with the LNG handling volume authorized in the Commission Order approving the Phase II Project. Ballast water carried by LNG vessels varies depending on size and type of vessel. The typical ships planned for loadings at LNG Dock 2 would carry between 175,000 m^3 and 165,000 m^3 of cargo. These ships would typically have a ballast capacity of between 65,000 m^3 to 70,000 m^3 depending on the vessel type. Assuming a mix of LNG vessel sizes calling on the Freeport LNG berth, this would result in an annual ballast discharge volume of approximately 7.1 billion gallons (21,890 acre feet) at a rate of 400 vessels per year. When the terminal is operating in liquefaction mode, arriving vessels would be carrying ballast water instead of LNG, and these vessels would necessarily have to discharge ballast water at the terminal berthing docks to maintain a constant draft during the LNG loading operation.

Potentially, discharge of ballast water in the terminal's berthing area could provide a pathway for the introduction of exotic aquatic nuisance species into U.S. coastal waters. This concern was also addressed in Freeport LNG's Export Authorization Project Environmental Assessment (EAP-EA) (FERC, 2009) under which LNG carriers would visit the terminal about eight times per year to receive LNG for re-export and necessarily discharge ballast water in the berthing area.

These potential impacts are mitigated via USCG regulations that require all vessels equipped with ballast water tanks, which enter or operate in U.S. waters to maintain a ballast water management plan. The plan requires vessels to implement strategies to prevent the spread of exotic aquatic nuisance species in U.S. waters. Based on this requirement and other applicable federal laws and regulations over the discharge of ballast water, we conclude that ballast water discharges for the Liquefaction Project would not represent a significant affect on aquatic resources. Further information on regulations affecting the discharge of ballast water and requirements with respect to discharging ballast water are discussed in section 4.5.4.

Pretreatment Plant Site

Table 4.3.2-2 lists waterbodies at or adjacent to the Pretreatment Plant site and summarizes the anticipated impacts for each waterbody associated with construction and operation of the proposed facilities. Impacts on the two naturally occurring waterbodies, Horseshoe Lake (with drainage channel) and the unnamed drainage channel associated with Wetland WL-1 (see table 4.3.2-2) are collectively confined to 0.06 acres of permanent fill at the southern and northern extremities of the main Pretreatment Plant footprint. However, both the Horseshoe Lake drainage channel and the unnamed drainage channel would need to be redirected to maintain the current drainage flow into the western Velasco Ditch and through the Velasco Drainage District pump station.

With respect to the four unnamed, waterbodies (C through F) on the Pretreatment Plant site, the area in which the small pond (Waterbody E) and drainage ditch (Waterbody F) are located would be filled and utilized for temporary workspace. Given that they are both man-made features associated with the commercial excavation of sand and clay that was recently terminated, it is not anticipated that restoration would be necessary. Moreover, as indicated in table 4.3.2-2, the drainage ditch has been partially filled previously by the original property owner.

Freeport LNG would use the central excavation pit (Waterbody C) to develop a retention pond for stormwater runoff during construction and operation; a smaller detention pond may also be installed in this area. The existing pit topography and water retaining capacity would be modified considerably; however, these modifications would result in shallower, vegetated side slopes which decrease erosion and increase the ecological value of the waterbody.

Table 4.3.2-2

Waterbodies and Associated Impacts at the Pretreatment Plant Site

Waterbody Name	Waterbody Type/Jurisdictional Status a/	Temporary Impact Acreage	Permanent Disturbance Acreage	Impact Profile
Waterbodies on the Pretreatment Plant Site				
Horseshoe Lake and Drainage Channel (Waterbody A)	Perennial open water/wetland complex (WL-9) in relict oxbow of Oyster Creek with open channel to Western Velasco Ditch - USACE Jurisdictional	0.04	0.03	Wetland periphery extends across south edge of operational plant footprint; channel crosses footprint of plant at southeast corner and south access road – requires redirection
Unnamed Drainage Channel (Waterbody B)	Perennial open channel through Wetland WL-1 to Western Velasco Ditch - USACE Jurisdictional	0.23	0.01	Crosses northeast corner of plant footprint – requires redirection
Open Water in Central Excavation Pit (Waterbody C)	Intermittent pooled water in bottom of pit - USACE Non-jurisdictional	0.00	10.56	Existing pit would be modified to create stormwater detention pond for construction and operation
Open Water in Northwestern Excavation Pit (Waterbody D)	Intermittent pooled water in bottom of pit USACE Nonjurisdictional	3.21	0.00	Pit would be site of soil excavation for construction fill – capacity to retain water would not be diminished
Unnamed Pond (Waterbody E)	Intermittent pond created from upland construction USACE Nonjurisdictional	0.00	0.42	Affected by construction of new permanent access road
Unnamed Drainage Ditch (Waterbody F) b/	Intermittent ditch created for water pumped from central pit to Horseshoe Lake USACE Nonjurisdictional	0.00	0.37	Affected by fill and grading for temporary workspace
Waterbodies Adjacent to the Pretreatment Plant Site				
Western Velasco Ditch (Waterbody G)	Perennial borrow ditch along Velasco Levee USACE Jurisdictional	0.39	0.55	Affected by culvert installation for two new permanent access roads between Pretreatment Plant and CR 690
	Total (USACE Jurisdictional):	**0.66**	**0.59**	
	Total (USACE Nonjurisdictional):	**3.21**	**11.35**	
	Total:	**3.87**	**11.94**	

a/ Jurisdictional status is based on PJD issued on August 9, 2012 (USACE, 2012).
b/ Recent field observations have indicated that, subsequent to Freeport LNG's wetland/waterbody delineation in March/April 2012, a portion (0.32 acres) of this nonjurisdictional, man-made ditch was filled by the original site owner during wind-down of the on-site sand extraction operation. The permanent disturbance acreage (0.11) presented in this table represents the remaining portion of the ditch.

The northwestern pit (Waterbody D) is located in an area from which Freeport LNG is planning to remove clay-based soil for use as fill material on the main Pretreatment Plant footprint. Like the water in the central pit, the water in the northwestern pit is only present by virtue of recent material extraction and any environmental impacts, such as sedimentation and associated turbidity that may be caused by the proposed activities would be no different from those attributable to past excavation.

In addition to mercury, the Pretreatment Plant is designed to remove three other contaminants from the feed gas for the liquefaction process: CO_2, sulfur compounds, and water. Of the constituents listed above, none would result in significant waste generation and none would be disposed of in any stormwater effluent streams originating from the processing unit areas or other equipment areas at the Pretreatment Plant.

The waterbody impacts at the Pretreatment Plant primarily affect low quality man-made features. Freeport LNG's Procedures would be implemented during construction, which would minimize the impacts of erosion during construction of the Pretreatment Plant on the onsite surface waters as well as nearby surface waters. Therefore, we conclude that construction and operation of the Pretreatment Plant would have some permanent impact on waterbodies but not have a significant affect on these waterbodies.

Pipeline/Utility Line System

Table 4.3.2-3 lists the waterbodies that are crossed by the proposed Pipeline/Utility Line System and, for each waterbody and provides a quantitative summary of anticipated impacts associated with facility construction.

Freeport LNG is proposing to cross three of the four major waterbodies on the Pipeline/Utility Line System (FHC, ICW, and Oyster Creek) by the HDD method, thereby avoiding in-stream and riparian impacts, including disturbance of benthic substrate and shoreline vegetation. The fourth major waterbody, the eastern Velasco Ditch, would be crossed by the HDD method at the lateral crossings and the push-pull open cut method at the longitudinal crossings. The same HDD crossing location would include the Velasco Levee, CR 690, and the western Velasco Ditch. Approximately 8,840 feet of the longitudinal Pipeline/Utility Line System sections would be installed by the push-pull open cut method within the bed of the eastern Velasco Ditch.

Use of this method, in which the pipe joints are welded on shore and pushed or pulled as a floating string through the water channel, would cause less in-stream disturbance than that associated with the installation of individual pipe joints. The primary surface water impact resulting from the push-pull method would be a temporary increase in the concentration of suspended sediments and consequent turbidity during construction.

Table 4.3-2-3

Waterbodies and Associated Impacts at the Pipeline/Utility Line System

Bank-to-Bank Milepost From	Bank-to-Bank Milepost To	Waterbody Name	Flow Regime	Approximate Width (Feet) a/	Crossing Method	Temporary Impact (acres)
0.79(A)	0.98(A)	FHC	Perennial	970	HDD	0.00
1.63(A)	1.72(A)	ICW	Perennial	410	HDD	0.00
3.66(A)	3.67(A)	CR 891 Ditch	Perennial	49	Open Cut	0.10
3.73(A)	5.40(A)	Eastern Velasco Ditch	Perennial	N/A b/	Open Cut (Push-Pull)	19.60
5.41(A)	5.59(A)	Eastern Velasco Ditch	Perennial	N/A b/	HDD	0.00
5.59(A)	5.65(A)	Oyster Creek	Perennial	180	HDD	0.00
8.05(A)	8.05(A)	Unnamed Tributary to Salt Bayou	Intermittent	5	Open Cut	N/A c/
8.48(A)	8.49(A)	Unnamed Tributary to Salt Bayou	Intermittent	75	Open Cut	0.20
0.21(B)	0.22(B)	Western Velasco Ditch	Perennial	80	HDD	0.00
0.14(B)	0.16(B)	Eastern Velasco Ditch	Perennial	105	HDD	0.00
0.00(B)	N/Ad	Unnamed Pond d/	Perennial	377	N/A d/	0.70
0.21(D)	0.22(D)	Unnamed Drainage Channel	Intermittent	40	Open Cut	0.10
0.23(D)	0.23(D)	Unnamed Drainage Channel	Intermittent	19	Open Cut	0.10
0.31(E)	0.39(E)	Horseshoe Lake	Perennial	450	Overhead	0.00 e/
		Total:				**20.80**

Notes:
N/A Not Applicable

a/ Waterbody widths provided in this table is based on review of USGS 7.5 minute series topographic quadrangle maps (Scale 1:24,000) and aerial based maps of the area.
b/ The pipeline would be placed longitudinally in the borrow ditch using the push-pull method.
c/ Impacts associated with this waterbody are included in the wetland impact calculations in table 4.3.5-3.
d/ This feature occurs in the ATWS for the HDD pull-back at the lateral pipeline/utility line crossing of the Velasco Levee – there would be no permanent pipeline/utility line crossing.
e/ Overhead crossing by electric line serving Pretreatment Plant – no in-stream impacts.

Freeport LNG is proposing to cross the CR 891 Ditch, the two tributaries to Salt Bayou, and the two unnamed drainage channels further north by the conventional open cut wet trench method with equipment operating from the banks. Assuming water is present during construction, the primary impact would be the similar to that associated with the push-pull method - a temporary increase in the concentration of suspended sediments and turbidity during construction.

As indicated above, Freeport LNG is proposing to use HDD at six of the 14 waterbody crossing locations on the Pipeline/Utility Line System, including all four major waterbodies (FHC, ICW, Oyster Creek, and eastern Velasco Ditch) crossed underground. The primary risk associated with directional drilling is the potential for inadvertent releases of drilling mud, commonly known as "frac-outs". In small quantities, drilling mud that enters a waterbody would not adversely affect overall water quality; in larger quantities, however, the release of drilling mud could adversely affect water quality and, consequently, resident aquatic life. Containment and disposal of the non-toxic mud (bentonite) used for HDD would be performed in accordance with permit requirements. In the event the proposed HDD methods are not feasible, Freeport LNG would use the open-cut trenching method as described in the Freeport LNG's Procedures.

For the HDD crossings of the Velasco Levee, Freeport LNG would follow the engineering design requirements set forth in *Technical Specification – Horizontal Directional Drilling under the Freeport, Texas Hurricane Flood Protection System* (Velasco Drainage District, 2011). Freeport LNG has prepared a *Draft HDD Monitoring and Contingency Plan* (see appendix C) for the Liquefaction Project that describes the remedial steps that would be taken to address frac-outs and drill failures. Standard clean-up practices for frac-outs include the deployment of straw bales, silt fencing, or turbidity curtains, and the subsequent use of mechanical or natural means to remove the drilling mud. We have reviewed the Draft HDD Monitoring and Contingency Plan and find it to be adequate. However, because we do not have the site specific HDD Monitoring and Contingency Plan information for the HDDs, **we recommend that:**

> **Prior to the start of HDD operations, Freeport LNG file a final site-specific HDD Monitoring and Contingency Plan for review and written approval by the Director of OEP.**

Given the construction procedures, our recommendation, and mitigation measures proposed, construction impacts associated with the work area is expected to be localized and of short duration, and would result in minor impacts on water quality.

Operation of the Pipeline/Utility Line System is not expected to have any significant affect on waterbodies. No new impervious areas outside of existing facility fence lines would be developed that could increase stormwater runoff. Freeport LNG indicates all facilities would be operated and maintained in accordance with government safety standards and regulations that are intended to ensure adequate protection for the public and to prevent facility accidents and failures. For the Pipeline/Utility Line System, these standards and regulations include, but are not limited to, those set forth by the USDOT in Title 49 CFR Part 192 and the RRC pipeline safety regulations found in Texas Administrative Code (TAC) Title 16, Part 1, Chapter 8. These provisions are designed to ensure pipeline integrity and minimize the risk of structural failures that could cause leaks or spills of conveyed materials into waterbodies. Under USDOT requirements, isolation valves would be installed on the NGL pipeline at Oyster Creek to minimize the risk of in-stream contamination by NGLs in the unlikely event of a pipeline failure.

Accidental Spills or Leaks of Hazardous Materials

Construction of the Liquefaction Project facilities could potentially impact surface water quality due to accidental spills of fuel, lubricants, or other chemicals used during construction. Freeport LNG would utilize its SPCC Plan with Project-specific changes made as necessary. During Project operation, the potential for a chemical spill that could adversely impact surface waters or wetlands is low and would be similarly minimized by adherence to established spill control procedures. Accordingly, operational impacts on water quality are expected to be minor.

4.3.2.2 Phase II Modification Project

Table 4.3.2-4 provides a summary of the impacts associated with construction and operation of the Phase II Modification Project on each jurisdictional waterbody at and adjacent to the Quintana Island terminal. Impacts are considered direct if the waterbody is located within the proposed construction workspace, is temporarily or permanently disturbed, and consequent impact acreages can be calculated. Indirect impacts, such as potential changes in flow regime, occur beyond the construction workspace, are secondary in nature, and are not included in temporary or permanent impact acreages.

Table 4.3.2-4

Waterbody Impacts for the Phase II Modification Project

Waterbody Name	Waterbody Type	Temporary Impact Acreage	Permanent Disturbance Acreage	Impact Profile
Waterbodies on the Terminal Site				
Pond 1	Perennial	0.00	0.90	Direct – construction and operation of the Phase II dock and berthing area
Pond 2	Perennial	0.00	0.00	No direct or indirect impacts
Drainage Channel A	Intermittent	0.00	0.00	No direct or indirect impacts
Drainage Channel B	Intermittent	<0.10	0.00	Direct – construction and operation of the temporary plant road. The LNG transfer pipelines would cross Channel B using an overhead crossing, thus avoiding direct impacts Indirect – stormwater discharges during construction and operation.
Drainage Channel C	Intermittent	0.00	0.40	Direct – construction and operation of the Phase II dock and berthing area. Indirect – stormwater discharges during construction and operation.
Waterbodies Adjacent to the Terminal Site				
(FHC – Berthing Area	Perennial	1.90	3.50	Direct – construction and operation of the Phase II dock and berthing area. Indirect – stormwater discharges during construction and operation.
ICW	Perennial	0.00	0.00	Indirect – use of existing construction dock and increased barge traffic during construction.
Total:		**1.90**	**4.80**	

The following activities associated with construction and operation of the Phase II Modification Project at the Quintana Island terminal site may result in impacts on surface water resources: clearing and grading, waterbody crossings, dredging of the berthing area, construction of the Phase II dock, and an accidental spill or leak of hazardous materials. Potential impacts on surface water resources due to these activities are discussed in the sections below and are similar to those discussed for the Liquefaction Project at the Quintana Island terminal site in the previous section.

As with the Liquefaction Project, Freeport LNG would implement protective measures similar to those approved and implemented for the Phase I Project to avoid or minimize adverse impacts on surface water resources. These include conformance with the Freeport LNG's Procedures, the SPCC Plan, and applicable permit conditions.

Clearing and Grading

As with construction of the Liquefaction Project, disturbed soils would be exposed to potential erosion during construction of Phase II Modification Project facilities. Land disturbing activities would be conducted in compliance with the National Pollutant Discharge Elimination System (NPDES) Construction General Permit for stormwater discharges and a project-specific SWPPP. As required under the NPDES regulations, Freeport LNG would modify, where necessary, its existing NPDES and SWPPP for the terminal site to accommodate Phase II activities. For the Phase I Project, Freeport LNG, in conjunction with the Velasco Drainage District, provided the FERC with a final design plan that identified the post-construction locations and grades of drainage features.

The plan indicated how the drainage properties of the preconstruction ditch system would be affected by levee relocation and facility construction. However, a revised drainage plan that includes the Projects has not been completed. Therefore, **we recommend that:**

Prior to construction of the Projects, Freeport LNG should file an updated Erosion and Sediment Control Plan to incorporate drainage modifications that meet the requirements of the Velasco Drainage District.

Waterbody Crossings

The two LNG transfer pipelines would be installed above Drainage Channel B. The aboveground crossing eliminates the need to excavate a trench through the channel, and would eliminate the impacts associated with sedimentation and turbidity from the standard wet open-cut construction technique. This waterbody crossing would be conducted in accordance with the Freeport LNG's Procedures, SPCC Plan, and applicable permit conditions.

In addition, a temporary plant road would be constructed between the existing Phase I process area and the northern end of the permanent plant road, which would require the installation of a temporary crossing over Drainage Channel B. This temporary crossing is included in the USACE's permit authorization for the Phase II Project (Permit No. SWG-2003-02110) which was issued on July 31, 2008. The temporary plant road would be constructed in accordance with the Freeport LNG's Procedures, SPCC Plan, and the requirements of the USACE permit.

Operational impacts on surface water quality would result from periodic maintenance dredging of the berthing area. Maintenance dredging of the LNG vessel berthing area would be required periodically to maintain the requisite water depth for LNG vessel maneuvering. Although maintenance dredging would result in a temporary increase in suspended sediment and turbidity levels, these impacts would be temporary and limited to the immediate vicinity of dredge operations. Freeport LNG would conduct maintenance dredging in accordance with the requirements of the USACE permit and state water quality certification and associated water quality impacts would be minor.

Accidental Spills or Leaks of Hazardous Materials

Water quality could be adversely affected by a spill, leak, or other release of hazardous materials during construction and operational activities. Freeport LNG would implement spill prevention and response procedures specified in their Project-specific SPCC Plan to minimize potential impacts associated with spills or leaks of hazardous materials during construction.

4.3.3 Hydrostatic Testing

Prior to placement in service, pipe sections would be hydrostatically or pneumatically tested, depending on the type of pipe and its intended function, to ensure structural integrity. Table 4.3.3-1 shows hydrostatic testing requirements (uptake source(s)[14] rate, discharge location/rate, holding time, and volume) for the Liquefaction Project.

Depending on the volume required, water to hydrostatically test the piping would be obtained from the two existing on-site water wells or a combination of existing on-site wells and the Town of Quintana's existing municipal wells.

Hydrostatic testing would be performed to ensure that pipe sections are free from leaks and that the required margin of safety is provided for operation at anticipated pressures. Hydrostatic testing would be conducted in accordance with the requirements of USDOT pipeline safety regulations in Title 49 CFR Part 192 and Freeport LNG's own testing specifications. Approximately 67,000 gallons of water would be necessary for hydrostatic testing of the Liquefaction Plant. Upon test completion, the water would be discharged to a man-made pond that lies south of the Phase I Project LNG storage tanks. Freeport LNG would conduct all hydrostatic testing in accordance with applicable permit requirements.

[14] The information presented in this section is provisional with respect to hydrostatic test water.

Table 4.3.3-1

Liquefaction Project Hydrostatic Testing Uptake and Discharge Requirements

Facility	Source	Uptake Rate (gpm)	Volume (x 1000 gallons)	Holding Time (hours)	Discharge Location	Discharge Rate (gpm)
Liquefaction Plant	On-site and/or Quintana Well(s)	150	67	8	terminal a/	100
Pretreatment Plant	PTP b/	150	48	8	PTP c/	50
Pipelines						
Nitrogen	UGS	150	105	8	terminal a/	100
NGL	PTP b/	150	67	8	PTP c/	100
BOG	PTP b/	150	115	8	terminal a/	100
NG Interconnect Inflow	PTP b/	150	45	8	PTP c/	50
NG Interconnect Outflow	PTP b/	150	45	8	PTP c/	50
Utility Lines						
Water Line	UGS	50	50	4	PTP c/	50
	Total:		**542**			

Notes:
NG natural gas
PTP Pretreatment Plant
UGS underground storage (existing Freeport LNG water line from Dow plant)

a/ Discharge location would be to Pond 1.
b/ Source at PTP may be composed of a combination of water from UGS (UGS waterline to PTP) and well(s) at PTP.
c/ Discharge location would be an upland area and in accordance with Freeport LNG’s Procedures.

Water quality in Pond 1 at the Quintana Island terminal site would not be affected by hydrostatic test discharges because only new pipe would be subject to testing and no chemicals would be added to the test water. New pipe is considered to be clean and contact with the metal surface would not introduce contamination into the test water. Freeport LNG would discharge hydrostatic test water through a hay bale dewatering structure or filter bag in an upland area, from which it would drain into Pond 1. In addition, Freeport LNG would use appropriate energy dissipation devices, containment structures, and other BMPs to minimize erosion and sedimentation at the point of discharge. The rate of flow would be controlled to prevent any temporary flooding of adjacent land. Hydrostatic testing is not required for construction of the Phase II Modification Project.

4.3.4 Stormwater Runoff

Land disturbing activities would be conducted in compliance with the NPDES Construction General Permit for stormwater discharges and Freeport LNG's Project–specific SWPPP, as required under the CWA, together with Freeport LNG's Project-specific Erosion and Sediment Control Plan. Freeport LNG would modify, where necessary, its existing plans to accommodate the increase in stormwater runoff due to the new Liquefaction and Phase II Modification Project facilities. LNG would not be considered a contaminant because it would evaporate upon release.

During construction, potential impacts involving stormwater discharges to surface waters at and adjacent to the Quintana Island terminal include erosion and sedimentation. There are no known existing soil- or sediment-borne chemical contaminants that could migrate into surrounding waterbodies from the terminal. The stormwater collection basin in the northwest corner of the former DMPA would be developed during initial site preparation and would receive construction stormwater channeled from perimeter outfalls in the western sector of the former DMPA; stormwater in the eastern sector would be conveyed to Drainage Channel A on the eastern perimeter. Stormwater in both the collection basin and Drainage Channel A would be discharged to the ICW through dedicated outfall structures and in accordance with applicable permit requirements. The collection basin and other sediment-retaining devices would help to minimize the sediment load of the discharges and any consequent environmental impacts on the ICW. Given the proposed mitigation to control stormwater runoff, the construction work is expected to have minor impacts on stormwater and associated water quality.

During operation of the Liquefaction Plant, the amount of impervious surface area would be increased, resulting in an increased volume of stormwater runoff. To accommodate this increase and any topographic changes resulting from site development, new systems of catchment areas and drainage conduits would be designed. For operation of the Liquefaction Plant, the existing *Stormwater Management Plan* for the Quintana Island terminal would be revised to incorporate the new facilities. Stormwater discharges from the Liquefaction Plant would be via outfalls regulated under the NPDES program.

Following construction of the proposed Pretreatment Plant, a new area of impervious surface materials would exist at the site, resulting in a potential increase in stormwater runoff volumes. To accommodate this increase and any topographic changes resulting from site development, new systems of catchment areas and drainage conduits would be designed. A Project-specific *Stormwater Management Plan* would be developed for operation of the Pretreatment Plant.

In regards to the Pipeline/Utility Line System, no new impervious areas outside of existing facility fence lines would be developed that could increase stormwater runoff. In regard to the Phase II Modification Project, like the Liquefaction Project, land disturbing activities would be conducted in compliance with an NPDES Construction General Permit and Freeport LNG's Project Specific SWPPP and operation of the Phase II Modification Project would include a Stormwater Management Plan developed in consultation with the Velasco Water Management District.

Given the above described stormwater control measures, operation of the Liquefaction Project and Phase II Modification Project are expected to have minor impacts on runoff and associated water quality.

4.3.5 Wetlands

The proposed Liquefaction Project and Phase II Modification Project would be constructed in areas that support numerous wetlands. These wetlands have historically been, and presently is, disturbed by industrial, agricultural, and grazing activities. Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of wetland vegetation typically adapted for life in saturated soil conditions (USACE, 1987). Freeport LNG conducted field delineations in accordance with the methodology outlined in the USACE *1987 Wetland Delineation Manual* (USACE, 1987).

Field delineation surveys were conducted for Freeport LNG's Phase I Project, Phase II Project, NGL Extraction Project, and Liquefaction Project. Information that was originally collected for the Phase I and Phase II Projects between 2003 and 2005 was re-evaluated and corroborated through contemporary field investigations in 2010 and 2011. Information for the proposed Pretreatment Plant site is based on a field delineation survey that was completed by Freeport LNG in March through May, 2012. See figures D-1 through D-3 (a-h) in appendix D for field determined waterbodies and wetlands for the Projects. Wetland vegetation species representative of the area are discussed in section 4.4 of this draft EIS.

The most common wetlands in the vicinity are palustrine emergent and estuarine emergent wetlands. Some upland scrub-shrub communities and species are also present. Typical wetland species are discussed in section 4.4 of this draft EIS.

4.3.5.1 Impacts and Mitigation

Liquefaction Project

The Liquefaction Project consists of three components which have potential affect on wetlands: the Liquefaction Plant/Quintana Island terminal site, the Pretreatment Plant, and the Pipeline/Utility Line System. These are discussed separately below.

<u>Liquefaction Plant</u>

There are nine wetlands within the vicinity of the Quintana Island terminal site. These consist of estuarine emergent and palustrine emergent wetlands, and are located mostly adjacent to the Liquefaction Plant or along the shoreline of the ICW. Many of these were created as compensatory mitigation for earlier phases of development of the facility. Table 4.3.5-1 lists the wetlands on the terminal site and indicates that there may be temporary impacts on wetlands adjacent to the area as a result of turbidity from the proposed dredging work (see table 4.3.2-1). Permanent impacts on wetlands would total 1.7 acres.

Freeport LNG's required adherence to permit conditions and implementation of the Freeport LNG's Procedures, SWPPP, and SPCC Plan would ensure the avoidance of indirect impacts (*e.g.,* from stormwater runoff) on the wetlands that lie beyond the proposed construction workspace.

Table 4.3.5-1

Wetland Impacts at the Liquefaction Plant

Wetland No.	Wetland Type	Temporary Workspace (acres)	Permanent Footprint (acres)	Comment
WL-1	Estuarine Emergent	a/	0.0	Impacts due to dredging turbidity. Adjacent to existing LNG berthing area
WL-2	Estuarine Emergent	a/	0.0	Impacts due to dredging turbidity. Adjacent to existing LNG berthing area
WL-3	Estuarine Emergent	a/	0.0	Impacts due to dredging turbidity. Adjacent to existing LNG berthing area
WL-5	Estuarine Emergent	a/	0.0	Impacts due to dredging turbidity. *Spartina alterniflora* bed on shoreline of ICW – compensatory mitigation wetland
WL-6	Estuarine Emergent	a/	0.0	Impacts due to dredging turbidity. *Spartina alterniflora* bed on shoreline of ICW – compensatory mitigation wetland
WL-7	Estuarine Emergent	0.00	1.1	*Spartina alterniflora* bed on shoreline of ICW – compensatory mitigation wetland
WL-9	Palustrine Emergent	0.00	0.63	Associated with Pond 1 - compensatory mitigation wetland
	Total:	**0.00**	**1.7**	

a/ Wetlands may be affected temporarily by turbidity from dredging plume

Because Freeport LNG's preliminary compensatory mitigation plan is still under development, **we recommend that:**

> **Prior to the end of the draft EIS comment period, Freeport LNG should file the Compensatory Wetland Mitigation Plan developed in consultation with the USACE. The plan should include:**
>
> **a. details regarding the amount, location, and types of mitigation proposed; and**
>
> **b. specific performance standards to measure the success of the mitigation; and remedial measures, as necessary, to ensure that compensatory mitigation is successful.**

Therefore, we conclude that with the avoidance and minimization measures that Freeport LNG would implement, and our recommendation that Freeport LNG file the Compensatory Wetland Mitigation Plan prior to the end of the draft comment period, the impacts on wetlands would be mitigated and would not be significant.

Pretreatment Plant

As indicated in table 4.3.5-2, construction and operation of the Pretreatment Plant would have temporary and permanent impacts on wetlands within the associated construction workspace. Figure D-2 in appendix D shows the impacts on wetlands at the Pretreatment Plant site, based on the field delineation performed in March through May, 2012. Based on the USACE's field review undertaken on July 18, 2012 and subsequent written confirmation provided on August 9, 2012, all wetlands on the site are considered USACE jurisdictional.

Freeport LNG has avoided or minimized wetland impacts during its facility layout design. Of the 15 wetlands listed in table 4.3.5-2, two small wetlands (WL-19 and WL-20) are located wholly in the temporary construction workspace and would be temporarily disturbed during site preparation.

Table 4.3.5-2

Wetland Impacts at the Pretreatment Plant Site

Wetland No. b/	Wetland Type	Temporary Workspace (acres)	Permanent Footprint (acres)
MS-WL-1	Palustrine Emergent	2.74	3.11
MS-WL-2	Palustrine Emergent	0.00	2.40
MS-WL-3	Palustrine Emergent	0.00	0.15
MS-WL-4	Palustrine Emergent	0.00	0.38
MS-WL-5	Palustrine Emergent	0.00	0.32
MS-WL-6	Palustrine Emergent	0.00	0.41
MS-WL-7	Palustrine Emergent	0.00	0.25
MS-WL-8	Palustrine Emergent	0.00	0.76
MS-WL-9	Palustrine Emergent	2.00	3.77
MS-WL-11	Palustrine Emergent	0.00	0.13
MS-WL-12	Palustrine Emergent	0.00	0.02
MS-WL-19	Palustrine Emergent/Scrub-Shrub	0.24	0.00
MS-WL-20	Palustrine Emergent	0.47	0.00
MS-WM-6	Palustrine Emergent/Upland Mosaic (20 percent wetland)	0.00	0.04
MS-WM-8	Palustrine Emergent/Upland Mosaic (50 percent wetland)	0.00	0.09
	Total:	**5.45**	**11.83**

a/ Jurisdictional status is based on PJD issued on August 9, 2012 (USACE, 2012).
b/ WL-10 no longer exists and WL-13 through WL-18 are located beyond the Pretreatment Plant site, hence the associated gaps in the numbering sequence.

Upon completion of the Pretreatment Plant, the topography of the emergent wetlands within the temporary workspaces would be restored as site drainage plans allow and the areas would be allowed to revegetate naturally, in accordance with the Freeport LNG's Procedures and the *Wetland Restoration and Monitoring Plan*. Redirection of drainage flows, together with compensatory mitigation for permanent loss of wetland acreage and decline in functional quality, would be coordinated with the USACE and other applicable regulatory agencies during the Section 404 permitting process.

The final approach to mitigation for the permanent fill of an estimated 11.8 acres of palustrine emergent wetland at the Pretreatment Plant site, may include a combination of purchase of credits in a wetland mitigation bank, placement of other wetlands (on or off-site) in a long term conservation agreement, creation, extension, or restoration of other wetlands. Freeport LNG would provide the USACE with a *Compensatory Wetland Mitigation Plan* offering specific details of the anticipated quantitative and qualitative wetland impacts resulting from Pretreatment Plant development and the mitigation measures to be adopted. This mitigation would be separate from the compensatory wetland mitigation plan for Phase I and Phase II activities at the terminal. Given the overall siting requirements of the Pretreatment Plant and the prevalence of similar wetland habitat throughout the region, we conclude that Freeport LNG has minimized the impacts on wetlands as much as possible through the design of the facility.

Pipeline/Utility Line System

In total, 36 emergent wetlands are crossed by the Pipeline/Utility Line System (see table 4.3.5-3). Construction and operation of the Pipeline/Utility Line System would have temporary impacts, but no permanent impacts, on wetlands within the associated construction workspace. Figure D-3 (a-h) in appendix D shows the type and extent of the wetlands within the proposed construction workspace, based on field delineations performed for the Phase I and Phase II Projects between 2002 and 2005, the NGL Extraction Project in August 2010, and the HDD workspace at MP 4.55(A)/0.15(B) in May 2012, along with corroboratory field reconnaissance of previous surveys in September 2010 and February 2011. The width of the construction right-of-way for the wetland crossings is 100 feet (refer to figures 2.4.1-1 and 2.4.1-2 which show right-of-way cross section configurations).

Table 4.3.5-3

Freeport LNG Liquefaction Project
Wetlands and Associated Impacts for the Pipeline/Utility Line System

Wetland No.	Location Along Pipeline and Utility Line Route		Crossing Length (feet) a/	Wetland Type	Temporary Impact (acres) b/	Permanent Impact (acres)
	From (Milepost)	To (Milepost)				
WL-1	0.01(A)	0.68(A)	262	Palustrine Emergent	0.5	0.0
WL-2	1.12(A)	1.16(A)	215	Palustrine Emergent	0.5	0.0
WL-3	1.17(A)	1.18(A)	60	Estuarine Emergent	0.1	0.0
WL-4	1.19(A)	1.51(A)	1710	Estuarine Emergent	3.9	0.0
WL-5	2.01(A)	2.29(A)	1507	Estuarine Emergent	2.6	0.0
WL-6	2.30(A)	2.35(A)	240	Estuarine Emergent	0.4	0.0
WL-7	2.36(A)	2.71(A)	1879	Estuarine Emergent	3.3	0.0
WL-8	3.59(A)	3.66(A)	375	Estuarine Emergent	0.9	0.0
WL-9	3.68(A)	3.69(A)	N/A a/	Estuarine Emergent	0.1	0.0
WL-10	3.73(A)	3.75(A)	N/A a/	Estuarine Emergent	0.1	0.0
WL-11	3.83(A)	3.86(A)	N/A a/	Estuarine Emergent	<0.1	0.0
WL-12	3.94(A)	3.95(A)	N/A a/	Estuarine Emergent	<0.1	0.0
WL-13	3.99(A)	4.01(A)	N/A	Estuarine Emergent	<0.1	0.0
WL-14	4.08(A)	4.12(A)	N/A a/	Estuarine Emergent	<0.1	0.0
WL-15	4.14(A)	4.14(A)	N/A a/	Estuarine Emergent	<0.1	0.0
WL-16	4.36(A)	4.38(A)	N/A a/	Estuarine Emergent	<0.1	0.0
WL-17	4.38(A)	4.55(A)	N/A a/	Estuarine Emergent	0.4	0.0

Table 4.3.5-3

Freeport LNG Liquefaction Project
Wetlands and Associated Impacts for the Pipeline/Utility Line System

Wetland No.	Location Along Pipeline and Utility Line Route		Crossing Length (feet) a/	Wetland Type	Temporary Impact (acres) b/	Permanent Impact (acres)
	From (Milepost)	To (Milepost)				
WL-18	4.56(A)	4.57(A)	N/A a/	Estuarine Emergent	<0.1	0.0
WL-19	4.62(A)	4.63(A)	N/A a/	Estuarine Emergent	<0.1	0.0
WL-20	4.62(A)	4.64(A)	N/A a/	Estuarine Emergent	<0.1	0.0
WL-21	4.96(A)	4.97(A)	7	Estuarine Emergent	<0.1	0.0
WL-22	5.25(A)	5.26(A)	N/A a/	Estuarine Emergent	<0.1	0.0
WL-23	5.32(A)	5.40(A)	N/A a/	Estuarine Emergent	0.1	0.0
WL-24	5.36(A)	5.39(A)	N/A a/	Estuarine Emergent	0.1	0.0
WL-35	7.23(A)	7.29(A)	205	Palustrine Emergent	0.3	0.0
WL-26	7.32(A)	7.35(A)	N/A a/	Palustrine Emergent	0.1	0.0
WL-27	7.33(A)	7.62(A)	731	Palustrine Emergent	1.6	0.0
WL-28	7.69(A)	7.72(A)	22	Palustrine Emergent	0.2	0.0
WL-29	8.03(A)	8.06(A)	40	Palustrine Emergent	0.1	0.0
WL-30	8.20(A)	8.26(A)	94	Palustrine Emergent	0.3	0.0
WL-31	8.43(A)	8.48(A)	250	Palustrine Emergent	0.6	0.0
WL-32	8.50(A)	8.60(A)	415	Palustrine Emergent	1.1	0.0
WL-33	8.72(A)	8.75(A)	N/A b/	Palustrine Emergent	0.1	0.0
WL-34	8.83(A)	8.84(A)	7	Palustrine Emergent	<0.1	0.0
WL-35	9.45(A)	9.45(A)	12	Palustrine Emergent	<0.1	0.0
WL-36	9.47(A)	9.47(A)	13	Palustrine Emergent	<0.1	0.0
WL-37	0.00(B)	N/A c/	745	Estuarine Emergent	1.3	0.0
WL-38	0.04(B)	0.04(B)	N/A a/	Palustrine Emergent/ Scrub-Shrub	<0.1	0.0
WL-39	0.09(B)	0.11(B)	N/A a/	Estuarine Emergent	0.1	0.0
WL-40	0.11(B)	0.12(B)	37	Palustrine Emergent/ Scrub-Shrub	<0.1	0.0
WL-41	0.13(B)	0.13(B)	24	Estuarine Emergent	<0.1	0.0
WL-42	0.14(D)	0.17(D)	45	Palustrine Emergent	0.2	0.0
WL-43	0.21(D)	0.21(D)	19	Palustrine Emergent	<0.1	0.0
WL-44	0.24(D)	0.32(D)	465	Palustrine Emergent	1.1	0.0
WL-45	0.34(D)	0.34(D)	25	Palustrine Emergent/ Scrub-Shrub	<0.1	0.0
WL-46	0.60(D)	0.62(D)	10	Palustrine Emergent	<0.1	0.0
WL-47	0.64(D)	0.65(D)	N/A a/	Palustrine Emergent	<0.1	0.0
				Total:	**20.2 d/**	**0.0**

Notes
N/A = Not Applicable

a/ Wetland is within the temporary workspace area but not directly crossed by the proposed pipelines or utility lines.
b/ Construction impacts for the pipeline are based on a nominal 100-foot-wide construction right-of-way.
c/ Includes all temporary workspace east of MP 0.0(B).
d/ 0.1 of total reflects a collective rounding up of <0.1 values.

During and following construction, Freeport LNG would ensure that the temporary wetland impacts associated with the pipeline and utility line facilities are appropriately addressed through adherence to permit conditions and implementation of the protective measures in Freeport LNG's Procedures, *Wetland Restoration and Monitoring Plan*, SWPPP, and SPCC Plan. For wetlands, these protective measures include:

- minimizing vegetation clearing and soil disturbance;
- avoiding unnecessary vehicular traffic and equipment use;
- installing and maintaining erosion and sedimentation control devices such as hay bales and silt fences;
- restricting the duration of construction to the extent practicable;
- using timber construction mats or layers of timber to create a temporary work surface in wet conditions; and
- using low pressure ground equipment in wet conditions to minimize vegetation damage, soil compaction, and rutting.

Through the same combination of measures, Freeport LNG would strive to avoid indirect impacts (*e.g.*, from stormwater runoff) to those peripheral wetlands that lie beyond the proposed construction workspace. With the above mitigation, impacts from the Pipeline/Utility Line System on wetlands would be temporary and short term.

Summary of Wetland Impacts

The total temporary impact on wetlands from the Liquefaction Project is 25.7 acres and includes the wetland impacts associated with the Pretreatment Plant and Pipeline/Utility Lines. The total permanent impact on wetlands from the Liquefaction Project is 13.5 acres, which includes impacts associated with the Liquefaction Plant (1.7 acres) and the Pretreatment Plant (11.8 acres), with no permanent impacts from the Pipeline/Utility Line System.

In addition to the mitigation measures in the Freeport LNG's Procedures, Freeport LNG would be required to comply with the permit conditions contained in the USACE's Section 404 and TCEQ's Section 401 Permits. In Freeport LNG's application to the USACE, it must demonstrate that it has taken appropriate and practicable steps to minimize wetland impacts in compliance with the USEPA's Section 404(b)1 guidelines that restrict discharges of dredged or fill material where a less environmentally damaging alternative exists. Per USACE requirements, the permanent loss of wetlands would require that Freeport LNG provide compensatory mitigation. Freeport LNG is in consultation with the USACE to address the wetland impacts and ensure their *Compensatory Wetland Mitigation Plan* adequately satisfies all USACE requirements. Given the overall siting requirements of the Liquefaction Project and the prevalence of similar wetland habitat throughout the region, and the mitigation to be developed through the USACE permitting process, we conclude that the Liquefaction Project would cause permanent but minor impacts on wetlands.

Phase II Modification Project

Construction and operation of the Phase II Modification Project would impact a total of approximately 6.2 acres of wetlands, approximately 6.1 of which would be permanently affected. Wetland areas affected by the Phase II Modification Project are identified in figure D-1 in appendix D and described in table 4.3.5-4.

Following construction, temporarily disturbed wetlands would be restored and allowed to revegetate in accordance with the Freeport LNG's Procedures and Freeport LNG's *Wetland Restoration and Monitoring Plan*. The latter plan describes measures for reestablishing wetland species and for subsequent revegetation monitoring to ensure that all disturbed areas are successfully restored.

Table 4.3.5-4

Freeport LNG Phase II Modification Project
Jurisdictional Wetland Impacts

Wetland No.	Wetland Type	Temporary Workspace (acres)	Permanent Footprint (acres)	Comment
WL-1	Estuarine Emergent	0.00	3.9	Within Phase II dock and berthing area
WL-2	Estuarine Emergent	0.00	1.9	Within Phase II dock and berthing area
WL-3	Estuarine Emergent	0.00	0.2	Within Phase II dock and berthing area
WL-4	Palustrine Scrub-Shrub	<0.1	<0.1	Within construction workspace and permanent easement for the new plant road
WL-5	Estuarine Emergent	0.01	0.00	Created/restored as compensatory mitigation for the Phase I Project
WL-6	Estuarine Emergent	0.00	0.00	Created/restored as compensatory mitigation for the Phase I Project
WL-7	Estuarine Emergent	0.00	0.00	Created/restored as compensatory mitigation for the Phase I Project
WL-8	Palustrine Emergent	0.00	0.00	Created/restored as compensatory mitigation for the Phase I Project
WL-9	Palustrine Emergent	0.00	0.00	Created/restored as compensatory mitigation for the Phase I Project
	Total:	**0.1**[a]	**6.1**	

To address the Phase II Modification Project, Freeport LNG is working with the USACE to seek an amendment to the existing Section 404/10 permit authorization and to update its *Compensatory Wetland Mitigation Plan* as necessary. Therefore we conclude that the Phase II Modification Project would cause permanent but minor impacts on wetlands.

4.4 VEGETATION

The Gulf Prairies and Marshes Region of East Texas, in which the Liquefaction Project is located, is a nearly level, slowly drained plain less than 150 feet in elevation, dissected by streams and rivers flowing into the Gulf. The region includes barrier islands that protect the coastline from ocean waves and highly productive estuaries and marshes that support a thriving fishing economy (Davis and Schmidly, 1994). Historically, post oak savanna and grassland have been the major climax vegetation types throughout most of the region. Neither the Liquefaction Project nor the Phase II Modification Project are located at or would affect any of the rare plant communities mapped on the Texas Natural Diversity Data Base (TPWD, 2012). The land on which the Liquefaction Project facilities would be sited has been subjected to and influenced by historic industrial, commercial, residential, and cattle grazing activities, some of which have significantly altered the natural vegetation profile. See figure 4.4-1 for the regional setting of the Projects.

4.4.1 Liquefaction Project

4.4.1.1 Quintana Island Terminal Site

The major vegetative cover types currently found at and adjacent to the Quintana Island terminal include upland herbaceous and scrub-shrub communities, as well as estuarine emergent wetland. The upland scrub-shrub community at the terminal site is heavily dominated by bigleaf marsh elder (*Iva frutescens*) and eastern baccharis (*Baccharis halimifolia*), although various intermingled herbaceous species are also well represented.

The upland herbaceous community at and adjacent to the terminal site has been previously disturbed and contains species such as annual ragweed (*Ambrosia artemisiifolia*), bushy bluestem (*Andropogon glomeratus*), Canada goldenrod (*Solidago canadensis*), herbaceous mimosa (*Mimosa strigillosa*), and seaside goldenrod (*Solidago sempervirens*). This community also contains certain opportunistic species that tend to favor wetter conditions such as Gulf cordgrass (*Spartina spartinae*) and sea oxeye (*Borrichia frutescens*). The presence of such species is indicative of recently disturbed soils.

Estuarine emergent wetlands occur along the low south shoreline of the ICW, where extensive beds of smooth cordgrass (*Spartina alternifolia*) have been planted as part of Freeport LNG's compensatory mitigation program, and on the east side of the terminal site between the LNG carrier berthing area and the east temporary workspace. Representative species include bulrush (*Scirpus* sp.), Carolina wolfberry (*Lycium carolinianum*), eastern baccharis, glasswort (*Salicornia* sp.), Gulf cordgrass, saltgrass (*Distichlis spicata*), saltmeadow cordgrass (*Spartina patens*), sand spikerush (*Eleocharis montevidensis*), sea oxeye, sea purslane (*Sesuvium maritimum*), and seaside goldenrod. Isolated clumps of scrub-shrub vegetation (mainly bigleaf marsh elder and eastern baccharis) punctuate the herbaceous cover. A detailed discussion of wetlands at the terminal site is included in section 4.3.5.

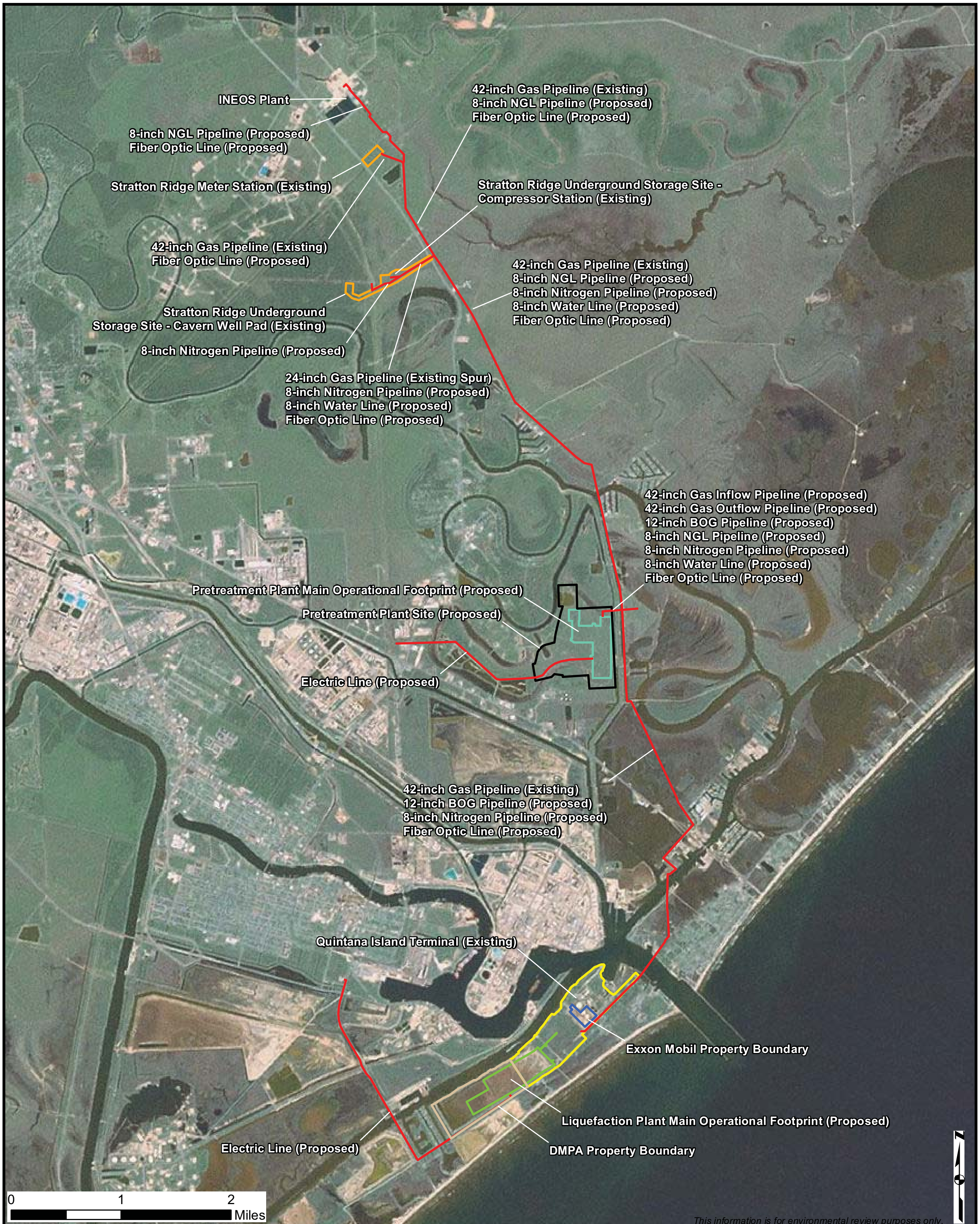

Figure 4.4-1
Freeport LNG - Liquefaction Project
Proposed Project Facilities -
Regional Setting
Brazoria County, Texas

FILE: M:\Clients\D-F\FRE\Liquefaction_ArcGIS\2013\05\reformatted_RRs_FRE_RR_4_3_1_1_LiqProj_Facilities_All.mxd | REVISED: 05/03/2013 | SCALE: 1:80,000 | DRAWN BY: JEBAKKEN

Impacts and Mitigation

The impacts on vegetation communities within the Quintana Island terminal's construction workspace are summarized in table 4.4.1-1. For the Liquefaction Project facilities at and adjacent to the terminal site, table 4.4.1-1 indicates those areas that are within the previously authorized Phase II Project footprint and other areas.

Approximately 35.0 acres of vegetation would be cleared during construction of the Liquefaction Project at and adjacent to the Quintana Island terminal, of which 20.8 acres would be temporary impacts. Approximately 14.2 acres of vegetation would be permanently cleared and lie outside the previously authorized construction footprint for the Phase II Project. Of the 20.8 acres temporarily affected, 18.3 acres lie inside the previously authorized construction footprint for the Phase II Project.

To minimize impacts on vegetation communities during and after construction, erosion control measures would be installed and temporary workspaces revegetated as applicable in accordance with Freeport LNG's Procedures and the SWPPP. With the implementation of these measures, impacts on vegetation are expected to be minor.

Operation and maintenance of the proposed facilities would have minimal impact on naturally occurring vegetation communities at the terminal site. Routine good housekeeping measures, such as mowing and weeding, would be used for tended areas among the Liquefaction Plant infrastructure; however, naturally vegetated areas peripheral to the permanent footprint of the facilities would not be included in Freeport LNG's maintenance program and would be allowed to grow without further disturbance.

4.4.1.2 Pretreatment Plant

The vegetation cover types at the Pretreatment Plant site are predominantly upland grassland, which has been actively grazed by cattle, and emergent wetland. Isolated trees and small patches of scrub-shrub cover punctuate the upland landscape.

Representative upland herbaceous species include annual ragweed, Bermuda grass (*Cynodon dactylon*), common dandelion (*Taraxacum officinale*), Johnson grass (*Sorghum halepense*), and wavy-leaf thistle (*Cirsium undulatum*). Upland scrub-shrub cover is dominated by Chinese tallow, goatbush (*Castela erecta*), and huisache (*Acacia smallii*). The isolated trees on the site are Chinese tallow.

The larger emergent wetlands on the site (*e.g.*, at Horseshoe Lake) are dominated by Gulf cordgrass, sea oxeye, and smooth cordgrass; smaller scrub-shrub sections within these wetlands are characterized by bigleaf marshelder. Wetland species in the small man-made drainage channels that cross the site include sand spikerush and prairie butter-cup (*Ranunculus platensis*).

Table 4.4.1-1

Freeport LNG Liquefaction Project
Vegetation Communities at Quintana Island Terminal Site Affected Within the Construction Workspace (in Acres) [a/]

Location	Upland Herbaceous		Upland Scrub-Shrub		Wetland Herbaceous e/		Scrub-Shrub Wetland		Total Vegetation	
	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
Within Previously Authorized Phase II Footprint										
Total:	18.3	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	18.3	<0.1
Outside Previously Authorized Phase II Footprint										
Liquefaction Plant:										
Trains 1, 2, and 3	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	7.0
Ancillary Facilities	0.0	5.5	0.0	1.3	0.0	0.0	0.0	0.0	0.0	6.8
LNG Pipeline & Troughs in Phase I Process Area	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1
Construction Dock	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Firewater Intake Structure	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1
BOG Compressor at Phase I Berthing Dock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vapor Return Blowers at Phase 1/11 Berthing Docks	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temporary Workspace (West)	1.1	0.0	0.8	0.0	0.0	0.0	0.0	0.0	1.9	0.0
Temporary Workspace (East Central)	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
Temporary Workspace (East)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total:	1.7	5.7	0.8	1.3	0.0	7.0	0.0	0.0	2.5	14.0
Quintana Island Terminal Site Total:	20.0	5.8	0.8	1.4	0.0	7.0	0.0	0.0	20.8	14.1
Pretreatment Plant Site Total	81.1	66.1	<0.1	<0.1	5.5	11.8	0.2	0.0	86.9	78.0
Pipelines/Utility Lines (Jurisdictional & Nonjurisdictional) MP 0.00(A)- MP 4.55(A) MP 0.00(B) - MP 0.35(8)	6.8	0.0	0.2	0.0	14.3	0.0	0.0	0.0	21.3	0.0
Pipelines/Utility Lines (Nonjurisdictional)	34.5	0.0	18.9	0.0	5.9	0.0	0.0	0.0	59.3	0.0
Pipelines/Utility Lines Total:	41.3	0.0	19.1	0.0	20.2	0.0	0.0	0.0	80.6	0.0

Notes:
a/ Does not include the nonjurisdictional electric lines

Impacts and Mitigation

The impacts on vegetation communities within Pretreatment Plant's construction workspace are summarized in table 4.4.1-1. For the Liquefaction Project facilities at and adjacent to the terminal site, table 4.4.1-1 indicates those areas that are within the previously authorized Phase II Project footprint and other areas.

About 164.9 acres of vegetation would be cleared during construction at the Pretreatment Plant, of which 78 acres would be permanently affected and 86.9 acres would be temporarily affected. Impacts on vegetation from construction of the Pretreatment Plant would be minor because the facility would impact an area predominantly used for grazing where there are no special and rare vegetative communities. Impacts on wetland vegetation are minimized through wetland compensation areas as described in section 4.3.5.

4.4.1.3 Pipeline/Utility Line System

The major vegetative cover types currently found on the Pipeline/Utility Line System include grazed upland grassland (pasture land), scrub-shrub communities, and herbaceous wetlands. No significant tree cover is present. Both estuarine and palustrine wetlands are represented, although estuarine wetlands are more significant than palustrine wetlands and are represented by several extensive areas on the main artery of the Pipeline/Utility Line System.

Estuarine emergent wetlands occur along the southern portion of the main Pipeline/Utility Line System from Follett's Island to just south of Oyster Creek at MP 5.62(A). These wetlands are dominated by extensive beds of smooth cordgrass. Other representative species include bulrush, Carolina wolfberry, eastern baccharis, glasswort, Gulf cordgrass, saltgrass, saltmeadow cordgrass, sand spikerush, sea oxeye, sea purslane, and seaside goldenrod. Isolated clumps of scrub-shrub vegetation (mainly big-leaf marsh elder and eastern baccharis) punctuate the herbaceous cover.

Several small palustrine emergent wetlands occur south of Oyster Creek but most occur to the north, where scrub-shrub inclusions are also found. Characteristic species include bulrush, Gulf cordgrass, jointed flatsedge (*Cyperus articulatus*) narrow-leaf marshelder (*Iva angustifolia*), rattle-bush (*Sesbania drummondii*), saltgrass, saltmarsh fimbristylis (*Fimbristylis castanea*), and spikerush (*Elodea*). A detailed discussion of wetlands along the proposed Pipeline/Utility Line System is included in section 4.3.5.

Common upland herbaceous plants along the Pipeline/Utility Line System include annual ragweed, bahiagrass, barnyard grass (*Echinochloa crus-galli*), Bermuda grass, coreopsis (*Coreopsis*), false indigo (*Baptisia australis*) fine-leaved sneezeweed (*Helenium amarum*), frog-fruit (*Phyla nodiflora*), fox-tail bristle grass (*Setaria italica*), Mexican hat (*Chiranthodendron pentadactylon*), prickly pear cactus (*Opuntia*), spotted beebalm (*Monarda punctate*), St. Augustine grass (*Stenotaphrum secundatum*), Vasey's grass (*Paspalum urvillei*), and windmill grass (*Chloris*). Scrub-shrub vegetation along the Pipeline/Utility Line System includes bigleaf marshelder, eastern baccharis, rattlebush, and salt cedar (*Tamarix*).

Impacts and Mitigation

The impacts on vegetation communities within the Pipeline/Utility Line System's construction workspace are summarized in table 4.4.1-1. For the Liquefaction Project facilities at and adjacent to the terminal site, table 4.4.1-1 indicates those areas that are within the previously authorized Phase II Project footprint and other areas.

About 80.6 acres of vegetation would be cleared during construction of the Pipeline/Utility Line System. The proposed Pipeline/Utility Line System would be collocated with existing pipelines and utilities within previously disturbed and maintained corridors as much as possible, which would help to minimize vegetation impacts. However, construction would necessitate the removal of surface vegetation and grading to facilitate pipeline installation and to allow safe operation of equipment. During grading, the root systems of herbs, shrubs, and small trees would be disturbed.

Following construction, all disturbed areas would be restored as near as practical to their original condition. Temporary and permanent erosion control measures would be installed as necessary and revegetation would be undertaken in accordance with Freeport LNG’s Procedures, SWPPP. Reseeding and/or tree replanting programs, where required, would be developed in consultation with federal, state, and/or local permitting authorities. As a result of these mitigation measures, impacts on vegetation along the right-of-way associated with Pipeline/Utility Line System are expected to be minor and temporary.

To the extent practical, temporarily disturbed wetlands would be returned to their original grade, hydrology, and vegetative cover type. Woody shrubs and trees would be allowed to naturally revegetate within temporary workspaces. Most of the permanent pipeline corridor would be maintained with low vegetative cover to facilitate access for operations and maintenance, accommodate underground utilities in the shared right-of-way, and comply with the safety requirements of 49 CFR Part 192. Mechanical methods, such as brush hogging, would be used as necessary in upland areas to keep the permanent right-of-way clear of excessive woody vegetation.

Operation and maintenance of the Pipeline/Utility Line System would have a minimal impact on the naturally occurring vegetation communities. Active maintenance of vegetation within the operational right-of-way (*e.g.*, mowing and brush-hogging) may be required in select locations on an infrequent basis.

4.4.1.4 Summary of Impacts

In summary, the Liquefaction Project would temporarily impact 188.3 acres of vegetation, and permanently impact 92.1 acres of vegetation. Impacts on vegetation would generally be minor as a substantial portion of the Liquefaction Plant work would affect vegetation associated with the dredge disposal site that does not have a high value with respect to wildlife habitat, and impacts on vegetation from construction of the Pretreatment Plant would impact an area predominantly used for grazing where there are no special and rare vegetative communities.

4.4.2 Phase II Modification Project

The Phase II Modification Project would be constructed on Quintana Island, mainly within the existing terminal footprint. An access road would also be constructed on Quintana Island. The major vegetative cover types currently found at and adjacent to the Quintana Island terminal include upland herbaceous and scrub-shrub communities, as well as estuarine emergent wetland. Specific descriptions of vegetation existing on Quintana Island, in and adjacent to the terminal, are in section 4.4.1.

Impacts and Mitigation

The Phase II Modification Project's impact on vegetation communities is summarized in table 4.4.2-1. Construction of the Freeport LNG Phase II Modification Project would affect a total of approximately 23.4 acres of vegetation, of which 14.3 acres would be permanent. The remaining 9.1 acres would be restored in accordance with the Freeport LNG's Procedures and Freeport's SWPPP. Excavation and construction of the new berthing dock would permanently impact estuarine emergent wetlands along the low south shore of the ICW and would require the removal of approximately 1,188,000 yd^3 of dredged material. See section 4.3.5 for a discussion of this construction activity as it affects wetlands and section 4.5.5 as it relates to EFH.

Table 4.4.2-1
Freeport LNG Phase II Modification Project
Vegetation Communities Affected
(Acres)

Project Component	Upland Vegetation				Wetland Vegetation			
	Herbaceous		Scrub-Shrub		Estuarine Herbaceous		Palustrine Scrub-Shrub	
	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
Phase II Dock and Berthing Area	3.0	5.4	0.4	0.4	0.1	6.0	0.0	0.0
LNG Transfer Pipelines	3.2	1.1	0.0	0.0	0.0	0.0	0.0	0.0
Access Road System	1.7	0.8	0.6	0.5	0.0	0.0	<0.1	<0.1
Total:	7.9	7.3	1.0	0.9	0.1	6.0	<0.1	<0.1
					Total Temp: 9.1		**Total Perm: 14.3**	

Notes
Temp = Temporary Impact
Perm = Permanent Impact

Freeport LNG proposes to utilize one or more of four existing DMPA sites in the Freeport area to dispose of the dredged material. The existing condition at each site varies according to the material placement history of each DMPA. Generally, DMPAs contain ruderal grasses, scrub/shrub vegetation, and unvegetated sand and clay areas. DMPAs where recent dredge material placement activities have occurred consist of open water and sparsely vegetated areas that are in the process of dewatering and decompression.

Within the site, all temporarily disturbed areas would be stabilized, and temporary and permanent erosion control measures would be installed as necessary. Areas not required for operation of the facility would be revegetated in accordance with the Freeport LNG's Procedures and Freeport LNG's SWPPP. Reseeding would be planned in consultation with federal, state, and/or local permitting agencies. Areas used for dredge disposal are expected to revegetate naturally to a similar state as the other existing DMPAs (*i.e.*, ruderal grasses and scrub/shrub vegetation). Impacts on vegetation as a result of the Phase II Modification Project would be temporary and minor.

Operation and maintenance of the Phase II Modification Project would have minimal impact on naturally occurring vegetation communities at the terminal site. Routine maintenance measures, such as mowing and weeding, would be used for tended areas among the Liquefaction Plant infrastructure; however, naturally vegetated areas peripheral to the permanent footprint of the Phase II Modification Project would not be included in Freeport LNG's maintenance.

4.5 WILDLIFE AND AQUATIC RESOURCES

4.5.1 Wildlife

The Liquefaction Project and the Phase II Modification Project are located within the Gulf Prairies and Marshes region of East Texas (Davis and Schmidly, 1997). Wildlife habitat within the region is diverse and includes highly productive estuaries and marshes, post oak savanna, and grassland habitats. Because of this habitat diversity, the region also contains a diverse range of wildlife species, including dozens of reptiles and amphibians (University of Texas, 2000). Davis and Schmidly (1997) lists 30 species of terrestrial mammals known to occur in the regional vicinity of the Liquefaction Project and Phase II Modification Project (Brazoria County) and an additional 15 species whose ranges include this area, although their presence has not been documented. As discussed further below, the upper and lower Texas coasts also provide habitat for over 300 migratory and non-migratory (resident) bird species.

Wildlife habitats at the Liquefaction Plant and Phase II Modification Project include previously disturbed herbaceous upland, scrub-shrub upland, barren or graveled industrial upland, emergent wetland, scrub-shrub wetland, and open water (*i.e.*, berthing area, ICW, three drainage channels, and two man-made ponds). Over 150 regional species commonly occurring within these habitat types are known to occur in Project area. These include mammal species that have been observed recently on or adjacent to the terminal site listed in table 4.5.1-1. Birds common to the region include American crow (*Corvus brachyrhynchos*), turkey vulture (*Cathartes aura*), the indigo bunting (*Passerina cyanea*), hawks (*Accipiter* sp.), owls (*Aegolius* sp.), and orioles (*Icterus* sp.). Reptiles common to the region include the green anole (*Anolis caroliniensis*), skinks (*Eumeces* sp.), the six-lined racerunner snake (*Aspidoscelis sexlineatus*), the eastern mud turtle (*Kinosternon subrubrum*), and the snapping turtle (*Chelydra serpentine*). Amphibian species, only found in non-saline habitats, include the American bullfrog (*Lithobates catesbeianus*), cricket frog (*Acris crepitans*), and green frog (*Rana clamitans*).

Table 4.5.1-1

Observed Mammal Species

Common Name	Scientific Name
Bobcat	*Lynx rufus*
Coyote	*Canis latrans*
White-tailed deer	*Odocoileus virginianus*
Feral hog	*Sus scrofa*
Raccoon	*Procyon lotor*
Striped skunk	*Mephitis mephitis*
Eastern gray squirrel	*Sciurus carolinensis*

Most of the construction and operational footprint for the Liquefaction Plant and Phase II Modification Project at and adjacent to the terminal site is on land that was previously affected by the Phase I Projects or would be affected by the Phase II Project as originally proposed. The one area of new impact is the former DMPA within and adjacent to the existing property boundary on the west side of the terminal site. Here, the available habitat is mostly open industrial land characterized by intermittent surface water pooling, with some peripheral herbaceous upland. The wildlife community in this location would be similar to that considered representative of the terminal site for the Phase I and Phase II Projects, although the uniformity of the landscape and the DMPA's historical function as a dredge spoil depository are unlikely to favor significant ecological diversity.

While the existing industrial infrastructure at the Quintana LNG terminal is not conducive to wildlife colonization, the two LNG storage tanks provide well-used aerial vantage points for raptors (owls and hawks) that hunt birds and other prey within the wetland and pond. The wetland and pond are situated just south of the storage tanks and were developed as part of the compensatory wetlands mitigation program for the Phase I Project. In addition to attracting various avian species, the pond supports a thriving population of red drum (*Sciaenops ocellatus*) when sufficient water is present.

Wildlife habitats at the Pretreatment Plant site and along the proposed Pipeline/Utility Line System include herbaceous upland, scrub-shrub upland, barren or graveled industrial upland, emergent wetland, scrub-shrub wetland, and open water (*e.g.*, Horseshoe Lake and Oyster Creek). Much of the herbaceous upland and drier emergent wetland areas, including those that characterize the Pretreatment Plant site, support cattle grazing and can be categorized also as pasture land. As with the Liquefaction and Phase II Modification Project, over 150 regional species commonly occurring within these habitat types are known to occur in Project area. These include mammal species that have been observed recently on or adjacent to the terminal site listed in table 4.5.1-1. Birds common to the region include American crow, turkey vulture, the indigo bunting, hawks, owls, and orioles. Reptiles common to the region include the green anole, skinks, the six-lined racerunner snake, the eastern mud turtle, and the snapping turtle. Amphibian species, only found in non-saline habitats, include the American bullfrog, cricket frog, and green frog.

4.5.1.1 Wildlife Resource Impacts and Mitigation

Liquefaction Project Impacts

Construction activities and noise could temporarily drive some wildlife away from the construction area and could inhibit the movement of wildlife during work hours. Potentially, some smaller, less mobile fauna could become entrapped in excavations or could be inadvertently injured or killed by construction equipment, although no negative population-level effects are expected. It should be noted that, because the area supports currently operating industrial facilities within the larger Port Freeport, Oyster Creek, and Stratton Ridge areas, wildlife present are likely fairly tolerant of industrial activity and noise. Additionally, because the habitats affected by construction are widespread and common in the area, it is expected that the small numbers of wildlife displaced during construction would relocate, either temporarily or permanently, to other nearby suitable habitat. Wildlife activity in the area would likely resume soon after the completion of construction.

Animals permanently displaced by the new facilities may relocate to similar habitats nearby, where some animals could be forced into suboptimal habitats. In some undisturbed areas, the influx of individuals and increased population densities caused by these dislocations could increase inter- and intra-specific competition and reduce the reproductive success of individuals. Corresponding population declines in the construction area could result in a decrease in the food stock available for predators. However, for the Liquefaction Project, the size of the permanently affected area relative to the expanse of available habitat elsewhere suggests that any such effects would be marginal. Also, due to their ability to move freely over large areas and demonstrated tolerance of ongoing activities at the terminal and beyond, larger mammals (*e.g.*, bobcat, coyote, and white-tailed deer) would likely experience only minimal direct adverse impacts.

To minimize wildlife impacts related to habitat loss, Freeport LNG's Procedures would be followed during construction and restoration activities. Other short-term impacts potentially occurring during construction include spills or leaks of hazardous materials and temporary water quality impacts resulting from stormwater runoff. Freeport LNG would implement an SPCC Plan and SWPPP to avoid or minimize such impacts. In addition, in wetland areas, the USACE would require compensatory mitigation where permanent impacts are proposed. Given the mitigation measures described above, effects on wildlife associated with the construction of the Liquefaction Project are expected to be minor.

Phase II Modification Project Impacts

Construction impacts associated with the Phase II Modification Project are expected to have similar impacts on wildlife as those described above for construction of the Liquefaction Plant that is also on Quintana Island (section 4.5.1). Specifically, construction activities and noise could temporarily drive some wildlife away from the construction area and could inhibit movement during construction hours. Smaller, less mobile fauna could become entrapped in excavations or could be inadvertently injured or killed by construction equipment, although no negative population-level effects are expected.

Due to the currently operating LNG terminal, wildlife in the immediate project area is accustomed to industrial activity and noise. Additionally, because the habitats affected by construction are widespread and common in the area, it is expected that the small numbers of wildlife displaced during construction would relocate, either temporarily or permanently, to suitable habitat nearby. Wildlife activity in area would likely resume soon after the completion of construction. To minimize impacts on wildlife habitat, Freeport LNG would implement the Freeport LNG's Procedures during construction and restoration activities.

Wildlife could also be affected if a spill or leak of hazardous materials were to occur; however, Freeport LNG would implement its SPCC Plan to avoid or minimize such impacts.

Vegetative clearing for construction of the Phase II Modification Project would impact a total of 23.2 acres of wildlife habitat, including 15.2 acres of upland herbaceous cover, 6.1 acres of wetland herbaceous cover, 1.9 acres of upland scrub-shrub cover, and less than 0.1 acre of scrub-shrub wetland. Of these, 9.0 acres (7.9 acres of upland herbaceous cover, 1.0 acres of scrub-shrub upland, and 0.1 acres of emergent wetland) would be temporarily affected; the remaining 14.2 acres would be permanently converted through replacement of vegetation with surfacing materials such as concrete or gravel, or through conversion to open water for the Phase II dock and berthing area.

4.5.2 Managed and Sensitive Wildlife Areas

Two National Wildlife Refuges (NWRs) - Brazoria and San Bernard - are located within 9.0 miles of the Quintana Island terminal. The closest of these is Brazoria NWR, located approximately 2.9 miles northeast of the terminal and 0.7 mile northeast of the Pretreatment Plant. Mottled ducks (*Anas fulvigula*), roseate spoonbills (*Platalea ajaja*), great blue herons (*Ardea herodias*), rails (Rallidae family), and sandhill cranes (*Grus canadensis*) have been known to frequent Brazoria NWR. This refuge is 40,000 acres in size and consists of saline and freshwater prairies, salt and mud flats, fresh and salt marshes, potholes, saltwater lakes, and a freshwater stream. It is located within the Freeport Christmas Bird Count circle, which attracts the highest number of migratory bird species seen in a 24-hour period in the nation.

San Bernard NWR is approximately 8.5 miles southwest of Quintana Island and approximately 10.6 miles southwest of the Pretreatment Plant site. The San Bernard NWR covers approximately 28,000 acres and consists of coastal prairies, salt and mud flats, saltwater and freshwater ponds, a stream, and a stand of trees such as hackberry (*Celtis* spp.), cedar elm (*Ulmus crassifolia*), Chinese tallow, and live oak (*Quercus virginiana*). Up to 30,000 snow geese (*Chen caerulescens*) and 25,000 ducks are found on the San Bernard refuge annually.

One Wildlife Management Area (WMA), the Justin Hurst WMA (previously Peach Point WMA), is located within the regional vicinity of the Liquefaction Project facilities. It contains two management units: the main unit, which is located approximately 3.5 miles northwest of the Liquefaction Plant site and about 4.8 miles west southwest of the Pretreatment Plant site; and the Bryan Beach unit, which is located approximately 2.6 miles southwest of the Liquefaction Plant site and approximately 6.5 miles southwest of the Pretreatment Plant site. Owned by the TPWD, habitats within the Justin Hurst WMA are managed for indigenous and migratory wildlife species with an emphasis on waterfowl.

The Quintana Neotropical Bird Sanctuary (NBS) is located less than 0.1 mile south of the Quintana Island terminal. This approximately 4-acre area is identified on the TPWD's Great Texas Coastal Birding Trail and Upper Texas Coast (UTC) Wildlife Trail as UTC Site No. 121. It is owned by the Town of Quintana and managed collectively by the Town of Quintana, the Gulf Coast Bird Observatory (GCBO), the Houston Audubon Society, and Partners in Flight (GCBO, 2005; Town of Quintana, 2011).

Before its origination in 1994, the Quintana NBS was an overgrown salt cedar lot, but it has since been improved by the addition of a nature trail, ponds, and benches, together with an observation tower funded by Freeport LNG. Since completion of the existing Phase I facilities at the terminal site in 2008, and despite significant tree damage caused by Hurricane Ike in the same year, the Quintana NBS has continued to attract a wide variety of neotropical birds (*e.g.*, warblers, vireos, buntings, thrushes, and hummingbirds) in high numbers, constituting an important stopover point as they migrate north over the Gulf. The small wooded area also attracts butterflies, small mammals, reptiles, and amphibians.

The Town of Quintana owns Xeriscape Park, which, in 2005, was relocated and expanded from 0.4 acre to 2.6 acres through the joint efforts of Freeport LNG, the Town of Quintana, and several local conservation groups. The new site is located close to the Quintana NBS. Xeriscape Park includes a hummingbird garden and pond. It attracts native birds and butterflies, and like Quintana NBS, serves as a stopover point for migratory birds. It is operated on land leased from Port Freeport and in part through a grant from the TPWD.

4.5.2.1 Impacts on Managed and Sensitive Wildlife Areas

Liquefaction Project

Due to the distances of the Brazoria NWR, San Bernard NWR, and Justin Hurst WMA from the proposed facilities, Project-related impacts on wildlife at these locations are not anticipated. Based on the results of Freeport LNG's study regarding construction impacts on avian species and the fact that wildlife in area are accustomed to industrial activities, we do not expect that construction of the Liquefaction Project would have a significant impact on managed and sensitive wildlife areas. In addition, the presence of the existing 21-foot-high storm levee between the proposed Project facilities and the sites would provide a buffer against noise during construction and operation.

Phase II Modification Project

As with the Liquefaction Project, due to the distance between the Phase II Modification Project facilities and the Brazoria NWR, San Bernard NWR, and Justin Hurst WMA, Project-related impacts on wildlife at these locations are not anticipated. Additionally, for the same reasons discussed above for the Liquefaction Project, the Phase II Modification Project is not expected to have a significant impact on managed and sensitive wildlife areas.

4.5.3 Migratory Birds

Migratory birds are protected under the Migratory Bird Treaty Act (MBTA), originally passed in 1918. The MBTA states that it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the Secretary of the Interior. “Take” is defined in the regulations as to “pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt any of the above” (50 CFR 10).

Executive Order 13186 (January 2001) was issued, in part, to ensure that environmental analyses of federal actions assess the impacts on migratory birds. It also states that emphasis should be placed on species of concern, priority habitats, and key risk factors and it prohibits the take of any migratory bird without authorization from the FWS. On March 30, 2011, the FWS and the Commission entered into a MOU that focuses on avoiding or minimizing the adverse impacts on migratory birds and strengthening migratory bird conservation through enhanced collaboration between the Commission and the FWS by identifying areas of cooperation. This voluntary MOU does not waive legal requirements under any other statutes and does not authorize the take of migratory birds.

As stated in Freeport LNG’s Migratory Birds Conservation and Compliance Plan, the FWS Migratory Bird Office has developed lists of Birds of Conservation Concern (BCC), a subset of birds protected under the MBTA, to stimulate proactive conservation action by federal/state agencies and private parties (FWS, 2008a). Consistent with guidance provided during consultation with the FWS on January 12, 2012, Freeport LNG found a total of 43 BCC species on the BCC list for the Gulf Coastal Prairie portion of Bird Conservation Region (BCR) 37 (FWS, 2008a), which have been documented or are cited as probable to occur in the region (USGS, 2010; Texas Bird Breeding Atlas [TBBA], 2013).

Each species was analyzed for nesting habitat and breeding distribution based on data provided by the Cornell Lab of Ornithology (2013), the USGS (2010), and the TBBA (2013). However, of these 43 species, less than half (16) actually breed in the region; the remaining 27 are non-breeding inhabitants only. Most of the 43 species, both breeders and non-breeders, favor herbaceous upland and/or emergent wetland habitat. Both habitat types are found within the Projects' construction workspace, including wetland habitats along the ICW and to the south of the LNG storage tanks at the terminal created as part of the compensatory wetlands mitigation program for the Phase I Project. Table 4.5.3-1 provides a list of migratory bird species with breeding habitats in the area, their preferred nesting habitat, and the amount of habitat, by percentage, within the construction footprint.

Table 4.5.3-1

Migratory Birds of Conservation Concern and Breeding Habits of Gulf Coast Prairie Portion of Bird Conservation Region (BCR) 37

Species*	FWS Status*	Comments	Percent of Construction Workspace
Ground Nesters that Breed in or Near the Area			44 a/
Least Bittern *(Ixobrychus exilis)*	-		
Black Rail *(Laterallus jamaicensis)*	-		
Wilson's Plover *(Charadrius wilsonia)*	-		
American Oystercatcher *(Haematopus palliatus)*	-		
Least Tern *(Sternula antillarum)*	^	Non-listed subspecies or population of threatened/endangered species	
Gull-billed Tern *(Gelochelidon nilotica)*	-		
Sandwich Tern *(Thalasseus sandvicensis)*	-		
Black Skimmer *(Rynchops niger)*	-		
Grasshopper Sparrow *(Ammodramus savannarum)*	-		
Shrub Nesters that Breed in or Near the Area			4 b/
Seaside Sparrow *(Ammodramus maritimus)*	^	Non-listed subspecies or population of threatened/endangered species	
Painted Bunting *(Passerina ciris)*	-	Observed in NBS	
Dickcissel *(Spiza americana)*	-		
Tree Nesters that Breed in or Near the Area			<1 c/
Reddish Egret *(Egretta rufescens)*	-		
Bald Eagle *(Haliaeetus leucocephalus)*	Delisted		
White-tailed Hawk *(Buteo albicaudatus)*	-		
Loggerhead Shrike *(Lanius ludovicianus)*	-	Observed in NBS	

Notes
* Species and Status list obtained from FWS (2008).
\- Not presently or historically listed as Threatened or Endangered by the FWS.
^ Population in proximity to the Freeport LNG not-listed by FWS.

a/ Includes all areas with herbaceous upland and wetland vegetation regardless of ongoing land management practices.
b/ Includes all areas with shrub-shrub upland and wetland vegetation regardless of ongoing land management practices (mowing, cattle grazing, etc.).
c/ Although no forested areas are present, several isolated individual trees are located within the construction workspace at the Pretreatment Plant site.

Much of the vegetated land in and around the area is previously disturbed and/or currently maintained by mowing and other land management practices that reduce nesting habitat value. The undisturbed areas contain higher quality nesting habitat which would be more attractive to breeding bird species.

4.5.3.1 Impacts and Mitigation on Migratory Birds

Liquefaction Project

Many migratory bird species and nocturnal birds use natural light from the sun, moon, and stars for navigation. Artificial light sources can hide natural light sources, having unknown effects on population levels. Fatalities to avian species, due to artificial light, are well documented. Avian fatalities are associated with attraction to light sources, especially in low light, fog, and when there is a low cloud ceiling (Orr *et al.*, 2013). To address this concern, Freeport LNG conducted a four-year bird-strike study at the Quintana Island terminal, which occurred during both construction and operation of the Phase I terminal facilities, focusing on the two LNG storage tanks, air tower, LNG dock unloading arms, and installed power lines. The results of this four-year study indicate that seven bird strikes were due to the facility and appurtenant structures. None of birds struck were migratory BCCs. Based on the results of this study and the similar nature of the proposed Project components to those previously studied, bird strikes into Liquefaction Project components would likely be rare. The results of the study indicate that these structures do not pose a significant potential for bird strikes.

To help address concerns about the potential for the Projects to impact migratory birds, Freeport LNG has proposed the following mitigation measures 1) crossing major waterbodies and an extensive emergent wetland using the HDD method; 2) avoiding vegetation clearing during the peak nesting season (March 1 through May 15) and summer/fall migration period (July 15 through October 31); and 3) conducting construction and restoration activities in accordance with Freeport LNG's Procedures.

In addition to the mitigation above, Freeport LNG has developed a draft Facility Lighting Design Plan (FLDP), which would be finalized upon further completion of facility design. The FLDP limits plant lighting to the illumination of paths, roadways, work surfaces, and process equipment while minimizing stray lighting onto surfaces beyond the plant boundary. Freeport LNG proposes to install and use only the minimum required light for safe and efficient operation of the facility; and employ the use of "Full cut-off" or "fully shielded" lighting to minimize direct glare, and prevent upward throw of light. In addition, the FLDP calls for the use of lighting timers and motion detectors to minimize light, and in all cases positioning lighting in a manner so as not to be obtrusive to the natural environment surrounding the facility.

The FWS had concerns over the potential of overhead power lines to create threats of avian collision and electrocution and requested that we look at an alternative of using underground power lines instead of overhead lines. Approximately 1/2 of the 4 miles of aboveground power lines are an upgrade of the existing line. As only 2 miles of new lines would be constructed, the potential to have a significant impact on avian species is minimal. Because the four-year bird-strike study at the Quintana Island terminal indicated that power lines and other facilities at that location posed only a minor threat to birds, the power lines proposed for the Projects are not expected to cause any significant impact on birds. However, because of the value of the area to migratory birds, **we recommend that**:

> **Prior to construction, Freeport LNG should incorporate the FWS Avian Protection Plan Guidelines[15] into the design for the proposed 2.93-mile-long 138 kV line to the Liquefaction Plant, and the 1.98 mile 138 kV to the Pretreatment Plant.**

Based on Freeport LNG's field surveys, agency input on concerns with avian impacts, our recommendations, and proposed mitigation to minimize impacts, the impacts of the Liquefaction Project on migratory and non-migratory birds are expected to be minor.

Phase II Modification Project

There would be no direct impacts (such as loss of habitat) to the NBS or Xeriscape Park that would affect migratory birds. Short-term impacts such as construction noise, increased traffic, and dust could potentially deter some birds from using the NBS or Xeriscape Park during construction. There would be no construction on the Gulf side of the levee in this area; therefore, no impacts on the Quintana NBS are anticipated from Project activities.

Freeport LNG conducted a study of avian species at the Quintana NBS and Xeriscape Park between May 2004 and June 2009. This study revealed that pre- and post-construction environments at the Quintana Island terminal did not affect species diversity or abundance. After construction, avian species continued to utilize the same habitats at both the Quintana NBS and Xeriscape Park. Based on these findings and the presence of the existing 21-foot-high storm levee located between the Liquefaction Plant site and the Quintana NBS and Xeriscape Park, noise associated with the Projects would not result in significant impacts on migratory birds.

Based on the limited impacts described above and proposed mitigation, the Phase II Modification Project would have a negligible impacts on migratory birds.

4.5.4 Aquatic Resources

The Gulf of Mexico and its adjoining waters offer a wide range of habitats, including coastal marshes, mangrove swamps, sea-grass beds, coral reefs, offshore banks, and non-vegetated water bottoms. Approximately 38 percent of Gulf waters are in shallow intertidal areas, 42 percent are on the continental shelf (less than 650 feet deep) and continental slope (between 650 feet and 9,840 feet deep), and 20 percent are in abyssal areas (over 9,840 feet deep) (USEPA, 2011). This diversity of habitat types, over an area of approximately 600,000 square miles, promotes a similar diversity of fish species and fishery resources, each with its own patterns of spatiotemporal distribution and abundance.

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[15] The Avian Power Plan Guidelines can be accessed at the link below. Additional references to this document in the draft EIS contain hyperlinks to allow access to this document.
: http://www.aplic.org/uploads/files/2634/APPguidelines_final-draft_Aprl2005.pdf.

Fisheries within the Gulf are some of the most productive in the world: In 2010, the commercial fish and shellfish harvest from the five Gulf States was approximately 1.3 billion pounds, representing almost 16 percent of the total annual domestic landings in the U.S. In Texas, the 2010 commercial fish and shellfish harvest was approximately 90 million pounds (National Marine Fisheries Service [NOAA Fisheries], 2011). In the same year, about 1,250,000 recreational fishing trips were made off the Texas Gulf coast (NOAA Fisheries, 2012).

Nearly all species significantly contributing to the Gulf's commercial and recreational catches are estuarine dependent. With the exception of such species as the eastern oyster (*Crassostrea virginica*) and speckled trout (*Cynoscion nebulosus*), most leave the estuaries as juveniles or sub-adults and spawn at sea after becoming reproductive adults. The eggs of the majority of these species hatch in the waters of the open Gulf and the developing larvae become part of the offshore planktonic community. Under the influence of tides, currents, and winds, the young eventually arrive at the estuarine nursery grounds where they feed, grow, and mature prior to migrating out to sea to repeat the spawning process.

With respect to local fisheries and aquatic habitats, the area of the Liquefaction Project and Phase II Modification Project can be divided into marine (tidal), estuarine (tidal), and inland freshwater (non-tidal) areas. The Quintana Island terminal, which encompasses a portion of the Liquefaction Project and the entirety of the Phase II Modification Project, is situated close to the marine coastal waters of the Gulf, while two waterbodies (ICW and FHC) that fringe the site are part of the Brazos River Estuary system. The Brazos River Estuary includes the tidally influenced wetlands and waterbodies that predominate along the most southerly 6 miles of the proposed Pipeline/Utility Line System for the Liquefaction Project, closest to the terminal. Freshwater wetlands and waterbodies are more prevalent in the northern sector of the route system beyond Oyster Creek at MP 5.63(A); and they also characterize the Pretreatment Plant site of the Liquefaction Project on the west side of the Velasco Levee, where the levee itself provides a physical barrier from estuarine tidal influences to the east. An overview of the Liquefaction Project and Phase II Modification Project, in relation to the waterbodies noted above is shown in figures D-1 to D-3 in appendix D.

4.5.4.1 Liquefaction Project

Liquefaction Plant

Quintana Island is fringed by the open waters of the Gulf to the south, the ICW to the north, the Brazos River to the west, and the FHC to the east[16] (see figure D-1 in appendix D). The terminal site is located at the junction of the ICW and the FHC. The inland waters in the vicinity of the terminal are considered part of the Brazos River estuary which, based on mapping developed in 1998 by the NOAA /National Oceanic Survey (NOAA/NOS) and the Gulf of Mexico Fishery Management Council (GMFMC) (Center for Coastal Monitoring and Assessment [CCMA], 2011), encompasses the ICW and the tidal sections of various rivers, creeks, dredged waterways, wetlands, and associated lentic waterbodies along an approximately 24-mile-long section of

[16] Compass directions provided for Quintana Island and the Terminal correspond with "Plant North", etc., where the Terminal site boundary along the ICW is considered the northern site boundary.

coastline four miles east to 20 miles west of the FHC. The ICW separates Quintana Island and Follet's Island from the mainland of Brazoria County. The two islands are bisected by the FHC and fringed by the open waters of the Gulf to the south and the ICW to the north.

Due to the salinity shifts and high suspended sediment levels within estuarine ecosystems, relatively few species are permanent residents but a large number of species can migrate through estuaries to and from spawning habitat. Similarly, many species utilize estuaries for spawning or nursery habitat due to the abundant food supply and general absence of marine predators. However, the Brazos River estuary is atypical of most estuaries, including others along the Texas coastline (*e.g.*, Galveston Bay to the east and Matagorda Bay to the west), because it has no bay system; instead, it is composed solely of the rivers, creeks, dredged waterways, wetlands, and associated lentic waterbodies noted above. Estuarine bays would typically support much more diverse, extensive habitat and fishery resources.

In a study for the Estuarine Living Marine Resources Program, Pattillo *et al*., (1997) classifies the Brazos River estuary as "tidal fresh zone" and "mixing zone", indicating the varying salinity of the water in this area. Reflecting this salinity profile, local fisheries are classified as either estuarine or marine. Individual fisheries can have commercial and/or recreational significance as discussed below.

Table 4.5.4-1 includes a description of representative commercial and recreational shellfish and finfish species potentially occurring in the regional vicinity of the Quintana Island terminal. Those species with a fishery classification of "estuarine" commonly occur in inshore waters close to the terminal site, whereas those species with a fishery classification of "coastal migratory pelagic, marine" or "reef, marine" are characteristically found further offshore in deeper water.

Commercial fisheries tend to be focused offshore; recreational fisheries involve both offshore and near-shore activities; the latter including land-based fishing from the FHC jetties. While no site-specific data are available for the Brazos River Estuary, the most important commercially harvested species in the nearest estuarine waters for which data are available typically include the species listed in table 4.5.4-1.

Other than species with significant commercial or recreational significance, the general fish assemblage in the vicinity of the terminal is likely to include species such as American eel (*Anguilla rostrata*), southern stingray (*Dasyatis americana*), Gulf killifish (*Fundulus grandis*), saltmarsh topminnow (*Fundulus jenkinsi*), sailfin molly (*Poecilia latipinna*), Gulf pipefish (*Syngnathus scovelli*), and inshore lizardfish (*Synodus foetens*) (Texas Gulf Coast Fishing, 2012).

Table 4.5.4-1

Representative Commercial and Recreational Shellfish and Finfish Species Potentially Occurring in the Vicinity of the Quintana Island Terminal

Common Name	Scientific Name	Fishery Classification
Shellfish		
Blue crab	*Callinectes sapidus*	estuarine
Brown shrimp	*Farfantepenaeus aztecus*	estuarine
White shrimp	*Litopenaeus setiferus*	estuarine
Stone crab	*Menippe adina*	estuarine
Finfish		
Sheepshead	*Archosargus probatocephalus*	estuarine
Gafftopsail catfish	*Bagre marinus*	estuarine
Sand seatrout	*Cynoscion arenarius*	estuarine
Speckled trout	*Cynoscion nebulosus*	estuarine
Gray snapper	*Lutjanus griseus*	estuarine
Striped mullet	*Mugil cephalus*	estuarine
Southern flounder	*Paralichthys lethostigma*	estuarine
Black drum	*Pogonias cromis*	estuarine
Red drum	*Sciaenops ocellatus*	estuarine
Dolphin	*Coryphaena hippurus*	coastal migratory pelagic, marine
Cobia	*Rachycentron canadum*	coastal migratory pelagic, marine
King mackerel	*Scomberomorus cavalla*	coastal migratory pelagic, marine
Spanish mackerel	*Scomberomorus maculatus*	coastal migratory pelagic, marine
Almaco jack	*Seriola rivoliana*	coastal migratory pelagic, marine
Red snapper	*Lutjanus campechanus*	reef, marine
Gag grouper	*Mycteroperca microlepis*	reef, marine
Scamp grouper	*Mycteroperca phenax*	reef, marine
Greater amberjack	*Seriola dumerili*	reef, marine
Lesser amberjack	*Seriola fasciata*	reef, marine

Source: Pattillo *et al*., 1997; Nelson *et al*., 1992; TPWD, 1975

Impacts and Mitigation

Potential fishery resources and habitat impacts that could occur during construction of the Liquefaction Project at the terminal site would include those associated with installation of a new aggregate barge dock, installation of a new construction dock, and installation of a new firewater intake structure. The new aggregate barge dock would be located on the south shore of the ICW near the northwest corner of the Liquefaction Plant site. The firewater intake structure would be located on the south shore of the ICW adjacent to the new construction dock. The locations of the docks and firewater intake structure are shown in figure 1-2.

Existing offshore conditions at the locations of the two docks and the firewater intake structure are characterized by soft benthic sediments, high turbidity, and a lack of submerged aquatic vegetation (SAV). The shoreline is narrow in the vicinity of the proposed new construction dock and the firewater intake structure. The narrow shoreline in the vicinity of the proposed new construction dock abuts the levee wall of the former DMPA on the west side of the terminal and the firewater intake structure is at the site of a former boat ramp. The *Spartina* beds that are found at other locations along the terminal shoreline are not present in the vicinity of the construction dock or firewater intake structure sites.

The new construction dock would be 300-foot-long by 75-foot-wide and would extend over both shoreline and open water, covering an area of 0.5 acre. Some shoreline disturbance and off-shore dredging would be necessary to install the platform, which would be supported on piles. Likewise, installation of the 50-foot-long by 20-foot-wide pile-mounted concrete platform for the firewater intake structure would require both shoreline and off-shore material removal, as would the aggregate barge dock. The aggregate barge dock consists of four 48-inch-diameter steel monopoles, which would be installed in the water channel approximately 80 feet from the existing southern shoreline. The dock platform would be a 100-foot-long by 30-foot-wide crane barge, covering an area of 0.07 acre and held in position by steel cables affixed to the monopiles, which would be located shoreward of the barge. The new dock would be a permanent structure which would create additional hard substrate areas allowing for the growth of attached organisms, and would also provide a three-dimensional structure to be used by some species for refuge.

The impacts on biota from dredging and dredge material placement include interference with respiration, feeding, and alteration of habitat suitability. Suspended particles can physically clog breathing and feeding organs or can result in lowered oxygen levels through increases in chemical oxygen demand. As suspended sediments settle out of the water column, they can smother immobile fish larvae and eggs and benthic invertebrate. Other potential effects of construction include temporary interruption of fish and invertebrate movement in and out of the estuary either during development changes or during foraging. Construction may cause temporary emigration of fish populations from the immediate area in order to avoid areas of elevated suspended sediments. However, it is unlikely that relocation or disrupted migration would significantly affect fish populations because construction activities are expected to be short-term and localized. Freeport LNG’s Procedures would be implemented to minimize migration of sediments, and Freeport LNG would follow the turbidity control measures specified in its Dredging Plan (see section 4.3.2).

In addition, the USACE performs periodic maintenance dredging of the ICW. During years when dredging is not performed, the ICW still has a high sediment load. However, high shoaling rates occur locally and sediments are expected to fall out rapidly after resuspension. The effects of resuspension, including increased turbidity, would be limited to the period during and immediately following dredging. Numerous studies indicate that dredge-induced turbidity plumes are generally localized, spreading less than a thousand meters from their sources and dissipating to ambient water quality within several hours after dredging is completed (Higgins *et al.*, 2004). Figure 4.3.2-1 shows the worst-case scenario turbidity impacts up to 1,000 meters from the dredging locations. The information shows the total size of the dredging plume based on this estimate would be 435 acres.

Concern was raised regarding impacts on oyster beds along the ICW during the comment period of the Pre-Filing Process. Potential impacts on oysters would be similar to those described above and are associated with sedimentation and alteration of habitat. As proposed, the Liquefaction Project would impact less than one acre of aquatic habitat along the shoreline of the ICW, although the turbidity plume may affect other areas of aquatic habitat. Shoreline impacts would be addressed in Freeport LNG's *Wetland Restoration and Monitoring Plan*, which would be developed in coordination with the FERC, USACE, and other federal and state resource agencies prior to construction. In addition, implementation of Freeport LNG's *Wetland Mitigation Plan* during construction of the Phase I Project (see FERC Docket No. CP03-75-000 and Department of the Army Permit SWG-2003-02110) resulted in an increase of the oyster population through the use of rock and wire gabions to contain soil and *Spartina* plantings along the ICW. Therefore, although construction activities would have some temporary impacts, we anticipate that the mitigation measures may have a positive impact on oyster populations along the ICW following construction.

<u>Ballast Water Discharges</u>

The EAP-EA discusses the effects of ballast water discharges on four ambient water quality parameters (temperature, pH, dissolved oxygen [DO], and salinity) and the consequent impacts on aquatic biota. It indicates that temperature and pH differentials between ballast water and ambient water would be insignificant, while the low DO and high salinity levels of ballast water are also found in the deeper zones in the FHC and the berthing area, where relatively dense saltwater from the Gulf characteristically underlies freshwater from inland sources. The EAP-EA recognizes that the resident species at this location, which are all euryhaline (able to live in waters with a wide range of salinity), are well adapted to natural spatiotemporal variation in salinity and oxygen levels. The EAP-EA concludes that this osmotic adaptability and the ability to move over a short distance to more suitable conditions precludes these species from potentially deleterious impacts associated with ballast water discharges.

While the number of LNG carrier visits to the terminal as a result of the Liquefaction Project would likely be much higher than the eight visits estimated in the EAP-EA, the above-described scientific rationale for preclusion of deleterious impacts is equally valid. Moreover, during both export and re-export of LNG, Freeport LNG would discharge all ballast water under federal oversight and in accordance with federal regulations. With respect to the latter, the EAP-EA states that "Under these requirements, to the maximum extent practicable and as safety considerations allow, vessels must implement strategies to prevent the unintentional introduction and spread of exotic aquatic nuisance species in U.S. waters. These strategies include retaining ballast water on board, minimizing uptake or discharge at certain times or locations, and exchanging ballast water from coastal sources with mid-ocean seawater at least 200 nautical miles from any coast, prior to release at port."

USCG regulations require that all vessels equipped with ballast water tanks which enter or operate in U.S. waters maintain a ballast water management plan that is specific for that vessel and assigns responsibility to the master or appropriate official to understand and execute the ballast water management strategy for that vessel. Under these requirements, vessels must implement strategies to prevent the spread of exotic aquatic nuisance species in U.S. waters. Examples of these strategies include retaining ballast water on board, minimizing discharge or uptake at certain times and locations, and exchanging ballast water with mid-ocean seawater. Vessels that have operated outside of the U.S. Exclusive Economic Zone (EEZ) must either retain their ballast water on board or undergo a mid-ocean (greater than 200 nautical miles from shore/water depth greater than 2,000 meters) Ballast Water Exchange (BWE) in accordance with applicable regulations. Applicable U.S. laws, regulations, and policy documents related to ballast water include the following:

- Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) that established a broad federal program "to prevent introduction of and to control the spread of introduced aquatic nuisance species…" FWS, USCG, USEPA, USACE, and NOAA all were assigned responsibilities.

- National Invasive Species Act of 1996 (NISA) that reauthorized and amended the NANPCA because "Nonindigenous invasive species have become established throughout the waters of the U.S. and are causing economic and ecological degradation to the affected near shore regions." The Secretary of Transportation was charged with developing national guidelines to prevent import of invasive species from ballast water of commercial vessels, primarily through mid-ocean BWE, unless the exchange threatens the safety or stability of the vessel, its crew, or its passengers.

- National Aquatic Invasive Species Act of 2003 (NAISA), amended in 2005 and again in 2007, established a mandatory National Ballast Water Management Program. The primary requirements established under NAISA are: 1) all ships operating in U.S. waters are required to have on board an Aquatic Invasive Species Management Plan; 2) the USCG was made responsible for the development of standards for mid-ocean BWE and ballast water treatment for vessels operating outside of the EEZ; and 3) implementing the control measures and available technology related to ballast water treatment.

- National Ballast Water Management Program originally established by NANPCA and further amended by NISA 1996 and NAISA 2003 that made the ballast water management program mandatory, including BWE with reporting to the USCG.

- Shipboard Technology Evaluation Program, a program authorized under the USCG Ballast Water Management Program and designed to facilitate the development of "effective ballast water treatment technologies, through experimental systems, thus creating more options for vessel owners seeking alternatives to BWE."

- Navigation and Vessel Inspection Circular 07-04, Change 1, a program developed by the USCG for the management and enforcement of ballast water discharge into U.S. ports and harbors.

- Vessels Carrying Oil, Noxious Liquid Substances. Garbage, Municipal or Commercial Waste, and Ballast Water, implementing regulations for the Act to Prevent of Pollution from Ships of 1980, which applies to all U.S.-flagged ships anywhere in the world and to all foreign-flagged vessels operating in navigable waters of the United States or while at port under U.S. jurisdiction.

Currently, the only approved ballast water treatment strategy is mandatory BWE for all vessels traveling beyond the EEZ. Correctly executed BWE can replace up to 99 percent of the volume of the initial coast water ballast water uptake with ocean water, thereby removing over 90 percent of coastal zooplankton within the ballast tanks (Minton *et al.*, 2005, Ruiz and Smith, 2005).

Vessels can replace foreign ballast water using the following two methods:

- Sequential Exchange Method - the ballasted tank is emptied by pumps until the pumps lose suction and then refilled via gravitation and pumping of mid-ocean water. With this method, 100 percent of ballast water is emptied from the tank before refilling.
- Flow-Through Method - mid-ocean water is pumped into a full tank or hold from below while the existing coastal water is forced out of an opening at the top. The USCG requires that three times the ballast tank capacity must be pumped out using this method.

Correspondence from the NOAA Fisheries during development of the EAP-EA (NOAA Fisheries, 2008a; NOAA Fisheries, 2008b) indicated that the agency had no specific concerns relating to ballast water discharges. In addition we did not receive any comments from NOAA Fisheries regarding ballast water.

Based on the above-described scientific rationale and adherence to applicable federal regulations, we determined that ballast water discharges for the Liquefaction Project would not present a significant impact on aquatic resources in the region.

Pretreatment Plant Site

Whereas the majority of waterbodies and wetlands within the Liquefaction Project area are within the region's estuarine zone, those adjacent to or within the Pretreatment Plant site are freshwater in nature. Construction of the Velasco Levee, which parallels the eastern border of the site, separated these latter wetland and waterbody features from the estuarine environment to the east, and localized drainage inflows from surface runoff and percolation have evidently promoted a transition to freshwater conditions through time.

Based on map review and field surveys, the waterbody/wetland complex consisting of Horseshoe Lake, the western Velasco Ditch, and two associated drainage channels through palustrine emergent wetlands, are the primary features supporting potential fisheries habitat on or in the vicinity of the Pretreatment Plant site (see figure D-2 in appendix D).

Public fishing access to Horseshoe Lake is available west of the Pretreatment Plant site. According to a local fishing guide website (Hookandbullet.com, 2012), fish commonly caught include bigmouth buffalo (*Ictiobus cypinellus*), bluegill (*Lepomis macrochirus*), blue catfish (*Ictalurus furcatus*), bowfin (*Amia calva*), and bullhead (*Ameiurus* sp.). All these species thrive in shallow backwater lakes and slow moving water channels with dense macrophytic vegetation, high levels of benthic detritus and turbidity, and relatively low DO. These conditions typify Horseshoe Lake, the western Velasco Ditch, and the interconnecting drainage channel. The fish species found in Horseshoe Lake are all warm water forage species found in freshwater conditions and none are considered ecologically sensitive.

Impacts and Mitigation

The waterbody/wetland complex consisting of Horseshoe Lake, the western Velasco Ditch, and two associated drainage channels through palustrine emergent wetlands are the primary features supporting potential fisheries habitat on or in the vicinity of the Pretreatment Plant site (see figure D-2 in appendix D). The small man-made drainage channels that cross the site and drain to the central excavation pit are unlikely to support sustainable fisheries due to their ephemeral nature and the steep drop to the pit below, which would prevent upstream access. Moreover, both the central and northwestern excavation pits are relatively recent features with no hydraulic connection to any downstream waterbody that could constitute a source of aquatic biota and ponded water in each pit has been periodically pumped out to allow excavation.

Construction impacts on fishery resources are most likely to occur where the operational footprint and/or peripheral temporary workspace directly overlap Horseshoe Lake, the western Velasco Ditch, and the two associated drainage channels through wetlands. In this regard, the southern extremity of the Pretreatment Plant's main operational footprint extends across a small portion of Horseshoe Lake and the interconnecting drainage channel to the western Velasco Ditch, while the other drainage channel that feeds directly into the western Velasco Ditch is crossed by the northeast corner of the footprint. In addition, disturbance would occur in the western Velasco Ditch due to culvert installation for the two short access roads between the Pretreatment Plant and CR 690. While the proposed Pretreatment Plant have been sited where possible to avoid waterbody and wetland impacts, development at the locations described here would be associated with approximately 5.4 acres of temporary impacts and 7.5 acres of permanent impacts in potential freshwater fisheries habitat. This potential freshwater habitat includes 1.3 acres of open water and 11.6 acres of palustrine wetlands adjacent to open water. Of the 1.3 acres of potential open water habitat, 0.7 acre would be temporarily affected while 0.6 acre would be permanently affected. Of the 11.6 acres of potential freshwater wetland fisheries habitat, 4.7 acres would be temporarily affected and 6.9 acres would be permanently affected. Permanent impacts would result from placement of fill, redirection of drainage channel segments, and road culvert installation.

Temporary construction impacts within Horseshoe Lake, the western Velasco Ditch, and the two drainage channels described above would be associated with vegetation clearing and mechanical disturbance of benthic material during excavation and grading at the southern and northern edges of the Pretreatment Plant's operational footprint and, in the case of the western Velasco Ditch, during road culvert installation. Such in-stream activities, together with surface runoff and erosion from adjacent work areas, can temporarily increase sediment suspension and deposition with a resultant increase in turbidity and decrease in soluble oxygen levels. If banks are not stabilized and revegetated properly, soil erosion associated with surface runoff and bank sloughing can result in in-stream sediment deposition after construction is completed.

Physical disruption of vegetation, substrate, and the water column can cause stress, injury, mortality, or migration in benthic organisms and fish. A reduction in foraging success resulting from the loss of benthic species during construction can impact fisheries. Long-term community changes can be associated with vegetation removal, physical or chemical alteration of the substrate, or other permanent habitat modifications.

Increases in water turbidity associated with the generation of suspended sediments may adversely affect biological activity and processes, including photosynthesis, both in the water column and in benthic areas where the suspended sediments resettle. Before sediments resettle, they can be transported from the point of origin by currents, thereby increasing turbidity and sedimentation farther afield.

Although some sedimentation and turbidity would be experienced in Horseshoe Lake, the western Velasco Ditch, and the two associated drainage channels during construction, population-level impacts on fisheries and other aquatic life are expected to be minor, short-term, and localized, based on the expanse of each waterbody and the ready availability of similar habitat beyond the construction sites. These features would allow displaced fish and other fauna to relocate temporarily elsewhere and disturbed vegetation would be reestablished from peripheral stock. As discussed above, those species that make up the existing fish community are known to be tolerant of relatively high turbidity and low DO. Given the sheltered essentially lentic nature of these waterbodies, sediment transportation by currents is not expected to be significant. Temporary impacts would be limited to the construction period and the reestablishment of vegetation is anticipated within one to two growing seasons. Impacts would be minimized by adherence to Freeport LNG's Procedures and would not be significant.

Pipeline/Utility Line System

The inland waters in the vicinity of the terminal and on most of the proposed Pipeline/Utility Line System are considered part of the Brazos River Estuary which, as previously mentioned, encompasses the ICW and the tidal sections of various rivers, creeks, dredged waterways, wetlands, and associated lentic waterbodies along an approximately 24-mile-long section of coastline 4 miles east to 20 miles west of the FHC.

The proposed Pipeline/Utility Line System is located in the Western Gulf Coastal Plain, which runs along the Texas coastline from the Louisiana border to the southernmost tip of Texas. This ecoregion is characterized by flat plains in which streams are typically sluggish and flow over sand and silt substrates. Turbidity is common and canopy cover is variable (Linam *et al*., 2002).

Bluegill, channel catfish (*Ictalurus punctatus*), green sunfish (*Lepomis cyanellus*), longear sunfish (*Lepomis megalotis*), red shiner (*Cyprinella lutrensis*), and western mosquito fish (*Gambusia affinis*) are common species found in this area. In the Brazos River drainage, other common species include bullhead minnow (*Pimephales vigilax*) and gizzard shad (*Dorosoma cepedianum*). The fish community at this location and further south consists primarily of common species (*e.g.*, Gulf killifish, sailfin molly, saltmarsh topminnow, sheepshead, silver perch (*Bairdiella chrysoura*), southern flounder, spotted seatrout, and striped mullet (*Mugil cephalus*) that are adapted to the higher salinities associated with estuarine conditions.

The crossing locations of the ICW and FHC are in relatively close proximity to the Gulf and are therefore likely to support fish communities that exhibit a combination of estuarine and marine characteristics.

Impacts and Mitigation

Impacts on open water, estuarine wetland, and unvegetated shallow water, all of which provide essential forage and refuge habitat for many coastal fishery species, may result from construction and operation of the proposed Pipeline/Utility Line System. Details regarding locations, characteristics, and potential impacts for waterbodies and wetlands are provided in sections 4.3.2, and 4.3.5, respectively.

In total, the proposed Pipeline/Utility Line System crosses five perennial waterbodies (FHC, ICW, Oyster Creek, and the eastern and western Velasco Levee ditches) and four intermittent waterbodies (two unnamed tributaries to Salt Bayou and two unnamed drainage channels). Additionally, the route also crosses several large estuarine wetland complexes and smaller palustrine wetlands. The route for the overhead electric line at the Pretreatment Plant crosses one perennial waterbody (Horseshoe Lake). The intermittent waterbodies are isolated from tidal flow and only provide potential fisheries habitat when flooded during wet times of the year, whereas the perennial waterbodies are tidally influenced and provide habitat for fisheries year-round. Waterbody and wetland crossing locations are identified in figure D-3 (a-h) in appendix D.

Pipeline construction across waterbodies can result in similar environmental impacts on those discussed in the previous section for the Pretreatment Plant site. Impacts on fisheries and benthic invertebrates during underground pipeline construction would be limited primarily to the period of active construction and would be dependent on construction season, construction duration, and crossing methods within wetlands and waterbodies.

Increased sedimentation and turbidity resulting from construction of the pipeline would have the greatest potential to adversely affect fishery resources. Sedimentation can bury fish eggs, while turbidity affects juvenile and adult fish by reducing oxygen uptake by the gills. Because most of the fish species spawn offshore, increased sedimentation from pipeline construction should not affect nesting sites where eggs and young fry concentrate. Studies have indicated that in-stream turbidity levels increase during construction, but decrease rapidly after construction activities are completed (Vinkour and Shubert, 1987; Blais and Simpson, 1997).

Increases in water turbidity caused by the generation of suspended sediments through trench excavation and lateral placement of spoil may also adversely affect biological activity and processes, including photosynthesis, both in the water column and in benthic areas where the suspended sediments resettle. Before sediments resettle, they can be transported from the point of origin by currents, thereby increasing turbidity and sedimentation farther afield. Freeport LNG would follow the Freeport LNG's Procedures to minimize migration of sediments from the construction areas. In addition, trench spoils would be stored on or above the stream banks at least 10 feet from the water's edge and would have silt fence, hay bales, or other erosion control devices installed to minimize the potential for sediment-laden water to enter the stream. All staging and ATWS areas would be located at least 50 feet back from the water's edge where topographic conditions permit (unless otherwise permitted) with the exception of the ATWS identified in table 2.4.1-1. These setback distances minimize the potential for erosion and sedimentation along the stream banks.

In addition, trench excavation and the lateral placement of spoil can directly affect the benthic community in the immediate vicinity through physical disruption of the existing substrate and consequent stress, injury, mortality, or migration. Impacts on fisheries can be associated with a reduction in foraging success resulting from the loss of benthic species during construction. Indirect impacts can include long-term habitat modification and consequent community changes through physical or chemical alteration of the substrate.

Impacts on surface water quality can result from alteration of the stream banks and removal of riparian vegetation required at open-cut stream crossings. Stream bank and shoreline vegetation and undercut banks provide important cover for fish. Thus, fish that normally reside in these areas would be temporarily displaced. In addition, if stream banks are not stabilized and revegetated properly, soil erosion associated with surface runoff and bank sloughing can result in in-stream sediment deposition after construction is completed. However, these effects would be relatively minor because of the small area affected at each stream. The 50-foot setback for extra workspace areas required by the Freeport LNG's Procedures would reduce the loss of riparian vegetation and provide a vegetated buffer between the workspace and the waterbody. In addition, Freeport LNG's Procedures limit vegetation maintenance on stream banks and allow for long-term revegetation of all shoreline areas within 25 feet of the normal high water mark with native herbaceous and woody plant species, except for a 10-foot-wide corridor over the pipelines that may be maintained in an herbaceous state.

Underground crossings of the FHC, the ICW, Oyster Creek, the eastern Velasco Ditch, and the western Velasco Ditch would be accomplished by the HDD method, which would cause no disturbance to substrate or shoreline vegetation as no excavation activities would take place within or along the banks of the waterbodies. Based on limited in-water construction activity with the HDD method and previous consultations with the NOAA Fisheries for the Phase I and Phase II Projects, Freeport LNG does not expect fishery resources would be adversely modified during construction or operation of the lines beneath the FHC, the ICW, and Oyster Creek.[17]

The HDD method would also be utilized to cross an approximately 0.9-mile-long section of estuarine wetland (*e.g.*, inundated and capable of containing fisheries habitat) along the pipeline route. Though impacts on a majority of the wetland area would be completely avoided with this method, temporary work spaces would be required within wetland areas to perform the drilling activities. These temporary work spaces would result in the temporary loss of fisheries habitat through wetland fill activities. Following construction, temporarily disturbed wetlands would be restored and allowed to revegetate in accordance with Freeport LNG's Procedures. These describe measures for reestablishing wetland species and for subsequent revegetation monitoring to ensure that all disturbed areas are successfully restored.

[17] The western Velasco Ditch is not designated as EFH.

The open-cut wet trench method would be used to cross the two intermittent tributaries to Salt Bayou and the two unnamed drainage channels, whereas the push-pull method would be used to lay the pipelines and utility lines along approximately 8,507 feet of the eastern Velasco Ditch between MP 3.74(A) and MP 5.34(A). ATWS areas would be required at these crossing locations.

Prior to trenching in the eastern Velasco Ditch, one end of the water channel would be closed with a soil berm (at CR 891) and existing culverts at the other end (at Galleywax Way) would be boarded up, as was successfully done during installation of the 42-inch-diameter sendout pipeline. The trench would be excavated in the channel bed with a barge-mounted backhoe working mid-stream. Spoil from the trench would be placed in the channel adjacent to the excavated trench. Pipe joints would be welded on shore and as the pipelines are fabricated into continuous floating strings, they would be pushed or pulled through the channel, weighted as necessary, and lowered into the trench.

Although in-stream construction activities are required for the two tributaries to Salt Bayou, the two unnamed drainage channels, and the eastern Velasco Ditch, they would have only minor, temporary impacts on any local aquatic resources. As previously discussed, some related effects (*e.g.*, increased sedimentation, increased turbidity, and streambank disturbance) could have short-term, localized impacts on any fishery resources present at the time of construction. These impacts would be mitigated by adherence to Freeport LNG's Procedures, which require most in-stream work to be completed within 24 hours and stream bank stabilization to be completed within 24 hours of in-stream construction. Suspended sediment concentrations and turbidity would be expected to return to preconstruction levels soon after construction in each waterway is completed.

Overall, construction of the Pipeline/Utility Line System would result in approximately 20.8 acres of temporary in-stream impacts, associated with the eastern Velasco Ditch, the two tributaries to Salt Bayou, and the two unnamed drainage channels, as described above. In addition, this acreage includes minor temporary impacts on an unnamed pond that is within the HDD pull-back ATWS for the lateral pipelines associated with the Pretreatment Plant. Although some sedimentation and turbidity would be associated with construction disturbance in these waterbodies, population-level impacts on fisheries and other aquatic life are expected to be minor, short-term, and localized. Given the inshore, sheltered nature of the area, sediment transportation by tidal or non-tidal currents is not expected to be significant. Temporary impacts would be limited to the construction period and vegetation is anticipated to reestablish within one to two growing seasons. Thus impacts from the Pipeline/Utility Line System would only result in temporary impacts and would not be significant.

<u>Accidental Spills or Leaks of Hazardous Materials</u>

Fisheries present in the vicinity of the Terminal, Pretreatment Plant, and Pipeline/Utility Line System could be adversely affected by a spill, leak, or other release of hazardous materials during construction activities. Freeport LNG would minimize potential impacts associated with spills or leaks of hazardous materials during construction by implementing the spill prevention and response procedures in its existing SPCC Plan, with any Project-specific changes made as necessary. The SPCC Plan addresses personnel training, secondary containment design, hazardous substance storage and disposal procedures, refueling areas, spill response procedures, mitigation measures, and other measures designed to reduce or eliminate potential adverse impacts on water resources.

4.5.4.2 Summary of Impacts

Potential fishery resources and habitat impacts that could occur during construction of the Liquefaction Plant would include those associated with installation of a new aggregate barge dock, installation of a new construction dock, and installation of a new firewater intake structure. Impacts on freshwater fishery resources associated with the Pretreatment Plant include 1.3 acres of open water and 11.6 acres of palustrine wetlands adjacent to open water. Overall, construction of the Pipeline/Utility Line System would result in approximately 20.8 acres of temporary in-stream impacts. Although some sedimentation and turbidity would be associated with construction disturbance in these waterbodies, population-level impacts on fisheries and other aquatic life are expected to be minor, short-term, and localized. Impacts would be minimized through adherence to Freeport LNG's Procedure and the use of the HDD method to cross the FHC, the ICW, Oyster Creek, the eastern Velasco Ditch, and the western Velasco Ditch.

4.5.4.3 Phase II Modification Project

The existing aquatic resources at the Phase II Modification Project area, including environmental conditions and fishery types and profiles, are similar to those discussed in section 4.5.4 for the Liquefaction Project at the Quintana Island terminal site.

Impacts and Mitigation

The following activities associated with construction and operation of the Phase II Modification Project at the Quintana Island terminal site may result in impacts on fisheries: dredging of the berthing area, construction of the Phase II dock, and an accidental spill or leak of hazardous materials. Potential impacts on fisheries resources due to these activities are discussed in the sections below and are similar to those discussed for the Liquefaction Project at the Quintana Island terminal site in the previous section.

Dredging of the Berthing Area

Dredging for the Phase II dock and associated berthing area would involve the removal of approximately 1,188,000 yd^3 of material to be placed in an approved DMPA. Impacts on fisheries from dredging and dredge material placement are expected to have some minimal and short-term impacts on local fishery resources. Fine particulates would be temporarily resuspended throughout the immediate area as a result of the dredging process, which can interfere with respiration and feeding or could result in lowered oxygen levels through increases in chemical oxygen demand. Fish in the immediate vicinity of dredging activities would be expected to relocate temporarily until dredging operations have ceased. The effects of resuspension, including increased turbidity, would be limited to the period during and immediately following dredging.

Dredging activities would be conducted in accordance with both federal and state agency requirements to minimize impacts on fisheries. Freeport LNG has developed a Dredging Plan that outline details of dredging methods proposed and measures to control turbidity (see section 4.3.2).

Construction of the Phase II Dock

Construction of the Phase II dock could potentially displace individuals within the affected area and/or result in direct mortality of less mobile individuals. During construction activities, mobile species (*e.g.*, fish) would be expected to leave the vicinity. Animals displaced by construction activities are expected to relocate into similar habitats nearby. The influx and increased density of animals in some undisturbed areas caused by these dislocations could increase inter- and intra-species competition and reduce the reproductive success of animals that are not displaced by construction. However, these impacts are expected to be temporary, minor, and inconspicuous at the population level. In addition, construction of the Phase II dock would provide additional hard substrate areas on the submerged structures that would allow for the growth of attached organisms and create a three-dimensional structure which is used by some species as refuge. Freeport LNG has initiated introductory communication with the NOAA (NRG, 2011a-b) and would continue to consult with the agency as necessary during Project development.

Accidental Spills or Leaks of Hazardous Materials

Fisheries present in the vicinity of the terminal could be adversely affected by a spill, leak, or other release of hazardous materials during construction activities. Freeport LNG would minimize potential impacts associated with spills or leaks of hazardous materials during construction by implementing the spill prevention and response procedures in its existing SPCC Plan, with any Project-specific changes made as necessary.

4.5.5 Essential Fish Habitat

The MSA (Public Law 94-265 as amended through October 11, 1996) was established with several goals in mind, one of which was to promote the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined in the MSA as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

Federal agencies that authorize, fund, or undertake activities that may adversely impact EFH must consult with the NOAA Fisheries. Although absolute criteria have not been established for conducting EFH consultations, NOAA Fisheries recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as the NEPA and ESA, in order to reduce duplication and improve efficiency. Generally, the EFH consultation process includes the following steps:

1. **Notification –** The action agency should clearly state the process being used for EFH consultations (*e.g.*, incorporating EFH consultation into the EIS or RHA permit).

2. **EFH Assessment –** The action agency should prepare an EFH Assessment that includes both identification of affected EFH and an assessment of impacts. Specifically, the EFH should include: 1) a description of the proposed action; 2) an analysis of the effects (including cumulative effects) of the proposed action on EFH, the managed fish species, and major prey species; 3) the federal agency's views regarding the effects of the action on EFH; and 4) proposed mitigation, if applicable.

3. **EFH Conservation Recommendations –** After reviewing the EFH Assessment, the NOAA Fisheries would provide recommendations to the action agency regarding measures that can be taken by that agency to conserve EFH.

4. **Agency Response –** The action agency must respond to the NOAA Fisheries within 30 days of receiving NOAA Fisheries recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH.

4.5.5.1 Liquefaction Project

Between 1979 and 1987, the GMFMC prepared FMPs for seven marine groups within the Gulf: reef fish, migratory pelagic fish, red drum, shrimp, spiny lobster (*Panulirus argus*), stone crab (*Menippe adina* and *Menippe mercenaria*), and corals. Each FMP has been amended at least several times since then. One important amendment that applied to all seven FMPs occurred in 1998 and involved the identification of EFH for each group. All estuarine systems of the Gulf, including the Brazos River Estuary, are considered EFH, which is managed by the GMFMC (GMFMC, 2010).

The GMFMC (2005) designated the Brazos River Estuary as EFH for several groups of shellfish and finfish, namely red drum, reef fish and coastal migratory pelagics, shrimp, and stone crab. However, the FMP for the stone crab was repealed effective October 24, 2011 and the corresponding EFH designation no longer applies (Federal Register, 2011). The Brazos River Estuary includes those portions of the FHC, ICW, Oyster Creek, unvegetated shallow water estuarine areas, and estuarine wetlands crossed by the proposed Pipeline/Utility Line System. It does not include waterbodies on or adjoining the Pretreatment Plant site, which, as described in section 4.5.4, are freshwater in nature and by virtue of the Velasco Levee, are beyond the estuarine influences further east.

The current EFH designations described above are based in part on the previously referenced mapping developed in 1998 by the NOAA/NOS and the GMFMC, as currently accessible through CCMA. For the Brazos River Estuary, this mapping shows the presence of two species of shrimp (brown shrimp and pink shrimp [*Farfantepenaeus duorarum*]), one species in the reef fish/coastal migratory pelagics group (Spanish mackerel [*Scomberomorus maculatus*]), and red drum.

For each of the four species identified above for the Brazos River Estuary, the 1998 mapping provides relative abundance estimates by life stage (juvenile/adult) and season. According to the mapping, brown shrimp juveniles are abundant throughout the year, whereas adults are listed as not present; pink shrimp juveniles are common throughout the year, whereas adults are listed as not present; Spanish mackerel juveniles are listed as not present in winter (December to February) and rare throughout the remainder of the year, whereas adults are listed as common throughout the year; and red drum juveniles are listed as common throughout the year, whereas no data exist for adults.

Five EFH categories are considered important for various life stages of the above-listed species: mud substrates, shell reefs, estuarine water column, estuarine emergent wetlands, and SAV. All EFH categories, with the exception of shell reefs, are available within the Brazos River Estuary system, although SAV may be relatively sparsely represented. EFH used by each of the species are indicated in table 4.5.5-1 and life history descriptions are provided in the paragraphs that follow.

Table 4.5.5-1

Summary of Essential Fish Habitat Categories Potentially used by Specific Life Stages of Federally Managed Fish Species in the Liquefaction Project and Phase II Modification Project Areas

Species/Life Stage	Mud-Substrates	Shell Reefs	Estuarine Water Column	Estuarine Emergent Wetlands	Submerged Aquatic Vegetation
Brown Shrimp					
Postlarval	X	-	X	X	X
Juvenile	X	-	X	X	X
Subadult	X	-	X	X	-
Pink Shrimp					
Postlarval	X	X	X	X	X
Juvenile	X	X	X	X	X
Subadult	X	X	X	-	X
Red Drum					
Postlarval	X	-	X	X	X
Juvenile	X	-	X	X	X
Subadult	X	X	X	-	-
Adult	X	X	X	-	-
Spanish Mackerel					
Postlarval	X	-	X	X	X
Juvenile	X	-	X	X	X
Subadult	X	-	X	X	X
Adult	X	-	X	X	X

Source: GMFMC, 2010

Brown Shrimp

Brown shrimp spawn offshore in the spring and fall. Larvae tend to remain in deeper water but post-larval brown shrimp migrate to shallow vegetated estuarine habitats, reaching their destination between February and April (with another minor peak in the fall). Late post-larval and juvenile brown shrimp are most numerous in estuarine habitats in the spring and early summer, but typically are present through the fall. They prefer marsh edges and areas of submerged vegetation, habitat types that are both found in the area (GMFMC, 1981).

Pink Shrimp

Pink shrimp spawn offshore year round, with more intense spawning in the spring and fall. Larvae tend to remain in deeper water but post-larval pink shrimp migrate to shallow vegetated estuarine habitats, reaching their destination between May and December. Late post-larval and juvenile pink shrimp are most numerous in the bays and estuaries. They prefer marsh edges and areas of submerged vegetation, habitat types that are both found in the area (GMFMC, 1981).

Red Drum

Red drum is common in Gulf estuaries and can be found over various substrates including sand, mud, and oyster reefs. It can inhabit waterbodies with salinities ranging from freshwater to highly saline. The red drum spawns in deep water habitats and eggs hatch in the Gulf, usually in late summer and early fall. Larvae are subsequently transported into estuarine waterbodies where the fish mature before returning to the deeper waters of the Gulf. Larvae are most common in estuarine waters between mid-August and late November (Pattillo *et al.*, 1997). Larval, post-larval, and juvenile stages prefer marshy nursery areas that are protected from currents, have muddy substrates, and support both submergent and emergent vegetation. These conditions are offered by the emergent marsh and open water habitat within the area. Larval and post larval red drum feed primarily on copepods, whereas juveniles feed on a wider variety of macroinvertebrates. Adult red drum tend to spend more time in deeper offshore waters as they age (Pattillo *et al.*, 1997).

Spanish Mackerel

Spanish mackerel is a fast-moving surface-feeding fish that forms immense schools of similar sized individuals. Adults frequent tidal estuaries, bays, and lagoons. Spawning occurs repeatedly during a prolonged spawning season from about April until September. The prolonged period of spawning allows for a wider distribution of larvae, with the greatest larval abundance of Spanish mackerel in the eastern Gulf. Spanish mackerel spawn close to shore and in shallow waters; larvae have been found in nearshore shallow water environments of the Gulf from Florida to south Texas (GMFMC and South Atlantic Management Fishery Council [SAFMC], 1983). Juveniles are found in the beach surf zone, occasionally in estuaries among clean sand substrates, and offshore, and prefer marine salinity and generally are not considered estuarine dependent.

Impacts and Mitigation

NOAA Fisheries consultation relating to aquatic resources, including EFH, was completed on January 13, 2004 (NOAA Fisheries, 2004) for the Phase I Project and on November 15, 2006 (FERC, 2006) for the Phase II Project. Species and habitat impacts reviewed by the NOAA Fisheries for both projects included those associated with LNG vessel dock construction, dredging within the berthing area, and construction dock operation during site development. NOAA Fisheries previously concluded that, with the implementation of appropriate and previously defined mitigation measures, the dredging involved in both the Phase I and Phase II Projects would have no adverse effects on the aquatic resources in question (see discussion of mitigation further below in this section). We are forwarding this draft EIS to NOAA Fisheries as our EFH assessment for the Projects.

Offshore construction at the Quintana Island terminal site could result in impacts including resuspension of sediments and interruption of invertebrate and fish movement. Suspended particles would temporarily increase turbidity and decrease oxygen levels, and have the potential to physically clog breathing and feeding organs and smother immobile fish eggs and larvae and benthic invertebrates. However, these impacts would be limited to the period during and immediately following construction. Furthermore, the conversion of approximately 6.5 acres of land into water bottom through the dredging required for LNG ship dock would add a small amount of habitat for the use of local fish and macroinvertebrate populations. The new dock would also create a hard substrate for the growth of attached organisms and a three-dimensional structure to be used by some species as refuge. In addition, no wetlands at the Quintana Island terminal site, considered part of the EFH designated for the Brazos River Estuary, would be affected by construction of the Liquefaction Plant except minor impacts due to dredging turbidity. Given the above information, this work is not expected to have a significant impact on EFH.

As described in section 4.5.4, waterbodies and wetlands on and adjoining the Pretreatment Plant site are freshwater in nature and by virtue of the Velasco Levee, are beyond the estuarine influences further east. Therefore, EFH designated in the Brazos River estuary does not include these areas, and any waterbody or wetland impacts caused by construction and operation of the Pretreatment Plant would not affect EFH.

Construction and restoration activities associated with the pipeline portion of the Liquefaction Project would not have any adverse impacts on EFH, since underground crossings of the FHC, the ICW, Oyster Creek, the eastern Velasco Ditch, and the western Velasco Ditch would be accomplished by the HDD method. HDD would cause no disturbance to substrate or shoreline vegetation as no excavation activities would take place within or along the banks of the waterbodies. In addition, other stream crossing areas trenched for pipeline construction through the open-cut wet trench and push-pull methods would be restored. In-stream trenching could result in increased turbidity and decreased oxygen levels, in addition to sediment deposition caused by soil erosion and bank sloughing upon alteration of stream banks and removal of riparian vegetation. Sedimentation could directly interfere with biotas ability to breathe and feed, and could bury immobile fish eggs, while turbidity could reduce oxygen uptake by the gills of juvenile and adult fish. Juvenile and adult fish are unlikely to be affected, however, as they have the ability and behavioral tendency to avoid disturbance. In addition, these impacts are expected to only occur during and immediately following construction. Therefore, based on limited in-water construction activity and previous consultations with the NOAA Fisheries for the Phase I and Phase II Projects, as discussed above, we do not expect that any designated EFH would be adversely modified during construction or operation of the Pipeline/Utility Line System beneath the FHC, the ICW, Oyster Creek, and the eastern Velasco Ditch.[18]

[18] The western Velasco Ditch is not designated as EFH.

As described in section 4.3.5.1, wetland impacts would occur only on a temporary basis as a result of construction and operation of the Pipeline/Utility Line System. In addition, an approximately 0.9-mile long section of estuarine wetland along the pipeline route would be avoided using the HDD method. Table 4.3.5-3 reveals that no wetland impacts along the pipeline route, within EFH, are categorized as permanent. Impacts on wetland and stream resources would include temporary loss of vegetation, increased turbidity and suspended solids, temporary blockage of access to these areas by the placement of spoil, and some potential mortality of EFH species. However, these effects would only occur for a six to eight month duration as post-construction right-of-way maintenance would be in accordance with Freeport LNG's Procedures and once restored, the pipeline right-of-way should offer comparable EFH to pre-existing conditions.

Consultation with NOAA Fisheries for the Phase I and Phase II Projects did not indicate that seasonal construction windows would be necessary for these projects. NOAA Fisheries also concluded that construction activities within the ICW and the FHC would not have a significant impact on marine resources. NOAA Fisheries' primary concern was the potential impacts on marine resources located in the shallow estuarine marshes traversed by the pipeline. Freeport LNG considered these concerns regarding potential impacts on EFH associated with the Phase I and Phase II Projects when developing the Liquefaction Project and Phase II Modification Project. As such, the Liquefaction Project avoids potential impacts on marine resources located in estuarine marshes through route selection and implementation of specialized construction techniques (*i.e.,* HDD). We find that these avoidance measures would assist in achieving successful restoration of wetlands and minimize impacts on EFH.

Conclusions of the Essential Fish Habitat Assessment

After a review of the four species with designated EFH in the Brazos River Estuary, one or more life stages of these species may be affected by construction activities associated with the Liquefaction Project and Phase II Modification Project. Because construction would not cause a net loss of benthic habitat that may serve as EFH for one or more life stages of the four EFH species, no permanent impacts on habitat are expected from either of the Projects. The primary impacts on EFH would be short-term and would affect the least mobile, most vulnerable life stages of species. These impacts include short-term stressors such as physical habitat disturbances and highly localized exposures to degraded surface water quality caused by increases in turbidity from silt-producing activities. Juvenile and adult finfish are less likely to be harmed by these impacts due to their mobility and behavioral tendency to move away from active work areas and areas with degraded water quality. Finally, temporary reductions in the abundance of benthic macroinvertebrate prey that may support local populations of bottom-feeding species would be minor and ecologically insignificant.

Project design and construction methods have incorporated items that should serve to minimize impacts on these species. Pro-active habitat restoration measures have been incorporated in Freeport LNG's Procedures and *Wetland Restoration and Monitoring Plan* to reduce the potential for long-term impacts. In addition, the area that would be affected is small relative to the available habitat in the area. Since the EFH areas of concern indicated by NOAA Fisheries during consultation for the Phase I and Phase II Projects were along the pipeline route in estuarine wetlands and streams, adherence to Freeport LNG's Procedures and *Wetland Restoration and Monitoring Plan* would help to minimize impacts on the tidal EFH caused by the Pipeline/Utility Line System portion of the Liquefaction Project.

While permanent impacts on EFH are not anticipated, we find that they would be adequately compensated for should they occur, and the minor and temporary impacts on EFH from construction of the Liquefaction Project would not have a substantial adverse effect on the four EFH species.

4.5.5.2 Phase II Modification Project

The impacts associated with construction of the Phase II Modification Project are similar to those described for construction of the Liquefaction Project at the Quintana Island terminal site. Based on limited in-water construction activity and consultations with NOAA Fisheries described above, no designated EFH would be adversely modified during construction or operation of the Phase II Modification Project.

4.6 THREATENED, ENDANGERED, AND OTHER SPECIAL STATUS SPECIES

Federal agencies are required by Section 7 of the ESA (Title 19 U.S.C. Part 1536[c]), as amended (1978, 1979, and 1982), to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally-listed threatened/endangered species, or result in the destruction or adverse modification of designated critical habitat of a federally-listed species. The FWS, which is responsible for terrestrial and freshwater species, and NOAA Fisheries, which is responsible for marine species, jointly administer the ESA. Additionally, FWS oversees implementation of the Bald and Golden Eagle Protection Act and NOAA Fisheries oversees the implementation of the MMPA. The action agency (*e.g.*, the FERC) is required to consult with the FWS and/or the NOAA Fisheries to determine whether federally-listed threatened/endangered species or designated critical habitat are found in the vicinity, and to determine the proposed action's potential effects on those species or critical habitats.

For actions with the potential to affect listed species or designated critical habitat, the federal agency must submit its BA to the FWS and/or NOAA Fisheries and, if it is determined that the action may adversely affect a listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. In response, the FWS and/or NOAA Fisheries would issue a Biological Opinion (BO) as to whether or not the federal action would likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat.

As required by Section 7 of the ESA, we request that FWS and NOAA Fisheries accept the information provided in this draft EIS as the BA for these Projects. Furthermore, based on our findings as described in this section, we also request the initiation of formal consultation for the Projects. The Projects may affect but would not likely adversely affect two bird species under FWS jurisdiction; two reptile species under the joint jurisdiction of FWS and NOAA Fisheries; and two marine mammals under NOAA Fisheries jurisdiction. Therefore, we request that FWS and NOAA Fisheries concur with our findings.

This review also includes Species of Concern, which are those species that federal agencies have concerns regarding status and threats, but where insufficient information is available to indicate a need to list the species under the ESA. Therefore, we are describing the potential impact on these species, but not making a formal determination of effect for Species of Concern.

4.6.1 Liquefaction Project

4.6.1.1 Federally-listed Threatened and Endangered Species

To obtain current information on federally-listed threatened/endangered species with potential to occur in the Liquefaction Project area, publicly available regional information on species and suitable habitat within or near the Liquefaction Project Sites were accessed along with relevant agency correspondence (NOAA Fisheries, 2011a and FWS, 2012a and 2012b). Table 4.6.1-1 summarizes potential impacts of the Liquefaction Project on federally-listed threatened/endangered species listed in Brazoria County, areas directly offshore, and in the Gulf of Mexico.

For species that did not have suitable habitat within or near the Liquefaction Project site, a "no effect" determination was made. For species that had suitable habitat within or near the site, the effects determination was based on proximity of suitable habitat to the Liquefaction Project, species mobility, and species sensitivity to construction and operational impacts. "Near" was defined as one-mile from the Liquefaction Project site.

Of the FWS jurisdictional federally-listed species in Brazoria County, two bird species (piping plover [*Charadrius melodus*] and whooping crane [*Grus americana*]) and two marine reptiles (Kemp's Ridley sea turtle [*Lepidochelys kempii*] and loggerhead [*Caretta caretta*]) have suitable habitat within or near the Liquefaction Project site. Nesting activities conducted by sea turtles on land are under the jurisdiction of the FWS, while in water they are under the jurisdiction of the NOAA Fisheries. The Kemp's Ridley and loggerhead sea turtles have been known to nest in the vicinity of the Liquefaction Project (National Park Service [NPS], 2012).

Of the NOAA Fisheries jurisdictional federally-listed species in the Gulf of Mexico, two marine mammal species (blue whale [*Balaenoptera borealis*] and humpback whale [*Megaptera novaeangliae*]) have suitable habitat near the Liquefaction Project site (*e.g.*, within the general area frequented by LNG vessels navigating to and from the Quintana Island terminal). Of the eight potential Species of Concern recognized by NOAA Fisheries that may occur in the Gulf of Mexico, two fish species (dusky shark [*Carcharinus obscurus*] and sand tiger shark [*Carcharias taurus*]) have suitable habitat near the site (*e.g.*, within the general area frequented by LNG vessels navigating to and from the Quintana Island terminal).

The following provides further supporting documentation about the species with suitable habitat within or near the area, their characteristics, suitability of habitat at or near the site, potential for impacts, mitigation, and our effects determination.

Table 4.6.1-1

Potential Impacts of the Liquefaction Project on Federally-listed Species and Species of Concern

Common Name	Scientific Name	Listing Status a/	Suitable Habitat within or near Project Site	Critical Habitat	Effect of Proposed Project b/
BIRDS					
Piping plover	*Charadrius melodious*	FT	Yes	0.5 miles to south	NLAA
Whooping crane	*Grus americana*	FE	Yes	100 miles to south	NLAA
REPTILES c/					
Green sea turtle	*Chelonian mynas*	FT	No	-	NE
Hawksbill sea turtle	*Eretmochelys imbricata*	FE	No	-	NE
Kemp's Ridley sea turtle	*Lepidochelys kempii*	FE	Yes	-	NLAA
Leatherback sea turtle	*Dermochelys coriacea*	FE	No	-	NE
loggerhead sea turtle	*Caretta caretta*	FT	Yes	-	NLAA
MARINE MAMMALS					
Blue whale	*Balaenoptera musculus*	FE	Yes		NLAA
Fin (finback) whale	*Balaenoptera physalus*	FE	No		NE
Humpback whale	*Megaptera novaeangliae*	FE	Yes		NLAA
Sei whale	*Balaenoptera borealis*	FE	No		NE
Sperm whale	*Physeter macrocephalus*	FE	No		NE
FISHES					
Alabama shad	*Alosa alabamae*	SOC	No		
Dusky shark	*Carcharinus obscurus*	SOC	Yes		
Key silverside	*Mendia conchorum*	SOC	No		
Nassau Grouper	*Epinephelus striatus*	SOC	No		
Sand tiger shark	*Carcharias taurus*	SOC	Yes		
Speckled hind	*Epinephelus drummondhayi*	SOC	No		
Warsaw grouper	*Epinephelus nigritus*	SOC	No		
INVERTEBRATES					
Ivory tree coral	*Oculina varicosa*	SOC	No		

a/ Listing Key: FE: Federal Endangered; FT: Federal Threatened; SOC: Species of Concern (FWS, 2013a)
b/ Impact Key: NLAA = Not likely to adversely affect, NE = No effect
c/ Jointly protected by FWS and NOAA Fisheries.

Piping plover

Piping plovers nest along sandy beaches, gravel shorelines, and on river sandbars and alkali wetlands. They prefer to nest in sparsely vegetated areas that are slightly raised in elevation (like a beach berm). Piping plover breeding territories generally include a feeding area, such as a dune pond or slough, or near the lakeshore or ocean edge. This species does not breed in Texas. These birds are primarily coastal inhabitants of Texas only during the winter, preferring areas with expansive sand or mudflats (feeding) in close proximity to a sandy beach (for roosting). Primary threats to the piping plover are habitat modification and destruction, and human disturbance to nesting adults and flightless chicks (TPWD, 2013a).

Piping plovers migrate and overwinter along the Texas Gulf Coast, and thus, have the potential to rest and forage near the Liquefaction Plant area. The high mobility of the species suggests that they would look elsewhere to forage and roost if disturbed by sight, noise, or sound of the construction or operation. The species can be injured by striking man-made objects, particularly at night or during inclement weather, and the Liquefaction Project structures would create additional obstacles. To address this concern, Freeport LNG conducted a four-year bird-strike study at the Quintana Island terminal, which occurred during both construction and operation of the Phase I terminal facilities, focusing on the two LNG storage tanks, air tower, LNG dock unloading arms, and installed power lines. The study did not detect injuries or mortalities to this species and only found seven bird strikes due to the facility and appurtenant structures. In addition, Freeport LNG's FLDP helps to reduce the potential for bird strike hazards. As the piping plover is high mobile and wide ranging, and given the mitigation discussed above, the construction or operation of the Liquefaction Project *may affect, but is not likely to adversely affect* the piping plover.

The piping plover has FWS designated critical habitat ("Unit") approximately 0.5 miles from the Liquefaction Plant's construction footprint at the terminal site (further from appurtenant facilities) on Bryan Beach. The terrain between the Bryan Beach Unit and the Liquefaction Project facilities consists of vegetated land, residential land, open water, and roadways; thus, it does not offer suitable habitat and thus connectivity, for overwintering piping plovers (TPWD, 2013a; FWS, 2011; and FWS, 2012c). This separation area would also act as a buffer helping to prevent significant lighting impacts from the facility on this beach area. Based on the 0.5-mile separation, and the make-up of the land and the resulting lack of biological connectivity between the Gulf beach and the Liquefaction Project facilities, construction and operation of the Liquefaction Project would have *no effect on designated critical habitat* for the piping plover.

Whooping crane

Whooping cranes are the tallest bird in North America, reaching up to five feet in height. Their breeding grounds are in northern Canada, and they winter from October through May in the Aransas NWR northeast of Rockport, Texas (100 miles southwest of the Liquefaction Project area), as well as at Matagorda and St. Joseph's Islands in Aransas, Calhoun, and Matagorda Counties (FWS, 2013b; TPWD, 2013b).

This species could be an incidental visitor to the Liquefaction Project area during migration, as Brazoria County is located within the central whooping crane migration flyaway. Within the area there are marshes in which the whooping cranes could forage. During migration, species can be injured by striking man-made objects, particularly at night or during inclement weather. The Liquefaction Project structures would therefore create additional obstacles for the whooping crane. To address this concern, Freeport LNG conducted a four-year bird-strike study (see above) which did not detect injuries or mortalities to this species. In addition, Freeport LNG's FLDP would help to reduce the potential for bird strike hazards. With the mitigation noted above, and the fact that whooping cranes are highly mobile and have the behavioral tendency to avoid areas of man-made disturbance, construction or operation of the Liquefaction Project *may affect, but is not likely to adversely affect* whooping cranes.

Critical habitat has been designated for the whooping crane on the coast, 100 miles south of the area in the Aransas NWR. Based on this separation, construction and operation of the Project would have *no effect on designated critical habitat* for the whooping crane.

Loggerhead sea turtle

Loggerhead sea turtles are distributed around the world and found on continental shelf, bays, estuaries, and lagoons in tropical to temperate waters. Mating takes place in late March to early June, and eggs are laid throughout the summer. Nesting sites are found on the U.S. Atlantic and Gulf Coasts. Hatchlings move towards the coastal waters and out to sea and reach maturity at 16 to 40 years (NOAA Fisheries, 2013d). It is assumed that hatchlings live out their "lost years" in rafts of sargassum and/or debris in open ocean drift lines. Hatchlings eat animals found in these seagrass mats along driftlines and eddies where they remain until large enough to migrate to the shallower coastal waters, which become their foraging habitat. Juveniles and adults prey on conch, clams, crabs, shrimp sponges, squid, and fish.

One loggerhead sea turtle nest was found on Quintana Beach (*e.g.*, on the Gulf side of Quintana Island), about 0.3 miles, at its closest point, from the Liquefaction Plant) in 2012 (NPS, 2012). As the loggerhead sea turtle is known to occur and nest within the general vicinity of the Liquefaction Plant, there is potential for it to occur near the terminal site in search of nesting habitat. However, suitable nesting habitat for this species is not available in the immediate vicinity of the Liquefaction Plant facilities.

If a nesting attempt were to be made, it would most likely occur on the Gulf side of Quintana Island, about 0.3 mile at its closest point from the Liquefaction Plant. With respect to the potential for noise and lighting impacts, this is considered in general minor in comparison to other more serious threats including commercial fisheries and by-catch (NOAA Fisheries, 2011c). Mitigation to minimize potential impacts from noise and light to nesting areas 0.3 miles from the facility would include the facility berm itself, which in addition to its flood control purpose, would minimize potential for light and noise impacts from the facility to affect marine turtles on Quintana Beach. Additionally, Freeport LNG's FLDP would minimize light impacts on the facility site and sea turtle habitat. Regarding noise, Quintana Beach is already exposed to varying manmade noise sources via vehicle traffic at the beach, and background noise levels associated with operation of the import facility and shipping in the ICW.

Other potential impacts on this species could come from vessel strikes. However, the Project does not represent a change in number of LNG ships from that proposed in the previous EIS for the Freeport LNG Import Facility (CP03-75-000) and thus we do not anticipate further risk specific to vessel strikes to threatened/endangered species under the Liquefaction Project.

A final source of impacts could come from an oil spill associated with the Liquefaction Project. Freeport LNG's SPCC plan would provide measures to reduce the potential for any contaminants entering the waters in the vicinity of the Project in the event of an oil spill and thus minimize the potential for harm to the loggerhead sea turtle. The SPCC Plan would include discharge prevention measures (*e.g.*, requirements for secondary containment, inspections, testing, security, truck and tank loading procedures) and spill response and countermeasures (*e.g.,* documenting and reporting spills, remediation, and waste disposal).

Given the lack of suitable habitat within the immediate vicinity of the project, the distance to nesting habitat and mitigation to reduce light, and oil spills, the construction or operation of the Liquefaction Project *may affect, but is not likely to adversely affect* the Loggerhead sea turtle.

Kemp's Ridley sea turtle

Kemp's Ridley sea turtles are the smallest of the marine turtles, and found throughout the Gulf, inhabiting sandy and muddy areas that are rich in invertebrate fauna, particularly crustaceans (NOAA Fisheries, 2013c). The main food item of this species is reported to be blue crab (*Callinectes spp*.) (Ogren, 1992), but other benthic prey items such as mollusks, echinoderms, and other crustaceans have been found to contribute to its diet. According to Ogren (1992), adult Kemp's Ridley sea turtles are believed to be restricted to the Gulf, although juvenile and immature Kemp's Ridley turtles range along the temperate coastal areas of the northwest Atlantic Ocean (FWS, 1991). The major nesting beach for Kemp's Ridley, however, is on the northeastern coast of Mexico near Rancho Nuevo in southern Tamaulipas (NOAA Fisheries, 2013c).

The Kemp's Ridley sea turtle is known to occur and nest within the general vicinity of the Liquefaction Project and it could potentially occur near the terminal site searching for nesting habitat. Five Kemp's Ridley sea turtle nests were found on Surfside Beach (a beach eastward of Quintana Island and separated by the ICW channel) in Brazoria County in 2012, approximately 0.5 miles east of the Project (NPS, 2012). Suitable nesting habitat for this species, however, is not available in the immediate vicinity of the Liquefaction Project facilities. If a nesting attempt were to be made, it would most likely occur on Surfside Beach (0.5 miles from the Project) on the Gulf side of Quintana Island, or on Quintana Beach, approximately 0.3 miles (at its closest point) from construction and operation of the Project. These beaches are open for vehicle traffic and heavily used for recreation by the public. At a distance of 0.3 miles, at its closest point from the Project, and the abundance of recreational beach goers, it is unlikely that noise from construction or operation of the project would have an impact on nesting sea turtles should they occur.

Given the lack of suitable habitat within the immediate vicinity of the project, the distance to nesting habitat and mitigation to reduce light, vessel strikes, and oil spills, the construction or operation of the Liquefaction Project may *affect, but is not likely to adversely affect* the Kemp's Ridley sea turtle.

Blue whale

Blue whales, the largest living animals on earth, are found in oceans worldwide from sub-polar to sub-tropical latitudes. In spring, they migrate toward the poles to take advantage of high zooplankton production in the summer and migrate towards the subtropics in the fall to reduce their energy expenditure while fasting, avoid ice entrapment, and engage in reproductive activities. Although blue whales are often found in coastal waters, they are thought to occur more offshore than other whales (NOAA Fisheries, 2013). Several records of blue whale strandings in the Gulf (pre-1970) suggest that blue whales historically strayed into Gulf waters.

There are only two records of the blue whale occurring in the Gulf of Mexico; one stranded near Sabine Pass, Louisiana, in 1924 and one stranded on the Texas coast between Freeport and San Luis Pass in 1940. Both of these identifications have been questioned (Davis and Schmidly, 1994). Though there is little information about where in the Gulf of Mexico blue whales may occur, their common depth is 100 meters, which corresponds to a distance of more than 80 miles from shore. Potential for impacts would be limited to the possibility of a vessel strike or encountering an oil spill.

Given the blue whales' high mobility and no specifically attractive habitat for this species within the area, it is not likely to be present or affected. In addition, the mitigation proposed helps minimize impacts on the blue whale should it occur in this area. As a result, the proposed Liquefaction Project *may affect, but is not likely to adversely affect* the blue whale.

Humpback whale

Humpback whales are found worldwide, generally in waters over and adjacent to continental shelves and around oceanic islands. However, this species rarely occurs in the Gulf (Davis and Schmidly, 1997b). During migration, humpback whales stay near the surface of the ocean and prefer shallow waters while feeding and calving. Calving occurs in the warmest waters available at that latitude near offshore reef systems, islands, and continental shores, while feeding occurs in cold, productive coastal waters (NOAA Fisheries, 2013k). In the Gulf, humpback whales have been captured in the Florida Keys and northern Cuba and have been sighted off the west coast of Florida and Alabama. The only known occurrence of a humpback whale sighting off the coast of Texas was near Galveston in 1992 (TPWD, 1994).

Given the humpback whales high mobility and no specifically attractive habitat for this whale within the area, humpback whales are not likely to be present or affected. In addition, the mitigation proposed helps minimize impacts on the humpback whale should it occur in this area. As a result, the Liquefaction Project *may affect, but is not likely to adversely affect* the humpback whale.

Dusky shark

The dusky shark is a large slender shark that has a low ridge along its back between the dorsal fins (Castro, 1983). They grow to lengths near 12 feet and weigh around 400 pounds (NOAA Fisheries, 2011b). The dusky shark is found throughout the world's oceans where waters are warm (66-82^{0}F). One study in the northern Gulf of Mexico found that they spend most of their time at depths of 33-260 feet (*e.g.,* this depth range corresponds to two to 80 miles offshore), and while they have been known to come close to shore, they often avoid estuaries due to low salinity levels (Compagno, L.J.V., 1984).

As the species is highly migratory and has no specific habitat attracting them to the Liquefaction Project area, it is not expected that this species would occur near in the Project area. Moreover, as it spends most of its time in deep depths, this would reduce its chances of being hit by a vessel.

Given the dusky shark's high mobility and no specifically attractive habitat for sharks within the vicinity of the Liquefaction Project, the dusky shark is not likely to be present or affected. In addition, the mitigation proposed helps minimize impacts should this species occur in the area. As a result, the proposed action may impact individuals but would not lead toward a trend to federal listing of the dusky shark.

Sand tiger shark

The sand tiger shark is a medium sized shark with individuals reaching up to nine feet in length. Sand tiger sharks are gray in color with brownish red spots on their backs (NOAA Fisheries, 2013h). This species inhabits warm tropical and semitropical waters of the world. They are found from the surf zone seaward to depths of approximately 630 feet. They actively feed (sometimes in large groups) on fish, including other sharks, crustaceans, squid and any other prey that they can catch. As the species is highly migratory and has no specific habitat attracting them to the Liquefaction Project area, it is unlikely that this species would be present (Virginia Aquarium, 2013).

Given sand tiger shark's high mobility and that there is no specifically attractive habitat for it within the area, the sand tiger shark is not likely to be present or affected. In addition, the mitigation proposed helps minimize vessel strikes in the event this shark visits the area. As a result, the proposed action may impact individuals but would not lead toward a trend to federal listing of the sand tiger shark.

Deposition Impacts

At the request of public commentors and the USEPA, we analyzed potential impacts on federally-listed threatened/endangered species from air emissions. In general, pollutants that may affect plant or animal species enter the ecosystem through deposition. The species identified in table 4.6.1-1 have suitable habitat within the area.

Air emissions stemming from construction and operation of the Projects contain nitrogen and sulfur compounds that contribute to acidification and nitrogen enrichment in the environment that may adversely impact terrestrial and aquatic ecosystems. Compounds emitted by the Projects that contain nitrogen and sulfur include inorganic compounds such as various oxides of nitrogen, ammonia (NH_3), and inorganic forms of sulfur such as sulfur dioxide (SO_2).

Oxides of nitrogen (NO_x) and sulfur (SO_x) react with water and oxygen in the atmosphere to form nitric and sulfuric acids, respectively. Acid rain occurs when precipitation or fog captures nitric and sulfuric acids from the atmosphere and deposits them on the land or water. In the atmosphere, nitric and sulfuric acid may react with ammonium ions or other cations to form nitrate and sulfate particulate matter. Nitrate and sulfate particles may be deposited on the land or water as a result of precipitation, gravitational settling, or impaction. Acid gases and nitrate and sulfate particulate matter deposition can adversely impact terrestrial and aquatic ecosystems by two pathways: acidification and nutrient enrichment.

Acid rain falling on the ground may result in increased soil acidification over time, and the washing of nutrients for plant growth deeper into the soil or out of the soil, resulting in decreased plant growth. Acid rain can also influence surface water chemistry, which in turn can affect the surrounding terrestrial and aquatic ecosystems and biodiversity.

Cumulative high levels of nitrogen deposition may upset the ecological balance and cause shifts in population dynamics, species composition, community structure, and in extreme instances, an entire ecosystem. Nitrogen loading is an important factor in causing eutrophication, the addition of artificial or natural substances including nitrates to an aquatic system. The symptoms of eutrophication include blooms of algae, declines in the health of fish and shellfish, loss of sea grass beds and coral reefs, areas of low DO (hypoxic), and ecological changes in food web.

Emissions from the Projects would contribute to existing overburdened levels of NO_x and SO_x in the industrialized Freeport-Houston-Galveston area. Additionally, high levels of eutrophication in the northern Gulf of Mexico, have resulted in one of the largest hypoxic zones in the United States (Rabalais *et al.*, 2001; Bricker *et al.*, 2007), which effects the food sources of species that may be affected by the Projects.

The estimated peak emissions of NO_x and SO_x from the Projects are 650.8 and 54.2 tons per year (tpy), respectively, during construction and 24.6 and 2.3 tpy, respectively, during operation. The emissions of SO_x during construction of the Projects would be minimized by the use of ultralow sulfur diesel (ULSD) fuel in construction equipment. With the exception of emergency engines that would burn ULSD, the operational combustion equipment would use only natural gas, which contains very little sulfur. Emissions of NO_x would be minimized by the use of these low sulfur fuels and proper equipment maintenance and operation.

For each of the endangered species, air emissions could cumulatively contribute to the formation of acid rain. Nitrification of the waters can result in eutrophication and eventual hypoxic/anoxic conditions in the Northern Gulf, thus negatively impacting food sources for each of the species. It is unlikely that these conditions could have a significant effect on the blue and humpback whale due to the abundant food sources. Ocean acidification negatively impacts the growth and development of the food sources for the sea turtle and bird species.

Since the emissions would never reach a scale where a “take” of federally-listed species occurs, the effects are deemed *insignificant* (USFWS, 1998). Based on cumulative data of air emission deposition and impacts on the environment, we conclude that the construction and operation of the Project would not result in a “take” for the federally-listed endangered species. The proposed Project would, however, add to the already high concentration of nitrogen and sulfur compounds in the area that contribute to acidification and nitrogen loading of surrounding terrestrial and aquatic ecosystems which, in turn, directly and indirectly affects federally-listed endangered species. As the emissions of SO_x and NO_x are small proportionally, they are unlikely to result in any significant increases in ecological impacts on federally-listed threatened/endangered species.

Thus depositional impacts do not change the previous determinations of *may affect, but is not likely to adversely affect* for each of the federally-listed threatened/endangered species.

4.6.1.2 State-Listed Threatened and Endangered Species

To obtain current information on state-listed threatened/endangered species with potential to occur in the area, Freeport LNG accessed publicly available regional information from the TPWD (2013e) website. Of the 27 state-listed species, seven are also recognized by the FWS and/or NOAA Fisheries as federally-listed species. Table 4.6.1-2 identifies the state-listed species listed in Brazoria County, which includes areas offshore that were not already discussed in section 4.6.1.1.

Table 4.6.1-2

Potential Impacts of the Liquefaction Project to TPWD State-listed Threatened and Endangered Species

Common Name	Scientific Name	Status a/	Suitable Habitat within or near Project Site
BIRDS			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Yes
Eskimo curlew	*Numenius borealis*	Endangered	No
Peregrine falcon	*Falco peregrinus*	Threatened	Yes
Reddish egret	*Egretta rufescens*	Threatened	Yes
Sooty tern	*Onychoprion fuscatus*	Threatened	No
White-faced ibis	*Plegadis chihi*	Threatened	Yes
White-tailed hawk	*Buteo albicaudatus*	Threatened	Yes
Wood stork	*Mycteria americana*	Threatened	Yes
FISH			
Smalltooth sawfish	*Pristis pectinata*	Endangered	No
MARINE MAMMALS			
West Indian Manatee	*Trichechus manatus*	Endangered	Yes
TERRESTRIAL MAMMALS			
Red wolf	*Canis rufus*	Endangered	No
Jaguarundi	*Herpailurus yaguarundi*	Endangered	No
Ocelot	*Leopardus pardalis*	Endangered	No
Louisiana black bear	*Ursus americanus luteolus*	Threatened	No
MOLLUSKS			
False spike mussel	*Quadrula mitchelli*	Threatened	No
Smooth pimpleback	*Quadrula houstonensis*	Threatened	No
Texas fawnsfoot	*Truncilla macrodon*	Threatened	No
AQUATIC REPTILES			
Alligator snapping turtle	*Macrochelys temminckii*	Threatened	No
TERRESTRIAL REPTILES			
Timber/canebrake rattlesnake	*Crotalus horridus*	Threatened	No
Texas horned lizard	*Phrynosoma cornutum*	Threatened	No

Source: a/ TPWD, 2013e.

The Texas Natural Diversity Data Base (TXNDD) provides geographic locations of species occurrences. Each occurrence is based on at least one observation but could include potentially hundreds of observations (TXNDD, 2013). In general, impacts on threatened/endangered species are not expected beyond one mile of the Liquefaction Project (see one mile designation line in figure 4.6.1-1) though occurrence data has been provided for up to five miles from the Project in the referenced figure. A total of seven species have recorded occurrences within a 5-mile radius of the Projects. The following provides additional documentation on the state-listed six birds and one marine mammal with suitable habitat present within or near the Liquefaction Project. With all of the bird species, the potential exists for birds to strike tall objects during periods of inclement weather. To address this concern, Freeport LNG conducted a four-year bird-strike study which did not detect injuries or mortalities to rare, threatened, or endangered species. In addition, Freeport LNG's FLDP would help to reduce the potential for bird strike hazards.

Bald Eagle

Delisted under the ESA in 2007 due to population recovery, Bald eagles continue to be protected under the *Bald and Golden Eagle Protection* Act as well as state-listed as threatened in Texas. The bald eagle ranges over much of the U.S. and Canada. This eagle is primarily a fishing species that prefers habitats associated with large bodies of water (FWS, 1987). In Texas, wintering and nesting activity occurs mainly near large freshwater impoundments with standing timber located in or around the water (Mabie, 1990). The nesting period usually extends from October 1 to May 15. Breeding pairs, which generally bond for life, return to their same territory year after year (FWS, 1987). Nests are often situated on ecotonal boundaries of forest, marsh, and open water, typically in trees higher than 40 feet (Arroyo, 1992).

In 2005, the species was documented within 1-mile radius of the Liquefaction Project. However, this species is highly mobile and would likely avoid the area during construction and operation due to the lack of feeding habitat and the presence of humans. Due to the characteristics of this species and the mitigation for raptors as described in the FWS Avian Protection Plan Guidelines noted above, the construction and operation of the Liquefaction Project facilities is not expected to impact the bald eagle.

Peregrine falcon and arctic peregrine falcon

The peregrine falcon is a widely distributed and highly migratory species nesting in the western U.S., Canada, and Mexico. While two subspecies are present in Texas, *F. p. anatum* and the Arctic Peregrine Falcon (*F.p. tundrius)*, the latter is no longer listed in Texas. However, because the subspecies are not easily distinguishable at a distance, reference is generally made only at the species level (TPWD, 2013m). Peregrine falcons are found primarily in the Trans-Pecos Ecoregion, but the Texas coastline plays an important role in the survival of migrant individuals. During each migration, falcons assemble on the Texas coast to feed on prey along the open coastline and tidal flats for up to one month in the spring or fall (TPWD, 2013m).

Figure 4.6.1-1
Freeport LNG - Liquefaction Project
TXNDD Species Occurrence Data within
Five Miles of the Liquefaction Project Area
Brazoria County, Texas

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Falcons could be incidental visitors to the Liquefaction Project area during migration. Due to the characteristics of this species and the mitigation for raptors as described in the FWS Avian Protection Plan Guidelines noted above, construction or operation of the Liquefaction Project is not expected to impact these species.

Reddish egret

Reddish egrets are coastal species with a limited range and breed along the Gulf Coast of Texas, Louisiana, Alabama, and both coasts of Florida. In Texas, they are permanent residents along the central and lower Texas Gulf coast, but are uncommon along the UTC (TPWD, 2013n). Reddish egrets are a medium-sized bird with a pinkish beige head, neck, and breast and a slate blue body. They forage in calm, shallow brackish marshes, shallow salt ponds, tidal flats, and lagoons, and nest on bare sand or amid cacti, willows, or other shrubs in Texas (National Audubon Society, 2013a).

There is potential for reddish egrets to use marsh like portions of proposed construction areas as foraging locations. Reddish egrets, if present, would likely avoid the area due the presence of humans and utilize suitable habitat adjacent to the Liquefaction Project. No permanent impacts on these areas are anticipated. Given their mobility, a reddish egret could temporarily avoid the area. Due to the characteristics of this species and rare presence in the area, construction or operation of the Liquefaction Project is not expected to impact the reddish egret.

White-faced ibis

White-faced ibis explore much of the western U.S. in search of breeding and foraging habitat in the spring and summer. They inhabit shallow freshwater marshes, swamps, ponds, and rivers, where islands of vegetation are available. In Texas, white-faced ibis breed in coastal marshes, but prefer freshwater locations. They nest between April and June on dead reeds or floating mats of dead plants and feed on insects, newts, leeches, earthworms, snails, and crayfish (National Audubon Society, 2013b).

There is potential for white-faced ibis to use the freshwater marsh like portions of the proposed construction areas as foraging locations. White-faced ibis, if present, would likely avoid the area due to the presence of humans and utilize suitable habitat adjacent to the Liquefaction Project. No permanent impacts on these areas are anticipated. Given their mobility, a white faced ibis could temporarily avoid the area. Due to the characteristics of this species, construction or operation of the Liquefaction Project is not expected to impact the white-faced ibis.

White-tailed hawk

White-tailed hawks occur from southeastern Texas south to Central and South America. In Texas, they are residents of coastal grasslands from the Rio Grande delta to the upper coast (Peterson, 1963) and farther inland in open-country with scattered mesquite, yucca, and large cacti. The white-tailed hawk perches on bushes, trees, utility wires, or on the ground. Breeding season extends from March to May and eggs are laid in nests found five to 15 feet above the ground in sizeable bushes and trees (Terres, 1996).

Coastal grasslands are present within construction work areas, thus this species could potentially perch or forage. White-tailed hawks, if present, would likely avoid the area due to the presence of humans and utilize suitable habitat adjacent to the Liquefaction Project. Impacts on the components of the area where the white-tailed hawk would forage are temporary. Additionally, given the mobility of the species, it could forage elsewhere during construction. Due to the characteristics of this species, construction or operation of the Liquefaction Project is not expected to impact the white-tailed hawk.

Wood stork

Wood storks are large white-bodied birds with a long heavy bill. They breed from Mexico to northern Argentina, and in the Caribbean islands of Cuba and Hispaniola. After nesting, some move into Texas, Louisiana, Mississippi, Alabama, and North Carolina, mainly along coastlines and large rivers (National Audubon Society, 2013c). Wood storks inhabit coastal marshes, bays, and prairie lakes, and forage in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. In Texas, it is a common summer resident along the coastal plain in search of mudflats and other wetlands (National Audubon Society, 2013c).

Wood storks, if present, would likely avoid the area due to the presence of humans and utilize suitable habitat adjacent to the Liquefaction Project. Impacts on the components of the Liquefaction Project area where the wood stork would forage are temporary. Additionally, given the mobility of the species, during construction it could forage elsewhere. Due to the characteristics of this species, construction or operation of the Liquefaction Project is not expected to impact the wood stork.

West Indian manatee

West Indian manatees inhabit both salt and fresh water of sufficient depth (five feet to usually less than 20 feet) throughout their range. They may be encountered in canals, rivers, estuarine habitats, saltwater bays, and on occasion have been observed as much as 3.7 miles off the Florida Gulf coast. Manatees select habitat based on the following characteristics (listed in order of decreasing importance): water temperature (preferring warm waters); food supply (aquatic vegetation); water depth; and proximity to fresh water. Manatees may not need fresh water but they are frequently observed drinking fresh water from hoses, sewage outfalls, and culverts (Powell and Rathbun, 1984; FWS, 1989). Manatees are extremely rare in Texas, although near the turn of the century they apparently were not uncommon in the Laguna Madre. In 1986, the sighting of a manatee in Texas was recorded approximately one mile west of Caplen, on the Bolivar Peninsula (52 miles to the east of the Liquefaction Project) (Davis and Schmidly, 1997d). In addition, a single female manatee appeared in Texas (Galveston Bay, 45 miles to the east of the Projects) in mid-1990. This individual was removed from Texas’ waters to join a population of manatees in Florida.

Due to the lack of SAV in waters of sufficient depth, the highly disturbed nature of the Liquefaction Project, and the rarity of manatees in Texas, the potential for occurrence of this species is extremely low. Thus, construction or operation of the Liquefaction Project is not expected to impact the West Indian manatee.

4.6.1.3 Phase II Modification Project

The federally- and state-listed species identified in tables 4.6.1-1 and 4.6.1-2, respectively, and described in section 4.6 for the Liquefaction Project, have similar potential to occur in the vicinity of the Phase II Modification Project due to both projects being located at the Quintana Island terminal. There is no habitat unique to the Phase II Modification Project that was not addressed in respect to the Liquefaction Project, and therefore all potential species impacts discussed in section 4.6.1.1 and section 4.6.1.2 are applicable.

Existing critical habitat for the overwintering population of the piping plover and migratory bird resources in the vicinity of the Phase II Modification Project are similar to that described in section 4.6.1.1 for the Liquefaction Project at the Quintana Island terminal site.

4.6.1.4 Conclusion

As described at the beginning of this section, and in compliance with Section 7 of the ESA, we have requested the initiation of formal consultation with FWS and NOAA Fisheries for the Projects. Therefore, **we recommend that:**

- **Freeport LNG should not begin construction activities until:**
  a. **the staff completes formal consultation with the FWS and NOAA Fisheries; and**
  b. **Freeport LNG has received written notification from the Director of OEP that construction or use of mitigation may begin.**

4.7 LAND USE, RECREATION, AND VISUAL RESOURCES

4.7.1 Land Use

As depicted in figure 4.7.1-1, existing land uses at the Quintana Island terminal include industrial, open land, and open water. The work on Quintana Island including the Liquefaction Plant, and Phase II Modification Project, which encompasses land at Freeport LNG's existing terminal site and land directly adjacent to but west of the site, is within the Port Freeport Industrial District and therefore, the entire Quintana Island Project area is zoned for industrial development. The terminal site is bounded by open water to the north (ICW) and east (FHC), open land (a former DMPA) to the west, and residential land (Town of Quintana) and open land (coastal grass/scrub upland) to the south.

The existing land uses at or in the regional vicinity of the proposed Pretreatment Plant site include industrial, residential, open land, wetland, and open water. The 218-acre site is located in a semi-rural area, the native vegetation communities of which are characterized mostly by upland grassland and emergent wetland. Cattle grazing (within the open land use category) is the predominant land use, but the area also supports several residential communities, commercial developments concentrated along arterial roads (SH 332 and FM Route 523), and infrastructure associated with oil and gas production and storage. Figure 4.7.1-2 shows local features in the vicinity of the Pretreatment Plant site.

The Pretreatment Plant site is bounded to the east and north by a relict oxbow of Oyster Creek, which was partially channelized during construction of the adjacent Velasco Levee and CR 690 to form the existing canal ditch (western Velasco Ditch) that borders the west edge of the levee. Another relict open water oxbow of Oyster Creek fringes the site's northwest boundary. Open pasture land on the site continues beyond the north and southeast property boundaries. A cell tower is located approximately 260 feet (0.05 mile) south of the site. A prominent feature that occupies the west central portion of Freeport LNG's property is the extensive excavation pit representing the site of commercial sand extraction (within the industrial land use category) that was undertaken by the previous landowner from 2005 until acquisition of the property purchase option by Freeport LNG in April 2012. Until recently, plant infrastructure supporting this extraction operation was located in a graveled area adjacent to and south of the pit; however, following Freeport LNG's option acquisition, this infrastructure has been removed by the owner. The central excavation pit covers approximately 29.0 acres and is approximately 20 feet to 40 feet deep in the western sector and approximately 10 feet to 20 feet deep in the eastern sector. A second excavation pit, which was developed for commercial clay extraction, is located in the northwestern portion of the property.

The majority of the Pipeline/Utility Line System is classified as open land comprised of emergent marsh, scrub/shrub wetlands, grassland/herbaceous land, and open land. Approximately 20 percent of the land crossed by the route system is emergent wetland, mainly represented by the extensive estuarine wetland areas that are located between the ICW and Oyster Creek. The remaining 80 percent of land is predominantly grassland and is commonly used as pastureland for cattle grazing. The Pipeline/Utility Line System crosses barren land on the north shore of the ICW, along with industrial land at the Stratton Ridge underground storage site and the INEOS Plant. Residential land abuts the route at several locations, including the Town of Quintana (MP 0.25[A]), City of Surfside (MP 1.34[A]), Bridge Harbor Yacht Club (MP 2.40[A]), and Turtle Cove (MP 5.49[A]). The land use in the area can be seen on the aerial photos in figure D-3 (a-h) in appendix D. The Projects do not have residential areas within the construction or operational footprint.

4.7.1.1 Impacts from Liquefaction Project

Quintana Island Terminal Site

Table 4.7.1-1 shows the acreage impacts associated with construction and operation of the Liquefaction Plant for the three land uses (open land, industrial land, and open water) represented at and adjacent to the terminal site.

Figure 4.7.1-1
Freeport LNG - Liquefaction Project
Existing Land Use Types at and Adjacent to the
Quintana Island Terminal Site
Brazoria County, Texas

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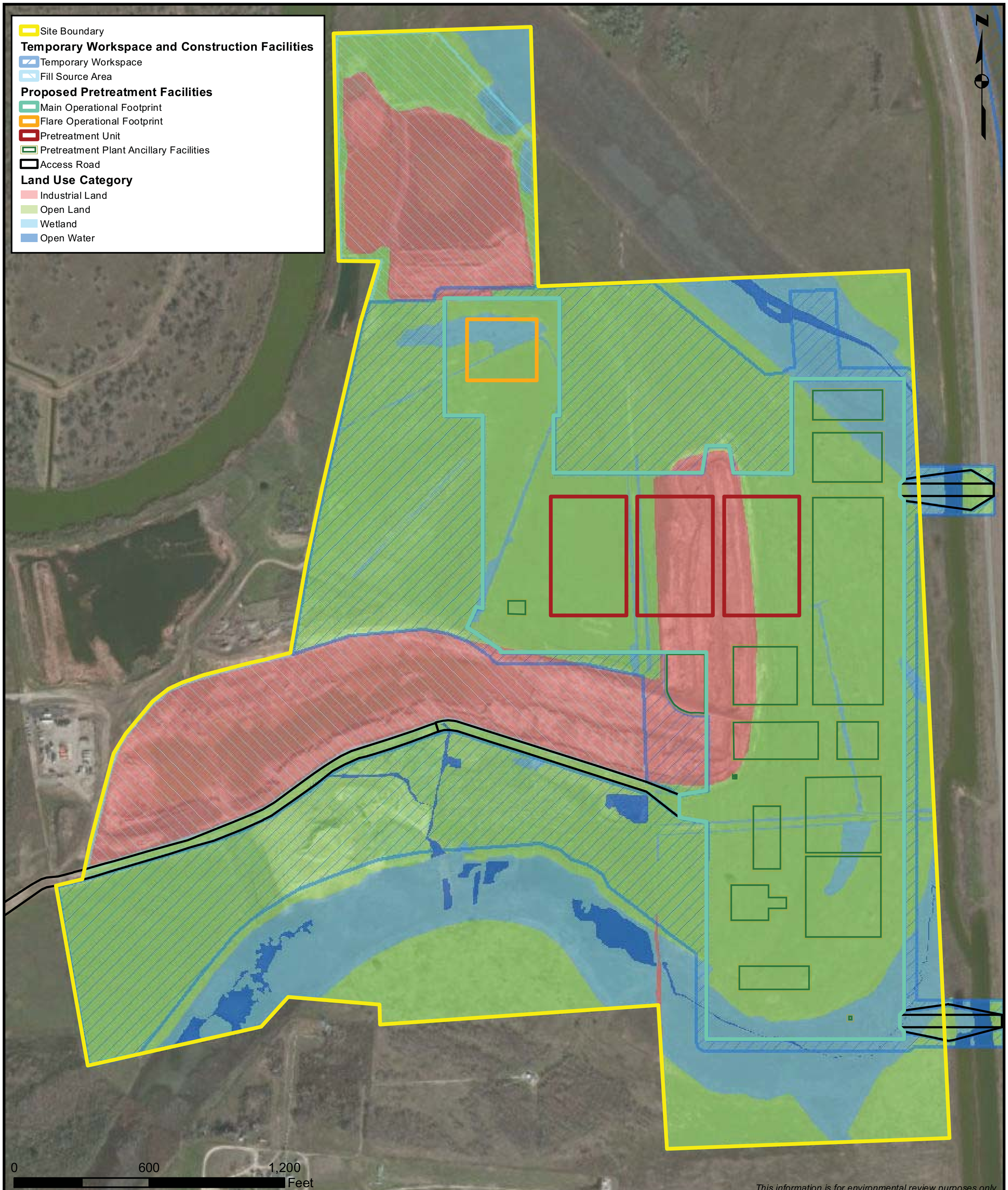

Figure 4.7.1-2
Freeport LNG - Liquefaction Project
Existing Land Use Types at the Pretreatment Plant Site
Brazoria County, Texas

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Table 4.7.1-1

Liquefaction Plant Land Use Impacts

Project Component	Open Land a/		Industrial Land b/		Open Water c/		Total	
	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
Trains 1, 2, 3	0.0	34.0	0.0	3.8	0.0	0.0	0.0	37.8
Ground Flare	0.0	2.6	0.0	0.0	0.0	0.0	0.0	2.6
Ancillary Facilities	0.0	46.4	0.0	20.9	0.0	0.0	0.0	67.3
Pipeline and Troughs in Phase I Process Area	0.0	<0.1	0.0	0.6	0.0	0.0	0.0	0.6
Pipelines (BOG, Nitrogen, Natural Gas) and Fiber Optic Line	0.0	N/A d/	0.0	0.0	0.0	0.0	0.0	0.0
New Construction Dock	0.0	0.1	0.0	0.0	e/	6.72		6.82
Aggregate Dock	0.0	0.0	0.0	0.0	e/	2.53		2.53
Firewater Intake Structure	0.0	0.0	0.0	0.0	e/	0.08	0.0	0.08
Dredging at Existing Construction Dock	0.0	0.0	0.0	0.0	e/	3.2	0.0	3.2
Drainage Channel A	0.0	0.0	0.0	0.0	0.1	0.07	0.0	0.07
BOG Compressors in Phase I Process Area (1 Regular, 3 Booster)	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5
Stormwater Collection Basin	N/A f/	23.0	0.0	0.0	0.0	0.0	0.0	23.0
Vapor Return Blowers at Phase I and Phase II LNG Berthing Docks	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	<0.1
Temporary Workspace (West)	61.9	0.0	4.9	0.0	0.0	0.0	66.8	0.00
Temporary Workspace (West Central)	0.0	0.0	5.4	0.0	0.0	0.0	5.4	0.00
Temporary Workspace (East Central)	0.0	0.0	4.0	0.0	0.0	0.0	4.0	0.00
Temporary Workspace (East)	0.0	0.0	21.1	0.0	0.0	0.0	21.1	0.00
Subtotal:	61.9	106.7	35.4	25.3	0.1	12.6	97.4	144.6
Total:	168.6		60.7		12.7		242.0	

Notes

Temp Temporary impacts during construction (not included in permanent impact totals)
Perm Permanent impacts during operation (not included in temporary impact totals)
a/ *Open land* includes land at and adjacent to the terminal site that has not been developed or modified previously for the Phase I Project and land that lies beyond the former FOC property boundary; *open land* can include both vegetated and non-vegetated land.
b/ *Industrial land* includes property developed as part of Phase I by Freeport LNG and property within the Quintana Island terminal site that was formerly owned and developed for industrial purposes by FOC; *industrial land* can include both vegetated and non-vegetated land.
c/ *Open water* includes on-site ponds and the LNG berthing area.
d/ Within existing operational footprint of terminal.
e/ Impact area of estimated dredging plume within Freeport Harbor Channel, ICW, and Dow Barge Canal is approximately 428.1 acres, assuming 100 meter plume.
f/ Temporary workspace for stormwater collection basin included in West Temporary Workspace total for Liquefaction Plant.

At the terminal site, open land includes scrub-shrub wetland, scrub-shrub upland, herbaceous wetland cover, and herbaceous upland[19]; it also includes those unvegetated sections of the former DMPA that are located on and adjacent to the west side of the terminal site and lie beyond the area affected by the Phase I Project (this latter area being categorized as industrial land). Open land encompasses much of the undeveloped vegetated shoreline of the ICW and extends south into the northern sector of the proposed temporary workspace east of the Phase I process area. In this northern sector, herbaceous upland predominates, with one small pocket of scrub-shrub upland.

Of the 168.6 acres of open land that lie within the proposed construction workspace at and adjacent to the terminal site, 61.9 acres would be temporarily affected and 106.7 acres would be permanently affected by facility operation. Development of the Liquefaction Plant would result in the permanent conversion of these latter 106 acres of open land to industrial use. Pre-construction use and functionality of open land beyond the Liquefaction Plant site would not be affected. Freeport LNG has purchased several residential properties close to the Liquefaction Plant to allow for adequate buffer zone with respect to noise impacts.

Industrial land includes property developed by Freeport LNG for the Phase I facilities, primarily the process area, the LNG berthing dock, and the temporary workspace that is now part of the proposed Liquefaction Plant footprint on the west side of the terminal site. Industrial land also includes the former FOC property that constitutes most of the proposed temporary workspace east of the Phase I process area.

Of the 60.7 acres of industrial land that lie within the Liquefaction Project's proposed construction workspace, 35.4 acres would be temporarily disturbed and 25.3 acres would be permanently affected by facility operation. This permanently affected area would continue to remain as industrial use.

Dredging would be necessary to accommodate barge visits to the existing construction dock on the south shoreline of the ICW in the vicinity of the Phase I process area. Dredging would also be associated with installation of the new construction dock, aggregate dock, and firewater intake structure on the same shoreline. In total, 12.53 acres of dredging would be required for these facilities.

The only onshore waterbody that would be directly affected by construction and operation of the Liquefaction Plant at the terminal site is Drainage Channel A. As indicated in figure D-1 in appendix D, Drainage Channel A would be crossed by aboveground facilities (LNG pipeline and trough) and underground Pipeline/Utility Line System, via a conventional bore or HDD. Discernible in-stream impacts would be avoided at both crossing locations. The work includes construction of a narrow walkway across Drainage Channel A, which would require installation of a concrete culvert and some bank-side disturbance. No permanent loss of waterbody acreage or redirection of drainage flow would occur.

[19] "Herbaceous upland" at the Terminal site can include isolated pockets of "scrub-shrub upland" and vice-versa.

Pretreatment Plant

For each of the three represented land uses (industrial land, open land, and open water), Table 4.7.1-2 shows the acreage impacts associated with the temporary workspace and permanent facility footprint at the proposed Pretreatment Plant site. Industrial land (16.7 acres of temporary impact; 34.9 acres of permanent impact) consists of areas of previous sand/clay excavation in the west central and northwest portions of the site. Open Land is the largest land use, accounting for 164.6 acres of the 218.3 acres affected overall, either temporarily or permanently. This includes emergent wetlands and grassland. Grassland on the Pretreatment Plant site has historically been used as pasture land for cattle grazing. Open water is the least represented land use category, accounting for 1.5 acres of temporary impact and 0.6 acres of permanent impact, and consisting of natural and man-made ponds, channels, and ditches.

Table 4.7.1-2

Freeport LNG Liquefaction Project
Impact Acreages for Land Uses at Proposed Pretreatment Plant Site

Project Component	Industrial Land a/		Open Land b/		Open Water c/		Total Impact	
	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
Pretreatment Plant Site	16.7	34.9	86.7	77.9	1.5	0.6	104.9	113.4
Total:	51.6		164.6		2.1		218.3	

Notes
Temp Temporary Workspace
Perm Permanent Facility Footprint

a/ *Industrial land* includes land within the Pretreatment Plant property boundary that is currently used as an excavation source for construction materials; *industrial land* can include both vegetated and non-vegetated land. Note that the 13.8 acres of ponded water in the central and northwest excavation pits is included in the *industrial land* category in this land use classification.
b/ Open Land includes both wetlands (emergent herbaceous wetlands and scrub-shrub wetlands) and grasslands that are undeveloped or used as pasture land for cattle grazing.
c/ *Open Water* includes natural and man-made ponds, channels, and ditches; acreages are based on field survey data.

Pipeline/Utility Line System

Table 4.7.1-3 shows the acreage impacts associated with construction and operation of the proposed Pipeline/Utility Line System and the three land uses (industrial land, open land, and open water) represented along the Pipeline/Utility Line System route network. These acreages include the minor footprints of the ancillary aboveground facilities (Air Liquide meter station and MLV station). Land use impacts would be avoided by the use of HDD to cross several waterbodies (constituting open water) and a wetland.

Construction and operation of the Pipeline\Utility Line System would not change the existing land use profile, construction and operation of the linear underground facilities would involve only temporary impacts, and the footprints of the aboveground ancillary facilities (<0.1 acres total) would be within Freeport LNG's existing pipeline rights-of-way or industrial property. Similarly, following temporary construction disturbance, the new operational right-of-way required for the NGL pipeline between the existing sendout pipeline route and the INEOS Plant would not change the land use classification there.

Of the four land use categories represented on the Pipeline/Utility Line System route, table 4.7.1-3 indicates that open land (82.8 acres) is the most affected land use category followed by open water (20.8 acres), and industrial land (15.7 acres). Open land is generally characterized by upland pasture used for cattle grazing and wetland areas, but also includes barren land, which has limited ability to support life and is less than one-third vegetative. Open water is primarily represented by a 1.7-mile length of the eastern Velasco Levee Ditch and accounts for 17 percent of the total construction workspace. The majority of industrial land is located at the terminal site, within the vicinity of the FHC and the ICW, and at the INEOS Plant; industrial land accounts for 13 percent of the total construction workspace.

Table 4.7.1-3

Freeport LNG Liquefaction Project
Impact Acreages for Land Uses on Proposed Pipeline/Utility Line System

Facility Type	Industrial Land a/		Open Land b/		Open Water c/		Total	
	CWS	OPF	CWS	OPF	CWS	OPF	CWS	OPF
Jurisdictional & Nonjurisdictional Pipelines - MP 0.00(A) – MP 4.55(A) & MP 0.00(B) – MP 0.35(B)								
Gas Inflow Gas Outflow BOG NGL Nitrogen Water Fiber Optic	**Construction Right-of-Way**							
	5.1	0.0	23.3	3.3d/	8.8	0.0	37.2	3.3
	Additional Temporary Workspace							
	0.0	0.0	6.2	0.0	1.2	0.0	7.4	0.0
Total:	5.1	0.0	29.5	3.3d/	10.0	0.0	44.6	3.3
Nonjurisdictional Pipelines/Utility Lines - MP 4.55(A) – 9.47(A) & MP 0.00(C) – MP 0.72(C) & MP 0.00(D) – MP 0.98(D)								
NGL Nitrogen Water Fiber Optic	**Construction Right-of-Way**							
	10.6	0.0	52.5	0.0	10.8	0.0	73.9	0.0
	Additional Temporary Workspace							
	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.0
Total:	10.6	0.0	53.3	0.0	10.8	0.0	74.7	0.0
Overall Total:	15.7		82.8		20.8		119.3	

Notes
CWS Construction workspace
OPF New operational footprint beyond existing sendout pipeline route
a/ *Industrial land* includes property (*high, medium, low intensity* and *open space*) developed for industrial and/or commercial purposes; *industrial land* can include both vegetated and non-vegetated land; acreages based on Land Use/Land Cover LULC data (USGS, 2010).
b/ Open Land includes both wetlands (emergent herbaceous wetlands and scrub-shrub wetlands), g*rasslands, which are undeveloped or used as pasture land for cattle grazing*; acreages based on LULC data (USGS, 2010), and barren lands.
c/ *Open water* includes ponds, lakes, and waterways; acreages based on map analysis and field survey data.
d/ Acreage for new operational footprint included in construction workspace total.
Land use category definitions based on Anderson *et al*., (1976 [revised 2001]).

4.7.1.2 Summary of Impacts

The Liquefaction Project would temporarily affect effect 321.7 acres of land and permanently affect 258.9 acres of land. Work on Quintana Island generally would take place adjacent or close to existing industrial uses of the Freeport LNG terminal and does not represent a substantial change in land use. The Pretreatment Plant work chiefly represents a change in land use from agricultural (associated with cattle grazing) to an industrial land use. Construction and operation of the Pipeline\Utility Line System would not change the existing land use profile. The visual impacts are shown to vary with distance from the facility, and generally are minor given the already existing LNG terminal and associated industrial views in the area. As a result, the Liquefaction Project would have a minor impact on land use in the area.

4.7.1.3 Impacts from the Phase II Modification Project

Construction and operation of the Phase II Modification Project facilities would involve both permanent and temporary land impacts at the Quintana Island terminal. A total of 38.5 acres of land would be required, including 14.6 acres that would be temporarily disturbed during construction and 23.9 acres that would be affected on a permanent basis for operation.

Table 4.7.1-4 shows the acreage impacts associated with construction and operation for the three land uses (open land, industrial land, and open water) represented within the Phase II Modification Project footprint.

Table 4.7.1-4

Freeport LNG Phase II Modification Project
Impact Acreages for Land Uses

Project Component	Open Land a/		Industrial Land b/		Open Water c/		Total	
	Temp	Perm d	Temp	Perm d/	Temp	Perm d/	Temp	Perm d/
Phase II Dock and Berthing Area	3.6	10.5 e/	0.5	2.1	1.9	4.8 f	6.0	17.4
LNG Transfer Pipelines	2.9	1.1	3.4	2.2	0.0	0.0	6.3	3.3
Access Road System	2.2	1.2	0.1	2.0	0.0	0.0	2.3	3.2
TOTAL:	9.1	12.5	4.0	6.3	1.9	4.8	14.6	23.9

Notes
Temp Temporary impacts during construction (not included in permanent impact totals)
Perm Permanent impacts during operation (not included in temporary impact totals)

a/ *Open land* includes upland grassland, upland scrubland, emergent wetland, scrub/shrub wetland, pasture land, and maintained rights-of-way.
b/ *Industrial land* includes property developed as part of Phase I by Freeport LNG and the plant road on the berm adjacent to the east side of the ExxonMobil property that currently provides access to the northern portion of the leased area; *industrial land* can include both vegetated and non-vegetated land.
c/ *Open water* includes on-site ponds, drainage channels, and dredging for the berthing area.
d/ Unless otherwise indicated, project operations would result in a conversion of the existing land use to industrial land.
e/ Includes the conversion of 8.2 acres of open land to open water and 2.3 acres of open land to industrial land.
f/ Includes 4.8 acres of open water within the berthing area. Land use within this area would not change.

Open lands within the Phase II dock and berthing area are composed of herbaceous uplands, emergent wetlands, and two small areas of scrub-shrub uplands. Of the 21.6 acres of open land affected, 9.1 acres would be temporarily affected and 12.5 acres would be permanently affected by operation. Development of the Phase II dock and berthing area would result in the permanent conversion of 8.2 acres of open land to open water and 2.3 acres of open land to industrial land. The plant road system and right-of-way for the elevated transfer pipelines would convert 1.2 acres and 1.1 acres, respectively, of open land to industrial land.

Industrial land includes property developed by Freeport LNG for the Phase I facilities, primarily the process area and the Phase I dock. Industrial land also includes the former FOC property that is located approximately 575 feet west of the existing berthing area. Of the 10.3 acres of industrial land affected, 4.0 acres would be temporarily disturbed and 6.3 acres would be permanently affected by facility operation. Development of the Phase II dock and berthing area would result in the permanent conversion of 1.2 acres of industrial land to open water.

Impacts on open water would occur as a result of construction and operation of the proposed Phase II dock and berthing area. The 4.8 permanently affected acres of open water represent an area along the north shore of the existing berthing area (3.5 acres), Drainage Channel C (0.4 acres), and Pond 2 (0.9 acres), all of which would be dredged specifically for the Phase II Modification Project. In addition, open water would be created for the berthing area as a result of shoreline excavation, which would convert 8.2 acres of open land and 1.2 acres of industrial land to open water. Open water impacts are expected to be minor, as Phase II Modification Project construction and operational activities would be consistent with current uses.

4.7.2 Recreation and Special Interest Areas

Recreational resources and activities in the vicinity of the Quintana Island terminal and along the existing sendout pipeline route have been described and evaluated previously for the Phase I Project (FERC, 2004) and/or the Phase II Project (FERC, 2006). Since these evaluations were completed, no significant changes in the recreation profile of the area have been evident. The most popular activities continue to include boating and fishing in the Gulf and adjoining waterbodies as well as camping, hunting, bird watching, and beach use.

Designated recreational areas on Quintana Island close to the terminal site include Quintana Beach County Park, the NBS, and Xeriscape Park (expanded in 2005), all of which are located 0.1 mile or less to the south, in or near the Town of Quintana. Quintana Beach County Park is a 50-acre park with amenities such as recreational vehicle sites, restrooms, and showers. It also includes elevated wooden boardwalks for beach and dune access, hiking trails, boating facilities, grassy areas for sports, two historic homes, several pavilions, and a fishing pier.

In addition to Quintana Beach County Park, two other parks are located on Quintana Island: Morrison Park and the Bryan Beach unit of the Justin Hurst WMA. Morrison Park is located on CR 723 (Lamar Street), approximately 0.2 mile southwest of the proposed Liquefaction Project site at the terminal. The park occupies a square 0.2-acre plot of land adjacent to a shoreline lagoon and includes cabanas, a barbecue pit, a picnic table, and a swing set. It also provides opportunities for fishing and crabbing in the lagoon. The Bryan Beach unit of the Justin Hurst

WMA is located on the south end of Quintana Island, south of CR 1495 and approximately 2.6 miles southwest of the proposed Liquefaction Plant. In addition, many residents in the community to the southwest of the Quintana Island terminal have boat docks adjacent to their homes and would use the ICW and FHC for transit or for other recreational purposes.

The Pretreatment Plant site is located in a semi-rural area that is predominantly used for cattle grazing but also supports several residential communities, commercial developments concentrated along arterial roads (SH 332 and FM 523), and infrastructure associated with oil and gas production and storage.

The closest recreational area to the Pretreatment Plant site is the Brazoria NWR, which lies about 0.7 miles northeast of the site at its closest point, beyond the Velasco Levee. The Brazoria NWR is characterized by extensive coastal wetlands. The only public road access is through the main entrance on CR 227, about 5.4 miles north of the Pretreatment Plant site. A gravel road runs for 7.5 miles through the Big Slough Recreation Area at the heart of the Brazoria NWR and a network of pathways allows pedestrian access to various woodland, wetlands, and open water habitats. Waterfowl hunting for duck, geese, and coots is permitted on the Christmas Point hunting area, which can only be reached by boat, and on Middle Bayou, which has both pedestrian and boat access. The hunting season is from late October to mid-January. Fishing is allowed year around and pedestrian and/or boat access is available in select areas.

The evaluation of the Pipeline/Utility Line System route did not identify any significant recreational or special interest areas beyond those discussed already with respect to the Quintana Island terminal site and the Pretreatment Plant site.

4.7.2.1 Impacts and Mitigation

Liquefaction Project

Neither Morrison Park nor the Bryan Beach unit of the Justin Hurst WMA would be directly affected by construction or operation of the Liquefaction Project. Visitor traffic for both areas would be addressed as necessary in Freeport LNG's *Transportation Management Plan*.

It is not anticipated at this time that any safety or security exclusion zones implemented around the terminal would affect recreational uses, including boating and fishing but boating and fishing would be affected during the time dredging activities would be conducted. In addition, the additional barge traffic may lead to minor delays or inconvenience for boating and fishing.

While the nearest section of the Brazoria NWR is in reasonably close proximity to the Pretreatment Plant site, the two locations are separated by the Velasco Levee and an extensive emergent wetland/upland complex. Given the separation distance between the NWR and the Pretreatment Plant site, and the fact that the only public road entrance to the NWR is far removed geographically from the site, it is not anticipated that Freeport LNG's proposed development would have any significant impact on the NWR or its visitors.

Phase II Modification Project

Impacts on Recreation and Special interest areas resulting from the Phase II Modification Project would be similar to those described for the Liquefaction Project since the Phase II Modification Project location overlaps that of the proposed Liquefaction Plant.

4.7.3 Visual Resources

Visual impacts may occur during construction when large equipment, excavation activities, spoil piles, and construction materials are visible to local residents and visitors and during operation to the extent facilities or portion of facilities and their lighting are visible to residents and visitors. The degree of visual impact resulting from a project is typically determined by the general character of the existing landscape and the visually prominent features of the proposed facilities.

4.7.3.1 Liquefaction Project

Liquefaction Plant

The primary/critical views to be protected on Quintana Island are those views towards the ocean. Currently, at all locations on the island views inland are of industrial facilities. During construction of the proposed Liquefaction Plant at the terminal site, there would likely be temporary visual impacts on residences on Beach Lake Drive, located directly south of the Liquefaction Plant construction footprint, and to other residences in the Town of Quintana, located directly south of the eastern temporary workspace. The closest of these residences, on Beach Lake Drive, is situated approximately 180 feet from the Liquefaction Plant construction footprint. However, all these residences, and those in the community of Bryan Beach located approximately 0.10 mile west of the Liquefaction Plant, would be visually shielded from portions of the construction activity by the 21-foot-high levee that runs along the southern perimeter of the terminal site and the 30-foot-high levee that runs along the southern and western perimeter of the adjacent former DMPA. Views of the Liquefaction Plant from other directions would be more distant, primarily from industrial locations across open land and waterways (ICW and FHC).

During operation, the most prominent visual feature of the Liquefaction Plant at the terminal site would be the multiple air cooling fans associated with the Liquefaction Plant. Each of the liquefaction trains (Trains 1, 2, and 3), would include 50 fan units arranged contiguously in two adjacent rows, one row containing 26 fan units, one row containing 24 units, and each fan unit containing 3 fans. For each train, both rows would be located centrally on the foundation pad, between other equipment assemblies. The two fan rows for each train would collectively form a structure approximately 660 feet long, 120 feet wide, and 27 feet high (see figure 1-2).

Six residences (including both temporary rental properties and permanently occupied homes) are located on Cortez Street, south of the proposed Liquefaction Plant. The view from this location would be from a distance of at least 660 feet (the distance of the nearest residence to the new structures). We requested visual simulations to assess the visual impacts on residences in the vicinity of the Liquefaction Project. A visual simulation created nearby (to the north on an unnamed beach road) shows the Liquefaction Plant and the new LNG tank constructed under Phase II would result in changes to the view shed, although the viewshed in this direction is already industrial in nature, and thus the adverse visual impacts would be lessened somewhat by the existing industrial context of the landscape (see figures E-1 and E-2 in appendix E, which show existing conditions and proposed conditions).

Several residences in the community of Bryan Beach, would have views of the Liquefaction Plant. The closest residence to the Liquefaction Plant from this location is 0.58 mile. Figures E-3 through E-6 in appendix E show a visual simulation study of the three liquefaction trains in their new location from a nearby residence on CR 806c west/southwest of the site. The simulations were taken at ground level and also from a height of 25 to 27 feet above the ground elevation in order to present views from the upper floors of residences. The existing view where the facility would be constructed was previously used as a DMPA. This view would also encompass existing industrial facilities across the ICW. The simulation shows the Liquefaction Project creates a new industrial feature in the viewshed, though adverse visual impacts would be lessened somewhat by the views of the existing industrial facilities. The facility would have no impact on the views toward the ocean, although some people would be sensitive to the change.

Nighttime visual impacts were assessed via the development of simulations that show the impacts of facility lighting on night time views. Three views were evaluated: Viewpoint 01 provides the view looking southeast from the north side of the Quintana Island bridge on FM Route 1495; Viewpoint 03 provides the view looking northeast from the south end of Bryan Beach Road, near Quintana Beach; and Viewpoint 05 provides the view from the south end of an unnamed beach road, near Quintana Beach northeast of the Viewpoint 03 location (Refer to figures E-7 through E-9 in appendix E, respectively). As would be expected, lighting impacts become more visually pronounced with decreasing distance between the viewpoint and the terminal site, though it should be noted that all viewpoints already have a substantial amount of industrial lighting via the lighting from the existing Freeport LNG terminal, and via lighting from other industrial facilities in the area. In addition, Freeport LNG has mitigated lighting impacts to the extent possible via its FLDP. Given the industrial lighting already existing in the area, and Freeport LNG's mitigation efforts that help minimize glare and extension of lighting offsite, the additional lighting impacts are expected to be minor.

Pretreatment Plant

During construction and operation of the Pretreatment Plant, the most significant potential visual impacts would likely involve residences along CR 230 and Elm Street, located west of the Pretreatment Plant site. The closest of these residences is situated about 0.17 mile from the construction footprint and about 0.47 mile from the operational footprint. Views of the site from other directions would be much more distant and from unpopulated areas across open land. Figures E-10 and E-11 in appendix E provide a simulated view east from CR 230 (Stringfellow Road) across the Pretreatment Plant site. This represents the closest residential view of the proposed facilities. The visual simulation shows the Pretreatment Plant adds an industrial dimension to the otherwise open landscape, though the distance of separation between the plant and the closest residence helps to minimize visual impacts.

To minimize the effects of Pretreatment Plant lighting on local residents, Freeport LNG has developed a FLDP. The general concepts addressed in the plan include compliance with the regulatory requirements for lighting described in 49 CFR Part 192, Federal Aviation Administration Advisory Circulars, NFPA 59A, and the American Petroleum Institute's Recommended Practice 540 *Recommended Practice for Electrical Installations in Petroleum Processing Plants*.

The FLDP provides an overview of the different categories of lighting utilized throughout the facility for plant operations, perimeter security, roadways, aircraft obstructions, and emergency lighting. Various attachments to the plan, including a lighting fixture schedule, would describe the different lighting fixtures that would be installed (*e.g.*, pendant, wall, stanchion with pole supports or angled fixtures, flood lights, and street lights). Specific luminaires that would be used for reducing light pollution would be reviewed along with shielding and or direction of lighting to minimize glare to residential.

The FLDP addresses the mitigation actions that Freeport LNG proposes to use to minimize the amount of required light for the safe and efficient operation of the Pretreatment Plant.

Pipeline/Utility Line System

For the Pipeline/Utility Line System, visual impacts during construction would be relatively short term at any given location, due to the geographically sequential nature of pipeline installation. Beyond the minor ancillary aboveground facilities (Air Liquide meter station, NGL pipeline shut-off valves at Oyster Creek) and pipeline markers, no permanent visual impacts would be associated with operation of the Pipeline/Utility Line System alone.

4.7.3.2 Phase II Modification Project

The Phase II modification Project would consist only of a LNG vessel berthing dock; LNG transfer pipelines; the LNG unloading arms; and the access road system that was analyzed in the previous Phase II Project EA, and as such, would not have any significant additional visual impact.

4.7.4 Coastal Zone Management

The CZMA gives states with federally approved coastal management programs the responsibility of reviewing federal agency actions and activities to ensure that they are consistent with the state program's goals and policies. Any project that is in or may affect land and water resources in the Texas coastal zone and that requires a federal license or permit must be reviewed for consistency with the Texas Coastal Management Program (TCMP). Applicants for federal permits in coastal areas must provide the federal agency with a "consistency certification" stating that the proposed Project is consistent with the state's coastal management program. Because the Projects are located within a designated coastal zone management area, Freeport LNG is responsible for documenting that its Project is consistent with the TCMP.

Brazoria County is one of several counties included in the TCMP. The Coastal Coordination Council (CCC) was established by the TCMP to serve as the forum to coordinate state, federal, and local programs and activities on the coast. In order to obtain a federal permit in Texas, an applicant must document consistency with the Texas CMP. In order to obtain a consistency determination in Texas for a federal action (*e.g.,* a FERC project), applicants must submit a section 404 permit application to the COE, along with a consistency statement. The COE will forward the Public Notice to the CCC and the RRC. The CCC will post the Public Notice on its website and in the Texas Register. The RRC is responsible for reviewing federal agency actions and activities to confirm they are consistent with the TCMP.

There are no Coastal Management Program (CMP) areas of special concern within the Liquefaction Project area; the nearest coastal area coordinated by the CMP is Christmas Bay Coastal Preserve, located about 10 miles east of the Liquefaction and Phase II Modification Project area.

Proposed actions subject to the CMP must be deemed consistent with the program to be authorized. Freeport LNG would seek confirmation to this effect through consultation with the CCC and the RRC as part of the USACE Section 404/10 permitting effort for the Liquefaction Project. A determination from the CCC that the Projects are consistent with the laws and rules of the CMP must be received before a notice to proceed could be issued. Therefore, **we recommend that:**

> **Freeport LNG should not begin construction of the Projects until it files a copy of the determination of consistency with the Texas Coastal Management Program issued by the CCC.**

We note that Brazoria County is one of the counties involved in the Galveston Bay Estuary Program. Administered by the TCEQ, the program is part of the USEPA's National Estuary Program, which was created to guide the conservation and restoration of estuaries of national significance. However, because the Galveston Bay Estuary is located about 40 miles northeast of Quintana Island, the Projects are not expected to have any impacts on this program. No other National Estuary Program special management areas are located in Brazoria County.

4.7.5 Hazardous Waste Sites

Freeport LNG has conducted multiple field investigations and data base searches and has not identified the presence of hazardous, potentially hazardous, and solid waste management sites within the area of the Liquefaction or Phase II Modification Projects.

4.7.6 Planned Developments

In addition to the Liquefaction Project, and Phase II Modification Project on Quintana Island, Port Freeport is continuing a program of facility expansion and enhancement, which, in recent years, has included development of a 65-acre cargo storage area for wind turbine blades and the LNG terminal itself. Other initiatives within the county, in addition to Freeport LNG's Liquefaction Project, include: nine industrial developments; the Port Freeport Channel Widening

Project; the Velasco Terminal Development Project; five pipeline development projects; oil and gas well field developments (74 new wells proposed); roadway improvement projects including construction of an overpass at FM Route 1495 and SH 36 (construction to be completed in 2014); three commercial development projects, and three other residential developments (in the Lake Jackson area) (refer to detailed descriptions of proposed residential, commercial, and industrial developments in the assessment of cumulative impacts in section 4.12).

Of the above-referenced projects, the Velasco Terminal Project and Port Freeport Channel Widening Project would be closest to the Liquefaction Project area: the Velasco Terminal Project is located approximately one mile to the north of the terminal site and the Port Freeport Channel Widening Project involves dredging activities in the FHC, adjacent to and east of the terminal's berthing area. The Liquefaction Project is actively supported by Port Freeport and it would not impact any of the developments, with the possible exception of the FM Route 1495/SH 36 overpass. If respective construction timeframes coincide, development of the overpass would need to be factored into the *Transportation Management Plan* for the Liquefaction Project. Construction associated with the Channel Widening Project was scheduled to commence in the first quarter of 2012, although no activity has taken place to date.

4.7.7 Land Ownership

The Liquefaction Project facilities at the Quintana Island terminal would be located on property within a designated Industrial District and available to Freeport LNG through existing and pending lease agreements with Port Freeport. The properties on which the Pretreatment Plant and Air Liquide meter station would be sited are owned or leased by Freeport LNG or one of its component companies, whereas the NGL meter station would be located on industrial property owned by INEOS. For the proposed pipelines and non-electric utility lines, most of the route system is collocated with Freeport LNG's 42-inch-diameter sendout pipeline and easement agreements with private landowners are in effect for this existing pipeline. Freeport LNG would work with property owners to ensure that multi-line rights-of-way are reflected in any new or modified easement agreements that are necessary.

4.8 SOCIOECONOMICS

This section evaluates the effect of the Liquefaction Project, and the Phase II Modification Project on socioeconomics in the area. The assessment includes an evaluation of the proposed Projects' effect on local population, employment, the economy, housing, public services, traffic, property values, tax revenue, and environmental justice. The socioeconomic data presented is derived via the Bureau of Labor Statistics (2011a and 2011b) and the U.S. Census Bureau (2010) unless otherwise noted.

4.8.1 Population

As indicated in table 4.8.1-1, the populations of the State of Texas, Houston-Sugar Land-Baytown Metropolitan Statistical Area ("Houston MSA" or "Greater Houston"),[20] and Brazoria County increased by over 20 percent between 2000 and 2010. In contrast, the populations of the cities of Freeport and Oyster Creek decreased slightly, while the much smaller population of the Town of Quintana increased by 47 percent (from 38 to 56 persons). Greater Houston is one of the fastest growing urban areas in the country.

Table 4.8.1-1

Freeport LNG Liquefaction Project
Existing Population Characteristics

Geographic Area	Population			Population Density b/ (square mile)	Population 2012 Estimates	Unemployment Rate 2011 (percent)	Unemployment Rate 2012 (Percent) Estimates
	2000 a/	2010 b/	Percent Change				
Texas	20,851,818	25,145,561	20.6	96.0	26,059,203	8.1 c/	5.1 h/
Greater Houston	4,715,417	5,946,800	26.1	666.0	6,204,161	7.3 d/	5.6 h/
Brazoria County	241,767	313,166	29.5	225.9	324,769	8.4 d/	4.3 h/
City of Freeport	12,708	12,049	-5.2	1,069.6	12,079	8.9 e/	g/
City of Oyster Creek	1,192	1,111	-6.8	584.7	1,121	8.9 f/	g/
Town of Quintana	38	56	47.4	93.3	62	g/	g/

a/ U.S. Census Bureau, 2000
b/ U.S. Census Bureau, 2010a
c/ U.S. Department of Labor, Bureau of Labor Statistics, 2011a
d/ U.S. Department of Labor, Bureau of Labor Statistics, 2011b
e/ Sperling's Best Places, 2011a
f/ Sperling's Best Places, 2011b
g/ Recent employment data not available.
h/ US Census American Community Survey 1 year estimates

4.8.2 Economy and Employment

The top employment sectors for Brazoria County in terms of employee numbers are: educational services, health care, and social assistance (30,355 persons); manufacturing (18,619 persons); and professional, scientific, management, administrative and waste management services (14,457 persons). The largest employers within the county include Dow, Independent School Districts (ISDs), Infinity Group, Texas Department of Criminal Justice (TDCJ), and Wal-Mart Stores, Inc. (Economic Development Alliance for Brazoria County, 2010).

[20] Houston-Sugar Land-Baytown Metropolitan Statistical Area is a 10-county area defined by the U.S. Office of Management and Budget for collecting, tabulating, and publishing Federal statistics.

Consistent with Brazoria County as a whole, the top employment industries within the City of Freeport include: construction (1,259 persons); educational services, health care, and social assistance (753 persons); and manufacturing (671 persons). Top employers include Brazosport ISD, Dow, Phillips 66 Company, TDCJ, and U.S. Contractors (City of Freeport, 2012). Freeport LNG's existing terminal provides the major source of employment on Quintana Island – currently about 50 full-time operations personnel work at the facility. The adjacent Town of Quintana provides limited employment (15 persons) in the areas of manufacturing, arts/entertainment/recreation, and public administration.

Table 4.8.1-1 provides the unemployment rates for Greater Houston and Brazoria County in November 2011 were 7.3 percent and 8.4 percent, respectively and the corresponding unemployment rates for the City of Freeport and City of Oyster Creek were both at 8.9 percent. Estimated unemployment rates for Greater Houston and Brazoria County decreased in 2012 to 5.6 percent and 4.3 percent, respectively, showing an improved economic trend in the area. Currently, the City of Freeport's annual rate of job growth is 1.6 percent; job growth over the next 10 years is predicted to be 34.4 percent. The Brazoria County economy has added about 500 jobs a month in the past year, many of which are attributable directly or indirectly to industrial sector production growth resulting from the low price of shale gas used for fuel and as a chemical feedstock (The Facts, 2012).

4.8.2.1 Impacts and Mitigation

Liquefaction Project

<u>Employment</u>

Construction of the Liquefaction Plant at the terminal site would require a monthly average of 850 on-site temporary workers over the course of construction; however, the number of workers present during construction would vary through time (see table 4.8.2-1). Initially, 100 to 200 workers would mobilize to the site. As construction activity progresses, the construction workforce would increase to a monthly average of 800 temporary construction workers. During peak construction, the workforce would number 1,400 to 1,650 workers. Note that the construction schedule for the three pretreatment units would be staggered to coincide with the construction schedule for the three liquefaction trains: each liquefaction train and its corresponding pretreatment unit would be constructed concurrently within the approximate 48- to 54-month timeframe. The Pipeline/Utility Line System is expected to take 12 to 18 months and would be performed concurrently with the Pretreatment Plant work.

Table 4.8.2-1

Number of Workers Duration Construction

Phase	No. of workers during early construction period (~ one – six months)	Monthly Average no. of workers after initial startup work	No. of workers at peak	Total Duration (months)
Liquefaction Plant	100 to 200	800	1,400 to 1,700	48 to 54
Pretreatment Plant and Pipeline/Utility Line System	20 to 70	850	1,200 to 1,350	48
Total	120 to 270	1650	2,600 to 3,050	48 to 54

As the Liquefaction Plant nears completion and commissioning, workforce numbers would decrease. During the peak construction period for the Pretreatment Plant approximately 1,200 – 1,350 workers would be required. This amount includes approximately 50 to 60 construction workers needed to construct the Pipeline/Utility Line System during the peak construction period. These workers are in addition to those required for construction of the facilities at the Liquefaction Plant site. However, like the workforce at Quintana Island terminal, the number of workers present during construction Pretreatment Plant would vary through time. Initially, 20 to 70 workers would mobilize at the Pretreatment Plant site. As construction activity progresses, the workforce would increase to a monthly average of 850.

Based on the numbers presented above, the Liquefaction Project as a whole would require, during the peak construction period, up to 3,000 temporary construction workers. Assuming 50 percent of the workers, at peak construction period, are non-local, and that they all would temporarily reside in Brazosport (*i.e.*, 1,500 personnel) during Project construction, the associated influx represents about 2.4 percent of the total population of this area. Should non-local workers be accompanied by family members, and based on an average family size of 3.4 persons in the State of Texas, up to 5,100 persons could temporarily relocate to the area. It is likely that the actual number of in-migrants could be smaller because individual workers could relocate at different times, for different durations, and may not bring families with them. As well, a significant portion of non-local workers are likely to commute from outside the area if possible to avoid added housing costs.

The type of general contractor awarded the construction contract (*i.e.*, local versus non-local and union versus non-union) would have a direct impact on the percentage of the workforce that would be hired locally, the number of workers that would commute daily from outside the area, and the number that would temporarily relocate to the area. Predominantly local workers from southern Brazoria County would be utilized; however, as much as half the workforce may originate from Greater Houston. In summary, the population impacts would be temporary, minor, and offset by employment and economic benefits.

Operation of the Liquefaction Project facilities would require the addition of approximately 163 permanent workers to Freeport LNG's existing staff: 22 terminal administration staff, 84 operations and maintenance staff for the Liquefaction Plant, and 57 operations and maintenance staff for the Pretreatment Plant and Pipeline/Utility Line System.

Freeport LNG intends to hire and train local residents where possible for operational positions; and therefore, it is anticipated that many of the approximately 163 additional full-time employees would come from the Brazosport area and impacts on local population from the facility's operation would be negligible.

Displacement of Businesses or Residences

Construction and operation of the Liquefaction Project would not result in direct competition with any local businesses and would not require the relocation or involuntary displacement of any residences or businesses. The Liquefaction Plant at the terminal site would be on industrial-zoned land leased from Port Freeport and wholly occupied by Freeport LNG. The Pretreatment Plant would be sited on land purchased by Freeport LNG under a voluntary transaction and the

Pipeline/Utility Line System would, for the most part, follow existing operational rights-of-way. New operational rights-of-way would not cause any changes to existing land use.

Property Values

The main operational footprint of the Pretreatment Plant is located at least 0.5 mile from the nearest residence on land previously in industrial use and we do not anticipate any impact on the value of adjacent properties or homes. The Liquefaction Plant would be adjacent to the terminal site would be constructed and operated on undeveloped, industrial-zoned property available to Freeport LNG through existing lease agreements. The area is already utilized for LNG import and other industrial activities, and while there would be visual and other environmental impacts, it is unknown if any impacts on the value of property on Quintana island would occur.

Payroll and Material Purchases

The Liquefaction Project would have an estimated total construction payroll of approximately $650 million over the 48- to 54-month construction timeframe and an annual operational payroll of $2 million. Because southeast Texas supports an extensive manufacturing and processing infrastructure for the chemical and petro-chemical industries, many construction materials and equipment supplies are readily available locally and Freeport LNG anticipates that most construction-related purchases would be made in Brazoria County. Although the specific amount that Freeport LNG would spend on construction material purchases within Brazoria County cannot be readily calculated, Freeport LNG estimates that the Liquefaction Project's spending profile would be similar to that for the Phase I Project, which would result in approximately 18 percent ($490 million) of the total Project construction outlay ($2.7 billion) being spent within Brazoria County.

Tax Revenues

Construction of the Liquefaction Project would result in increased sales tax revenues for local communities, Brazoria County, and the State of Texas. Freeport LNG paid approximately $5,740,000 in taxes or other payments to city, county, and state agencies that support local communities, schools, and transportation infrastructure in 2010. This included $1,211,000 for the Town of Quintana, $2,770,000 for various Brazoria County entities (including Brazosport ISD), and $1,759,000 for the State of Texas. Although specific tax revenues for the Liquefaction Project cannot be readily calculated at this time, increases would likely be significant and are estimated at $36 million per year after construction. New revenues would provide direct and indirect benefits to residents throughout the life of the Projects.

Removal of Agricultural, Pasture, or Timberland from Production

There would be no loss of cropland or timberland resulting from construction or operation of the Liquefaction Project.

Phase II Modification Project

Employment

Construction of the Phase II Modification Project would require about 300 on-site workers; however, the number of workers present during construction would vary through time. Initially, 200 to 250 workers would mobilize to the site. As construction activity progresses, the construction workforce would ramp up to an average of 300 workers. During peak construction, the workforce would number 500 to 600 workers. The number workers associated with construction of the LNG storage tank authorized as part of the Phase II Project, which would be constructed in conjunction with the Phase II facilities as modified. As the facilities near completion and commissioning, workforce numbers would decrease. It is anticipated that that three to five full-time operational employees would be hired at the terminal as a consequence of the Phase II Modification Project.

It is expected that Freeport LNG would utilize predominantly local workers from the southern Brazoria County area; however, as much as half the workforce may originate from the Greater Houston area.

Assuming all non-local workers (150 personnel or 50 percent of the estimated average construction workforce) temporarily reside in Brazosport during Project construction, the associated influx represents 0.2 percent of the total population of this area (estimated as 57,288 in 2010 [U.S. Census Bureau, 2010b]). Should non-local workers be accompanied by family members, up to 510 persons could temporarily relocate to the area.

This estimate is based on an average family size of 3.4 persons in the State of Texas. For purposes of estimating impacts on the local population, the 510 persons estimated to relocate to the area assumes that each non-local construction worker would be accompanied by 2.4 family members. It is likely that actual number would be much smaller because individual workers would relocate at different times, for different durations, and may not be accompanied by family members, and a significant portion of the non-local workers are expected to commute to the area daily from the Greater Houston area from 45 to 100 miles away.

Based on the above-described estimates for construction personnel, any temporary increase in local population size resulting from the Phase II Modification Project would be minor.

Displacement of Businesses or Residences

The Phase II facilities at the terminal site would be on industrial-zoned land leased from Port Freeport and wholly occupied by Freeport LNG. The Phase II Modification Project would not result in direct competition with any local businesses and would not require the relocation or involuntary displacement of any residences or businesses.

Property Values

The Phase II facilities at the terminal site would be on industrial-zoned land leased from Port Freeport and wholly occupied by Freeport LNG and similar in visual impacts on the existing facilities. No consequential impact on the value of this property or other nearby property on Quintana Island is anticipated.

Payroll and Material Purchases

Freeport has estimated that construction of the Phase II facilities would have a total construction payroll of approximately $150 million over the 36-month construction timeframe. Given Brazoria County's well-developed petroleum and chemical industrial infrastructure, many construction materials and equipment supplies are readily available locally. Therefore, Freeport LNG anticipates that a large portion of construction-related purchases would be made in Brazoria County. Freeport LNG estimates that the Phase II facilities' spending profile would result in approximately 18 percent ($117 million) of the total construction outlay ($650 million) being spent within Brazoria County.

Tax Revenue

Similarly to the Liquefaction Project, the Phase II facilities would result in increased tax revenues for the State of Texas, Brazoria County, and local communities.

Removal of Agricultural, Pasture, or Timberland from Production

Construction and operation of Phase II facilities at the Quintana Island terminal would not require the removal of agricultural land, pasture, or timberland from production.

4.8.3 Public Services

4.8.3.1 Emergency Response

The Freeport LNG Liquefaction Project resides in an area of longstanding petrochemical, port, and urban activity which has a well-developed ability to handle large-scale emergencies.

The Brazosport Industrial Community Awareness & Emergency Response (CAER) coordinates emergency preparedness and response procedures between its 18 member companies and promotes emergency planning with the community. CAER operates several sirens for public awareness of incidents occurring within their area, a website providing up-to-date information on emergencies and evacuation notices, emergency training, emergency drills, and support (manpower, equipment, expertise) in emergency situations within the Brazosport industrial area.

In addition, the Brazoria County Emergency Planning Committee meets monthly at the Brazoria County Sheriff's office to review any drills/exercises that have been conducted by various entities and also upcoming ones. In attendance at this meeting are the 18 CAER participating companies, Brazoria County Emergency Manager and his deputy, Freeport Fire and Police Department, Oyster Creek Police Department, Alvin Police Department, Emergency Managers from Quintana, Freeport, Alvin, Oyster Creek, TCEQ Emergency Response, Lake Jackson, Port Freeport, Dow ER both pipeline and facilities, Kinder Morgan pipeline, and usually NOAA weather service.

Freeport LNG annually updates its Emergency Response Plan (ERP) to incorporate the latest in emergency response information as well as for each of the implemented projects. Each year Freeport LNG hosts a review of the ERP with area emergency responders, law enforcement, local and area governmental officials, and USCG. The Texas Department of Public Safety maintains an office in downtown Freeport with statewide access to personnel in the event of a large-scale emergency.

The Brazoria County Sheriff's Department is located in Angleton, 21 road miles from the Quintana Island terminal site and 17 road miles from the Pretreatment Plant site. In addition, many of the local municipalities, including the cities of Freeport and Oyster Creek, maintain their own police departments.

The Freeport Fire Department and the Oyster Creek Volunteer Fire Department provide fire protection services in the area. Eight other fire departments and volunteer fire departments are within 30 – 40 minutes from Quintana Island some of which have industrial firefighting capabilities. Freeport LNG annually provides for several terminal personnel and local firefighters to attend the LNG fire school at Texas A&M University.

The USCG's Freeport Station, which is located in Surfside across the FHC from the terminal, serves the Gulf Coast in search and rescue, law enforcement, and other missions. Emergency services, including medical, fire, and law enforcement, are available through the "911" service. USCG also has assets and personnel at the Galveston Station and the Marine Safety Unit (MSU) Texas City.

These groups work closely together to plan, drill, and integrate response plans for small and large-scale emergency response events for the petrochemical and industrial complexes, private business, port facilities as well as Freeport LNG's terminal.

Medical facilities in or near Brazosport include three hospitals (Brazosport Regional Health System, Sweeny Community Hospital, and Angleton Danbury Medical Center). The closest of these, Brazosport Regional Health System, is an acute care, not-for-profit hospital with 175 beds and the only Level III Trauma Center in Brazoria County. The hospital is located in Lake Jackson, 15 road miles from the Quintana Island terminal site and 11 road miles from the Pretreatment Plant site. Sweeny Community Hospital, located in Sweeny, is 30.3 miles from the terminal site and 31.7 miles from the Pretreatment Plant site. Sweeny Community Hospital has 20 beds. Angleton Danbury Medical Center, located in Angleton, is 25.4 miles from the terminal site and 18.6 miles from the Pretreatment Plant site. Angleton Danbury Medical Center has 64 beds. The above hospitals, along with Mategorda Regional Medical Center in Mategorda County (within 20 miles of the Projects) all have trauma centers and together serve over 100,000 emergency patients annually.

The Brazoria County Sheriff's Department is located in Angleton, 21 road miles from the Quintana Island terminal site and 17 road miles from the Pretreatment Plant site. In addition, many of the local municipalities, including the cities of Freeport and Oyster Creek, maintain their own police departments. The Freeport Fire Department and the Oyster Creek Volunteer Fire Department provide fire protection services in the Project area.

4.8.3.2 School System

The City of Freeport and its surrounding communities (including the City of Oyster Creek and Town of Quintana) are part of the Brazosport ISD. For the 2011-2012 school year, the Brazosport ISD was rated as an "Academically Acceptable" district by the Texas Education Agency (potential ratings include Academically Unacceptable, Academically Acceptable, Recognized, and Exemplary). The district has 19 schools (11 elementary, two middle, three intermediate, two high, one alternative) and 12,498 students for the 2011 - 2012 school year (TEA, 2013). Current capacity within the Brazosport ISD is 13,586 students (Ritchie, 2011). Based on current enrollment, the school district has capacity for an eight percent increase in the student population. Within the district, the student-to-teacher ratio is 19:1.

4.8.3.3 Public Service Impacts and Mitigation

Liquefaction Project

Brazoria County has a well-developed infrastructure to provide health, police, fire, emergency, and social services. Because the non-local workforce would be small relative to the current population of the area and its available services, construction of the Liquefaction Project would result in minor temporary, or no impact on 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 non-local workers that would be required for the Liquefaction Project. Other construction-related demands on local agencies could include increased enforcement activities associated with issuing permits for vehicle load and width limits, local police assistance during construction to facilitate traffic flow, and emergency medical services to treat injuries resulting from construction accidents. Freeport LNG would not have a significant impact with respect to its electric, water, gas, and sewage disposal requirements. The Brazosport ISD has the capacity for an 8 percent increase in its student population (more than 1,000 additional students) and should be able to address any small increase in student population resulting from a percentage of construction workers bringing their families to the area.

Phase II Modification Project

The Phase II Modification Project would not adversely impact the availability of local community facilities, and necessary public services (*e.g.*, medical care, police, and fire protection) are generally in adequate supply (see section 4.8.3.1). It is unlikely that many non-local construction workers would relocate to the area, either with or without their families. Therefore, there should be no impacts on the Brazosport ISD resulting from increased student enrollment. Even if all non-local workers were to relocate their families to the Liquefaction Project area, about 210 new students might be enrolled in the Brazosport ISD, which would constitute a 1.6 percent numerical increase in the 2010-2011 student population of 13,000. Impacts on public services and infrastructure associated with operation of the Phase II Modification Project would be negligible given the small number of operational employees involved.

4.8.4 Housing

In Brazoria County there are more than 4,200 vacant housing units for rent, and another more than 5,100 vacant units defined by the census as seasonal, recreational, occasional, migrant use, (U.S. Census Bureau, 2010a) and the county offers more than 2,800 motel/hotel rooms with an estimated 52 percent occupancy rate (Source Strategies, 2011). In addition there are 27 recreational vehicle/trailer parks within 20 miles of the site offering an additional option for temporary housing. In total, this data shows there may be as many as 10,700 potential places for vacant workers to stay. Table 4.8.4-1 shows additional information on housing characteristics.

Table 4.8.4-1

2010 Housing Characteristics in Brazoria County (2012 Estimates)

State/County	Owner Occupied (percent)	Renter Occupied (percent)	Median Value, Owner Occupied Units ($)	Median Contract Monthly Rent ($)	Vacancy Rate (percent)
Texas	62.3	37.7	$129,200	$831	11.7
Brazoria County	70.6	29.4	$146,900	$866	9.9

Source: U.S. Department of Commerce, Bureau of the Census, 2010 Census of Population and Housing and American Community Survey 1-year Estimates, (www.census.gov).

4.8.4.1 Housing Impacts and Mitigation

Liquefaction Project

The Liquefaction Project has a required peak workforce of approximately 3,000 which is significantly smaller than 10,700 potential vacant units available to house workers. There appears to be an adequate supply of housing and temporary accommodations in the area. In addition, a significant number of employees are expected to be hired locally and therefore already have housing, which would reduce the overall demand from the Freeport LNG Project workforce. The proposed construction schedule for the Liquefaction Project could coincide with other demands for housing and temporary accommodations from tourism and other unrelated construction projects. Because the demand (in both numbers and time) from these other users would be influenced by factors such as weather and economic conditions, such demand would be unpredictable. At present, it is reasonable to assume that the facilities available to accommodate the expected workforce, however, the increased demand may at times cause low motel/hotel room availability and/or price increases.

Phase II Modification Project

Despite the large workforce associated with construction of the Phase II Modification Project, the use of local labor to the extent practicable would minimize potential impacts on housing availability. In addition, there is adequate temporary housing in the form of motels, hotels and rental properties to address the conservative estimate of 150 workers who might require housing. Independently, no appreciable impacts on housing are expected from the Phase II work as a result of Project operation, given the small number of operational employees involved.

4.8.5 Traffic

The Projects would generate roadway traffic related to deliveries of construction supplies, and traffic generated by construction workers along roadways to the Quintana Island terminal site, the Pretreatment Plant site, and along the Pipeline/Utility Line System.

Quintana Island is reached from the mainland and the City of Freeport by FM Route 1495, also known as Navigation Boulevard. Major roads connecting to FM Route 1495 in the Freeport area are SH 36 and FM Route 523. The Quintana Island terminal site is approached by turning left (east) from FM Route 1495 onto CR 723, which becomes Lamar Street parallel to, and just south of the ICW.

The Pretreatment Plant site is located on the west side of CR 690 (Levee Road), approximately 0.7 mile north of the intersection of CR 690 and SH 332. The site is regionally situated about 0.5 mile east of the nearest development in the City of Oyster Creek and about 3.5 miles northeast of downtown Freeport. Current road access to the site property is provided by two roads: 1) a private haulage road that runs for approximately 0.6 mile between an entrance on SH 332 (located about 0.9 mile southeast of the SH 332/FM Route 523 intersection) and the west side of Freeport LNG's property (located to the northeast of the intersection); and 2) CR 230, which runs for approximately 1.3 miles between an intersection with FM Route 523 to an intersection with the above-referenced haulage road adjacent to and west of Freeport LNG's property.

Access to the Pipeline/Utility Line System construction areas beyond Quintana Island would be via the existing local roadway network in Surfside Beach, CR 690 (Levee Road) and CR 792 (Suggs Road) in the Oyster Creek area, and FM Route 523 in the Stratton Ridge area.

4.8.5.1 Traffic Impacts and Mitigation

Liquefaction Project

<u>Quintana Island Terminal Deliveries</u>

Delivery of materials and equipment to the Quintana Island terminal site during construction would be accomplished by two primary methods:

- most major pieces of equipment (*e.g.,* compressors, vessels) and large volume bulk materials (*e.g.,* aggregate, structural steel) would be barged to the Liquefaction Plant site and off-loaded at the aggregate barge dock and new construction dock; and

- local supplies of construction consumables and smaller volume freighted materials would be transported to the site by truck.

The new aggregate barge dock would be located on the south shore of the ICW near the northwest corner of the Liquefaction Plant site; the new construction dock would also be located on the south shore of the ICW, approximately 1.1 miles east in the vicinity of existing Terminal Maintenance Building. At the aggregate barge dock, barges would be tied up to the spud breasting barge (unloading barge). At the construction dock, barges would be tied up to breasting dolphins and to the unloading platform. If loaded barges arrive ahead of schedule, they would be moored in the existing berthing area on the east side of the terminal site until they can be moved into position for unloading. Freeport LNG estimates that 300 to 450 barge visits would occur during facility construction.

Road transportation of materials, earthen fill, and equipment to the terminal site would generate at least 10 to 12 deliveries via tandem truck per day during construction, with a peak of at least 15 to 20 trips per day during the most active period. A similar number of trips by small, two-axle trucks would be anticipated. The large amount of fill material needed for the Liquefaction Plant, if trucked to the Quintana Island terminal, would generate adverse traffic impacts and inconvenience the residents of the Town of Quintana. It would also potentially cause increased roadway dust and debris. Freeport LNG has indicated its intent to limit truck deliveries to the extent practicable due to the potential for adverse impacts that a high trucking volume would have on Town of Quintana residents and to accommodate local weight restrictions on the ICW Bridge and Lamar Street.

Quintana Island Terminal Construction Worker Traffic

Construction workers would leave their vehicles at a dedicated parking lot on the mainland and would be bused to and from the construction site on Quintana Island. Coordination with Port Freeport has identified an area along FM Route 1495 that is within the Port secure area and was used for off-site parking during the Phase I Project. This area would be similarly used for off-site parking for the Liquefaction Project, having the advantage of safe and easy entry and exit from both SH 36 and FM Route 1495. This would limit the amount of traffic on CR 723, the single means of road access for the terminal and the Town of Quintana on Quintana Island. Parking would not be permitted on Quintana Island, with the exception of a limited number of contractor staff. Each bus journey from the parking lots to the construction site would take approximately 8 minutes. Each bus driver would make multiple trips. For an estimated average construction workforce of 1,000 persons, 12 buses would be needed (based on two trips per bus).

Freeport LNG has indicated that traffic control, particularly at the end of the work day when employees are leaving the mainland parking areas, would be handled through the use of contracted off-duty City of Freeport police and/or Brazoria County sheriff's deputies. During these times, traffic impacts would be at its most severe. As with construction traffic control for the Phase I Project, the cost of police assistance with traffic control for the Liquefaction Project would be borne by Freeport LNG.

Pretreatment Plant Site Deliveries

Direct deliveries of materials and equipment to the Pretreatment Plant site and Pipeline/Utility Line System construction areas would be by truck. Road transportation of materials and equipment to the Pretreatment Plant site would generate at least 12 to 15 deliveries via tandem truck per day during construction, with a peak of 25 to 30 trips per day during the most active period. During construction, the substantial amount of fill required for the Pretreatment Plant would necessitate the delivery of large amounts of fill by truck. These trips, along with other deliveries could potentially have an adverse impact on local roadway traffic and inconvenience nearby residents, as well as issues with road dust and debris.

Pretreatment Construction Worker Traffic

During construction, use of CR 230 would be avoided or restricted to small trucks and cars because the road runs through a small residential area near the site. Construction worker parking would be provided at the Pretreatment Plant construction site, in a dedicated 14- to 18-acre portion of the temporary workspace. Until the two access roads between the Pretreatment Plant site and CR 690 are built, all commuter traffic would enter and leave via the existing haulage road that connects the property with SH 332. Overflow parking, if required, would be located at Freeport LNG's existing underground storage facility, located approximately 5.4 miles from the construction site. In this case, workers would be bused to and from the site. Freeport LNG has indicated that off-duty City of Freeport police and/or Brazoria County sheriff's deputies would be contracted to provide traffic control, as necessary.

Pipeline/Utility Line System Deliveries

Road transportation of materials and equipment for the Pipeline/Utility Line System would be transitory and would revolve predominantly around pipe deliveries and deliveries associated with HDD. This would result in approximately 130 to 150 tandem truck deliveries to various points along the system. As with construction of the Phase I sendout pipeline, a large percentage of pipeline welding would occur adjacent to CR 891 and the eastern Velasco Ditch. This would be the main area for truck deliveries of pipe joints and HDD-associated deliveries.

Pipeline/Utility Line System Construction Worker Traffic

Access to the Pipeline/Utility Line System construction areas beyond Quintana Island would be via the existing local roadway network in Surfside Beach, CR 690 (Levee Road) and CR 792 (Suggs Road) in the Oyster Creek area, and FM Route 523 in the Stratton Ridge area. Access is also available at several of the road crossing locations. However, area roads generally do not provide sufficient room and/or suitable traffic flow conditions for the temporary parking of personal vehicles during construction. As such, construction workers would leave their vehicles at ATWSs and/or off-site parking lots at existing Freeport LNG facilities, including the Stratton Ridge underground storage site. Where needed, the workers would be bused between the parking areas and the work sites.

Modeled Traffic Impacts

Quintana Island and the area of Freeport close to the terminal site, as well as the Brazosport region generally, are accustomed to notable fluctuations in road traffic flows due to their socioeconomic profile. Brazosport is characterized by a mix of traffic associated with industrial, construction, shipping, and recreational/tourism activities. Some local petrochemical and industrial complexes experience large daily inflows and outflows of vehicles during work shift turnarounds and construction projects. Port Freeport experiences large increases in road traffic when vessels are being unloaded and commodities transported out of the area. Recreational and tourist traffic patterns vary seasonally, with most activity taking place at weekends and during special events.

Characteristic traffic conditions on any given roadway system are typically measured and categorized according to Level of Service (LOS), which is a rating system used in traffic engineering to measure the effectiveness of the operating conditions of roadways and intersections. Each level is used to describe traffic flow in terms of delay experienced by motorists. Several variables impact the quality of traffic flow, including speed, travel time, vehicular delays, traffic interruptions, and the freedom to maneuver.

There are six LOS levels ranging from "A" to "F". Level A is defined as being ideal flow conditions with little or no delay, whereas Level F is defined as conditions where extreme delays may be encountered.

Based on LOS standards, Freeport LNG modeled existing traffic flow patterns in the Liquefaction Project area and any changes in these patterns that might be anticipated during facility construction and operation. Modeling was performed for two construction years - 2015 and 2018 - and incorporated known planned and on-going construction projects (*e.g.*, Dow ethylene plant) in the Brazosport area.

Modeling of traffic volumes during peak construction activities associated with the Liquefaction Project and Phase II Modification Project combined would result in a LOS of F for SH 288/SH 36, FM Route 1495/Gulf Boulevard, SH 36/FM Route 1495, FM523/SH 332, and SH332/CR690 during certain times of the construction work. However, the use of traffic mitigation strategies can reduce all of these intersections to a worst case of level D or better. These mitigation strategies include use of flagmen during construction and in some cases improvements to the intersections to allow for better traffic flow as outlined in Freeport LNG's Traffic Impact Study but would result in reduced traffic flow and on local traffic arteries in Brazoria County and near the Town of Quintana.

Transportation Management Plan

Freeport LNG has prepared a Traffic Management Study, but has not specifically committed to implement traffic and transportation mitigation measures. Because Freeport LNG has not provided a consolidated set of mitigation measures to reduce transportation-related impacts associated with the movement of materials and commuting construction workers and other issues **we recommend that:**

> **Prior to the end of the draft EIS comment period, Freeport LNG should develop a Transportation Management Plan that details specific measures that would be used to transport materials and construction workers safely to the project work sites. The Transportation Management Plan should identify off-site vehicle parking areas, alternative worker transportation methods including buses and/or barges, traffic control measures, pedestrian safety measures, traffic control personnel, and construction and delivery hours.**
>
> **Freeport LNG shall file the plan, along with any comments provided by Brazoria County agencies, for review and written approval by the Director of OEP.**

As stated above, nearby residents, especially those of the Town of Quintana would be affected by the large increase in construction and worker vehicle traffic. This would be minimized to the extent practicable by the Transportation Management Plan however this would result in a significant and unavoidable impacts on the residents of the Town of Quintana during construction of the Liquefaction Plant and Phase II Modification Projects. For the wider Brazoria County, our recommendation and Freeport LNG's construction plans would mitigate these impacts and would not be significant.

Phase II Modification Project

Phase II Modification Project Deliveries

Delivery of materials and equipment to the terminal site would be accomplished as follows:

- large commodities and bulk materials associated with construction of the Phase II dock would be delivered to the site via 10 to 12 barge visits over the construction period. Because construction would generally occur from within the berthing area, off-loading of the materials onto a construction dock would not occur. In those relatively infrequent cases where Freeport LNG's existing construction dock on the ICW is utilized for receipt of barged commodities and materials, the barges would be tied up to the spud breasting barge (unloading barge).
- Local supplies of construction consumables and smaller volume freighted materials would be transported by truck.

The existing construction dock is located on the south shore of the ICW adjacent to the terminal (see figure 1-2). Barge cargo can be stored at Port Freeport until needed at the site. Alternatively, if loaded barges arrive ahead of schedule, they would be moored in the berthing area on the east side of the terminal site until they can be moved into position for unloading.

Road transportation of materials and equipment to the site would generate, on average, 10 to 12 deliveries via tandem truck per day during construction, with a peak of 15 to 20 trips per day during peak construction in addition to those required for the Liquefaction Plant. A similar number of trips by small, two-axle trucks can be expected. We are recommending that Freeport LNG prepare and utilize a Transportation Management Plan for the Projects that would mitigate transportation impacts as much as practicable.

Phase II Modification Project Construction Worker Traffic

As with the Phase I Project, construction workers would park their vehicles at dedicated parking lots on the mainland and would be bused to and from the Quintana Island terminal similar to that for the Liquefaction Project. For an estimated construction workforce of 300 persons, seven buses would be needed (based on two trips per bus) in addition to that required for the Liquefaction Project.

The same traffic controls would be implemented as with the Liquefaction Project. Impacts on traffic flows on Quintana Island or elsewhere as a result of operation of the Phase II Modification

Project, when combined with the operational traffic for the Liquefaction Project, would be minor given the small number of permanent employees involved.

4.8.6 Vessel Traffic

4.8.6.1 Vessel Traffic Impacts and Mitigation

Liquefaction Project

The proposed facilities are designed such that the addition of liquefaction capability would not preclude the terminal from operating in vaporization or sendout mode as business conditions dictate. Having dual liquefaction and regasification capabilities does not result in the terminal requiring any increase in the number of vessel transits and would not exceed thresholds authorized under the Commission's 2006 Order approving the Phase II Project.

It is unlikely that LNG import and export activities would occur concurrently: over any given period and as dictated by market conditions, vessels visiting the terminal would either be delivering LNG for regasification or taking LNG on board for export. The Liquefaction Project would not result in any additional vessel transits to/from the terminal beyond the level accommodated by current authorizations, and thus no vessel traffic impacts are anticipated.

Phase II Modification Project

Both the Phase I and Phase II docks have been designed with the capability to off-load LNG from, or load LNG onto, visiting vessels. The Phase II dock would have the capability of up to 200 vessels per year. Simultaneous transferring at both docks would accommodate up to 400 total vessels per year. The Phase II Modification Project would not result in any additional vessel transits to/from the terminal beyond the level accommodated by current authorizations.

In an effort to identify and minimize potential impacts on other waterway users and the public, Freeport LNG has consulted with elected officials, marine facility operators, local residents, and representatives of the USCG, Port Freeport, and Brazos Pilots regarding LNG vessel safety and movements associated with the approved Phase II dock. On November 11, 2011, after reviewing the possible navigational safety and security concerns associated with the Phase II Modification Project, the USCG informed Freeport LNG that neither submission of a Letter of Intent (LOI) nor a revision to the existing Waterway Suitability Assessment (WSA) was required since the Phase II Modification Project would not result in an increase in vessel size and/or the frequency of marine traffic.

Under current Port Freeport operating rules, LNG carriers would enter and leave the berth during daylight hours only, under one-way traffic conditions, and with the necessary tugs in attendance. Port entry, docking, cargo operations, undocking, and departure would typically take less than 24 hours. The potential impacts of LNG operations on other port traffic have been discussed in detail with Port Freeport officials and vessel pilots in the Brazos Pilots. Both groups maintain that LNG traffic would not create substantial delays for other deep draft traffic due to the short distances involved in port entry and departure transits, along with the planned availability of dedicated tugs. The Pilots estimate that the worst possible delay would be less than 30 minutes.

Berth placement and design take into consideration the establishment of USCG- mandated safety zones around the LNG carriers while they are moored. The docks would be set back far enough from the edge of the navigation channel such that safety zone entry restrictions would not hamper other traffic. Recent coordination between Freeport LNG and the USCG regarding the Phase II Modification Project indicates that, because the proposed Project would not result in an increase in the size and/or frequency of LNG marine traffic, the currently proposed Phase II Modification Project would require neither submission of a LOI nor revision of the existing WSA (USCG, 2011).

4.8.7 Environmental Justice

Executive Order 12898 on Environmental Justice requires that each federal agency address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. Federal agencies' responsibilities under this Order apply equally to Native American programs. Based on data from the U.S. Census Bureau (2010a), racial/ethnic population and income statistics for the Liquefaction Project are presented at state, county, and local levels in table 4.8.7-1.

As shown in table 4.8.7-1, in terms of minority representation, the communities in the immediate vicinity of the Projects do not show any fundamental characteristics that would differentiate them from Brazoria County or the State of Texas as a whole. While a relatively high percentage of the City of Freeport's population lives below the poverty level, Freeport LNG's continued payment of significant local taxes would help to support this area economically.

To evaluate information more specific to the area affected by the Liquefaction Project, the FERC assessed environmental justice statistics at the U.S. Census block group level, which is the smallest available geographic census unit. The information is presented below with respect to the Liquefaction Plant, the Pretreatment Plant, and the Pipeline/Utility Line System work.

Liquefaction Plant

The estimated percentage of the population living below the poverty limit and percentage of the population that is a minority was determined for each census block group within a study area that extends 0.5 mile from the Liquefaction Plant work area. Table 4.8.7-2 shows the poverty and minority data for the Liquefaction Plant area. This area covers three census block groups with the percent living below poverty ranging from 5.8 to 16.2 percent. Within these three census block groups, minorities constitute 10.8 to 63.4 percent of the population.

Table 4.8.7-1

**Freeport LNG Liquefaction Project
Existing Ethnic and Economic Conditions**

State/County	Race/Ethnicity (percent) White	Black	Native American	Asian	Hispanic or Latino a/	Other	Annual Per Capita Income b/	Percent Below Poverty Level b/
Texas	70.4	11.8	0.7	3.4	37.6	13.3	$24,870	16.8
Brazoria County	70.1	12.1	0.6	5.5	27.7	11.7	$27,529	10.6
City of Freeport	65.0	12.2	0.8	0.5	59.9	21.5	$16,866	19.4
City of Oyster Creek	83.5	3.8	1.6	0.4	23.5	7.6	$18,108 b/	14.6
Town of Quintana	100.0	0.0	0.0	0.0	0.0	0.0	$27,864	8.3

Notes
Source: U.S. Census Bureau, 2010a, unless otherwise indicated

a/ The Census Bureau treats ethnicity and race separately. Hispanics may be of any race, so also are included in applicable race categories; thus, the Hispanic/Latino percentages should not be added to percentages for other racial categories.
b/ U.S. Census Bureau, 2010b

Table 4.8.7-2

Poverty and Minority Populations in Census Block Groups within ½-mile of Liquefaction Plant

Census Tract	Block Group	Percent Below Poverty a/	Percent Minority b/
Census Tract 6644	Block Group 2	5.8	63.4
Census Tract 6642	Block Group 3	10.2	10.8
Census Tract 6642	Block Group 2	16.2	32.9

a/ U.S. Census America Community Survey 2008 – 20012
b/ U.S. Decennial Census, 2010

Pretreatment Plant

The study area for the Pretreatment Plant extends 0.5 mile from the Pretreatment Plant site and includes a single census block group (Census Tract 6642, Block Group 2). In that group, 16.2 percent of population lives below the poverty level and minorities represent 32.9 percent of the population (U.S. Census, 2010a).

Pipeline/Utility Line System

The study area for the Pipeline/Utility Line System extends 0.5 mile from the pipeline centerline and includes six census block groups (see table 4.8.7-3). The percent of the population that lives below the poverty line here ranges from 3.5 to 16.2 percent and the percentage of the population represented by minority's ranges from 10.8 to 63.4 percent.

Table 4.8.7-3

Poverty and Minority Populations in Census Block Groups within ½-mile of Pipeline/Utility lines

Census Tract	Block Group	Percent Below Poverty a/	Percent Minority b/
Census Tract 6644	Block Group 2	5.8	63.4
Census Tract 6642	Block Group 3	10.2	10.8
Census Tract 6641	Block Group 5	3.5	27.5
Census Tract 6642	Block Group 1	20.8	23.7
Census Tract 6642	Block Group 2	16.2	32.9
Census Tract 6640	Block Group 2	9.1	41.4

a/ U.S. Census America Community Survey 2008 – 20012
b/ U.S. Decennial Census, 2010

The analysis shows that some block groups have a higher percentage of minority population than Brazoria County and other block groups have a lower percentage of minority population than Brazoria County (*e.g.*, 10.8 percent to 63.4 percent minorities in the block groups affected versus 48.4 percent minorities in Brazoria County). The same is true for percent of persons living below the poverty line: this percentage ranged from 3.5 to 16.2 percent in the block groups affected versus a poverty rate in Brazoria County of 10.6 percent. Accordingly, we find the Liquefaction Project does not disproportionately affect minority populations or low income populations. The Phase II Modification Project is located in the same area as the Liquefaction Plant, and the above results apply to this work as well.

Under Executive Order 12898, each federal agency must ensure that public documents, notices, and hearings are readily available to the public. The mailing list for the Projects was initiated when the FERC's NOI was issued, and has been continually updated during the EIS process. All property owners affected by the Projects, as identified by Freeport LNG, received the notices about the Projects without any distinction based on minority or income status. The distribution list for the draft EIS included local newspapers and libraries; and all landowners, miscellaneous individuals, and environmental groups who provided scoping comments or asked to remain on the mailing list.

The FERC held two public scoping meetings in Brazoria County to provide residents, municipalities, special interest groups and federal and state regulatory agencies an opportunity to comment. The date and location of the meetings were included in both NOIs. Throughout this document we identify impacts on environmental resources that potentially may have a direct or indirect effect on the local population. We have not identified any disproportionately high and adverse human health or environmental effects on minority and low-income communities or Native American groups.

With our Traffic Management Plan recommendation we conclude that the traffic impacts would be mitigated and would not have a significant adverse impact on Brazoria County. In general, construction and operation of the Projects would not have a significant adverse socioeconomic impact on the local population, including public services, property values, or disadvantages communities.

4.9 CULTURAL RESOURCES

Section 106 of the NHPA of 1966, as amended, requires that federal agencies consider the effect that their undertakings would have on historic properties, and afford the ACHP and opportunity to comment. An undertaking includes any activity for which a federal agency has jurisdiction, including licensing or certification. Historic properties are prehistoric or historic districts, sites, buildings, structures, objects, landscapes, or properties of traditional, religious, or cultural importance, which are listed or eligible for listing on the NRHP. Freeport LNG, as a non-federal party, is assisting the FERC in meeting our obligations under Section 106, by providing data, analyses, and recommendations in accordance with the ACHP's implementing regulations at 36 CFR 800.2(a)(3). While we have delegated the gathering of cultural resources information to Freeport LNG, the Commission retains its authority to make final findings and determinations. This section discusses the status of the Projects' compliance with Section 106. The steps in the process to comply with Section 106 include consultations, identification of historic properties, assessment of effects, and resolution of any adverse effects.

4.9.1 Consultations

We sent copies of our NOIs for the Projects to a wide range of stakeholders, including the ACHP, U.S. Department of the Interior (USDOI), NPS, USDOI Bureau of Indian Affairs (BIA), the Texas State Historic Preservation Office (SHPO), and Indian tribes which may have an interest in the area. The NOIs contained a paragraph about Section 106 of the NHPA, and stated that we use the notice to initiate consultations with the SHPO, and to solicit their views, and those of other government agencies, interested Indian tribes, and the public on the potential effects on historic properties.

The USEPA responded to our NOIs in a letter dated August 15, 2012. The USEPA requested that our EIS for the Liquefaction Project describe the process and outcome of government-to-government consultations between the FERC and interested Indian tribes. This is described below. The USEPA also requested that the FERC consult with the SHPO, discuss impacts on historic properties, and address compliance with Section 106 of the NHPA. This is also described below. No other comments on cultural resources issues were received in response to our NOIs.

Through a review of Freeport LNG's application, and independent research, we identified Indian tribes that may have historically used or occupied the area, and may attach religious or cultural significance to historic properties in the Area of Potential Effect (APE), in accordance with Section 101(d)(6)(B) of the NHPA. In addition to sending our NOIs to potentially interested Indian tribes, on September 26, 2011 we wrote letters to the Alabama-Coushatta Tribe, Caddo Nation, Tonkawa Tribe, and Wichita and Affiliated Tribes, describing the Liquefaction Project and requesting comments. No Indian tribes responded to our letters.

In addition to the FERC's consultation program, Freeport LNG, through its environmental consultant (NRG), also communicated with Indian tribes it thought may have an interest in the Projects. On December 3, 2010, NRG sent letters by certified mail to the Tonkawa Tribe of Oklahoma, the Caddo Nation of Oklahoma, and the Alabama-Coushatta Tribe of Texas. The letters contained a project description and requested comments. On April 20, 2012, a second set of letters were sent to the three tribes, as well as the Wichita and Affiliated Tribes of Oklahoma, providing an update on Freeport LNG's current activities (Liquefaction Project, and Phase II Modification Project). To date, no comments have been filed by any of the tribes in response to the Freeport LNG letters.

Freeport LNG also communicated with the Texas SHPO. On November 19, 2010, NRG requested that the SHPO participate in the FERC pre-filing environmental review process for the proposed Liquefaction Project. On April 20, 2012, NRG sent another letter to the SHPO providing an update about the Liquefaction Project. Freeport LNG provided the SHPO with copies of its cultural resources reports, and the SHPO reviews of those reports are discussed below.

4.9.2 Overview and Survey Results

4.9.2.1 Area of Potential Effect

Since the Liquefaction Project contains three distinct components (*i.e.*, the Liquefaction Plant, a Pretreatment Plant, and a Pipeline/Utility Line System) the APE and cultural resources survey results for each is discussed separately below. Portions of the APE for the Phase II Modification Project and components of the Liquefaction Project were previously investigated for cultural resources during the prior Freeport LNG Phase I Project and Phase II Project overviews and surveys, and a summary of that work is discussed below.

4.9.2.2 Liquefaction Project Facilities

Liquefaction Plant at the Quintana Island Terminal

The Liquefaction Plant facilities would be located within the western portion of the existing Quintana Island terminal and on adjacent industrial-zoned land that was formerly a DMPA. The Liquefaction Plant facilities, and the associated laydown area at the Seaway DMPA, cover a total of about 305 acres. The Phase II Modification Project is also located at Quintana Island terminal.

The first overview report covering the Phase I Project was produced by Panamerican Consultants, Inc. (Panamerican) in 2002 (Cinquino *et al*., 2002). This report addressed 181 acres at the Quintana Island terminal, and was basically a literature review and site file search. Four previously recorded archaeological sites (41BO116, 41BO123, 41BO135, and 41BO175) were identified on Quintana Island.

In October 2004, Freeport LNG's contractor SWCA produced a cultural resources survey report for the Quintana Island terminal (Lawrence *et al.*, 2004). The survey of the "tank site" concentrated on 89 acres, excluding dredged materials and a marsh. No cultural materials were found in this area. Investigations of 48 acres at the "marine terminal" found 20 features related to the historic Quintana town site (previously recorded site 41BO135). SWCA evaluated those remains as not qualifying for nomination to the NRHP. In addition, previously recorded site 41BO123 was confirmed as the extant remains of the Quintana Cemetery.

In a letter dated October 20, 2004, the SHPO stated that the portion of the historic Quintana townsite (41BO135) located within the proposed Project construction area is not eligible for the NRHP. Further, the SHPO agreed with the recommendation that the Quintana Cemetery should be avoided. We concur.

In April 2005, Freeport LNG's contractor HRA Gray & Pape conducted a cultural resources survey of 48 acres at Quintana Island for the Phase II Project. No new cultural resources were found during that investigation (Pickering and Hughley, 2005). On June 2, 2005, the SHPO accepted the HRA Gray & Pape report, and stamped the cover letter "No Historic Properties Affected." We concur.

There are portions of Quintana Island where the Liquefaction Project facilities would be located that have not been covered by cultural resources surveys. This includes portions of the liquefaction trains area, the stormwater collection basin, and the temporary construction laydown area on the Seaway DMPA at the western end of the proposed terminal. Freeport LNG estimated that there are about 146 acres of proposed construction workspace for the Liquefaction Plant outside of the area previously investigated for the Phase I and Phase II Projects. Freeport LNG characterized this unsurveyed tract as DMPA land. In its April 20, 2012 letter to the SHPO, NRG requested concurrence with its recommendation that no further cultural resources surveys be conducted for the Liquefaction Project at or adjacent to the Quintana Island terminal, or along the route of the Pipeline/Utility Line System route, except for the electric power line. We believe the SHPO concurred with that recommendation, when it stamped the NRG letter on May 8, 2012, with its "No Historic Properties Affected" finding. The SHPO that no additional archaeological investigations should be necessary within the unsurveyed portions of the Liquefaction Plant at the Quintana Island terminal and on DMPA land, because those areas have a low potential to contain historic properties.

Pretreatment Plant

The proposed Pretreatment Plant would be located about 2.5 miles north of the Quintana Island terminal and about 3.5 miles southeast of Freeport LNG's Stratton Ridge gas storage facilities, along the route of the Pipeline/Utility Line System corridor. The Pretreatment Plant would occupy about 104.2 acres within a larger tract of 276 acres for which Freeport LNG has an option to purchase. Formerly, there was a sand extraction operation at this location.

In July 2012, HRA Gray & Pape produced a report that documented a cultural resources inventory of the proposed Pretreatment Plant (Nash *et al.*, 2012). A total of 309 acres were surveyed at this location. One group of structures, consisting of a corral and barn, were noted adjacent to the tract. These structures are still in use and were recommended as not qualifying for the NRHP.

HRA Gray & Pape provided the SHPO with a copy if its survey report for the Pretreatment Plant on June 18, 2012. On July 3, 2012, the SHPO stamped the cover letter with its finding of "No Historic Properties Affected." We concur.

Pipeline/Utility Line System

We consider the APE for the Pipeline/Utility Line System to be about 11.3-miles-long between Quintana Island and the INEOS Plant, covering about 127 acres combined. Most of the route for the Pipeline/Utility Line System would be collocated adjacent to Freeport LNG's existing 9.6-mile-long sendout pipeline between the Quintana Island terminal and the Stratton Ridge Meter Station. The exceptions, outside of the existing pipeline route, include:

- 2.9-mile-long electric line to the Liquefaction Plant;
- 0.4-mile-long Pipeline/Utility Line System route between the existing sendout pipeline right-of-way and the newly proposed Pretreatment Plant;
- 2.0-mile-long electric line to the Pretreatment Plant;
- 0.7-mile-long Pipeline/Utility Line System route between Stratton Ridge gas storage facilities and the existing sendout pipeline right-of-way; and
- 1.0-mile-long Pipeline/Utility Line System route between the end of the existing sendout pipeline near the existing Stratton Ridge Meter Station and the INEOS Plant.

Cultural resource investigations along the route of the sendout pipeline date back to the 2002 Panamerican overview report. That report identified four previously recorded sites (41BO4, 41BO70, 41BO114, and 41BO115) within 150 feet of the pipeline route (Cinquino, M., *et al.*, 2002).

In 2004, SWCA inspected a 120-to-150-foot-wide corridor along the proposed route of the 9.6-mile-long sendout pipeline, covering about 107 acres. Trenching at the previously recorded location of site 41BO125 (historic fort and townsite of Velasco) found scattered shells but no cultural artifacts or features. Previously recorded site 41BO114 was found to be outside of the extra workspace, and previously recorded site 41BO115 could not be relocated. SWCA concluded that no historic properties would be affected along the pipeline route, and the SHPO agreed on October 20, 2004. We concur.

In 2005, HRA Gray & Pape documented a survey covering about 249 acres at the Stratton Ridge gas storage facilities area. No cultural resources were found during that survey. On June 2, 2005, the SHPO agreed that no historic properties would be affected in the surveyed area. We concur. This surveyed area would contain the proposed location of the 0.7-mile-long Pipeline/Utility Line System route within the Stratton Ridge gas storage facility, including an 8-inch-diameter nitrogen line and an 8-inch-diameter water line. No other cultural resources investigations are necessary for those facilities.

In a letter to the SHPO dated August 23, 2010, HRA Gray & Pape discussed a 1.0-mile-long pipeline route for Freeport LNG's proposed NGL Extraction Project (Nash, 2010). That letter recommended that no field surveys be required, and the SHPO agreed on September 13, 2010. We cannot concur, because the copy of the report filed in LNG's application to the FERC did not contain any project maps, as required in the OEP's *Guidelines for Reporting on Cultural Resources Investigations for Pipeline Projects* (December 2002 version). It is possible that this report covers the proposed 1.0-mile-long Pipeline/Utility Line System route between the Stratton Ridge Meter Station and the INEOS Plant, outside of the existing sendout pipeline right-of-way. However, we cannot make this finding based on the data filed with the FERC, nor are we convinced by the report that historic properties could not exist along the unsurveyed Pipeline/Utility Line System route, and request this information per the recommendation in section 4.9.4.

The 2.9-mile-long 137-kV electric line from the CenterPoint substation in City of Freeport to the Quintana Island Liquefaction Plant does not require a cultural resources survey. Freeport LNG stated that the line would be placed on existing aerial infrastructure (poles), and therefore, installation of the new line would cause no ground disturbance or new visual impacts that may adversely affect historic properties. According to Freeport LNG, cultural resources information for the existing infrastructure was provided during the Phase I Project.

In a November 14, 2012 response to the FERC staff's October 25, 2012 data request, Freeport LNG stated that it had not yet conducted a survey of the proposed electric line to the Pretreatment Plant, due to routing issues and lack of landowner access. In Freeport LNG's data response of July 1, 2013, Freeport LNG stated it still did not have land owner permission to conduct such a survey, that a different company (CenterPoint) was in charge of the electrical line, and therefore that Freeport LNG does not have access to the cultural resource reports for the electric line.

4.9.3 Unanticipated Discoveries Plan and Cemetery Avoidance Plan

Freeport LNG originally prepared a *Plan Addressing Unanticipated Discoveries of Cultural Resources and Human Remains* for the Phase II Project that was accepted by the SHPO on June 2, 2005. However, to address FERC staff comments on that plan, for the Liquefaction Project Freeport LNG filed a modified *Unanticipated Discoveries Plan* as appendix 4D of Resource Report 4 in Freeport LNG's application. In its April 20, 2012 letter to the SHPO, NRG requested review of the revised plan. We determined that the SHPO accepted that plan when it accepted the April 20, 2012 letter using a stamp dated May 8, 2012. We also find Freeport LNG's revised *Unanticipated Discoveries Plan* to be acceptable.

The October 2004, SWCA survey report contained a protection plan for the Quintana Cemetery (Lawrence *et al.*, 2004). SWCA recommended that a three-foot-high earthen levee be built around the cemetery, secured with a chain-link fence on the outside of the berm, with controlled fenced access to the cemetery across the Velasco Drainage District levee. We believe that the SHPO accepted the recommendation to protect the historic Quintana Cemetery (site 41BO123) when it accepted the SWCA report on October 20, 2004.

Freeport LNG attached a copy of its *Cemetery Avoidance Plan* as appendix 4-C of its application to the FERC for the Liquefaction Project. The Quintana Cemetery is currently located within the existing Freeport LNG terminal, and is surrounded by a chain-link fence. An existing 21-foot-high storm protection levee should separate construction activities associated with the Liquefaction Project, including the Pipeline/Utility Line System route, from the cemetery. In addition, the terminal's secure area fence would be relocated higher up on the levee slope, and an infrared detection system would be installed. Also, Freeport LNG would hire a qualified professional archaeologist to monitor construction along the Pipeline/Utility Line System route across Quintana Island and through the community of Surfside. We find this plan acceptable.

4.9.4 Status of Compliance with the NHPA

No traditional cultural properties, burials, or sites of religious significance to Indian tribes were identified in the APE by the NPS, BIA, SHPO, Freeport LNG and its consultants, or the Indian tribes contacted by the FERC. We agree with the SHPO that no historic properties would be adversely affected in areas that have been inventoried.

We have not yet completed the process of compliance with Section 106, because not all Project facilities have been inventoried. Freeport LNG has not documented that the all elements of its Pipeline/Utility Line System and electric line for the Pretreatment Plant have been covered by cultural resources surveyed, outside of the existing 9.6-mile long sendout pipeline route between Quintana Island and the Stratton Ridge gas storage facility. The FERC must ensure that our responsibilities under the NHPA and the ACHP's implementing regulations for Section 106 at 36 CFR 800 are met. Therefore, **we recommend that:**

> **Freeport LNG should not begin construction of the Pretreatment Plant electric transmission line, and Pipelines/Utilities Line System and use of ancillary areas for staging, storage, and temporary work areas, and new or to-be-improved access roads, until:**
>
> a. **Freeport LNG files with the Secretary:**
>
> > **(1) remaining cultural resources survey report(s) and their attachments for work proposed by Freeport LNG;**
> > **(2) site evaluation report(s) and avoidance/treatment plan(s), as required; and**
> > **(3) comments on the cultural resources reports and plans from the SHPO;**
>
> b. **the ACHP is afforded an opportunity to comment if historic properties would be adversely affected; and**
>
> c. **the FERC staff reviews and the Director of OEP approves the cultural resources reports and plans, and notifies Freeport LNG in writing that treatment plans/mitigation measures (including archaeological data recovery) may be implemented and/or construction may proceed.**

All materials filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "CONTAINS PRIVILEGED INFORMATION - DO NOT RELEASE."

4.9.5 Phase II Modification Project

The Phase II Modification Project is located at the existing Quintana Island terminal. Freeport LNG has prepared a cultural resources overview report for the area of the Phase II Modification work and concluded that no impacts on cultural resources would occur. The Texas SHPO has concurred with this recommendation.

4.10 RELIABILITY AND SAFETY

The transportation of natural gas by pipeline involves some risk to the public in the event of an accident and subsequent release of gas. The pipeline facilities as part of Liquefaction Project are identified in table 2.1.3-1 and include the BOG pipeline and interconnects. In addition to the natural gas pipelines, there would be a water pipeline, nitrogen pipeline, and a nonjurisdictional NGL pipeline.

In regards to natural gas pipelines, the greatest hazard is a fire or explosion following a major pipeline rupture. Methane (CH_4), the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic, but is classified as a simple asphyxiate, possessing a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death.

As identified in section 1, the proposed facilities must be designed, constructed, operated, and maintained in accordance with the DOT Minimum Federal Safety Standards in 49 CFR 192. The regulations are intended to ensure adequate protection for the public and to prevent natural gas facility accidents and failures.

The DOT pipeline standards are published in Parts 190-199 of Title 49 of the CFR. For example, Part 192 specifically addresses natural gas pipeline safety issues, prescribes the minimum standards for operating and maintaining pipeline facilities, and incorporates compressor station design, including ESDs and safety equipment (sections 192.163-192.173). Part 192 also requires a pipeline operator to establish a written emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency.

These standards, along with advances in pipeline minimize the potential for accidental gas leakage or other system failure. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials.

4.10.1 LNG Regulatory Agencies

Three federal agencies share regulatory authority over the siting, design, construction and operation of LNG terminals: the USCG, the USDOT, and the FERC. The USCG has authority over the safety of an LNG facility's marine transfer area and LNG marine traffic, as well as over security plans for the entire LNG terminal facility and LNG marine traffic. The USDOT establishes federal safety standards for siting, construction, operation, and maintenance of onshore LNG facilities, as well as for the siting of marine cargo transfer systems at waterfront LNG plants. Those standards are codified in Title 49, CFR, Part 193 (Part 193 or 49 CFR 193). Under the NGA and delegated authority USDOE, the FERC authorizes the siting and construction of LNG import and export facilities.

In 1985, the FERC and USDOT entered into a MOU regarding the execution of each agency's respective statutory responsibilities to ensure the safe siting and operation of LNG facilities. In addition to FERC's existing ability to impose requirements to ensure or enhance the operational reliability of LNG facilities, the MOU specified that FERC may, with appropriate consultation with USDOT, impose more stringent safety requirements than those in Part 193.

In February 2004, the USCG, USDOT, and FERC entered into an Interagency Agreement to ensure greater coordination among these three agencies in addressing the full range of safety and security issues at LNG terminals, including terminal facilities and tanker operations, and maximizing the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. Under the Interagency Agreement, the FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with terminal construction and operation. The USDOT, and USCG when necessary, participate as cooperating agencies.

As part of the review required for a FERC authorization, FERC staff must ensure that all proposed facilities would operate safely and securely. The design information that must be filed in the application to the FERC is specified by Title 18 CFR, Part 380.12 (m) and (o). The level of detail necessary for this submittal requires the sponsor to perform substantial front-end engineering of the complete facility. The design information is required to be site-specific and developed to the extent that further detailed design would not result in changes to the basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which we considered during our review process. FERC's filing regulations also require Freeport LNG to identify how its proposed design would comply with USDOT's siting requirements of 49 CFR 193, Subpart B. As part of our NEPA review, we use the Freeport LNG's information, developed to comply with USDOT's regulations, to assess whether or not the facility would have a public safety impact. As a cooperating agency, USDOT assists the FERC in evaluating whether Freeport LNG's proposed siting meets those requirements.

The following sections contain the conclusions of our reliability and safety analysis and incorporate comments of the USDOT as a cooperating agency. In accordance with the working arrangements allowed by the 1985 MOU, the USDOT has reviewed our analysis of the Freeport LNG's compliance with the requirements in Part 193 for the Phase II Modification Project and for the Liquefaction Plant, as well as our recommended mitigation measures, and has no objections at this time. In accordance with 33 CFR 127, the USCG previously provided FERC with a Letter of Recommendation regarding the suitability of the waterway for the type and frequency of the planned LNG carrier traffic and has noted that the proposed Projects would not result in an increase in the size and/or frequency of the LNG marine traffic.

The remotely located Pretreatment Plant for the Liquefaction Project would fall under FERC jurisdiction due to the type of facilities proposed and their necessity for the Liquefaction Project. However, unlike the terminal facilities, the USCG would not be involved in the regulation of these inland pretreatment facilities. In addition, USDOT indicated that the Pretreatment Plant would be subject to the USDOT regulations in 49 CFR Part 192, rather than Part 193, because natural gas would not be liquefied and LNG would not be transferred, stored, or vaporized in any of those facilities. As Part 192 does not have applicable siting regulations for process facilities, we assessed public impacts from the siting of the Pretreatment Plant using an approach consistent to that in Part 193.

For both the Liquefaction and Phase II Modification Projects, section 4.10.2 discusses the principal hazards associated with LNG, liquid nitrogen, NGLs, aqueous ammonia, acid gas, and refrigerants; section 4.10.3 discusses our technical review of the preliminary designs; section 4.10.4 discusses siting requirements; section 4.10.5 includes a siting analysis of hazards resulting from an LNG or refrigerant spill at the terminal; section 4.10.6 includes a siting analysis of hazards resulting from a release of NGLs, aqueous ammonia or acid gas at the Pretreatment Plant; section 4.10.7 discusses facility security and the results of the USCG's review on waterway suitability; and section 4.10.8 discusses emergency response and evacuation planning.

4.10.2 Hazards

The principal hazards associated with the substances involved in the liquefaction, storage and vaporization of LNG result from loss of containment, vapor dispersion characteristics, flammability, and the ability to produce damaging overpressures. A loss of the containment provided by storage tanks or process piping would result in the formation of flammable vapor near the release location, as well as the potential for nearby pooled liquid. Releases occurring in the presence of an ignition source would most likely result in a fire located at the vapor source. A spill without ignition would form a vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limits or encountered an ignition source. In some instances, ignition of a vapor cloud may produce damaging overpressures. The dispersion of toxic components would also be a hazard associated with substances at the Pretreatment Plant. These hazards are described in more detail below.

4.10.2.1 Cryogenic and Flashing Liquid Releases

The Phase II Modification Project and the Liquefaction Plant would handle LNG at a cryogenic temperature of -260°F. The Liquefaction Plant would also store liquid nitrogen at -320°F and would handle mixed refrigerant liquid (including propane and ethylene) at near-cryogenic temperatures.

The Pretreatment Plant would store liquid nitrogen at -320°F and would handle NGLs at near-cryogenic temperatures.

Loss of containment of these cryogenic or near-cryogenic liquids could release both liquid and vapor into the immediate area. Exposure to either cold liquid or vapor could cause freeze burns and, depending on the length of exposure, more serious injury or death. However, any spills would be kept on-site by impoundments, and the extent of the cold state of these releases would be greatly limited due to the continuous mixing with the warmer air. The cold temperatures from the release should not present a hazard to the public, which would not have access to on-site areas.

These cryogenic and near-cryogenic liquids would quickly cool any materials contacted by the liquid upon release, causing extreme thermal stress in materials not specifically designed for such conditions. The thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These temperatures, however, would be accounted for in the design of equipment and structural supports, and would not be substantially different from the hazards associated with the storage and transportation of liquid oxygen at -296ºF or several other cryogenic liquids that have been routinely produced and transported in the United States.

A significant amount of these liquids may flash evaporate to vapor upon release. Methane (the primary component of LNG), ethylene, propane, nitrogen, and the components of NGLs are asphyxiants and may pose extreme health hazards, including death, if inhaled in significant quantities within a limited time. However, the locations of concentrations where oxygen-deprivation effects could occur are greatly limited due to the continuous mixing with the air surrounding the spill site. The potential for asphyxiation normally represents a negligible risk to the public, who would not have access to on-site areas.

4.10.2.2 Flammable Vapor Dispersion

In the event of a loss of containment, LNG, refrigerants (including ethylene and propane) and NGLs would create vapor when released from storage or process facilities. Depending on the size of the release, a liquid pool may also form and vaporize. Additional vaporization would result from exposure to ambient heat sources, such as water or soil. When released from a containment vessel or transfer system, LNG would produce about 620 standard cubic feet of natural gas for each cubic foot of liquid. Each cubic foot of refrigerants or NGLs would generally produce a similar or smaller volume of vapor upon release than LNG.

If the loss of containment does not result in immediate ignition of the LNG, refrigerant, or NGL vapors, the vapor cloud would travel with the prevailing wind until it either encountered an ignition source or dispersed below its flammable limits.

An LNG vapor cloud would initially sink to the ground due to the cold temperature of the vapor. As an LNG vapor cloud disperses downwind and mixes with the warm surrounding air, the LNG vapor cloud may become buoyant. The LNG vapor cloud would not typically be warm, or buoyant, enough to lift off from the ground before the LNG vapor cloud becomes too diluted to be flammable. As an ethylene vapor cloud disperses downwind and mixes with the warm surrounding air, the ethylene vapor would become neutrally buoyant. However, a dispersing propane vapor cloud would remain denser than the surrounding air, even after warming to ambient temperatures. The buoyancy of a NGLs vapor cloud would depend on its composition, which would vary, and this vapor could be either positively or negatively buoyant. As a result, estimating the dispersion of the vapor cloud is an important step in addressing potential hazards and is discussed in section 4.10.5 for the facilities at the terminal and in section 4.10.6 for the Pretreatment Plant.

4.10.2.3 Vapor Cloud Ignition

Flammability of a vapor cloud would be dependent on the concentration of the vapor when mixed with the surrounding air. In general, higher concentrations within the vapor cloud would exist near the spill, and lower concentrations would exist near the edge of the cloud as it disperses downwind. Mixtures occurring between the lower flammability limit (LFL) and the upper flammability limit (UFL) could be ignited. Concentrations above the UFL or below the LFL would not ignite.

The LFL and UFL for methane are between 5 -percent-volume and 15 percent-volume in air, respectively. Propane has a narrower flammability range, but has a lower LFL of approximately 2.1 percent-volume and a UFL of 9.5 percent-volume in air, respectively. Ethylene has a much wider flammability range and a lower LFL of approximately 2.7 percent-volume and a UFL of 36 percent-volume in air. Mixed refrigerant would have a UFL and LFL based on the amount of LNG, ethylene, and propane it contains, which would vary throughout the process. NGLs would have similar UFLs and LFLs based on the amounts of heavier hydrocarbons it contains, which would also vary.

If the flammable portion of a vapor cloud encounters an ignition source, a flame would propagate through the flammable portions of the cloud. In most circumstances, the flame would be driven by the heat it generates, a process known as a deflagration. A methane vapor cloud deflagration in an uncongested and unconfined area travels at slower speeds and does not produce significant pressure waves. Confined and congested methane vapor clouds may produce higher flame speeds and overpressures, and are discussed later in section 4.10.5.5.

Once the flammable portion of a vapor cloud has encountered an ignition source, a deflagration may propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. When the flame reaches vapor concentrations above the UFL, the deflagration could transition to a fireball and result in a pool or jet fire back at the spill source. A fireball would occur near the source of the release and would be of a relatively short duration compared to an ensuing jet or pool fire. Radiant heat modeling for pool fires at the terminal site is discussed in section 4.10.5.3. Radiant heat modeling for pool fires at the Pretreatment Plant is discussed in section 4.10.6.3.

The extent of the affected area and the severity of the impacts on objects either within an ignited cloud or in the vicinity of a pool fire would primarily be dependent on the quantity and duration of the initial release, the surrounding terrain, and the environmental conditions present during the dispersion of the cloud. A vapor cloud fire can ignite combustible materials within the cloud and can also cause severe burns and death. Fires may also cause failures of nearby storage vessels, piping, and equipment. The failure of a pressurized vessel could cause fragments of material to fly through the air at high velocities, posing damage to surrounding structures and a hazard for operating staff, emergency personnel, or other individuals in proximity to the event. In addition, failure of a pressurized vessel when the liquid is at a temperature significantly above its normal boiling point could result in a boiling-liquid-expanding-vapor explosion (BLEVE). BLEVEs of flammable liquids can produce overpressures and a subsequent fireball when the superheated liquid rapidly changes from a liquid to a vapor upon the release from the vessel. This concern is addressed in section 4.10.5.6 for the pressurized propane and ethylene storage tanks for the Liquefaction Plant. The NGLs at the Pretreatment Plant would not be stored in pressurized tanks. Atmospheric storage tanks, such as those existing and approved for LNG storage at the terminal, are unlikely to BLEVE due to the smaller difference between their design pressure and ambient pressure.

4.10.2.4 Overpressures

If the deflagration in a flammable vapor cloud accelerates to a sufficiently high rate of speed, pressure waves that can cause damage would be generated. As a deflagration accelerates to super-sonic speeds, larger pressure waves are produced, and a shock wave is created. This shock wave, rather than the heat, would begin to drive the flame, resulting in a detonation. Deflagrations or detonations are generally characterized as “explosions” as the rapid movement of the flame and pressure waves associated with them cause additional damage beyond that from heat. The amount of damage an explosion causes is dependent on the amount that the produced pressure wave is above atmospheric pressure (*i.e.*, an overpressure) and its duration (*i.e.*, pulse). For example, a 1 pound per square inch (psi) overpressure, often cited as a safety limit in U.S. regulations, is associated with shattering glass with glass fragments traveling with velocities high enough to lacerate skin.

Flame speeds and overpressures are primarily dependent on the reactivity of the fuel, the ignition strength and location, the degree of congestion and confinement of the area occupied by the vapor cloud, and the flame travel distance.

The potential for unconfined LNG vapor cloud detonations was investigated by the USCG in the late 1970s at the Naval Weapons Center in China Lake, California. Using methane, the primary component of natural gas, several experiments were conducted to determine whether unconfined LNG vapor clouds would detonate. Unconfined methane vapor clouds ignited with low-energy ignition sources (13.5 joules), produced flame speeds ranging from 12 to 20 mph. These flame speeds are much lower than the flame speeds associated with a deflagration with damaging overpressures or a detonation.

To examine the potential for detonation of an unconfined natural gas cloud containing heavier hydrocarbons that are more reactive, such as ethane and propane, the USCG conducted further tests on ambient-temperature fuel mixtures of methane-ethane and methane-propane. The tests indicated that the addition of heavier hydrocarbons influenced the tendency of an unconfined natural gas vapor cloud to detonate. Less processed natural gas with greater amounts of heavier hydrocarbons would be more sensitive to detonation.

Although it has been possible to produce damaging overpressures and detonations of unconfined LNG vapor clouds, the LNG proposed for liquefaction by this project would have lower ethane and propane concentrations than those that resulted in damaging overpressures and detonations.

The substantial amount of explosives needed to create the shock initiation during the limited range of necessary vapor-air concentrations also renders the possibility of detonation of unconfined LNG vapors as unrealistic. Ignition of a confined LNG vapor cloud could result in higher overpressures. In order to prevent such an occurrence, measures are taken to mitigate LNG vapor dispersion into confined areas, such as buildings, and also the potential for ignition inside them. In general, the primary hazards to the public from an LNG spill that disperses to an unconfined area, either on land or water, would be from dispersion of the flammable vapors or from radiant heat generated by a pool fire, as discussed in the previous sections.

In comparison with LNG vapor clouds, there is a higher potential for unconfined propane to produce damaging overpressures, and an even higher potential for unconfined ethylene vapor clouds to produce damaging overpressures. Unconfined ethylene vapor clouds also have the potential to transition to a detonation much more readily than propane. This has been shown in multiple experiments conducted by the Explosion Research Cooperative to develop predictive blast wave models for low, medium, and high reactivity fuels and varying degrees of congestion and confinement (Pierorazio, 2005). The experiments used methane, propane, and ethylene, as the respective low, medium, and high reactivity fuels. In addition, the tests showed that if methane, propane, or ethylene is ignited within a confined space, such as in a building, they all have the potential to produce damaging overpressures. The NGLs process streams at the Pretreatment Plant would contain similar or heavier hydrocarbon components. Therefore, a potential exists for these process streams to produce unconfined vapor clouds that could produce damaging overpressures in the event of a release.

These overpressure hazards are discussed in section 4.10.5.5 for the facilities at the terminal and in section 4.10.6.5 for the Pretreatment Plant.

4.10.2.5 Toxic Vapor Dispersion

A toxicity hazard would be associated with the pretreatment of natural gas at the Pretreatment Plant, due to the mercury in the feed gas, hydrogen sulfide (H_2S) in the acid gas stream, and benzene and toluene in NGLs stream. Aqueous ammonia would also be stored and handled at the Pretreatment Plant.

Mercury would be removed from the feed gas and accumulated in sulfur-impregnated activated carbon beds, forming mercuric sulfide, which is stable, insoluble, and not classified as hazardous waste. However, the H_2S, benzene, toluene, and aqueous ammonia would have potential for dispersion upon release. These hazards are discussed in section 4.10.6.6.

4.10.2.6 Past Incidents at LNG Plants

With the exception of the October 20, 1944, failure at an LNG facility in Cleveland, Ohio, the operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200 to 400 people.[21] The failure of the LNG storage tank was due to the use of materials inadequately suited for cryogenic temperatures. LNG migrating through streets and into underground sewers due to the lack of adequate spill impoundments at the site was also a contributing factor. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used and that spill impoundments are designed and constructed properly to contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG facility in Lusby, Maryland. A pump seal failure resulted in gas vapors entering an electrical conduit and settling in a confined space. When a worker switched off a circuit breaker, the gas ignited, causing heavy damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident resulted in changing the national fire codes to ensure that the situation would not occur again.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction facility, which killed 27 and injured 56 workers. No members of the public were injured. Findings of the accident investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced to the high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train 40 had been operating with its original equipment since start-up in 1981.

To ensure that this potential hazard would be addressed for the proposed Projects, all combustion and ventilation air intake equipment would be provided with hazard detection devices that would alarm and enable isolation and deactivation of any combustion equipment whose continued operation could add to or sustain an emergency.

4.10.3 Technical Review of the Preliminary Engineering Designs

Operation of the proposed facilities poses a potential hazard that could affect the public safety if strict design and operational measures to control potential accidents are not applied. The primary concerns are those events that could lead to an LNG spill of sufficient magnitude to create an off-site hazard, as discussed in section 4.10.2. However, it is important to recognize the stringent requirements in place for the design, construction, operation, and maintenance of the facility, as well as the extensive safety systems proposed to detect and control potential hazards.

[21] For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944," dated February 1946.

As part of the preliminary safety reviews for the Projects, Freeport LNG's design development team conducted a hazard identification (HAZID) analysis of the Front-End Engineering Design (FEED) design to identify the major hazards that may be encountered during the operation of facilities. In addition, a hazard and operability (HAZOP) study of the completed design would also be performed by Freeport LNG's design development team during the detailed design phase. The HAZOP study addresses hazards of the process, engineering, and administrative controls, and provides a qualitative evaluation of a range of possible safety and environmental effects which may result from the design or operation of the facility. Recommendations to prevent or minimize these hazards are generated from the results of the HAZOP review. These studies help establish the required safety control levels and identify whether additional process and safety instrumentation, mitigation, and/or administrative controls would be needed.

Once the design has been subjected to a HAZOP review, the design development team tracks changes to the facility design, operations, documentation, and personnel. These changes would be evaluated to ensure that the safety and environmental risks arising from these changes are addressed. Resolution of the recommendations generated by the HAZOP review are also monitored.

Based on these analyses, various layers of safeguards would be included in the facility designs to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public. These layers of protection are independent of one another so that any one would perform its function regardless of the action or failure of any other protection layer or initiating event. These layers of protection typically include:

1) A facility design that prevents hazardous events through the use of suitable materials of construction; operating and design limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;

2) Control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure the facility stays within the established operating and design limits;

3) Safety-instrumented prevention systems, such as safety control valves and ESD systems, to prevent a release if operating and design limits are exceeded;

4) Physical protection systems, such as appropriate electrical area classification, proper equipment and building spacing, pressure relief valves, spill containment, and structural fire protection, to prevent escalation to a more severe event;

5) Site security measures for controlling access to the facility, including security inspections and patrols; response procedures to any breach of security; and liaison with local law enforcement officials; and

6) On-site and off-site emergency response, including hazard detection and control equipment, firewater systems, and coordination with local first responders to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

The use of these protection layers would mitigate the potential for an initiating event to develop into an incident that could damage the facility, injure operating staff, or impact the safety of the off-site public.

As part of the applications, Freeport LNG provided FEEDs for the Projects. The FEEDs and specifications submitted for the proposed facilities to date are preliminary, but would serve as the basis for any detailed design to follow. During the FERC review process, we analyzed the information filed by Freeport LNG to determine the extent that layers of protection or safeguards to enhance the safety, operability, and reliability of the facilities were included in the FEEDs.

As a result of the technical review of the information provided by Freeport LNG in the submittal documents, we identified a number of concerns relating to the reliability, operability, and safety of the proposed design. In response to staff's questions, Freeport LNG provided written responses. However, some of these responses indicated that corrections or modifications would be made in order to address issues raised in the information request. As a result, **we recommend that**:

> **<u>Prior to construction of the final design</u>, Freeport LNG should file with the Secretary, for review and written approval by the Director of OEP, information/revisions pertaining to Freeport LNG's responses, as listed in Table 4.10.3-1 of the EIS, which indicated features to be included in the final design and documentation.**

Table 4.10.3-1

Freeport LNG Responses Indicating Features to be Included in the Final Design of the Projects

Project	Filing Date	Response Numbers
Liquefaction	December 10, 2012	55, 56, 64, 66, 67, 75, 77, 81, 90, 98, 99, 100, 119, 122, and 127
Liquefaction	June 6, 2013	17, 23, 24, 30, 32, 33, 35, 36, and 37
Phase II Modification	December 10, 2012	134
Phase II Modification	June 6, 2013	2 and 3

The objectives of our FEED reviews focused on the engineering design and safety concepts of the various protection layers, as well as the projected operational reliability of the proposed facilities.

The designs would use materials of construction suited to the pressure and temperature conditions of the process design. Valves and other equipment would be designed to recommended and generally accepted good engineering practices. Freeport LNG indicated that the terminal facilities would be designed in accordance with the regulations in 49 CFR 193, which includes requirements for piping to be designed in accordance with ASME B31.3 and pressure vessels to be designed in accordance with ASME Section VIII.

The process equipment containing LNG and refrigerants would be designed to withstand the effects of hurricane force winds based on the requirements of ASCE 7-05, Minimum Design Loads for Buildings and Other Structures. The design wind velocity would be 150 mph, which is equivalent to a 3-second gust of 183 mph wind. Freeport LNG stated that this design wind velocity corresponds to a Category 4 hurricane on the Saffir-Simpson hurricane scale. The same design wind velocity would be used for facilities at the Pretreatment Plant.

The existing terminal facilities were constructed at an elevation of 14 feet amsl. The pipe supports for the piping associated with the Liquefaction Plant would be elevated to approximately 26 feet above sea level (NAVD 88), and liquefaction process equipment would be elevated to 28 feet above sea level, which would minimize the risk of flooding. The jetty platform for the proposed Phase II Modification Project would have a maximum elevation of 25 feet above sea level. The Pretreatment Plant lies outside the 100-year and 500-year flood zones. To ensure flood protection, the ground elevation of the pretreatment equipment areas would be raised to 8 feet amsl.

Process control valves and instrumentation would be installed to safely operate and monitor the facility. Alarms would have visual and audible notification in the control room to warn operators that process conditions may be approaching design limits. Operators would have the capability to take action from the control room to mitigate an upset.

Freeport LNG would update the existing facility operations procedures to include the facilities proposed for the Projects and would provide these updates for review after completion of the final design. This timing is fully consistent with accepted industry practice. We have made recommendations for Freeport LNG to provide updates to the operating and maintenance procedures as they are developed. In addition, we have recommended measures, such as the labeling of all instrumentation and valves, to address human factor considerations and improve facility safety.

Safety valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. Safety instrumented systems would comply with International Society for Automation (ISA) Standard 84.01 and other recommended and generally accepted good engineering practices. We also made recommendations on the design, installation, and commissioning of instrumentation and ESD equipment to ensure appropriate cause and effect alarm or shutdown logic.

Safety relief valves, vent stacks, and flares would be installed to protect the process equipment and piping. The safety relief valves would be designed to handle process upsets and thermal expansion within piping. Freeport LNG also had an analysis prepared in accordance with NFPA 59A (2001), which determined that the vacuum relief valves on the existing LNG storage tanks and the approved Phase II LNG storage tank would continue to adequately protect the storage tanks during the proposed future operations, which would include the use of in-tank pumps with larger capacities.

Storage and process facilities would be provided with spill containment systems designed to direct any spills away from equipment and occupied areas. This design would minimize the potential for heat from a fire to impact adjacent equipment and occupied areas if ignition occurs and would also minimize the potential for flammable vapors from dispersing to confined or occupied areas. Impoundment systems are further discussed in sections 4.10.5.1 and 4.10.6.1.

None of the facilities proposed for the Projects would exceed the threshold heights in 14 CFR Part 77.9 and the USDOT advisory circular AC 70/7460-1K. Therefore, FAA notification due to tall structures would not be required for any project facilities.

Freeport LNG provided a preliminary fire protection plan to demonstrate that adequate hazard detection, hazard control, and firewater coverage would be installed to detect and address any upset conditions. The hazard detection systems would detect, alarm, and alert personnel in the area and control room to initiate an ESD and/or initiate appropriate procedures. These systems would meet NFPA 72 and other recommended and generally accepted good engineering practices. Hazard control devices would be installed to extinguish or control incipient fires and releases and would meet NFPA 10 and 17 and other recommended and generally accepted good engineering practices. Automatic firewater systems and monitors would be provided for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire and would meet NFPA 22 and 24 requirements. We also made a recommendation for Freeport LNG to provide a finalized fire protection evaluation. In addition, we made a recommendation for Freeport LNG to provide more information on the design, installation, and commissioning of the hazard detection, hazard control, and firewater systems as this information would be developed during the final design phase.

In order to minimize the risk of an intentional event, Freeport LNG would install security fencing, lighting, camera systems, and intrusion detection to deter, monitor, and detect intruders into the Liquefaction Project areas. In addition, as discussed in section 4.10.8, Freeport LNG must update its Operations Manual, Emergency Manual, and the Facility Security Plan in accordance with the USCG's regulations, which can be found in 33 CFR 127 and 33 CFR 105. We also made recommendations to provide incident reporting during operation.

Freeport LNG would also be required to update its Emergency Response Plan to include the Projects in accordance with the Energy Policy Act of 2005, as discussed further in section 4.10.7. In addition, Freeport LNG would update its emergency procedures in accordance with 49 CFR 193 for the terminal facilities. In accordance with 49 CFR Part 193.2509, the emergency procedures for the terminal facilities would provide for protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the facility.

If authorization is granted by the Commission, the next phase of the Projects would include development of the final design, including final selection of equipment manufacturers, process conditions, and resolution of some safety-related issues. To ensure the final design would be consistent with the safety and operability characteristics identified in the FEED, information regarding the development of the final design, as detailed below, would need to be filed with the Secretary for review and written approval by the Director of the OEP before equipment construction at the site would be authorized.

In addition to the final design review, we would conduct inspections during construction and would review additional materials, including quality assurance and quality control plans, non-conformance reports, and cooldown and commissioning plans to ensure that the installed design would be consistent with the safety and operability characteristics of the FEED. We would also conduct inspections during operation to ensure that the facility would be operated and maintained in accordance with the filed design throughout the life of the facility.

To ensure that the concerns we've identified relating to the reliability, operability, and safety of the proposed designs are addressed by Freeport LNG, and to ensure that the facilities would be subject to the Commission's construction and operational inspection program, **we recommend that the following measures should apply to the Projects, including the Pretreatment Plant. Information pertaining to these specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP either: <u>prior to initial site preparation</u>; <u>prior to construction of final design</u>; <u>prior to commissioning</u>; <u>prior to introduction of hazardous fluids</u>; or <u>prior to commencement of service</u>, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. ¶31,228 (2006). Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements would be subject to public disclosure. All information should be filed <u>a minimum of 30 days</u> before approval to proceed is requested.**

- **<u>Prior to initial site preparation</u>, Freeport LNG should provide procedures for controlling access during construction.**

- **<u>Prior to initial site preparation</u>, Freeport LNG should file the quality assurance and quality control procedures for construction activities.**

- **<u>Prior to initial site preparation</u>, Freeport LNG should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.**

- **<u>Prior to initial site preparation</u>, Freeport LNG should file an overall project schedule, which includes the proposed stages of the commissioning plan.**

- **The <u>final design</u> should include change logs that list and explain any changes made from the FEED provided in Freeport LNG's application and filings. A list of all changes with an explanation for the design alteration should be provided and all changes should be clearly indicated on all diagrams and drawings.**

- **The <u>final design</u> should provide up-to-date Process Flow Diagrams with heat and material balances and Piping and Instrument Diagrams (P&IDs), which include the following information:**

  a. **equipment tag number, name, size, duty, capacity, and design conditions;**

  b. **equipment insulation type and thickness;**

  c. **storage tank pipe penetration size and nozzle schedule;**

  d. **valve high pressure side and internal and external vent locations;**

e. piping with line number, piping class specification, size, and insulation type and thickness;

f. piping specification breaks and insulation limits;

g. all control and manual valves numbered;

h. relief valves with set points; and

i. drawing revision number and date.

- **The final design should provide P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect to the existing facilities.**

- **The final design should provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications.**

- **The final design should provide complete drawings and a list of the hazard detection equipment. The drawings should clearly show the location and elevation of all detection equipment. The list should include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.**

- **The final design should provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings should clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list should include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units.**

- **The final design should provide facility plans and drawings that show the location of the firewater and foam systems. Drawings should clearly show: firewater and foam piping; post indicator valves; and the location, and area covered by, each monitor, hydrant, deluge system, foam system, water-mist system, and sprinkler. The drawings should also include P&IDs of the firewater and foam system.**

- **The final design should provide an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A 2001, chapter 9.1.2. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed.**

- **The final design should specify that for hazardous fluids, the piping and piping nipples 2 inches or less are to be no less than Schedule 160.**

- **The final design should provide an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an**

electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that: should continuously monitor for the presence of a flammable fluid; should alarm the hazardous condition; and should shutdown the appropriate systems.

- **The final design should provide electrical area classification drawings.**

- **The final design should provide spill containment system drawings with dimensions and slopes of curbing, trenches, and impoundments.**

- **The final design of the hazard detectors should account for the calibration gas when determining the LFL set points for methane, propane, ethylene, and NGLs.**

- **The final design should include a HAZOP review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations should be filed.**

- **The final design should include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and ESD system. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and setpoints.**

- **The final design should include a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice required by 49 CFR 193 and should provide justification if not using an inert or non-flammable gas for cleanout, dry-out, purging, and tightness testing.**

- **The final design should provide the sizing basis and capacity for the final design of pressure and vacuum relief valves for major process equipment, vessels, storage tanks, and vent stacks.**

- **The final design should provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3, as required by 49 CFR 193.**

- **The final design should include a drawing showing the location of the ESD buttons. ESD buttons should be easily accessible, conspicuously labeled and located in an area which would be accessible during an emergency.**

- **The final design should include a delayed automatic start for the ICW firewater pumps.**

- **The final design should provide a hydraulic study for the LNG storage tank piping with the larger in-tank pumps, and confirm the final size of the discharge nozzle and header pipe.**

- **The final design should ensure that the LNG storage tank piping supports are adequately designed for the higher rated in-tank pump flow rates.**

- **The final design should provide a list of the UPS locations, sizes with load capacities, and services.**

- **The final design should include detection of a leak through the pump primary electrical seals, in addition to monitoring and alarming the nitrogen gas pressure to the seal purge, in order to account for small leaks that pressure indicators may not be able to detect. Low temperature or flammable gas detection should be provided downstream of primary seal. The junction box should be equipped with flammable gas detection.**

- **The final design should include the addition of high pressure alarm and shutdown on the LNG Transfer Drums.**

- **The final design should include double isolation valves on the propane vaporizer drains.**

- **The final design should specify that the refrigeration system vent lines be equipped with double isolation valves.**

- **The final design should specify a pipe class of T39 for the LNG cooldown lines (4”-LNG-111032, 4”-LNG-121032, and 4”-LNG-131032) to downstream of isolation valves (V10448, V20448, and V30448), respectively.**

- **The final design should specify that relief valves should not vent back into a system that has a design pressure equal to or above the relief valve set pressure. The calculated operating pressure of all relief valves should not exceed the allowable operating pressure of that particular relief valve under any condition.**

- **The final design should include a list of the recommendations not considered or included in the final design that are listed in the HAZID review of December 8, 2011 and the justification for the omission.**

- **Prior to commissioning, Freeport LNG should file plans and detailed procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**

- **Prior to commissioning, Freeport LNG should provide a detailed schedule for commissioning through equipment startup. The schedule should include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. Freeport LNG should file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued.**

- **Prior to commissioning, Freeport LNG should provide tag numbers on equipment and flow direction on piping.**

- **Prior to commissioning, Freeport LNG should tag all instrumentation and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**

- **Prior to commissioning, Freeport LNG should file updates addressing the Projects in the operation and maintenance procedures and manuals, as well as safety procedures.**

- **Prior to commissioning, Freeport LNG should maintain a detailed training log to demonstrate that operating staff has completed the required training.**

- **Prior to introduction of natural gas or hazardous fluids, Freeport LNG should complete a firewater pump acceptance test and a firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on the facility plot plan(s).**

- **Prior to introduction of natural gas or hazardous fluids, Freeport LNG should complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and Safety Instrumented System that demonstrates full functionality and operability of the system.**

- **Prior to commencement of service, progress on the construction of the proposed systems should be reported in monthly reports filed with the Secretary. Details should include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current project schedule. Problems of significant magnitude should be reported to the Commission within 24 hours.**

In addition, we recommend that the following measures should apply throughout the life of the Freeport LNG facilities:

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an annual basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Freeport LNG should respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, should be submitted.**

- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil-off/flash gas,**

etc.), plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to: unloading/loading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non- scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted <u>within 45 days after each period ending June 30 and December 31</u>. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.

- **Significant non-scheduled events, including safety-related incidents (e.g., LNG, NGL, refrigerant, or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) should be reported to the FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made <u>immediately</u>, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to the FERC staff <u>within 24 hours</u>. This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids related incidents include:**

  a. **fire;**

  b. **explosion;**

  c. **estimated property damage of $50,000 or more;**

  d. **death or personal injury necessitating in-patient hospitalization;**

  e. **release of hazardous fluids for five minutes or more;**

  f. **unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;**

  g. **any crack or other material defect that impairs the structural integrity or**

reliability of an LNG facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents to hazardous fluids vessels occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

4.10.4 Siting Requirements

The principal hazards associated with the substances involved in the liquefaction, storage and vaporization of LNG result from cryogenic and flashing liquid releases; flammable and toxic vapor dispersion; vapor cloud ignition; pool fires; BLEVEs; and overpressures. As part of our review, we assess the potential for these hazards to impact the safety of the off-site public by analyzing the design's compliance with the federal siting requirements. The Commission's regulations under 18 CFR 380.12(o)(14) require Freeport LNG to identify how the proposed design would comply with the siting requirements of 49 CFR 193, Subpart B. As part of our review, we use this information, developed by Freeport LNG to comply with USDOT's regulations, to assess whether or not the facility would have a public safety impact. Although the facilities at both the terminal site and the Pretreatment Plant would be subject to USDOT regulation, only the terminal site facilities would be subject to USDOT's siting requirements in 49 CFR 193. However, in order to provide a consistent assessment of potential public impacts which could result from the construction of the facilities at both sites, we applied the Part 193 siting standards to the Pretreatment Plant. The siting analysis is divided into two discussions. The first, section 4.10.5, covers the Liquefaction Plant and Phase II Modification Project, which would both be located at the terminal site and are subject to the siting requirements of 49 CFR 193. The second, section 4.10.6, covers the Pretreatment Plant.

The standards in 49 CFR 193 require that an operator or governmental authority exercise control over the activities that can occur within an "exclusion zone," defined as the area around an LNG facility that could be exposed to specified levels of thermal radiation or flammable vapor in the event of a release of LNG or ignition of natural gas. Certain mathematical models must be used to calculate the dimensions of these exclusion zones. The siting requirements in the 2001 edition of NFPA 59A, an industry consensus standard for the production, storage, and handling of LNG facilities, are incorporated into 49 CFR 193, Subpart B by reference, with regulatory preemption in the event of conflict. These standards also require hazard zone analyses for the release or ignition of other flammable liquids.

The following sections of Part 193 specifically address siting requirements for each LNG container and LNG transfer system:

- Part 193.2051, Scope, states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in accordance with subpart B and NFPA 59A. In the event of a conflict with NFPA 59A, the regulatory requirements in Part 193 prevail.

- Part 193.2057, Thermal Radiation Protection, requires that each LNG transfer system have thermal exclusion zones in accordance with section 2.2.3.2 of NFPA 59A.

- Part 193.2059, Flammable Vapor-Gas Dispersion Protection, requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A.

The above LNG siting requirements would be applicable to the following facilities that are proposed for the Liquefaction Plant:

- Two 6,788-gpm LNG transfer pumps per liquefaction train and associated piping;

- Six 11,007-gpm LNG in-tank pumps, which would replace the six existing 5,065-gpm in-tank pumps in the existing LNG storage tanks, and associated piping; and

- Three 11,007-gpm LNG in-tank pumps, which would replace the three approved 5,065-gpm pumps for the Phase II LNG storage tank, and associated piping.

On October 10, 2010, after consultation with the USDOT, FERC issued a letter to Freeport LNG requiring a revised siting analysis for the original Phase II project (Docket No. CP05-361-000) for the facilities "that are not yet in existence or under construction" due to the July 7 and 16, 2010 USDOT interpretations.[22] In response, Freeport LNG provided revised modeling in their application and filings as part of their siting analysis for the Phase II Modification Project. For the LNG facilities proposed for the Phase II project, these Part 193 requirements would be applicable to the following equipment:

- One 40,629,700 gallon (net) full containment LNG storage tank and associated piping and appurtenances - Parts 193.2057 and 2959 require the establishment of thermal and flammable vapor exclusion zones for LNG tanks;

- Three 5,065-gpm in-tank pumps in the proposed Phase II LNG Storage Tank T-3 and associated piping; and

- A marine LNG unloading dock consisting of three 16-inch-diameter liquid transfer arms and one 16-inch-diameter vapor return arm, two 26-inch-diameter vacuum insulated transfer pipes, and other associated process vessels, piping and appurtenances.[23]

Previous FERC EAs and impact statements for past projects have identified inconsistencies and areas of potential conflict between the requirements in Part 193 and NFPA 59A (2001). Sections 193.2057 and 193.2059 require exclusion zones for each LNG container and LNG transfer system, and an LNG transfer system is defined in Section 193.2007 to include cargo transfer system and transfer piping (whether permanent or temporary). However, NFPA 59A (2001) requires exclusion zones only for "transfer areas," which is defined as the part of the plant where the facility introduces or removes the liquids, such as truck loading or ship-unloading areas. The NFPA 59A (2001) definition does not include permanent plant piping, such as cargo transfer lines. Section 2.2.3.1 of NFPA 59A (2001) also states that transfer areas at the water edge of marine terminals are not subject to the siting requirements in that standard.

The USDOT has addressed some of these issues in a March 2010 letter of interpretation.[24] In that letter, USDOT stated that: (1) the requirements in the NFPA 59A (2001) for transfer areas for LNG apply to the marine cargo transfer system at a proposed waterfront LNG facility, except where preempted by the regulations in Part 193; (2) the regulations in Part 193 for LNG transfer systems conflict with NFPA 59A (2001) on whether an exclusion zone analysis is required for transfer piping or permanent plant piping; and (3) the regulations in Part 193 prevailed as a result of that conflict. The USDOT has determined that an exclusion zone analysis of the marine cargo transfer system is required.

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[22] Accession No. 20101008-3043

[23] The proposed Phase II Modification Project (Docket No. CP12-29-000) involves (1) reorientation of the marine LNG unloading dock; (2) decreasing the diameter of the two LNG transfer pipelines from 32-inch to 26-inch; and (3) reducing the number of LNG unloading arms from four to three.

[24] U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) Interpretation "Re: Application of the Siting Requirements in Subpart B of 49 CFR Part 193 to the Mount Hope Bay Liquefied Natural Gas Transfer System" (March 25, 2010).

In FERC EAs and impact statements for past projects, we have also noted that when the USDOT incorporated NFPA 59A into its regulations, it removed the regulation that required impounding systems around transfer piping. As a result of that change, it is unclear whether Part 193 or the adopted sections of NFPA 59A (2001) require impoundments for LNG transfer systems. We note that Part 193 requires exclusion zones for LNG transfer systems, and that those zones were historically calculated based on impoundment systems. We also note that the omission of containment for transfer piping is not a sound engineering practice. For these reasons, we generally recommend containment for all LNG transfer piping within the plant's property lines.

Federal regulations issued by OSHA under 29 CFR 1910.119 (Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents [PSM]), and the USEPA under 40 CFR 68 (Risk Management Plans) cover flammable liquids, such as propane and ethylene at many facilities in the U.S. However, on October 30, 1992, shortly after the promulgation of the OSHA Process Safety Management regulations, OSHA issued a letter of interpretation that precluded the enforcement of PSM regulations over gas transmission and distribution facilities. In a subsequent letter on December 9, 1998, OSHA further clarified that this letter of interpretation applies to LNG distribution and transmission facilities.

In addition, USEPA's preamble to its final rule in the Federal Register, Volume 63, Number 3, 639-645, clarified that exemption from the requirements in 40 CFR 68 for regulated substances in transportation, including storage incident to transportation, is not limited to pipelines. The preamble further clarified that the transportation exemption applies to LNG facilities subject to oversight or regulation under 49 CFR 193, including facilities used to liquefy natural gas or used to transfer, store, or vaporize LNG in conjunction with pipeline transportation. Therefore, the above OSHA and USEPA regulations are not applicable to facilities regulated under 49 CFR 193. As stated in Part 193.2051, LNG facilities must be provided with the siting requirements of NFPA 59A (2001 edition). The siting requirements for flammable liquids within an LNG facility are contained in NFPA 59A, Chapter 2:

- NFPA 59A section 2.1.1 requires consideration of clearances between flammable refrigerant storage tanks, flammable liquid storage tanks, structures and plant equipment, both with respect to plant property lines and each other. This section also requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility.

- NFPA 59A section 2.2.2.2 requires impoundments serving flammable refrigerants or flammable liquids to contain a 10-minute spill of a single accidental leakage source or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the USDOT. In addition, NFPA section 2.2.2.5 requires impoundments and drainage channels for flammable liquid containment to conform to NFPA 30, Flammable and Combustible Liquids Code.

- NFPA 59A section 2.2.3.2 requires provisions to minimize the damaging effects of fire from reaching beyond a property line, and requires provisions to prevent a radiant heat flux level of 1,600 BTU/ft^2-hr from reaching beyond a property line that can be built upon. The distance to this flux level is to be calculated with LNGFIRE or using models that have been validated by experimental test data appropriate for the hazard to be evaluated and that are acceptable to USDOT.

- NFPA 59A section 2.2.3.4 requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard. Determination of the distance that the flammable vapors extend is to be determined with DEGADIS or alternative models that take into account physical factors influencing LNG vapor dispersion. Alternative models must have been validated by experimental test data appropriate for the hazard to be evaluated and must be acceptable to USDOT. Section 2.2.3.5 requires the design spill for impounding areas serving vaporization and process areas to be based on the flow from any single accidental leakage source.

For the Liquefaction Plant, FERC staff identified that these siting requirements would be applicable to the following facilities:

- Two 15,000-gallon ethylene storage tanks and associated process piping;
- Two 15,000-gallon propane storage tanks and associated pumps and process piping;
- Piping and equipment in the three liquefaction process trains;
- Liquefaction Area LNG Containment Sump and associated impoundment system;
- Propane and Ethylene Storage Containment Sump and associated impoundment system; and
- Propane Collection Area A and B impoundment systems.

The Pretreatment Plant would be subject to the regulations in 49 CFR Part 192, rather than Part 193. However, since Part 192 does not have applicable siting regulations for process facilities, the siting of the Pretreatment Plant facilities, including the impoundment systems, was evaluated using criteria consistent with the requirements of Part 193. The siting requirements for flammable liquids within an LNG facility, which are contained in NFPA 59A, Chapter 2, would not apply to but would relate to the following Pretreatment Plant facilities:

- Piping and equipment in the three pretreatment process trains;
- Aqueous ammonia system;
- Pretreatment Collection Area A and B impoundment systems; and
- NGL Surge Drum impoundment system.

4.10.5 Siting Analysis for Facilities at the Terminal

4.10.5.1 Impoundment Sizing at the Terminal

Suitable sizing of impoundment systems and selection of spills on which to base hazard analyses are critical for establishing an appropriate siting analysis. Although impoundment capacity and spill scenarios for LNG storage tank impoundments are well described by Part 193, a clear definition for other impoundments is not provided either directly by the regulations or by the adopted sections of NFPA 59A (2001). Under NFPA 59A (2001) Section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume that can be discharged from any single accidental leakage source during a 10-minute period or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the USDOT. However, no definition of single accidental leakage source is provided in the regulations.

We recommend impoundments to be sized based on the greatest flow capacity from a single transfer pipe for 10 minutes, while recognizing that different spill scenarios may be used for the single accidental leakage sources for the hazard calculations required by Part 193. A similar approach is used with impoundments for process vessels. We recommend these impoundments to also be able to contain the contents of the largest process vessel served, while recognizing that smaller design spills may be appropriate for Part 193 calculations.

Liquefaction Plant

Freeport LNG proposes to construct a Liquefaction Area LNG Containment Sump that would be 60 feet long by 60 feet wide by 26.25 feet deep, of which 8.25 feet would be below the bottom of the trench, to serve the liquefaction process area. This sump would be constructed of concrete and its interior surfaces would be lined with insulated concrete. Any spills in the liquefaction area would flow along insulated concrete troughs to this sump.

The Liquefaction Area LNG Containment Sump would have a volumetric capacity of 653,000 gallons, with a net volumetric capacity of about 222,150 gallons before backflowing into the trench system. Freeport LNG designed the Liquefaction Area LNG Containment Sump to contain a 10-minute spill from a full rupture of the 26-inch diameter LNG transfer header, resulting in 220,680 gallons. The rupture of the largest refrigerant line that could drain to this sump, which would be the 36-inch propane line from the Propane Accumulator, would provide less than 64,810 gallons of propane liquid over a 10 minute period based on UniSim calculations done by Freeport LNG. Therefore, the proposed impoundment system would be sized to contain the largest volume of LNG or refrigerant that could be discharged into this impoundment from the full rupture of a single transfer pipe for a 10-minute spill.

Leaks from most propane equipment in the liquefaction trains would be directed to local concrete collection areas within curbed containment systems. Propane Collection Area A would have dimensions of 26 by 26 by 1.25 feet within a 191 by 229.5 by 0.5 foot curbed area, minus a 23 by 55.25 foot curbed inset. Freeport LNG determined that this curbed area would have a total liquid capacity of 214,500 gallons, including geometry inside the area such as sloped floors.

This sump capacity would be greater than the full 20,350 gallon capacity of the HP MR/MP Propane Vaporizer, of which Freeport LNG determined that only about 16,690 gallons would be expected to remain a liquid upon release. This capacity would also be greater than the largest potential piping release in that area, which would be from a 10 minute spill from the full rupture of the 36” propane line to the Vaporizers, having a total volume of 82,740 gallons based on UniSim software calculations provided by Freeport LNG.

Propane Collection Area B would have dimensions of 52.5 by 52.5 by 1.25 feet within a 140 by 52.5 by 0.5 foot curbed area. Freeport LNG determined that this curbed area would have a total liquid capacity of 82,900 gallons, including geometry inside the area such as sloped floors. This sump capacity would be greater than the full 82,290 gallon capacity of the Propane Accumulator, of which Freeport LNG determined that about 22,720 gallons would be expected to remain a liquid upon release. This total curbed capacity would also be greater than the largest potential piping liquid release in that area, which would be from a 10 minute spill from the full rupture of the 36-inch line from the Propane Accumulator, resulting in less than 64,810 gallons based on UniSim software calculations provided by Freeport LNG.

Because the impoundment system that includes Propane Collection Area B would need to have significant internal geometry features in order to achieve the total calculated liquid capacity and contain the sizing spill, **we recommend that:**

> **<u>Prior to the end of the draft EIS comment period</u>, Freeport LNG should file with the Secretary detailed drawings and calculations to verify the total volume of the Propane Collection Area B impoundment system.**

Any potential spills from the refrigerant storage area would be captured by spill containment troughs and directed to the concrete Propane and Ethylene Containment Sump, which would be 15 feet long, 15 feet wide and 10 feet deep. This sump would provide a total of 16,830 gallons of sump capacity, with 15,000 gallons of capacity below the trough intersection. This capacity would accommodate the volume of any one of the 15,000 gallon refrigerant storage vessels, even though not all of the propane or ethylene would be expected to remain a liquid upon release. A sump of this size would also accommodate the total loss of containment of a delivery truck, which typically contains 6,000 gallons. (The refrigerant storage tanks would contain the amount of propane and ethylene needed for 90 and 70 days, respectively, of normal operation for the three liquefaction units. Trucks deliveries would refill these refrigerant tanks.)

Table 4.10.5-1 summarizes the Liquefaction Plant impoundments and their sizing spills.

Table 4.10.5-1

Liquefaction Plant Impoundment Sizing Spills

Spill Source	Sizing Spill (gallons)	Impoundment System	Impoundment Size (gallons)
26-inch-diameter LNG Transfer Header	220,680	Liquefaction Area LNG Containment Sump	222,150
Refrigerant Storage Tank	< 15,000	Propane and Ethylene Storage Containment Sump	15,000
36-inch Propane Line to Vaporizers	82,740	Propane Collection Area A System	214,500
36-inch Line from Propane Accumulator	< 64,810	Propane Collection Area B System	82,900

In addition, LNG spilled near the existing process area would flow into the existing Process Area LNG Drain Sump located near the LNG storage tanks. The sizing spill for the existing Process Area LNG Drain Sump was 10 minutes of the flow from a full break of a 26-inch diameter LNG ship transfer line carrying 10,000 cubic meters per hour (m^3/hr), which was analyzed under docket CP03-75-000. This 10,000 m^3/hr spill would continue to be the largest liquid volume from a single source that could drain to the existing Process Area LNG Drain Sump.

Although the Liquefaction Project would replace the in-tank pumps in the existing and approved LNG storage tanks with higher capacity pumps, Freeport LNG proposes to operate fewer pumps in order to achieve the 10,000 m^3/hr ship transfer rate approved for the existing operations. Freeport LNG stated that operating procedures would be developed to ensure that the 10,000 m^3/hr rate is not exceeded in any piping segment. However, USDOT has indicated that in these situations mechanical prevention measures, such as interlocks, would be necessary to ensure that this flow rate is not exceeded. Therefore, **we recommend that:**

- **<u>Prior to construction of the final design</u>, Freeport LNG should file with the Secretary for review and written approval by the Director of OEP, details of the mechanical measures that would prevent the ship transfer rate from exceeding 10,000 m^3/hr in any pipe segment. This information should be filed a minimum of 30 days before approval to proceed is requested.**

Phase II Modification Project Impoundments

For the Phase II Modification Project, two 26-inch-diameter vacuum-insulated aboveground LNG transfer lines would be constructed from the proposed Dock 2 area to the LNG storage tanks. The two 26-inch-diameter transfer lines would be installed within elevated troughs and potential spills occurring from the two transfer lines would drain into the troughs and be directed towards the existing LNG Drain Sump (Dock Area). The existing LNG Drain Sump (Dock Area), which was constructed under docket CP03-75-000, is 85-feet-long and 85-feet-wide with a depth of 14.8-feet. The existing LNG Drain Sump (Dock Area) has a volumetric capacity of 799,892 gallons, with a net volumetric capacity of 443,182 gallons (see table 4.10.5-2) before backflowing into the trench system. For the Phase II Modification Project, the largest spill to the existing LNG Drain Sump (Dock Area) would be from the guillotine rupture of one 26-inch-diameter transfer line at a maximum unloading/loading rate of 10,000 m^3/hr. The resulting 10-

minute spill volume would be 440,287 gallons. Therefore, the existing LNG Drain Sump (Dock Area) is properly sized to contain the greatest volume of LNG that can be discharged into the impoundment system from the full rupture of a single transfer pipe during a 10-minute period.

Table 4.10.5-2

Phase II Modification Project Impoundment Area Sizing

Spill Source	Spill Size (gallons)	Impoundment System	Impoundment Size (gallons)
26-inch-diameter LNG Transfer Line from Dock 2	440,287	LNG Drain Sump (Dock Area)	443,182
26-inch-diameter LNG Transfer Line in process area	440,287	LNG Drain Sump (Process Area)	451,315

The two 26-inch-diameter LNG transfer lines would be routed from the proposed Phase II dock to the existing LNG storage tank and vaporization area. Potential spills occurring in the process area from the two 26-inch-diameter LNG transfer lines would be captured in concrete troughs and drain to the existing LNG Drain Sump (Process Area). The existing LNG Drain Sump (Process Area), constructed under CP03-75-000, is 80-feet-long by 76-feet-wide by 16-feet-deep. The existing LNG Drain Sump (Process Area) has a volumetric capacity of 735,654, with a net volumetric capacity of 451,315 gallons (see table 4.10.5-2) before backflowing into the trench system. A 10-minute spill volume of 440,287 gallons from a guillotine rupture of the 26-inch-diameter LNG transfer line would be contained in the LNG Drain Sump (Process Area).

4.10.5.2 Design Spills for Facilities at the Terminal

Design spills are used in the determination of the hazard calculations required by Part 193. Prior to the incorporation of NFPA 59A in 2000, the design spill in Part 193 assumed the full rupture of “a single transfer pipe which has the greatest overall flow capacity” for not less than 10 minutes (old Part 193.2059(d)). With the adoption of NFPA 59A, the basis for the design spill for impounding areas serving only vaporization, process, or LNG transfer areas became the flow from any single accidental leakage source. Neither Part 193 nor NFPA 59A (2001) defines “single accidental leakage source.”

In a letter to the FERC staff, dated August 6, 2013, USDOT requested that LNG facility applicants contact the Office of Pipeline Safety's Engineering and Research Division regarding the Part 193 siting requirements.[25] Specifically, the letter stated that USDOT required a technical review of the applicant’s design spill criteria for single accidental leakage sources on a case-by-case basis to determine compliance with Part 193. In response, Freeport LNG provided USDOT with its design spill criteria and identified leakage scenarios for the proposed equipment. These are discussed below for the Liquefaction Plant and the Phase II Modification Project.

[25] August 6, 2013 Letter from Kenneth Lee, Director of Engineering and Research Division, Office of Pipeline Safety to Terry Turpin, LNG Engineering and Compliance Branch, Office of Energy Projects. Filed in Docket Number CP12-509 under Accession Number 20130813-4010.

After a review of component failure rates and process conditions, as well as leak locations, Freeport LNG selected the following leakage source design spills for the Liquefaction Plant facilities:

- 6-inch hole in the LNG rundown line near Liquefaction Unit 11
- 2-inch hole in a propane line within Liquefaction Unit 11
- 2-inch hole in a mixed refrigerant line within Liquefaction Unit 11
- 3-inch hole in a propane line in the refrigerant storage area
- 3-inch hole in an ethylene line in the refrigerant storage area

Freeport LNG determined that Liquefaction Unit 11 was of most interest because it would be closer to the property boundary than the other liquefaction trains. The conditions for these design spills are listed in the following table 4.10.5-3.

Table 4.10.5-3

Liquefaction Plant Design Spills

Hole Diameter	Location	Pressure (psig)	Temp. (°F)	Vapor Release Rate (kg/s)	Duration (s)
6-inch	LNG rundown line	272	-261	462	600
2-inch	Propane process line	263	131	43.6	600
2-inch	Mixed refrigerant process line	807	-30	91.6	600
3-inch	Propane storage	165	95	92.9	318
3-inch	Ethylene storage	140	-50	82.7	344

Freeport LNG estimated the release heights for the design spills at 3 feet for the LNG rundown line, 10 feet for the propane and mixed refrigerant process lines, 10 feet for the propane storage release, and 5 feet for the ethylene storage release.

The conditions for the design spills for the Phase II Modification Project are listed in table 4.10.5-4 below.

Table 4.10.5-4

Phase II Modification Project Design Spills

Hole Diameter	Location	Pressure (psig)	Temperature (°F)	Vapor Release Rate (kg/s)	Release Height (ft)	Duration(s)
2-inch	Process (Tank) Area	130	-258	35.51	15.5	600
2-inch	Tank T-3 Sendout Line at Top of the LNG Storage Tank	130	-258	35.51	144	600
2-inch	Dock 2 Transfer Line (at Dock 2)	81	-256	28.03	14.5	600
2-inch	Dock 2 Transfer Line (Halfway along transfer line)	81	-256	28.03	30	600

In general, higher flow rates would result in larger releases and longer dispersion distances, and higher pressures would result in higher rates of jetting and aerosol formation. Therefore, the pressure in the line was considered to be maintained by pumps and/or hydrostatic head to produce the highest total vapor flow rate.

For cases where a containment sump might be located a long distance from the leakage source location, a depressurized release may also be considered in order to produce the highest rate of liquid flow to the sump for vapor dispersion analysis in that area of the plant. However, the sumps in the Liquefaction Plant would be located in the same area of the plant as the leakage source releases and not closer to the nearby property lines. For the Phase II Modification Project, the extent of the vapor clouds from the existing sumps is discussed in section 4.10.5.4.

NFPA 59A Table 2.2.3.5, as adopted by 49 CFR 193, requires the design spill duration to be 10 minutes or less based on demonstrable surveillance and shutdown provisions that are acceptable to the USDOT. The design spill scenarios identified by Freeport LNG assume constant release rates for 10 minutes, except for the propane and the ethylene storage area releases, which were limited by the available inventory in the storage vessels.

USDOT reviewed the data and methodology Freeport LNG used to determine the design spills based on the flow from various leakage sources including piping, containers, and equipment containing LNG, refrigerants, and flammable fluids. On December 31, 2013, USDOT provided a letter to the FERC staff stating that USDOT had no objection to Freeport's methodology for determining the candidate design spills to be used in establishing the Part 193 siting requirements for the proposed LNG facilities at the terminal site.[26,27] The design spills produced by this methodology were identified in the documents reviewed by USDOT and are the same design spills listed in this section.

[26] December 31, 2013 Letter "Re: Freeport LNG Development, L.P., Freeport LNG Liquefaction, LLC, Freeport LNG Liquefaction 2, LLC, and Freeport LNG Liquefaction 3, LLC Freeport LNG Phase II and Liquefaction Projects FERC Docket Nos. CP12-29-000 and CP12-509-000 Design Spill Determination" from Kenneth Lee to Lauren H. O'Donnell. Filed in Docket Number CP12-509 under Accession Number 20140106-4003.

[27] PHMSA based this decision on the following documents: (1) Resource Report 11 Reliability and Public Safety, Accession Number 20120831-5215; (2) Resource Report 11 Reliability and Public Safety, Accession Number 20111209-5264; (3) Hazardous Analysis Assumptions for the Liquefaction Project, Accession Number: 20121015-5078 & 5079; (4) Freeport Response to Information Request # 1, Question # 1, Accession Number: 20130920-5154 & 5155; (5) Freeport Balance of response to Information Request #1, Questions 2, 3 & 4, Accession Number: 20130927-5205 & 5206. PHMSA has also indicated to FERC staff that this decision was based on Freeport's filings made on December 31, 2013 in Accession Numbers 20131231-5265 and 20131231-5266.

DOT's conclusions on the candidate design spills used in the siting calculations required by Part 193 were based on preliminary design information which may be revised as the engineering design progresses. If Freeport LNG's design or operation of the proposed facilities differs from the details provided in the documents on which USDOT based its review, then the facilities may not comply with the siting requirements of Part 193. As a result, **we recommend that:**

- **<u>Prior to the construction of the final design</u>, Freeport LNG should file with the Secretary for review and approval by the Director of OEP, certification that the final design of the facilities at the terminal is consistent with the information provided to USDOT as described in the design spill determination letter dated December 31, 2013 (Accession Number 20140106-4003) as well as in Freeport LNG's filings on December 31, 2013 (Accession Numbers 20131231-5265 and 20131231-5266). In the event that any modifications to the design alters the candidate design spills on which the Title 49 CFR Part 193 siting analysis was based, Freeport LNG should consult with USDOT on any actions necessary to comply with Part 193.**

4.10.5.3 Thermal Radiation Analysis at the Terminal

As discussed in section 4.10.2, if flammable vapors are ignited, the deflagration could propagate back to the spill source and result in a pool fire causing high levels of thermal radiation (*i.e.*, heat from a fire). In order to address this, 49 CFR Part 193.2057 specifies hazard endpoints for spills into LNG storage tank containment and spills into impoundments for process or transfer areas in terms of flux levels. For any distance from a pool fire, a flux level, which expresses how much thermal radiation would be received at that point, can be calculated.

The Part 193 requirement for spills from process or transfer areas specifies that the 1,600 Btu/ft^2-hr flux level cannot extend beyond the facility's property line that can be built upon. This is the Part 193 standard that we used in assessing public impacts from the siting of the terminal facilities.

The 1,600 BTU/ft^2-hr flux level is associated with producing second degree burns in approximately 30 seconds, assuming no shielding from the pool fire. For distances farther away from the pool fire, the flux levels would be less.

Title 49 CFR 193 requires the use of either the LNGFIRE3 computer program model or the report developed by the Gas Technology Institute to determine the thermal radiation exclusion distances. Alternatively, a different model may be used subject to the approval of the USDOT.

In May 2012, the USDOE released a Report to Congress, *Liquefied Natural Gas Safety Research*, on the findings of new experimental data on large LNG pool fires conducted over water by Sandia National Laboratories. Using data gathered from these tests and earlier methane gas burner tests, Sandia developed recommendations on parameters, including mass burning rate, pool fire flame height, surface emissive power (SEP), and atmospheric transmissivity, appropriate for use in solid flame models for pool fires over water. We examined the effect of altering the LNGFIRE3 model to incorporate Sandia's recommendations regarding LNG pool fire modeling over water and on data provided by the largest LNG pool fire tests on land (Gaz de France Montoir tests) or water (Phoenix tests).[28] Our conclusions were that LNGFIRE3, as currently prescribed by 49 CFR 193, is appropriate for modeling thermal radiation from LNG pool fires on land and is suitable for use in siting onshore LNG facilities.

NFPA 59A, as incorporated in 49 CFR 193, also establishes certain atmospheric conditions (0 mph wind speed, 70°F, and 50 percent relative humidity), which are to be used in calculating the distances. However, section 193.2057 supersedes these requirements and stipulates that the wind speed, ambient temperature, and relative humidity that produce the maximum exclusion distances must be used, except for conditions that occur less than 5 percent of the time based on recorded data for the area.

Liquefaction Plant

In accordance with the thermal radiation siting regulations in Title 49 CFR Part 193.2057, Freeport LNG used LNGFIRE3 to predict the maximum distance to a thermal radiation level of 1,600-BTU/ft^2-hr for fires from the design spills in the sumps. Although LNGFIRE3 is specifically designed to calculate thermal radiation flux levels for LNG pool fires, LNGFIRE3 can also be used to conservatively calculate the thermal radiation flux levels for other flammable hydrocarbons such as ethylene and propane.

LNGFIRE3 calculates thermal radiation flux using parameters that include the mass burning rate of the fuel and the SEP of the flame, which is an average value of the thermal radiation flux emitted by the fire. Both the mass burning rate and SEP of an ethylene or propane fire would be less than that of an equally sized LNG fire. Since the thermal radiation from a pool fire is directly proportional to the SEP, and other parameters would not counter this effect, Freeport LNG determined that the thermal radiation exclusion zone distances for ethylene and propane fires would not extend as far as the exclusion zone distance calculated for an LNG fire in the same sump. Based on our consultation with the USDOT, we determined that use of LNGFIRE3 for calculating thermal radiation from refrigerant fires complies with 49 CFR Part 193.

Consistent with the siting of the existing Freeport LNG terminal impoundments, the following weather data was used to calculate thermal radiation exclusion distance for the Liquefaction Area LNG Containment Sump: ambient temperature of 35°F; relative humidity of 60 percent; and a wind speed of 27.6 mph. For calculating thermal radiation distances from the Propane and Ethylene Storage Containment Sump, Freeport LNG used 70°F, a relative humidity of 50 percent and a wind speed of 30 mph. FERC staff also produced LNGFIRE3 results for thermal radiation from the Propane and Ethylene Storage Containment Sump using the weather conditions consistent with those approved for the original terminal siting, and these results demonstrated that Freeport LNG's weather selections for this sump provided conservative distances. Therefore, we agree that Freeport LNG's selection of weather data would result in conservative distances in both cases. The maximum distance calculated from each sump to the 1,600 Btu/ft^2-hr level is listed in table 4.10.5-5.

[28] "Recommended Parameters for Solid Flame Models for Land Based Liquefied Natural Gas Spills," Issued January 23, 2013 in Docket AD13-4-000 (eLibrary Accession Number: 20130123-4002).

Table 4.10.5-5

Thermal Radiation from Liquefaction Plant Impoundments

Impoundment	Distance from Sump to 1,600 Btu/ft^2-hr (feet)	Distance from Sump to Nearest Property Line that Could be Built Upon (feet)
Liquefaction Area LNG Containment Sump	320	980
Propane and Ethylene Storage Containment Sump	105	430

Propane Collection Areas A and B would not have any liquid design spill that would drain into them. Due to the properties of propane, the propane design spills would turn entirely to vapor upon release. Therefore, no design spill thermal radiation zone would be calculated for these sub-impoundments. To be overly conservative, Freeport LNG modeled thermal radiation from the full surface area of Propane Collection Areas A and B. The results showed that the 1,600 Btu/ft2-hr zone would extend 165 and 290 feet from the collection areas, respectively, which would remain within Freeport LNG property.

None of the 1,600 Btu/ft^2-hr thermal radiation zones would extend beyond a property line that could be built upon. Based on our consultation with the USDOT, Freeport LNG's siting calculations for the project design would meet the requirements specified in Title 49 CFR 193.2051 and 193.2057 and NFPA 59A section 2.2.3.2 (2001 edition). As a result, we conclude that the siting of the proposed project would not have a significant impact on public safety.

An LNG fire over the full surface area of the existing Process Area LNG Drain Sump near the LNG storage tanks was previously examined under docket number CP03-75-000.

Phase II Modification Project

As described in the June 21, 2006 Phase II Project EA, under docket CP05-361-000, the thermal radiation for LNG storage tank T-3 was determined to meet the thermal radiation exclusion zone requirements. Additionally, the proposed facilities for the Phase II Modification Project would not affect the capacity of the existing spill containment systems and the impoundment sizing volumes that were used to determine the thermal radiation zones for the existing Freeport LNG Terminal. The thermal radiation exclusion zones considered under the original Freeport LNG project and the Phase II project (Docket Nos. CP03-75-000 and CP05-361-000, respectively) would remain unchanged. Therefore, based on our consultation with USDOT, we conclude the thermal radiation analysis provided by Freeport LNG for the spills associated with the proposed Phase II Modification Project equipment would meet the requirements specified in 49 CFR Part 193.2057 and would not have a significant impact on public safety.

4.10.5.4 Vapor Dispersion Analysis for Facilities at the Terminal

As discussed in section 4.10.2.2, a large quantity of LNG spilled without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it is either dispersed below the flammable limit or encountered an ignition source. In order to address this hazard, 49 CFR Part 193.2059 requires each LNG container and LNG transfer system to have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001 edition).

Taken together, Part 193 and NFPA 59A (2001) require that flammable vapors either from an LNG tank impoundment or a single accidental leakage source do not extend beyond a facility property line that can be built upon.

Title 49 CFR Part 193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration (one-half the LFL of LNG vapor) under meteorological conditions which result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for stability Class F, a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature.

The regulations in Part 193 specifically approve the use of two models for performing these dispersion calculations, DEGADIS and FEM3A, but also allow the use of alternative models approved by the USDOT. Although Part 193 does not require the use of a particular source term model, modeling of the spill and resulting vapor production is necessary prior to the use of vapor dispersion models. In the past, applicants have typically used the SOURCE5 program to model the vapor production from an LNG spill.

On July 7 and 16, 2010, the USDOT issued written interpretations in response to two requests regarding the regulations under 49 CFR 193.[29] Specifically, these requests sought clarification on whether Part 193.2059 allowed the use of the SOURCE5 source term model and whether Part 193.2059 required the effects of jetting and flashing to be considered in vapor dispersion exclusion zone calculations. In these interpretations, the USDOT stated that:

- SOURCE5 could no longer be used to determine the vapor gas exclusion zone for compliance with Part 193.2059 unless the deficiencies identified in the Fire Protection Research Foundation's reports "Evaluating Vapor Dispersion Models for Safety Analysis of LNG Facilities Research Project (Apr. 2007)" and "LNG Source Term Models for Hazard Analysis: A Review of the State-of-the-Art and an Approach to Model Assessment (Mar. 2009)" had been addressed;

- the effects of jetting and flashing must be considered in order to comply with Part 193.2059; and

- source term models must have a credible scientific basis and must not ignore phenomena which can influence the discharge, vaporization, and conveyance of LNG.

[29] PHMSA Interpretation "Re: Request for Written Interpretation on the Applicability of 49 CFR 193 to Proposed Waterfront Liquefied Natural Gas Plant in the City of Fall River, Massachusetts" (July 7, 2010) and PHMSA Interpretation "Re: Request for Written Interpretation on the Applicability of 49 CFR 193 to Proposed LNG Import Terminal in Robbinston, Maine" (July 16, 2010).

As a result of these interpretations, alternative dispersion models became necessary in order to examine the effects of jetting, flashing, and the conveyance of LNG for exclusion zone calculations. In August 2010, the USDOT issued Advisory Bulletin ADB-10-07 (Advisory Bulletin) to provide guidance on obtaining approval of alternative vapor-gas dispersion models under Subpart B of 49 CFR Part 193. In October 2011, two dispersion models were approved by USDOT for use in vapor dispersion exclusion zone calculations: PHAST-UDM Version 6.6 and Version 6.7 (submitted by Det Norske Veritas) and FLACS Version 9.1 Release 2 (submitted by GexCon). PHAST 6.7 and FLACS 9.1, with their built-in source term models, were used by Freeport LNG in its vapor dispersion analyses. Based on our consultation with the USDOT, we determined that these built-in source term models are suitable for flashing and jetting, pool spread and vaporization simulations, and that they comply with the siting requirements of Part 193.

For all the release scenarios in the Projects, Freeport LNG used the following conditions: average regional temperature of 71.5°F, relative humidity of 50 percent, wind speed of 4.5 mph, Pasquill-Gifford Atmospheric Stability Class F and a ground surface roughness of 0.03 meter.

Liquefaction Plant

Freeport LNG accounted for the facility geometry in the vapor dispersion model, including the impoundments, trenches and liquefaction train geometry details. The model also included vapor fences (barriers) that are proposed to be installed at specific locations along the southern plant property line and inside the plant, as shown in figure 4.10.5-1. The vapor barriers would be 20 feet tall and impermeable.

The liquefaction units would include numerous air coolers, consisting of arrays of axial fans mounted to pull air from near ground level to flow through the pipe racks and then discharge it upwards. The air coolers for a liquefaction train would be operating continuously while that train is active and would continue running until they are stopped by operator intervention, even during automatic shutdowns. This is to ensure that the refrigerant in the pipes remains cool following a shutdown in order to prevent pressure buildup in the refrigerant lines. For conservative vapor dispersion simulation purposes, the air coolers were considered to be operating only for the train in which a release occurs.

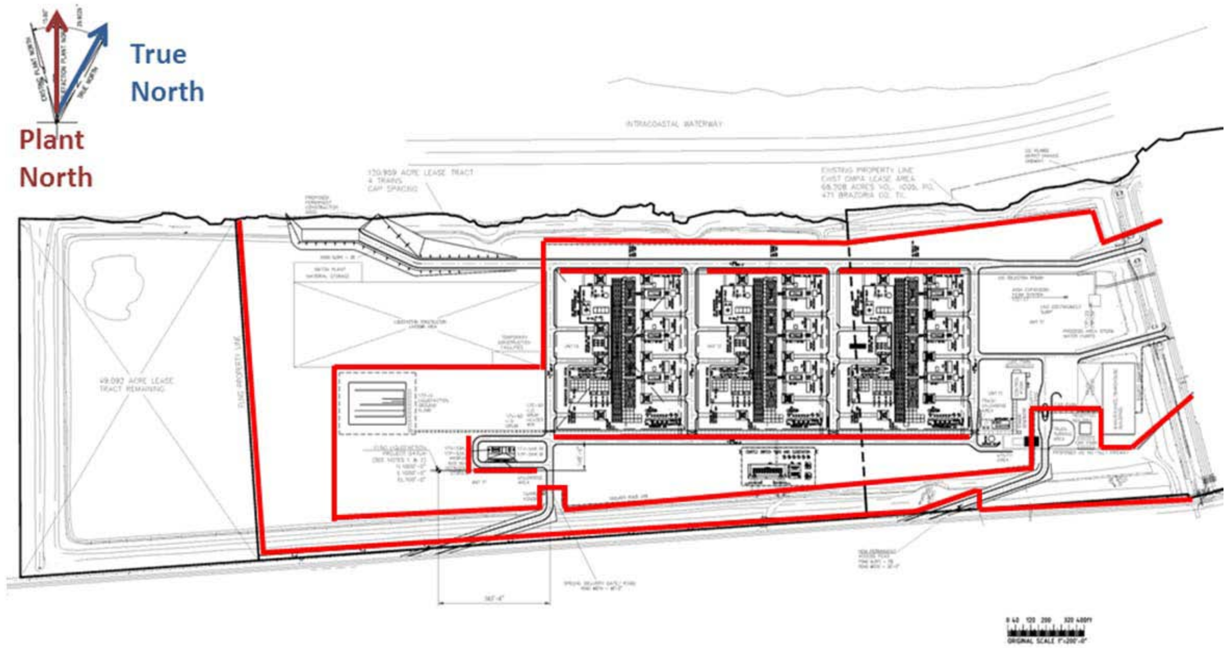

Figure 4.10.5-1 Vapor Fence Placement – Shown as Red Lines

The Freeport LNG terminal receives power from CenterPoint Energy’s transmission system rather than the distribution system, which is used elsewhere on Quintana Island. If a power outage would occur during a release scenario, the facility is designed to safely shut down the process operations, including the pumps. Since start up in 2008, the Freeport LNG terminal has experienced only one unexpected power outage, which was a momentary loss of power caused by a shrimp boat contacting the transmission lines.

Vapor dispersion was first evaluated from the long straight trench for the LNG rundown line because of the potential for a long vapor cloud to form when the wind direction would be parallel to the trench. Freeport LNG considered the guillotine rupture of the 24-inch-diameter LNG rundown line, which is a much larger spill than the design spills identified in section 4.10.5.2, for the liquid release into the liquefaction area trough system, resulting in a flow rate of 15,570 gpm.

As seen in figure 4.10.5-2 below, the ½ LFL vapor cloud for this scenario would not reach significant distances from trough and would remain well within the Freeport LNG property line.

Liquid spills of refrigerant would be confined by curbing placed around the process areas and would be directed either into the same trenches used for LNG spills or to propane collection areas. Since LNG has a higher vaporization rate, LNG spills into trenches were considered to be the bounding case for the extent of vapor clouds that would be formed by liquid spills of refrigerants into the same trenches.

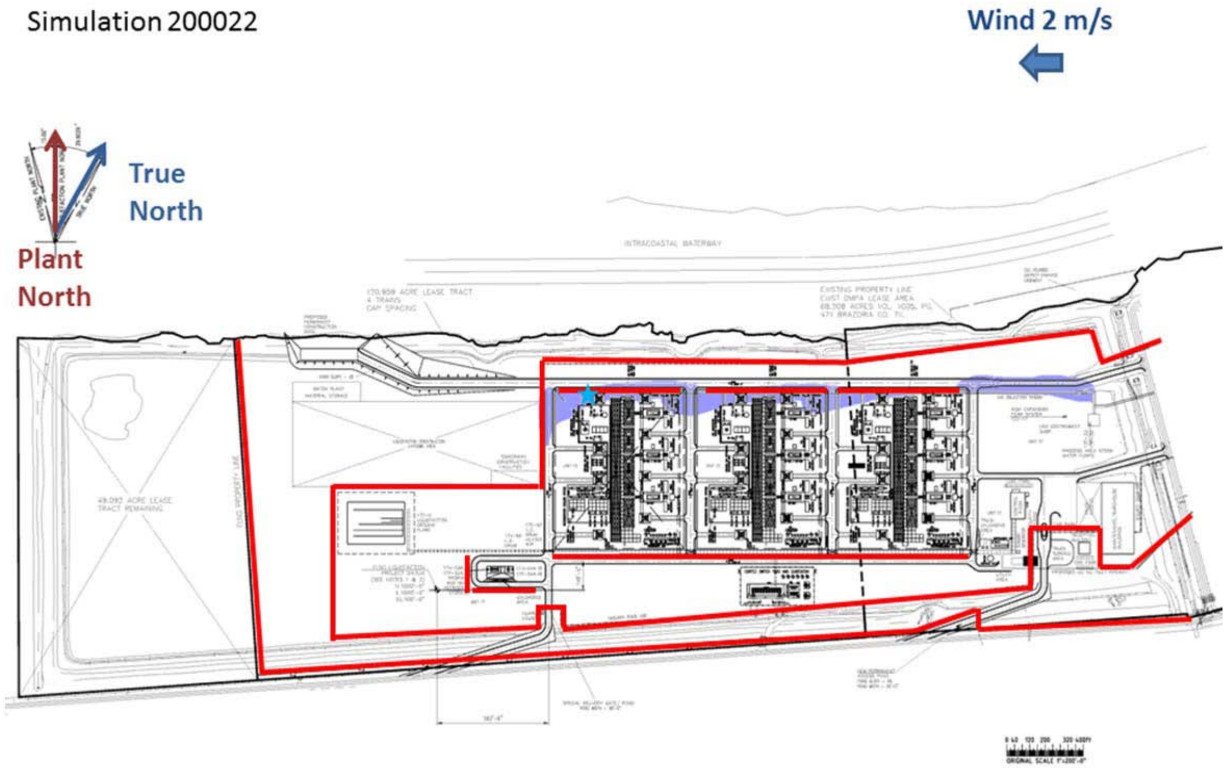

Figure 4.10.5-2 Flammable Vapor Dispersion from the LNG Trough with Parallel Wind – Shown as Shaded Area

As discussed in section 4.10.5.2, USDOT has no objections to Freeport LNG using the design spill selection methodology that resulted in the following set of design spills for determining compliance with 49 CFR Part 193 for the Liquefaction Plant:

1) a 6-inch diameter LNG flashing release from Liquefaction Unit 11;
2) a 2-inch diameter propane flashing release from Liquefaction Unit 11;
3) a 2-inch diameter mixed refrigerant flashing release from Liquefaction 11;
4) a 3-inch diameter ethylene flashing release from the refrigerant storage area; and
5) a 3-inch diameter propane flashing release from the refrigerant storage area.

This selection methodology considered failure rates for plant components, as well as process conditions and release locations.

Various wind directions and were modeled for each case. Freeport LNG found that the cases with the most significant vapor dispersion toward the southern plant property line were from a 3-inch ethylene release in the storage area with release and wind directions to either the south or to the west. See figures 4.10.5-3 and 4.10.5-4.

Figure 4.10.5-3 Flammable Vapor Dispersion from the Ethylene Storage Area Design Spill to the South – Shown as Shaded Area

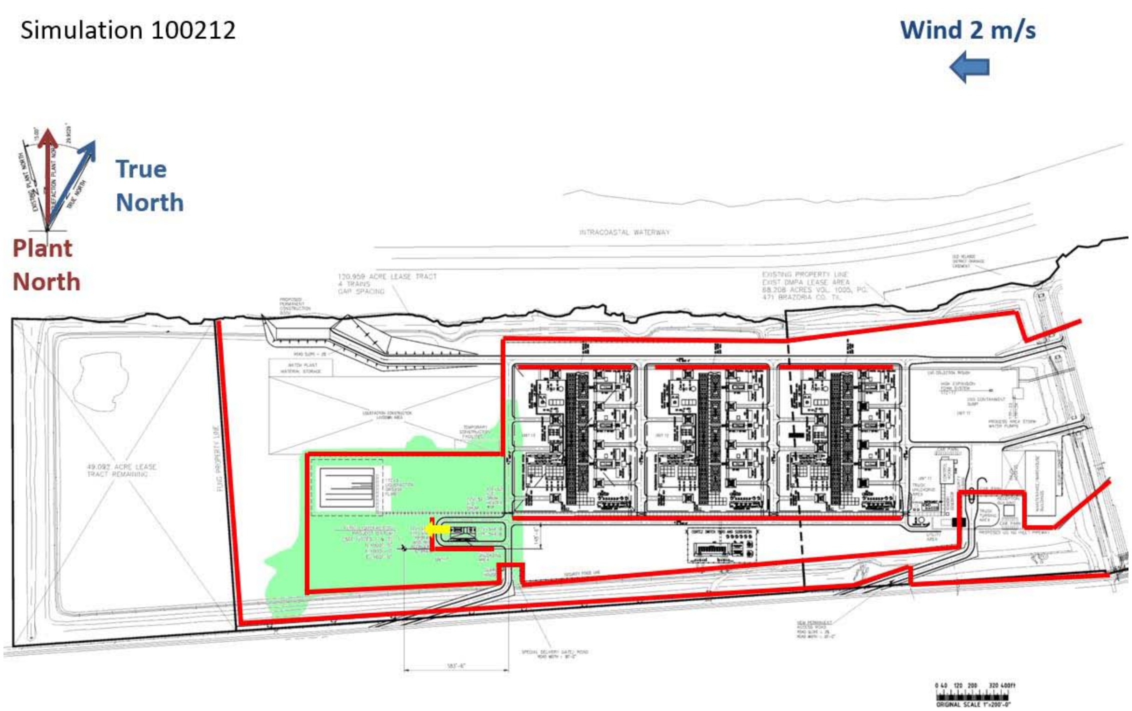

Figure 4.10.5-4 Flammable Vapor Dispersion from the Ethylene Storage Area Design Spill to the West – Shown as Shaded Area

Freeport LNG found the case with the most significant vapor dispersion to the north, toward the shoreline property across the IWC, to be the 6-inch LNG release from the LNG rundown line with release and wind directions to the north. See figure 4.10.5-5.

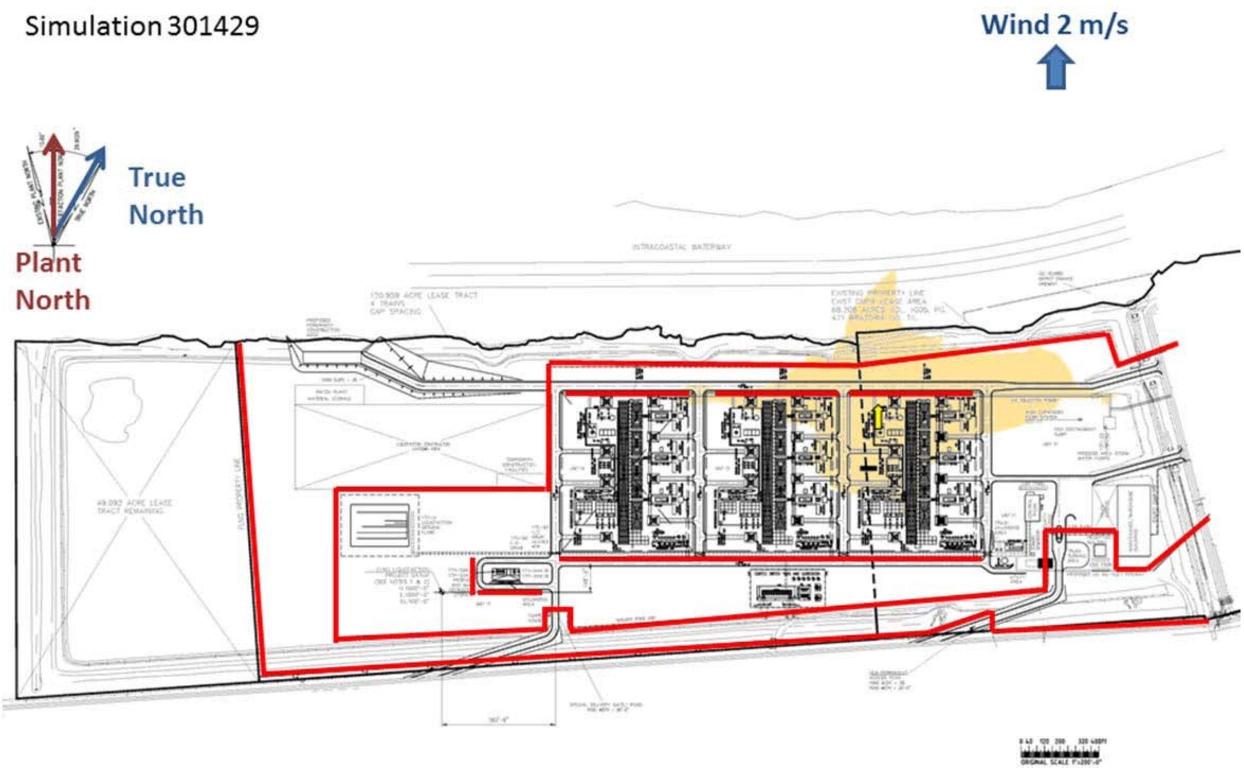

Figure 4.10.5-5 Flammable Vapor Dispersion from an LNG Rundown Line Design Spill to the North – Shown as Shaded Area

The FLACS simulations showed that, due to the proposed vapor fences within the plant and near the property lines, none of the design spills would result in the ½ LFL vapor dispersion extending over a property line that could be built upon. Based on our consultation with the USDOT, Freeport LNG's siting calculations for the project design would meet the requirements specified in Title 49 CFR 193.2051 and 193.2059 and NFPA 59A section 2.2.3.4 (2001 edition). As a result, we conclude that the siting of the proposed Liquefaction Plant would not have a significant impact on public safety.

Phase II Modification Project

In the Phase II Modification Project, the facility geometry was accounted for in the vapor dispersion model, including large structures (LNG storage tanks, pipe racks, and the air tower building), existing impoundments, and trench geometry details as established by available plant layout drawings. The model also included the proposed vapor fences (barriers) that would extend along specific locations of the plant property line and inside the plant as shown in figure 4.10.5-6. The vapor fences would be 10-feet, 12-feet, and 20-feet tall chain-link wire fences with privacy slats threaded through the metal links with 10 percent porosity. Figure 4.10.5-6 identifies the heights of the vapor fences. The releases were initiated after 60 seconds had passed before the introduction of LNG to allow the wind profile to stabilize from the effects due to the presence of buildings and other on-site obstructions.

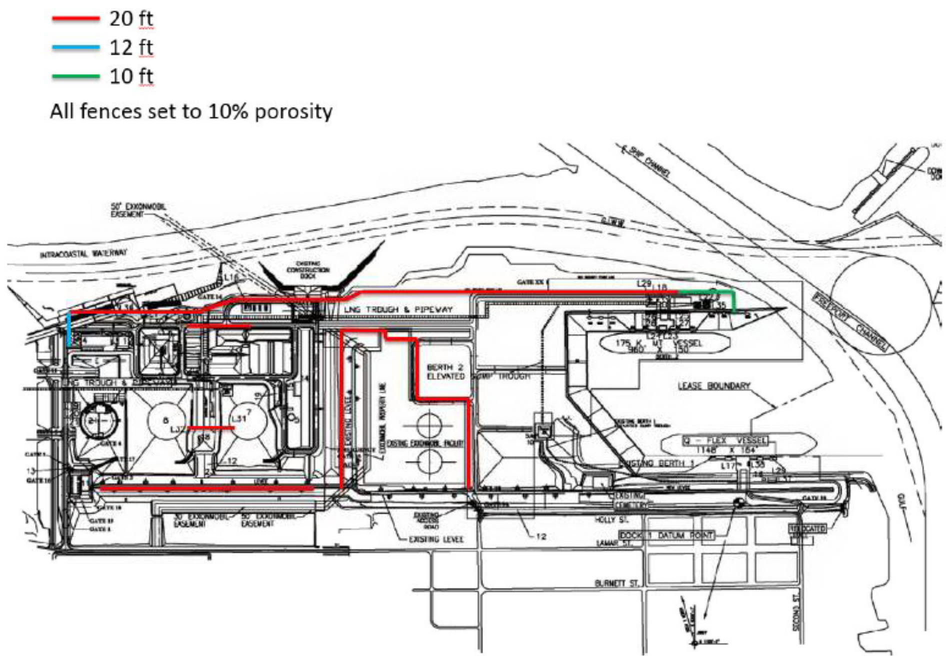

Figure 4.10.5-6 Vapor Fences Proposed for the Phase II Modification Project

According to table 2.2.3.5 of NFPA 59A, the design spill is the largest flow from the container (*i.e.*, storage tank) withdrawal pumps for a 10-minute duration at full-rated capacity. In order to address the highest rate of LNG liquid flow (*i.e.,* liquid scenario) into the existing LNG Drain Sump – Process Area, Freeport LNG specified the design spill as the guillotine rupture of the 24-inch-diameter LNG Storage Tank T-3 discharge header with three in-tank pumps operating at maximum pump run-out [(7,378 gpm pump run-out flow) x (3 in-tank pumps) = 22,134 gpm]. FLACS was used to predict the extent of the ½-LFL vapor cloud. The FLACS simulations at the proposed Tank T-3 process area identified the need for a 20-foot tall fence to prevent the LNG vapor from extending beyond the south property line. The results of the FLACS simulation, as shown in figure 4.10.5-7, showed that the ½-LFL vapor cloud would remain within the property boundary at all times as a result of the vapor fence.

Although Freeport LNG selected 2-inch-diameter design spills for the Dock 2 area, a greater LNG liquid spill (*i.e.,* liquid scenario) into the existing LNG Drain Sump (Dock Area) was evaluated. Freeport LNG evaluated a hole equivalent to 1/3 the diameter of the 26-inch-diameter LNG unloading line at Dock 2, resulting in a 18,770 gpm spill rate. For the simulations, the LNG is assumed to spill directly into the trench. The FLACS simulations were evaluated at the existing LNG Drain Sump (Dock Area) and in the trough at the Dock 2 area. The FLACS simulations at the existing LNG Drain Sump (Dock Area) showed that the vapor cloud did not extend beyond the property boundary.

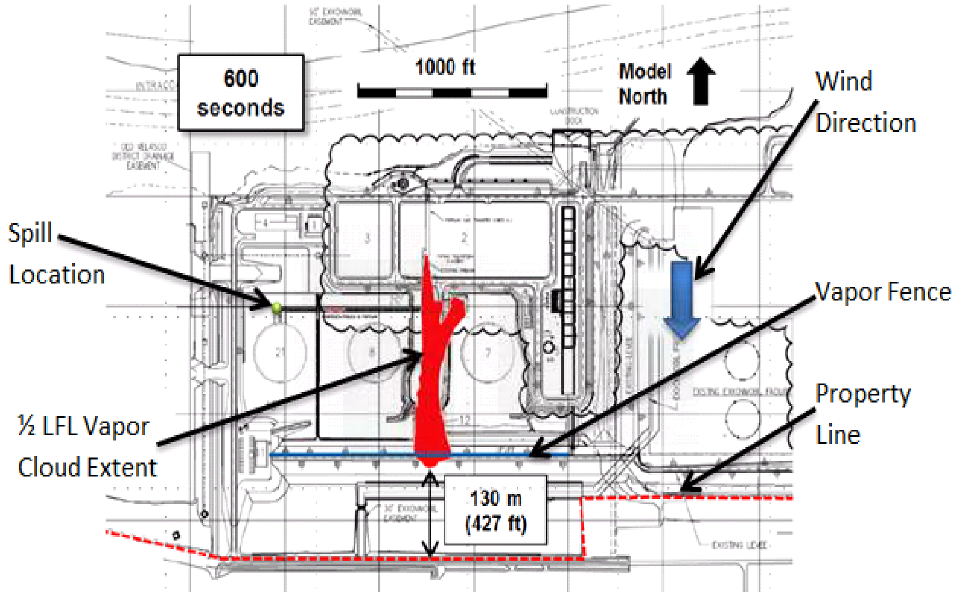

Figure 4.10.5-7 Tank 3 Sendout Vapor Dispersion Zone – Liquid Spill

The FLACS results, shown in figures 4.10.5-8 and 4.10.5-9, indicate that the ½-LFL vapor clouds would remain within the property boundary. Based on our consultation with the USDOT, Freeport LNG's siting calculations for vapor dispersion from LNG liquid spills would meet the requirements specified in Title 49 CFR 193.2059. As a result, we conclude that vapor dispersion from the LNG liquid spills evaluated for both the original Phase II project and the Phase II Modification Project would not have a significant impact on public safety.

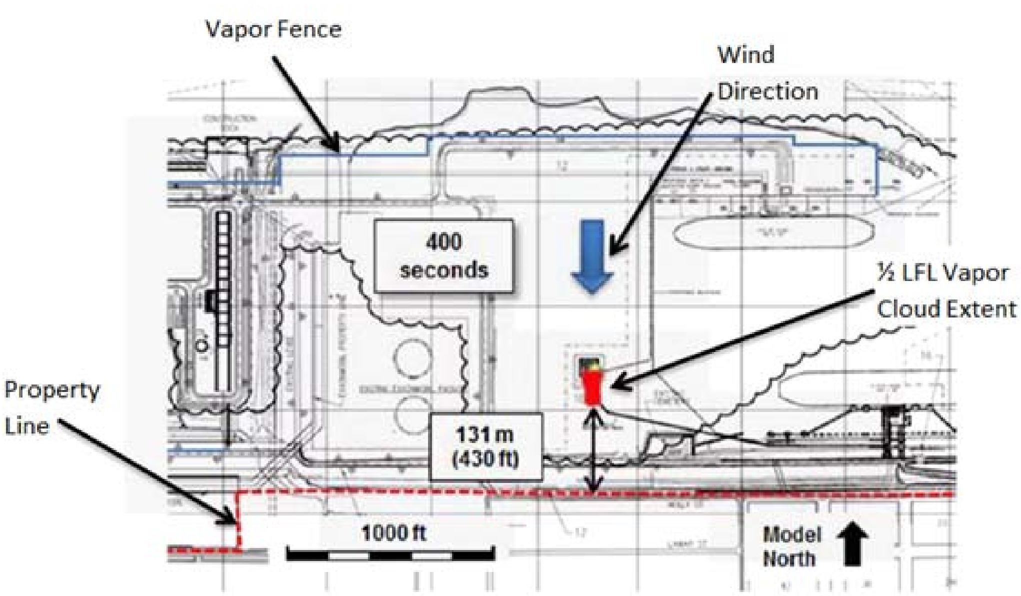

Figure 4.10.5-8 Dock 2 Vapor Dispersion Zone – Liquid Spill at Existing LNG Drain Sump (Dock Area)

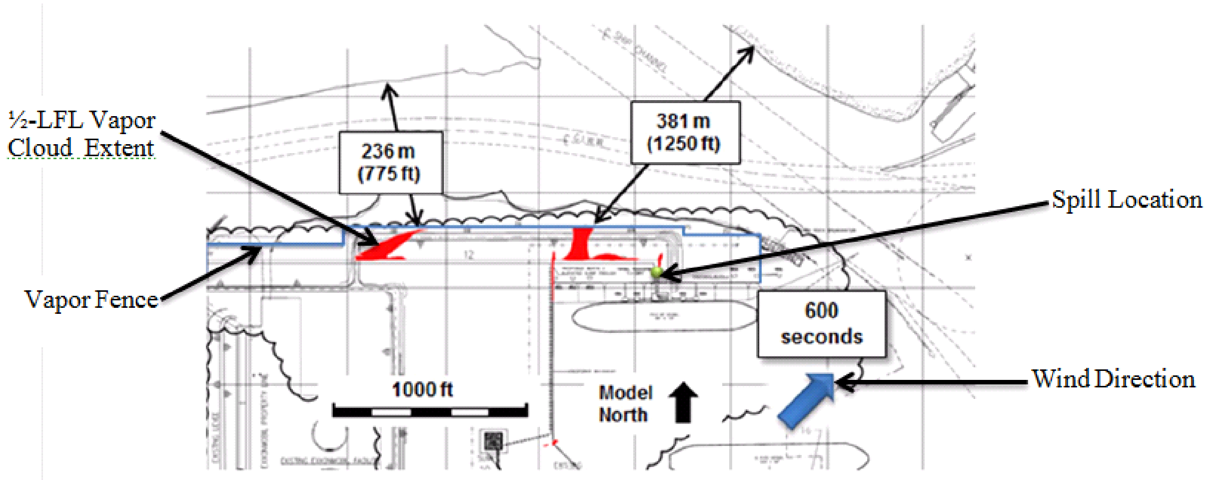

Figure 4.10.5-9 Dock 2 Vapor Dispersion Zone – Liquid Spill in Dock 2 Trough

Freeport LNG considered the highest rate of LNG flashing and jetting from the Dock 2 area would be a release from a 2-inch-diameter hole from the 26-inch-diameter unloading/loading line as shown in figure 4.10.5-10. Freeport LNG also considered 2-inch-diameter holes from the 24-inch-diameter Tank T-3 sendout LNG header in the process area and the 24-inch-diameter Tank T-3 sendout LNG header located at the top of Tank T-3. Freeport LNG determined that the largest hole size that would generate the greatest vapor production rate from each of the three release sources would be from a 2-inch-diameter hole. The FLACS results indicated that the ½-LFL vapor clouds at the Dock 2 and process area releases extended beyond the shoreline along the northern property line and into the ICW. Based on our consultation with USDOT, we conclude these vapor dispersion analyses over the ICW would not be prohibited under 49 CFR Part 193.

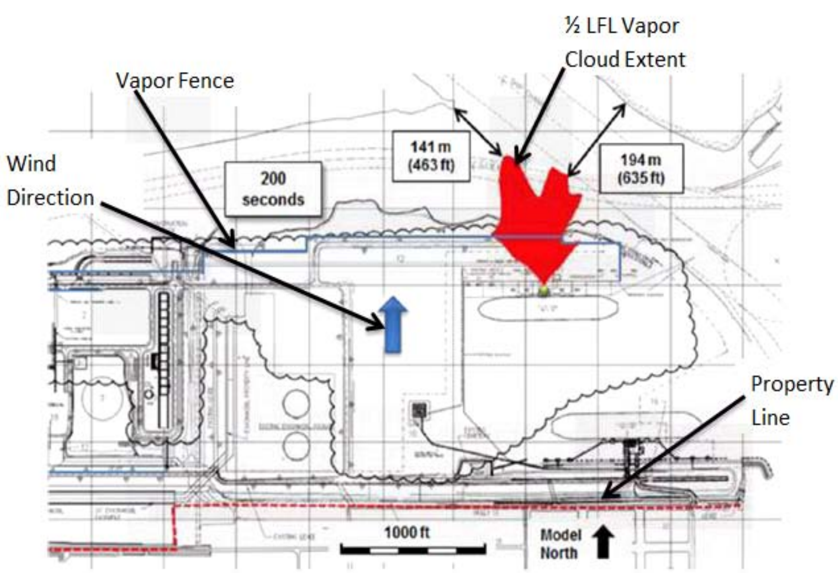

Figure 4.10.5-10 Dock 2 Vapor Exclusion Zone – Flashing and Jetting

As shown in figure 4.10.5-11, additional 10-foot-high vapor fences in the area of the ExxonMobil facility would be provided to limit the extent of the vapor dispersion zones onto the ExxonMobil property. Freeport LNG indicated that the vapor fences around the perimeter of the ExxonMobil facility would not follow the facility boundaries, but the existing fence line. As shown in figure 4.10.5-11, the FLACS results from a 2-inch-diameter hole release from the 26-inch-diameter unloading/loading line showed a small portion of the ½-LFL vapor cloud extending onto the northern edge of the ExxonMobil facility.

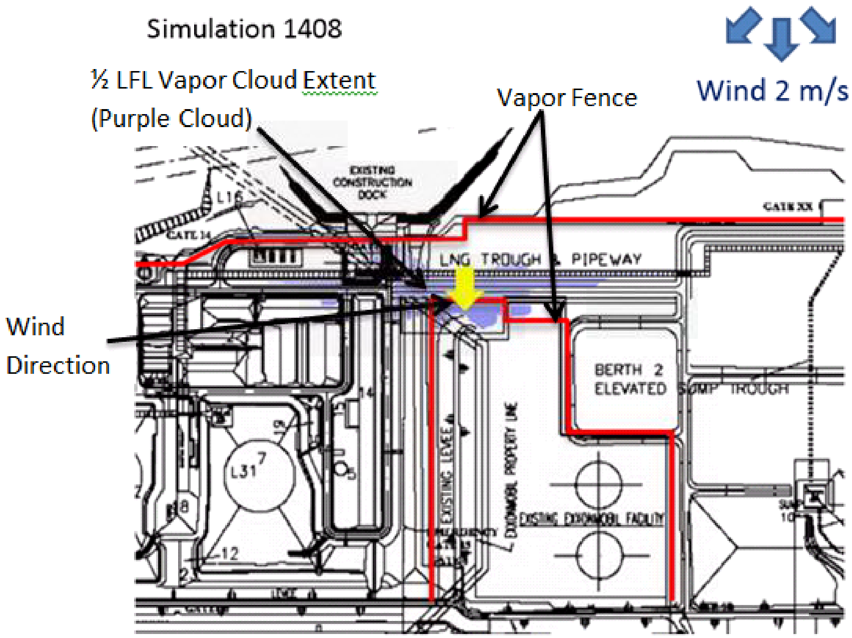

Figure 4.10.5-11 Dock 2 Vapor Dispersion Exclusion Zone - Flashing and Jetting

However, the vapor does not extend beyond the vapor fence. It would appear that relocating the vapor fence farther north to follow the facility boundary instead of the existing fence line may prevent vapors from extending onto the ExxonMobil facility. Therefore, **we recommend that:**

Because Freeport LNG's filings indicate that the vapor cloud would extend onto an adjacent industrial property not under legal control by Freeport LNG, which would be prohibited by 49 CFR 193, **we recommend that:**

- **Prior to the end of the draft EIS comment period, Freeport LNG should document how it would ensure that the portion of the vapor cloud that extends onto the ExxonMobil facility would comply with the exclusion zone requirements of 49 CFR 193.2059.**

After Freeport LNG files information to explain how this situation would comply with 49 CFR 193, FERC staff will consult with DOT to determine whether the company's response is acceptable. The vapor cloud would not extend onto an area accessed by the public, and we, therefore, conclude that the vapor dispersion over the ExxonMobil property would not pose a significant impact on the public.

Vapor Fencing

Because the vapor dispersion simulations for both the Liquefaction Plant and the Phase II Modification Project took into account the use of vapor fences, Freeport LNG indicated that the vapor fences would be incorporated into the existing facilities maintenance and inspection program and would be maintained in accordance with the vendor or manufacturer's specifications. However, in order to ensure that the design of the vapor fencing and the procedures for maintaining the vapor fencing are appropriate, **we recommend that:**

- **<u>Prior to construction of the final design</u>, Freeport LNG should file with the Secretary, for review and written approval by the Director of OEP, design details of the vapor fences as well as procedures to maintain and inspect the vapor fences provided to meet the siting provisions of 49 CFR Part 193.2059. This information should be filed a minimum of 30 days before approval to proceed is requested.**

4.10.5.5 Overpressure Considerations for Facilities at the Terminal

The propensity of a vapor cloud to detonate or produce damaging overpressures is influenced by the reactivity of the material, the level of confinement and congestion surrounding the vapor cloud, and the flame travel distance. It is possible that the prevailing wind direction may cause the vapor cloud to travel into a partially confined or congested area. The primary flammable substances in the liquefaction area would be methane, propane, ethylene and mixed refrigerant. As adopted by Part 193, section 2.1.1 of NFPA 59A (2001 edition) requires an evaluation of potential safety incidents and safety measures incorporated in the design or operation of the facility. In order to address potential incidents related to overpressures associated with an LNG or refrigerant release, Freeport LNG analyzed the distance to an overpressure threshold value of 1 psi to determine the potential impact on the public. The 1 psi value is used in consequence analyses required under federal regulations such as Title 40 CFR Part 68.22 and thus is considered a reasonable threshold for consequence analyses.

Freeport LNG modeled overpressures based on the proposed layout and pipe rack cross-sections of the Liquefaction Plant using FLACS Version 9.1 software. Distances were determined with a safety factor of 2 (*i.e.*, ½ psi), as a result of previous validation studies and peak-pressure averaging (Hansen, *et al.*, 2010).

As discussed in the section 4.10.2.4, unconfined methane or LNG vapor clouds would not be expected to produce damaging overpressures given the LNG compositions handled onsite and the expected vapor dispersion characteristics. For this reason, Freeport LNG did not model unconfined LNG releases in its overpressure analysis.

However, ignition of a confined LNG vapor cloud could result in higher overpressures. To address this concern, gas detectors would be installed in the vicinity of the air intakes of all combustion equipment and all buildings. The detectors would be calibrated based upon the potential flammable vapors near each location. If multiple types of flammable vapors would be possible at a specific location, the respective detector(s) would be calibrated accordingly. Gas detection would lead to alarms, and in certain cases, equipment shutdown. Therefore, we determined the potential for overpressures from confined vapor clouds is negligible.

As discussed in the section 4.10.2.4, propane, ethylene and mixed refrigerant have higher reactivities than methane, and therefore ignition of these substances would have a higher potential to result in damaging overpressures and would pose a higher risk to the public.

In the event of a vapor cloud deflagration, the largest overpressures would typically be produced by flame acceleration within the regions of the vapor cloud with the largest degrees of congestion and/or confinement. The Liquefaction Plant would have three liquefaction units containing areas of congestion. The most important unit to be evaluated for overpressure hazards is Liquefaction Unit 11, which would be closer to the property line than the others.

Each liquefaction unit includes two significant refrigerant process streams: propane and mixed refrigerant. In order to determine the most reactive stream, identical near-stoichiometric vapor clouds of both fluids were placed in the congested region of a liquefaction train in the computer model, and ignition was simulated. This comparison demonstrated that the mixed refrigerant vapors would produce more significant overpressures than the propane vapors.

In order to determine which mixed refrigerant vapor dispersion scenario would most likely result in the largest overpressure hazard, the mixed refrigerant release was evaluated to determine the combination of release direction, wind speed, and wind direction that would create the greatest equivalent stoichiometric cloud within the congested area of a liquefaction process train. This method converts non-homogeneous clouds into equivalent stoichiometric clouds that can be modeled using FLACS, considering that both the reactivity of a mixture and its gas expansion ratio are functions of the local stoichiometry. The largest equivalent stoichiometric cloud occurred for a release to the south with wind from the northeast at 4.5 mph. This stoichiometric cloud was inserted into the congested areas of Liquefaction Train 11, at locations nearest to property lines, and ignited at locations that would allow the most flame acceleration toward the property lines. As shown in figure 4.10.5-12, these results demonstrated that an overpressure of 1 psi, which was actually modeled to the ½ psi to account for any uncertainty in the model, would remain onsite.

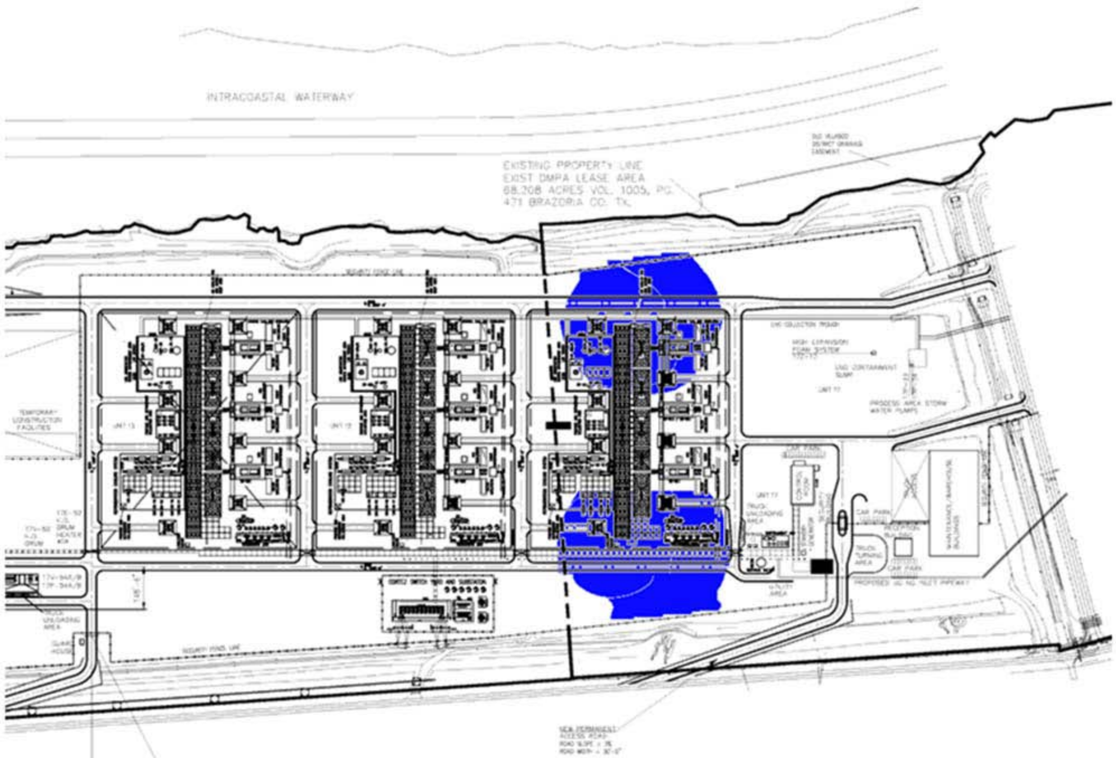

Figure 4.10.5-12 Extent of 1 Psi Overpressures Due to a Design Spill in the Liquefaction Plant Process Area – Shown as Shaded Areas

In addition, Freeport LNG performed FLACS modeling of potential overpressures in the refrigerant storage area. A near stoichiometric cloud of ethylene was placed over the entire refrigerant storage area and ignited at a location that would allow the most flame acceleration toward the nearest property line. Freeport LNG notes that this stoichiometric cloud size was extremely conservative, given that dispersion results showed only 10 percent of the available area would be included in an equivalent stoichiometric cloud. The company indicated that this degree of conservatism would have a more significant effect than any layout changes made after the modeling was conducted, either in FEED or in final design. Because the model showed that the ½ psi distance for this conservative scenario would remain onsite and because ethylene has a higher reactivity than propane, the results indicate that an overpressure of 1 psi would remain onsite for flammable vapor scenarios in the refrigerant storage area. See figure 4.10.5-13.

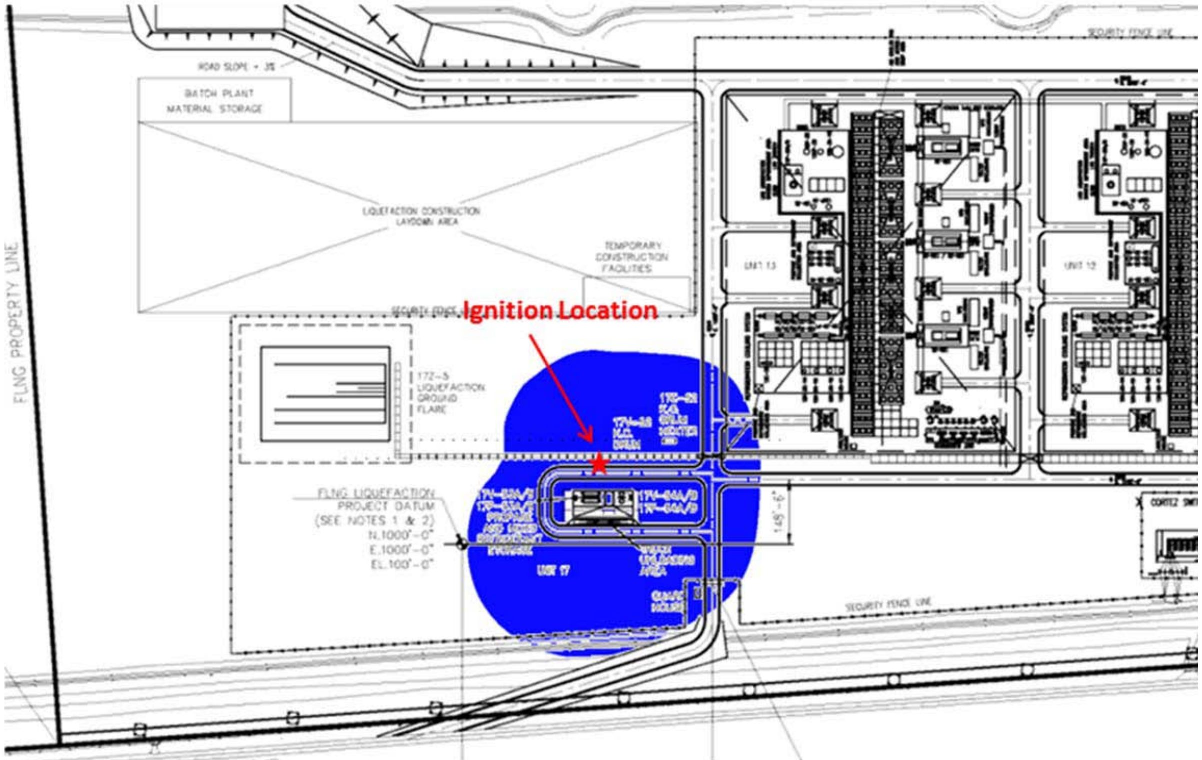

Figure 4.10.5-13 Extent of 1 Psi Overpressures Due to a Design Spill in the Liquefaction Plant Refrigerant Storage Area – Shown as Shaded Areas

Using FLACS, Freeport LNG also analyzed the potential for overpressures from the substation shown to the south of the middle liquefaction train. The substation area was completely filled with a stoichiometric cloud of ethylene and ignited at corners opposite the nearest property line in order to project any blast waves in that direction. However, because the substation area has very little congestion, the maximum pressure produced was 1/4 psi, which did not leave the substation area.

The ground flare, which is also an area with very little congestion, can be seen located to the north and west of the refrigerant storage area in figure 4.10.5-13. Similar insignificant overpressures would be expected to be produced from ignition of an ethylene gas cloud covering the flare area, which is much farther from the property line than the substation.

None of the vapor dispersion scenarios from the design spills would have the potential for offsite overpressures of 1 psi. Based on our consultation with the USDOT, Freeport LNG's overpressure analyses for LNG and refrigerants for the project design would meet the requirements specified by Title 49 CFR 193.2051 and NFPA 59A section 2.1.1 (2001 edition). As a result, we conclude that the siting of the proposed Liquefaction Plant would not have a significant impact on public safety.

The overpressure analyses were based on the preliminary information contained in the FEED submitted by Freeport LNG. Piping and equipment arrangements may differ in final design, potentially resulting in increased congestion or confinement in the liquefaction area and an increase in the overpressure distance. Therefore, **we recommend that:**

- **Prior to construction of the final design, Freeport LNG should file with the Secretary, for review and written approval by the Director of OEP, plant geometry models or drawings that verify the confinement and congestion represented in the FEED of the Liquefaction Project facilities or provide revised overpressure calculations indicating that a 1 psi overpressure would not impact the public. This information should be filed a minimum of 30 days before approval to proceed is request.**

4.10.5.6 Boiling Liquid Expanding Vapor Explosion

Freeport LNG would install two pressurized propane storage tanks and two pressurized vacuum-insulated ethylene storage tanks at the Liquefaction Plant. Freeport LNG originally proposed to locate the Propane and Ethylene Storage Area Sump within the curbed area around the storage tanks. However, the company revised the layout to provide passive protection from a BLEVE of a storage tank by locating this sump 113 feet away from the closest storage tank and 93 feet away from the truck unloading area. This arrangement would locate the tanks and truck unloading area outside of the 3,000 Btu/ft^2-hr thermal radiation zone from a fire over the full surface area of the Propane and Ethylene Storage Area Sump. In addition, Freeport LNG would orient flanges and small nozzles in the refrigerant storage area so that a jet fire would not impinge on adjacent equipment or piping. Where necessary, Freeport LNG would use mitigation measures such as flange shrouds and the use of welded valves.

As additional layers of protection in the event of a fire, water spray and fire water monitors would be installed to cool the propane and ethylene storage tanks as well as the delivery truck tanks in the unloading area. The water spray would be designed in accordance with API 2510A to provide 0.25 gpm/ft^2 of water for the surface of the tanks. Three firewater monitors in the area would also be designed in accordance with API 2510A to provide 500 gpm of cooling water each.

As there would be no pressurized storage vessels proposed as part of the Phase II Modification Project, we would not expect public safety impacts from BLEVEs at the Phase II Modification Project facilities.

Based on our consultation with the USDOT, Freeport LNG's siting calculations for the Liquefaction Plant design would meet the requirements specified by Title 49 CFR 193.2051 and NFPA 59A section 2.1.1 (2001 edition). As a result, we conclude that the siting of the proposed Liquefaction Plant would not have a significant impact on public safety.

4.10.6 Siting Analysis for the Pretreatment Plant

As previously discussed, we applied the Part 193 siting standards to the Pretreatment Plant in order to provide a consistent assessment of potential public impacts with could result from the construction of the facilities at both this site and the terminal site. Although the Part 193 siting standard was used for our review, the Pretreatment Plant is not subject to these regulations and would not have to comply with any of the requirements under 49 CFR 193 unless otherwise determined by USDOT.

4.10.6.1 Pretreatment Plant - Impoundment System

The proposed Pretreatment Plant impoundment system would have several curbed concrete spill containment areas. The first area would contain spills in the Utility Storage Area and would be 198 feet long by 79 feet wide by 14 inches deep. This containment area would contain 110 percent of the volume of the amine storage tank, which is the largest tank in that area, having a capacity of 103,490 gallons.

Two other spill containment areas would be located in each of the three pretreatment process units, Pretreatment Collection Area A having dimensions of 178 feet long by 60 feet wide with a 6 inch curb and Pretreatment Collection Area B being 122 feet long and 54 feet wide with a 6-inch curb. Both containment areas would have a 13 foot by 13 foot by 2 foot sub-impoundment and would have total containment volumes of 47,720 and 22,560 gallons respectively, including internal geometry such as sloped floors. Although there would be no storage tanks in the pretreatment units and the supports for the process vessels would have cryogenic insulation where needed and fireproofing, these impoundment systems would be sized adequately to contain the total potential liquid releases from all the process vessels located within them. Freeport LNG determined that this would result in total liquid spills of 1,980 gallons for Collection Area A and 2,830 for Collection Area B. These collection areas would also contain 10 minutes of the greatest liquid release from a single pipe in that area, which would be less than 1,640 gallons from the 6-inch feed line to the Deethanizer Reflux Pump for Collection Area A and less than 4,230 gallons from the 10-inch line from the Absorber Bottoms for Collection Area B, based on calculations done in UniSim software by Freeport LNG.

Paving within the containment areas would be sloped a minimum of 1 percent to grated drainage channels. The drainage system includes a normally closed valve located outside of each containment area to allow fluids to be inspected and then either released to the plant drainage system or removed by vacuum truck if needed.

In addition, an NGL Surge Drum impoundment would contain any hydrocarbon spills from the NGL surge drum. This impoundment would have a sump that is 60-feet long by 3.5-feet wide by 2.5-feet deep, with an additional 6-inch curb around a 60-foot by 32-foot area, which together would contain a volume of 7,960 gallons, considering all internal geometry. This capacity would fully contain the 7,460 gallon liquid capacity of the NGL Surge Drum. The greatest liquid release from any single pipe in this area for 10 minutes would be 935 gallons from the 6-inch inlet line to the NGL Surge Drum, based on calculations done in UniSim software by Freeport LNG.

The process impoundments and their sizing spills are summarized in table 4.10.6-1 below.

Table 4.10.6-1

Pretreatment Plant Process Impoundment Sizing

Spill Source	Sizing Spill (gallons)	Impoundment	Impoundment Size (gallons)
NGL Surge Drum	7,460	NGL Surge Drum impoundment	7,960
Deethanizer and Debutanizer Vessels	1,980	Pretreatment Collection Area A	47,720
10-inch Line from Absorber Bottoms	< 4,230	Pretreatment Collection Area B	22,560

4.10.6.2 Pretreatment Plant – Design Spills

As discussed in section 4.10.5.2, design spills are used to determine thermal radiation and vapor dispersion distances.

Freeport LNG indicated that its siting calculations for the Pretreatment Plant would be conducted in accordance with 49 CFR 193. To select the design spills, Freeport LNG evaluated the Pretreatment Plant's design in the same manner as that for the terminal facilities, basing the selections on failure rate design in the same manner as that for the terminal facilities, basing the selections on failure rate criteria and the proposed process conditions. This selection process identified the design spills listed in table 4.10.6-2.

Table 4.10.6-2

Natural Gas Liquids Release Mass Flow Rates and Rainout Percentages

Spill #	Process Line Diameter (inch)	Hole Size (inch)	Release Mass Flow Rate (lb/hr)	Liquid Spill (%)	Vapor Mass Flow Rate (lb/hr)
NGL-3	4	4	52,965	93%	3,708
NGL-12	10	1	81,289	0%	81,289
NGL-14	4	4	63,488	90%	6,349
NGL-17	6	6	33,204	93%	2,324

In order to address the most significant vapor dispersion scenario from each design spill, Freeport LNG determined the hole sizes that would release the greatest vapor mass flow rate. Table 4.10.6-3 demonstrates that the vapor flow rates were maximized by reducing the 4-inch diameter holes to 1-inch and the 6-inch diameter hole to 0.5-inch.

The design spill durations were 10 minutes. All leaks were assumed to be horizontal. The release heights were estimated to be 7 feet for case NGL-3 and 10 feet for NGL-12, 14 and 17.

Table 4.10.6-3

Natural Gas Liquids Hole Size Sensitivity Analysis

Spill #	HOLE Size (in)	Equilibrium Pressure (psig)	Equilibrium Temp (°F)	Release Mass Flow Rate (lb/hr)	Rainout Percentage	Vapor Mass Flow Rate (lb/hr)
NGL-3	4	0.21	-213	52,695	93%	3,708
	2	3.5	-206.2	54,107	84%	8,657
	1.5	12	-192.1	55,753	65%	19,514
	1	**66**	**-142.6**	**55,434**	**0%**	**55,434**
NGL-12	**1**	**159**	**111**	**81,289**	**0%**	**81,289**
NGL-14	4	0.3	-38.21	63,488	90%	6,349
	2	5	-25.21	64,354	73%	17,376
	1.5	16	-2.77	63,953	44%	35,814
	1	**82**	**67.39**	**61,516**	**0%**	**61,516**
NGL-17	6	0.015	76	33,204	94%	1,992
	4	0.09	76	36,149	93%	2,530
	2	1.3	76	34,347	90%	3,435
	1	24	76	36,783	43%	20,966
	0.5	**147**	**76**	**22,819**	**0%**	**22,819**

The design spills were chosen at various steps in the pretreatment process and represent varying NGL compositions. The composition of scenario NGL-3 would be expected to produce greater flammable vapor dispersion than the other heavier compositions. However, the heavier compositions would be expected to have greater reactivity when considering the potential for overpressures from within a congested area. Table 4.10.6-4 presents the design spill compositions.

Table 4.10.6-4

Natural Gas Liquids Design Spill Compositions

Component	NGL-3 (mol%)	NGL-12 (mol%)	NGL-14 (mol%)[5]	NGL-17 (mol%)
Nitrogen	0.017	0.0	0.0	0.0
Methane	18.38	0.006	0.006	0.0
Ethane	33.25	5.285	5.285	0.0
Propane	36.76	45.23	45.23	0.0
Butane (n-Butane & i-Butane)	10.76	42.53	42.53	1.0
Pentane (n-Pentane & i-Pentane)	0.789	6.857	6.865	62.68
C6s (Hexane)	0.002	0.027	0.027	16.18
C7s (Heptane)	0.0	0.0	0.0	9.298
C8s (Octane)	0.0	0.0	0.0	4.226
C9s (Nonane)	0.0	0.0	0.0	1.6905

Based on a review of the potential leakage sources, FERC staff determined that the NGLs design spills were selected in accordance with the philosophy used for design spill selection from the Liquefaction Plant.

Our conclusions on the candidate design spills were based on preliminary design information which may be revised as the engineering design progresses. If Freeport LNG's design or operation of the proposed facilities differs from that provided, our conclusions may change. As a result, **we recommend that:**

- **Prior to the construction of the final design, Freeport LNG should file with the Secretary for review and approval by the Director of OEP, certification that the final design of the Pretreatment Plant facilities is consistent with the information provided to FERC in the project docket. In the event that any modification to the design alters the candidate design spills on which the siting analysis was based, Freeport LNG should consult with FERC staff on any actions necessary to re-evaluate the siting of the Pretreatment Plant facilities.**

4.10.6.3 Pretreatment Plant - Thermal Radiation

Amine would be handled at temperatures below its flash point (the lowest temperature at which it can vaporize to form an ignitable mixture in air), which would also be above ambient temperatures. Therefore, the amine solution would not pose a thermal radiation hazard. Aqueous ammonia in an outdoor environment is also generally not considered to be a flammable hazard.

However, spills of NGLs would pose a fire hazard. For the reasons discussed in section 4.10.5.3, Freeport LNG used LNGFIRE3 to conservatively estimate the thermal radiation from impoundments serving these heavier hydrocarbons. The same climate conditions used for thermal radiation modeling at the terminal were used: an ambient temperature of 35°F, wind speeds of 0 to 27.6 mph, and 60 percent relative humidity.

Freeport LNG determined that the largest liquid design spill in the NGL Surge Drum impoundment would be a 10-minute spill from the rupture of the 6-inch piping into the NGL surge drum, having a total potential liquid release of 1,025 gallons. The ignition of this design spill in the 60-foot long by 3.5-foot wide NGL Surge Drum Containment Sump would produce a thermal flux level of 1,600 Btu/ft^2-hr at a maximum of 92 feet from the sides of the sump and 62 feet from the ends of the sump.

The largest liquid design spill release into the 13 by 13 foot sub-impoundment in either Collection Area A or B would be 2,240 gallons. The maximum distance to a thermal flux level of 1,600 Btu/ft^2-hr from a fire in each sub-impoundment would be 93 feet (see table 4.10.6-5).

Table 4.10.6-5

Thermal Radiation from Pretreatment Area Impoundments

Impoundment	Maximum Distance to 1,600 Btu/ft2-hr (feet)	Distance to Nearest Property Line that Could be Built Upon (feet)
NGL Surge Drum Containment Sump	92	775
Pretreatment Collection Area A sub-impoundment	93	680
Pretreatment Collection Area B sub-impoundment	93	690

These thermal radiation zones would stay within the Pretreatment Plant property line. As a result, we conclude that thermal radiation hazards from the Pretreatment Plant would not have a significant impact on public safety.

4.10.6.4 Pretreatment Plant - Flammable Vapor Dispersion

A large quantity of NGL released without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limit or encountered an ignition source. For the Pretreatment Plant facilities, Freeport LNG used the same conditions as the Liquefaction Plant for modeling vapor dispersion: average regional temperature of 71.5 °F, relative humidity of 50 percent, wind speed of about 4.5 mph, Pasquill-Gifford Atmospheric Stability Class F and a ground surface roughness of 0.03 meter.

Freeport LNG submitted vapor dispersion modeling using PHAST software for cases NGL-12, NGL-14, and NGL-17 in unobstructed terrain and using FLACS software for the NGL-3 case in the actual plant geometry. The release and wind directions that could cause vapor dispersion toward the nearest property lines, to the north and to the east, were evaluated. As with the vapor dispersion modeling done for the terminal facilities, vapor dispersion was performed with a safety factor of 2 to account for uncertainty in the model (using the ½ LFL rather than the LFL).

The most significant ½ LFL distance with respect to the northern property line occurred for the NGL-3 case. The results of this case are shown in figure 4.10.6-1 below.

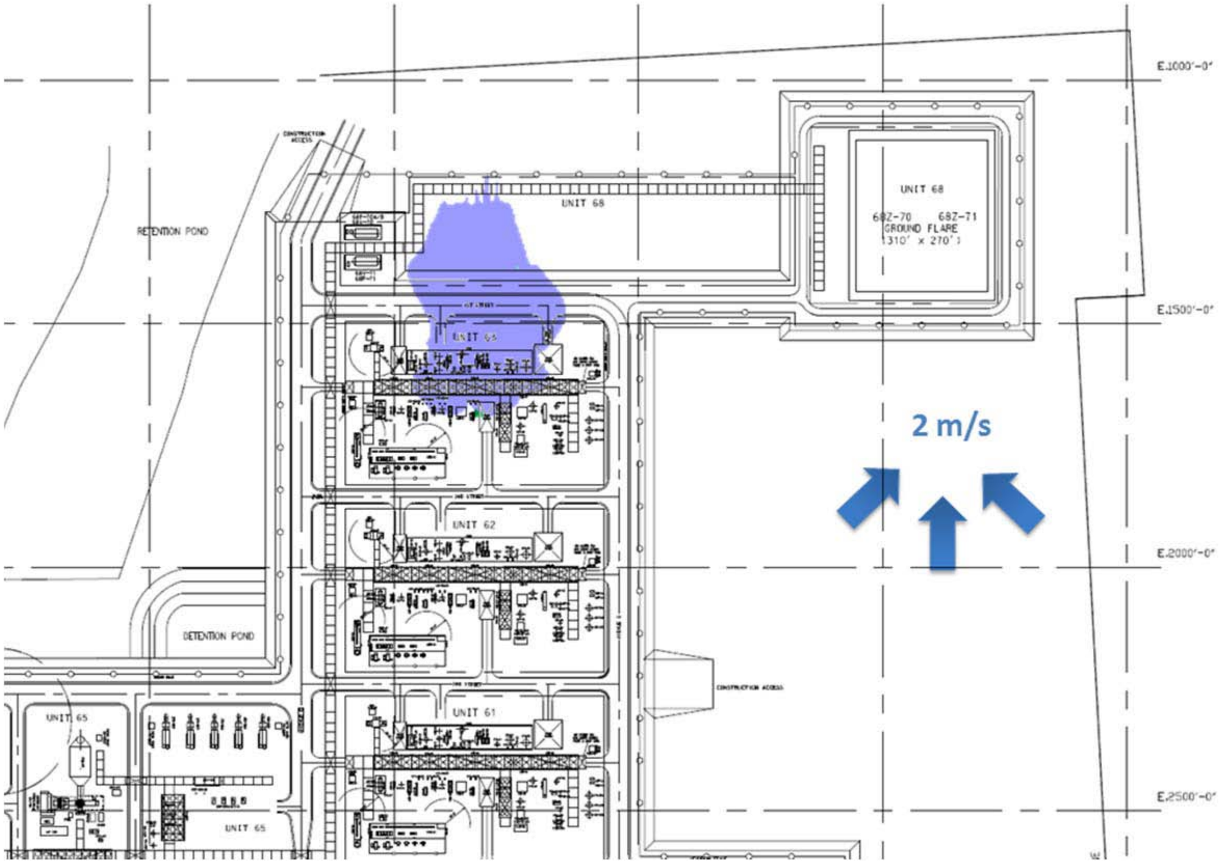

Figure 4.10.6-1 Flammable Vapor Dispersion from the N-3 Design Spill in the Pretreatment Plant Process Area for Wind Directions to the North

The most significant ½ LFL distance toward the eastern property line occurred for the NGL-17 case. See figure 4.10.6-2.

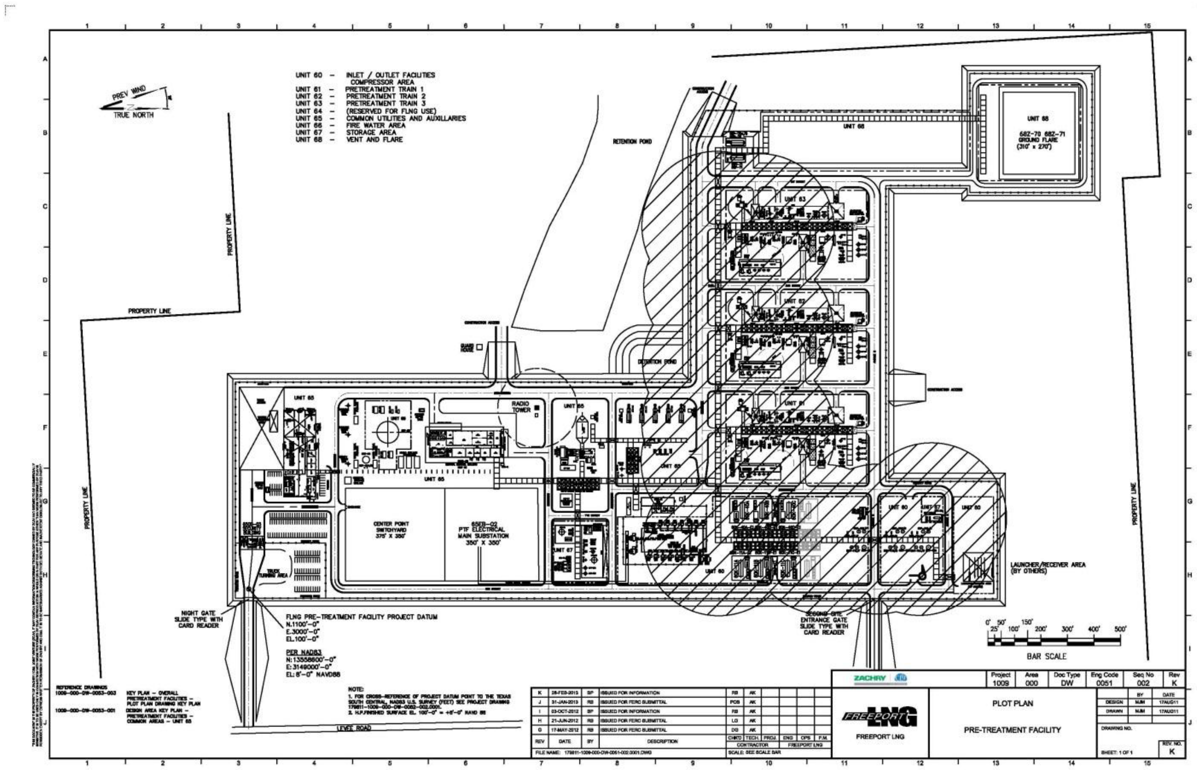

Figure 4.10.6-2 Flammable Vapor Dispersion from the N-17 Design Spill in the Pretreatment Plant Areas for all Wind Directions Combined

No flammable vapor would reach a property line that could be built upon in any design spill scenario. As a result, we conclude that flammable vapor dispersion hazards from the pretreatment area would not have a significant impact on public safety.

4.10.6.5 Pretreatment Plant – Overpressures

The propensity of a vapor cloud to detonate or produce damaging overpressures is influenced by the reactivity of the material, the level of confinement and congestion surrounding the vapor cloud, and the flame travel distance.

Consistent with the refrigerant overpressure analysis at the Liquefaction Plant, Freeport LNG used an overpressure threshold value of 1 psi to determine the potential impact on the public. The 1 psi value is used in consequence analyses required under federal regulations such as Title 40 CFR Part 68.22 and thus is considered to be reasonable.

Freeport LNG modeled overpressures based on the proposed layout of piping and equipment in the pretreatment area. Overpressure distances were evaluated using the FLACS model and considering a safety factor of 2 (*i.e.*, ½ psi), as a result of previous validation studies and peak-pressure averaging (Hansen, *et al.*, 2010).

A reactivity comparison indicated that spills NGL-12, 14, and 17 would have very similar reactivities, while recognizing that spill NGL-3 would have less reactivity due to its higher methane component. Therefore, because the release locations for each of these spills are relatively near to each other and spills NGL-12 and 14 have the largest flow rates, NGL-12 and 14 were selected for overpressure modeling.

In order to determine which of these vapor dispersion scenarios would most likely result in the largest overpressure hazard, the NGL-12 and 14 scenarios were evaluated to determine which potential vapor dispersion cloud within a pretreatment process train area would convert to the greatest equivalent stoichiometric cloud. This method takes into account that both the reactivity of a mixture and its gas expansion ratio are functions of the local stoichiometry. The greatest equivalent stoichiometric cloud was found to result from the NGL-12 scenario when released to the north with winds to the south.

The equivalent stoichiometric cloud was placed fully within the congested region of a pretreatment train. This cloud was ignited at the end that would allow the most flame acceleration but only resulted in peak overpressures of 0.15 to 0.30 psi at the property line, which would be less than the 0.5 psi threshold. As a result, we conclude that overpressure hazards from the Pretreatment Plant would not have a significant impact on public safety.

As with the overpressure modeling done for the Liquefaction Plant, this overpressure analysis is based on the preliminary information contained in the FEED submitted by Freeport LNG. Piping and equipment arrangements may differ after final design, resulting in increased congestion or confinement in the facilities and an increase in the overpressure distance. Therefore, **we recommend that:**

- **Prior to construction of the final design, Freeport LNG should file with the Secretary, for review and written approval by the Director of OEP, plant geometry models or drawings that verify the confinement and congestion represented in the FEED of the Liquefaction Project or provide revised overpressure calculations indicating that a 1 psi overpressure would not impact the public. This information should be filed a minimum of 30 days before approval to proceed is requested.**

4.10.6.6 Pretreatment Plant – Toxic Dispersion

The NGLs would contain potentially toxic products: benzene and toluene. Aqueous ammonia and H_2S would also be present at the pretreatment site and would have potential for toxicity. Freeport LNG calculated the dispersion distances for these substances to toxic threshold exposure limits based on the Acute Exposure Guideline Level (AEGLs) maintained by the USEPA. AEGLs are recommended for use by federal, state, and local agencies, as well as the private sector for emergency planning, prevention, and response activities related to the accidental release of hazardous substances. Other federal agencies, such as the USDOE, use AEGLs as the primary measure of toxicity.

There are three AEGLs which are distinguished by varying degrees of severity of toxic effects with AEGL-1 (level 1) being the least severe to AEGL-3 being the most severe. AEGL-1 is the airborne concentration of a substance that the general population, including susceptible individuals, could experience notable discomfort, irritation, or asymptomatic nonsensory effects. However, these effects are not disabling and are temporary and reversible upon cessation of the exposure. AEGL-2 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. AEGL-3 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death. The USEPA provides AEGLs for a list of chemicals at varying exposure times (10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours).

PHAST Version 6.7 was used to perform the toxic dispersion modeling. PHAST is an industry standard model for performing various hazard modeling and is validated against numerous experiments. Similar to the flammable vapor dispersion modeling, a safety factor of 2 was applied to the AEGL results to account for uncertainty in the model. The averaging times used in the modeling were based on the exposure duration.

Of the design spills identified for the process areas (see section 4.10.6.2), stream N-17 was determined to be the worst case scenario for this analysis as it contains the highest concentration and mass flow rate of benzene and toluene. The maximum distances calculated by PHAST to each AEGL level are listed in table 4.10.6-6 below.

Table 4.10.6-6

Benzene and Toluene Vapor Dispersion Distances

Component:	**½ AEGL-1 10 minutes Distance (feet)**	**½ AEGL-2 10 minutes Distance (feet)**	**½ AEGL-3 10 minutes Distance (feet)**
Benzene	344	56	None
Toluene	287	26	None

The distance from these releases to the nearest property line would be 640 feet. All of these dispersion distances would remain within Freeport LNG property.

Design spills were also calculated for the piping and equipment in the aqueous ammonia system using the same failure rate data used to identify the process area design spills. The following aqueous ammonia system design spills were identified:

- A-9: A full rupture of a 1-inch diameter aqueous ammonia line
- A-10: A 0.4-inch hole in the aqueous ammonia storage vessel

Release conditions for each aqueous ammonia release scenario are reported in table 4.10.6-7.

Table 4.10.6-7

Aqueous Ammonia System Design Spills

Scenario	Hole Size (inch)	Operating Pressure (psig)	Temperature (°F)	Vapor Mass Flow Rate (lb/hr)	Duration (s)
A-9	1.0	35	80	1,120	600
A-10	0.4	15	80	1,155	600

Freeport LNG estimated these releases to occur at a height of 10 feet. Freeport LNG calculated the maximum distances to AEGL levels 1, 2 and 3 for both scenarios with a safety factor of 2, and these distances are provided in the table 4.10.6-8 below.

Table 4.10.6-8

Aqueous Ammonia Vapor Dispersion Distances

Scenario	Hole Size (inch)	½ AEGL-1 10 minutes Distance (feet)	½ AEGL-2 10 minutes Distance (feet)	½ AEGL-3 10 minutes Distance (feet)
A-9	1.0	727	239	None
A-10	0.4	447	258	96

The distance from these releases to the nearest property line would be 650 feet. Therefore, the ½ AEGL-1 level for the A-9 scenario would extend approximately 80 feet offsite. However, no residences are located in this area, and the AEGL-1 concentrations would have reversible effects if experienced by persons in that area during a release.

Based on the component failure rate data, the largest design spill identified for the acid gas stream is a 0.4-inch hole in the amine reflux drum, which would occur at a height of 30 feet. Because of the low concentration of H_2S in the acid gas, no ½ AEGL hazard was calculated for this release at any distance.

As none of the potentially toxic substances for the design spills at the Pretreatment Plant would result in an AEGL levels that would impact the public, we conclude that toxicity hazards from the Pretreatment Plant would not have a significant impact on public safety.

4.10.7 Emergency Response

Section 3A(e) of the NGA, added by section 311 of the Energy Policy Act of 2005, stipulated that in any order authorizing an LNG terminal, the Commission shall require the LNG terminal operator to develop an Emergency Response Plan (ERP) in consultation with the USCG and state and local agencies. The existing ERP for the Freeport LNG terminal has been in place since the beginning of operations in July of 2008. The expansion would not change the marine pick-up points established for the public in the existing ERP, however the existing ERP would need to be updated to include the proposed Projects, including those facilities at the Pretreatment Plant, and emergencies related to the handling of hazardous fluids. Therefore, **we recommend that:**

- **Freeport LNG should file its updated Emergency Response Plan which includes the Projects, as well as instructions to handle on-site hazardous fluid emergencies. The Emergency Response Plan should be filed with the Secretary for review and written approval by the Director of OEP <u>prior to initial site preparation</u>.**
- **The updated Emergency Response Plan should include a Cost-Sharing Plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. The Cost-Sharing Plan should be filed of review and written approval by the Director of OEP <u>prior to initial site preparation</u>.**

4.10.8 Facility Security and LNG Vessel Safety

Security requirements for the facilities at the terminal are governed by 49 CFR 193, Subpart J – Security. This subpart includes requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. Additional requirements for maintaining security of the terminal are found in 33 CFR 105.

The Freeport LNG terminal commenced service in July 2008 and has been receiving LNG shipments for import and re-export purposes. The existing facility has a Facility Security Plan, as required by 33 CFR 105, which has been approved by the USCG. Marine safety and vessel maneuverability studies were submitted for the Freeport LNG terminal under FERC docket numbers CP03-75-000 and CP05-361-000. Freeport LNG has also consulted with the Captain of the Port (COTP) regarding the Projects. In a letter to the USCG dated November 19, 2010, Freeport LNG detailed the Liquefaction Project modifications, which included no changes to the marine facilities. The COTP issued a letter on December 15, 2010, stating that since the Liquefaction Project would not result in an increase in the size and/or frequency of LNG marine traffic, neither submission of a LOI nor revision to the WSA is required. In that letter, the USCG also specified that applicable amendments to the Operations Manual, Emergency Manual, and Facility Security Plan must be made to capture changes to the operations associated with the Liquefaction Project.

Additionally, in a letter to the USCG dated September 13, 2011, Freeport LNG described the proposed Phase II project modifications. In a letter dated November 11, 2011, the USCG states that an LOI and a revision to the WSA are not required. However, the USCG specified that applicable amendments to the Operations Manual, Emergency Manual, and Facility Security Plan must be made that capture changes to the operations associated with the proposed projects.

For the Pretreatment Plant, the Department of Homeland Security, which includes the Transportation Security Administration for pipeline security, along with the USDOT (requirements administered by the RRC) would have oversight of the security plan. This plan would be shared, reviewed, and exercised with local authorities and responders including the

Brazoria County Sheriff's Department. Although the Pretreatment Plant would not be subject to the security requirements in 49 CFR 193, the Pretreatment Plant would have similar security features as the terminal site, including security fencing, security cameras, and intrusion detection. Therefore, we conclude that the Pretreatment Plant would be provided with a level of security appropriate for this type of facility.

4.10.9 Conclusions on Facility Reliability and Safety

As part of the review required for a FERC authorization, Commission staff must assess whether the proposed facilities would be able to operate safely and securely. Based on our technical review of the preliminary engineering designs, we conclude that sufficient layers of safeguards would be included in the facility designs to mitigate the potential for an incident that could damage the facility, injure operating staff, or impact the safety of the off-site public.

The principal hazards associated with the substances involved in the liquefaction, storage and vaporization of LNG result from cryogenic and flashing liquid releases; flammable and toxic vapor dispersion; vapor cloud ignition; pool fires; BLEVEs; and overpressures. As part of our review, we also assess the potential for public safety impacts using the information which Freeport LNG must produce to comply with the federal siting standards in 49 CFR 193, except for the vapor dispersion that extends onto the existing ExxonMobil facility. Prior to the end of the draft EIS comment period, Freeport LNG is required to provide information to FERC staff explaining how the portion of the vapor cloud extending onto the ExxonMobil facility would comply with the exclusion zone requirements of 49 CFR 193. FERC staff will consult with DOT after Freeport LNG files this information. The small area of the ExxonMobil property that the vapor dispersion extends over is an adjacent industrial property and is not publicly accessed. As a result, we conclude that the siting of the facilities at the terminal would not have a significant impact on public safety.

In order to provide a consistent assessment of potential public impacts which could result from the construction of the facilities at both the terminal site and the Pretreatment Plant, we applied a similar review technique to the Pretreatment Plant facilities, which do not fall under the jurisdiction of the Part 193 regulations. Based on our review of Freeport LNG's siting analyses, we conclude that potential hazards from the Pretreatment Plant would also not have a significant impact on public safety.

4.11 AIR QUALITY AND NOISE

4.11.1 Air Quality

Construction and operation of the Projects can potentially have effects on local and regional air quality. The climatic conditions in the Brazoria area are outlined at the beginning of section 4 and can have a significant change how emissions of pollutants impact local air quality. The term *air quality* refers to relative concentrations of pollutants in the ambient air. The subsections below describe well-established air quality concepts that are applied to characterize air quality and to determine the significance of increases in air pollution. This includes metrics for specific air pollutants known as ambient air quality standards (AAQS), regional designations to manage air quality known as Air Quality Control Regions (AQCRs), and efforts to monitor ambient air concentrations.

Federal and state air quality standards have been designed to protect human health and the environment from airborne pollutants. The USEPA has developed National Ambient Air Quality Standards (NAAQS) for criteria air pollutants such as nitrogen oxides (NO_x) and carbon monoxide (CO), ozone (O_3), SO_2, and inhalable particulate matter ($PM_{2.5}$ and PM_{10}). $PM_{2.5}$ includes particles with an aerodynamic diameter less than or equal to 2.5 microns, and PM_{10} includes particles with an aerodynamic diameter less than or equal to 10 microns. The NAAQS were set at levels the USEPA determined are necessary to protect human health and welfare.

GHG, the most common of which are CO_2, CH_4, nitrous oxide (N_2O), O_3, hydrofluorocarbons, and perfluorocarbons, are naturally-occurring pollutants in the atmosphere and products of human activities, including burning fossil fuels. Fossil fuel combustion emits CO_2, CH_4, and N_2O. GHG emissions are generally calculated in terms of CO_2 equivalents (CO_2e) where the global warming potential of each gas is expressed as a multiple of the global warming potential of CO_2.

4.11.1.1 Existing Air Quality and Regulations

The USEPA has established NAAQS for criteria pollutants. Primary standards are set to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards are set to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The NAAQS are codified in 40 CFR Part 50 and summarized in table 4.11.1-1. Attainment with the NAAQS is determined based on whether or not measured ambient air pollutant concentrations are above or below the NAAQS. Texas has adopted the Federal NAAQS at Title 30 (TAC 30) Part101.21.

Ambient Air Quality

The TCEQ maintains an extensive network of air quality monitors located throughout the state for a variety of purposes. Data from these monitors are reported to the USEPA AirData database (AirData). Estimates of existing ambient air quality for the area were obtained from the most recent available data reported to AirData from the nearest available representative monitoring station for each criteria pollutant. The resulting estimates are summarized in table 4.11.1-2. The 8-hour and 1-hour O_3 concentrations reported in table 4.11.1-2 are greater than the NAAQS. As discussed below, the Projects are located in a designated O_3 nonattainment area.

Table 4.11.1-1

National Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Form
		(ppm)	(ug/m^3)	(ppm)	(μg/m^3)	
Carbon Monoxide (CO)	8-hour	9	10,300	---	---	Not to be exceeded more than once per year
	1-hour	35	40,000	---	---	Not to be exceeded more than once per year
Lead (Pb)	3-month rolling	---	0.15	---	0.15	Not to be exceeded
Nitrogen Dioxide (NO_2)	1-hour	0.1	188	0.100	188	98th percentile, averaged over 3 years
	Annual	0.053	100	0.053	100	Annual Mean
Ozone (O_3)	8-hour (2008)	0.075	147	0.075	147	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
	8-hour (1997)	0.08	157	0.08	157	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
	1-hour	0.12	236	0.12	236	Not to be exceeded more than once per year
Fine Particulate ($PM_{2.5}$)	Annual	---	12	---	15	Annual mean, averaged over 3 years
	24-hour	---	35	---	35	98th percentile, averaged over 3 years
Respirable Particulate (PM_{10})	24-hour	---	150	---	150	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)	1-hour	0.075	196	---	---	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	3-hour	---	---	0.5	1,300	Not to be exceeded more than once per year

Notes:
ppm = parts per million
μg/m3 = micrograms per cubic meter.

Table 4.11.1-2

Existing Ambient Air Quality

Pollutant	Monitoring Station	Monitoring Station ID	Averaging Time	Years	Concentrations (ppm)	Concentrations ($\mu g/m^3$)
CO	Deer Park	48-201-1039	8-hour	2010-2012	0.933	1,069
			1-hour		1.476	1,690
Pb	Houston East	48-201-1034	3-month rolling	2006-2008	---	0.008
NO_2	Lake Jackson	48-201-1016	1-hour	2010-2012	0.020	37.8
			Annual		0.0076	14.3
O_3	Deer Park	48-201-1039	8-hour	2010-2012	0.085	167
			1-hour		0.114	223
$PM_{2.5}$	Galvestone 99th Street	48-167-1034	Annual	2009-2011	---	9.3
			24-hour		---	20.7
PM_{10}	Deer Park	48-201-1039	24-hour	2010-2012	---	41.0
SO_2	Houston Seabrook Friendship Park	48-201-1050	1-hour	2010-2012	0.021	55.1
			3-hour		0.014	36.8

Notes:
ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter.

AQCRs and Attainment Status

The USEPA has established AQCRs in accordance with the CAA of 1970, which are defined as contiguous areas within a state or an interstate metropolitan area considered to have relatively uniform ambient air quality, and are treated as single units for reducing emissions and determining compliance with the NAAQS. The proposed Project would be in the Metropolitan Houston-Galveston Intrastate AQCR (HG-AQCR). The AQCR is a nonattainment area for both the 1-hour and 8-hour O_3 standards. The designations for other criteria pollutants are attainment or the equivalent.

Federal Air Quality Requirements

The CAA of 1970, 42 USC 7401 *et seq.*, amended in 1977 and 1990, and codified at 40 CFR Parts 50-99 are the basic federal statutes and regulations governing air pollution. Currently in Texas, the USEPA is the lead agency for permitting emissions of GHG. The TCEQ is the lead agency for all other air quality permitting. The TCEQ implements its own regulations which incorporate USEPA's federal regulatory requirements. The Brazoria County Health Department does not have any air permit requirements beyond those in the federal and state programs. The following federal requirements were reviewed to determine their applicability to the proposed Project.

Conformity of Federal Actions

A General Conformity Analysis (General Conformity) is required when a federal action would generate emissions exceeding conformity threshold levels of pollutants for which an air basin is designated as nonattainment. According to Section 176(c)(1) of the CAA (40 CFR Section 93.153), a federal agency cannot approve or support activity that does not conform to an approved State Implementation Plan (SIP). General Conformity is not applicable to activities at locations in attainment areas or operating emissions covered by an air quality permit.

The proposed Projects would be in the HG-AQCR, which is a nonattainment area for both the 1-hour and 8-hour O_3standards. The designations for other criteria pollutants are attainment or the equivalent.

The proposed Projects would generate air emissions as a result of its construction and long-term operation that would be subject to a General Conformity applicability determination. Air pollutants would be emitted from vehicles transporting workers to and from the construction sites, and from vehicles and barges used to transport materials and equipment to the construction site. Fugitive dust and mobile source emissions would result from construction equipment operating within the Liquefaction Plant, Pretreatment Plant and during pipeline construction. Construction emissions would occur between 2014 through 2018. As can be seen in table 4.11.1-3, the construction emissions from 2014 through 2018 would exceed the General Conformity Applicability Threshold with the HG-AQCR.

Table 4.11.1-3
Summary of Estimated Emissions for Facility Construction
Material Deliveries, Worker Commuting, and Construction Equipment

Year	Estimated Emissions (tons)							
	VOC	PM_{10} a/	$PM_{2.5}$ a/	CO	NO_x	SO_2	CO_2e	Total HAPs
Houston-Galveston-Brazoria Nonattainment Area								
2014	17.8	689.9	77.8	382.6	145.2	9.8	40,171	7.0
2015	67.4	706.6	94.1	1,895.0	374.5	30.5	80,523	17.0
2016	94.5	703.3	90.9	3,028.9	331.3	27.0	77,293	14.8
2017	80.0	693.4	81.1	2,710.5	193.1	13.4	53,438	9.8
2018	33.3	685.9	73.7	1,129.5	85.1	5.8	19,071	3.3
Applicability b/	25	---	---	---	25	---	---	---

Note:
HAPs = Hazardous Air Pollutants

a/ Does not include fugitive dust
b/ General Conformity applicability thresholds for O_3severe non-attainment area

In addition, the vessels that transport construction materials and equipment may travel through other areas including the Beaumont-Port Arthur and Baton Rouge maintenance areas, and attainment areas. Table 4.11.1-4 provides a breakdown of the vessel emissions among these areas. As can be seen, the NO_x and volatile organic compound (VOC) emissions in the two maintenance areas would be less than the General Conformity applicability thresholds for each area (each 100 tpy).

A General Conformity Determination is required for the HG-AQCR to demonstrate that NO_x and VOC emissions resulting from construction activities (2014 through 2018) and operation of LNG carriers and assist tugs (2019 and later) would not cause new violations of the O_3NAAQS, increase the frequency or severity of O_3NAAQS violations, or delay timely attainment of the O_3NAAQS.

Freeport LNG must comply with General Conformity and thus we are including a condition that would require Freeport LNG to offset the emissions of NO_x and VOC from construction, obtain a specific commitment from TCEQ to account for emissions of NO_x and VOC in the region's SIP, or otherwise comply with the General Conformity demonstration under the CAA. Freeport LNG would be required to conform with the Houston-Galveston-Brazoria (HGB) SIP based on the criterion provided in 40 CFR Part 93.158(a)(5)(i)(A).

Table 4.11.1-4

Summary of Estimated Emissions for Facility Construction Barge Deliveries a/

Year	Estimated Emissions (tons)							
	VOC	PM_{10}	$PM_{2.5}$	CO	NO_x	SO_2	CO_2e	Total HAPs
Beaumont-Port Arthur Maintenance Area								
2014	0.3	0.4	0.4	2.6	5.1	0.7	518	0.2
2015	0.9	1.3	1.3	8.8	17.3	2.3	1,755	0.8
2016	0.5	0.6	0.6	5.0	9.8	1.3	1,001	0.5
2017	0.1	0.3	0.3	1.6	3.1	0.4	316	0.2
2018	0.2	0.2	0.2	1.1	2.1	0.3	213	0.1
Baton Rouge Maintenance Area								
2014	0.1	0.3	0.3	1.9	3.7	0.4	373	0.1
2015	0.6	0.9	0.9	6.3	12.4	1.6	1,264	0.3
2016	0.3	0.5	0.5	3.6	7.1	1.0	724	0.2
2017	0.1	0.2	0.2	1.2	2.2	0.3	225	0.1
2018	<0.1	0.2	0.2	0.8	1.6	0.2	156	<0.1
Louisiana Attainment Areas								
2014	0.9	1.3	1.3	9.3	18.1	2.5	1,848	0.2
2015	3.1	4.5	4.5	31.4	61.6	8.2	6,256	0.8
2016	1.8	2.6	2.6	17.9	35.0	4.7	3,575	0.5
2017	0.6	0.8	0.8	5.7	11.1	1.5	1,123	0.2
2018	0.3	0.5	0.5	3.8	7.4	0.9	766	0.1

a/ Estimated from Freeport LNG's application.

As the lead agency, the FERC must prepare and make public both the draft General Conformity Analysis and the final General Conformity Analysis prior to authorization of construction. This separate document would be prepared once the appropriate information is obtained from Freeport LNG.

So that the FERC can prepare a General Conformity Determination, **we recommend that:**

At least 90 days prior to the start of construction, Freeport LNG should file documentation:

a. **from the TCEQ that the Liquefaction Project's direct and indirect construction and operation emissions, including vessel NO_x and VOC emissions, together with all other emissions in the HGB area, would not exceed the emissions budgets specified in the federally-approved HGB SIP; or**

b. **that the TCEQ commits to explicitly include the Proposed Liquefaction Project's direct and indirect NO_x and VOC emissions in the next revision of the HGB SIP; or**

c. **that Freeport LNG would provide a demonstration of obtained offsets or an alternative demonstration of General Conformity under the CAA.**

New Source Review

PSD and Nonattainment New Source Review (NNSR) were established for pre-construction review of proposed projects in attainment areas and nonattainment areas, respectively. A project can undergo both types of review, depending on its potential emissions and the attainment status of the area in which it is located.

The PSD program applies to the construction of a new major stationary source of air pollutants, or a major modification to existing major stationary sources of air pollutants, in an attainment area. PSD is intended to prevent the new source from contributing to deterioration of air quality to levels which violate the NAAQS.

NNSR applies to the construction of a major stationary source of air pollutants, or a major modification to existing major stationary sources of air pollutants in a nonattainment area. NNSR applies to pollutants that are classified as nonattainment and their precursors. NNSR is intended to help ensure that areas which have not achieved the NAAQS with respect to one or more criteria pollutants do so within prescribed time frames.

The Pretreatment Plant and the Liquefaction Plant are treated differently by TCEQ and USEPA for permitting purposes. The USEPA indicated their intent to permit the facilities as a single stationary source because they share Standard Industrial Classification Code 1321, are under common control, and operate interdependently. The TCEQ has indicated that they would issue separate permits for the Pretreatment Plant and Liquefaction Plant however they would look at the Pretreatment Plant and Liquefaction Plant as a single facility for air modeling purposes.

Prevention of Significant Deterioration

The emissions threshold for major stationary sources under PSD depends on the facility type. As defined by 40 CFR Part 52.21(b)(1)(i), a facility is considered major stationary source under PSD if:

- It emits or has the potential to emit 250 tpy or more of any regulated New Source Review (NSR) pollutant

- It is in one of the 28 source categories listed in 40 CFR Part 52.21(b)(1)(i)(a) and emits or has the potential to emit 100 tpy or more of any regulated NSR pollutant

None of the Projects' facilities are in one of the 28 source categories. A new source is also subject to PSD if it's potential or actual GHG emissions equal or exceed 100,000 tpy on a CO_2e basis, and the applicable major source threshold on a mass-basis. GHGs include CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

As defined by 40 CFR Part 52.21(b)(2), a major modification is any physical change in or change in the method of operation of a major stationary source that would result in a significant net emissions increase of a regulated NSR pollutant. As defined by 40 CFR 52.21(b)(23) significant net emissions increase is a rate of emissions that would equal or exceed one of the following:

- CO - 100 tpy
- Nitrogen dioxide (NO_2) - 40 tpy
- SO_2 - 40 tpy
- Particulate matter (PM) - 25 tpy
- PM_{10} - 15 tpy
- $PM_{2.5}$ - 10 tpy
- O_3 - 40 tpy of VOCs or NO_x
- Lead (pb) - 0.6 tpy
- Sulfuric acid mist (H_2SO_4) - 7 tpy
- H_2S - 10 tpy
- Total reduced sulfur - 10 tpy
- GHG - 70,000 tpy CO_2e.

If a project is a major source or major modification, PSD applies to any attainment pollutant whose potential or actual emissions equals or exceeds the significance level.

Note that fugitive emissions are not counted toward the major source or major modification thresholds unless the source in question is included in one of the 28 listed source categories.

For all pollutants except GHG, the TCEQ has been delegated authority by the USEPA to prepare the PSD Permit. However, the State of Texas has only recently passed a law (Texas House Bill 788) allowing TCEQ to include GHG permitting within the PSD permitting process. Thus the

USEPA Region 6 is the lead for permitting the stationary GHG emissions under PSD until such a time that the USEPA approves the TCEQ for GHG permitting.

Table 4.11.1-5 lists the estimated operating emissions for the existing and proposed facilities. These facilities are interdependent and therefore considered to be one source by the USEPA. A comparison of the potential emissions and regulatory thresholds shows that the stationary facilities are subject to PSD permitting for GHG, NO_x, PM_{10}, $PM_{2.5}$, and SO_2. The required PSD permitting studies include an air quality analysis to show that proposed emissions would not significantly cause or contribute to a prohibited violation of any NAAQS or PSD increment.

Table 4.11.1-5

Air Emission Estimates for the Existing and Proposed Stationary Facilities

Source	Potential Emissions (tpy)								
	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_x	H_2SO_4	H_2S	CO_2e
Existing Phase I Facilities									
Vaporization Plant	24.6	80.2	6.5	6.4	6.4	2.3	0.22	---	715,023
Proposed Facilities									
Liquefaction Plant	14	26	7	0.07	0.07	0.003	<0.001	0.00	12,241
Pretreatment Plant	51	68	17	87	87	25	2	1.86	1,568,667
Total	65	94	24	87	87	25	2	1.86	1,580,907
Regulatory Thresholds									
Federal NNSR Major Source	25	---	25	---	---	---	---	---	---
Federal PSD Major Source	250	250	250	250	250	250	250	250	100,000
Federal PSD Significant Modification	40	100	100	15	10	40	7	10	70,000
Federal Title V Major Source	25	100	25	100	100	100	100	100	100,000
Texas Mass Emissions Cap and Trade	10	---	---	---	---	---	---	---	---

The PSD and NNSR applications to the TCEQ are currently under review as PSD Permit No. PSD-TX-1302 and Nonattainment NNSR permit No. N170 for the Pretreatment Plant, and Permit No. PSD-TX-1282 and N150 for the Liquefaction Plant.

USEPA has published in the Federal Register the draft PSD permit for the GHG emissions on December 2, 2013. The USEPA concluded that the Liquefaction Project would utilize energy-efficient technologies (primarily electric motors and variable speed drives for its primary drivers) and process design features (primarily modular liquefaction trains and natural gas pretreatment units) to minimize GHG emissions and their adverse impacts. Electric motors produce no GHG emissions, have energy efficient operating characteristics over a wide range of weather and load conditions, and can be sized to allow for a more efficient design. Variable speed drives allow the electric motor to operate in the most efficient manner for a given load. The Liquefaction Project would employ three modular liquefaction trains, each with a natural gas pretreatment unit, which would promote energy efficiency over the range of throughputs that may occur.

As part of the TCEQ PSD permitting process, Freeport LNG submitted a refined air quality modeling analysis for the combined Pretreatment and Liquefaction Plants. This analysis is presented later in this section.

Federal Class I Areas

Federal Class I areas are required to have more stringent air quality protection for air quality-related values such as visibility. The closest Class I Area is Breton NWR located southeast of New Orleans, approximately 300 miles east. As part of the PSD permitting process, Freeport LNG is required under PSD rules to determine if the PSD Permitted facility would have any impacts on air quality related values. It is required to notify the Federal Land Manager if a project may affect a Class I area. Such notification must be made in writing and include a copy of all information relevant to the permit application within 30 days of receipt of and at least 60 days prior to public hearing by the State on the application for permit to construct. The meaning of the term "may affect" is interpreted by USEPA include all major sources or major modifications which propose to locate within 100 km of a Class I area. However, the Federal Land Manager may ask Freeport LNG to perform an analysis of the proposed major source's potential impacts a Class I area even if it is located more than 100 km distant.

As the closest Class I area is located approximately 300 miles east of Quintana Island, no Class I areas should be affected, and there should be not have any impact on air quality related values in Class I areas.

Nonattainment New Source Review

NNSR applies to a new major sources or a major modification at an existing source for pollutants where the area in which the source is located is not in attainment with the NAAQS. NNSR requirements are customized for the nonattainment area. Sources that trigger NNSR are subject to a variety of requirements, including the need to apply control technologies capable of achieving the Lowest Achievable Emission Rate (LAER) and the need to obtain emissions offsets. The HGB area is a severe nonattainment area for the 1-hour O_3standard, and a marginal nonattainment area 8-hour O_3standard. The major source threshold for O_3 precursors, NO_x and VOC, is 25 tpy. Table 4.11.1-5 lists the estimated operating emissions for the existing and proposed facilities. These show that the Projects would be subject to NNSR permitting for NO_x and VOC. As stated above, a permit application has been submitted to the TCEQ. As is discussed above, air dispersion modeling for NO_2 was performed as a part of the PSD permitting studies.

New Source Performance Standards

New Source Performance Standards (NSPS) establish emission limits and associated requirements for monitoring, reporting, and recordkeeping for various emission source categories. The following NSPS apply to affected new, modified, or reconstructed sources.

- 40 CFR 60 Subpart A - General Provisions

- 40 CFR 60 Subpart KKK - Standards of Performance for Equipment Leaks of VOC from Onshore Natural Gas Processing Plants

- Subpart LLL - Onshore Natural Gas Processing: SO_2
- 40 CFR 60 Subpart IIII - Standards of Performance for Stationary Compression Ignition Internal Combustion Engines
- 40 CFR 60 Subpart KKKK - Standards of Performance for Stationary Combustion Turbines

National Emissions Standards for Hazardous Air Pollutants

National Emissions Standards Hazardous Air Pollutants (NESHAP) standards, at 40 CFR 61, apply to emissions of specific Hazardous Air Pollutants (HAPs) from specified source categories. Natural gas processing facilities are not a specified category under 40 CFR 61 and would not apply to the Projects.

Maximum Achievable Control Technology (MACT) standards, 40 CFR 63, apply to major sources and certain area sources of HAPs in specified source categories. A major source of HAPs is a stationary source with the potential to emit 10 tpy or more of any individual HAP or 25 tpy of aggregate HAPs. An area source is a stationary source with potential HAP emissions less than the aforementioned thresholds. Table 4.11.1-6 summarizes the potential HAP emissions. The proposed Projects are area HAP sources.

Table 4.11-1-6

Hazardous Air Pollutant Emission Estimates for the Existing and Proposed Facilities

Source	Potential Emissions	
	Single HAP (tpy)	Aggregate HAPs (tpy)
Existing Phase I Facilities		
Vaporization Plant	<10-a/	<25-a/
Proposed Facilities		
Liquefaction Plant	0.04 - Hexane	0.06
Pretreatment Plant	3.48 - Formaldehyde	6.60
Regulatory Thresholds		
Major Source of HAPs (either)	10	25
Area Source of HAPs (both)	<10	<25

a/ The principal HAPs emitted are formaldehyde, acetaldehyde, and acrolien. From 2010 through 2012, the estimated total annual emissions of these pollutants were less than 1 ton per year due to low operation levels.
b/ Hexane
c/ Formaldehyde

As previously stated, for the Phase II Modification Project at the Quintana Island terminal, the only operation emissions would be fugitive VOC emission, totaling 1.18 tpy, from piping systems. These would not trigger NSR Permitting. Therefore, all Project facilities would be area sources of HAPs.

The following NESHAP rules would not apply to the facilities:

- 40 CFR 63 Subpart HH – Hazardous Air Pollutants from Oil and Natural Gas Production Facilities
- 40 CFR 63 Subpart HHH – Hazardous Air Pollutants from Natural Gas Transmission and Storage Facilities
- 40 CFR 63 Subpart YYYY– Hazardous Air Pollutants for Stationary Combustion Turbines

The following NESHAP rules would apply:

- 40 CFR 63 Subpart ZZZZ – Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. The emergency generators and firewater pump engines would comply with 40 CFR 60 Subpart IIII.

Title V Operating Permit

The Title V Permit Program, as described in 40 CFR Part 70, requires major sources of air emissions and certain affected non-major sources to obtain federal operating permits. In Texas, authority to issue Title V operating permits has been delegated by USEPA to the TCEQ. Title V Operating Permit No. O2878 was issued by TCEQ to cover operations at the Quintana Island terminal on February 8, 2012, and is in effect through February 7, 2017.

TAC 30 Section 112 requires that a new or modified source submit a Title V permit abbreviated application prior to starting operation as major source or major modification. TCEQ then sends the source a letter which specifies the information required for a Site Operating Permit application. Freeport LNG has indicated its intent to submit application for any necessary amendments to the current permit for Quintana Island terminal 12 to 18 months prior to the anticipated start of operation of the Phase II Modification Project. The Pretreatment Plant would be a new major source for Title V. Freeport LNG has indicated its intent to submit an application for the Title V permit 12 to 18 months prior to the anticipated start of operation. This schedule is in accordance with the applicable requirements.

Greenhouse Gas Reporting Rule

The USEPA's Mandatory Reporting of GHGs Rule requires reporting of GHG emissions from suppliers of fossil fuels and facilities that emit greater than or equal to 25,000 tonnes of GHG CO_2e per year.

Based on the existing GHG emission estimates, the Pretreatment Plant, Liquefaction Plant and existing Vaporization Plant would be subject to the GHG Mandatory Reporting rule and would be required to report the GHG emissions to USEPA if the actual emissions exceed 25,000 tonnes of GHG CO_2e per year.

State Air Quality Requirements

Air emission sources in Texas must meet state air emission standards codified in TAC Section 30 (TAC 30) Chapters 100-122. Emission related standards that would apply to the proposed Projects are discussed below.

TAC 30 Chapter 101, Subchapter H, Division 3 (Mass Emissions Cap and Trade) would apply to the Projects, since they would have an uncontrolled design capacity to emit 10 tpy or more of NO_x. Freeport LNG would be required to hold on March 1 of each year adequate NO_x allowances in its compliance account to cover its emissions during the prior calendar year.

TAC 30 Section 111.111 limits visible emissions from stationary vents to opacity of no greater than 20 percent averaged over a six-minute period. The use of natural gas and ultra-low sulfur diesel as fuels and proper equipment maintenance and operation would help ensure that visible emission limits are satisfied.

TAC 30 Section 111.145 requires the use of water or suitable oil or chemicals to control dust from demolition and construction activities at sites greater than one acre in size. Freeport LNG would utilize dust suppressants, such as water or chemicals, to minimize fugitive dust emissions during construction.

TAC 30 Section 111.151 limits emissions of PM as a function of stack gas volumetric flow rate. The proposed Project would be designed and operated such PM emissions would be below these limits.

TAC 30 Section 112.3 limits impacts of SO_2 emissions at off-site location to no greater than 0.28 parts per million on a volume basis (ppmv), equivalent to approximately 734 $\mu g/m^3$, over a 30-minute period. Dispersion modeling results show that, albeit on a one-hour average basis, predicted off-site concentrations of SO_2 are a small fraction of this limit.

TAC 30 Section 112.9 limits SO_2 emissions from the combustion of liquid fuel to no greater than 440 ppmv averaged over a 3-hour period. Calculations show that the proposed SO_2 emissions from the emergency generators and the fire water pumps would be below the levels allowed by 30 TAC Part112.9. The use of ultra-low sulfur diesel fuel would help ensure that this limit is satisfied.

TAC 30 Section 112.31 limits impacts of H_2S emissions at off-site locations to no greater than 0.08 parts per million (ppm) on a 30 minute average. Scaling the dispersion modeling results for SO_2 by the ratio of H_2S to SO_2 emissions shows that, albeit on a one-hour average basis, predicted off-site concentrations of H_2S are a small fraction of this limit.

TAC 30 Section 112.41 limits impacts of H_2SO_4 emissions at off-site locations to no greater than 15 $\mu g/m^3$ on a 24-hour average, to no greater than 50 $\mu g/m^3$ on a 1-hour average, and to no greater than 100 $\mu g/m^3$ at any time. Scaling the dispersion modeling results for SO_2 by the ratio of H_2SO_4 to SO_2 emissions shows that these ambient limits would not be exceeded.

TAC 30 Section 115 Subchapter D, Division 3 contains requirements for the control of fugitive emissions of VOC in O_3nonattainment areas. These apply to a variety of operations, including natural gas processing. Freeport LNG would comply with all applicable VOC control requirements and satisfy the associated monitoring and inspection requirements.

TAC 30 Section 116.111(a)(2)(C) requires an application for a NSR permit to include a demonstration that Best Available Control Technology (BACT) would be applied. Freeport LNG would implements BACT controls for emission sources of GHG, NO_x, PM_{10}, $PM_{2.5}$, and SO_2, and LAER, which is equally or more stringent than BACT, for emission sources of NO_x and VOC.

TAC 30 Section 117 Subchapter B Division 3 sets requirements for control NO_x from major sources in the HGB O_3nonattainment area. Freeport LNG would comply with all applicable NO_x control requirements and satisfy the associated monitoring and inspection requirements.

4.11.1.2 Air Quality Impacts and Mitigation

Construction Air Pollutant Emissions

During construction, a temporary reduction in ambient air quality would result from emissions and fugitive dust generated by construction equipment. Fugitive dust emission levels would vary in relation to moisture content, composition, and volume of soils disturbed. Fugitive dust and other emissions from construction activities generally do not result in a significant increase in regional pollutant levels, although local pollutant levels could increase temporarily.

Construction air pollutant emissions include exhaust and crankcase emissions from construction equipment, vehicles that transport workers and materials, vessels that transport equipment and constructing materials. All construction emissions are summarized in tables 4.11.1-3 and 4.11.1-4.

To mitigate construction-related emissions, Freeport LNG would maintain all construction equipment in accordance with manufacturers’ recommendations and minimize engine idling time. Construction equipment would combust diesel fuel with no more than 0.0015 percent sulfur, and vessels would combustion fuel that complies with International Convention for the Prevention of Pollution from Ships (MARPOL) and USEPA standards for sulfur content.

Freeport LNG would employ proven construction practices, such as water sprays and dust suppressants, to mitigate fugitive dust emissions during construction. The particular frequencies and methods employed would depend on the specific construction activities, terrain, soil conditions, and weather conditions. Additionally, all areas disturbed by construction would be stabilized in accordance with the Freeport LNG’s Plan.

Emissions would occur over the duration of construction activity and would vary along the length of the Pipeline/Utility Line System. Construction emissions, including dust emissions would impact residents near to the Liquefaction and Pretreatment Plant. As stated, impacts from construction equipment would be temporary, but would occur over the 4.5 years of construction at the Quintana Island terminal. While these would not result in a significant impact on regional air quality or result in any violation of applicable ambient air quality standard, it may result in elevated pollutant levels near to the construction sites.

As is discussed above, measures to mitigate the air emissions during Project construction include the following:

- use of construction equipment engines which incorporate modern pollution control technology;
- properly maintaining construction equipment engines;
- use of clean fuels in construction equipment engines;
- use of dust control measures water sprays and dust suppressants; and
- stabilizing areas disturbed by construction.

As was noted previously, the Projects are subject to General Conformity. As such, we have included a recommendation that Freeport LNG much submit, at least 90 days prior to construction either documentation showing that the Projects' direct and indirect construction and operation emissions, together with all other emissions in the HGB area, would not exceed the emissions budgets specified in the federally-approved HGB SIP; or documentation that the TCEQ commits to explicitly include the Proposed Liquefaction Project's direct and indirect NO_x and VOC emissions in the next revision of the HGB SIP.

Air Pollutant Emissions from Operations

Anticipated emission for the proposed Project facilities are shown in table 4.11.1-5. The emission estimates are based on manufacturer-supplied emission factors supplemented with USEPA default emission factors obtained from AP-42 (*i.e.*, AP-42 refers to USEPA's Compilation of Air Pollutant Emission Factors, Volume 1, Fifth Edition).

Table 4.11.1-7 lists the estimated operating emissions for operation of the LNG vessel and the associated tug vessels while the carriers are within Texas waters. These emission estimates are based on calculations submitted by Freeport LNG and modified by FERC to better characterize the expected operations. Additional information on the assumptions and calculations for the ship emissions can be found in appendix F.

Table 4.11.1-5 lists the estimated operating emissions for the existing and proposed stationary facilities. As identified previously, these show that the Projects would be subject to NNSR permitting for NO_x and VOC, and PSD permitting for GHG, NO_x, PM_{10}, $PM_{2.5}$, and SO_2.

For the Phase II Modification Project at the Quintana Island terminal, the only operation emissions would be fugitive emissions, totaling 1.18 tpy of VOC from piping systems. These would not trigger NSR Permitting.

Table 4.11.1-7

Air Emission Estimates for the Anticipated LNG Vessels and Support Vessels

Source	Potential Emissions (tpy)						
	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_x	CO_2e
LNG Vessels							
Main Engines	11.1	8.6	0.6	0.9	0.8	0.4	12,669
Auxiliary Engines	93.2	37.7	6.7	0.4	0.4	0.3	4,521
Total	104.4	46.2	7.3	1.2	1.2	0.7	17,190
Assist Tugs							
Main Engines	31.9	8.1	0.9	0.9	0.8	0.4	2,258
Auxiliary Engines	4.5	0.7	0.1	0.1	0.1	0.1	320
Total	36.5	8.8	1.0	1.0	0.9	0.5	2,578
Total Vessel Emissions	**140.8**	**55.1**	**8.3**	**2.2**	**2.2**	**1.1**	**19,768**

Freeport LNG submitted its PSD Permit Air Dispersion Modeling Report for the Pretreatment Plant and Liquefaction Plant to the TCEQ on July 19, 2013. AERMOD was used to model simultaneously the proposed emissions from the Pretreatment Plant, the Liquefaction Plant, and offsite stationary sources as warranted. The detailed modeling process, including assumptions, is described in appendix F.

At the request of FERC, in December 2013 Freeport LNG submitted the estimates of the emissions of NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, VOC, and GHG from the existing LNG ships, tugs and escort vessels within the moored safety zone as well as those within Texas waters. Also at the request of FERC, Freeport LNG provided the results Project's $PM_{2.5}$ multi-source air dispersion modeling (*i.e.*, the modeling submitted to TCEQ with its air permit application) with these vessel emissions included. In January 2014 FERC revised the emission calculations to better characterize the expected operations and account for all the reasonably expected vessel emissions. The assumption and details on how the air modeling was conducted is identified in appendix F

For refined multi-source modeling, two sets of runs, significance and multi-source were executed with AERMOD.

- The significance runs identify the impact area - which is the area where the predicted concentrations exceed the USEPA significant impact levels (SILs). The SILs are used to determine if additional modeling is required. Any impacts below the SILs would not have a potential to result in exceedances of the NAAQS

- The multi-source runs include both the emission sources, and important sources within 50 km of the impact area.

The basis of the refined multi-source modeling is the modeling reviewed and approved by TCEQ for the Freeport LNG Project PSD permit. This was revised by Freeport LNG to include its vessel emission, and submitted to FERC on December 2013. As a first step, FERC ran

AERMOD to benchmark these analyses, and successfully reproduced their results for both the 24-hour and annual impacts.

The December 2013 analysis included our revised vessel emission rates (retaining same source inventories, source parameters, source groups, receptor arrays, meteorology, and AERMOD model version) to create new January 2014 model results. A summary of all the modeling results are included in table 4.11.1-8.

As shown in table 4.11-1-9, the significance runs (project emissions, including vessel emissions were applicable) were approximately 2 $\mu g/m^3$ higher for 24-hour impacts and marginally higher (0.01 $\mu g/m^3$) for annual impacts. However, the revised vessel emission rates substantially increased the size of the 24-hour and annual impact areas by 124 percent and 42 percent. Previously, the impact areas were surrounding the Pretreatment Plant. The new impact areas include locations near the Liquefaction Plant, Quintana Island and Industrial facilities across the ICW.

Thus, although the revised vessel emissions do not by themselves markedly increase the predicted impacts of Project, they trigger the need to greatly expand the region where the multi-source impacts must be calculated. This is especially relevant in the vicinity of existing industrial facilities located near the LNG carrier loading berths.

As shown in table 4.11.1-10, the multi-source runs did not demonstrate compliance with the NAAQS for either averaging time (24-hour and annual), due to the significant receptors adjacent to the Liquefaction Plant. These receptors were outside the impact areas for the December 2013 submittal.

Figure 4.11.1-1 shows the grid points at which the total predicted impact of the Projects' sources, sources not part of the Projects, and background exceed the 24-hour $PM_{2.5}$ NAAQS. These are located over industrial facilities.

Table 4.11.1-8

Air Dispersion Modeling Summary

Pollutant and Averaging Time	Pollutant Concentration (μg/m³)								
	Modeling Significant Impact Level	PSD Class II Increment Standard	NAAQS	Single-Source Modeling Results	Background a/	Applicant Multi-Source Modeling Results	Applicant Multi-Source Modeling Results Result + Background	FERC Multi-Source Modeling Results Result + Background	PSD Class II Increment Results
CO									
8-hour	---	500	10,300	325.3	1,069	Not Required			
1-hour	---	2,000	40,000	550.3	1.476	Not Required			
NO_2									
1-hour	7.5	---	188	4.64	37.8	Not Required			
Annual	1	25	100	0.49	14.3	Not Required			
$PM_{2.5}$									
Annual	0.3	4	12 b/	0.88	9.3	2.35	11.65	14.5	0.89
24-hour	1.2	9	35 b/	4.95	20.7	10.63	31.33	248.5	4.88
PM_{10}									
Annual	1	17	c/	0.88	---	Not Required			
24-hour	5	30	150	4.95	41	Not Required			
SO_2									
1-hour	7.9	---	196	4.34	55.1	Not Required			
3-hour	25	512	1,300	3.00	36.8	Not Required			

a/ From table 4.11.1-2
b/ Remanded back to Court on 1/22/13, but not precluded from being used
c/ Revoked
μg/m3 = micrograms per cubic meter.

Table 4.11.1-9

Air Emission Estimates for the Anticipated LNG Carriers and Support Vessels

Averaging Period	Model Runs	Maximum $PM_{2.5}$ Predicted Concentration (ug/m^3)	$PM_{2.5}$ Significance Level (ug/m^3)	Number of Receptors in the Impact Area
24 hour	Freeport LNG December 2013 Submittal	4.50	0.3	3,639
24-hour	FERC January 2014 Revision	6.49	0.3	8,131
Annual	Freeport LNG December 2013 Submittal	0.76	1.2	1,083
Annual	FERC January 2014 Revision	0.77	1.2	1,535

Table 4.11.1-10

$PM_{2.5}$ Predicted Cumulative Impacts

Averaging Period	Model Runs	$PM_{2.5}$ Concentration (ug/m^3)			
		Multi-Source Maximum Predicted	Background	Multi-Source Maximum Predicted + Background	NAAQS
24 hour	Freeport LNG December 2013 Submittal	10.5	20.7	31.2	35
24 hour	FERC January 2014 Revision	227.8	20.7	248.5	35
Annual	Freeport LNG December 2013 Submittal	2.4	9.3	11.7	12
Annual	FERC January 2014 Revision	5.2	9.3	14.5	12

The results demonstrate that impacts are below NAAQS with the exception of $PM_{2.5}$ and would not result in significant impacts on residents in the vicinity of the Pretreatment Plant and would be below the NAAQS. Near the Liquefaction Plant, the impacts from only the Liquefaction Project (Liquefaction Plant, Pretreatment Plant, Vessel Emissions) would result in impacts below the NAAQS. However, because there are numerous industrial facilities near the Liquefaction Plant, the cumulative impacts would be above the NAAQS. These impacts in excess of the NAAQS near the Liquefaction Plant exist regardless of the emissions from the Projects. Thus, Freeport LNG’s facilities are not the cause of the exceedances and significant adverse impacts on residents or sensitive environments are not expected to occur as a result of operation of the Liquefaction or Phase II Modification Projects.

We received comments from the public and inquiries from the USEPA and NOAA Fisheries regarding deposition impacts on local wildlife. Depositional impacts on wildlife, vegetation, and aquatic ecosystems are discussed in section 4.6.1.1. The analyses also show that the Projects' air emissions would not produce significant adverse impacts on soils, vegetation, or visibility.

PM2.5 NAAQS 24-Hour, Significant Receptors

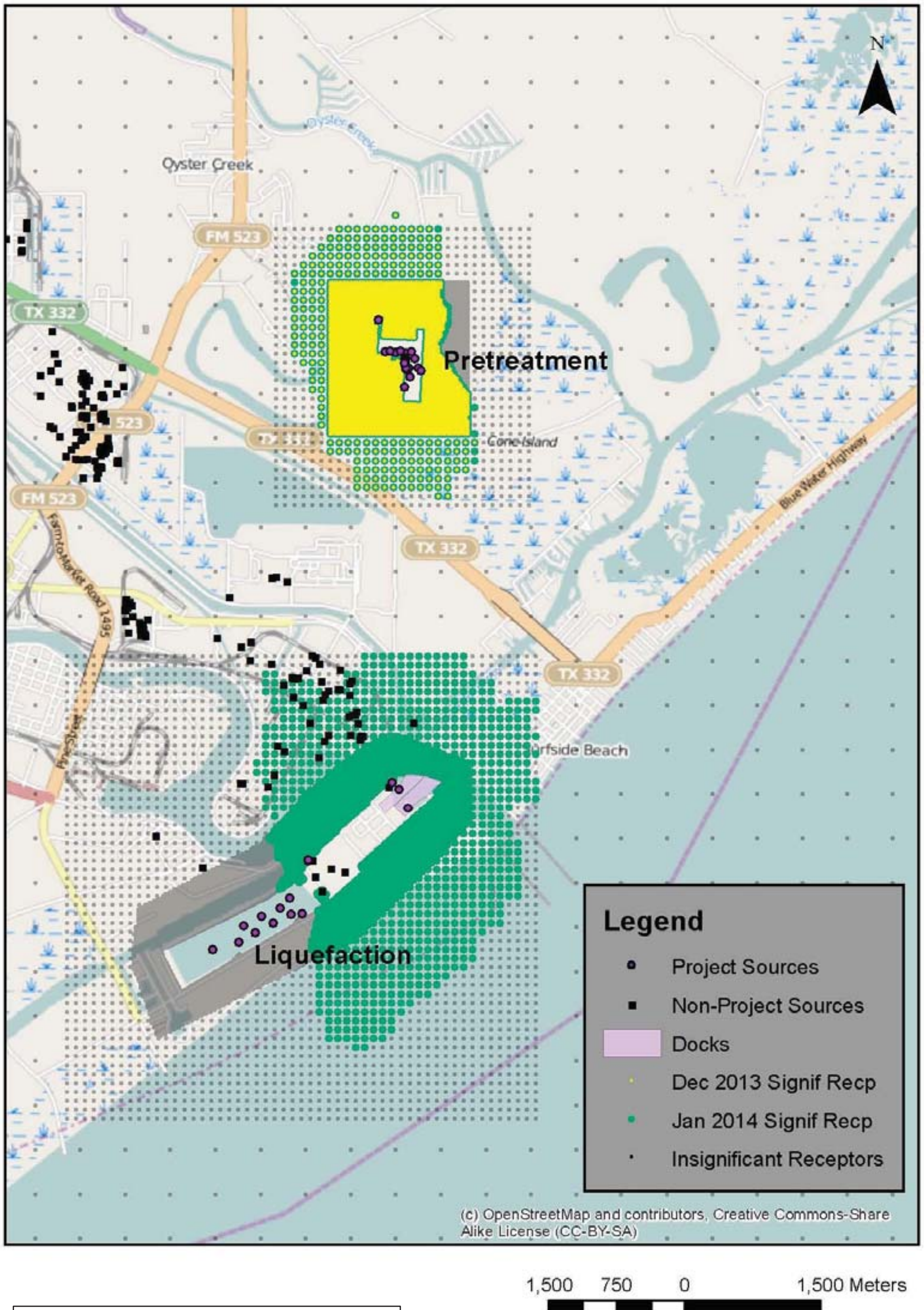

Figure 4.11.1-1

Thus through implementation of construction work practices, our recommendation for a general conformity analysis of the estimated emissions from construction and operation, and an analysis of the modeled air quality impacts from operation of Liquefaction Plant, Pretreatment Plant and Vaporization Plant, we find there would be no regionally significant impacts on air quality although residents near the construction areas would have elevated fugitive dust impacts during the period of construction.

4.11.2 Noise and Vibration

Noise quality can be affected during construction and operation of the Projects and the magnitude and frequency of noise can vary considerably during the day, week, or the seasons, based on changing weather conditions, vegetative cover, and non-Project sources of noise. Two measures that associate the time-varying quality of noise to its effect on people are the 24-hour equivalent sound level (L_{eq}) and day-night averaged sound level (L_{dn}). The L_{eq} is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{dn} is the L_{eq} plus 10 decibels on the A-weighted scale (dBA), added to account for people's greater sensitivity to nighttime sound (between the hours of 10 p.m. and 7 a.m.). The A-weighted scale is used as human hearing is less sensitive to low and high frequencies than mid-range frequencies. The human ear's threshold of perception for noise change is considered to be 3 dBA; 6 dBA is clearly noticeable to the human ear, and 9 dBA is perceived as a doubling of noise.

In 1974, the USEPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. This publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The USEPA has determined that to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. The FERC has adopted this criterion for new compression and associated facilities, and it is used here to evaluate the potential noise impact from operation of each of the proposed compressor stations. An L_{dn} of 55 dBA is equivalent to a continuous noise level L_{eq} of 48.6 dBA for facilities that operate at a constant level of noise.

The City of Freeport noise ordinance is mainly a "nuisance" type ordinance which basically prohibits loud and unreasonable sounds such as radios and television sets, which disturb the peace and quiet of neighboring residents, unnecessary horns and signaling devices on automobiles, yelling and shouting, and un-muffled exhausts of internal combustion engines. Other unreasonable sounds are also enumerated. The ordinance does not place numerical limits on any noise generating sources associated with the Projects. There are no applicable state or county noise regulations.

4.11.2.1 Existing Ambient Noise Conditions

Liquefaction Project

The ambient sound level of a region is defined by the total noise generated within the specific environment, and is usually comprised of sound emanating from natural and artificial sources. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day, throughout the week, and over the course of the year. This variation is caused in part by changing weather conditions and the effects of seasonal vegetative cover.

Freeport LNG conducted a baseline sound level survey at both the Liquefaction Plant site and the Pretreatment Plant site on June 5-6, 2012. Existing Noise Sensitive Area (NSAs) were identified in the vicinity of each of the sites. Five locations were chosen for the Liquefaction Plant, and two for the Pretreatment Plant. Some locations were chosen to represent the nearest NSAs, while others were taken at the Projects' property lines. For the Liquefaction Plant, NSAs were present at three of the five noise monitoring locations. For the Pretreatment Plant, one monitoring location was selected to represent nearby NSAs and a second location was at the Pretreatment Plant property line.

Measurements were conducted during daytime and nighttime hours. For locations where nighttime measurements were not taken, the area was assumed to experience the same sound level as the nighttime sound level at the nearest site where monitoring was conducted. The noise monitoring locations and NSAs, their distance and direction from each site, and the measured or estimated noise levels are summarized in table 4.11.2-1.

Table 4.11-2-1

Identified NSA Locations and Measured/Estimated Ambient Noise Levels

Project	Monitoring Site	NSA	Distance/Direction	L_{Day}	L_{Night}	L_{dn}
Liquefaction Plant	Site 1	Property Line (no NSA)	2,765 feet / WSW	49.3	43.6	51.4
	Site 2	Property Line (no NSA)	1,250 feet / E	45.5	44.1	50.7
	Site 5 a/	NSA 1 Cortez Street	2,210 feet / SE	47.7	44.1 b/	51.2
	Site 6	NSA 3 Lamar Street	4,140 feet / E	54.1	44.1 b/	54.1
	Site 7	NSA 2 Deep Sea Drive	3,345 feet / WSW	53.1	44.1 b/	53.5
Pretreatment Plant		NSA 1 Jeffers Road	3,560 feet / W			
	Site 3	NSA 2 Johnson Drive	4,275 feet / NW	51.1	42.0	51.5
		NSA 3 Duncan Drive	4,390 feet / NW			
	Site 4	Property Line (no NSA)	2,765 feet / WSW	39.7	42.0	48.1

a/ This NSA was subsequently purchased by Freeport LNG and no longer exists.
b/ L_{night} was not measured at these locations; it was assumed to be equal to the L_{Night} of Site 2.

Phase II Modification Project

The existing noise environment as described above for the Liquefaction Plant provides representative data for the Phase II Modification Project.

4.11.2.2 Liquefaction Project Impacts and Mitigation

Construction Noise

Freeport LNG conducted detailed noise analyses to determine estimated noise levels associated with pile driving activities and dredging. The analyses included calculating construction noise at nearby NSAs and comparing the levels to measured ambient noise levels. Pile driving would be conducted for multiple areas of the Liquefaction Project including the construction dock/fire water intake structure, electric substation, liquefaction train pads, LNG storage tank, aggregate dock, ground flare/pipe rack, main plant entrance, warehouse/office building, and LNG berthing dock at the Quintana Island terminal site for up to 3 years. Dredging would occur for the new construction dock/firewater intake structure, the new aggregate dock, the existing construction dock, and the new LNG berthing dock for approximately 120 days.

Pile Driving

Freeport LNG stated in their analysis, that pile driving activities would be limited to daytime hours only but would occur for a period of 3 years. Their noise analysis consisted of identifying the nearest NSAs within one half mile of each pile driving area, and calculating estimated pile driving noise levels at these NSAs. Freeport LNG obtained impact pile driving noise levels from measurements conducted at another site. A noise emission level of 90 dBA at 50 feet was utilized. Their analysis also assumed a 20 percent usage factor (*i.e.*, the percentage of time that the maximum sound level is generated), which is standard practice for construction noise analyses. Freeport LNG calculated pile driving noise levels for the nearest NSAs at each pile driving site. Table 4.11.2-2 provides a summary of the pile driving areas, the nearest NSAs, measured ambient noise levels, calculate pile driving noise levels, and projected increases over ambient conditions.

In addition to the above analysis, Freeport LNG also evaluated eight potential scenarios for pile driving, where multiple piles would be driven simultaneously at multiple sites. A summary of this analysis is provided in table 4.11.2-3.

The results of Freeport LNG's analysis of single piles being driven at any one site (table 4.11.2-2) indicates that L_{eq} noise levels would range from 47.3 dBA to 57.1 dBA at any NSA. Increases over ambient conditions were shown to range from 1.4 dBA to 9.9 dBA. As noted previously, the analysis accounted for a 20 percent usage factor to arrive at an L_{eq} noise level. The maximum impact noise level (L_{max}) that occurs during each hammer strike would be 7 dBA higher. Accordingly, L_{max} levels from pile driving would range from 54.3 dBA to 64.1 dBA and increases over ambient conditions would be 8.4 dBA to 16.9 dBA.

Table 4.11.2-2

Single Impact Pile Driving Noise Levels

Pile Driving Locations and Nearest NSA	Distance (feet)/Direction to NSA	Daytime Ambient L_{eq} (dBA)	Calculated L_{eq} Pile Driving Noise at NSA (dBA) a/	Impact Pile Driving Plus Ambient (dBA)	Increase Above Ambient (dBA)
Aggregate Dock/Crane Barge Area					
NSA-A	1,877 / SW	51.4	51.5	54.5	3.1
Firewater Intake Structure/Construction Dock					
NSA-B	1,975 / SE	47.7	51.1	52.7	5.0
NSA-C	2,335 / E	47.7	49.6	51.8	4.1
Liquefaction Train					
NSA-B	2,307 / ENE	47.7	49.7	51.8	4.1
NSA-A	3,064 / WSW	51.4	47.3	52.8	1.4
LNG Berthing Dock					
NSA-E	1,579 / SE	46.1	53.0	53.8	7.7
NSA-D	1,900 / SE	46.1	51.4	52.5	6.4
NSA-F	2,240 / NE	46.1	50.0	51.5	5.4
LNG Storage Tank					
NSA-B	1,253 / E	47.7	55.0	55.8	8.1
NSA-C	2,020 / ENE	47.7	50.9	52.6	4.9
Ground Flare					
NSA-A	1,833 / SW	51.4	51.7	54.6	3.2
Main Plant Entrance					
NSA-B	988 / NE	47.7	57.1	57.6	9.9
NSA-C	2,190 / NE	47.7	50.2	52.1	4.4
Electric Substation					
NSA-B	1,995 / ENE	47.7	51.0	52.7	5.0
Warehouse/Office Building					
NSA-B	1,451 / ENE	47.7	53.8	54.7	7.0
NSA-C	2,551 / NE	47.7	48.9	51.3	3.6
Pretreatment Plant					
NSA-1	2,806 / W	51.1	48.0	52.8	1.7

a/ Assumes one pile driver at each location and a 20 percent usage factor. L_{max} levels would be 7 dBA greater.

Table 4.11.2-3

Multiple Impact Pile Driving Noise Levels

Pile Driving Locations and Nearest NSA	Daytime Ambient L_{eq} (dBA)	Calculated L_{eq} Pile Driving Noise at NSA (dBA) a/	Impact Pile Driving Plus Ambient (dBA)	Increase Above Ambient (dBA)
Construction Dock/Firewater Intake, Electric Substation				
NSA-B	47.7	54.0	55.0	7.3
Construction Dock/Firewater Intake, Electric Substation, LNG Tank, Ground Flare				
NSA-A	51.4	51.7	54.6	3.2
NSA-B	47.7	57.6	58.0	10.3
NSA-C	47.7	53.3	54.4	6.7
Construction Dock/Firewater Intake, Electric Substation, LNG Tank, Ground Flare, Liquefaction Trains				
NSA-A	51.4	54.1	55.9	4.5
NSA-B	47.7	58.8	59.1	11.4
NSA-C	47.7	53.3	54.4	6.7
Construction Dock/Firewater Intake, Electric Substation, LNG Tank, Ground Flare, Liquefaction Trains, LNG Berthing Dock, Main Plant Entrance, Warehouse/Office Area				
NSA-A	51.4	54.1	55.9	4.5
NSA-B	47.7	61.8	62.0	14.3
NSA-C	47.7	56.0	56.6	8.9
NSA-D	46.1	51.4	52.5	6.4
NSA-E	46.1	53.0	53.8	7.7
NSA-F	46.1	50.0	51.5	5.4
Construction Dock/Firewater Intake, LNG Tank, Ground Flare, Liquefaction Trains, Main Plant Entrance, Warehouse/Office Area				
NSA-A	51.4	54.9	56.5	5.1
NSA-B	47.7	61.7	61.9	14.2
NSA-C	47.7	56.0	56.6	8.9
LNG Tank, Ground Flare, Liquefaction Trains, Main Plant Entrance, Warehouse/Office Area				
NSA-A	51.4	54.9	56.5	5.1
NSA-B	47.7	61.3	61.5	13.8
NSA-C	47.7	54.8	55.6	7.9
Liquefaction Trains, Main Plant Entrance, Warehouse/Office Area				
NSA-A	51.4	52.0	54.7	3.3
NSA-B	47.7	60.1	60.4	12.7
NSA-C	47.7	52.6	53.8	6.1
Liquefaction Trains				
NSA-A	51.4	52.0	54.7	3.3
NSA-B	47.7	54.5	55.3	7.6

a/ Assumes multiple pile drivers at multiple locations and a 20 percent usage factor. L_{max} levels would be 7 dBA greater.

Freeport LNG's analysis for multiple piles at multiple sites (table 4.11.2-3) indicated higher L_{eq} pile driving noise levels (up to 62 dBA), with much larger increases over ambient conditions, ranging from 3.2 dBA to 14.3 dBA. As noted above, L_{max} levels would be 7 dBA greater, resulting in maximum levels of up to 69 dBA, and increases over ambient conditions of up to 21 dBA.

The above discussed pile driving noise levels, in absolute levels, and as increases over ambient conditions, would result in significant noise impacts if unmitigated. Freeport LNG is proposing to limit pile driving to daytime hours and has identified several noise mitigation measures that could be utilized in order to reduce noise levels and minimize the potential for noise impacts. These measures include the following:

- pile driving caps;
- pile driving caps with acoustical enclosures;
- noise mitigation blankets;
- encasements; and
- noise dampening compound painted onto piles.

Freeport LNG noted that in particular, wood pile driving caps can reduce pile driving noise by 11 dBA, however, Freeport LNG has not committed to implement any specific mitigation measures and thus the nearby residents of the Town of Quintana would be subjected to the impulse noise from pile driving for 3 years.

Dredging

Freeport LNG's analysis of dredging, similar to their pile driving analysis, utilized dredging noise emission data from another project, with a noise level of 80 dBA at 50 feet being utilized. Dredging would be conducted 24 hours per day for approximately 120 days. Freeport LNG's analysis did not account for any intervening terrain or structures, which would act to reduce noise levels somewhat over their calculated levels. Provided in table 4.11.2-4 is a summary of Freeport LNG's analysis, which includes measured ambient noise levels, dredging noise levels, and increases over existing conditions.

Table 4.11.2-4

Dredging Noise Analysis

Dredging Area	Distance (feet) and Direction to Nearest NSA	Existing Ambient L_{dn} Noise Level (dBA)	Calculated L_{dn} Dredging Noise Level (dBA)	Combined Dredging Plus Ambient L_{dn} Noise Level (dBA)	Increase Above Ambient (dBA)
1	NSA 1, 1,500 / WSW	57.8	56.9	60.4	2.6
2	NSA-2, 2,004 / SE	54.1	54.3	57.2	3.1
3	NSA 3, 1,834 / SE	54.1	55.1	57.6	3.5
4	NSA-3, 1,885 / SE	54.1	54.9	57.5	3.4
5	NSA-5, 448 / SE	54.1	67.4	67.6	13.5

A review of the data in table 4.11.2-4 reveals that dredging noise would be near to just over 55 dBA as an L_{dn} at the nearest NSAs to Dredging Areas 1 through 4, ranging from 54.9 dBA to 56.9 dBA. It is anticipated that the aforementioned intervening structures would act to reduce these noise levels somewhat, such that noise levels would be below FERC's 55 dBA L_{dn} criterion.

Much higher noise levels were calculated at NSA-5 near Dredging Area 5, with an L_{dn} of 67.4. Freeport LNG's Dredging Plan suggests mitigation for Freeport LNG to follow should noise levels exceed 55 dBA, but does not committed to implement the mitigation measures. These measures include: residential grade mufflers on the power generation units; the construction of temporary noise barriers around the predominant noise producing units; the use of noise dampening blankets, or temporary relocation of nearby residents.

Without mitigation, there could be significant noise impacts from construction due to the length of time for pile driving and dredging construction. During the construction of the Quintana Island terminal, Freeport LNG documented several instances of noise and vibration complaints from nearby residents. As with the construction of the original project, pile driving would last approximately 36 months at the Liquefaction Plant site, 20 months at the Pretreatment Plant site and 18 months at the Phase II LNG Berthing dock. Dredging would last up to 120days on a continuous bases. Overall construction at the Quintana Island terminal could last up to 4.5 years. Thus to ensure that the noise impacts from dredging are reduced to 55 dBA, and pile driving noise is minimized **we recommend that:**

> **Prior to construction, Freeport LNG should file a Construction Noise Mitigation Plan, for review and approval by the Director of the OEP that identifies measures that Freeport LNG would implement to reduce dredging noise to no greater than 55 dBA L_{dn} at NSAs, and pile driving noise (L_{max}) to no greater than 10 dBA over ambient levels.**

Horizontal Directional Drill Noise

HDD techniques would be utilized at five locations where river, wetland, and roadway crossings are proposed. These locations are:

- Channel;
- ICW;
- Wetland;
- Oyster Creek; and
- Pretreatment Plant.

Freeport LNG has identified the nearest NSAs at each HDD entry and exit point. Freeport LNG also conducted ambient noise level measurements at each HDD site where NSAs were identified within a 0.5 mile radius of each site. The Pretreatment Plant HDD and the Wetland HDD site has no NSAs within 0.5 miles of the HDD exit point.

Freeport LNG utilized the SoundPLAN noise model in order to calculate expected HDD noise levels at the nearby NSAs. The model incorporated area topography, spreading of sound waves with distance, and atmospheric absorption using the ISO 9613-2 standard. A noise emission level of 83 dBA and 71 dBA at 50 feet was utilized for the entry and exit sound levels, respectively, and 24 hour HDD operation was assumed. Results of the initial calculations showed that expected sound levels would exceed the FERC limit of 55 dBA as an L_{dn} and/or an increase over existing ambient conditions of 10 dBA or more. Mitigation in the form of temporary barrier walls, providing a nominal 10 dBA decrease in sound, reduced levels to below the FERC criteria at all but two HDD sites. Results for the HDD analysis, including the distance and direction to the nearest NSAs at each site, are provided in table 4.11.2-5.

Table 4.11.2-5

Calculated HDD Noise Levels at the Nearest NSA Locations at Each Site (dBA)

HDD Location and NSAs	Distance (feet) / Direction	Ambient L_{dn}	Without Mitigation: Calculated L_{dn} due to HDD	Without Mitigation: HDD Noise plus Ambient	Without Mitigation: Increase Above Ambient	With 10 dBA Mitigation: Calculated L_{dn} due to HDD with 10 dBA Mitigation	With 10 dBA Mitigation: HDD Mitigated Noise plus Ambient	With 10 dBA Mitigation: Increase Above Ambient with Mitigation
Channel HDD Entry								
NSA 1	1,080 / SW	52.5	61.2	61.7	9.2	51.2	54.9	2.4
NSA 2	1,410 / SW	52.5	58.3	59.3	6.8	48.3	53.9	1.4
NSA 3	2,150 / N	52.5	53.7	56.1	3.6	43.7	53.0	0.5
Channel HDD Exit								
NSA 1	182 / E	55.1	66.3	66.6	11.5	56.3	58.8	3.7
NSA 2	592 / NE	55.1	55.4	58.3	3.2	45.4	55.5	0.4
NSA 3	1,120 / WSW	55.1	46.7	55.7	0.6	36.7	55.2	0.1
ICW HDD Entry								
NSA 1	586 / S	56.3	67.3	67.6	11.3	57.3	59.8	3.5
NSA 2	938 / NNE	56.3	62.6	63.5	7.2	52.6	57.8	1.5
NSA 3	1,120 / WSW	56.3	60.8	62.1	5.8	50.8	57.4	1.1
ICW HDD Exit								
NSA 1	864 / SSE	50.4	51.7	54.1	3.7	41.7	50.9	0.5
NSA 2	2,410 / SW	50.4	41.0	50.9	0.5	31.0	50.4	0.0
NSA 3	2,640 / NE	50.4	40.0	50.8	0.4	30.0	50.4	0.0
Wetland HDD Entry								
NSA 1	751 / SE	52.7	64.9	65.1	12.4	54.9	56.9	4.2
NSA 2	1,150 / SW	52.7	60.5	61.2	8.5	50.5	54.7	2.0
NSA 3	1,720 / W	52.7	56.2	57.8	5.1	46.2	53.6	0.9
Oyster Creek HDD Entry								
NSA 1	1,440 / SE	61.3	58.1	63.0	1.7	48.1	61.5	0.2
NSA 2	1,600 / SSE	61.3	57.0	62.7	1.4	47.0	61.5	0.2
NSA 3	2,080 / NW	61.3	54.1	62.1	0.8	44.1	61.4	0.1
Oyster Creek HDD Exit								
NSA 1	363 / N	62.7	60.0	64.6	1.9	50.0	62.9	0.2
NSA 2	1,190 / NW	62.7	48.5	62.9	0.2	38.5	62.7	0.0
NSA 3	1,1400 / NW	62.7	46.8	62.8	0.1	36.8	62.7	0.0

Based on the estimates presented in the acoustical analysis, even with noise mitigation incorporated, it appears that HDD related noise may exceed the stated criteria in at least two HDD sites, however considering the mitigation that would be utilized, the limited time of drilling and the short drill length the noise impacts on nearby residents should not be significant due to the HDD.

In conclusion, construction noise impacts would be particularly intrusive to residents of the Town of Quintana near the Liquefaction Plant and Phase II Modification Project. Pile driving would result in high levels of impulse noise levels over 3 years, dredging noise impacts for up to 120 days; and general construction noise extending up to 4.5 years. Even with mitigation, these adverse noise impacts would likely cause residents of the Town of Quintana annoyance. Therefore, we conclude that the impacts from construction noise on the nearby residents of the Town of Quintana would be significant and unavoidable.

The Pretreatment Plant noise impacts would also result in elevated noise impacts during construction, but due to the distance between the construction areas and the nearby residents, the construction noise impacts would not be significant.

For the Pipeline/Utility Line System, the noise would be elevated but would only occur during daytime, and would be short-term. Freeport LNG has also proposed mitigation to address HDDs. Therefore, we expect noise impacts from construction of the Pipeline/Utility Line System to be minor.

Operational Noise

Freeport LNG performed noise analyses to calculate noise levels that would be attributable to operation of both the proposed Liquefaction Plant and the Pretreatment Plant. These levels were evaluated against the existing baseline L_{dn} noise levels and our impact criterion to determine potential impacts at the nearby NSAs. For both Projects, Freeport LNG utilized the SoundPLAN noise model in order to calculate expected operational noise levels at the nearby NSAs. The model incorporated area topography, spreading of sound waves with distance, and atmospheric absorption using the ISO 9613-2 standard. The analysis included downwind conditions for all receiver points. The proposed elevation changes at both sites were also incorporated into the analysis. Ground cover was modeled as acoustically reflective for waterbodies and paved surfaces, and acoustically absorptive for most remaining areas. Freeport LNG provided estimates of noise emissions data for the major facility sources at each Project site, and the number of each piece of equipment anticipated. Noise mitigation features were also included in the analysis of each site.

Liquefaction Plant

The Liquefaction Plant would contain many significant noise generating sources, including multiple compressors, combustion turbines, coolers, piping and pumps. A total of three liquefaction trains would be operational. The noise modeling analysis for Liquefaction Plant operational noise included several iterations with noise mitigation added to reduce noise levels at the NSAs. Freeport LNG's analysis revealed that even with extensive noise mitigation, the 55 dBA L_{dn} limit could not be achieved at the nearest NSAs along Cortez Street. Freeport LNG subsequently purchased all of the NSAs along Cortez Street.

The calculated Liquefaction Plant operational noise levels at the remaining NSA locations with mitigation measures included, existing ambient levels, and projected increases in future noise, are provided in table 4.11.2-6.

Table 4.11.2-6

Liquefaction Plant Calculated Operational Noise Levels Summary – All Three Trains in Operation

Entity	Location	Existing Measured L_{dn} (dBA)	Calculated Project L_{dn} Level (dBA)	Cumulative Future Noise Level (L_{dn}) a/ (dBA)	Increase Over Existing (dBA)
Liquefaction Plant	Site 6	54.1	54.8	57.5	3.4
	Site 7	53.5	51.9	53.5	2.3

a/ L_{dn} of station plus ambient noise.

The noise modeling analysis included significant noise mitigation measures in order to achieve compliance with our 55 dBA L_{dn} noise level limit at any NSAs. Freeport LNG indicated that these measures were included in their noise analysis to achieve the noise levels presented. These mitigation measures included some or all of the following measures:

- acoustical enclosures;
- pipe lagging;
- silencers; and
- equipment specific noise limits.

The results of Freeport LNG's analysis reveals that the Liquefaction Plant, with noise mitigation measures incorporated, would achieve compliance with our 55 dBA L_{dn} noise limit at all remaining NSA locations. Increases in noise over existing conditions would range from about 2-3 dBA. Increases in noise of 3 dBA or less are not considered to be significant.

Cooldown Flaring

A multiple tip ground flare system would be installed at the Liquefaction Plant site. The flare system would have a radiation barrier surrounding all four sides of the system. Flaring operations would include planned and emergency flaring. Planned flaring (cooldown flaring) would be associated with plant start-up, and during maintenance, which would only happen once every few years. Freeport LNG states that cooldown flaring would only last 8-10 hours during either plant start-up or maintenance. Emergency flaring may never occur.

Freeport LNG conducted a noise modeling analysis to determine noise levels that would occur with cooldown flaring and normal plant operation. The flaring modeling analysis utilized the same methodology as for the above discussed operational noise modeling. Provided in table 4.11.2-7 are the calculated noise levels anticipated during cooldown flaring at the nearest NSA locations.

Table 4.11.2-7

Liquefaction Plant Calculated Cooldown Flaring Noise Levels Summary

Entity	Location	Calculated Cooldown Flaring Plus Normal Plant Operation L_{eq} Level (dBA)
Liquefaction Plant	Site 6	53.8
	Site 7	61.9

Freeport LNG provided the above as calculated L_{eq} noise levels, not L_{dn} levels, because cooldown flaring would not be a continuous or 24-hour noise source. The above calculated levels would be significant if they were to occur continuously over longer periods of time, be significant, as they would be well above our 55 dBA L_{dn} limit (6.4 dBA must be added to an L_{eq} level in order to arrive at an L_{dn} level). However, because cooldown flaring would only occur once every few years, and the duration was stated by Freeport LNG as being limited to 8 to 10 hours, we do not anticipate significant noise impacts associated with cooldown flaring.

Much higher noise levels would be associated with emergency flaring, although this would be an emergency event only, and may never occur.

Pretreatment Plant

The modeling analysis for Pretreatment Plant operational noise included several iterations with noise mitigation added to reduce noise levels at the NSAs. The calculated Pretreatment Plant operational noise levels, existing ambient levels, and projected increases in future noise, are provided in table 4.11.2-8.

Table 4.11.2-8

Pretreatment Plant Calculated Operational Noise Levels Summary

Entity	Location	Existing Measured L_{dn} (dBA)	Calculated Project L_{dn} Level (dBA)	Cumulative Future Noise Level (L_{dn}) a/ (dBA)	Increase Over Existing (dBA)
Pretreatment Plant	Site 3	51.5	54.2	56.1	4.6

a/ L_{dn} of station plus ambient noise.

The noise modeling analysis included specific noise mitigation measures in order to achieve compliance with our 55 dBA L_{dn} noise level limit at any NSAs. These measures were included in the noise analysis to achieve the noise levels presented. Mitigation measures included some or all of the following measures:

- Acoustical enclosures;
- Pipe lagging;
- Silencers; and
- Equipment specific noise limits.

The above analysis indicates that a noise level of less than 55 dBA as an L_{dn} would be achieved at the nearest NSA. A 4.6 dBA increase over existing ambient conditions is projected.

The Liquefaction Project is required to operate in compliance with our noise criteria and minimize noise impacts. Because of the complex and disparate operations of the Liquefaction Plant and Pretreatment Plant, we have developed separate conditions to ensure that noise impacts from these facilities would not result in significant adverse noise impacts on local residents. Therefore, for the Pretreatment Plant**, we recommend that:**

> **Freeport LNG file a full load noise survey for the Pretreatment Plant <u>no later than 60 days</u> after placing the plant into service. If a full load condition noise survey is not possible, Freeport LNG should file an interim survey at the maximum possible operation within 60 days of placing the Pretreatment Plant into service and file the full load survey <u>within 6 months</u>. If the noise attributable to the operation of all the equipment of the Pretreatment Plant at full operation exceeds 55 dBA L_{dn} at any nearby NSAs, Freeport LNG should install additional noise controls to meet the level <u>within 1 year</u> of the in-service date. Freeport should confirm compliance with this requirement by filing a second full power noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

The Liquefaction Plant would have a phased in-service, thus to ensure that the noise would not significantly impact local residents during all phases of operation, **we recommend that:**

> **Freeport LNG should file, a full load survey for the Liquefaction Plant, with the Secretary <u>no later than 60 days</u> after each of the first two liquefaction trains are placed into service at the Liquefaction Plant. If the noise attributable to the operation of the equipment at the Liquefaction Plant exceeds 55 dBA L_{dn} at any nearby NSA, Freeport should reduce operation of the Liquefaction Plant or install noise mitigation to reduce noise levels at the nearest NSAs. Freeport LNG should confirm compliance with this requirement by filing a second full power noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

> **Freeport LNG should file, a full load noise survey for the Liquefaction Plant <u>no later than 60 days</u> after placing the plant into service. If a full load noise survey is not possible, Freeport should file an interim survey at the maximum possible operation within 60 days of placing the Liquefaction Plant into service and file the full operational surveys <u>within 6 months</u>. If the noise attributable to the operation of all the equipment of the Liquefaction Plant at full operation exceeds 55 dBA L_{dn} at any nearby NSAs, Freeport LNG should install additional noise controls to meet the level <u>within 6 months</u> of the in-service date. Freeport should confirm compliance with this requirement by filing a second full power noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

LNG Vessel Transit and Loading Noise and Vibration

Freeport LNG conducted an analysis to determine expected noise levels associated with LNG vessel docking and loading, LNG transfer and vessel hoteling, and the potential for noise induced vibration from these activities. Their analysis consisted of conducting noise level measurements of an actual LNG vessel in operation in Freeport Harbor Channel and extrapolating the measured levels to nearby NSA locations.

Four NSA locations in the vicinity of the LNG berthing dock and LNG transit route were identified for analysis. Ambient noise level measurements were conducted at three nearby locations the day before the arrival of an LNG vessel.

LNG vessel docking includes navigation into the harbor and vessel backing into the dock. LNG vessels are maneuvered within the channel by tugboats, which are the main noise generators. Noises from the LNG vessel are not as significant as those from the tug boats during docking. Provided in table 4.11.2-9 are the NSA locations, the measured ambient noise levels, the calculated LNG vessel docking noise levels, and the projected increases over ambient conditions.

The data in table 4.11.2-9 reveal that ambient noise level increases would range from 2.2 dBA to 6.4 dBA during vessel backing, which is the loudest activity but may occur up to 400 times per year. Vessel backing is a short-term event, and increases in noise during this activity would be less than 10 dBA. Accordingly, no significant adverse noise impacts are anticipated due to vessel transit maneuvering and docking within the harbor.

Table 4.11.2-9

LNG Vessel Transit Noise Levels Within Harbor

Location	Existing Measured L_{eq} (dBA)	Calculated LNG Vessel Docking Noise L_{eq} (dBA) a/	Cumulative Future Noise Level (L_{eq}) b/ (dBA)	Increase Over Existing (dBA)
NSA 1	47.7	52.0	53.4	5.7
NSA 2	47.7	49.0	51.4	3.7
NSA 3	47.7	45.9	49.9	2.2
NSA 4	48.7 c/	54.0	55.1	6.4

a/ Vessel backing into the dock is the loudest activity, and is the noise level presented here
b/ Measured ambient level plus LNG vessel noise
c/ Ambient noise level for NSA 4 measured during an October 4, 2012 noise survey.

An additional analysis was conducted to determine noise levels that would occur during LNG transfer activities and vessel hoteling. The analysis included two vessels transferring LNG simultaneously. Provided in table 4.11.2-10 are the results of this analysis.

Table 4.11.2-10

LNG Transfer Noise Levels – Two Vessels

Location	Existing Measured L_{eq} (dBA)	Calculated LNG Transfer Noise L_{eq} (dBA) a/	Cumulative Future Noise Level (L_{eq}) b/ (dBA)	Increase Over Existing (dBA)
NSA 1	47.7	39.1	48.3	0.6
NSA 2	47.7	36.4	48.0	0.3
NSA 3	47.7	34.5	47.9	0.2
NSA 4	48.7	33.3	48.8	0.1

a/ Two vessels transferring LNG.
b/ Measured ambient level plus LNG transfer noise

As provided in table 4.11.2-10 noise levels associated with LNG transfer at two vessels simultaneously would generate low noise levels, and result in minimal increases over ambient conditions. The L_{eq} noise levels presented, even when converted to L_{dn} levels, would be below our 55 dBA noise level limit. No significant noise impacts are therefore anticipated to occur with LNG transfer activities.

LNG Vessel Noise Induced Vibration

Freeport LNG conducted an analysis to determine the potential for noise induced vibration during LNG vessel transit and LNG transfer at the four nearby NSA locations. Their analysis included evaluating the calculated noise levels at each NSA in the lower octave band center frequencies (31.5 Hertz, 63 Hertz and 125 Hertz) associated with LNG vessel transit and LNG transfer and comparing these levels against the American National Standards Institute (ANSI) S12.2 standard for determining the potential for noise induced vibration. The ANSI S12.2 standard includes two vibration thresholds: Moderately Perceptible Vibration and Clearly Perceptible Vibration.

Freeport LNG's analysis revealed that during LNG vessel backing (a short term event) the Moderately Perceptible Vibration threshold would be exceeded at the NSA 4 location in the Town of Quintana, although noise levels would be below the Clearly Perceptible Vibration Threshold. Noise levels would be below both threshold levels at the remaining locations. In addition, the Commission has received complaints from residents of Town of Quintana through our Enforcement hotline regarding vibration and noise impacts from ship traffic from the existing Quintana Island terminal.

Noise levels during LNG transfer, which is a much longer activity, would be well below both thresholds at all NSA locations, and no noise induced vibration would be expected during LNG transfer.

Noise induced vibration may be experienced during the LNG vessel backing at the NSA 4 area. Under previous authorizations up to 400 ship- calls may occur at the Quintana Island terminal, and up to 200 at the dock nearest to the NSAs. We require that the compressor stations do not cause increased vibration at NSAs. Because of the potential for excess noise and vibration during LNG vessel transit, and the pre-existing complaints over vibration, **we are recommending that**:

Prior to construction, Freeport LNG should file with the Secretary for review and approval by the Director of OEP, a Ship Noise & Vibration Monitoring Plan that details how Freeport LNG would monitor noise and vibration from LNG ship movement and loading operations to ensure that noise would not exceed 55 dBA L_{dn}, and would not cause vibration in excess of the Clearly Perceptible Vibration Threshold under ANSI S12.2-2008.

In conclusion, Freeport LNG has proposed mitigation to minimize its operational noise and vibration levels, and our recommendations above would ensure that the 55 dBA L_{dn} noise standard is met for the Pretreatment and Liquefaction Plants. Therefore, we expect noise impacts associated with operation of the Liquefaction Project to be minor, with minor to moderate vibrational impacts at one NSA due to LNG vessel movement.

Phase II Modification Project

Construction

Freeport LNG relied on the construction noise assessment for the original LNG facility to estimate potential construction related noise levels for the Phase II Modification Project. Construction activities associated with the Phase II Modification Project would generate short-term increases in sound levels, but would occur over an approximate 36 month period, predominately during the day.

The construction equipment utilized would differ during each phase of construction, but in general, heavy equipment (bulldozers, loaders, dump trucks) would be used during the excavation phase. Noise is generated during construction primarily from diesel engines that power the equipment. Exhaust noise is usually the predominant source of diesel engine noise. Pile drivers would also be used during preparation of the dock foundation.

Pile driving activity would generate the highest construction related sound levels, and has the potential to generate sound levels in excess of existing ambient conditions. In addition, dredging of the dock would also result in increased ambient noise levels. Freeport has indicated that pile driving activities would only be done during daytime hours and dredging would be a 24-hour activity. Both construction activities has the potential for significant adverse noise impacts, thus we have recommended that Freeport LNG prepare a Construction Noise Mitigation Plan to ensure that noise impacts are minimized.

Operation

No new operational noise generating sources would be associated with the Phase II Modification Project that were not already assessed and approved under the Phase II Project.

In conclusion, the above recommendation would minimize construction noise and no new operational noise levels are expected associated with the Phase II Project. Therefore noise impacts from the Phase II Project are expected to be minor.

4.12 CUMULATIVE IMPACTS

4.12.1 Introduction

Cumulative impacts may result when the environmental effects associated with a proposed project are added to temporary (construction-related) or permanent (operations-related) impacts associated with past, present, or reasonably foreseeable projects. The need for a cumulative impact analysis, required by NEPA Part1508.7, stems from the fact that although impacts might be insignificant if they were to occur in isolation on an individual project basis, the additive effects of multiple projects can be significant.

Because of the isolation of the Quintana Island with respect to the mainland, the residents of the town would be subjected to numerous adverse impacts from construction and operation of the Projects for up to 4.5 years. The residents of the island would have: significant noise impacts from pile driving noise for up to 3 years, dredging noise impacts for up to 120 days, general construction noise, large increases in barge traffic, large increases in construction vehicle traffic including numerous bus trips to deliver workers, large increases in tandem truck deliveries of materials and supplies, higher traffic flows on the mainland roads, and increased dust and air pollutants during construction. During construction of the original Quintana Island terminal, Freeport LNG documented several instances of complaints from the public regarding noise and vibration. Although individual members of the community may be affected to a greater or lesser extent, these aggregate impacts would result in significant and unavoidable impact on the residents of the Town of Quintana.

This cumulative impact analysis considers the effects of the proposed Projects (*i.e.*, including the Liquefaction Project, Phase II Project,[30] and the Phase II Modification Project), and other existing or proposed Project developments that:

- affect a resource or resources potentially affected by the proposed Project for which the cumulative impacts analysis is being undertaken;
- cause this impact within all, or part of, the study area; and
- cause this impact within all, or part of, the time span associated with the potential impact from the proposed Project.

Brazoria County was selected as the geographic study area of investigation for the cumulative impacts analysis as the predominance of environmental impacts occur there. Based on the analysis of impacts addressed in this EIS, we identified a subset of resources that could incur additional, or cumulative, impacts as a consequence of the construction and operation of the Projects (see table 4.12.1-1).

[30] Previously authorized proposed Phase II work was also considered in this analysis to provide a full and complete understanding of cumulative impacts in the area. In this Section, the proposed previously authorized Phase II work and the Phase II Modification Project are referred to together as the “Phase II developments.”

Table 4.12.1-1

Freeport LNG Liquefaction Project
Factors Selected for Cumulative Impacts Analysis

Environmental		Socioeconomic
Wetlands	Air Quality	Land Use
Waterbodies	Noise Levels	Visual Impacts
Essential Fish Habitat (EFH)	Water Quality	Traffic / Roads
Listed Species		Housing
		Public Services
		Water Supply

4.12.2 Regional and Economic Context

Brazoria County's economy is built around a diverse array of employment sectors, primarily the petrochemical industry, deep water port (Port Freeport), fishing, tourism, agribusiness, education, medical, and retail. All eight of the petrochemical companies listed as major employers in the county have manufacturing plants located in southern Brazoria County. The eight companies and their locations are Dow (Freeport), ConocoPhillips (Sweeny), BASF Corporation (Freeport), Ascend Performance Materials (Chocolate Bayou), INEOS Olefins & Polymers (Chocolate Bayou), Chevron Phillips Chemical Company (Sweeny), Shintech (Freeport), and SI Group (Freeport) (The Economic Development Alliance for Brazoria County [EDC-BC], 2012).

The Brazoria County economy added about 500 workers a month in the preceding 12 months, many of these workers being attributable directly or indirectly to industrial sector production growth resulting from the low price of shale gas used for fuel and as a chemical feedstock (The Facts, 2012). Net job growth continued in the first quarter of 2013, mainly in the construction sector.

Most of the recent and proposed industrial development is concentrated in southern Brazoria County, specifically Freeport, Sweeny, and Chocolate Bayou. About $20 billion of new and expanded industrial facilities, including those proposed by Freeport LNG, are under construction or would be developed in the next several years (The Facts, 11-10-13). Collectively, these developments would require approximately 15,950 new construction workers and 885 new operational jobs. Many of the construction worker requirements would overlap. In addition, Port Freeport is undergoing a comprehensive expansion program which, along with the widening and deepening of the FHC, would allow larger vessels to utilize the port and would increase cargo handling capacity.

4.12.3 Present and Reasonably Foreseeable Projects

Major current and proposed developments in Brazoria County are listed in table 4.12.3-1. Figures 4.12.3-1 and 4.12.3-2 show the general locations of the Projects within Brazoria County and the Freeport area, respectively.

Table 4.12.3-1

Freeport LNG Liquefaction Project
Present and Reasonably Foreseeable Actions within the Cumulative Impacts Study Area

Company/Sponsor	New Project	Regional Location	Site	Construction Timeframe	Present or Reasonably Foreseeable a/
Industrial Developments					
BASF	Ammonium Sulfate Crystallizer	Freeport	Existing Plant Site	2012	Present
Chevron Phillips	Two Plastic Resin Producing Facilities	Old Ocean	Existing Plant Site	2014 - 2017	Reasonably Foreseeable
Cyanco	Sodium Cyanide Plant	Chocolate Bayou	Existing Plant Site	2012	Present
Dow	Chlor-alkali Plant	Freeport	Existing Plant Site	2013	Present
Dow	Propane Dehydrogenation Plant	Freeport	Existing Plant Site	2011 - 2015	Present
Dow	Ethylene Plant	Freeport	Existing Plant Site	2013 - 2017	Reasonably Foreseeable
Dow	AgroSciences Plant	Freeport	Existing Plant Site	2015 (in-service)	Reasonably Foreseeable
INEOS	Cracking Furnace	Chocolate Bayou	Existing Plant Site	2012 - 2013	Present
Shin-Etsu	Silicon Plant	Freeport	Existing Plant Site	2013 - 2014	Reasonably Foreseeable
Port & Harbor Channel Developments					
Port Freeport & Local	FHC Widening	Freeport	Offshore	2013 - 2018	Reasonably Foreseeable
Port Freeport & USACE	FHC Deepening	Freeport	Offshore & Onshore	2015 - 2021	Reasonably Foreseeable
Port Freeport	Velasco Terminal Development	Freeport	Existing Port Site	2008 - 2016	Present
Pipeline Developments					
Dow	30-inch Hydrogen Pipeline (2.3 miles)	Freeport	Between Existing Plant Sites	2012	Present
Enterprise	24-inch NGL Pipeline (2 miles in Brazoria County)	Alvin	Pipeline Right-of-way	2012	Present
Seaway	30-inch Crude Oil Pipeline - Flow Reversal in Existing Pipeline (43 miles in Brazoria County)	Damon southwards to Jones Creek	Pipeline Right-of-way	2012	Present
Seaway	30-inch Crude Oil Loop (43 miles in Brazoria County)	Damon southwards to Jones Creek	Pipeline Right-of-Way	2013 - 2014	Reasonably Foreseeable

Table 4.12.3-1

Freeport LNG Liquefaction Project
Present and Reasonably Foreseeable Actions within the Cumulative Impacts Study Area

Company/Sponsor	New Project	Regional Location	Site	Construction Timeframe	Present or Reasonably Foreseeable a/
Kinder Morgan / Phillips 66	27-mile, 12-inch Crude Oil Lateral Pipeline	Sweeny	Pipeline Right-of-way	2012 - 2014	Reasonably Foreseeable
Seaway	Jones Creek to Echo Crude Oil Extension Pipeline	Jones Creek northeastwards	Pipeline Right-of-way	2012 -2014 (assumed)	Reasonably Foreseeable
Oil & Gas Field Developments					
Most Active Companies: Denbury, Maverick, Hilcorp and Chalker – account for 59 of 74 well applications	74 New, Recompleted, or Re-entered wells	Clustered: Pearland/Alvin Damon Sweeny Danbury	Appear to be Established Oil Fields with Existing Infrastructure	2012	Present (assumed)
Land & Air Transportation Developments					
State and County Roadway Improvement Projects	SH 288 overpasses in Lake Jackson and Clute	Lake Jackson and Clute	Existing Road Corridor	2010 - 2012	Present
	SH 288 Tollway	Northern Brazoria County near Pearland	Existing SH 288 Median between SH 59 and Beltway 8	2016+	Reasonably Foreseeable
	FM 1495 / SH 36 grade separation	Freeport	Existing Intersection at Port Freeport	2014	Reasonably Foreseeable
	Improvements to SH 35, SH 36, SH 288, SH 332, CR 220	Various	Existing Road Corridors	2012 - 2013	Present
Brazoria County	Texas Gulf Coast Regional Air Expansion	5 miles south of Angleton	Existing Airport Site	2012 - 2013	Present
Commercial Developments					
Kelsey-Seybold	Office Building	Pearland	Existing Commercial Zone	2012 - 2013	Present
Ref-Chem	Office Building	Pearland	Existing Commercial Zone	2012 - 2013	Present
Angleton/Danbury Medical Center	Medical Pavilion	Angleton	Existing Hospital Site	2012+	Reasonably Foreseeable

Table 4.12.3-1

Freeport LNG Liquefaction Project
Present and Reasonably Foreseeable Actions within the Cumulative Impacts Study Area

Company/Sponsor	New Project	Regional Location	Site	Construction Timeframe	Present or Reasonably Foreseeable a/
Residential Developments					
Aplin Homes	108 New Houses – Northwoods Estates	Lake Jackson	Residential Subdivision	2013+	Reasonably Foreseeable
Aplin Homes	250 New Houses - Oyster Bend Subdivision	Lake Jackson	Residential Subdivision	2013+	Reasonably Foreseeable
Cresco	Alden Lakes Master Planned Community	Lake Jackson	Residential Subdivision	2013+	Reasonably Foreseeable
Miscellaneous Developments					
City of Lake Jackson	Downtown Revitalization	Lake Jackson	Downtown Area	2011 - 2012	Present
City of Surfside Beach	Walking Trail	Surfside	Near Shoreline	2012 - 2014	Reasonably Foreseeable
General Land Office	Beach Re-nourishment	Surfside	Shoreline	2012	Present

a/ Projects are identified as "present" if construction was completed in 2012/2013 or are scheduled for completion in 2014. "Reasonably foreseeable" projects are those for which development plans have been announced and construction is scheduled for completion after 2014. Future construction dates are estimates only.

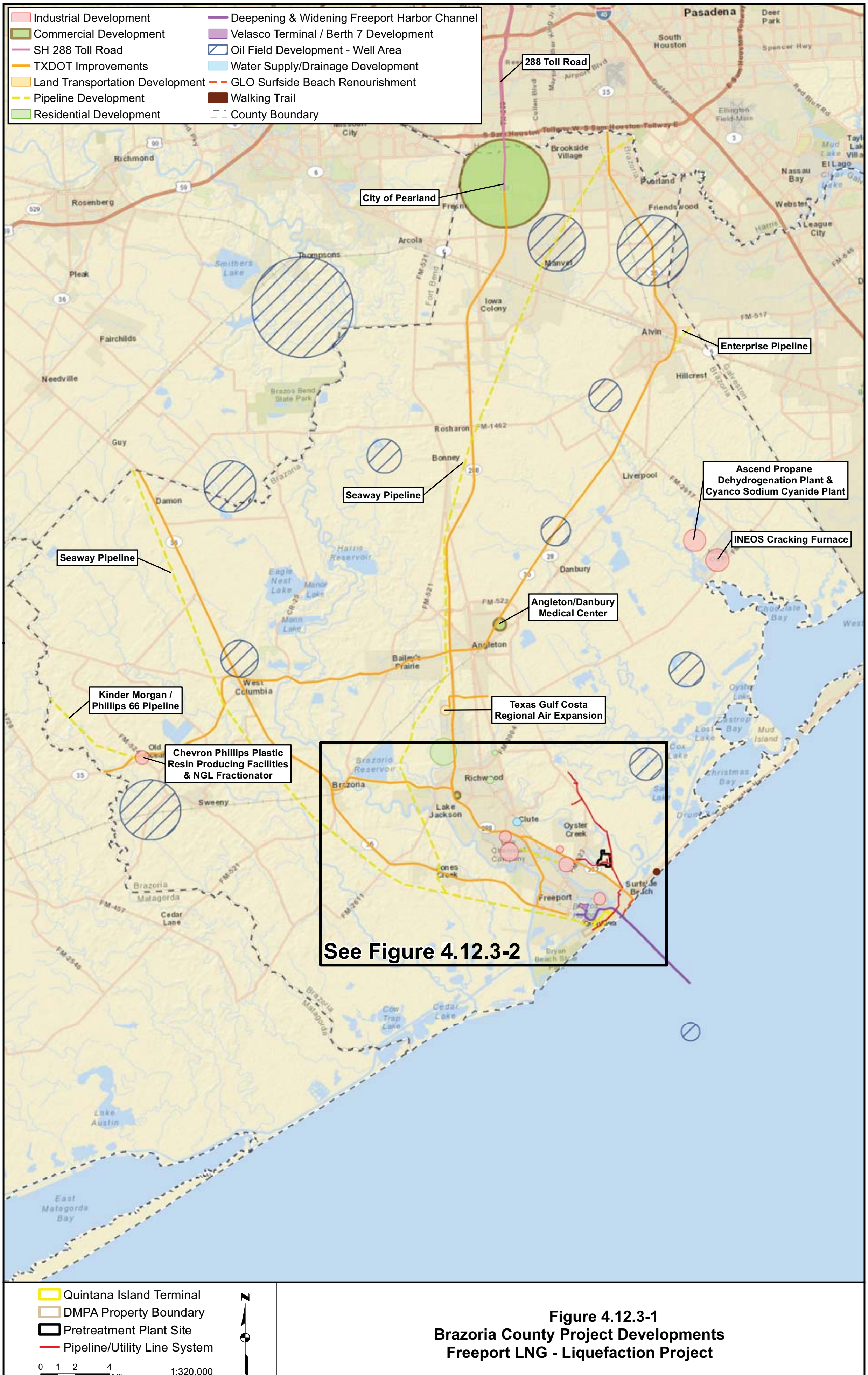

Figure 4.12.3-1
Brazoria County Project Developments
Freeport LNG - Liquefaction Project

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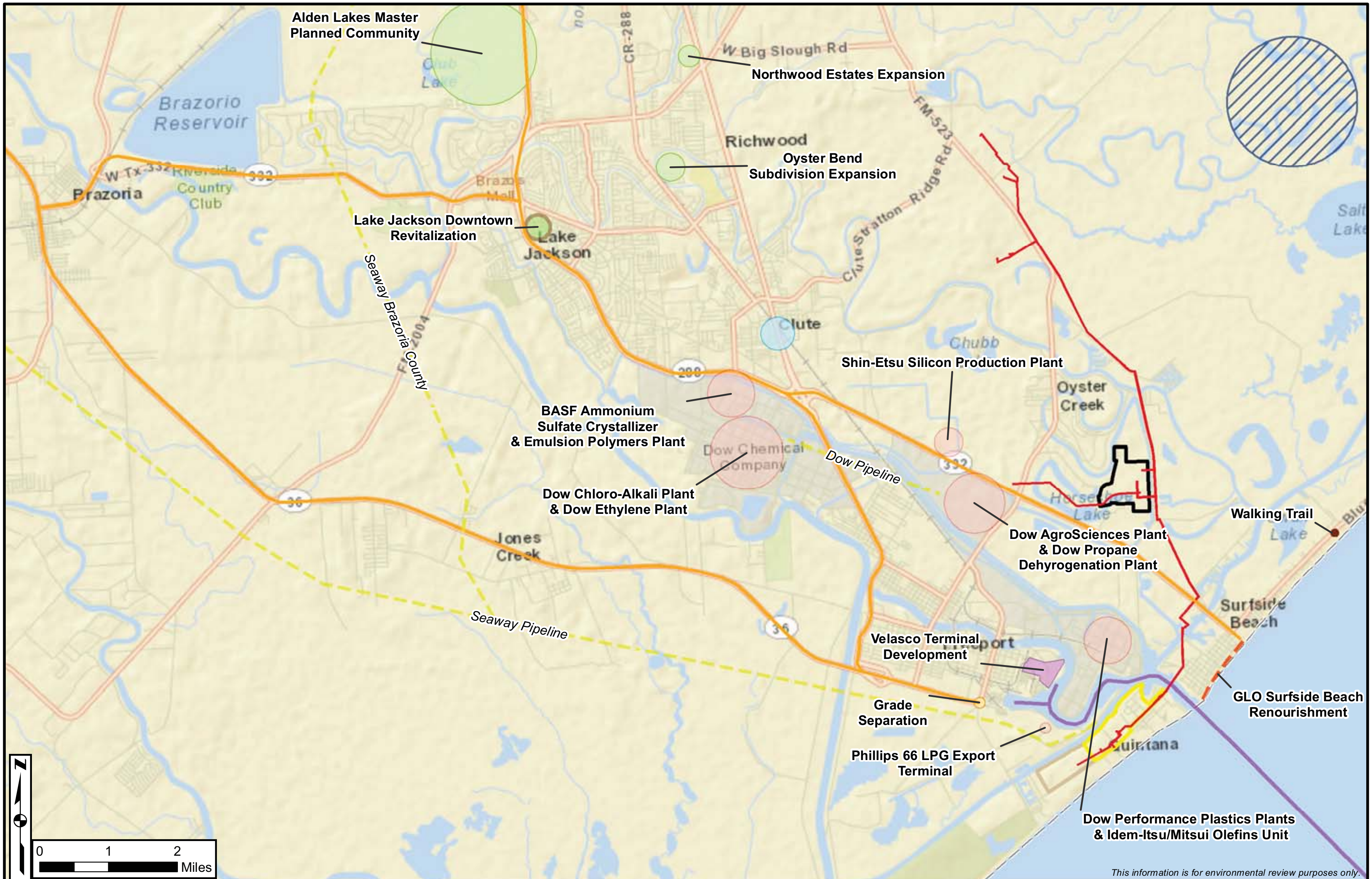

Quintana Island Terminal
DMPA Property Boundary
Pretreatment Plant Site
Pipeline Utility System
Industrial Development
Commercial Development
Deepening & Widening Freeport Harbor Channel
Velasco Terminal / Berth 7 Development
Pipeline Development
Oil Field Development - Well Area
Residential Development
County Boundary
TXDOT Improvement
Land Transportation Development
Water Supply/Drainage Development
GLO Surfside Beach Renourishment
Walking Trail

1 in = 2 miles

Figure 4.12.3-2
Freeport Area Project Developments
Freeport LNG - Liquefaction Project

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4.12.3.1 Industrial Developments

In addition to Freeport LNG's proposed Projects (Liquefaction Project, Phase II Project and Phase II Modification Project), which involve construction at and adjacent to the existing Quintana Island terminal (and at additional locations in the case of the Liquefaction Project), various industrial developments have recently been completed, are currently under construction, or are proposed for construction in Brazoria County over the next several years. Many of the developments are in the Freeport area and represent significant expansions of or upgrades to existing facilities. These projects share the greatest similarities with Freeport LNG's Projects and involve similar potential impacts.

Airgas Carbonic – Carbon Dioxide Manufacturing Plant

Airgas Carbonic is planning to build a $9.9 million CO_2 manufacturing plant just north of Alvin, approximately 40 miles from the Quintana Island terminal. The plant will ship 450 tons of liquid CO_2 daily. Construction, requiring 10 workers, was scheduled to begin in June 2013. The plant will employ 14 operational personnel (The Facts, 04-25-13).

Artland Louisiana and Performance Contractors – Pipe Fabrication Facility

In 2013, Artland Louisiana and Performance Contractors announced plans to build a pipe Fabrication Facility on an 18-acre site in Rosharon, approximately 27 miles from the Quintana Island terminal. The facility was scheduled for completion between May and December, 2013, with operational start-up in January 2014. The project would require 60 construction, and 45 operational workers (The Facts, 04-25-13).

Ascend Performance Materials – Propane Dehydrogenation Plant

Ascend Performance Materials is proposing to construct a $1.2 billion propane dehydrogenation plant on a 30-acre site at the company's existing Chocolate Bayou industrial facility, approximately 22 miles from the Quintana Island terminal. The project will require 1,500 construction, and 100 permanent workers. Construction is scheduled to begin in October 2014 and will be completed in 2015 (The Facts, 03-08-13).

BASF - Ammonium Sulfate Crystallizer

BASF, in association with American Plant Food Corporation, is constructing a new $13 million ammonium sulfate crystallizer at BASF's existing Copper Road facility site in Freeport, approximately seven miles from the Quintana Island terminal. Ammonium sulfate is a byproduct of caprolactum production and would be sold as plant fertilizer. Construction was originally scheduled to occur between April and October in 2012; however, construction was initiated in mid-2013 and is expected to be completed by mid-2015. The project will require 20 new construction workers but no new operational jobs (The Facts, 04-25-12; PRNewswire, 2013).

BASF – Emulsion Polymers Plant

BASF is constructing a new $90 million emulsion polymers plant at the company's existing Copper Road facility site in Freeport, approximately 7 miles from the Quintana Island terminal. The new plant will use acrylic acid produced elsewhere on site to make chemicals used in paints, pigments, and coatings for paper. Groundbreaking took place in February 2013 and the plant is scheduled for start-up in mid-2014. The project will require approximately 200 new construction, 20 new operational workers (BIC Magazine, February 2013; The Facts, 02-09-13).

Chevron Phillips Chemical Company – Resin Production Facilities

Chevron Phillips Chemical Company is proposing two plastic resin production facilities at its existing Old Ocean facility site in Sweeny, approximately 27 miles from the Quintana Island terminal. Each facility would be capable of producing up to 500,000 tons of plastic resin per year. The $1 billion project would be constructed between 2014 and 2017; it would require 1,000 new construction workers and 92 new operational workers (The Facts, 05-01-12).

Cyanco International / Ascend Performance Materials – Sodium Cyanide Plant

Cyanco International is constructing a new $47 million sodium cyanide plant at Ascend Performance Materials' existing Chocolate Bayou facility site, approximately 22 miles from the Quintana Island terminal. The 55,000 ton plant will manufacture cyanide briquettes, which are used in the gold mining process. Construction was completed and in September 2012 Cyanco International began production at the facility. (The Facts, 07-16-12; Brazoria County Community Plan 2012-2013; BIC Magazine, 2014).

Dow-Mitsui Chlor-Alkali LLC – Chlorine Plant

Dow-Mitsui Chlor-Alkali LLC is constructing a new $411 million chlorine plant at Dow's existing Plant B facility site in Freeport, approximately five miles from the Quintana Island terminal. The plant will provide chlorine and caustic soda feedstock for Dow products. The new plant was scheduled for completion in mid-2013 (current status undocumented) requiring 1,000 new construction workers and 50 new operational workers (Dow "Impact", Spring/Summer 2012; the Facts, 04-22-12).

Dow Chemical Company - Propane Dehydogenation Plant

Dow is constructing a propane dehydrogenation (propylene) plant at the company's existing Oyster Creek Plant in Freeport, approximately four miles from the Quintana Island terminal. The new plant would provide raw materials for derivatives such as epoxy and polyurethanes. Construction started in January 2014 and is scheduled for completion in 2015. The Project will require 1,300 new construction workers and 120 new operation workers (Dow "Impact", Spring/Summer 2012; The Facts, 03-08-12; Dow Press Release, 03-18-13).

Dow Chemical Company - Ethylene Plant

Dow is proposing a $1.7 billion, 1.5 million tonnes per year ethylene plant at the company's existing Plant B facility site in Freeport, approximately five miles from the Quintana Island terminal. The new plant would produce ethylene from ethane and other NGLs. Construction is scheduled from 2014 through 2017 and the project would require 2,000 new construction, and 150 new operational workers (Dow "Impact", Spring/Summer 2012; The Facts, 04-19-12; The Facts, 01-02-13; ICIS, 2013).

Dow AgroSciences - AgroSciences Plant

In April 2012, Dow AgroSciences announced the planned construction of a new facility at its existing Oyster Creek Plant, approximately four miles from the Quintana Island terminal. The new plant is designed to produce 2,4-D choline, a key component of certain herbicides produced by the company. Construction start-up was scheduled for spring 2013 and the project will be completed by the summer of 2014. Employment projections include 150 construction workers and 10 operational workers (Brazoria County, 2012; The Facts, 01-02-13; Dow Press Release, 04-19-13).

Dow Chemical Company – Performance Plastics Plant

Dow is proposing two performance plastics plants at the company's existing Plant A facility site in Freeport, approximately one mile from the Quintana Island terminal. The new plants, referred to as "Alpha" and "Beta" will produce materials for products in various market segments, *e.g.*, packaging, hygiene and medical, and electrical and telecommunications. Construction of both units is scheduled to begin in 2015; the Alpha unit will be completed in 2016 and the Beta unit will be completed in 2017. The project will require 2,000 new construction, and 100 new operational workers (Dow "Impact", Spring/Summer 2012; The Facts, 04-19-12; Houston Business Journal, 2013a; The Facts, 02-27-13).

Idem-Itsu Kosan. Co. & Mitsui Co. – Linear Alpha Olefins Unit

Idem-Itsu Kosan Co. and Mitsui Co. are planning to lease 46 acres at Dow's Plant A Freeport site to build and operate a $496 million linear alpha olefins unit, which will produce components needed for plastic products. Construction was scheduled to start in January 2014 and will last until March 2016. The project will require 2,200 construction, and 50 operational workers. The facility will require 103 tons of water per hour to operate (The Facts, 08-28-13).

INEOS Olefins & Polymers - Cracking Furnace

INEOS Olefins & Polymers is constructing a new $1.7 billion cracking furnace for NGLs and other liquids at its existing Chocolate Bayou facility site, approximately 22 miles from the Quintana Island terminal. The furnace will add 465 million pounds per year of olefins production capacity and was scheduled for completion in November 2013 (current status undocumented) (ICIS News, 05-31-12).

Phillips 66 – LPG Export Terminal

Phillips 66 is planning a $2 billion liquefied propane gas (LPG) export terminal at its existing terminal and storage facility on the north side of the ICW, opposite Freeport LNG's Quintana Island terminal site. The new facility will have an export potential of 4.4 million barrels of LPG export per month. The LPG will be supplied from Phillips 66's Sweeny complex in Old Ocean. Construction is scheduled to begin in mid-2016 (The Facts, 11-10-13; Houston Business Journal, 2013b).

Phillips 66 – NGL Fractionator

In April 2013, Phillips 66 announced plans to construct a 100,000 barrel per day NGL fractionator at its existing Sweeny facility. The project will require 200 to 300 construction, and 25 full-time workers. Construction is scheduled to begin in the first half of 2014 and operations will begin in late 2015 (The Facts, 04-03-13; Phillips 66 Press Release, 12-06-13).

Sabar Power Services – Electrical Equipment Fabrication Facility

In 2013, Sabar Power Services constructed and opened a new electrical equipment fabrication facility on an 8-acre site in Rosharon, approximately 36 miles from the Quintana Island terminal. The $2.5 million facility focuses on electrical system and substation testing, maintenance, commissioning, construction and emergency repair. The facility requires 40 new workers. (Brazoria County, 2012).

Shin-Etsu Silicones of America – Silicon Production Plant

Shin-Etsu Silicones of America (Shin-Etsu) is proposing a $65 million silicon production plant at its existing Freeport facility site, approximately three miles from the Quintana Island terminal. The new plant would produce silicones for paint and sealant additives, fiberglass shingles, and coatings for hydraulic fracturing. The project is scheduled for construction from early 2013 to mid-2014 and would require 80 new construction, and 15 new operational workers (The Facts, 04-11-12).

City of Sweeny – Industrial Park

The City of Sweeny is developing a 79-acre Industrial Park, designed for multiple industrial occupants. At present, Phillips 66 pipeline is planning to construct an office building, warehouse, and laydown area on 10 acres at the park. The new office building will house up to 20 employees, including 10 new full-time positions over the next decade. Apache Oil is also planning an office building and tank farm at the park (The Facts, 12-13-13).

Mitsubishi Heavy Industries Manufacturing Site

In late 2013/early 2014, Mitsubishi Heavy Industries Compressor Corporation broke ground on a new 26-acre manufacturing site in Pearland. The new facility will produce, service, and market industrial compressors and steam turbines. The project will require 100 new operational workers and the facility is scheduled for operational start-up in the fall of 2014 (Houston Business Journal, 01-13-14).

4.12.3.2 Port and Harbor Channel Developments

Port Freeport continues its efforts to deepen and widen its ship channel in anticipation of the opening of the expanded Panama Canal in 2014. A deeper and wider ship channel will allow the Port to accommodate the much larger container ships that in 2014 will be able to make passage through the expanded Panama Canal.

Port Freeport – Freeport Harbor Entrance Channel Widening

Port Freeport is proposing to widen the 45-foot-deep Freeport Harbor Entrance Channel from 400 feet to up to 600 feet for 6.1 miles, including 0.6 mile between the USCG Station and Surfside Jetty Park across from the Quintana Island terminal, and 5.5 miles off-shore in the Gulf. Financial assistance for the $35 million project is being provided wholly by local interests. Construction was scheduled to commence in early 2013 and would be completed over several years. The federal government would assume responsibility for channel maintenance when the project is complete. The project would accommodate the largest LNG tankers in service today and would allow two-way traffic for certain class vessels (Port Freeport, 2012a, b).

Port Freeport and USACE – Freeport Harbor Entrance Channel Deepening

Port Freeport and the USACE are proposing to deepen the Freeport Harbor Entrance Channel from 45 feet to between 50 feet and 57 feet depending on location. The channel section adjacent to the Quintana Island terminal would be deepened to 55 feet. Approximately 11.8 miles of dredging would be involved, including turning basins and channel sections inland from the Freeport Harbor Entrance Channel. The project would allow two-way traffic, night-time operations for larger vessels, and navigation that is currently restricted under certain weather and channel flow conditions. Larger crude and container carriers would have direct access to Port facilities instead of lightering. Overall, the project would improve the control and flow of maritime shipping and reduce transportation costs (Port Freeport, 2012a, b).

A feasibility study for the project was initiated by the USACE over a decade ago and was released by the USACE Civil Works Review Board on August 23, 2012 for review. The final EIS for the project was issued by the USACE on September 7, 2012 (USACE, 2012). The Chief of Engineers gave approval in January 2013 and the project was submitted for Congressional review. The $291 million project would be completed between 2015 and 2021.

Port Freeport – Velasco Terminal Development

Port Freeport is currently constructing a new 85-acre terminal ("Velasco Terminal") at its existing port facilities, consisting of two berths totaling 2,400 feet in length, a truck gate, on-dock rail, maintenance and repair facilities, marine buildings, and an administration building. The Velasco Terminal Project is recognized as the first major development project to be implemented under Port Freeport's Master Plan. It will allow separation of like cargoes and will provide better service and facilities for Port Freeport's customers. The overall $201 million project is scheduled for completion in 2016 and it will required an estimated 7,500 direct and indirect temporary and/or workers (Port Freeport, 2012a, b). One (Berth 7) of the two planned berths is currently operational (Port Freeport, 2013).

4.12.3.3 Pipeline Developments

Four significant pipeline projects are wholly or partly located in Brazoria County as described below.

Dow Chemical Company – Hydrogen Pipeline

In January 2012, Dow submitted a notice to begin construction one month later of a 2.3- mile-long, 30-inch-diameter hydrogen pipeline in Freeport between Plant B and the Oyster Creek Plant, about four miles from the Quintana Island terminal.

Enterprise Products Operating LLC – NGL Pipeline

In January 2011, Enterprise Products Operating LLC submitted a notice to begin construction in March 2012 of a 48.9-mile long, 20-inch-diameter NGL pipeline between Alvin and Mont Belvieu (Chambers County). The pipeline was scheduled to be placed in service during the fourth quarter of 2012. Approximately two miles of the pipeline route crosses the northern sector of Brazoria County, approximately 34 miles from the Quintana Island terminal.

Kinder Morgan, Inc. & Phillips 66 – Crude Oil & Condensate Pipeline

Kinder Morgan, Inc. and Phillips 66 are planning to construct a 27-mile-long, 12-inch- diameter pipeline to deliver crude oil/condensate from a mainline in neighboring Wharton County to the Phillips 66 refinery in Sweeny, approximately 27 miles from the Quintana Island terminal. Approximately nine miles of the new pipeline route crosses Brazoria County. Construction was scheduled to begin in spring 2013 and would be completed in first quarter 2014.

Enterprise Products Partners L.P. & Enbridge, Inc. – Seaway Crude Oil Pipeline System

Enterprise Products Partners L.P. (Enterprise) and Enbridge, Inc. (Enbridge), through a joint venture (Seaway Crude Pipeline Company LLC [Seaway]), reversed the flow of the existing 500-mile-long Seaway pipeline in May 2012, to deliver crude oil from the Cushing, Oklahoma hub to the Enterprise's existing terminal at Jones Creek, approximately six miles from the Quintana Island terminal. Seaway is also proposing construction of a new 500-mile-long, 30-inch-diameter loop pipeline alongside the existing line, to carry additional crude oil between the same origination and receipt points. Approximately 43 miles of the loop pipeline would cross Brazoria County. The total system capacity would be 850,000 barrels per day. The pipeline is scheduled to be in service by mid-2014. In addition, a 65-mile-long, 36-inch-diameter lateral pipeline would carry crude oil from the Jones Creek terminal to Enterprise's ECHO storage facility in southeast Houston.

4.12.3.4 Oil & Gas Field Developments

Review of the RRC database for oil/gas well applications (W-1s) submitted in 2012 and 2013 (RRC, 2012) indicates that most of the proposed drilling activity is led by a small group of companies and is concentrated in several existing production areas. The most active companies in terms of applications for new, recompleted, or reentered wells are Denbury Onshore LLC, Maverick Production Company, Inc., Hilcorp Energy Company, and LINC Gulf Coast Petroleum. Collectively these four companies account for 113 of the 171 applications reviewed for new, reentered, or recompleted wells.

Drilling activity is clustered around Pearland/Alvin, Damon, Sweeny, and Danbury; the closest of these areas of activity (Danbury) is located over 22 miles from the Quintana Island terminal. The closest non-clustered well for which an application was sought in 2012 is located over nine miles from the Quintana Island terminal. Based on review of aerial imagery, most or all drilling activity appears to be in known oil fields with existing pad and road infrastructure. This cumulative impacts analysis assumes that all well development would be undertaken between 2012 and 2014.

4.12.3.5 Land & Air Transportation Developments

The TxDOT's Detail Letting Schedule for 2013 (TxDOT, 2013) lists 29 road construction projects in Brazoria County, including improvements to SH 35, SH 36, SH 288, SH 332, and CR 220, many of which are in southern Brazoria County. Of note is the proposed grade separation at the intersection of FM Route 1495 and SH 36 which would separate Port Freeport traffic from other traffic and is located approximately one mile from Freeport LNG's terminal on the only road (FM Route 1495) that provides access to Quintana Island.

A $2.8 million expansion of the Texas Gulf Coast Regional Airport was initiated in September 2010 and completed in August 2013. Additions to the existing airport, located approximately five miles south of Angleton and 14 miles from the Quintana Island terminal, include a new 11,000 square foot terminal plus a 12,000 square foot aircraft hangar. The expansion is expected to increase the number of corporate and private planes using the airport (The Facts, 09-26-12; HoustonNewcomerGuides.com, 2013; Houston Chronicle, 01-08-13).

4.12.3.6 Commercial, Residential, and Miscellaneous Developments

In addition to the projects described in sections 4.12.3.1 through 4.12.3.5, various commercial, residential, and miscellaneous developments in Brazoria County have recently been initiated or announced. Several communities are undergoing downtown revitalization, including Lake Jackson. Most of the larger scale residential and commercial developments are concentrated in northern Brazoria County, particularly in the Pearland area, which has 222 newly constructed homes for sale (Realtor.com, 2012). Several residential community developments are planned in the Brazosport area as indicated in table 4.12.3-1 and table G-1 and G-2 in appendix G (The Facts, 01-03-12, 04-22-12, 01-01-13).

4.12.4 Analysis of Cumulative Impacts

To illustrate the cumulative impact of the Freeport LNG work, cumulative impacts were first assessed for the Liquefaction Project in combination with Freeport LNG's Phase II Modification Project across applicable impact categories noted in table 4.12.1-1 (*i.e.*, wetlands, waterbodies, EFH, listed species, air quality, noise levels, water quality, land use, visual, traffic, housing, public services, and water supply. After this, the collective impact of Freeport LNG's work was evaluated with respect to other proposed development projects within the development categories noted in table 4.12.3-1 (*i.e.,* industrial, port and harbor, oil and gas fields, land and air transportation, commercial, residential, and miscellaneous work) and then combined overall cumulative impacts were described. Projects considered are detailed in appendix G and impacts are discussed further below.

Wetlands

Collectively, Freeport LNG's Projects would temporarily impact 25.7 acres of wetlands, including 11.9 acres of palustrine emergent wetland, 13.6 acres of estuarine emergent wetland, and 0.2 acre of palustrine emergent/scrub-shrub wetlands. Freeport LNG's Projects would also permanently impact 19.6 acres of wetland, including 11.8 acres of palustrine emergent wetlands, 7.7 acres of estuarine emergent wetlands, and 0.1 acre of palustrine scrub-shrub wetland. In total, the Projects would impact 45.3 acres of wetland, either temporarily or permanently.

Where sufficient siting information is available, review of NWI maps and recent aerial imagery suggests that none of the other present or reasonably foreseeable industrial developments identified in southern Brazoria County would impact wetlands. All of the industrial developments are on existing industrial sites that have undergone significant modifications through time and if any wetlands were present in the past they have been likely lost through historic industrial development. For several of the other project groups, including oil and gas field developments, land and air transportation developments, commercial developments, residential developments, and miscellaneous developments, a lack of specific site footprint information precluded quantification of wetlands acreage or functional impacts.

There are four pipeline development projects in Brazoria County that are more than 56 miles long and likely cross multiple wetlands. Impacts would occur through trench excavation although these are generally considered temporary in emergent and scrub-shrub wetlands and both acreage and functional quality would be restored through mitigation. None of the wetlands potentially affected by pipeline development would be contiguous with or close to Freeport LNG's proposed Projects. The closest pipeline development would be at Jones Creek, approximately 6 miles from the Quintana Island terminal.

New oil and gas well developments are unlikely to cause significant wetlands impacts. Pads for the new wells proposed would be set outside wetlands where possible. The nearest new well to Freeport LNG's Projects is approximately 6 miles east of the Pipeline/Utility Line System near Stratton Ridge.

The only wetland impacts identified in the general vicinity of the Freeport LNG Project footprint are those associated with the USACE's Freeport Harbor Entrance Channel Deepening Project, Port Freeport's Velasco Terminal Project, and the SH 36/FM Route 1495 Grade Separation Project. As indicated in tables E-1 and E-2 of appendix G, the channel deepening project would generate 17.3 million yd^3 of dredge spoil, which would be deposited in two newly constructed DMPAs on the west bank of the Brazos River, just south of Dow's Plant B and approximately 4 miles from the Quintana Island terminal. Approximately 39 acres of palustrine emergent wetland would be lost at the DMPAs, which would cover an overall area of 418 acres.

According to the final EIS (USACE, 2012) for the Freeport Harbor Entrance Channel Deepening Project, the Velasco Terminal Project is expected to permanently impact approximately 2.1 acres of wetlands (NWI mapping suggests palustrine emergent wetlands). These wetlands are at least one mile from the Quintana Island terminal and are not contiguous with or hydraulically connected to any wetland associated with Freeport LNG's Projects. The final EIS indicates that compensatory mitigation for the 2.1-acre loss would involve creation/enhancement of approximately 15.7 acres of wetlands, specifically creation of 8.5 acres of new wetland and enhancement of 7.2 acres of existing wetland in the Justin Hurst WMA.

Various development projects in Brazoria County, including Freeport LNG's Projects, have recently affected or would impact wetlands in the next several years. However, given the distances separating the projects and the lack of direct hydraulic connectivity or spatial contiguity between the wetland areas, the overall impact appears only at the scale of a larger watershed. Moreover, all development projects in Brazoria County would need to obtain permit authorization from the USACE and water quality certification from the RRC or TCEQ for construction activities in wetlands. This authorization is contingent upon providing appropriate mitigation for temporary impacts, permanent acreage loss, and any decrease in functional quality. As such, Freeport LNG Projects are unlikely to cause any significant cumulative impact on area wetlands.

Waterbodies

Collectively, Freeport LNG's Projects would temporarily impact 37.3 acres of waterbodies through in-stream excavation and/or dredging. Freeport LNG's projects would also permanently impact 2.9 acres of waterbodies through facility placement. In total, the Projects would impact 40.2 acres of waterbodies, either temporarily or permanently. The Projects would involve 145,000 yd^3 and 1,188,000 yd^3 of dredging and/or excavation in waterbodies, respectively.

The cumulative impact profile for waterbodies, with respect to both the individual project groupings and the collective evaluation, is very similar to that discussed for wetlands: The industrial projects beyond those of Freeport LNG would have no measurable impact on waterbodies in terms of acreage loss, and any impacts associated with pipeline projects are expected to be temporary only. In addition, new oil and gas well pad placement would avoid waterbodies where possible, and, except for the harbor channel deepening and widening projects, a lack of specific site location information precludes a quantitative evaluation for other project group impacts.

The Freeport Harbor Entrance Channel Widening Project would involve a 3.9-acre increase in open water where scrub-shrub vegetation, beach, and tidal mud flats would be cut back to widen a section of the existing channel fringing Surfside and located opposite Freeport LNG's berthing area. No acreage loss would be associated with widening the channel from 400 feet to up to 600 feet for 6.1 miles. The main impact would be associated with the removal of 2.9 million yd^3 of clay/silt material and 300,000 yd^3 of silty sand material. The clay/silt material would be placed in the New Work Ocean Dredged Material Disposal Site (ODMDS), located about 5.9 miles offshore from the Quintana Island terminal; the silty sand dredged material would be placed on Quintana Beach in front of the Seaway DMPA. About 3.3 million yd^3 of material would be removed during long-term maintenance, an increase of about one million yd^3 per year over the current maintenance volume. This material would continue to be placed in the Maintenance ODMDS, located about 3.3 miles offshore from the Quintana Island terminal (USACE, 2012).

The Freeport Harbor Entrance Channel Deepening Project would generate an estimated 17.3 million yd^3 of dredged material during construction and 176 million yd^3 of additional dredged material over 50 years of maintenance. Of the 17.3 million yd^3 of material dredged during construction, 12.7 million yd^3 would be placed in the New Work ODMDS, and 4.6 million yd^3 would be placed in the two new onshore DMPAs on the west side of the Brazos River (USACE, 2012).

In comparison with the dredge volumes for the channel widening and deepening projects described above, the amounts associated with Freeport LNG's Liquefaction Project and Phase II developments are relatively small and would be placed in one or more onshore DMPAs, separate from those for the channel deepening projects. It is possible that the channel widening and deepening projects could overlap with Freeport LNG's activities in terms of schedule. The projects are in close proximity, and as such, the Freeport LNG Projects and the two channel projects would generate cumulative impacts at the larger watershed scale. However, given the relative size of the dredging activities proposed by Freeport LNG and the mitigation measures proposed to reduce impacts, we conclude that the Projects would not cause a significant cumulative impact on waterbodies.

Essential Fish Habitat

Of the projects listed in table 4.12.3-1, and also in table G-1 and G-2 in appendix G, the only ones potentially affecting marine or estuarine habitat, and therefore EFH, are Freeport LNG's proposed Projects, the Port and Harbor Channel Developments, and the Surfside Beach Re-nourishment Project. The latter project is expected to have a neutral or positive impact on local habitat. No adverse modifications to EFH have been identified for the Freeport LNG Projects and, according to the USACE (2012), the Freeport Harbor Entrance Deepening Project would have no adverse effect on EFH. Given the close similarity of the Freeport Harbor Channel Widening Project and the Velasco Terminal Project to Freeport LNG's Projects in terms of geographic location and dredging scope, no significant cumulative impacts on EFH are anticipated.

Threatened and Endangered Species

Of the projects listed in table 4.12.3-1, and also in table G-1 and G-2 in appendix G, and other than Freeport LNG's Projects, the only ones for which the results of any listed species impact assessments appear publicly available are the Freeport Harbor Entrance Channel Widening and Deepening Projects, and the INEOS Cracking Furnace Project.

According to the final EIS for the Deepening Project (USACE, 2012), dredging associated with channel deepening is likely to adversely affect four species of sea turtles (green, hawksbill, Kemp's Ridley, and loggerhead) and may affect, but is not likely to adversely affect, one species of sea turtle (leatherback). Placement of dredged materials in the New Work ODMDS may affect, but is not likely to adversely affect, all five turtle species. The final EIS also indicates that the Deepening Project is likely to adversely affect, but is not likely to jeopardize, the continued existence of all five turtle species.

The greatest concern for both the Freeport Harbor Entrance Channel Widening and Deepening Projects relates to the use of hopper dredging as opposed to pipeline or hydraulic dredging. Both projects call for the use of both hopper and pipeline dredges. The final EIS for the Deepening Project states that "It has been well documented that hopper dredging activities occasionally result in sea turtle entrainment and death, even with seasonal dredging windows." It also states that "Sea turtles easily avoid pipeline dredges due to the slow movement of the dredge" and indicates that use of hopper dredges should be restricted to between December 1 and March 31, when sea turtle abundance is lowest throughout coastal waters in the Gulf. Freeport LNG's dredging activities would be restricted to the ICW and the existing berthing area, where turtles might reasonably be expected to be less common than in off-shore Gulf waters. Also, Freeport LNG is proposing to use conventional barge-mounted cutter/suction dredging or a combination of shore-based dragline and barge-mounted cutter/suction techniques, rather than hopper dredging. No adverse impacts on sea turtles are expected to result from Freeport LNG's Project activities; consequently, no cumulative impacts are anticipated.

A BA (TRC, 2012) was completed for INEOS' Cracking Furnace Project, located at the company's existing Chocolate Bayou facility. The BA was prepared in support of a permit application to the USEPA under the GHG PSD Program. The BA concluded that no federally-listed species would be affected by the project; precluding the possibility of any cumulative impact associated with Freeport LNG's Liquefaction Project and Phase II Modification Project.

Air Quality

The proposed Project would be located in the HG-AQCR. The HG-AQCR is a nonattainment area for both the 1-hour and 8-hour O_3NAAQS. The designations for other criteria pollutants are attainment or the equivalent. Air pollutants would be released as a result of Project facilities construction and operation. Release of pollutants during construction would be intermittent, temporary, and short-term. Given the relatively modest quantities of pollutants released, the limited duration of their release, and the fact that releases would occur over a wide area, the cumulative air quality impacts due to construction would not be significant.

The cumulative impacts resulting from construction of the Project's facilities can be assessed by comparing the construction emissions to the budgets listed in the SIP. Updates to the HGB SIP proposed by TCEQ include budgets for point sources, area sources, non-road vehicles, and on-road vehicles. The proposed 2018 HGB weekday O_3season NO_x budgets for non-road and on-road vehicles are 119.88 and 55.39 tons per day (tpd), respectively. The proposed 2018 HGB weekday O_3season VOC budgets for non-road and on-road vehicles are 59.84 and 46.68 tpd, respectively. As is shown previously in table 4.11.1-3, the maximum NO_x and VOC estimated emissions for construction equipment, material deliveries, worker commuting, and construction equipment are 374.5 and 94.5 tpy, respectively, in 2015 and 2016. Assuming 250 working days per year, these are equivalent to daily NO_x and VOC emissions of 1.50 and 0.38 tpd, respectively. These correspond to 0.85 percent and 0.36 percent of the HGB 2018 vehicle weekday O_3season budgets for NO_x and VOC, respectively. These emissions would be spread roughly uniformly through the year, would constitute a small fraction of the total emissions in the HG-AQCR, and would not have an appreciable cumulative impact on air quality. Note that the aforementioned vehicle NO_x and VOC budgets should not be confused with the motor vehicle emission budget for transportation conformity.

Both Freeport LNG and FERC staff performed air dispersion modeling for NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$ for the direct emissions resulting from operation of the Project facilities using the USEPA-guideline AERMOD modeling system. AERMOD is a steady-state plume dispersion model for near-field applications (within 50 km) in areas with both simple and complex terrain. The air dispersion modeling demonstrates that air pollutants released by the Projects would not be the cause of any exceedance of the NAAQS, however as identified in section 4.11.1, as a result of the number of industrial facilities in the area of the Liquefaction Plant, the operation of existing facilities are the prime factor in any NAAQS exceedance. Hence, the air dispersion modeling demonstrates that operation of the Project would not cause significant adverse air pollution impacts on nearby residents, to the Brazoria NWR, or to birds and other wildlife. It also demonstrates that modest contribution from operation of the Projects would occur within the HG-AQCR.

The cumulative impacts resulting from operation of the Projects can also be assessed by comparing its emissions to the budgets listed in proposed updates to the HGB SIP. The proposed 2018 RFP point source inventories for NO_x and VOC are 158.75 and 185.38 tpd, respectively. As is shown in table 4.11.1-5, the maximum NO_x and VOC estimated emissions for facility operation are 65 and 24 tpy. Assuming 365 operating days per year, these are equivalent to daily NO_x and VOC emissions of 0.18 and 0.066 tpd, respectively. These correspond to 0.11 percent and 0.04 percent of the 2018 RFP point source inventories for NO_x and VOC. These very small percentages indicate that operation of the facilities would contribute modestly to the cumulative impacts on air quality in the HG-AQCR.

Climate Change

Climate change is the modification of climate over time, whether due to natural causes or as a result of human activities. Climate change cannot be represented by single annual events or individual anomalies. For example, a single large flood event or particularly hot summer is not an indication of climate change. However, unusually frequent or severe flooding, or several consecutive years of abnormally hot summers over a large region may be indicative of climate change.

The Intergovernmental Panel on Climate Change (IPCC) is the leading international, multigovernmental scientific body for the assessment of climate change. The United States is a member of the IPCC and participates in the IPCC working groups. The leading United States scientific body on climate change is the United States Global Change Research Program (USGCRP). Thirteen federal departments and agencies[31] participate in the USGCRP, which began as a presidential initiative in 1989 and was mandated by Congress in the Global Change Research Act of 1990.

The USGCRP have recognized that:

- Globally, anthropogenic GHGs have been accumulating in the atmosphere since the beginning of the industrial era causing recent global warming;
- Combustion of fossil fuels (coal, petroleum, and natural gas), combined with agriculture and clearing of forests is primarily responsible for the accumulation of GHG;
- The anthropogenic GHG emissions are the primary contributing factor to recent climate change; and
- Impacts extend beyond atmospheric climate change alone, and include changes to water resources, transportation, agriculture, ecosystems, and human health.

The USGCRP issued its Second National Climate Assessment (NCA) titled, *Global Climate Change Impacts in the United States*, in 2009 summarizing the impacts climate change has already had on the United States and what projected impacts climate change may have in the future. The report includes a breakdown of overall impacts by resource and impacts described for various regions of the United States. The Third NCA is currently in draft form and is scheduled for issuance in early 2014.

Climate change has modified the environment in the area around the Projects and is projected to cause additional changes to the project area. The Second and draft Third NCAs identifies climate change impacts that have occurred along coastal regions in the continental Southeast and Gulf Coast. Previous impacts on historical baseline climate and as well as projected climate change impacts that could affect the project area are identified below:

- Average temperatures have risen about 2° F since 1970 and are projected to increase another 4.5 to 9°F during this century;
- Increases in illness and death due to greater summer heat stress;

[31] The USEPA, USDOE, Department of Commerce, Department of Defense, Department of Agriculture, Department of the Interior, Department of State, USDOT, Department of Health and Human Services, National Aeronautics and Space Administration, National Science Foundation, Smithsonian Institution, and Agency for International Development.

- Destructive potential of Atlantic hurricanes has increased since 1970 and the intensity (with higher peak wind speeds, rainfall intensity, and storm surge height and strength) is likely to increase during this century;

- In the United States, within the past century, relative sea level changes ranged from falling several inches to rising about 2 feet and are projected to increase another 3 to 4 feet this century;

- Declines in DO in streams and lakes have caused fish kills and loss of aquatic species diversity;

- Moderate to severe spring and summer drought areas have increased 12 percent to 14 percent (with frequency, duration and intensity also increasing also projected to increase);

- Longer periods of time between rainfall events may lead to declines in recharge of groundwater and decreased water availability;

- Responses to decreased water availability, such as increased groundwater pumping, may lead to stress or depletion of aquifers and strain on surface water sources;

- Increases in evaporation and plant water loss rates may alter the balance of runoff and groundwater recharge, which would likely to lead to saltwater intrusion into shallow aquifers;

- The oceans are currently absorbing about a quarter of the CO_2 emitted to the atmosphere annually and are becoming more acidic as a result, leading to concerns about potential impacts on marine ecosystems;

- Increasing risk from sea-level rise and storm surge;

- Coastal waters have risen about 2°F in several regions and are likely to continue to arm as much as 4 to 8°F this century; and

- Coastal water warming may lead to the transport of invasive species through BWE during ship transit.

The USEPA, in their draft PSD Permit concluded that the Liquefaction Project would utilize energy-efficient technologies, including the following:

- electric motors (which produce no GHG emissions) and variable speed drives (which have energy-efficient operating characteristics over a wide range of weather and load conditions) for its primary drivers, and

- modular design for the liquefaction trains, which would promote energy efficiency over the range of throughputs that may occur.

As identified in section 4.11.1, the Projects would obtain a PSD Permit from the USEPA to limit emissions of GHG from the Projects. The draft PSD GHG Permit is attached as appendix B Freeport LNG's GHG emissions are small in relation to overall GHG emissions within the Project area. Although the Projects emissions would contribute to the overall amount of atmospheric GHG, it is impossible, to quantify the impacts that the emissions of GHG from construction and operation of the Projects would have on climate change.

Noise Levels

Cumulative noise impacts could occur during construction and operation of Freeport LNG's Projects if any of the other projects under consideration were in close enough spatial proximity to exert a compounding effect. This would be of greatest significance if any regulatory thresholds were consequently exceeded.

However, only the Freeport Harbor Entrance Channel Widening and Deepening Projects appear in close enough proximity to Freeport LNG's Projects to potentially add to or compound noise levels. This would likely be most relevant during any overlap between construction of Freeport LNG's new facilities and channel dredging operations. The final EIS (USACE, 2012) for the Deepening Project indicates that neither channel deepening nor widening would have an adverse effect on noise levels, either singly or in combination with other area projects, including Freeport LNG's Phase II Project (as originally proposed) and periodic maintenance dredging of the ICW. In this respect, the final EIS states that "noise impacts included in those projects associated with dredging would include operation and maintenance noise. This impact would be temporary, would move up and down the project area depending on the section being dredged, and is not expected to differ from current maintenance dredging for many of the projects. Additionally, it is unlikely dredging would occur for more than one of the reviewed projects at one time." Freeport LNG anticipates its own off-shore construction activities and channel dredging operations would be temporally sequenced to avoid concurrent and potentially conflicting activities in terms of workspace congestion and associated safety concerns. Consequently, we conclude that the noise impact of the Projects is largely not additive with other ongoing construction and would only contribute minor cumulative noise impact on the larger region.

Water Quality

With respect to the projects listed in table 4.12.3-1, and also in table G-1 and G-2 in appendix G, the only potential for direct hydraulic overlap with Freeport LNG's Projects is associated with the Freeport Harbor Entrance Channel Widening and Deepening Projects. The most significant consideration relates to the increase in turbidity caused by sediment disturbance during dredging, spoil placement, and other off-shore construction activities. Such disturbance can also deplete oxygen levels in the water column and release sediment-bound contaminants and nutrients.

Turbidity impacts associated with channel dredging, off-shore spoil placement, and Freeport LNG's Projects would be of short duration and would not be expected to overlap temporally (see section 4.3.2), precluding the chance of any spatial overlap at the interface of Freeport LNG's existing berthing area and the FHC, where the projects are in relatively close proximity. The final EIS (USACE, 2012) for the Deepening Project concludes that if turbidity-induced temporary degradation in water quality occurs, a rapid return to ambient conditions would follow the completion of dredging.

Operational water discharges from local industrial facilities could theoretically have a compounding cumulative effect if discharge streams were mixed. However, permit levels for constituents and physico-chemical parameters are developed on the basis of total loadings for a given area, thereby incorporating consideration of cumulative effects into regulatory control. Thus, even if process water discharges from Freeport LNG's proposed facilities were mixed with those of neighboring facilities, permit conditions would help to preclude any compounding effects. If is likely that if the dredging from the USACE and the Projects overlap, impacts would be cumulative, but due to the high turbidity existing in the Brazosport turning basin, FHC, and the ICW it is unlikely that the 120 days of dredging would result in significant worsening of the water quality.

4.12.4.1 Socioeconomic Issues

Land Use

Based on available site information for the projects listed in table 4.12.3-1 and also in table G-1 and G-2 in appendix G, there would be some minor changes in land use classifications, but no synergistic cumulative effects on land use patterns. The industrial projects, which are concentrated in southern Brazoria County and represent the most significant land-based projects in relatively close proximity to Freeport LNG's Project footprint, would be constructed almost exclusively on existing disturbed sites within the boundaries of existing industrial facilities, in much the same way as Freeport LNG's proposed facilities at and adjacent to the Quintana Island terminal.

Visual Impacts

Cumulative visual impacts could occur during facility construction and operation if Freeport LNG's work activities or new facilities occupy the same viewshed as the work activities or new facilities of one or more of the other projects listed in table 4.12.3-1, and also in table G-1 and G-2 in appendix G. However, based on the degree of geographic separation and, in some cases, the presence of intervening structures, Freeport LNG's proposed facilities would not occupy the same viewshed as any of the other proposed facilities, except those to be constructed in existing heavily industrialized settings on the north side of the ICW; therefore, cumulative visual impacts would not occur with respect to new facilities. In terms of inclusion in the same viewshed, the only cumulative impacts for Freeport LNG's Projects would occur if dredging activities for the Freeport Harbor Entrance Channel Widening and Deepening Projects occurred within the same timeframe as construction or operation of Freeport LNG's new facilities. In this case, viewsheds from Surfside, Quintana, or Freeport could include channel dredging equipment and Freeport LNG's construction equipment and/or new facilities. However, the impact would essentially be insignificant given the industrial setting and the amount of commercial shipping that regularly passes through the channel on a day-to-day basis.

Road Traffic

Of the projects listed in table 4.12.3-1 and also in table G-1 and G-2 in appendix G, the only ones that are likely to have a cumulative impact on traffic patterns and road use are the industrial development projects and the Velasco Terminal Project in Freeport, and this would occur only during construction. The other projects, even those located elsewhere in southern Brazoria County (*e.g.*, Chocolate Bayou and Sweeny), are likely too remote geographically to influence or be influenced by Freeport LNG's traffic patterns. However, table 4.12.3-1 indicates that, between 2014 and 2018, a total of about 13,150 construction workers, including the 4,200 workers estimated for Freeport LNG's Projects, would be required at five plant sites within a roughly 3-mile radius. This represents a significant group of commuters in a city with a population of just over 12,000, even if many of the commuters live locally. In addition, each project would likely involve multiple road deliveries of supplies and equipment on a daily basis.

Freeport LNG's Projects are scheduled for construction between mid-2014 and 2018. Where other projects or project phases are constructed at the same time, the potential for consequent traffic congestion exists, particularly where the projects share routes for workers and/or site deliveries. In this case, a compounding cumulative impact could be realized.

In combination with Freeport LNG's Projects, traffic flows in the immediate vicinity of Quintana Island could be influenced most heavily by the Velasco Terminal Project, due for completion in 2016, the associated grade separation at the nearby SH 36/FM Route 1495 intersection, due for completion in 2014, and the Phillips 66 LPG Export Terminal Project, located near this intersection. If the grade separation coincides with construction on Quintana Island, a bottleneck could result. Conversely, completion of the grade separation prior to Freeport LNG's Project construction could help separate Quintana Island and Port Freeport traffic flows, thereby helping to alleviate congestion. Additionally, the recent major improvements to SH 288 in Lake Jackson and Clute, would improve traffic flows and access to the other project sites further north in Freeport, allowing quicker and safer access for traffic destined for Freeport LNG's work sites.

Housing

The projects listed in table 4.12.3-1 and also in table G-1 and G-2 in appendix G represent extensive, long-term capital development county-wide, with about $20 billion invested in industrial expansion projects in southern Brazoria County alone, including those of Freeport LNG. For these industrial projects, the need to accommodate a potential peak cumulative construction workforce of about 15,950 personnel, about 26 percent of whom would be assigned to Freeport LNG's Projects, represents a significant issue with respect to short-term accommodation. In addition, long-term housing would be required for the estimated 885 new operational workers associated with the industrial projects.

The cumulative impact of Freeport LNG's Projects in association with other industrial projects in Freeport and southern Brazoria County could be heavy, sustained use of motels, campgrounds, and recreational vehicle parks during construction, with increased competition for space among transient construction workers, tourists, and other visitors. Much would depend on the exact specific timing of the respective projects; 15,950 represents the sum of the peak estimated workforce numbers for each project, but it is highly unlikely that all these workers would be mobilized at the same time and it is estimated that only about 50 percent would relocate to the Brazosport area from elsewhere and require residential accommodation. Nonetheless, the Freeport LNG Projects would contribute a significant influx of workers, which may exacerbate housing shortages overall but would likely be remedied by some workers enduring longer commute times from temporary accommodations in more distant communities than preferred, (*e.g.,* Alvin, where a new 86-bed extended stay motel is being planned [City of Alvin, 2012]). The Project may result in hotel/motels in the area being fully booked and rate increases in hotel/motels. Effects would be temporary, lasting only for the duration of construction, and there would be no long-term cumulative impacts on housing. Positive cumulative impacts would be associated with the increase in local spending on food, lodging, and entertainment by construction personnel.

With respect to permanent housing for the estimated 885 new operational workers in southern Brazoria County, the local real estate market has recently been fairly static in terms of construction with no significant increase in the number of new houses available for occupancy. The seven cites of southern Brazoria County (Alvin, Angleton, West Columbia, Lake Jackson, Freeport, Brazoria, Sweeny) currently have 2,144 houses for sale, including 408 in the Lake Jackson/Freeport area (Realtor.com, 2014). Commute times to the new industrial facilities from new large-scale residential developments in northern Brazoria County (specifically the Pearland/Rosharon/ Manvel area) are reasonable and this latter area offers additional housing opportunities for new permanent workers.

Public Services

As discussed previously, Freeport LNG's Projects and the other major industrial projects in southern Brazoria County would require about 15,950 new workers and 885 new operational workers. Much of the construction worker requirement would overlap. As such, they would likely result in increased demand for public services such as schools, health care facilities, social services, utilities, and emergency services.

The cumulative impact of Freeport LNG's Projects and the others listed in table 4.12.3-1 and appendix G on public services during construction would depend on the number of projects underway at any one time. In Freeport, where most of the new projects are concentrated, local schools could see student enrollment numbers increase, depending on how many temporary workers are accompanied by their families. Demands on police, fire, and ambulance services would be alleviated to some extent by the fact that the new industrial projects are at or adjacent to existing facilities with well-established emergency response plans, where site-security and day-to-day events would be handled by site personnel.

The Brazosport Industrial CAER program provides information to the local community in the event that an emergency should occur at one of the area's industrial plants. CAER deals with internal safety precautions in addition to emergency response plans for the community and stresses two-way communication between the public and industry. The CAER program greatly reduces the probability of a major chemical emergency due to the fact that both the community and industry are prepared. In addition to Freeport LNG, member companies in the CAER program include Air Liquide, BASF, ChevronPhillips, ConocoPhillips, Enterprise Crude Pipeline, DM, Dow, DSM Nutritional, Gulf Chemical, Huntsman, INEOS, Mineral Research, Nalco, Perstorp Coatings, Shin-Etsu Silicones of America, Shintech, and SI Group. With respect to public safety, the CAER program constitutes a well-established and effectively functioning system that would allow easy integration of the new industrial expansions proposed by Freeport LNG and other companies in Brazosport.

Water Supply

The Liquefaction Project, in concert with other industrial developments in southern Brazoria County, would increase local water supply demands. As indicated in tables G-1 and G-2 of appendix G, Freeport LNG's Projects would require 38,400 gpd of process water and 375 gpd of potable water beyond current use. Other industrial developments would require additional water too, which could put a burden on local supplies, particularly during a severe drought like that experienced in 2011.

The primary source of water for industries and communities in Freeport LNG's Project area is the Brazos River. One intake on the Brazos River (the "Dow Intake") provides process water for all of Dow's Freeport operations and is also the primary potable water supply for Brazosport through the Brazosport Water Authority (BWA). The BWA supplies potable water to seven municipalities (Clute, Freeport, Lake Jackson, Oyster Creek, Quintana, Richwood, and Surfside Beach), two prison systems, and multiple industrial users.

Freeport LNG's process water supply needs, which constitute approximately 99 percent of its overall needs for additional water volumes, are restricted to the proposed Pretreatment Plant. As currently proposed, process water may be obtained via pipeline from Dow's Stratton Ridge brine production facility or it may be obtained from an on-site well. In the first case, where the water is delivered via pipeline from Dow, the new demand would cause an increase in the overall regional demand for water from the Brazos River, given that Dow obtains its water for the Stratton Ridge facility from this source. This could be viewed as an additive impact that would only become a cumulative impact if it caused or contributed to a reduction in supply elsewhere during times of regional water shortage. Dow, among other area industries, is actively engaged in identifying and adopting water conservation measures including, since November 2011, the re-use of 3.0 to 3.5 million gpd of treated wastewater from the City of Lake Jackson for manufacturing processes.

4.12.5 Conclusion

Freeport LNG's Projects would not have any significant and readily identifiable cumulative impacts from a natural resources perspective. While some additive effects would occur (*e.g.*, Freeport LNG's Projects would increase the sum total of wetland acreage impacts and, in concert with FHC improvements, may cause water column turbidity across a wider area) no compounding effects have been recognized. Often any such effects appear to be precluded by the degree of geographic separation between projects, which is also the case with visual impacts.

With respect to socioeconomic factors other than visual impacts, Freeport LNG's Projects could contribute to cumulative impacts in so much as the demand for housing and number of workers would increase and there may be associated additional burdens on road usage and public services. However, as with natural resource factors, these impacts would essentially be additive rather than compounding. More road congestion could theoretically occur but it is unlikely to precipitate a complete functional breakdown of traffic flows. In summary, impacts on housing and traffic would be offset by the economic benefits but would not offset the environmental impacts to the residents of the Town of Quintana during construction. However, at the scale of Brazoria County, no significant cumulative impacts are expected.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations presented in this section are those of the FERC environmental staff. Our conclusions and recommendations are based on input from the USDOE, USEPA, USDOT, the USACE, and the NOAA Fisheries as cooperating agencies. However, the USDOE, USEPA, and USACE may present their own conclusions and recommendations in their respective Records of Decision and can adopt this draft EIS consistent with 40 CFR 1501.3 if, after an independent review of the document, they conclude that their requirements have been satisfied. Otherwise, they may elect to conduct their own supplemental environmental analyses.

We conclude that construction and operation of Freeport LNG's Liquefaction Project and the Phase II Modification Project would result in mostly temporary and short-term adverse environmental impacts. Certain adverse impacts from construction, such noise, traffic, dust and air emissions may vary in intensity and composition over the up to 4.5 years of construction and would require our recommended mitigation to reduce impacts. However, as identified in Section 4.12.1 - Cumulative Impacts, Section 4.8.5 - Traffic Impacts, and Section 4.11.2 - Noise and Vibration, construction would result in significant and unavoidable impacts on the residents of the Town of Quintana. Permanent impacts are limited and include changes to land use, wetlands impacts, minor socioeconomic impacts (traffic, decrease in housing availability), and increases in ambient noise and regional air pollutants. In addition, we considered the cumulative impacts of the proposed Projects with the past, present, and reasonably foreseeable actions in the Brazoria County region. As part of our analysis, we developed specific mitigation measures that we determined are practical, appropriate, and reasonable for the construction and operation of the Projects. We are, therefore, recommending that these mitigation measures be attached as conditions to any authorization issued by the Commission. We conclude that implementation of the mitigation proposed by Freeport LNG and our recommended mitigation would ensure that impacts in the area would, with the exception of construction impacts to the residents to the Town of Quintana, be avoided or minimized and would not be significant. Further, based on the mitigation that Freeport proposed, and our additional recommendations, we conclude that the Projects would be in compliance with the ESA, the NHPA, and the CZMA.

A summary of the Projects' impacts and our conclusions are presented below by resource.

5.1 ALTERNATIVES CONSIDERED

5.1.1 Liquefaction Project

The FERC conducted an alternatives analysis for the Liquefaction Project and found no other practicable alternative that would result in less environmental impact that would meet the purpose of the Liquefaction Project. Alternatives considered included the no action alternative, system alternatives, and site alternatives.

With respect to the no action alternative, this is not viable as the purpose of the proposed Project would not be met and Freeport LNG would not be able to provide U.S. natural gas producers with new access to global gas markets.

With respect to system alternatives, the FERC analyzed proposed LNG Export facilities on the West Coast, Gulf Coast, and East Coast of the United States and whether these could be considered system alternatives. In all cases we found that these alternatives would not address the Liquefaction Project's purpose and would not offer any significant environmental advantage.

We considered the possibility of expanding the size of another proposed LNG export terminal to address Freeport LNG's desired export capacity. However, this alternative would involve further impacts such as: construction of additional liquefaction infrastructure plus the potential need for expanded docking facilities. Hence, the environmental impacts would not be significantly different that those that would occur as a result of Freeport LNG's proposals.

We evaluated site alternatives for the components of the Liquefaction Project but did not find any viable alternatives that addressed the purpose and need of the Liquefaction Project. Siting of the Liquefaction Plant was dictated by the need to be sited close to the existing offloading areas, LNG storage tanks, docking area, and other existing LNG infrastructure at the Quintana Island terminal. Thus it was not practicable to site the Liquefaction Plant in an area other than on Quintana Island, as that would require the construction of duplicative and significantly costly infrastructure at another location with added environmental impacts.

We evaluated the feasibility of lowering the pad elevation of the Liquefaction Plant and the difference this would have on impacts on visibility, noise, safety, stormwater, and site engineering. The results of the work showed that this alternative would not provide substantial improvements in visibility and noise attenuation, and that there would be significant issues with respect to safety, engineering design, traffic and land use.

With respect to the siting of the Pretreatment Plant, the FERC first assessed five sites, all of which were deemed unsuitable due to site constraints and or environmental impacts, except for one site (Site E) located along CR 690, and northeast of the preferred site. However, based on comments from residents regarding the lack of a suitable evacuation route in case of emergency at Site E, Freeport chose its currently preferred site (Site F).

As a result of concerns expressed by persons living in residential areas in proximity to Site F, we requested evaluation of four additional alternative sites. However these sites were not deemed viable alternatives due to site constraints and or environmental impacts, and we concluded that the preferred site (Site F) provides a suitable location without the safety issues regarding access to homes during an emergency that were evident with Site E.

With respect to siting of the Pipeline/Utility Line System, the main criteria were the functional interdependency and geographic locations of the proposed process facilities (Liquefaction Plant and Pretreatment Plant), Freeport LNG's existing natural gas sendout pipeline, and the existing sendout pipeline meter station at Stratton Ridge. The existing sendout pipeline route constitutes the "preferred" route as it follows an area already disturbed right-of-way and minimizes environmental impacts.

5.1.2 Phase II Modification Project

The purpose of Freeport LNG's Phase II Modification Project is to provide enhanced LNG storage and ship handling options to allow Freeport LNG to respond to import, re-export, and export opportunities with optimum market positioning and service flexibility. Such enhanced options cannot be achieved through new or modified LNG terminal facilities elsewhere in the U.S., given that the location, design, and purpose of the Phase II Modification Project facilities are predicated on and inextricably linked to the existing plant facilities and operations at Freeport LNG's terminal. As such, no system alternatives exist that could achieve the same level of functional integration or optimize the terminal's operational flexibility and capabilities.

The location, design, and purpose of the Phase II Modification Project facilities are wholly dependent on the existing plant facilities and operations at the Quintana Island terminal; therefore, other geographically separate sites beyond the terminal are not viable.

The location and configuration of the proposed Phase II facilities (both for the Phase II Project and the Phase II Modification Project) at the terminal site are essentially dictated by technological considerations and the need for compatible design integration into the existing Phase I layout, and thus relocating these structures elsewhere onsite is not a viable alternative.

5.2 GEOLOGY

5.2.1 Liquefaction Project

The area of the Liquefaction Project sites is not known to be actively seismic. No faults were identified east and west the Liquefaction Plant, though the Pretreatment Plant fault study identified three faults in proximity to the site, and although it is unlikely that a fault underlies the location, we are recommended that a fault study be conducted at the proposed Pretreatment Plant location to verify that no active faults are present.

Freeport LNG conducted an investigation that concluded liquefaction beneath the Liquefaction Plant area was unlikely due to the proposed improvements. Similarly, at the Pretreatment Plant site there is a low risk of seismic activity and a low propensity for the underlying soils to undergo liquefaction. However, we are recommending that Freeport LNG provide detailed final design and construction details for the Liquefaction Plant to ensure that the design would minimize the risk from geological hazards. Thus, we conclude that construction and operation of the Liquefaction Project would not have a significant impact on geological resources in the area, and the potential for geologic hazards or other natural events to significantly impact the Liquefaction Project (*e.g.,* subsidence, flooding, and shoreline erosion) is low.

5.2.2 Phase II Modification Project

The Phase II Modification Project would have a very limited footprint within the existing Quintana Island terminal site and there would be no significant impact on geological resources and/or from geological hazards.

5.3 SOILS AND SEDIMENTS

5.3.1 Liquefaction Project

The Liquefaction Plant would result in approximately 97.3 acres of temporary construction workspace, and approximately 132.5 acres of permanent impacts for the aboveground facility. Construction impacts on soils would be minor in the area of Quintana Island given the vast majority of the site is a dredge disposal area and or contains disturbed soils. The Pretreatment Plant site would result in approximately 104.9 acres of temporarily impacts for construction workspace and approximately 113.4 acres of permanent impacts for facility placement and operation. The Pipeline/Utility Line System would result in 119.3 acres of temporary impacts associated with construction and installation and no permanent impacts as it would be installed in the existing right-of-way. The overall impacts on soils at the Pretreatment Plant site and for the Pipeline/Utility Line System would be minor, and minimized through the use of Freeport LNG's Procedures and SWPPP. No significant impacts on soils, including hydric soils, or sediments would occur from construction or operation of the Liquefaction Project.

5.3.2 Phase II Modification Project

The Phase II Modification Project would result in approximately 14.6 acres of temporarily impacts for construction workspace and approximately 23.9 acres of permanent impacts. The overall impacts on soils from the Phase II Modification Project would be minor, and minimized through the use of Freeport LNG's Procedures and SWPPP. No significant impacts on soils would result from the construction and operation of the Phase II Modification Project.

5.4 WATER RESOURCES

5.4.1 Ground Water

5.4.1.1 Liquefaction Project

The Town of Quintana operates two municipal water wells located approximately 125 feet south of the temporary workspace for the Pipeline/Utility Line System at MP 0.20. The greatest potential for impact on groundwater would be from spills, leaks, or other releases of hazardous substances during construction or operation. Water for the Pretreatment Plant may either be sourced from industrial sources or an existing water well on the Dow site. To minimize the potential effects of a hazardous substance release, Freeport LNG would implement the preventative and mitigative measures specified in its SPCC Plan. No known active water wells are located within 150 feet of the construction workspace for the Pretreatment Plant or Pipeline/Utility Line System. Thus, construction and operation of the Liquefaction Project would not have a significant impact on groundwater resources in the area, including the underlying Chicot Aquifer.

5.4.1.2 Phase II Modification Project

Because the Phase II Modification Project is located in the same area as the Liquefaction Project, and Freeport LNG would follow the same procedures to minimize the potential for a spill, it would not have a significant impact on groundwater resources in the area.

5.4.2 Surface Waters

5.4.2.1 Liquefaction Project

Along the Freeport Harbor Channel and ICW, dredging of approximately 1,333,000 yd^3 of material would be required to construct a new LNG dock and berthing area, construction dock, aggregate dock, firewater intake, and to dredge at the existing construction dock. To minimize impacts associated with dredging, Freeport LNG developed a Dredging Plan that outlines procedures to minimize the spread of turbidity in surface waters.

Two waterbodies would be directly affected by construction of the Liquefaction Plant on Quintana Island: one intermittent drainage channel, and the ICW. We analyzed the worst case extent of increased turbidity due to dredging and determined that residents of Quintana Island could be affected, although impacts would be temporary. To minimize impacts associated with dredging, Freeport LNG developed a Dredging Plan that outlines procedures to minimize the spread of turbidity in surface waters. In addition, we have reviewed Freeport LNG's Dredging Plan and find it acceptable.

Seven waterbodies would be affected at or adjacent to the Pretreatment Plan site: two drainage channels, two areas of open water in the existing excavation pit, an unnamed pond, a drainage ditch, and the Velasco ditch. Seven waterbodies would be affected by construction of the Pipeline/Utility Line System: 4 perennial, 1 intermittent stream, and 2 unnamed intermittent drainage channels. To minimize impacts on surface waters, Freeport LNG would use HDD to entirely avoid construction impacts on the 7 water crossings along the Pipeline/Utility Line System, and would implement the measures in its Procedures and its SPCC Plan to minimize impacts on the remaining waterbodies. We are recommending that prior to construction, Freeport LNG submit a final site-specific HDD monitoring and contingency plan for review and approval that addresses all the HDDs proposed for the Liquefaction Project.

LNG exports through the Liquefaction Project would not result in any increase in the maximum number of vessel visits (400 per year) that were authorized in the Commission Order approving the Phase II Project. Potentially, discharge of ballast water in the terminal's berthing area could provide a pathway for the introduction of exotic aquatic nuisance species into U.S. coastal waters. However, these potential impacts are mitigated by USCG regulations that require all vessels equipped with ballast water tanks that enter or operate in U.S. waters to implement a ballast water management plan. This is discussed further below in section 5.7.1.

With the implementation of Freeport LNG's Procedures and our recommendation, construction and operation of the Liquefaction Project would not have a significant impact on surface waters.

5.4.2.2 Phase II Modification Project

Construction of the Phase II Modification Project would directly affect 2 waterbodies, and the Freeport Harbor adjacent to the site. The ICW would be indirectly affected by the Phase II Modification Project. To minimize impacts on waterbodies from construction and operation of the Phase II Modification Project, Freeport LNG's would implement its Procedures. In addition, we are recommending that Freeport LNG consult with the Velasco Drainage District and file an updated Erosion and Sediment Control Plan to incorporate drainage modifications specific to the Phase II Modification Project. Through the use of Freeport LNG's Procedures, and with our recommended mitigations, construction and operation of the Phase II Modification Project would not have a significant impact on surface waters.

5.4.3 Wetlands

5.4.3.1 Liquefaction Project

Construction of the Liquefaction Plant would result in 1.07 acres of permanent impacts on wetlands and no temporary impacts on wetlands. The Pretreatment Plant would result in approximately 5.4 acres of temporary impacts on wetlands and approximately 11.8 acres of permanent impacts on wetlands, and the Pipeline/Utility Line System would result in 20.2 acres of temporary impacts on wetlands, and no permanent impacts on wetlands. The required adherence to permit conditions and implementation of Freeport LNG's Procedures, SWPPP, and SPCC Plan would minimize the potential for indirect impacts (*e.g.,* from stormwater runoff) on the wetlands that lie beyond the proposed construction workspace. In addition, Freeport LNG would provide compensatory mitigation for wetlands in accordance with the USACE regulatory requirements. We have included a recommendation that Freeport LNG provide the final Compensatory Wetland Mitigation Plan before the end of the draft comment period. Considering the low quality of any wetland loss, and with our recommended condition, we conclude that the impacts on wetlands due to construction and operation would not be significant.

5.4.3.2 Phase II Modification Project

The Phase II Modification Project would result in permanent impacts on 6.1 acres of wetlands. Freeport LNG is working with the USACE to amend its existing Section 404/10 permit authorization and to update its Compensatory Wetland Mitigation Plan, as necessary to mitigate for the permanent impacts on wetlands. With this mitigation plan, we conclude that construction and operation of the Phase II Modification Project would not have a significant impact on wetlands.

5.5 VEGETATION

5.5.1 Liquefaction Project

Approximately 34.9 acres of vegetation would be cleared during construction of the Liquefaction Plant at and adjacent to the Quintana Island terminal. Of the total, 20.8 acres would be temporarily affected, and 14.1 acres would be permanently affected. Of the 20.8 acres temporarily affected, 18.3 acres lie inside the previously authorized construction footprint for the Phase II Project, and generally consist of vegetation associated with the dredge disposal site. This area does not have a high value with respect to wildlife habitat or contain rare vegetative species.

About 164.9 acres of vegetation would be cleared during construction at the Pretreatment Plant, of which approximately 86.9 acres would be temporarily affected and approximately 78 acres would be permanently affected. Impacts on vegetation from construction of the Pretreatment Plant would be minor because the facility would impact an area predominantly used for grazing where there are no special and rare vegetative communities.

About 80.6 acres of vegetation would be cleared during construction of the Pipeline/Utility Line System. The Pipeline/Utility Line System would be collocated with existing pipelines and utilities within previously disturbed and maintained corridors, which minimizes vegetation impacts. The areas would be restored and revegetated according to Freeport LNG's Procedures. Therefore, the Liquefaction Project would not have a significant impact on vegetation.

5.5.2 Phase II Modification Project

The Phase II Modification Project would affect approximately 9.1 acres of vegetation temporarily as a result of construction and 14.3 acres permanently as a result of Project operation. As noted above, most of this area does not have a high value with respect to wildlife habitat or contain rare vegetative species, and vegetative impacts are minor. Thus, the Phase II Modification Project would not have a significant impact on vegetation.

5.6 WILDLIFE

5.6.1 Liquefaction Project

Wildlife habitat at the Liquefaction Plant includes previously disturbed herbaceous upland, scrub-shrub upland, barren or graveled industrial upland, emergent wetland, scrub-shrub wetland, and open water (*i.e.*, berthing area, ICW, three drainage channels, and two man-made ponds). Wildlife habitats at the Pretreatment Plant site and along the proposed Pipeline/Utility Line System include herbaceous upland, scrub-shrub upland, barren or graveled industrial upland, emergent wetland, scrub-shrub wetland, and open water (*e.g.*, Horseshoe Lake and Oyster Creek). Much of the herbaceous upland and drier emergent wetland areas, including those that characterize the Pretreatment Plant site, support cattle grazing and can be categorized also as pasture land.

The primary impact on wildlife would be the cutting, clearing, and/or removal of existing vegetation within the construction work areas, and the permanent loss of habitat associated with new aboveground facilities. As the area supports currently operating industrial facilities within the larger Port Freeport, Oyster Creek, and Stratton Ridge areas, wildlife present are likely fairly tolerant of industrial activity and noise. Additionally, because the habitats affected by construction are widespread and common in the area, it is expected that the small numbers of wildlife displaced during construction would relocate, either temporarily or permanently, to suitable habitat nearby.

However, to protect raptors and other large birds we are recommending that Freeport LNG implement FWS's Avian Protection Plan Guidelines when constructing the new electric transmission lines needed for the Projects. Wildlife activity in the area would likely resume soon after the completion of construction of the Liquefaction Project, and with our mitigation, would not have a significant impact on migratory birds, or other wildlife.

5.6.2 Phase II Modification Project

Because the Phase II modification Project location is within the area of the Liquefaction Plant, impacts on wildlife would be the same as those described for the Liquefaction Plant and would not be significant.

5.7 AQUATIC RESOURCES

5.7.1 Liquefaction Project

Potential fishery resources and habitat impacts that could occur during construction and dredging of the Liquefaction Project at the Quintana Island terminal site. Construction may cause temporary emigration of fish populations from the immediate area in order to avoid areas of elevated suspended sediments. However, it is unlikely that relocation or disrupted migration would significantly affect fish populations because construction activities are expected to be short term and localized. In addition, Freeport LNG's Procedures and its Dredging Plan would minimize migration of sediments from the Liquefaction Project sites.

Operation of the Projects would result in the discharge of ballast water of approximately 7.1 billion gallons (21,890 acre feet) annually, assuming a rate of 400 ships per year and a mix of LNG vessel sizes. Potentially, discharge of ballast water in the Quintana Island terminal's berthing area could provide a pathway for the introduction of exotic aquatic nuisance species into U.S. coastal waters near Quintana Island. However, these potential impacts are mitigated via USCG regulations that require all vessels equipped with ballast water tanks, which enter or operate in U.S. waters to maintain a ballast water management plan.

Impacts on fisheries and other aquatic life are expected to be minor, short-term, and localized, based on the expanse of each waterbody and the ready availability of similar habitat beyond the construction sites. These features would allow displaced fish and other fauna to relocate temporarily elsewhere and disturbed vegetation would be reestablished from peripheral stock. Impacts would be minimized by implementation of Freeport LNG's Procedures.

The proposed Pipeline/Utility Line System construction of the Pipeline/Utility Line System would result in temporary in-stream impacts. Although some sedimentation and turbidity would be associated with construction disturbance in these waterbodies, population-level impacts on fisheries and other aquatic life are expected to be minor, short-term, and localized. Impacts would be minimized through implementation of Freeport LNGs Procedures and the use of HDD to cross the FHC, the ICW, Oyster Creek, the eastern Velasco Ditch, and the western Velasco Ditch.

The Brazos River Estuary is designated as EFH for four groups of shellfish and finfish, and includes those portions of the FHC, ICW, Oyster Creek, unvegetated shallow water estuarine areas, and estuarine wetlands crossed by the proposed Pipeline/Utility Line System. It does not include waterbodies on or adjoining the Pretreatment Plant site. NOAA Fisheries previously concluded for Freeport LNG's Phase I and Phase II Projects that, with the implementation of appropriate and previously defined mitigation measures, dredging in these areas would have no adverse effects on the aquatic resources. Consultation is ongoing with NOAA Fisheries to ensure that impacts on the aquatic species are minimized.

As a result, we conclude that with careful implementation of Freeport LNG's Procedures and Dredging Plan, and our recommendations the current work would not result in significant impacts on these EFH resources.

5.7.2 Phase II Modification Project

Because the Phase II Modification Project location is within the area of the Liquefaction Project, and the same mitigation measures would be employed as discussed above, impacts on aquatic resources would be minor and not significant.

5.8 THREATENED AND ENDANGERED SPECIES

5.8.1 Liquefaction Project

Of the FWS jurisdictional federally-listed species in Brazoria County, two bird species (piping plover and whooping crane) and two reptiles (Kemp's Ridley sea turtle and loggerhead) have suitable habitat within or near the Liquefaction Project. The Kemp's Ridley and loggerhead sea turtles have been known to nest in the vicinity of the Liquefaction Project.

Of the NOAA Fisheries jurisdictional federally-listed species in the Gulf of Mexico, two marine mammal species (blue whale and humpback whale have suitable habitat near the Liquefaction Project (*e.g.,* within the general area frequented by LNG ships navigating to and from the Quintana Island terminal). Of the eight potential Species of Concern recognized by NOAA Fisheries that may occur in the Gulf of Mexico, two fish species (dusky shark and sand tiger shark) have suitable habitat near the Liquefaction Project.

Based on our review and the mitigation proposed, we have determined that the Liquefaction Project *may affect, but is not likely to adversely affect* the referenced federally-listed species from construction or operation of the Liquefaction Project. The referenced Species of Concern are not likely to be present or affected. Mitigation proposed includes Freeport LNG's FLDP, which helps minimize lighting and potential for bird strikes. No threatened/endangered habitat exists at the Liquefaction Plant site, Pretreatment Plant site or Pipeline/Utility Line System areas. Any such habitat is separated and buffered by other land.

Our effects determination is supported by the lack of any known impact on threatened/endangered species caused by the construction and operation of Freeport LNG's Phase I and Phase II facilities as evidenced in part by its four yearlong bird strike study. The bird strike study showed no injuries or mortalities to any threatened/endangered (or migratory) avian species occurred during construction and operation of the Phase I terminal facilities, which includes the two LNG storage tanks, air tower, LNG dock unloading arms, and installed power lines. We have included a recommendation to ensure that consultation with USFWS and NOAA Fisheries are finalized prior to construction.

At the request of public commenters and the USEPA, we analyzed potential impacts on federally-listed threatened/endangered species from air emissions. Air emissions stemming from construction and operation of the Freeport LNG Project contain nitrogen and sulfur compounds that contribute to acidification and nitrogen enrichment in the environment that may adversely impact terrestrial and aquatic ecosystems. Based on cumulative data of air emission deposition and its impacts on the environment, we conclude that, by themselves, the construction and operation emissions would not result in a "take" for the federally-listed endangered species. Thus depositional impacts do not change the previous determinations of *may affect, but is not likely to adversely affect* for each of the federally-listed threatened/endangered species.

As previously discussed, the Liquefaction Project does not represent a change in number of LNG ships from what was analyzed in the Freeport LNG Import Facility (CP03-75-000) and Phase II Project and thus we do not anticipate further impacts on threatened/endangered species under the Liquefaction Project due to shipping.

There are 27 state-listed species with potential to occur in the area (*i.e.*, 10 birds, one fish, one marine mammal, four terrestrial mammals, three mollusks, six aquatic reptiles, and two terrestrial reptiles). Due to the characteristics of these species, Freeport LNG's mitigation measures, and our recommendation for design of the electric lines to accommodate raptors and large birds, construction or operation of the Liquefaction Project is not expected to impact these species.

5.8.2 Phase II Modification Project

The federally-listed and state-listed species identified above have similar potential to occur in the vicinity of the Phase II Modification Project because the footprint is within the Liquefaction Plant area.

5.9 LAND USE

5.9.1 Liquefaction Project

Work on Quintana Island related to the Liquefaction Plant would involve (97.3 acres of temporary impact and 144.6 acres of permanent impact and generally would take place adjacent or close to existing industrial uses of the LNG terminal and does not represent a substantial change in land use. The majority of the land affected at the Liquefaction Plant is open land and industrial land.

The site of the Pretreatment Plant was selected as a result of concerns expressed by stakeholders about land use impacts including visual, noise traffic impacts, and safety concerns at the original site. Construction of the Pretreatment Plant would require 218.3 acres, of which 104.9 acres would be temporary impacts, and 113.4 acres would be permanent impacts. Open land is the largest affected land use at the Pretreatment Plant site, accounting for 164.6 acres (75 percent) of the 218.3 acres affected overall: The Pretreatment Plant work chiefly represents a change in land use from agricultural (associated with cattle grazing) to an industrial land use.

Construction and operation of the Pipeline/Utility Line System would not permanently change the existing land use profile. Construction and operation of the linear underground facilities would involve only temporary impacts, and the footprints of the aboveground ancillary facilities (<0.1 acres total) would be within Freeport LNG's existing pipeline rights-of-way or industrial property. Impacts on land use associated with the Pipeline/Utility Line System would be minimized by both locating the work along existing right-of-ways.

Photo simulations show that the while residences to the south and west of the Liquefaction Plant on Quintana Island would have views of the new facility, their views toward the Liquefaction Plant already have an industrial context as a result of the existing Freeport terminal. In addition, views would be partially blocked by the 21-foot-high levee that runs along the southern perimeter of the terminal site and the 30-foot-high levee that runs along the southern and western perimeter of the adjacent former DMPA. Nighttime simulations of the facility show similar results: although the residential areas of Quintana Island would be able to see the lighting from the Liquefaction Plant, the residential locations already have views of the existing Freeport LNG terminal, and Freeport LNG has taken measures to reduce lighting impacts offsite using its FLDP.

Visual impacts would also occur around the Pretreatment Plant. Here the closest residence is situated about 0.17 mile from the construction footprint and about 0.47 mile from the operational footprint. The visual simulation shows the Pretreatment Plant adds an industrial dimension to the otherwise open landscape, though the distance between the plant and the closest residence minimizes visual impacts.

With respect to TCMP review, Freeport LNG has not received its coastal zone consistency determination from the TCMP Texas General Land Office, CCC. We are recommending that Freeport LNG not be allowed to begin construction until it receives the CCC's determination that the Projects are consistent with the TCMP.

As a result, while the residents of the Town of Quintana would be able to see the Liquefaction Plant and would have minor visual impacts, the Liquefaction Project would not result in a significant impact on land use including planned developments, land ownership, transportation, recreation and special interest areas, residential areas and visual resources.

5.9.2 Phase II Modification Project

A total of 38.5 acres of land would be required for the Phase II Modification Project, including 14.6 acres that would be temporarily disturbed during construction and 23.9 acres within existing fence line or on existing DMPA that would be affected on a permanent basis for operation. Like the land use impacts associated with the Liquefaction Plant, the Phase II Modification Project is located at or adjacent to the existing Freeport LNG terminal and the land affected consists mostly of open lands (21.6 acres) and industrial land (10.3 acres). Visual impacts associated with the Phase II Modification Project would not be significant given the industrial nature of the existing Freeport LNG terminal and the minor changes proposed.

5.10 SOCIOECONOMICS

5.10.1 Liquefaction Project

The Liquefaction Project as a whole would require, during the peak construction period, more than 3,000 temporary workers and operation of the Liquefaction Project facilities would require the addition of approximately 163 permanent workers. While there may be temporary and minor constrictions of the supply of temporary housing and increased congestion of roadways near the Liquefaction Project, we conclude that there are sufficient resources (*e.g.,* housing, emergency services, roadway capacity, school system and other municipal services) to address both the temporary influx of workers who may want to move to the area, and the permanent workers to fill the 163 job openings. We are recommending that Freeport LNG finalize a Transportation Management Plan prior to construction for review and approval to ensure that both construction and worker traffic is mitigated to the extent possible. Nearby residents, especially those of the Town of Quintana would be most affected by the large increase in construction and worker vehicle traffic. This would be minimized to the extent practicable by the Transportation Management Plan however this would result in a significant and unavoidable impacts on the residents of the Town of Quintana during construction of the Liquefaction Plant and Phase II Modification Projects. For the wider Brazoria County, our recommendation and Freeport LNG's construction plans would mitigate these impacts and we conclude that the construction and operation of the Liquefaction Project would not have a significant adverse impact on population, including public services, traffic, schools, emergency services, property values, and disadvantaged communities.

5.10.2 Phase II Modification Project

The Phase II Modification Project would require, during the peak construction period, up to 500 to 600 temporary workers and operation of the Phase II Modification Project would require approximately three to five new permanent workers. The construction traffic would add cumulatively to the impacts from the Liquefaction Project. The impacts on the local population would be similar, but less, than that of the Liquefaction Project due to the smaller workforce.

5.11 CULTURAL RESOURCES

5.11.1 Liquefaction Project

Freeport LNG prepared a cultural resources overview report for the Liquefaction Plant site and the Pretreatment Plant site and concluded that no impacts on cultural resources would occur. The Texas SHPO concurred with these recommendations. Based on our review, we also agree with the determination. Freeport LNG has not documented that the all elements of its Pipeline/Utility Line System have been covered by cultural resources surveys, other than the existing 9.6-mile long sendout pipeline route between Quintana Island and the Stratton Ridge gas storage facility. The FERC must ensure that our responsibilities under the NHPA and the ACHP's implementing regulations for Section 106 at 36 CFR 800 are met. Accordingly, we are recommending that work not commence until Freeport LNG files with the Secretary: (1) remaining cultural resources survey report(s) and their attachments for work proposed by Freeport LNG; (2) site evaluation report(s) and avoidance/treatment plan(s), as required; and (3) comments on the cultural resources reports and plans from the SHPO. With the limited scope and our recommendation to complete the Section 106 process, that the Commission would ensure the Liquefaction Project would not have a significant impact on cultural resources.

5.11.2 Phase II Modification Project

The Phase II Modification Project would not have a significant impact on air quality. Construction of the Phase II Modification Project at the Quintana Island terminal would result in intermittent and short-term fugitive emissions, primarily of fuel combustion products in non-road and on-highway construction equipment as well as delivery vehicles. The extent of any fugitive dust emissions caused by excavation or vehicular use would depend on the moisture content and texture of the soils or other materials that would be disturbed.

For the Phase II Modification Project, the only operation emissions would be fugitive emissions, totaling 1.18 tpy of VOC, from piping systems at the Quintana Island terminal.

5.11.3 Phase II Modification Project

Freeport LNG has prepared a cultural resources overview report for the area of the Phase II Modification work and concluded that no impacts on cultural resources would occur. The Texas SHPO has concurred with these recommendations and we also agree with the determination. Therefore, we find that the Phase II Modification Project would not have significant impacts on cultural resources.

5.12 RELIABILITY AND SAFETY

We evaluated the safety of the proposed pipeline and LNG facilities associated with the Liquefaction Project and the Phase II Modification Project, including a review of the cryogenic design of the facilities proposed for liquefaction, related facilities, and safety systems. Our assessments addressed hazards, preliminary engineering design, siting requirements, siting analysis, emergency response, and facility security. In accordance with the working arrangements allowed by the 1985 MOU between the FERC and the USDOT, the USDOT reviewed our analysis of Freeport LNG's compliance with the requirements in 49 CFR 193, as well as our recommended mitigation measures, and has no objections at this time. Section 5.15 identifies the specific recommendations to be addressed by Freeport LNG prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, and prior to commencement of service.

Freeport LNG would design, construct, operate and maintain its pipeline facilities to meet or exceed the USDOT Minimum Federal Safety Standards in 49 CFR 192 and other applicable federal and state regulations.

Based on our technical review of the preliminary engineering designs, we conclude that sufficient layers of safeguards would be included in the design of the Projects to mitigate the potential for an incident that could damage the facility, injure operating staff, or impact the safety of the off-site public.

The principal hazards associated with the substances involved in the liquefaction, storage and vaporization of LNG result from cryogenic and flashing liquid releases; flammable and toxic vapor dispersion; vapor cloud ignition; pool fires; BLEVEs; and overpressures. As part of our review, we assessed the potential for public safety. Prior to the end of the draft EIS comment period, Freeport LNG is required to provide information to FERC staff detailing how the portion of the vapor cloud extending onto the ExxonMobil facility would comply with the exclusion zone requirements of 49 CFR 193. The small area of the ExxonMobil property that the vapor dispersion extends over is an adjacent industrial property and is not publicly accessed.

In order to provide a consistent assessment of potential public impacts, we applied a similar review technique to the Pretreatment Plant facilities. Based on our review of Freeport LNG's siting analyses, we conclude that potential hazards from the Pretreatment Plant would also not have a significant impact on public safety. As a result, we conclude that the siting of the Pretreatment Plant, Liquefaction Plant and Phase II Modification Project would not have a significant impact on public safety and would represent only a slight increase in risk to the nearby public.

5.13 AIR AND NOISE

5.13.1 Air Quality

5.13.1.1 Liquefaction Project

Air emissions during the construction of the proposed Projects would consist of tailpipe emissions (due to fossil fuel combustion from equipment and vehicles) and fugitive dust (ground and roadway dust). The greatest emissions for any given year of construction are estimated to be the following: NO_x 650.8 tpy; CO 5,871.6 tpy; VOC 180.7 tpy; PM_{10} 727.4 tpy; $PM_{2.5}$ 114.5 tpy; SO_2 54.2 tpy; and GHG 101,821 tpy CO_2e.

These emissions would be temporary and may vary in intensity and composition over the 4.5 years of construction. While, the construction emissions would significantly affect air quality in the region, they may cause elevated dust and pollutant levels in close proximity to the Projects. Freeport LNG must comply with General Conformity and thus we are recommending that Freeport LNG offset the emissions of NO_x and VOC from construction, obtain a specific commitment from TCEQ to account for emissions of NO_x and VOC in the region's SIP, or otherwise comply with the General Conformity demonstration under the CAA. As the lead agency, the FERC must prepare and make public both the draft General Conformity Analysis and the final General Conformity Analysis prior to authorization of construction. This separate document would be prepared once the appropriate information is obtained from Freeport LNG.

Air emissions from the operation of the Liquefaction Plant, and Pretreatment Plant stationary sources would be minimized by using electric-powered equipment, high-efficiency equipment, state of the art emission controls, burning natural gas, and using proper maintenance and operating procedures. The emissions from stationary sources are estimated to be the following: NO_x 65 tpy; CO 95 tpy; VOC 24 tpy; PM_{10} 87 tpy; $PM_{2.5}$ 87 tpy; SO_2 25 tpy; and GHG 1,580,866 tpy CO_2e.

Freeport LNG submitted permit applications to the TCEQ and USEPA for these emissions. These applications included simulations showing that the emissions would not cause a violation of a NAAQS or PSD Increment.

As part of the TCEQ permitting process, Freeport LNG used an air quality model to estimate the air quality impacts from the facility. The results demonstrated that air quality impacts from the facilities and surrounding industrial facilities would not exceed the NAAQS. We updated this air quality model with revised emissions from the LNG vessels and escort vessels. We confirmed that, although cumulative impacts from all the industrial facilities in the area combined with operation of the Projects would exceed the NAAQS for $PM_{2.5}$, Freeport LNG's facilities are not the cause of the exceedance. Thus, we conclude that impacts on air quality would not be significant.

5.13.2 Environmental Noise and Vibration

5.13.2.1 Liquefaction Project

The ambient noise environment would be affected during construction of the Pipeline/Utility Line System and construction and operation of the Pretreatment and Liquefaction Plants.

Residents in the immediate vicinity of construction activities at the Pretreatment and Liquefaction Plant would experience an increase in noise during the 4.5 years of construction. Certain construction activities at the Liquefaction Plant, such as HDD work, dredging, and pile driving, while temporary, would take 3 years to finish and would result in longer term noise impacts and greater annoyance of the residents of the Town of Quintana.

Based upon Freeport LNG's noise calculation, noise from pile driving at the Liquefaction Plant would be distinctly heard by Quintana Island residents with noise increases up to 21 dBA over ambient and above 55 dBA. However, pile driving would only be done during daytime hours. Dredging activities have the potential for 24-hour per day elevated noise impacts sustained over 120 days. Freeport estimated that the dredging noise impact would be significantly over 55 dBA L_{dn} at one NSA. To address noise concerns associated with both pile driving and dredging, we are recommending that Freeport LNG submit a Construction Noise Mitigation Plan that outlines measures to reduce dredging noise to no greater than 55 dBA L_{dn}, and includes mitigation measures to reduce pile driving noise (L_{max}) to no greater than 10 dBA over ambient levels. This would represent a doubling of existing ambient noise and would be a significant adverse impact on the residents of the Town of Quintana during construction.

HDD noise for the pipeline installation would elevate noise levels at several NSAs. At most locations where noise would be above 55 dBA L_{dn}, Freeport LNG committed to install mitigation to reduce noise to below 55 dBA L_{dn}. At a few NSAs, the mitigation would not reduce noise below 55 dBA L_{dn}, however the noise increase over ambient would be below 6 dBA.

Operational noise at the Pretreatment Plant would increase ambient noise; however, the noise attributable to the facility would remain below 55 dBA L_{dn}. We are recommending that Freeport LNG conduct a full load noise survey to confirm this after the facility becomes operational.

Ship loading, and LNG Vessel Movement would be other sources of noise. Freeport estimated that ship loading noise would be minor, and should not rise to levels above 55 dBA L_{dn} at the nearest NSA. LNG Vessel movement may cause short term noise elevation above 55 dBA L_{dn}, but would not exceed 10 dBA above ambient at the nearest NSAs.

The noise modeling analysis for Liquefaction Plant operation initially revealed that even with extensive noise mitigation, the 55 dBA L_{dn} limit could not be achieved at the some of the nearest NSAs. Freeport LNG subsequently purchased all of the NSAs where noise impacts could not be mitigated. Operational noise at the Liquefaction Plant would increase ambient noise; however, the noise attributable to the facility would remain below 55 dBA L_{dn}. Freeport LNG would include significant noise mitigation measures in order to achieve compliance with our 55 dBA L_{dn} noise level limit at any NSAs and noise increases would be below 3 dBA at the nearest

NSAs. We are recommending that Freeport LNG conduct a noise survey after each Liquefaction Train becomes operational to ensure that the noise attributable to the Liquefaction Plant would not exceed 55 dBA L_{dn}.

The only exception to this would be cool down flaring operations, which would occur very infrequently, (once every few years), but would have elevated noise levels during this operation.

Noise and vibration from LNG vessel movement during operation may be elevated and cause annoyance at the nearest NSAs on Quintana Island. LNG vessel backing is a short term event, and increases in noise during this activity would be less than 10 dBA. Freeport LNG’s analysis revealed that during LNG vessel backing, moderately perceptible vibration would occur at an NSA. This activity may occur up to 400 times per year. The FERC has received complaints from residents of the Town of Quintana regarding ship vibration. As a result, we are recommending that Freeport prepare a Ship Noise & Vibration Monitoring Plan that details how Freeport LNG would monitor noise and vibration from LNG ship movement and loading operations to ensure that noise would not exceed 55 dBA L_{dn}, and would not cause vibration in excess of the Clearly Perceptible Vibration Threshold under ANSI S12.2-2008. With Freeport LNG's mitigation and our recommendations, we expect noise impacts associated with operation or the Liquefaction project to be minor, with minor to moderate vibration impacts at least one NSA in the Town of Quintana.

5.13.2.2 Phase II Modification Project

The Phase II Modification Project would have construction noise impacts similar to the noise from construction of the Pretreatment Plant. Both the construction of the dock and the operational noise was analyzed in the EAP-EA. No new operational noise generating sources would be associated with the Phase II Modification Project that were not already assessed and approved under the Phase II Project.

5.14 CUMULATIVE IMPACTS

Freeport LNG’s Liquefaction and Phase II Modification Projects would not have any significant and readily identifiable cumulative impacts from a natural resources perspective. While some additive effects would occur, *e.g.*, Freeport LNG’s Projects would increase the sum total of wetland acreage impacts and, in concert with FHC improvements, may cause water column turbidity across a wider area, no compounding effects have been recognized. Often any such effects appear to be precluded by the degree of geographic separation between projects, which is also the case with visual impacts. Similarly, construction and operation of the Projects along with other facilities would be additive to the existing air quality problems in Brazoria County. As discussed in section 4.11.1, although the Projects would not be the primary cause of any violation of the NAAQS, they would add a small amount to the existing nonattainment status of the area.

We conclude that the construction impacts on the small Town of Quintana would not be minor, as residents in the small community would be subjected to compounding adverse impacts from construction and operational noise, dust and air pollutants from construction and operation, vibration, visual impacts, and much higher traffic flows of construction and worker vehicles during the 4.5 years of construction. During construction of the original Quintana Island terminal, Freeport LNG documented several instances of complaints from the public regarding noise and vibration. Although individual members of the community may be affected to a greater or lesser extent, these impacts on the residents of the Town of Quintana would be significant and unavoidable.

With respect to socioeconomic factors, Freeport LNG's Projects would contribute to cumulative impacts in so much as the demand for housing and number of workers would increase and there would be associated additional burdens on road usage and public services. However, as with natural resource factors, these impacts would essentially be additive rather than compounding. In contrast to the environmental impact and traffic impacts, the socioeconomic impacts on the Town of Quintana should be primarily positive or neutral, including additional tax base. In summary, cumulative impacts associated with Freeport LNG's Projects should not result in significant additional burdens on public service, housing or other socioeconomic factors on Freeport, Brazosport, and across Brazoria County.

5.15 FERC STAFF'S RECOMMENDED MITIGATION

We conclude that construction and operation of the Projects would result in adverse impacts on certain resources and nearby communities. We have identified that there would be significant and unavoidable impacts to residents of the Town of Quintana due to construction noise and construction traffic if the Projects are approved by the Commission. The other adverse impacts would be reduced to less-than-significant levels with the implementation of Freeport LNG's mitigation measures and the additional measures we recommend in this EIS.

If the Commission authorizes the proposed Projects, we recommend that the following measures be included as specific conditions in the Commission's Order. We conclude that these measures would further mitigate environmental impacts associated with construction and operation of the proposed Projects. Where the recommended conditions require the filing of information, the information should be filed with the Secretary of the Commission.

1. Freeport LNG shall follow the construction procedures and mitigation measures described in their applications, supplemental filings (including responses to staff data requests), and as identified in the EIS, unless modified by the Order. Freeport LNG must:

    a. request any modification to these procedures, measures, or conditions in a filing;

    b. justify each modification relative to site-specific conditions;

    c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and

    d. receive approval in writing from the Director of OEP **before using that modification**.

2. The Director of OEP has delegated authority to take all steps necessary to ensure the protection of life, health, property, and the environment during construction and operation of the Projects. This authority shall include:

   a. stop-work authority and authority to cease operation; and

   b. the design and implementation of any additional measures deemed necessary to assure continued compliance with the intent of the conditions of the Order.

3. **Prior to any construction**, Freeport LNG shall file an affirmative statement, certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with construction and restoration activities.

4. The authorized facility location shall be as shown in the EIS, as supplemented by filed alignment sheets. **As soon as they are available, and before the start of construction**, Freeport LNG shall file any revised detailed survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these alignment maps/sheets.

5. Freeport LNG shall file detailed alignment maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage yards, new access roads, and other areas that would be used or disturbed and have not been previously identified in filings. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

   This requirement does not apply to extra workspace allowed by the Freeport LNG's procedures and/or minor field realignments per landowner needs and requirements which do not affect other landowners or sensitive environmental areas such as wetlands.

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   a. implementation of cultural resources mitigation measures;

   b. implementation of endangered, threatened, or special concern species mitigation measures;

   c. recommendations by state regulatory authorities; and

d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

6. **Within 60 days of the acceptance of the authorization and before construction begins**, Freeport LNG shall file a single Implementation Plan for the review and written approval by the Director of OEP for the Projects. Freeport LNG must file revisions to the plan as schedules change. The plan shall identify:

   a. how Freeport LNG will implement the construction procedures and mitigation measures described in its respective application and supplements (including responses to staff data requests), identified in the EIS, and required by the Order;

   b. how Freeport LNG will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;

   c. the number of EIs assigned per spread and aboveground facility sites, and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;

   d. company personnel, including EIs and contractors, who will receive copies of the appropriate materials;

   e. the location and dates of the environmental compliance training and instructions Freeport LNG will give to all personnel involved with construction and restoration (initial and refresher training as the Projects progress and personnel change), with the opportunity for OEP staff to participate in the training session(s);

   f. the company personnel (if known) and specific portion of Freeport LNG's organization having responsibility for compliance;

   g. the procedures (including use of contract penalties) Freeport LNG will follow if noncompliance occurs; and

   h. for each discrete facility, a Gantt or PERT chart (or similar Project scheduling diagram), and dates for:

      1) the completion of all required surveys and reports;
      2) the environmental compliance training of onsite personnel;
      3) the start of construction; and
      4) the start and completion of restoration.

7. Freeport LNG shall employ at least one EI for the Liquefaction Plant and the Phase II Modification Project and at least one EI for the Pretreatment Plant and the Pipeline/Utility Line System. Each EI shall be:

a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or other authorizing documents;

b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 7 above) and any other authorizing document;

c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;

d. a full-time position, separate from all other activity inspectors;

e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and

f. responsible for maintaining status reports.

8. Beginning with the filing of its Implementation Plan, Freeport LNG shall file updated status reports on a **bi-weekly** basis for the Projects until all construction and restoration activities are complete. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

a. an update on Freeport LNG's efforts to obtain the necessary federal authorizations;

b. the construction status at the Liquefaction and Phase II Modification Project sites, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally sensitive areas;

c. a listing of all problems encountered and each instance of noncompliance observed by each EI during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);

d. a description of the corrective actions implemented in response to all instances of noncompliance, and their cost;

e. the effectiveness of all corrective actions implemented;

f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the Order, and the measures taken to satisfy their concerns; and

g. copies of any correspondence received by Freeport LNG from other federal, state or local permitting agencies concerning instances of noncompliance, and Freeport LNG's response.

9. Freeport LNG shall develop and implement an environmental complaint resolution procedure. The procedure shall provide affected landowners with clear and simple directions for identifying and resolving their environmental mitigation problems/concerns during construction and restoration of the Projects. **Prior to construction**, Freeport LNG shall mail the complaint procedures to each landowner whose property would be crossed by the Projects.

   a. In its letter to affected landowners, Freeport LNG shall:

      1) provide a local contact that the landowners should call first with their concerns; the letter should indicate how soon a landowner should expect a response;
      2) instruct the landowners that if they are not satisfied with the response, they should call Freeport LNG's Hotline; the letter should indicate how soon to expect a response; and
      3) instruct the landowners that if they are still not satisfied with the response from Freeport LNG's Hotline, they should contact the Commission's Dispute Resolution Division Helpline at 877-337-2237 or at ferc.adr@ferc.gov.

   b. In addition, Freeport LNG shall include in its biweekly status report a copy of a table that contains the following information for each problem/concern:

      1) the identity of the caller and date of the call;
      2) the location by milepost and identification number from the authorized alignment sheet(s) of the affected property;
      3) a description of the problem/concern; and
      4) an explanation of how and when the problem was resolved, will be resolved, or why it has not been resolved.

10. **Prior to receiving written authorization from the Director of OEP to commence construction of the Projects**, Freeport LNG shall file documentation that has received all applicable authorizations required under federal law (or evidence of waiver thereof).

11. Freeport LNG must receive written authorization from the Director of OEP **prior to introducing hazardous fluids into the Projects**. Instrumentation and controls, hazard detection, hazard control, and security components/systems necessary for the safe introduction of such fluids shall be installed and functional.

12. Freeport LNG must receive written authorization from the Director of OEP **before placing the Projects into service**. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with FERC approval and applicable standards, the facilities can be expected to operate safely as designed, and the rehabilitation and restoration of the areas affected by the Projects are proceeding satisfactorily.

13. **Within 30 days of placing the authorized facilities in service**, Freeport LNG shall file an affirmative statement, certified by a senior company official:

    a. stating that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

    b. identifying which of the Order conditions Freeport LNG has complied with or will comply with. This statement shall also identify any areas affected by the Projects where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

14. **Prior to the end of the draft EIS comment period,** Freeport LNG shall file a detailed fault investigation for the Pretreatment Plant site for review and written approval by the Director of OEP. This investigation shall provide sufficient information to document the absence of active faulting that may affect the Pretreatment Plant facility. (*section 4.1.1.3*)

15. **Prior to construction**, Freeport LNG shall file the following design and construction details:

    a. an updated slope stability analysis of the north side of Liquefaction Plant area including the slope below the water level early in the design phase. This analysis shall include an updated bathymetry along the waterway channel that defines the underwater continuation of the slope included in the stability analysis;

    b. design details of structures and foundations of the Liquefaction Plant. These design and construction details shall be stamped and sealed by the professional engineer-of-record, registered in the state where the facility where the facility is being constructed, responsible for the design; and

    c. seismic specifications used in conjunction with procuring equipment prior to the issuing of requests for quotations. (*section 4.1.1.3*)

16. **Prior to the start of HDD operations**, Freeport LNG shall file a final site-specific HDD Monitoring and Contingency Plan for review and written approval by the Director of the OEP. (*section 4.3.2.1*)

17. **Prior to construction** of the Projects, Freeport LNG shall file an updated Erosion and Sediment Control Plan to incorporate drainage modifications that meet the requirements of the Velasco Drainage District. (*section 4.3.2.2*)

18. **Prior to the end of the draft EIS comment period**, Freeport LNG shall file the Compensatory Wetland Mitigation Plan developed in consultation with the USACE. The plan shall include:

    a. details regarding the amount, location, and types of mitigation proposed; and

b. specific performance standards to measure the success of the mitigation; and remedial measures, as necessary, to ensure that compensatory mitigation is successful. (*section 4.3.5.1*)

19. **Prior to construction,** Freeport LNG shall incorporate the FWS Avian Protection Plan Guidelines into the design for the proposed 2.93-mile-long 138 kV line to the Liquefaction Plant, and the 1.98 mile 138 kV electric transmission line to the Pretreatment Plant. (*section 4.5.3.1*)

20. Freeport LNG **shall not begin construction activities** until:

    a. the staff completes formal consultation with the FWS and NOAA Fisheries; and

    b. Freeport LNG has received written notification from the Director of OEP that construction or use of mitigation may begin. (*section 4.6.1.4*)

21. Freeport LNG **shall not begin construction** of the Projects until it files a copy of the determination of consistency with the Texas Coastal Management Program issued by the CCC. (*section 4.7.4*)

22. **Prior to the end of the draft EIS comment period**, Freeport LNG shall develop a Transportation Management Plan that details specific measures that would be used to transport materials and construction workers safely to the project work sites. The Transportation Management Plan shall identify off-site vehicle parking areas, alternative worker transportation methods including buses and/or barges, traffic control measures, pedestrian safety measures, traffic control personnel, and construction and delivery hours.

    Freeport LNG shall file the plan, along with any comments provided by Brazoria County agencies, for review and written approval by the Director of OEP. (*section 4.8.5.1*)

23. Freeport LNG **shall not begin construction** of its Pretreatment Plant electric line and the Pipelines/Utility Lines System and/or use of related ancillary areas for staging, storage, and temporary work areas, and new or to-be-improved access roads, **until**:

    a. Freeport LNG files:

        1) remaining cultural resources survey reports;
        2) site evaluation report and avoidance/treatment plan, as required; and
        3) comments on the cultural resources reports and plans from the SHPO;

    b. the ACHP is afforded an opportunity to comment if historic properties would be adversely affected; and

    c. the FERC staff reviews and the Director of OEP approves the cultural resources reports and plans, and notifies Freeport LNG in writing that treatment plans/mitigation measures (including archaeological data recovery) may be implemented and/or construction may proceed.

All materials filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: **"CONTAINS PRIVILEGED INFORMATION - DO NOT RELEASE."** (*section 4.9.4*)

24. **Prior to the end of the draft EIS comment period**, Freeport LNG shall document how it will ensure that the portion of the vapor cloud that could extend onto the ExxonMobil facility would comply with the exclusion zone requirements of 49 CFR 193.2059. (*section 4.10.5)*

Recommendations 25 through 75 shall apply to the Projects. Information pertaining to these specific recommendations shall be filed for review and written approval by the Director of OEP either: **prior to initial site preparation**; **prior to construction of final design**; **prior to commissioning; prior to introduction of hazardous fluids; or prior to commencement of service**, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, shall be filed as critical energy infrastructure information (CEII) pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. 31,228 (2006). Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements, will be subject to public disclosure. All information shall be filed **a minimum of 30 days** before approval to proceed is requested. *(section 4.10.3).*

25. **Prior to initial site preparation**, Freeport LNG shall provide procedures for controlling access during construction.

26. **Prior to initial site preparation,** Freeport LNG shall file an updated Emergency Response Plan which includes the Projects, as well instructions to handle on-site hazardous fluid emergencies.

27. **Prior to initial site preparation,** Freeport LNG shall file an updated Emergency Response Plan which includes a Cost-Sharing Plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base.

28. **Prior to initial site preparation**, Freeport LNG shall file the quality assurance and quality control procedures for construction activities.

29. **Prior to initial site preparation**, Freeport LNG shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.

30. **Prior to initial site preparation**, Freeport LNG shall file an overall project schedule, which includes the proposed stages of the commissioning plan.

31. **The final design** shall address the information/revisions to Freeport LNG's responses to the Engineering Information Requests identified in table 4.10.3-1 of the EIS, which indicated features to be included in the final design and documentation.

32. **The final design** shall include change logs that list and explain any changes made from the FEED provided in Freeport LNG's applications and filings. A list of all changes with an explanation for the design alteration shall be provided and all changes shall be clearly indicated on all diagrams and drawings.

33. **The final design** shall provide up-to-date Process Flow Diagrams with heat and material balances and P&IDs, which include the following information:

    a. equipment tag number, name, size, duty, capacity, and design conditions;

    b. equipment insulation type and thickness;

    c. storage tank pipe penetration size and nozzle schedule;

    d. valve high pressure side and internal and external vent locations;

    e. piping with line number, piping class specification, size, and insulation type and thickness;

    f. piping specification breaks and insulation limits;

    g. all control and manual valves numbered;

    h. relief valves with set points; and

    i. drawing revision number and date.

34. The final design shall provide P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect to the existing facilities.

35. **The final design** shall provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications.

36. **The final design** shall provide complete drawings and a list of the hazard detection equipment. The drawings shall clearly show the location and elevation of all detection equipment. The list shall include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.

37. **The final design** shall provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings shall clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list shall include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units.

38. **The final design** shall provide facility plans and drawings that show the location of the firewater and foam systems. Drawings shall clearly show: firewater and foam piping; post indicator valves; and the location, and area covered by, each monitor, hydrant, deluge system, foam system, water-mist system, and sprinkler. The drawings shall also include P&IDs of the firewater and foam system.

39. **The final design** shall include an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A 2001, chapter 9.1.2 as required by 49 CFR Part 193. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed.

40. **The final design** shall specify that for hazardous fluids, the piping, and piping nipples 2 inches or less are to be no less than Schedule 160.

41. **The final design** shall provide an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that: shall continuously monitor for the presence of a flammable fluid; shall alarm the hazardous condition; and shall shutdown the appropriate systems.

42. **The final design** shall provide electrical area classification drawings.

43. **The final design** shall provide spill containment system drawings with dimensions and slopes of curbing, trenches, and impoundments.

44. **The final design** of the hazard detectors shall account for the calibration gas when determining the LFL set points for methane, propane, ethylene, and NGLs.

45. **The final design** shall include a HAZOP review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations shall be filed.

46. **The final design** shall include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and ESD system. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and setpoints.

47. **The final design** shall include a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas Association's Purging Principles and Practice required by 49 CFR 193, and shall provide justification if not using an inert or non-flammable gas for cleanout, dry-out, purging, and tightness testing.

48. **The final design** shall include the sizing basis and capacity for the final design of pressure and vacuum relief valves for major process equipment, vessels, storage tanks, and vent stacks.

49. **The final design** shall provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3, as required by 49 CFR 193.

50. **The final design** shall include a drawing showing the location of the ESD buttons. ESD buttons shall be easily accessible, conspicuously labeled and located in an area which would be accessible during an emergency.

51. **The final design** shall include a delayed automatic start for the ICW firewater pumps.

52. **The final design** shall provide a hydraulic study for the LNG storage tank piping with the larger in-tank pumps, and confirm the final size of the discharge nozzle and header pipe.

53. **The final design** shall ensure that the LNG storage tank piping supports are adequately designed for the higher rated in-tank pump flow rates.

54. **The final design** shall provide a list of the UPS locations, sizes with load capacities, and services.

55. **The final design** shall include detection of a leak through the pump primary electrical seals, in addition to monitoring and alarming the nitrogen gas pressure to the seal purge, in order to account for small leaks that pressure indicators may not be able to detect. Low temperature or flammable gas detection shall be provided downstream of primary seal. The junction box shall be equipped with flammable gas detection.

56. **The final design** shall include the addition of high pressure alarm and shutdown on the LNG Transfer Drums.

57. **The final design** shall include double isolation valves on the propane vaporizer drains.

58. **The final design** shall specify that the refrigeration system vent lines be equipped with double isolation valves.

59. **The final design** shall specify a pipe class of T39 for the LNG cooldown lines (4”-LNG-111032, 4”-LNG-121032, and 4”-LNG-131032) to downstream of isolation valves (V10448, V20448, and V30448), respectively.

60. **The final design** shall specify that relief valves shall not vent back into a system that has a design pressure equal to or above the relief valve set pressure. The calculated operating pressure of all relief valves shall not exceed the allowable operating pressure of that particular relief valve under any condition.

61. **The final design** shall include a list of the recommendations not considered or included in the final design that are listed in the HAZID review of December 8, 2011 and the justification for the omission.

62. **The final design** shall provide plant geometry models or drawings that verify the confinement and congestion represented in the FEED of the liquefaction train facilities or

provide revised overpressure calculations indicating that a 1 psi overpressure would not impact the public.

63. Freeport LNG shall certify that the **final design** of the facilities at the terminal is consistent with the information provided to USDOT as described in the design spill determination letter dated December 31, 2013 (Accession Number 20140106-4003) as well as in Freeport LNG's filing on December 31, 2013 (Accession Numbers 20131231-5265 and 20131231-5266). In the event that any modifications to the design alters the candidate design spills on which the Title 49 CFR 193 siting analysis was based, Freeport LNG shall consult with USDOT on any actions necessary to comply with Part 193.

64. Freeport LNG shall certify that the **final design** of the Pretreatment Plant is consistent with the information provided to FERC in the project docket. In the event that any modification to the design alters the candidate design spills on which the siting analysis was based, Freeport LNG shall consult with FERC staff on any actions necessary to re-evaluate the siting of the Pretreatment Plant.

65. **The final design** shall include the details of the vapor fences as well as procedures to maintain and inspect the vapor fences provided to meet the siting provisions of 49 CFR Part 193.2059.

66. **The final design** shall include details of the mechanical measures that would prevent the ship transfer rate from exceeding 10,000 m^3/hr in any pipe segment.

67. **Prior to commissioning,** Freeport LNG shall file plans and detailed procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.

68. **Prior to commissioning**, Freeport LNG shall provide a detailed schedule for commissioning through equipment startup. The schedule shall include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. Freeport LNG shall file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued.

69. **Prior to commissioning,** Freeport LNG shall provide tag numbers on equipment and flow direction on piping.

70. **Prior to commissioning**, Freeport LNG shall tag all instrumentation and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.

71. **Prior to commissioning**, Freeport LNG shall file updates addressing the Projects in the operation and maintenance procedures and manuals, as well as safety procedures.

72. **Prior to commissioning**, Freeport LNG shall maintain a detailed training log to demonstrate that operating staff has completed the required training.

73. **Prior to introduction of hazardous fluids**, Freeport LNG shall complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s).

74. **Prior to introduction of hazardous fluids**, Freeport LNG shall complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and Safety Instrumented System that demonstrates full functionality and operability of the system.

75. **Prior to commencement of service**, progress on the construction of the proposed systems shall be reported in **monthly** reports filed with the Secretary. Details shall include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current project schedule. Problems of significant magnitude shall be reported to the FERC **within 24 hours**.

In addition, recommendations 76 through 78 shall apply throughout the life of the Freeport LNG facilities: (*section 4.10.3*)

76. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual basis** or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Freeport LNG shall respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be filed.

77. Semi-annual operational reports shall be filed to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil-off/flash gas, etc.), plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to: unloading/loading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days after each period ending June 30 and December 31**. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also shall be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.

78. Significant non-scheduled events, including safety-related incidents (*e.g.,* LNG, refrigerant, or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (*e.g.*, attempts to enter site, suspicious activities) shall be reported to FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to FERC staff **within 24 hours**. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids related incidents include:

a. fire;

b. explosion;

c. estimated property damage of $50,000 or more;

d. death or personal injury necessitating in-patient hospitalization;

e. release of hazardous fluids for five minutes or more;

f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents to hazardous fluids vessels occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident.

79. **At least 90 days prior to the start of construction** Freeport LNG shall file documentation:

a. from the TCEQ that the proposed Liquefaction Project's direct and indirect construction and operation emissions, including vessel NO_x and VOC emissions, together with all other emissions in the HGB area, would not exceed the emissions budgets specified in the federally-approved HGB SIP; or

b. that the TCEQ commits to explicitly include the Proposed Liquefaction Project's direct and indirect NO_x and VOC emissions in the next revision of the RFP SIP; or

c. that Freeport LNG would obtain offsets or an provide alternative demonstration of General Conformity under the CAA. (*section 4.11.1*)

80. **Prior to construction**, Freeport LNG shall file a Construction Noise Mitigation Plan, for review and approval by the Director of OEP that outlines measures to reduce dredging noise to no greater than 55 dBA L_{dn} at NSAs, and to reduce pile driving noise (L_{max}) to no greater than 10 dBA over ambient levels. (*section 4.11.2.2*)

81. Freeport LNG shall file a full load noise survey **no later than 60 days** after placing the Pretreatment Plant into service. If a full load condition noise survey is not possible, Freeport LNG shall file an interim survey at the maximum possible load **within 60 days** of placing the Pretreatment Plant into service and file the full load survey **within 6 months**. If the noise attributable to the operation of the equipment at the Pretreatment Plant at full load exceeds 55 dBA L_{dn} at any nearby NSAs, Freeport LNG shall install additional noise controls to meet the level **within 1 year** of the in-service date. Freeport LNG shall confirm compliance with this requirement by filing a second full load noise survey **no later than 60 days** after it installs the additional noise controls. (*section 4.11.2.2*)

82. Freeport LNG shall file a full load noise survey **no later than 60 days** after each of the first two liquefaction trains are placed into service at the Liquefaction Plant. If the noise attributable to the operation of the equipment at the Liquefaction Plant exceeds 55 dBA L_{dn} at any nearby NSA, Freeport LNG shall reduce operation of the Liquefaction Plant or install noise mitigation to meet that level at the nearest NSAs. Freeport LNG shall

confirm compliance with this requirement by filing a second full power noise survey **no later than 60 days** after it installs the additional noise controls. (*section 4.11.2.2*)

83. Freeport LNG shall file a full load noise survey **no later than 60 days** after placing the entire Liquefaction Plant into service. If a full load noise survey is not possible, Freeport LNG shall file an interim survey at the maximum possible load within 60 days of placing the Liquefaction Plant into service and file the full operational surveys **within 6 months**. If the noise attributable to the operation of all the equipment of the Liquefaction Plant at full load exceeds 55 dBA L_{dn} at any nearby NSAs, Freeport LNG shall install additional noise controls to meet the level **within 6 months** of the in-service date. Freeport LNG shall confirm compliance with this requirement by filing a second full load noise survey **no later than 60 days** after it installs the additional noise controls. (*section 4.11.2.2*)

84. **Prior to the end of the draft EIS comment period**, Freeport LNG shall file a Ship Noise and Vibration Monitoring Plan that details how Freeport LNG would mitigate noise and vibration from LNG ship movement and loading operations to ensure that noise would not exceed 55 dBA L_{dn}, and would not cause vibration in excess of the Clearly Perceptible Vibration Threshold under ANSI S12.2-2008 (section 4.11.2.2) at the NSAs.

APPENDIX A

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APPENDIX A
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Fredrick J. Fluck, Rio Rancho, NM
G H Turney, Houston, TX
Gary & Louise Bullard, Angleton, TX
Gary Bassinger, Richwood, TX
Gary F & Kathy V Wilson, Freeport, TX
Gary L. & Susan K. Meyer, Lake Jackson, TX
Gary M & Donna L Gabriles, Freeport, TX
Gary R Harris, West, TX
Genice Kopecky Clark, La Port, TX
George & Laurinda Mccloud, Freeport, TX
George Edward Kolb, Wallisville, TX
George Glenn Galloway Est Separate Property Trust, Lake Jackson, TX
George Kaldis, Freeport, TX
George P & Teresa D Kaldis, Houston, TX
George Shakarji, Gaithersburg, MD
George T & Linda C Cressman, Houston, TX
Gerald A & Donna Propst, Freeport, TX
Gerald Propst, Freeport, TX
Gerald Smith
Gilbert Boger, Freeport, TX
Gilbert Charles Rodrick, Houston, TX
Gilbert Gene & Glenda Lenan Muir, Richwood, TX
Gilner L Murrell, Freeport, TX
Glen D Salyer, Freeport, TX
Glen D. Salyer, Freeport, TX
Glenn E Gaumer Jr, Danbury, TX
Greg & Karen Ledenham, Arlington, TX
Gregory French Smith, Freeport, TX
Gregory P Upton, Freeport, TX
Guy N. Matelli, Pearland, TX
Gwen Schroeder, Lake Jackson, TX
Hailey Zuma, Angleton, TX
Harold Doty, Quintana, TX
Harry Bland, Manvel, TX
Hausman Gst Trust F/B/O, Freeport, TX
Hazel Darnell Et Al C/O James B Craig, Beaumont, TX
Helen Caldwell Holm Estate, Dallas, TX
Helen Jones, Lake Jackson, TX
Henry P. & Karen Clayton Jr., Sugarland, TX
Heriberto Montes, Freeport, TX
Herman J Kresse, Houston, TX
Hibbetts Revocable Living Trust, Lake Jackson, TX
Hiram P Arnold Md Estate, Lufkin, TX
Horace Earl Wilson, Wimberley, TX
Howard H Louvier, Freeport, TX
Howard H Louvier, Houston, TX

Howard N Wailes, Jones Creek, TX
Ira Schramek, Deer Park, TX
Jack Patterson, Brazoria, TX
Jeffrey & Christina Jackson, Freeport, TX
Jeffrey C Levanas Trust, Fallbrook, CA
Jeffrey E & Mary D Kapala, Quintana, TX
Jeffrey K & Arden A Tucker, Houston, TX
Jennifer Sanchez, Brazoria, TX
Jerry & Brenda Ensign, Freeport, TX
Jerry Masters, Freeport, TX
Jim & Dawn Hallaman, Sugar Land, TX
Jim Conner, Freeport, TX
Jim Heath, Lake Jackson, TX
Jim Martin, Quintana, TX
Jimmy C Hilton, Angleton, TX
Jimmy D & Carol Walden, Lake Jackson, TX
Jimmy D. & Guindal A. Smith, Freeport, TX
Jimmy D. Urban, Brazoria, TX
Joe & Deborah Luycx, Clute, TX
Joe Kresse, Freeport, TX
Joe Megger, New Caney, TX
Joe P. Goodwin, Freeport, TX
Joe Ripple, Lake Jackson, TX
John & Carol Cox, Freeport, TX
John & Helene Toney, Denham Springs, LA
John & Jennifer Mcalister, Pearland, TX
John A West Jr, Freeport, TX
John Ace Coody, Seabrook, TX
John B & Patricia Phillips, Lockhart, TX
John C Masterson Etal, Houston, TX
John D. Postorino, Angleton, TX
John Eric Buckheit, Freeport, TX
John F & Patricia Castella, Nacgodoches, TX
John F Schott, Sylvania, OH
John H Montgomery Estate, Tyler, TX
John Letulle, Freeport, TX
John M. Leach Ii, Clute, TX
John O & Carole J Mouton, Sugarland, TX
John P Benkenstein, Rosharon, TX
John R & Marsha G Robbins, Freeport, TX
John R Fuller, Houston, TX
John R Huovinen, Brazoria, TX
John Richard Cranston, Spring, TX
John Taylor Kersh, Freeport, TX
John Wiley Thomas, The Hills, TX
John Williams, Portland, OR
Johnie James Schiro Jr., Porter, TX
Johnny & Diane Shipman, Sealy, TX
Johnny L & Linda Richey, Freeport, TX
Jon & Thao Hongthi Nguyen Le, Sugarland, TX
Jon M. Gantenbein, Freeport, TX
Jon Shafer, Montgomery, TX
John Sticklany, Deer Park, TX
Jordan Family Trust, Lake Jackson, TX
Jorge G. Lopez, Freeport, TX
Jose A Torres, Katy, TX
Jose Lopez, Freeport, TX
Jose V & Julie A Saavedra, Lake Jackson, TX
Joseph B Taylor, Houston, TX
Joseph F Kresse, Freeport, TX
Joseph H Walsh, Stafford, TX
Joseph H. Snow, Angleton, TX
Josephine W Session, Manvel, TX
Joyce Burch, Freeport, TX
Joyce Smith, Jones Creek, TX
Juan & Lydia R Longoria, Pearland, TX
Juanita Booth, Baytown, TX
Judge Allen L Stilley, Spring, TX
Judy & Doug Watkins, Freeport, TX
Judy K Starnes, Freeport, TX
Julia J Gee, Houston, TX
Julian S Harmon, Freeport, TX
K C Sharak, West Hollywood, CA
Kara Lee Brandwood, Ottawa, Ottowa, Ontario, Canada
Karen Collins, St Thomas, VI
Karen Summers, Freeport, TX
Kari Macon, Freeport, TX
Kari Maion, Freeport, TX
Karl M. Jr. & Florence Parker, Freeport, TX
Katherine M & Robert M Perry, San Antonio, TX
Kathleen Williams &, West Columbia, TX
Kathy Davis
Kay Turney, Freeport, TX
Keith C & Shelley D Strack, Spring, TX
Kelly Craft, Lake Charles, LA
Ken Plato, Freeport, TX
Kenneth A Gonzales Estate, Palm Beach Gard, FL

Kenneth Edwards, Pearland, TX
Kentaro Toyokawa, Houston, TX
Kevin B & Debra Mays, Freeport, TX
Kevin Foster, Sargent, TX
Kevin Tilley, Freeport, TX
Kevin Walker, Houston, TX
Kevin William Durham, Port Lavaca, TX
Kim & Scott Foster, Freeport, TX
Kim Living Jesse Nugent, Houston, TX
Kim Wessels, Freeport, TX
Kimberly A. Roper Flannery, Dripping Springs, TX
Kirby Marina Inc C/O Lj Kirby, Pasadena, TX
Kodi Maynard, Oyster Creek, TX
Kristin Plunkett, Lake Jackson, TX
Kurt Evans, Clute, TX
L.L. Rhodes, Freeport, TX
Lamar Jordan, Lake Jackson, TX
Lance Albin, Bush, LA
Larry Bontekoe, TX
Larry & Judy Shaefer, Angleton, TX
Larry G & Laura S Jones, Freeport, TX
Larry J & Patricia Heidel, Freeport, TX
Larry Ortiz, Angleton, TX
Larry W Davison, Freeport, TX
Laura & Larry Jones, Freeport, TX
Laura Patricia Ruiz, Spring, TX
Laura Ruddick Abbott, Freeport, TX
Lawrence Kelly, Dickinson, TX
Lawrence Ray & Jimmie Louise Vernon, College Sta, TX
Lawson Revocable Living Trust, England, AR
Leo C Gregory Living Trust, Freeport, TX
Leon A Richardson, Sugar Land, TX
Leonard C & Audrey F Koska, Tomball, TX
Leroy Brooking, Notrees, TX
Leslie Don Jackson, Dallas, TX
Leslie S Willard, West Columbia, TX
Linda J Harris, Houston, TX
Linda M & Mark Felder, Plano, TX
Lisa Annette Moody, Conroe, TX
Lisa Cardenas Jackson, Houston, TX
Lolita Mcneill Muhm, Brazoria, TX
Lou Maddox, Clute, TX
Louis & Debra Snider, Freeport, TX
Louise Irene Stohr, Freeport, TX
Louisi Hinososa, Clute, TX
Luke & Linda Vollemaere, Humble, TX
Lynda D Buchanan, Freeport, TX
Lyndie Just Lyndie, Las Vegas, NV
Lyndsey Miller Delange, Richmond, TX
Lynn & Marlene Brownlow, Sweeny, TX
Lynn B Walker, Freeport, TX
M & Jerry A Miller, Pearland, TX
M Bedingfield & H Johnston, Bandera, TX
Mancil Wilfred, Freeport, TX
Margaret Elaine Steffen Chase, Houston, TX
Marion Norris, Houston, TX
Mark & Diana Taylor, Freeport, TX
Mark Alan Blalock, Katy, TX
Mark Hess, Houston, TX
Mark Mallett, Cypress, TX
Mark Troyer, Rickwood, TX
Martha Burnett Trustee, Houston, TX
Martial Trust & Decendants C/O L & Michael E Miller George Trs, Kemah, TX
Marvin D Lynch, Freeport, TX
Marvin D Lynch, Pasadena, TX
Marvin Eugene Reneau, Clute, TX
Marvin Lynch, Freeport, TX
Mary Ann Thomas, Angleton, TX
Mary E Coulter, Freeport, TX
Mary Kathryn Cornett, Freeport, TX
Mary W. Carter, Houston, TX
Matthew & Yvette Schenck, Conroe, TX
Matthew D. Baumgart, Freeport, TX
Matthew John Briedenbaugh, Houston, TX
Max Bowen, Alvin, TX
Melanie Oldham, Angleton, TX
Melvin Sides, Freeport, TX
Michael & Kirsten Elledge, Freeport, TX
Michael & Susan Luycx, Freeport, TX
Michael Chao, Houston, TX
Michael Cox, Lake Jackson, TX
Michael D Blanchard, Freeport, TX
Michael Duane Merkel, Alvin, TX
Michael F Williamson, Freeport, TX
Michael G Sanderson, Freeport, TX
Michael J. & Lori E. Sorrell, Oyster Creek, TX
Michael Lee Terry, Freeport, TX

Michael T Mcclure, Palestine, TX
Michael Wayne & Helen Mabe, Santa Fe, TX
Michael Wayne Luycx, Freeport, TX
Miguel M Suarez And Celia Von Mering, Quintana, TX
Mike Blanchard, Freeport, TX
Mike H Ainbinder, Freeport, TX
Mike Holmes, Oyster Creek, TX
Mike Lange, Lake Jackson, TX
Miles & Julia Prillaman, Houston, TX
Milton Mendoza Jr, Grand Prairie, TX
Minh Dang, Pflugerville, TX
Morrison Living Trust, Fort Worth, TX
Mrs. Elva Mae Blachowiak, Houston, TX
Mrs. Evelyn H Mcneill Trustee, Brazoria, TX
Mrs. Fay Hudson, Jersey Village, TX
Mrs. Frank T Smith, Victoria, TX
Mrs. M S Munson Estate, Brazoria, TX
Mrs. Polly Beacroft Estate, Freeport, TX
Mrs. C Ezon, Deal, NJ
Ms. Karen Robertson, Freeport, TX
Nancy Hadeler Wilson, Freeport, TX
Nancy Wilson, Freeport, TX
Neida J Krebbs Estate, Muldrow, OK
Nellie Morgan, Neches, TX
Nicole Tomich, Houston, TX
Noe & Guillerma Martinez, Freeport, TX
O T Maxwell, Midland, TX
O.T. Maxwell, Albuquerque, NM
Oscar Acuna, Freeport, TX
Oscar Dowdy, Oyster Creek, TX
P.M. Williams C/O B.H. Williams, Houston, TX
Pat Barnes & Debbie Gann, Benbrook, TX
Patricia A Pettit, Freeport, TX
Patrick D & Susan Burke, Freeport, TX
Patrick F. & Nancy L. Laurie, Freeport, TX
Patt And John Swanson, Houston, TX
Paul & Starlet Zuma, Freeport, TX
Paul A Batts, Freeport, TX
Paul D Gonzales Trustee, Palm Beach Gardens, FL
Paul E Daugherty Jr, Dallas, TX
Paul J Lucco, Sugarland, TX
Paul Layton Brillon, Freeport, TX
Pearl Bales Exec C/O K.G. Archer, Mesa, AZ
Peggy L. Madden, Freeport, TX
Percival T Beacroft Jr, Freeport, TX
Perry Corridor C/O Tom Scott, Midland, TX
Perry Warren Hardwick, Houston, TX
Pete Kaldis, Burton, TX
Peter M. & Martha Lee Lucas, Freeport, TX
Phan Nguyen, Houston, TX
Philip H. Dunn, Houston, TX
Phillip & Kathy Daley, Houston, TX
Phillip G Padgett Jr, Williamsburg, VA
Pink Holdings Co, Houston, TX
Policarpio & Patricia Cisneros, Freeport, TX
R J Kleimann, Houston, TX
R.W. Sells C/O Jacque Sells & Rita Sells, Blackwell, OK
Ra & Jorene Aycock, Lake Jackson, TX
Ralph G & Juanita L Moreno, Freeport, TX
Ralph Thompson, Houston, TX
Randall D Mosman, Dallas, TX
Randall L & Shelley T Waters, Conroe, TX
Randall Valk, Houston, TX
Randell D & Jerri L Williams, Freeport, TX
Raul & Juana Alonso, Freeport, TX
Ray F Horihan, Canton, GA
Ray Cook, Freeport, TX
Ray M & Sandra D Meyer, Freeport, TX
Ray M Cornett, Quintana, TX
Ray M Lester, Jones Creek, TX
Raymond Donald & Eugenia Mapp, Freeport, TX
Raymond Thomas, Houston, TX
Rebecca Amanda Thomas, Lakeway, TX
Rebecca Elizabeth Rayburn, Austin, TX
Rebecca Garza Martinez, Richmond, TX
Rebecca Hall, Rosharon, TX
Rebecca J Mims, Freeport, TX
Reese Hayes Rambo, Freeport, TX
Regina S Mccoy, Freeport, TX
Renalde Mulhollan, Lake Jackson, TX
Rene Flynn, Freeport, TX
RIc Badger, Houston, TX
Richard & Sharlene Shigley, Granbury, TX
Richard A Slane, Yukon, OK
Richard D & Dianna L Linn, Katy, TX
Richard L & Dawn E Hays, Freeport, TX

Richard M & Lynn Waters, Freeport, TX
Richard R. & Wanda F. Blake Kenneth J. Chaney, Freeport, TX
Richard S & Marsha J Griffis, Hilltop Lakes, TX
Rick M & Barbra Osterman, Freeport, TX
Rick Work, Bay City, TX
Robert & Anita Tiano, Freeport, TX
Robert A Hinson, Canyon Lake, TX
Robert Aycock, Richwood, TX
Robert C & Faye L Hagner, Houston, TX
Robert D & Paula Loggins, Freeport, TX
Robert D Archer, Freeport, TX
Robert D Matthews, Katy, TX
Robert E & Sherry Furlough, Kingwood, TX
Robert E Robinson, Freeport, TX
Robert Fleming, West Columbia, TX
Robert G & Sherry A Rasberry, Freeport, TX
Robert H & Kelly L Nipper, Spring, TX
Robert L & Judith Bork, Freeport, TX
Robert Lindveit, Freeport, TX
Robert M. Munson, Angleton, TX
Robert Maddison
Robert Oczowski, Pearland, TX
Robert Tiano, Freeport, TX
Robert W Spencer Jr & Ouida Spencer Capps, Houston, TX
Robert Worley, Freeport, TX
Robin P & Deborah Chapman, Pearland, TX
Robin Rio, Freeport, TX
Rockwell Alice V Trust C/O David Z. Rosensweig, Bronxville, NY
Rodney Leshler, Oyster Creek, TX
Rodney W Holder, Aquilla, TX
Roger K & Patricia Vice, Crosby, TX
Roland E Johnson, Freeport, TX
Romeo F. Laurel , Atlanta, GA
Romeo Rodriguez, Freeport, TX
Romie M. Davis, Lake Jackson, TX
Ron & Carmen Bailer Living Trust C/O Ron & Carmen Bailer, Freeport, TX
Ron & Pat Thibodeaux, Freeport, TX
Ron Paggemoreller, Freeport, TX
Ronald E & Bea G Mcclung, Missouri City, TX
Ronald M & Patricia Thibodeau, Freeport, TX
Ronald Nelson Bailey, Freeport, TX
Ronald P & Suzanne B Coots, Freeport, TX
Ronald V & Maria Poggemoeller, Freeport, TX
Rosalinda R Garcia, Freeport, TX
Rose M. Winn, Freeport, TX
Ross M Hart, Freeport, TX
Roy & Donna Haley, Freeport, TX
Roy C Vanaverbeke, Houston, TX
Roy Marsh, Freeport, TX
Roy Sanchez, Pasadena, TX
Russell C. Singley, Freeport, TX
Russell Lee Estate, Houston, TX
Russell S & Elizabeth A Valles, Freeport, TX
Rusty Merrell, Nederland, TX
Sagness Girouard Jr, Freeport, TX
Sam D Bass, Sweeny, TX
Sam L. Taylor Jr., Palmetto, FL.
Sandra L Tantillo, Friendswood, TX
Sandra Tellez, Oyster Creek, TX
Sandra West Potts, Trinity, TX
Sarabeth Caldwell Waller, Rosharon, TX
Scot H & Perla M Counts, Freeport, TX
Seacrest Co. Llc C/O Jerry Verbout, Houston, TX
Shane Pirtle, Lake Jackson, TX
Sharon S Major, Newburgh, IN
Sharron Stewart, Lake Jackson, TX
Shawn C & Kimberly D Burns, Spring, TX
Snapp Decision Ii, Houston, TX
Sorrell Family Ltd Prtsp, Freeport, TX
Stanley E Berkefelt, Lake Jackson, TX
Stephen & Deborah Alongis, Freeport, TX
Stephen & Lisa Vasek, Freeport, TX
Stephen & Pam Davis, Freeport, TX
Stephen B Richers, Freeport, TX
Stephen Geren, Freeport, TX
Stephen J Kovacs, Clute, TX
Stephen Perry Iii, Freeport, TX
Steve Foley, Kerrville, TX
Steve Gagnon, Clute, TX
Steven G & Vivian A Alford, Freeport, TX
Steven L & Camille M Koska, Freeport, TX
Sunny Jo Dye, Freeport, TX
Suzanne Coots, Freeport, TX
Sylvia Roberts Larson, Baytown, TX
T S Clements Etal, Victoria, TX

T.S. Mccants C/O Mike Sorrell, Oyster Creek, TX
Ta V Low, Brenham, TX
Tallis V. & Lois Turner, Clute, TX
Tami D Soltz, Venice, FL
Tamsey L Mims, Pearland, TX
Ted Laws, Freeport, TX
Teddy Ray & Lynola M Schuster, Freeport, TX
Temple Street Moore Byers, Nacogdoches, TX
Teresa Cornelison, Freeport, TX
Terrence & Mary Jopplin, Spring, TX
Terry A & Phyllis D Voyles, Freeport, TX
Terry D & Mary J Spence, Freeport, TX
Terry Moore, Freeport, TX
Terry Voyler, Freeport, TX
Thanh Dinh, Round Rock, TX
Thanh Van & Quynh T. Duong, Angleton, TX
Theresa Cornelison, Freeport, TX
Thien Nguyen, Freeport, TX
Thomas Edward Lewis Etal, Leakey, TX
Thomas Grant Johnson, Houston, TX
Thomas J & Babich Shayne Yarick, Hempstead, TX
Thomas Joel Garner, Oyster Creek, TX
Timothy J. Mckinley, Houston, TX
Tina Laporte, Freeport, TX
Tobey Davenport, Freeport, TX
Tom & Linda Cressman, Freeport, TX
Tom N Leblanc Sr, Freeport, TX
Tommy J & Deborah Muston, Houston, TX
Tommy Paul & Dianna F Tutle, Southlake, TX
Tommy R. Tomblin, Brazoria, TX
Tony & Debbie Isacks, Freeport, TX
Tony Chrisman, Little Elm, TX
Trvis W & Barrett J Gibson, Houston, TX
Tyson Sowell, Houston, TX
Val P & Nancy A Hoffman, Freeport, TX
Val P. Hoffman, Freeport, TX
Van L Jensen, Freeport, TX
Venila Gladys Nichols, Freeport, TX
Vernon A & Billie Joy Martin Revocable Living Trust, Friendswood, TX
Victor Ruiz, Spring, TX
Virginia & Jamie Murray Johnson, Angleton, TX
Virginia Hall, Clute, TX
Vivian Louise Mcnally, Freeport, TX
W D & Freda P Cavin, Freeport, TX
W J White, Latexo, TX
W R & Margaret Barber, Buffalo, TX
W. David Tidholm, Houston, TX
Wade Cook, Freeport, TX
Walter F. Harris, Freeport, TX
Warren D & Barbara Hawkins, Houston, TX
Wayne & Anita Cromis, Oyster Creek, TX
Wayne A Kovar, Rosenberg, TX
Wayne Shaw, Lake Jackson, TX
Wes K & Stacey E Lincecum, Houston, TX
Wilhelmina Bennington, S Pasadena, CA
William Arraez, The Woodlands, TX
William B Blackwell, Freeport, TX
William B Mock, Houston, TX
William Bess, Quintana, TX
William Bryan Shaver Etal, North Zulch, TX
William Candelaria, Freeport, TX
William D & Wanda T Bennett, Auburndale, FL
William G Bounds, Freeport, TX
William Gene Mackey, Glen Rose, TX
William H. Manuel, Orange, TX
William P. & Denise L. Carter, Pearland, TX
William R Sledge, Lake Jackson, TX
William T & Richard C Kennedy, Washington, TX
Wiltshire Wiltshire, Clute, TX
Zimin Su, Missouri City, TX

APPENDIX B

Draft PSD Greenhouse Gas Emission Permit

PREVENTION OF SIGNIFICANT DETERIORATION PERMIT FOR GREENHOUSE GAS EMISSIONS ISSUED PURSUANT TO THE REQUIREMENTS AT 40 CFR § 52.21

U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 6

PSD PERMIT NUMBER:	PSD-TX-1302-GHG
PERMITTEE:	Freeport LNG Development, L.P. 333 Clay Street, Suite 5050 Houston, TX 77002
FACILITY NAME:	Freeport LNG Liquefaction Project
PRETREATMENT FACILITY LOCATION:	CR 690, approximately 0.25 miles north of the intersection of CR690 and CR891 Freeport, TX 77541
LIQUEFACTION PLANT LOCATION:	1500 Lamar Street Quintana, TX 77541

Pursuant to the provisions of the Clean Air Act (CAA), Subchapter I, Part C (42 U.S.C. Section 7470, *et. Seq.*), and the Code of Federal Regulations (CFR) Title 40, Section 52.21, and the Federal Implementation Plan at 40 CFR § 52.2305 (effective May 1, 2011 and published at 76 FR 25178), the U.S. Environmental Protection Agency, Region 6 is issuing a *Prevention of Significant Deterioration* (PSD) permit to Freeport LNG Development, L.P. (Freeport LNG) for Greenhouse Gas (GHG) emissions. The Permit for the Freeport LNG Liquefaction Project applies to the construction of a natural gas liquefaction plant contiguous to Freeport LNG's existing Liquefied Natural Gas Terminal facility on Quintana Island and a natural gas pretreatment facility to be located approximately 3.5 miles from the Quintana Island Terminal, both in Brazoria County, Texas.

Freeport LNG is authorized to construct a new liquefaction plant and pretreatment facility as described herein, in accordance with the permit application (and plans submitted with the permit application), the federal PSD regulations at 40 CFR § 52.21, and other terms and conditions set forth in this PSD permit in conjunction with the corresponding Texas Commission on Environmental Quality (TCEQ) PSD permit No. PSD-TX-1302 and Nonattainment New Source Review (NNSR) permit No. N170 for the Pretreatment Facility and permit No. PSD-TX-1282 and N150 for the Liquefaction Plant. Failure to comply with any condition or term set forth in this PSD Permit may result in enforcement action pursuant to Section 113 of the Clean Air Act

(CAA). This PSD Permit does not relieve Freeport LNG of the responsibility to comply with any other applicable provisions of the CAA (including applicable implementing regulations in 40 CFR Parts 51, 52, 60, 61, 72 through 75, and 98) or other federal and state requirements (including the state PSD program that remains under approval at 40 CFR § 52.2303).

In accordance with 40 CFR §124.15(b), this PSD Permit becomes effective 30 days after the service of notice of this final decision unless review is requested on the permit pursuant to 40 CFR §124.19.

Wren Stenger, Director Multimedia Planning and Permitting Division	Date

Freeport LNG Development, L.P. (PSD-TX-1302-GHG)
Prevention of Significant Deterioration Permit
For Greenhouse Gas Emissions
Draft Permit Conditions

PROJECT DESCRIPTION

Freeport LNG is proposing to add liquefaction infrastructure to its existing Quintana Island Terminal to provide export capacity of a nominal 13.2 million tons per annum (mtpa) of liquefied natural gas (LNG), which equates to processing a nominal 2.2 billion standard cubic feet per day (BSCFD) of pipeline quality natural gas. Pipeline quality natural gas will be delivered from interconnecting intrastate pipeline systems through Freeport LNG Development's existing Stratton Ridge meter station. The gas will be pretreated in the Pretreatment Facility to remove carbon dioxide (CO_2), sulfur compounds, water, mercury, and heavy hydrocarbons. The pretreated natural gas will then be delivered to the Liquefaction Plant through Freeport LNG's existing 42-inch gas pipeline. At the Liquefaction Plant, the pretreated natural gas will be liquefied and then stored in the LNG storage tanks. LNG will be exported from the terminal by ships arriving via marine transit through the Port Freeport channel.

The Pretreatment Facility will be located approximately 3.5 miles inland to the northeast of the Quintana Island Terminal along Freeport LNG's existing 42-inch natural gas pipeline route. The Pretreatment Facility will be comprised of three natural gas pre-treatment systems, five heating medium heaters, three thermal oxidizers, a Natural Gas Liquids removal unit, an emergency ground flare system, a combustion turbine/heat recovery system, five diesel fuel-fired emergency electrical generators, one diesel fuel-fired emergency air compressor engine, one diesel fuel-fired firewater pump system, and additional electrical compression units and connecting laterals for natural gas supply to the Liquefaction Plant.

The Pretreatment Facility includes a heating medium system that is integrated with power production. The heating medium is circulated from the combustion turbine waste heat exchangers to heaters in the amine units, molecular sieve dehydration system, and heavies removal unit. Treated gas from the Pretreatment Facility will be sent via pipeline to the proposed Liquefaction Plant at the Quintana Island Terminal location.

The main components of the Liquefaction Plant will be three liquefaction trains (Train 1, Train 2, and Train 3), each capable of producing a nominal 4.4 million tons per annum (mtpa) of LNG. All three trains and their supporting facilities will be located to the southwest of the existing liquefaction storage and vaporization facilities. In addition to the three liquefaction trains, peripheral aboveground infrastructure will include an emergency ground flare, six diesel fuel-fired emergency electrical generators, one diesel fuel-fired emergency air compressor engine, an emergency firewater unit including two diesel fuel-fired firewater pump engines, an electrical substation, refrigerant and utility storage units, pipe racks and pipes, sumps and associated LNG troughs, a control room, and a maintenance building.

EQUIPMENT LIST

The following equipment is subject to this GHG PSD permit.

Pretreatment Facility Equipment

FIN	EPN	Description
CT	CT	Natural Gas-Fired General Electric 7EA Combustion Turbine (Combustion Unit). The unit has a nominal base-load gross electric power output of approximately 87 MW vented to a heat exchanger for waste heat recovery. The combustion turbine is equipped with selective catalytic reduction (SCR) exhausting through a single flue gas stack.
65B-81A 65B-81B 65B-81C 65B-81D 65B-81E	65B-81A 65B-81B 65B-81C 65B-81D 65B-81E	5 Heating Medium Heaters (Combustion Unit). Each unit has a maximum design heat input rate of 130 MMBtu/hr (HHV), and is fired with natural gas, boil off gas (BOG), or a natural gas/BOG blend. Emissions are combined into an emissions cap (HTRCAP).
AU1/TO1 AU2/TO2 AU3/TO3	TO1 TO2 TO3	3 Regenerative Thermal Oxidizers (Combustion Units).
PTFFLARE	PTFFLARE	1 Emergency Ground Flare (Combustion Units).
PTFFWP	PTFFWP	1 Fire Water Pump (Combustion Units). 660 horsepower (hp) Diesel Fuel-Fired Fire Water Pump limited to 100 hours of operation per year for non-emergency activities.
PTFEG-1 PTFEG-2 PTFEG-3 PTFEG-4 PTFEG-5	PTFEG-1 PTFEG-2 PTFEG-3 PTFEG-4 PTFEG-5	5 Emergency Generators (Combustion Units). 755 horsepower (hp) Diesel Fuel-Fired Emergency Generators limited to 50 hours of operation per year for non-emergency activities for each unit.
PTFEAC-1	PTFEAC-1	1 Emergency Air Compressor Engine (Combustion Unit). 300 horsepower (hp) Diesel Fuel-Fired engine limited to 50 hours of operation per year for non-emergency activities.
FUG-PTSF6	FUG-PTSF6	SF_6 Insulated Electrical Equipment (i.e., circuit breakers) with 978 pounds SF_6 capacity.
FUG-TREAT	FUG-TREAT	Process Fugitives.

Liquefaction Plant Equipment

FIN	EPN	Description
LIQFLARE	LIQFLARE	1 Emergency Ground Flare (Combustion Unit).
LIQFWP-1 LIQFWP-2	LIQFWP-1 LIQFWP-2	2 Fire Water Pumps (Combustion Units). 660 horsepower (hp) Diesel Fuel-Fired Fire Water Pumps limited to 100 hours of operation per year for non-emergency activities for each unit.
LIQEG-1 LIQEG-2 LIQEG-3 LIQEG-4 LIQEG-5	LIQEG-1 LIQEG-2 LIQEG-3 LIQEG-4 LIQEG-5	5 Emergency Generators (Combustion Units). 755 horsepower (hp) Diesel Fuel-Fired Emergency Generators limited to 50 hours of operation per year for non-emergency activities for each unit.
LIQEG-6	LIQEG-6	1 Emergency Generator (Combustion Unit). 400 horsepower (hp) Diesel Fuel-Fired Emergency Generator limited to 50 hours of operation per year for non-emergency activities.

FIN	EPN	Description
LIQEAC-1	LIQEAC-1	1 Emergency Air Compressor Engine (Combustion Unit). 300 horsepower (hp) Diesel Fuel-Fired Engine limited to 50 hours of operation per year for non-emergency activities for each unit.
FUG-LIQSF6	FUG-LIQSF6	SF_6 Insulated Electrical Equipment (i.e., circuit breakers) with 5,683 pounds SF_6 capacity.
FUG-LIQ	FUG-LIQ	Process Fugitives.

I. GENERAL PERMIT CONDITIONS

1) PERMIT EXPIRATION

As provided in 40 CFR §52.21(r), this PSD Permit shall become invalid if construction:

1. is not commenced (as defined in 40 CFR §52.21(b)(9)) within 18 months after the approval takes effect; or
2. is discontinued for a period of 18 months or more; or
3. is not completed within a reasonable time.

Pursuant to 40 CFR §52.21(r), EPA may extend the 18-month period upon a written satisfactory showing that an extension is justified.

2) PERMIT NOTIFICATION REQUIREMENTS

Permittee shall notify EPA Region 6 in writing or by electronic mail of the:

1. date construction is commenced, postmarked within 30 days of such date;
2. actual date of initial startup, as defined in 40 CFR §60.2, postmarked within 15 days of such date; and
3. date upon which initial performance tests will commence, in accordance with the provisions of Section V, postmarked not less than 30 days prior to such date. Notification may be provided with the submittal of the performance test protocol required pursuant to Special Condition V.C.

3) FACILITY OPERATION

At all times, including periods of startup, shutdown, and maintenance, Permittee shall, to the extent practicable, maintain and operate the facility including associated air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the EPA, which may include, but is not limited to, monitoring results, review of operating maintenance procedures and inspection of the facility.

4) MALFUNCTION REPORTING

1. Permittee shall notify EPA by mail within 48 hours following the discovery of any failure of air pollution control equipment, process equipment, or of a process to operate in a normal manner, which results in an increase in GHG emissions above the allowable emission limits stated in Section II and III of this permit.
2. Within 10 days of the restoration of normal operations after any failure described in Special Condition I.4.1., Permittee shall provide a written supplement to the initial notification that includes a description of the malfunctioning equipment or abnormal operation, the date of the initial malfunction, the period of time over which emissions were increased due to the failure, the cause of the failure, the estimated resultant emissions in excess of those allowed in Section II and III, and the methods utilized to mitigate emissions and restore normal operations.
3. Compliance with this malfunction notification provision shall not excuse or otherwise constitute a defense to any violation of this permit or any law or regulation such malfunction may cause.

5) RIGHT OF ENTRY

EPA authorized representatives, upon the presentation of credentials, shall be permitted:

1. to enter the premises where the facility is located or where any records are required to be kept under the terms and conditions of this PSD Permit;
2. during normal business hours, to have access to and to copy any records required to be kept under the terms and conditions of this PSD Permit;
3. to inspect any equipment, operation, or method subject to requirements in this PSD Permit; and,
4. to sample materials and emissions from the source(s).

6) TRANSFER OF OWNERSHIP

In the event of any changes in control or ownership of the facilities to be constructed, this PSD Permit shall be binding on all subsequent owners and operators. Permittee shall notify the succeeding owner and operator of the existence of the PSD Permit and its conditions by letter; a copy of the letter shall be forwarded to EPA Region 6 within thirty days of the letter signature.

7) SEVERABILITY

The provisions of this PSD Permit are severable, and, if any provision of the PSD Permit is held invalid, the remainder of this PSD Permit shall not be affected.

8) ADHERENCE TO APPLICATION AND COMPLIANCE WITH OTHER ENVIRONMENTAL LAWS

Permittee shall construct this project in compliance with this PSD Permit, the application on which this permit is based, the TCEQ PSD Permits PSD-TX-1302 and PSD-TX-1282 and NNSR Permits N150 and N170 (when issued) and all other applicable federal, state, and local air quality regulations. This PSD permit does not release the Permittee from any liability for compliance with other applicable federal, state and local environmental laws and regulations, including the Clean Air Act.

9) ACRONYMS AND ABBREVIATIONS

API	American Petroleum Institute
BACT	Best Available Control Technology
BOG	Boil-off Gas
BSCFD	Billion Standard Cubic Feet per Day
CAA	Clean Air Act
CC	Carbon Content
CCS	Carbon Capture and Sequestration
CEMS	Continuous Emissions Monitoring System
CFR	Code of Federal Regulations
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CT	Combustion Turbine
DLNB	Dry Low-NO_x Burner
dscf	Dry Standard Cubic Foot
EF	Emission Factor
EPN	Emission Point Number
FIN	Facility Identification Number
Fc	Carbon Dioxide-Based Fuel Factor
FR	Federal Register
GCV	Gross Calorific Value
GHG	Greenhouse Gas
gr	Grains
GWP	Global Warming Potential
HHV	High Heating Value
hr	Hour
LAER	Lowest Achievable Emission Rate
lb	Pound
LDAR	Leak Detection and Repair
LNG	Liquid Natural Gas
MMBtu	Million British Thermal Units
MSS	Maintenance, Start-up and Shutdown
mtpa	Million Tons per Annum
NNSR	Nonattainment New Source Review
N_2O	Nitrous Oxides
NO_x	Nitrogen Oxides
NSPS	New Source Performance Standards
PSD	Prevention of Significant Deterioration
QA/QC	Quality Assurance and/or Quality Control
SCFH	Standard Cubic Feet per Hour
SCR	Selective Catalytic Reduction
SF_6	Sulfur Hexafluoride
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TPY	Tons per Year
USC	United States Code
VOC	Volatile Organic Compound

II. Annual Emission Limits

Annual emissions, in tons per year (TPY) on a 12-month, rolling total, shall not exceed the following:

Table 1. Annual Emission Limits[1]

FIN	EPN	Description	GHG Mass Basis		TPY CO_2e[2,3]	BACT Requirements
				TPY[2]		
CT	CT	Combustion Turbine/Waste Heat Recovery (Pretreatment Facility)	CO_2	561,118	561,669	738 lbs CO_2/MWh (based on gross CT energy output and equivalent energy produced) on a 365-day rolling average. See Special Condition III.C.1.
			CH_4	10.6		
			N_2O	1.06		
65B-81A 65B-81B 65B-81C 65B-81D 65B-81E	65B-81A 65B-81B 65B-81C 65B-81D 65B-81E	Heating Medium Heaters[4] (Pretreatment Facility)	CO_2	79,968	80,046	117 lb CO_2e/MMBtu (HHV) for each heater. Minimum Thermal Efficiency of 80% (LHV basis). See Special Condition III.E.1. and 2.
			CH_4	1.5		
			N_2O	0.15		
AU1/TO1	TO1	Amine Unit / Regenerative Thermal Oxidizer 1 (Pretreatment Facility)	CO_2	301,338	301,339	Good Combustion and Operating Practices. See Special Condition III.F.
			CH_4	0.05		
			N_2O	No Emission Limit Established[5]		
AU2/TO2	TO2	Amine Unit / Regenerative Thermal Oxidizer 2 (Pretreatment Facility)	CO_2	301,338	301,339	Good Combustion and Operating Practices. See Special Condition III.F.
			CH_4	0.05		
			N_2O	No Emission Limit Established[5]		
AU3/TO3	TO3	Amine Unit / Regenerative Thermal Oxidizer 3 (Pretreatment Facility)	CO_2	301,338	301,339	Good Combustion and Operating Practices. See Special Condition III.F.
			CH_4	0.05		
			N_2O	No Emission Limit Established[5]		
PTFFLARE	PTFFLARE	Ground Flare (Pretreatment Facility)	CO_2	2,208	2,212	Vent gas releases to flare limited to no more than 3 MMscf/yr on a 12-month rolling total. See Special Condition III.G.3.
			CH_4	0.06		
			N_2O	0.01		

FIN	EPN	Description	GHG Mass Basis		TPY CO_2e[2,3]	BACT Requirements
				TPY[2]		
PTFFWP	PTFFWP	Fire Water Pump (Pretreatment Facility)	CO_2	38	38	Limit operation to no more than 100 hours on a 12-month rolling total. See Special Condition III.H.2.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
PTFEG-1	PTFEG-1	Emergency Generator 1 (Pretreatment Facility)	CO_2	22	22	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
PTFEG-2	PTFEG-2	Emergency Generator 2 (Pretreatment Facility)	CO_2	22	22	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
PTFEG-3	PTFEG-3	Emergency Generator 3 (Pretreatment Facility)	CO_2	22	22	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
PTFEG-4	PTFEG-4	Emergency Generator 4 (Pretreatment Facility)	CO_2	22	22	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		

FIN	EPN	Description	GHG Mass Basis		TPY CO_2e[2,3]	BACT Requirements
				TPY[2]		
PTFEG-5	PTFEG-5	Emergency Generator 5 (Pretreatment Facility)	CO_2	22	22	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
PTFEAC-1	PTFEAC-1	Emergency Air Compressor Engine (Pretreatment Facility)	CO_2	9	9	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
LIQFWP-1	LFWP-1	Fire Water Pump (Liquefaction Plant)	CO_2	38	38	Limit operation to no more than 100 hours on a 12-month rolling total. See Special Condition III.H.2.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
LIQFWP-2	LFWP-2	Fire Water Pump (Liquefaction Plant)	CO_2	38	38	Limit operation to no more than 100 hours on a 12-month rolling total. See Special Condition III.H.2.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
LIQEG-1	LIQEG-1	Emergency Generator 1 (Liquefaction Plant)	CO_2	22	22	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		

FIN	EPN	Description	GHG Mass Basis		TPY CO_2e[2,3]	BACT Requirements
				TPY[2]		
LIQEG-2	LIQEG-2	Emergency Generator 2 (Liquefaction Plant)	CO_2	22	22	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
LIQEG-3	LIQEG-3	Emergency Generator 3 (Liquefaction Plant)	CO_2	22	22	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
LIQEG-4	LIQEG-4	Emergency Generator 4 - Liquefaction (Liquefaction Plant)	CO_2	22	22	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
LIQEG-5	LIQEG-5	Emergency Generator 5 (Liquefaction Plant)	CO_2	22	22	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
LIQEG-6	LIQEG-6	Emergency Generator 6 - Liquefaction (Liquefaction Plant)	CO_2	11	11	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		

FIN	EPN	Description	GHG Mass Basis		TPY CO_2e[2,3]	BACT Requirements
				TPY[2]		
LIQEAC-1	LIQEAC-1	Emergency Air Compressor Engine (Liquefaction Facility)	CO_2	9	9	Limit operation to no more than 50 hours on a 12-month rolling total. See Special Condition III.H.3.
			CH_4	No Emission Limit Established[5]		
			N_2O	No Emission Limit Established[5]		
LIQFLARE	LIQFLARE	Emergency Ground Flare (Liquefaction Plant)	CO_2	11,512	11,523	Vent gas releases to flare limited to no more than 167 MMscf/yr on a 12-month rolling total. See Special Condition III.G.4.
			CH_4	0.22		
			N_2O	0.02		
FUG-PTFSF6 FUG-LIQSF6	FUG-PTFSF6 FUG-LIQSF6	Circuit Breakers (Liquefaction Plant)	SF_6	No Emission Limit Established[6]	No Emission Limit Established[6]	Implementation of LDAR program using infrared camera. See Special Condition III.I.5.
FUG-TREAT and FUG-LIQ	FUG-TREAT and FUG-LIQ	Fugitive Process Emissions (Pretreatment and Liquefaction)	CH_4	No Emission Limit Established[7]	No Emission Limit Established[7]	Implementation of LDAR and AVO monitoring program. See Special Condition III.I.1. and 2.
Totals[8]			**CO_2**	**1,559,209**	**CO_2e 1,561,445**	
			CH_4	**74.5**		
			N_2O	**1.2**		

1. Compliance with the annual emission limits (tons per year) is based on a 12-month, rolling total.
2. The TPY emission limits specified in this table are not to be exceeded for this facility and include emissions from the facility during all operations and include MSS activities.
3. Global Warming Potentials (GWP): CH_4 = 21, N_2O = 310, SF6=23,900
4. The 5 heaters have an emissions cap.
5. Values are less than 0.01 TPY with appropriate rounding. The emission limit will be a design/work practice standard as specified in the permit.
6. SF_6 fugitive emissions from EPN FUG-PTFSF6 are estimated to be 0.002 TPY of SF_6 and 47.8 TPY of CO_2e. SF_6 fugitive emissions from EPN FUG-LIQSF6 are estimated to be 0.01 TPY of SF_6 and 239 TPY of CO_2e. The emission limit for EPNs FUG-PTSF6 and FUG-LIQSF6 will be a design/work practice standard as specified in the permit.
7. Fugitive process emissions from EPNs FUG-TREAT and FUG-LIQ are estimated to be 62 TPY of $CH_{4,}$ and 1,306 TPY CO_2e. The emission limit will be a design/work practice standard as specified in the permit.
8. The total emissions for CH_4 and CO_2e include the PTE for process fugitive emissions of CH_4. Total emissions are for information only and do not constitute an emission limit.

III. SPECIAL PERMIT CONDITIONS

A. Sitewide Energy Efficiency Requirements

Permittee shall utilize only electric motor primary drivers for the Liquefaction Project. The Permittee shall construct each liquefaction train to have an accompanying natural gas pretreatment unit. Each pretreatment unit shall have the capacity, but is not limited to the capacity, to treat natural gas for one liquefaction train.

B. Combustion Turbine (EPN: CT) Work Practice Standards, Operational Requirements, and Monitoring at Pretreatment Facility:

1. Permittee shall limit fuel to the combustion turbine (CT) to pipeline quality natural gas, boil-off gas (BOG), or BOG supplemented with pipeline quality natural gas with a fuel sulfur content of up to 5 grains of sulfur per 100 dry standard cubic feet (gr S/100 dscf). The gross calorific value of the fuel shall be determined monthly by the procedures contained in 40 CFR Part 98 and records shall be maintained of the monthly fuel gross calorific value for a period of five years.
2. Natural gas quality fuels with the carbon content will be obtained by semiannual testing per 40 CFR§98.34(b)(3)(A). Upon request, Permittee shall provide a sample and/or analysis of the fuel that is fired in the combustion turbine (CT) at the time of the request, or shall allow a sample to be taken by EPA for analysis.
3. Permittee shall monitor fuel gas flow continuously; determine fuel higher heating value whenever there is a fuel change or monthly, whichever is less; and calculate the total daily heat input.
4. The flow rate of the fuel combusted in the combustion turbine, identified as CT, shall be measured and recorded using an operational non-resettable elapsed flow meter.
5. Natural gas/boil-off gas flow meter shall be calibrated in accordance with 40 CFR§98.34(b)(1).
6. Flow meters shall meet the specification in 40 CFR 60 Appendix B Spec. 6.
7. All flow meters shall meet the Quality Assurance Specifications in 40 CFR Appendix F.
8. In accordance with 40 CFR Part 60, the Permittee shall ensure that all required fuel flow meters are installed, a periodic schedule for GCV fuel sampling is initiated and all certification tests are completed on or before the earlier of 90 unit operating days or 180 calendar days after the date the affected combustion unit commences commercial operation.
9. Permittee shall measure and record the energy output (MWh [based on adjusted gross CT energy output and equivalent energy produced]) on an hourly basis.
10. The emission limits established in Table 1 include emissions associated with MSS activities.

11. Permittee shall monitor and record the following parameters daily:
    a. Inlet air flow, temperature, pressure, and humidity;
    b. CT fuel input – volumetric measurement of fuel flow converted into mass (lb/hr) and energy flow (MMBtu/hr);
    c. Combustion temperature;
    d. Exhaust temperature;
    e. Gross hourly energy output (Mwh);
    f. CT plant thermal efficiency %;
    g. Gas turbine electrical output, MW;
    h. Chilled water supply and return temperatures; and
    i. Energy input to the chillers.
12. Permittee shall determine the hourly CO_2 emission rate in accordance with 40 CFR Part 98 Subpart C § 98.33(a)(3)(iii).
13. Permittee shall calculate the CH_4 and N_2O emissions on a 12-month rolling basis to be updated by the last day of the following month. Permittee shall determine compliance with the CH_4 and N_2O emissions limits contained in this section using the default CH_4 and N_2O emission factors contained in Table C-2 and equation C-8 of 40 CFR Part 98 and the HHV (for natural gas and/or boil-off gas), converted to short tons.
14. Permittee shall calculate the CO_2e emissions on a 12-month rolling basis, based on the procedures and Global Warming Potentials (GWP) contained in Greenhouse Gas Regulations, 40 CFR Part 98, Subpart A, Table A-1, as published on October 30, 2009 (74 FR 56395). The record shall be updated by the last day of the following month.

C. Combustion Turbine (EPN: CT) BACT Emission Limits at Pretreatment Facility:

1. On or after the date of initial startup, Permittee shall not discharge or cause the discharge of emissions from the Combustion Turbine /Waste Heat Recovery Units (CT) into the atmosphere in excess of 738 lbs CO_2/MWh (based on gross CT energy output and equivalent energy produced) on a 365-day rolling average. To determine this BACT emission limit, Permittee shall calculate the limit based on the measured hourly energy output (MWh [based on adjusted gross CT energy output and equivalent energy produced]) and CO_2 emissions as calculated in Special Permit Condition III.B.12. above. The calculated hourly rate is averaged daily.
2. Permittee shall not exceed a Combustion Turbine average heat rate of 5,210 Btu/kWh (LHV, adjusted gross CT energy heat rate with compliance margin) on a 12 month rolling average. To determine this limit, Permittee shall calculate the average heat rate on a hourly basis using the fuel flow rate, fuel HHV,and the measured hourly energy output (kwh [based on adjusted gross CT energy output and equivalent energy produced])). The calculated hourly heat rate is averaged monthly.

3. Within 180 days of the date of initial startup of the combustion turbine, the Permittee shall perform an initial emission test for CO_2 and use emission factors from 40 CFR Part 98. To verify compliance with the BACT emission limit, the Permittee shall calculate the limit based on the measured hourly energy output (MWh [based on adjusted gross CT energy output and equivalent energy produced]) when the CT is operating above 90% of its design capacity, and the results shall be corrected to ISO conditions (59^{o}F, 14.7 psia, and 67% humidity). If the CT does not meet the BACT emissions limit, the Permittee may continue operation of the CT in order to perform necessary corrective actions and to continue plant operations. Once corrective actions have been made, the Permittee will schedule a follow-on emissions test and will make appropriate notifications to the EPA.
4. On or after initial performance testing, Permittee shall use the combustion turbines, and waste heat recovery units energy efficiency processes, work practices and designs as represented in the permit application.

D. Heating Medium Heaters (EPNs: 65B-81A, 65B-81B, 65B-81C, 65B-81D, and 65B-81E) Work Practice Standards, Operational Requirements, and Monitoring at the Pretreatment Facility:

1. Heaters shall combust only pipeline quality natural gas, BOG, or a natural gas/BOG mixture.
2. Permittee shall measure and record the fuel flow rate using an operational non-resettable elapsed flow meter.
3. Permittee shall calibrate and perform a preventative a maintenance check of the fuel gas flow meters and document annually.
4. Permittee shall perform a preventative maintenance check of oxygen control analyzers and document annually.
5. Permittee shall perform maintenance of the burners, at a minimum of, annually.
6. The maximum firing rate for the heaters shall not exceed 130 MMBtu/hr (HHV) per unit.
7. The one-hour maximum firing rates shall be calculated daily to demonstrate compliance with the firing rates in Special Condition III.D.6.
8. Permittee shall install, operate, and maintain an automated air/fuel control system.
9. Permittee shall calibrate and perform preventative maintenance on the air/fuel control analyzers, at a minimum, annually.
10. The heaters must comply with the CO_2e emissions cap in Table 1.
11. Permittee shall calculate the amount of CO_2 (mass basis) emitted for the heaters in tons per year (tpy) on a 12-month rolling total based on metered fuel consumption and using the Tier III methodology in accordance with 40 CFR Part 98 Subpart C § 98.33(a)(3)(iii).
12. Permittee shall calculate the CH_4 and N_2O emissions on a 12-month rolling basis to be updated by the last day of the following month. Permittee shall determine

compliance with the CH_4 and N_2O emissions limits contained in this section using the default CH_4 and N_2O emission factors contained in Table C-2 and equation C-8 of 40 CFR Part 98 and the HHV (for natural gas and/or boil-off gas), converted to short tons.

13. Permittee shall calculate the CO_2e emissions on a 12-month rolling basis, based on the procedures and Global Warming Potentials (GWP) contained in Greenhouse Gas Regulations, 40 CFR Part 98, Subpart A, Table A-1, as published on October 30, 2009 (74 FR 56395). The record shall be updated by the last day of the following month.

E. Heating Medium Heaters (EPNs: 65B-81A, 65B-81B, 65B-81C, 65B-81D, and 65B-81E) BACT Emission Limits at Pretreatment Facility:

1. The heaters shall meet a BACT limit of 117 lb CO_2e/MMBtu for each heater on a 12-month rolling average basis.
2. The Permittee shall maintain a minimum overall thermal efficiency of 80% (LHV) or greater on a 12-month rolling average basis, calculated monthly, for the heaters (65B-81A, 65B-81B, 65B-81C, 65B-81D, and 65B-81E).
3. The heaters (65B-81A, 65B-81B, 65B-81C, 65B-81D, and 65B-81E) will be continuously monitored for exhaust temperature, input fuel temperature, and stack oxygen. Thermal efficiency for heaters will be calculated monthly from these parameters using equation G-1 from American Petroleum Institute (API) methods 560 (4^{th} ed.) Annex G.

F. Regenerative Thermal Oxidizers (EPNs: TO1, TO2, and TO3) Work Practice Standards, Operational Requirements, and Monitoring at the Pretreatment Facility

1. Each of the three natural gas pre-treatment train amine units (AU1, AU2, and AU3) shall be equipped with a regenerative thermal oxidizer (TO1, TO2, and TO3). Each regenerative thermal oxidizer shall combust low-VOC concentration waste gas from the amine units. The maximum heat input rate to each regenerative thermal oxidizer combustion burner shall not exceed 5 MMBtu/hr when firing natural gas, BOG, or a natural gas/BOG blend.
2. Each regenerative thermal oxidizer shall have an initial stack test, to verify destruction and removal efficiency (DRE) for VOC of 99% or an outlet concentration of 10 ppmv VOC, as propane, corrected to 3% O2 whichever limit is more stringent.
3. For combustion burner fuel flow shall be recorded using an operational non-resettable elapsed flow meter at each thermal oxidizer.
4. The flow rate of the fuel gas (natural gas, BOG or natural gas/BOG blend to the regenerative thermal oxidizer burner) and waste gas flow rate to each thermal oxidizer shall be measured and recorded separately using an operational non-resettable elapsed flow meter at each regenerative thermal oxidizer. Waste gas will be sampled and analyzed on a quarterly basis for composition. The sampled data will be

used to calculate GHG emissions to show compliance with the limits specified in Table 1.

5. Permitee shall calculate CO_2 emissions to show compliance with the limits specified in Table 1, on a monthly basis, using the measured waste gas flow rate and equation W-3 in 40 CFR Part 98, Subpart W [98.233(d)(2)] for the vent gas stream from the amine units.
6. Periodic maintenance shall be performed to maintain the efficiency of the regenerative thermal oxidizer at a minimum annually or as recommended by manufacturer specifications.
7. The Permittee shall maintain the combustion temperature at a minimum of 1,525 ºF (on a rolling 3-hour block average basis) at all times when processing waste gas from the amine units in the regenerative thermal oxidizer. Temperature monitoring of the regenerative thermal oxidizer will ensure proper operation. The Permittee shall install a temperature sensor with a measurement sensitivity of 5 degrees Fahrenheit or 1.0 percent of the temperature value, whichever is larger, expressed in degrees Farenheight.

G. Flares (EPN: PTFFLARE (Pretreatment Facility) and EPN: LIQFLARE (Liquefaction Plant)) Work Practice Standards, Operational Requirements, and Monitoring

1. Flares shall have a minimum destruction and removal efficiency (DRE) of 99% for methane based on flow rate and gas composition measurements as specified in 40 CFR Part 98 Subpart W § 98.233(n).
2. Flares (PTFFLARE and LIQFLARE) are intermittent use flares, not continuous process flares. Emission Units, PTFFLARE and LIQFLARE, shall only combust pilot gas as a continuous stream.
3. Both flares are pressure-assisted. BACT for the Pretreatment Flare (PTFFLARE) will be to limit maintenance startup and shutdown vent gas releases to the flare to no more than 3 MMscf/yr based on a rolling 12-month rolling total.
4. BACT for the Liquefaction Flare (LIQFLARE) will be to limit maintenance startup and shutdown vent gas releases to the flare to no more than 167 MMscf/yr based on a rolling 12-month rolling total.
5. Permittee must record the time, date, volume of gas sent to flare in cubic feet and duration of each MSS event. The records must include hourly CH_4 emission levels as measured by the in-line gas analyzer (Gas chromatograph or equivalent with volumetric gas flow rate) and the calculations based on the actual volumetric flow for the CO_2, N_2O, and CH_4 emissions during each MSS event. These records must be kept for five years following the date of each event.
6. Permittee must record the fuel heat input rate (HHV) in MMBtu/hr to the flare pilots during flare operation. The records must include hourly CH_4 emission levels as measured by the in-line gas analyzer (Gas chromatograph or equivalent with volumetric stack gas flow rate) and the calculations based on the actual heat input for

the CO_2, N_2O, and CH_4 emissions. These records must be kept for five years following the date of each event.

7. Each flare shall be designed and operated in accordance with 40 CFR 60.18 including specifications of minimum heating value of the waste gas, maximum tip velocity, and pilot flame monitoring. An infrared monitor is considered equivalent to a thermocouple for flame monitoring purposes.

H. Fire Water Pumps (EPN: PTFFWP (Pretreatment Facility) and EPN: LIQFWP-1 and LIQFWP-2 (Liquefaction Plant)) and Emergency Generators (EPNs: PTFEG-1, PTFEG-2, PTFEG-3, PTFEG-4, and PTFEG-5 (Pretreatment Facility) and EPNs: LIQEG-1, LIQEG-2, LIQEG-3, LIQEG-4 , LIQEG-5, and LIQEG-6 (Liquefaction Plant)) Emergency Air Compressors (EPN: PTFEAC-1 (Pretreatment Facility) and EPN: LIQEAC-1 (Liquefaction Plant))Work Practice Standards, Operational Requirements, and Monitoring

1. The Diesel Fired Fire Water Pumps (PTFFWP, LIQFWP-1, and LIQFWP-2), Diesel Fired Emergency Generators (PTFEG-1, PTFEG-2, PTFEG-3, PTFEG-4, PTFEG-5 LIQEG-1, LIQEG-2, LIQEG-3, LIQEG-4, LIQEG-5, and LIQEG-6), and Emergency Air Compressors (PTFEAC-1 and LIQEAC-1) are authorized to fire diesel fuel containing no more than 0.0015 percent sulfur by weight. Upon request, Permittee shall provide a sample and/or an analysis of the fuel-fired in the emission units (PTFFWP, LIQFWP-1, LIQFWP-2, PTFEG-1, PTFEG-2, PTFEG-3, PTFEG-4, PTFEG-5, LIQEG-1, LIQEG-2, LIQEG-3, LIQEG-4, LIQEG-5, LIQEG-6, PTFEAC-1, and LIQEAC-1) or shall allow a sample to be taken by EPA for analysis to demonstrate the percent sulfur of the fuel.
2. The Diesel Fired Fire Water Pumps (PTFFWP, LIQFWP-1, and LIQFWP-2) are limited to 100 hours of non-emergency operation per year, based on a rolling 12-month total, for each unit.
3. The Diesel Fired Emergency Generators (PTFEG-1, PTFEG-2, PTFEG-3, PTFEG-4, PTFEG-5 LIQEG-1, LIQEG-2, LIQEG-3, LIQEG-4, LIQEG-5, and LIQEG-6) and Emergency Air Compressors (PTFEAC-1 and LIQEAC-1) are limited to 50 hours of non-emergency operation per year, based on a rolling 12-month total, for each unit.
4. The Fire Water Pumps shall have a rating of no more than 660 hp.
5. Emergency Generators (PTFEG-1, PTFEG-2, PTFEG-3, PTFEG-4, PTFEG-5 LIQEG-1, LIQEG-2, LIQEG-3, LIQEG-4, and LIQEG-5) will have a rating of no more than 755 hp.
6. Emergency Generator LIQEG-6 will have a rating of no greater than a 400 hp .
7. Emergency Air Compressors (PTFEAC-1 and LIQEAC-1) will have a rating of no greater than 300 hp.
8. The Diesel Fired Fire Water Pumps, Diesel Fired Emergency Generators, and Emergency Air Compressors shall meet the monitoring and recordkeeping

requirements as required in 40 CFR Part 60 Subpart IIII, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines.

9. Permittee shall install and maintain an operational non-resettable elapsed run time meter for the Diesel Fired Fire Water Pumps, Diesel Fired Emergency Generators, and Emergency Air Compressors.
10. Permittee shall maintain a file of all records, data measurements, reports and documents related to the operation of the Diesel Fired Fire Water Pumps, Diesel Fired Emergency Generators, and Emergency Air Compressors including, but not limited to, the following:
    a) all records or reports pertaining to maintenance performed;
    b) for each diesel fuel oil delivery, documents from the fuel supplier certifying compliance with the fuel sulfur content limit of Special Condition III.H.1.;
    c) hours of operation; and
    d) any other information required by this permit recorded in a permanent form suitable for inspection.
11. The file must be retained for not less than five years following the date of such measurements, maintenance, reports, and/or records.
12. Compliance with the Annual Emission Limit shall be demonstrated on a 12-month total, rolling monthly, calculated in accordance with 40 CFR Part 98, Subpart C, § 98.33(a)(1)(i).

I. Fugitive Emission Sources (EPNs: FUG-TREAT, FUG-LIQ, FUG-PTFSF6, and FUG-LIQSF6) at the Pretreatment Facility and Liquefaction Plant Work Practice Standards, Operational Requirements, and Monitoring

1. The Permittee shall implement the TCEQ 28MID leak detection and repair (LDAR) program for fugitive emissions of methane.
2. The Permittee shall implement an audio/visual/olfactory (AVO) monitoring program to monitor for leaks in between instrument monitoring required by III.I.1.
3. AVO monitoring shall be performed on a weekly basis.
4. For emission unit FUG-PTSF6 and FUG-LIQSF6, SF_6 emissions shall be calculated annually (calendar year) in accordance with the mass balance approach provided in equation DD-1 of the Mandatory Greenhouse Gas Reporting rules for Electrical Transmission and Distribution Equipment Use, 40 CFR Part 98, Subpart DD.
5. The Permittee shall monitor for leaks of SF6 on a monthly basis using an infrared camera.
6. Permittee shall not exceed 19 new 163 lb (6 at the Pretreatment Facility and 13 at the Liquefaction Plant) and 27 new 132 lb (Liquefaction Plant) enclosed-pressure SF_6 circuit breakers with leak detection.
7. The Permittee shall maintain a file of all records, data measurements, reports and documents related to the fugitive emission sources including , but not limited to, the following: all records or reports pertaining to maintenance performed, all records

relating to compliance with the Monitoring and Quality Assurance and Quality Control (QA/QC) procedures outlined in 40 CFR 98.304.

J. Continuous Emissions Monitoring Systems (CEMS)

1. As an alternative to Special Conditions III.B.12., III.D.11., and III.F.5. Permittee may install a CO_2 CEMS and volumetric stack gas flow monitoring system with an automated data acquisition and handling system for measuring and recording CO_2 emissions discharged to the atmosphere, and use these values to show compliance with the annual emission limit in Table 1.
2. Permittee shall ensure that all required CO_2 monitoring system/equipment are installed and all certification tests are completed on or before the earlier of 90 unit operating days or 180 calendar days after the date the unit commences operation.
3. Permittee shall ensure compliance with the specifications and test procedures for CO_2 emission monitoring system at stationary sources, 40 CFR Part 98, or 40 CFR Part 60, Appendix B, Performance Specification numbers 1 through 9, as applicable.

IV. Recordkeeping and Reporting

1. In order to demonstrate compliance with the GHG emission limits in Table 1, the Permittee will monitor the following parameters and summarize the data on a calendar month basis.

   a. Operating hours for all affected emergency generator engines, emergency compressor engines, and firewater pump engines;
   b. The natural gas fuel and boil off gas usage rate (scf) for all combustion sources, using non-resettable elapsed fuel flow monitors; and
   c. Monthly fuel sampling for fuel gas (BOG), quarterly fuel sampling of waste gas.

2. Permittee shall implement the TCEQ 28MID leak detection and repair (LDAR) program and keep records of the monitoring results, as well as the repair and maintenance records.
3. Permittee shall maintain all records, data, measurements, reports, and documents related to the operation of the affected combustion units, including, but not limited to, the following: all records or reports pertaining to significant maintenance performed on any affected combustion unit; duration of maintenance, startup, shutdown events and the initial startup period for the affected combustion units; malfunctions that may result in excess GHG emissions; all records relating to performance tests, calibrations, checks, and monitoring of affected combustion equipment; duration of an inoperative monitoring devices and affected combustion units with the required corresponding emission data; and all other information required by this permit recorded in a permanent form suitable for inspection. The records must be retained for not less than five years following the date of such measurements, maintenance, reports, and/or records.

4. Permittee shall maintain records of all CO_2 emission certification tests and monitoring and compliance information required by this permit.
5. Permittee shall maintain records and submit a written report of all excess emissions to EPA semi-annually, except when: more frequent reporting is specifically required by an applicable subpart; or the Administrator or authorized representative, on a case-by-case basis, determines that more frequent reporting is necessary to accurately assess the compliance status of the source. The report is due on the 30th day following the end of each semi-annual period and shall include the following:

   a. Time intervals, data and magnitude of the excess emissions, the nature and cause (if known), corrective actions taken and preventive measures adopted;
   b. Applicable time and date of each period during which the monitoring equipment was inoperative (monitoring down-time);
   c. A statement in the report of a negative declaration; that is; a statement when no excess emissions occurred or when the monitoring equipment has not been inoperative, repaired or adjusted; and
   d. Any failure to conduct any required source testing, monitoring, or other compliance activities.

6. Excess emissions shall be defined as any period in which the facility emissions exceed a maximum emission limit set forth in this permit.
7. Excess emissions indicated by GHG emission source testing as required by Special Condition V or compliance monitoring shall be considered violations of the applicable emission limit for the purpose of this permit.
8. All records required by this PSD Permit shall be retained and remain accessible for not less than 5 years following the date of such measurements, maintenance, and reporting.

V. Initial Performance Testing Requirements:

A. The Permittee shall perform stack sampling and other testing to establish the actual pattern and quantities of air contaminants being emitted into the atmosphere from the stacks of the Combustion Turbine/Waste Heat Recovery Units (CT), Heating Medium Heaters (65B-81A, 65B-81B, 65B-81C, 65B-81D, and 65B-81E), and Thermal Oxidizers (TO1, TO2, and TO3) to determine the initial compliance with the CO_2 emission limits established in this permit. Sampling shall be conducted in accordance with 40 CFR § 60.8 and EPA Method 3a or 3b for the concentration of CO_2.

1. The Permittee shall multiply the CO_2 hourly average emission rate determined under maximum operating test conditions by 8,760 hours except for the five Heating Medium Heaters (65B-81A, 65B-81B, 65B-81C, 65B-81D, and 65B-81E). For the five Heating Medium Heaters (65B-81A, 65B-81B, 65B-81C, 65B-81D, and 65B-81E), a composite average CO_2 emission rate of all five heaters (based on the CO_2

hourly average emission rate determined for each heater) shall be multiplied by 26,952 hours of operation per year for all 5 heaters combined for comparison to the heaters' CO_2 emission limit (TPY) in Table 1.

2. If the above calculated CO_2 emission total does not exceed the tons per year (TPY) specified on Table 1, no compliance strategy needs to be developed.
3. If the above calculated CO_2 emission total exceeds the tons per year (TPY) specified in Table 1, the facility shall:

   a. Document the potential to exceed in the test report; and
   b. Explain within the report how the facility will assure compliance with the CO_2 emission limit listed in Table 1.

B. Within 60 days after achieving the maximum production rate at which the affected facility will be operated, but not later than 180 days after initial startup of the facility, performance tests(s) must be conducted and a written report of the performance testing results furnished to the EPA. Additional sampling may be required by EPA.

C. Permittee shall submit a performance test protocol to EPA no later than 30 days prior to the test to allow review of the test plan and to arrange for an observer to be present at the test. The performance test shall be conducted in accordance with the submitted protocol, and any changes required by EPA.

D. Fuel sampling for emission units CT, 65B-81A, 65B-81B, 65B-81C, 65B-81D, and 65B-81E, shall be conducted in accordance with 40 CFR Part 75 and Part 98.

E. The combustion turbine shall be tested at or above 90% of maximum load operation. The permit holder shall present at the pretest meeting the manner in which stack sampling will be executed in order to demonstrate compliance with the emissions limits contained in Section II.

F. Performance tests must be conducted under such conditions to ensure representative performance of the affected facility. The owner or operator must make available to the EPA such records as may be necessary to determine the conditions of the performance tests.

G. The owner or operator must provide the EPA at least 30 days' prior notice of any performance test, except as specified under other subparts, to afford the EPA the opportunity to have an observer present and/or to attend a pre-test meeting. If there is a delay in the original test date, the facility must provide at least 7 days prior notice of the rescheduled date of the performance test.

H. The owner or operator shall provide, or cause to be provided, performance testing facilities as follows:

1. Sampling ports adequate for test methods applicable to this facility,
2. Safe sampling platform(s),
3. Safe access to sampling platform(s), and
4. Utilities for sampling and testing equipment.

I. Unless otherwise specified, each performance test shall consist of three separate runs using the applicable test method. Each run shall be conducted for the time and under the conditions specified in the applicable standard. For purposes of determining compliance with an applicable standard, the arithmetic mean of the results of the three runs shall apply.

J. Emissions testing, as outlined above, shall be performed every five years, plus or minus 6 months, of when the previous performance test was performed, or within 180 days after the issuance of a permit renewal, whichever comes later, to verify continued performance at permitted emission limits.

VI. Agency Notifications

Permittee shall submit GHG permit applications, permit amendments, and other applicable permit information to:

Multimedia Planning and Permitting Division
EPA Region 6
1445 Ross Avenue (6 PD-R)
Dallas, TX 75202
Email: Group R6AirPermits@EPA.gov

Permittee shall submit a copy of all compliance and enforcement correspondence as required by this Approval to Construct to:

Compliance Assurance and Enforcement Division
EPA Region 6
1445 Ross Avenue (6EN)
Dallas, TX 75202

APPENDIX C

Draft HDD Monitoring and Contingency Plan

Freeport LNG

Liquefaction Project

HDD Monitoring and Contingency Plan

DRAFT

Prepared By

NATURAL RESOURCE GROUP

June 2012

TABLE OF CONTENTS

1.0 PURPOSE AND NEED

Freeport LNG proposes to use the Horizontal Directional Drilling (HDD) method to install pipe across multiple waterbodies and wetlands as part of its Liquefaction Project (Project). Although the HDD method generally avoids or minimizes the environmental impacts on resources, the potential for impacts from an inadvertent release of drilling mud associated with this crossing technique still exists.

The purpose of this document is to establish procedures for addressing potential impacts associated with inadvertent releases or "frac-outs" of drilling mud during the HDD process. In addition, this document establishes the criteria by which Freeport LNG will determine when a proposed HDD is unsuccessful and must be abandoned.

2.0 DRILLING BASICS

The HDD method is a technically advanced process involving specialized equipment and skilled operators. The primary environmental risk associated with this crossing method comes from the potential for inadvertent release of drilling mud. The selection and supervision of the drilling contractor will be the responsibility of Freeport LNG.

Minimal, consistent loss of drilling mud typically occurs during the drilling process when layers of loose sand, gravel, or fractured rock are encountered and drilling mud fills voids in the material. However, a significant loss of returning drilling mud and a concomitant reduction in drilling pressure indicates that seepage is occurring outside of the hole.

3.0 DRILLING MUD AND DRILLING MUD SYSTEM

The directional drilling process uses drilling mud consisting primarily of water and bentonite, a naturally occurring clay. Drilling mud removes the cuttings from the borehole, stabilizes the walls of the borehole and acts as a coolant and lubricant to the drill bit during the drilling process. The drilling mud mixture consists of 1 to 5 percent bentonite clay and from 0 to 40 percent inert solids from the borehole cuttings, with the remainder being water.

The drilling mud is prepared in the mixing tank using both new and clean recycled drilling mud. The mud is pumped at rates of 200 gallons per minute (gpm) to 1,000 gpm through the center of the drill pipe to the drilling tools. Return flow is through the annulus created between the wall of the drilled hole and the drill pipe. During pilot hole drilling, the cuttings are returned to a small excavation at the entry point called the entry pit. From the entry pit, the returned mud is pumped to the mud processing equipment. Typically, shaker screens, desanders, desilters and centrifuges process and remove increasingly finer cuttings from the drilling mud. The cleaned mud is recycled to the mixing tank for reuse in the borehole. The cuttings removed by the cleaning process are disposed of at a site approved to accept this type of material.

4.0 DRILLING MUD RELEASE

4.1 Prevention

HDD is a pipeline installation method typically used to avoid congested areas and/or disturbance of sensitive surface features, including waterbodies and wetlands. HDD does, however, present a remote potential for surface disturbance through inadvertent drilling mud releases. Drilling mud releases are typically caused by blockage of the return flow path around the drill pipe where pressurization of the drilling mud rises above the containment capability of the overburden soil material. Pressurized drilling mud follows the path of least resistance, which may result in the drilling mud flowing to the ground surface should the annulus around the drill pipe become plugged. Releases may follow fractures in bedrock or other voids in the strata that allow the mud to surface.

4.1.1 Suitable Material and Adequate Overburden

Prevention of drilling mud seepage is a major consideration in determining the profile of the HDD crossing. The primary factors in selecting the pipeline crossing profile include the type of soil and rock in the geological material and the depth of cover material. Cohesive soils, such as clays, dense sands and competent rock are considered ideal materials for horizontal drilling. The depth of adequate overburden is also considered. A minimum depth of cover of 25 feet in competent soils is required to provide a margin of safety against drilling mud seepage.

The areas that present the highest potential for drilling mud seepage are the drill entry and exit points where the overburden depth is minimal. At both the entry and exit points, above ground containment pits can be constructed with berms to collect and provide temporary storage for the inadvertently released drilling mud or seepage until it can be pumped back into the drilling system.

4.1.2 Pipeline Geometry

The geometry of the pipeline profile can slightly affect the potential for drilling mud seepage. In a profile that forces the pipe to make compound or excessively tight radius turns, key-seating of the drill pipe may develop, blocking the return flow to surface, allowing downhole pressures to build up, thereby increasing the potential for drilling mud seepage. The profiles for Freeport LNG's pipeline crossings minimize this potential, with a smooth, deep-seated trajectories affording maximum cover.

4.1.3 Responsibility of Drilling Contractor

The drilling contractor is responsible for execution of the HDD, including actions for detecting and controlling drilling mud seepage. Freeport LNG will closely supervise the progress and actions of the drilling contractor.

4.2 Detection and Monitoring Procedures

To determine if an advertent release has occurred, HDD activities will be monitored constantly on this project, either by the Contractor, Construction Inspector, Environmental Inspector (EI), or any combination of the three. Monitoring procedures and associated activities will include:

- Inspection along the drill path;
- Continuous examination of drilling mud pressure gauges and return flows to the surface pits;
- Monitoring of drilling status information regarding drilling conditions and drill profile alignments;
- If a release occurs in a wetland or waterbody:
  - containment of the drilling mud where practicable;
  - continued inspection to determine any potential for movement of released drilling mud within the wetland or waterbody;
  - collection of drilling mud returns at the location for future analysis, as required; and
  - photographic documentation and other documentation of the release by the EI (Freeport LNG will keep photographs of release events on record).

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5.0 NOTIFICATION PROCEDURES

If monitoring indicates a release is occurring or has occurred, the Contractor will begin containment immediately while the Construction Inspector or EI will notify Freeport LNG's construction management personnel immediately.

Freeport LNG will notify the appropriate agencies immediately upon discovery of an inadvertent wetland or waterbody release, detailing the location and nature of the release, corrective actions being taken, and whether the release poses any threat to public health and safety.

6.0 CORRECTIVE ACTION

The greatest potential for drilling mud seepage is during drill entry and exit, where the overburden is reduced for entry and exit of drilling tools at the low approach angle. Drilling mud seepage containment is incorporated into contingency planning for the pipeline crossings. The proposed entry or exit locations are generally located in upland areas where drilling mud seepage can be readily detected and contained. To isolate and contain potential drilling mud seepage, an aboveground containment pit will be constructed between the entrance and exit points and the feature boundary. Straw bales or silt fencing may also be used to further reinforce the berm.

The Contractor will have equipment and materials available on site to contain and control drilling mud seepage in upland areas. Such equipment and materials will include hand tools, backhoes or small bulldozers, lumber for temporary shoring, portable pumps, sand bags, straw bales, and silt fencing.

Freeport LNG will address an inadvertent release immediately upon discovery. The following measures will be implemented to minimize or prevent further release, contain the release, and clean up the affected area:

<u>Upland Release:</u>

- The Contractor will determine and implement any modifications to the drilling technique or composition of drilling mud (e.g., thickening of mud by increasing bentonite content, temporary lowering of the downhole pressures) to minimize or prevent further releases of drilling mud.
- Freeport LNG will oversee the placement of containment structures at the affected area to prevent migration of the release.
- If the amount of the release is large enough to allow collection, the drilling mud will be collected and returned to either the drilling operations or a disposal site by hose or tanker.
- If the amount of the release is not large enough to allow collection, the released drilling mud will be swept, shoveled, or mixed with sand and temporarily left in place to dry. Steps will be taken to prevent drilling mud or silt-laden water from flowing into a wetland or waterbody.
- If public health and safety are threatened by an inadvertent release, drilling operations will be shut down until the threat is eliminated.

<u>Waterbody or Wetland Release:</u>

- If a release occurs within a waterbody or wetland, Freeport LNG will inform the appropriate agency as soon as possible whether or not the release can be corrected without incurring additional environmental impact. If necessary, drilling operations will be reduced or suspended to assess the extent of the release and to implement corrective actions.
- If the release is a single-point release, accessible with a hose and truck, the Contractor will attempt to 'cap' the release, if possible, by placing a section of pipe over the release to contain the mud within the pipe section. With a larger release, the Contractor may attempt to place a water-filled bladder around the release in order to isolate it from the waterbody or wetland prior to removal. After the release is contained, the mud will be pumped into trucks and reused or disposed of at an appropriate facility.
- If public health and safety are threatened, drilling mud circulation pumps will be turned off. This measure will be taken as a last resort because of the potential for drill hole collapse resulting from loss of down-hole pressure.
- If monitoring indicates that the intake water quality at downstream user locations is impacted to the extent that it is no longer suitable for treatment, alternative water sources (i.e., trucked or bottled water) will be provided to impacted users.
- Freeport LNG will assist agencies with any sampling they may require.

Uncontrollable Release:

- If an inadvertent release of drilling mud exceeds that which can be contained and controlled either because of volume or rate, HDD activities will cease. An evaluation of the probable cause of the release and the stage of the drill will be done. Based on the evaluation, the measures described in the following paragraphs will be implemented.

  Depending on the current stage of the installation, the HDD contractor may choose to plug the hole near the fracture with heavyweight material (i.e., sawdust, nut shells, bentonite pellets, or other commercially available non-toxic product). If the inadvertent release of drilling mud occurs while drilling the pilot hole, the HDD contractor may choose to back out of the hole by a predetermined distance and then create a new hole by drilling out of the original hole. Therefore, Procedures 1 or 2 listed below could occur in either order.

  1. Plug the fissures/fracture.

     a) Pump sealers such as sawdust, nutshells, bentonite pellets, or other commercially available non-toxic products into the drill hole;
     b) Let set for an appropriate period of time (dependent upon sealant used); and
     c) Resume HDD activities.

  2. If a fissure/fracture cannot be plugged, then, if practical:

     a) Remove drill pipe from the existing drill hole to a point where a new drill path can be attempted by drilling out of the existing hole and creating a new hole. The original hole will be abandoned and filled with bentonite and cuttings. The cuttings that are returned to the hole should only be equal to those removed from the hole. The return should not be under high pressure and therefore additional releases would not be anticipated.
     b) Resume HDD activities.

  3. If the original drill path cannot be utilized:

     a) Abandon the original drill hole by pumping bentonite and cuttings downhole, then seal the top 5 vertical feet with grout. Grouting abandoned drill holes is an industry standard practice and serves to prevent the abandoned hole from disrupting groundwater flow.
     b) Move the drill rig to a new, adjacent location.
     c) Verify that the new, adjacent location meets the requirements of all applicable project permits and approvals. If the new, adjacent location does not meet the requirements of all applicable project

permits and approvals, operations will cease until new permits and approvals are received.

d) Design an alternative alignment for the redrill.

e) Begin HDD redrill activities.

- If all HDD attempts fail, then the crossing will be constructed using an alternative method after all necessary permits and approvals have been received. Failure is defined in Section 7.0.

7.0 DEFINITION OF HDD FAILURE AND ABANDONMENT CRITERIA

Freeport LNG considers the failure criteria described below as sufficient reason to abandon the HDD process and install the crossing using an approved alternative method.

Pilot Hole Step Failure

- The HDD installation method will be considered a failure if there are two unsuccessful attempts at completing the pilot hole. If this happens, the HDD contractor will demobilize its equipment from the site after approval from Freeport LNG.

Hole Opening Step Failure

- The HDD installation method will be considered a failure if there is one unsuccessful attempt at opening the hole to the required diameter, as long as the failure does not include losing parts of the hole opening tool, or loss of the entire hole opening tool downhole. The HDD contractor will then be allowed 7 working days to attempt to retrieve the missing tool or parts from the hole and continue the hole opening process. If failure occurs, the HDD contractor will demobilize its equipment from the site after approval from Freeport LNG.

Pullback Step Failure

- The HDD installation method will be considered a failure if there is one unsuccessful attempt at completing the pullback, unless the pipe can be removed from the hole. In the latter case, a second attempt will be made after the hole has been reopened and reconditioned with any necessary hole opening passes as determined jointly by the HDD contractor and Freeport LNG. If failure occurs, the HDD contractor will demobilize its equipment from the site after approval from Freeport LNG.

Mechanical Breakdown Failure

- The HDD installation method will be considered a failure if, at any point during the HDD, the HDD contractor has a major mechanical breakdown and after either repairing or replacing the broken drilling rig or vital ancillary equipment, the drill pipe, hole opening tool, or pipeline cannot be rotated or pulled. If failure occurs, the HDD contractor will demobilize its equipment from the site after approval from Freeport LNG.

8.0 FREEPORT LNG/AGENCY APPROVAL FOR HDD ABANDONMENT

Freeport LNG will provide on-site inspection during the HDD process to keep adequate documentation, daily progress reports, as-built information, etc., and will describe the events leading up to the HDD failure. Freeport LNG will submit this documentation to the appropriate agencies notifying them of the HDD failure and Freeport LNG's schedule for implementing the approved alternate crossing method as described in Section 9.0. The HDD contractor will not demobilize until Freeport LNG's approval has been received. The alternative crossing method will not be implemented until Freeport LNG has received confirmation that the FERC and U.S. Army Corps of Engineers (COE) have received the documentation of HDD failure.

9.0 HDD CONTINGENCY

If HDD failure occurs, Freeport LNG will construct the proposed pipeline facilities across both wetland/waterbody complexes using the open cut trenching method that is described in Freeport LNG's project-specific Wetland and Waterbody Construction and Mitigation Procedures and is the approved method for crossings outside of the designated HDD areas. Push-pull/float installation will be used where hydrological conditions and sufficient pipeline length make this approach feasible.

Freeport LNG will ensure that has obtained the necessary authorizations from the appropriate federal (FERC/COE) and state agencies (Railroad Commission of Texas) prior to the implementation of any alternative crossing methods.

APPENDIX D

Water and Wetland Delineation Maps

Figure D-1

Freeport LNG - Liquefaction Project

Waterbodies and Wetlands at the Quintana Island Terminal Site -

Field Delineation Map

Brazoria County, Texas

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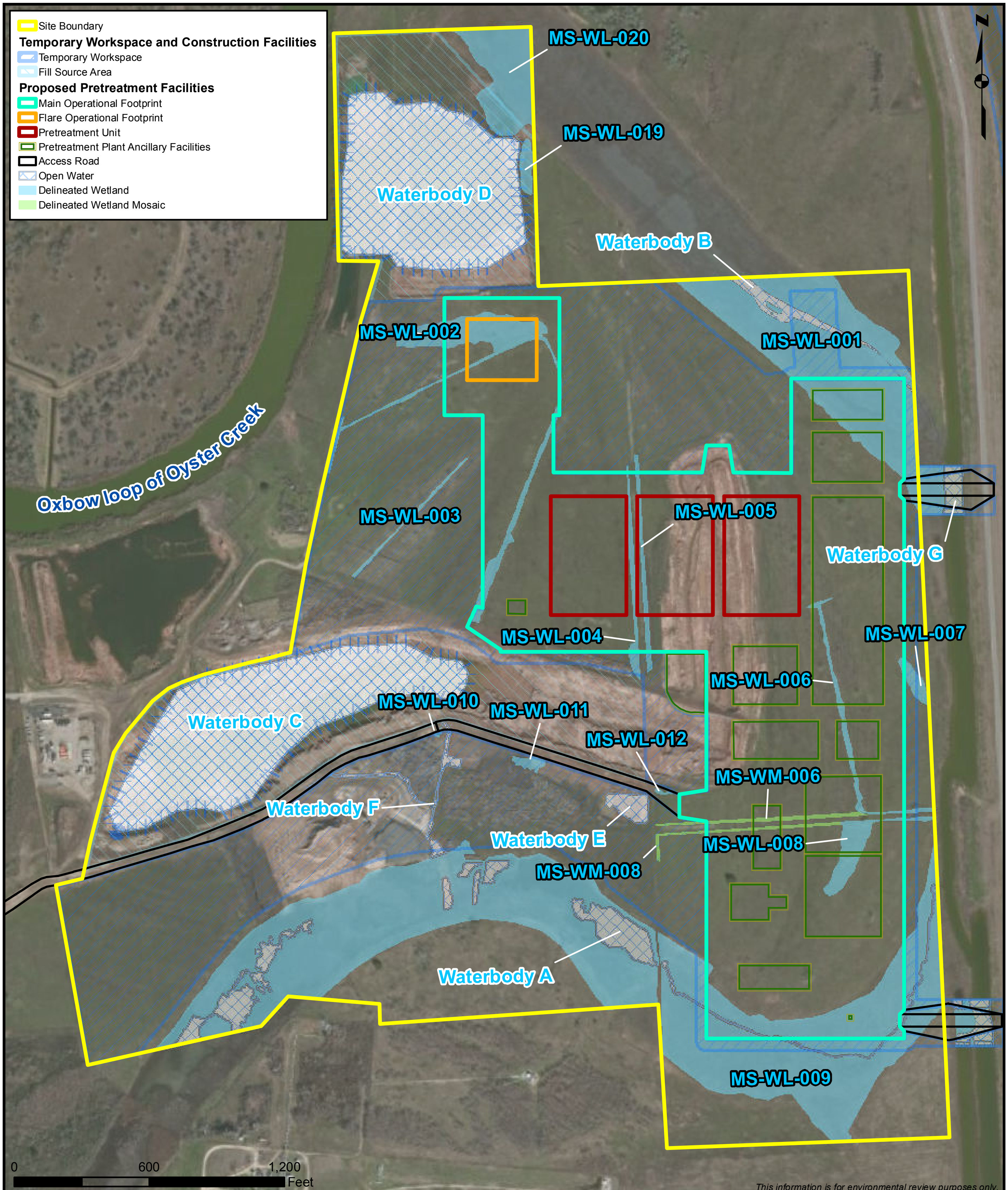

Figure D-2

Freeport LNG - Liquefaction Project

Waterbodies and Wetlands at the Pretreatment Plant Site - Field Delineation Map

Brazoria County, Texas

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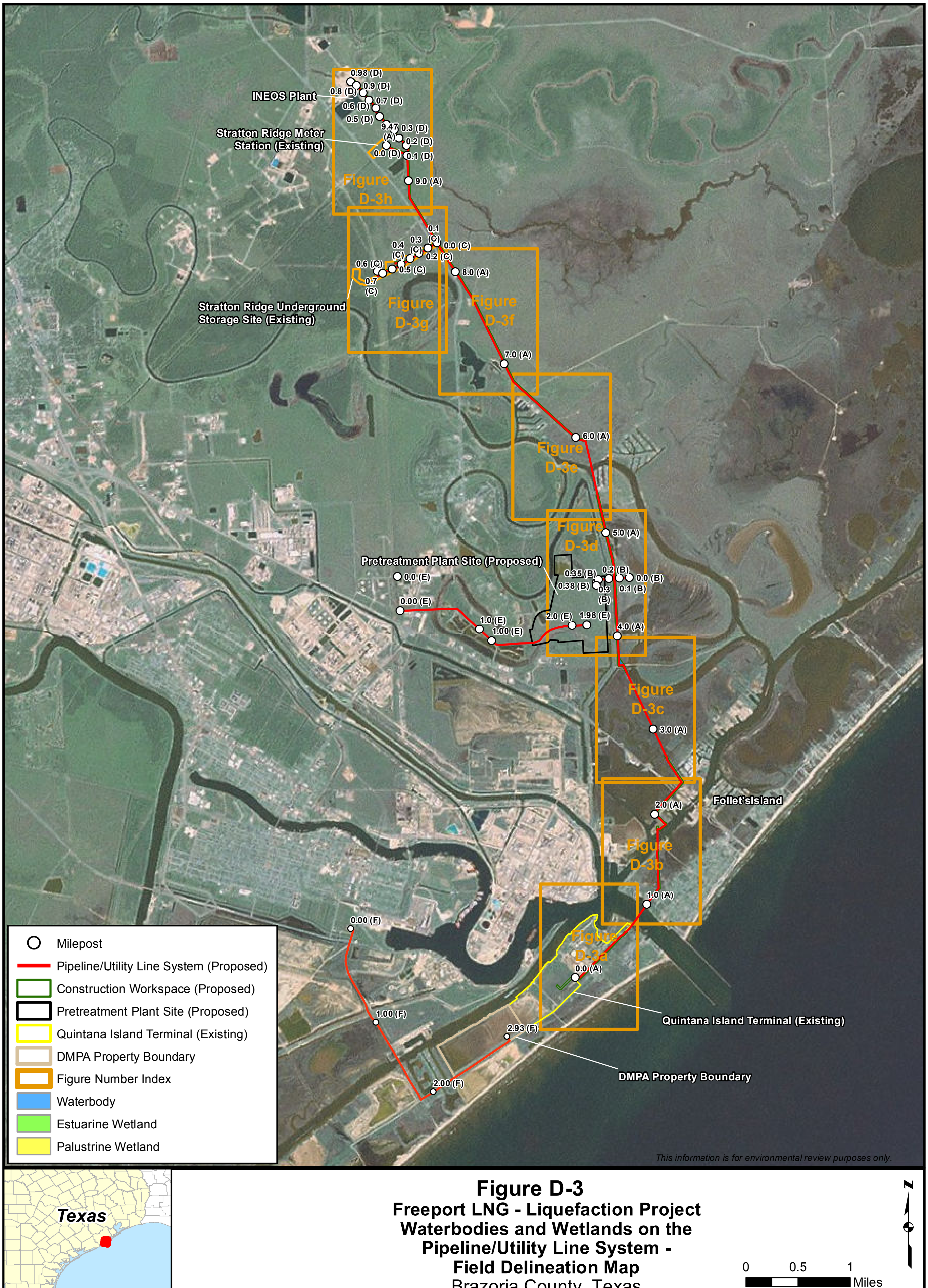

Figure D-3
Freeport LNG - Liquefaction Project Waterbodies and Wetlands on the Pipeline/Utility Line System - Field Delineation Map
Brazoria County, Texas

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DRAWN BY: JEBAKKEN

Figure D-3a
Freeport LNG - Liquefaction Project
Waterbodies and Wetlands on the Pipeline/Utility Line System - Field Delineation Map
MP 0.0(A) to MP 0.8(A) MP 0.0(F) to MP 2.93(F)
Brazoria County, Texas

FILE: M:\Clients\D-F\FRE\Liquefaction_ArcGIS\2013\05\reformatted_RRs_FRE_RR_4_2_2_3_LiqProj_Facilities_All_Water_Wetlands_MapSet.mxd | REVISED: 05/06/2013 | SCALE: 1:63,360 DRAWN BY: JEBAKKEN

Figure D-3b
Freeport LNG - Liquefaction Project
Waterbodies and Wetlands on the Pipeline/Utility Line System - Field Delineation Map
MP 0.7(A) to MP 2.4(A)
Brazoria County, Texas

FILE: M:\Clients\D-F\FRE\Liquefaction_ArcGIS\2013\05\reformatted_RRs_FRE_RR_4_2_2_3_LiqProj_Facilities_All_Water_Wetlands_MapSet.mxd | REVISED: 05/06/2013 | SCALE: 1:10,000 DRAWN BY: JEBAKKEN

Figure D-3c

Freeport LNG - Liquefaction Project

Waterbodies and Wetlands on the Pipeline/Utility Line System - Field Delineation Map

MP 2.4(A) to MP 3.9(A)

Brazoria County, Texas

FILE: M:\Clients\D-F\FRE\Liquefaction_ArcGIS\2013\05\reformatted_RRs_FRE_RR_4_2_2_3_LiqProj_Facilities_All_Water_Wetlands_MapSet.mxd | REVISED: 05/06/2013 | SCALE: 1:10,000 DRAWN BY: JEBAKKEN

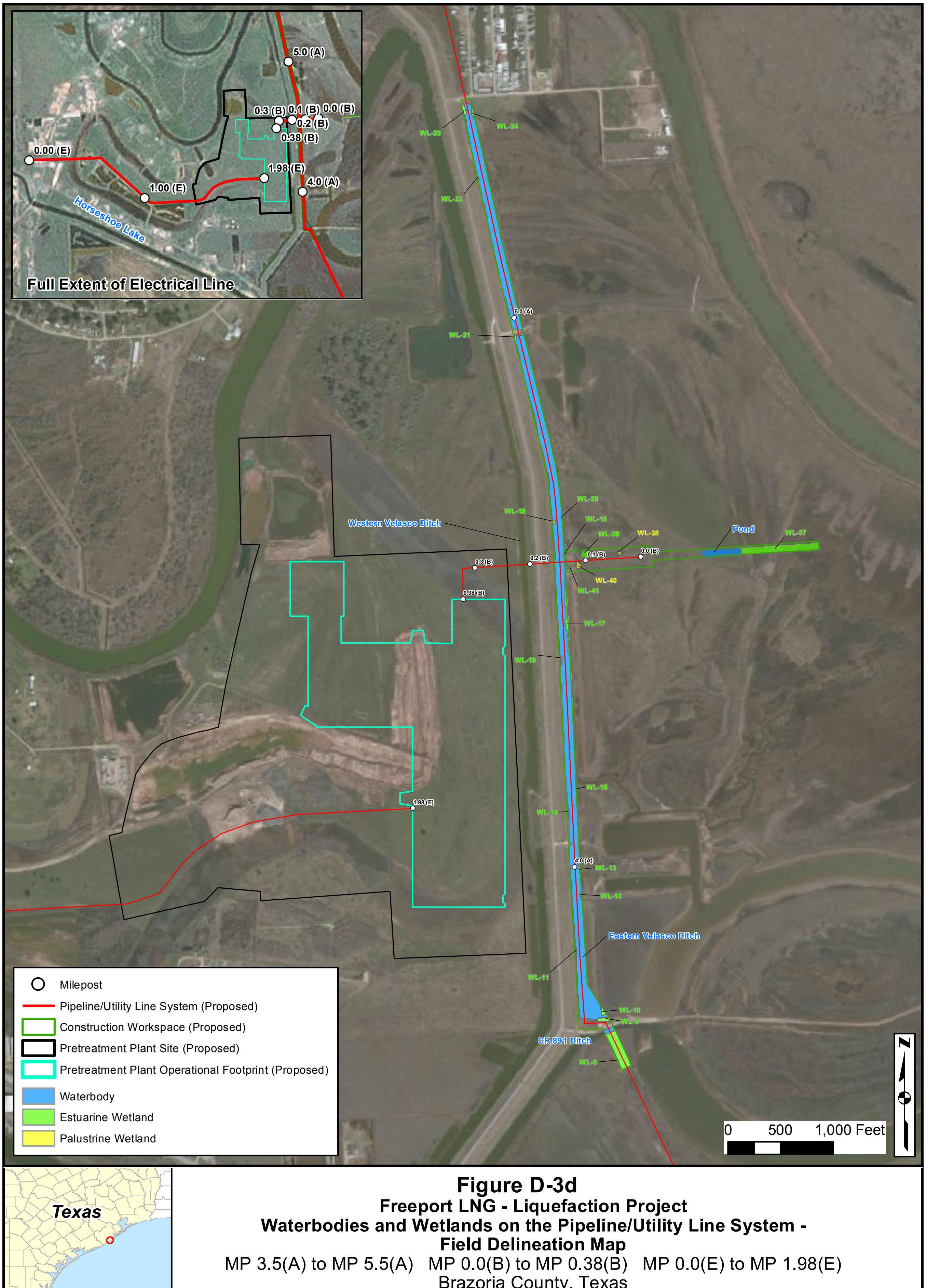

Figure D-3d

Freeport LNG - Liquefaction Project

Waterbodies and Wetlands on the Pipeline/Utility Line System - Field Delineation Map

MP 3.5(A) to MP 5.5(A) MP 0.0(B) to MP 0.38(B) MP 0.0(E) to MP 1.98(E)

Brazoria County, Texas

FILE: M:\Clients\D-F\FRE\Liquefaction_ArcGIS\2013\05\reformatted_RRs_FRE_RR_4_2_2_3_LiqProj_Facilities_All_Water_Wetlands_MapSet.mxd | REVISED: 05/06/2013 | SCALE: 1:63,360 DRAWN BY: JEBAKKEN

Figure D-3e
Freeport LNG - Liquefaction Project
Waterbodies and Wetlands on the Pipeline/Utility Line System -
Field Delineation Map
MP 5.2(A) to MP 6.8(A)
Brazoria County, Texas

FILE: M:\Clients\D-F\FRE\Liquefaction_ArcGIS\2013\05\reformatted_RRs_FRE_RR_4_2_2_3_LiqProj_Facilities_All_Water_Wetlands_MapSet.mxd | REVISED: 05/06/2013 | SCALE: 1:10,000 DRAWN BY: JEBAKKEN

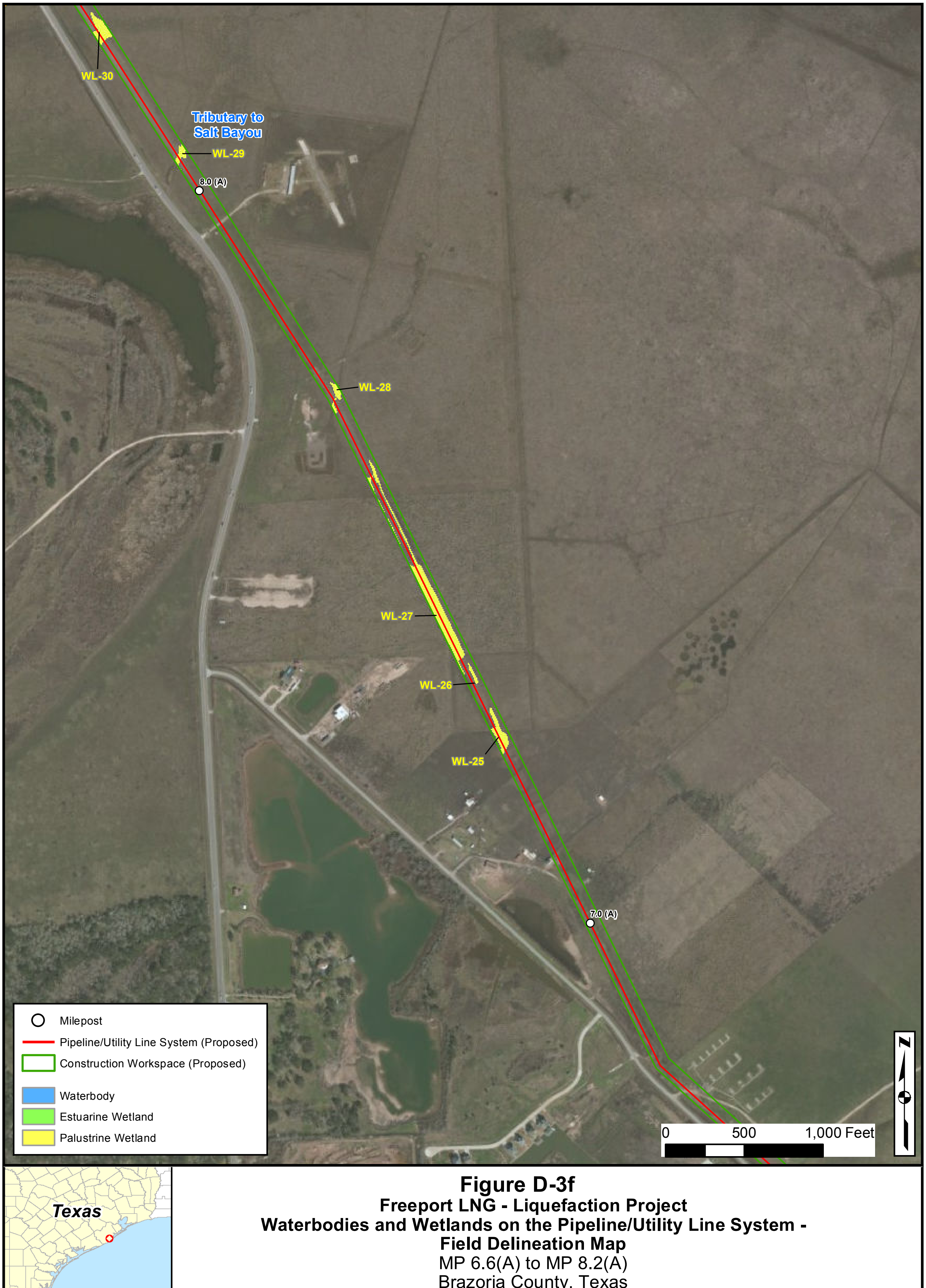

Figure D-3f
Freeport LNG - Liquefaction Project
Waterbodies and Wetlands on the Pipeline/Utility Line System -
Field Delineation Map
MP 6.6(A) to MP 8.2(A)
Brazoria County, Texas

FILE: M:\Clients\D-F\FRE\Liquefaction_ArcGIS\2013\05\reformatted_RRs_FRE_RR_4_2_2_3_LiqProj_Facilities_All_Water_Wetlands_MapSet.mxd | REVISED: 05/06/2013 | SCALE: 1:10,000 DRAWN BY: JEBAKKEN

Figure D-3g

Freeport LNG - Liquefaction Project

Waterbodies and Wetlands on the Pipeline/Utility Line System - Field Delineation Map

MP 8.2(A) to MP 8.7(A) MP 0.0(C) to MP 0.72(C)

Brazoria County, Texas

FILE: M:\Clients\D-F\FRE\Liquefaction_ArcGIS\2013\05\reformatted_RRs_FRE_RR_4_2_2_3_LiqProj_Facilities_All_Water_Wetlands_MapSet.mxd | REVISED: 05/06/2013 | SCALE: 1:10,000 DRAWN BY: JEBAKKEN

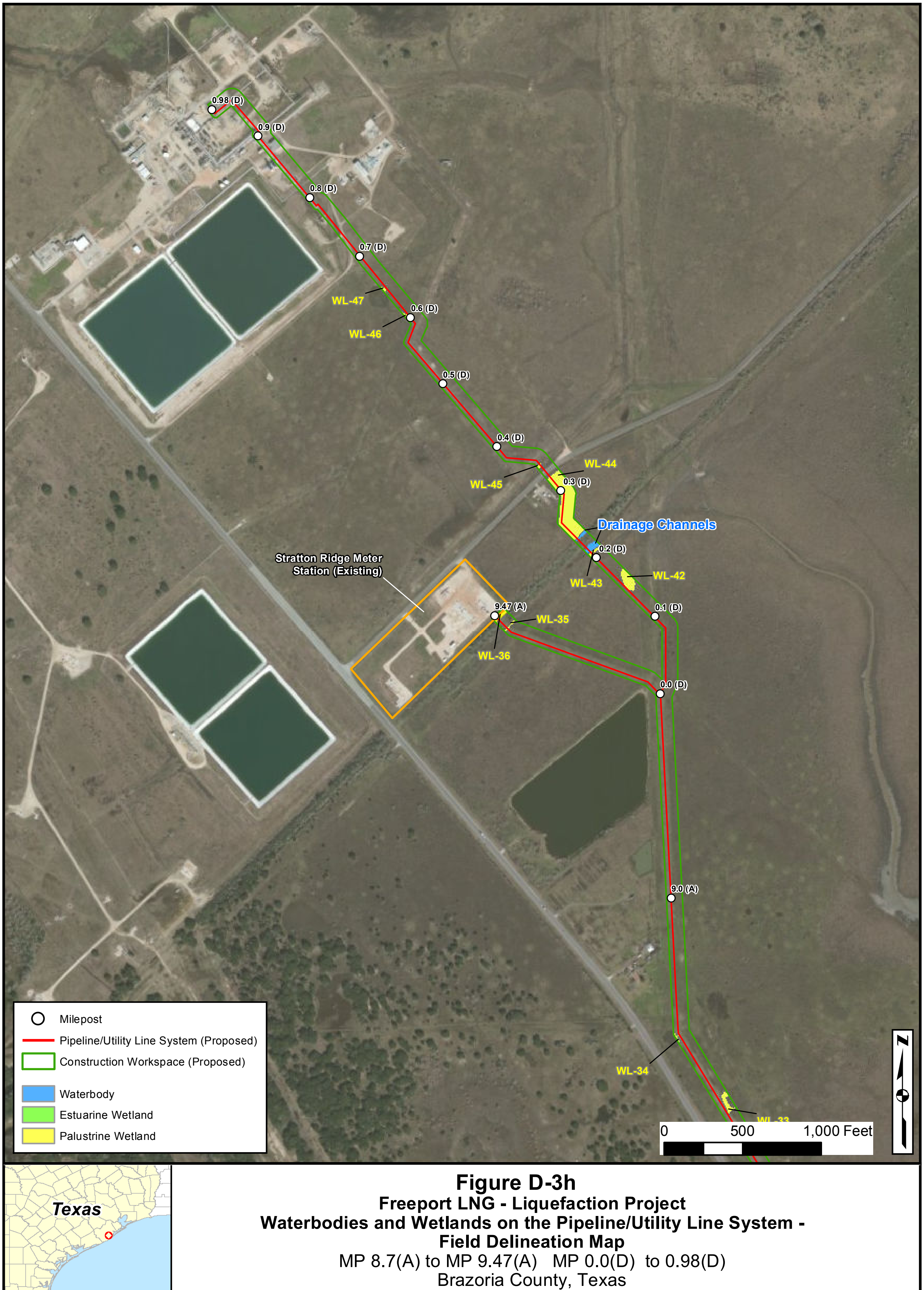

Figure D-3h

Freeport LNG - Liquefaction Project

Waterbodies and Wetlands on the Pipeline/Utility Line System -

Field Delineation Map

MP 8.7(A) to MP 9.47(A) MP 0.0(D) to 0.98(D)

Brazoria County, Texas

FILE: M:\Clients\D-F\FRE\Liquefaction_ArcGIS\2013\05\reformatted_RRs_FRE_RR_4_2_2_3_LiqProj_Facilities_All_Water_Wetlands_MapSet.mxd | REVISED: 05/06/2013 | SCALE: 1:10,000 DRAWN BY: JEBAKKEN

APPENDIX E

Visual Impact Study Figures

Existing View

Proposed View

20121207_1858NRGFreeportLNG_VP52right

Freeport LNG

Phase II and Liquefaction Project Facilities at and Adjacent to Quintana Island Terminal

South end of unnamed beach road looking Northwest

- Viewpoint Location
- Proposed Facilities Boundary
- Proposed Facilities Operational Footprint

Easting Position:	**3147105**
Northing Position:	**13539263.2**
Elevation of Viewpoint Position (ft):	**6.3**
Height of Camera Above Ground (ft):	**5.4**
Date of Photography:	**November 24, 2012 at 12:01 pm**
Orientation of View:	**NW**
Horizontal Field of View:	**124°**
Vertical Field of View:	**55°**

NOTES:

Viewpoint locations have been precision surveyed by:
Doyle & Wachtstetter
131 Commerce Street, Clute,
Texas

Projection/Zone/Datum:
State Plane Co-ordinate System, Texas South Central (NAD 83)

Elevations are above Mean Sea Level (NAVD 88)

Units are in feet unless otherwise stated

Photosimulation Created Using TrueView™ Technology (Patent No.: US 8,184,906 B2)

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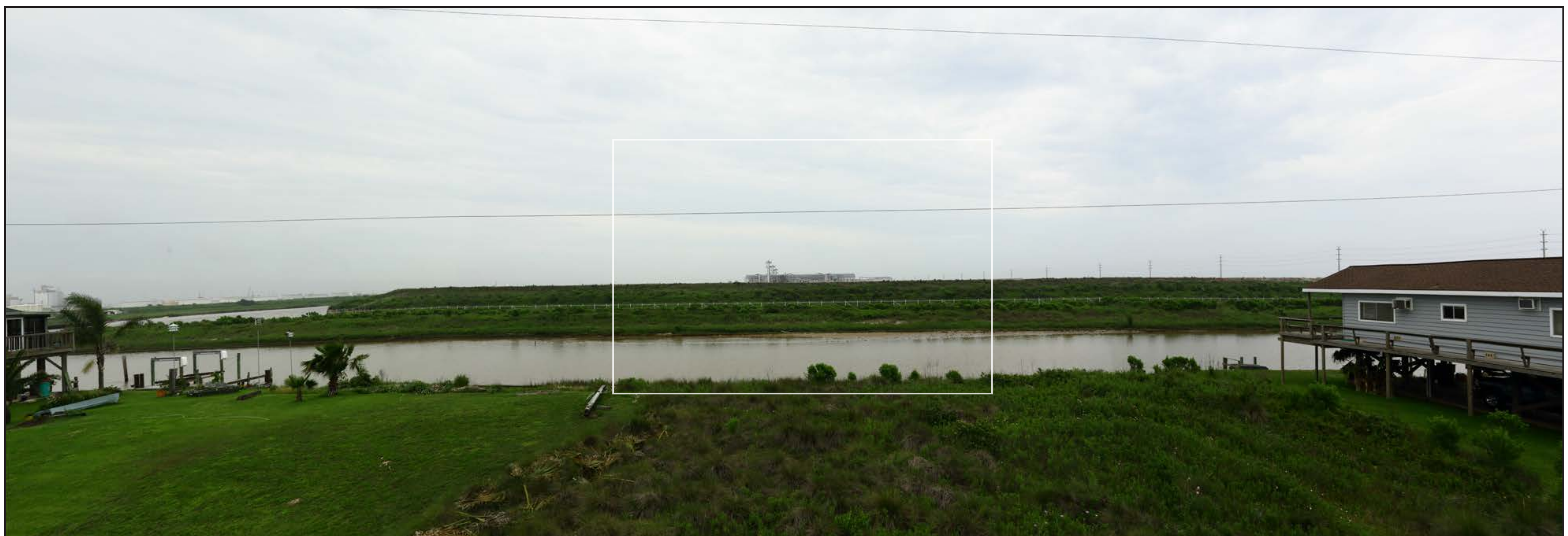
Figure E-1. Existing and Proposed Views from Unnamed Beach Road Looking Northwest

20121207_1858NRGFreeportLNG_VP52right

Figure E-2 Proposed View
Enlargement Area of Figure E-1

Existing View



Proposed View

Figure E-3. Existing and Proposed View of Central Area of 806c Looking Northeast (Ground Level)

Freeport LNG

Viewpoint 07
Northern end of 806c
Looking North East

Viewpoint Location
Site Boundary

Easting Position:	**3140396.79**
Northing Position:	**13537277.09**
Elevation of Viewpoint Position (ft):	**25.51**
Date of Photography:	**April 29, 2013 at 5:51 pm**
Orientation of View:	**NE**
Horizontal Field of View:	**124°**
Vertical Field of View:	**55°**

NOTES:

Viewpoint locations have been precision surveyed by:
Doyle & Wachtstetter
131 Commerce Street, Clute,
Texas

Projection/Zone/Datum:
State Plane Co-ordinate System, Texas South Central (NAD 83)

Elevations are above Mean Sea Level (NAVD 88)

Units are in feet unless otherwise stated

Photosimulation Created Using
TrueView™ Technology
(Patent No.: US 8,184,906 B2)

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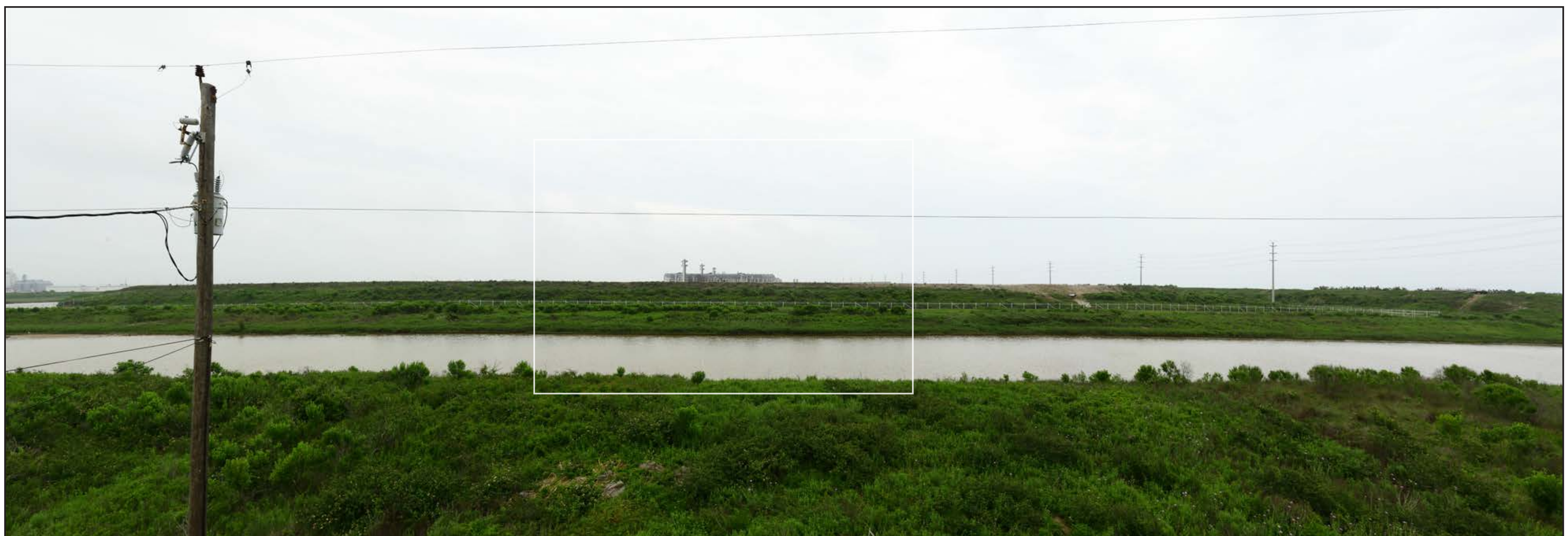
Figure E-4 Northern end of 806c - Looking North East **- Proposed View (Ground Level)**
Enlargement Area of Figure E-3

Existing View



Proposed View

Figure E-5. Existing and Proposed Views of Central Area of 806c Looking Northeast (Elevated)

Freeport LNG

Central area of 806c
Looking North East

● Viewpoint Location
● Site Boundary

Easting Position:	**3140639.4**
Northing Position:	**13536859.57**
Elevation of Viewpoint Position (ft):	**25.87**
Date of Photography:	**April 29, 2013 at 5:28 pm**
Orientation of View:	**NE**
Horizontal Field of View:	**124°**
Vertical Field of View:	**55°**

NOTES:

Viewpoint locations have been precision surveyed by:
Doyle & Wachtstetter
131 Commerce Street, Clute,
Texas

Projection/Zone/Datum:
State Plane Co-ordinate System, Texas South Central (NAD 83)

Elevations are above Mean Sea Level (NAVD 88)

Units are in feet unless otherwise stated

Photosimulation Created Using
TrueView™ Technology
(Patent No.: US 8,184,906 B2)

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Figure E-6. Central area of 806c - Looking North East **- Proposed View (Elevated)**
Enlargement Area of Figure E-5

Existing

Proposed

Figure E-7. Existing and Proposed Nighttime Views for Viewpoint 01 Farm to Market Route 1495, Looking Southeast

TRC

12/17/2013

Existing

Proposed

Figure E-8. Existing and Proposed Nighttime Views for Viewpoint 03, Bryan Beach Road, Looking Northeast

TRC

12/17/2013

Existing

Proposed

Figure E-9. Existing and Proposed Nighttime Views for Viewpoint 05
South End of Unnamed Beach Road , Looking Northwest

12/17/2013

Existing View

Proposed View

Figure E-10. Existing and Proposed Views - County Road 230 (Stringfellow Road) Looking East

Freeport LNG

Liquefaction Project Facilities at the Pretreatment Plant Site

County Road 230
(Stringfellow Road)
looking East

- Viewpoint Location
- Proposed Facilities Boundary
- Proposed Facilities Operational Footprint

Easting Position:	**3144983.6**
Northing Position:	**13560027.2**
Elevation of Viewpoint Position (ft):	**3.2**
Height of Camera Above Ground (ft):	**5.4**
Date of Photography:	**November 22, 2012 at 11:59 am**
Orientation of View:	**E**
Horizontal Field of View:	**124°**
Vertical Field of View:	**55°**

20121207_1858NRGFreeportLNG_VP56right

NOTES:

Viewpoint locations have been precision surveyed by:
Doyle & Wachtstetter
131 Commerce Street, Clute,
Texas

Projection/Zone/Datum:
State Plane Co-ordinate System, Texas South Central (NAD 83)

Elevations are above Mean Sea Level (NAVD 88)

Units are in feet unless otherwise stated

Photosimulation Created Using
TrueView™ Technology
(Patent No.: US 8,184,906 B2)

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Figure E-11 County Road 230 (Stringfellow Road) looking East **- Proposed View**
Enlargement Area of Figure E-10.

APPENDIX F

Air Quality Appendix

APPENDIX F

AIR QUALITY APPENDIX

Methodologies for Air Dispersion Modeling, Estimating Operational Vessel Emissions, and Modeling Cumulative $PM_{2.5}$ Impacts

This appendix describes the methodologies used to:

- Perform air dispersion modeling of the Freeport LNG Project's stationary source emissions.
- Estimate of the emissions of NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, VOC, and GHG from the LNG carriers, tugs and escort vessels within the moored safety zone as well as those within Texas waters.
- Perform multi-source air dispersion modeling of the $PM_{2.5}$ emissions from the Freeport LNG Project, as well as LNG carriers, tugs and escort vessels within the moored safety zone as well as those within Texas waters.

<u>Air Dispersion Modeling of Stationary Source Emissions</u>

The refined modeling used an air quality computer model called AERMOD. The EPA describes AERMOD as, *"A steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain."*

The first step was to define the Project's emissions inventory. The pollutant sources listed below, with the modeled pollutant(s) emitted by each source shown in parentheses.

- Liquefaction Plant – Onsite Facilities
  - Six emergency generators (CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$)
  - One emergency air compressor (CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$)
  - Two firewater pumps (CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$)
  - Liquefaction Plant flare (CO and NO_2) and flare pilots (CO and NO_2)
- Pretreatment Plant – Onsite Facilities
  - Five process heaters (CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$)
  - Three thermal oxidizers (CO, NO_2, SO_2, PM_{10}, and $PM_{2.5,}$)
  - One combustion turbine (CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$)
  - Lube oil vent (PM_{10}, $PM_{2.5}$, and VOC emissions)
  - Five emergency generators (CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$)
  - One emergency air compressor (CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$)

- One firewater pump (CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$)
- Pretreatment Plant flare and flare pilots (CO and NO_2)

The second step was to evaluate the emission sources with respect to their proximity to structures in the vicinity to determine if stack discharges might be drawn into the turbulent wakes of nearby structures. Building dimensions and locations and stack parameters were inputs Building Profile Input Program with Plume Rise Model Enhancements (BPIP-PRIME) to identify the dominant structures and generate building downwash input data for the dispersion model.

The third step was to define the receptor grid. For PSD and NNSR modeling, ambient air starts at the Project's fence line or other physical barrier to public access. The dispersion model's grid covers a region extending from the Project's fenceline to at least 10 km beyond the Project sources. A "tight grid" with 25-meter spacing was used close to the Project's fenceline. The grid becomes coarser at increasing distances, reaching 1 km at its most distant extent.

The fourth step was to obtain and process meteorological data. Meteorological data sets for the years 2006 through 2010 were obtained from TCEQ. These data are based on surface observations taken from the Angleton Brazoria Airport, and upper air observations taken from Lake Charles, Louisiana. TCEQ pre-processed these data with the AERMET program using parameters representative of Brazoria County.

The fifth step was to perform a Significance Analysis in which each maximum predicted offsite concentration resulting from operation of the Project's facilities are compared to its respective significant impact level (SIL). Note that there are currently no SILs for CO, and the PSD increment limits are uses in lieu of the SILs. If a pollutant's "single source" impact for specific averaging period is less than the corresponding SIL, no further analysis needed. Each pollutant was modeled for a range of operating scenarios. As shown in Table D-1, the predicted impacts for PM_{10}, NO_2, CO, and SO_2 are below the applicable SILs and increment levels. The $PM_{2.5}$ predicted impacts exceed the applicable SILs. Therefore, the multi-source refined modeling is required for this pollutant.

Table D-1

Air Dispersion Modeling Summary

Pollutant and Averaging Time	Pollutant Concentration ($\mu g/m^3$)							
	Modeling Significant Impact Level	PSD Class II Increment Standard	NAAQS	Single-Source Modeling Results	Background a/	Multi-Source Modeling Results	Multi-Source Modeling Results Result + Background	PSD Class II Modeling Results Result
CO								
8-hour	---	500	10,300	325.3	1,069	e/	e/	e/
1-hour	---	2,000	40,000	550.3	1.476	e/	e/	e/
NO_2								
1-hour	7.5	---	188	4.64	37.8	e/	e/	e/
Annual	1	25	100	0.49	14.3	e/	e/	e/

Table D-1

Air Dispersion Modeling Summary

Pollutant and Averaging Time	Pollutant Concentration ($\mu g/m^3$)							
	Modeling Significant Impact Level	PSD Class II Increment Standard	NAAQS	Single-Source Modeling Results	Background a/	Multi-Source Modeling Results	Multi-Source Modeling Results Result + Background	PSD Class II Modeling Results Result
$PM_{2.5}$								
Annual	0.3	4	12 c/	0.88	9.3	2.35	11.65	0.89
24-hour	1.2	9	35 c/	4.95	20.7	10.63	31.33	4.88
PM_{10}								
Annual	1	17	d/	0.88	---	e/	e/	e/
24-hour	5	30	150	4.95	41	e/	e/	e/
SO_2								
1-hour	7.9	---	196	4.34	55.1	e/	e/	e/
3-hour	25	512	1,300	3.00	36.8	e/	e/	e/

a/ From Table 4.9.1-2
b/ PSD Air Dispersion Modeling Report, enclosure to letter from L.M. Tonery (Fulbright & Jaworski) to K.D. Bose (FERC), July 23, 2013, Table 14-2
c/ Remanded back to Court on 1/22/13, but not precluded from being used
d/ Revoked
e/ The predicted impact from screening modeling is less than the modeling significant impact level. Therefore, multi-source and PSD Class II modeling are not required.
ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter.

The sixth step was to establish the radius of influence (ROI) for the $PM_{2.5}$ multi-source analysis. The ROI is the farthest distance from the center of the proposed emissions source to the receptor where modeled ground-level concentrations are equal to or less than the applicable SIL. Because two facilities (*i.e.*, Pretreatment and Liquefaction Facilities) are included in the same modeling runs, the distance to the ROI was measured from the center of the facility with the greatest of emissions (*i.e.*, the Pretreatment Plant). This distance is 1.8 km.

The seventh step was to compile the multi-source $PM_{2.5}$ emissions inventory. The inventory of offsite sources was obtained from the Texas Point Source Database (PSDB). Stationary sources located with 51.8 km of the Pretreatment Plant were selected, based on the 1.8 km ROI the plus 50 km, and supplemented using additional data obtained from TCEQ.

The eighth step was to run AERMOD with the Pretreatment Plant, Liquefaction Plant, and the offsite $PM_{2.5}$ inventory sources operating simultaneously using each year (2006 through 2010) of meteorological data. For each averaging period (*i.e.*, 24-hour and annual) background concentrations are added to offsite maximum predicted impacts, and the sum compared to the relevant NAAQS. As is shown in Table D-1, the $PM_{2.5}$ maximum predicted 24-hour and annual impacts plus background concentration sums are less than the applicable NAAQS. For each averaging period, the maximum offsite predicted combined impact of the Project's facilities and offsite sources is less than the applicable increment standard.

The ninth step was to compile the offsite inventory for $PM_{2.5}$ PSD Class II increment analysis. USEPA established the major source baseline date as October 20, 2010 for $PM_{2.5}$ increment. Major sources located within the ROI plus 50 km of the Pretreatment Plant and permitted after April 20, 2009 (18 month before the major source baseline date) were included in the offsite inventory of increment-consuming sources. TCEQ considers the submittal date of the Project's PSD application, December 20, 2011, as the minor source baseline date. Minor sources located within the 12 km of the Pretreatment Plant and permitted after June 16, 2009 (approximately 18 month before the minor source baseline date) were included in the offsite inventory of increment-consuming sources.

The tenth step was to conduct the $PM_{2.5}$ PSD Class II increment analysis. The Pretreatment Plant, Liquefaction Plant, and the inventory of offsite $PM_{2.5}$ increment-consuming sources operating were modeled simultaneously with AERMOD using each year (2006 through 2010) of meteorological data. The predicted impacts are less than the PSD Class II increment standards.

The refined modeling protocol for the Texas PSD and NNSR permit was reviewed by TCEQ personal and by FERC staff. It was determined by the TCEQ that operational marine emissions would not be included as stationary sources in the model. Subsequently, FERC staff determined that these emissions should be evaluated in the cumulative impact model.

Vessel Emissions

At the request of FERC, in December 2013 Freeport LNG submitted the estimates of the emissions of NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, VOC, and GHG from the existing LNG ships, tugs and escort vessels. These analyses did not properly account for all the reasonably expected vessel emissions. Therefore, in January 2014 FERC revised the emission calculations to better characterize the expected operations using the methodology described in U. S. Environmental Protection Agency Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, ICF International, April 2009. The following was assumed:

- A typical LNG carrier vessel will have an LNG capacity of 180,000 m^3.
- There will be 200 LNG carrier calls per year. Each call will entail 3.7 hours cruise, reduced speed zone (RSZ), and maneuvering operations as well as 23 hours of hotelling.
- A typical LNG carrier's main propulsion system will utilize boilers and steam turbines with a rated total maximum output of 32,500 hp. The boilers will fire 97% boil-off gas (BOG) and 3% fuel oil with 0.1% by weight sulfur. The boilers will operate at 50%, 15%, 15%, and 10% loads during cruise, RSZ, maneuvering, and hotelling operations, respectively.
- A typical LNG carrier will utilize reciprocating internal combustion auxiliary engines with a rated total maximum output of 8,125 hp. The auxiliary engines will fire marine diesel oil with 0.1% by weight sulfur. The auxiliary engines will operate at 17%, 27%, 45%, and 22% loads during cruise, RSZ, maneuvering, and hotelling operations, respectively.

- Four tug vessels will be employed on the round trip to escort each carrier through the reduced speed zone to and from the loading area. One tug will remain with the carrier while it is moored at the dock.
- Each tug vessels will be equipped with two 2,065 hp main propulsion engines and two 134 hp auxiliary engines. The engines will fire diesel oil. The main propulsion engines will operate at 100% and 25% loads during RSZ and hotelling operations, respectively. The auxiliary engines will operate at 31% loads during RSZ, maneuvering, and hotelling operations.
- The emission factors listed in Table D-2 were used to calculate vessel emissions.

Table D-2

Vessel Emission Factors (g/hp-hr)

Pollutant	LNG Carrier Main Propulsion Boilers / Steam Turbines		LNG Carrier Auxiliary Engines		Tug Engines Marine Diesel Oil	
	Boil-off Gas	Marine Diesel Oil	Boil-off Gas	Marine Diesel Oil	Main Propulsion	Auxiliary
NO_x	0.45	1.49	8.17	10.37	7.31	7.31
CO	0.38	0.15	3.41	0.82	1.86	1.12
PM_{10}	0.034	0.13	0.032	0.13	0.19	0.19
$PM_{2.5}$	0.034	0.11	0.032	0.13	0.19	0.19
VOC	0.025	0.075	0.60	0.30	0.20	0.20
SO_2	0.027	0.43	0.018	0.31	0.10	0.10
CO_2	544	688	350	508	515	515
CH_4	0.01	0.027	1.80	0.0015	0.067	0.067
N_2O	0.01	0.06	-	0.06	0.0015	0.0015

Vessel Modeling Methodology

FERC also requested that Freeport LNG perform cumulative modeling of the Project's $PM_{2.5}$ emissions plus the $PM_{2.5}$ emissions from aforementioned vessel operations. As part of the New Source Review (NSR) air permit application, Freeport LNG performed refined multi-source air dispersion modeling of the Project's stationary air emission sources plus influential stationary sources in the vicinity of the Project. The modeling protocol and report were reviewed and approved by TCEQ. This modeling did not include emissions from LNG carrier and tug vessels, as these are out of the scope for NSR. Therefore, Freeport LNG revised its NSR modeling inputs to include the vessel emissions, and ran the dispersion model. This entailed:

- Repeat the Significance Analysis (step 5 above), but include the vessel emissions. This identified five additional receptors with impacts above the $PM_{2.5}$ SILs.

- Repeat the Refined Multi-source Analysis (step 8 above) with the Pretreatment Plant, Liquefaction Plant, and the offsite $PM_{2.5}$ inventory sources operating simultaneously using each year (2006 through 2010) of meteorological data, but add the vessel emissions and five additional receptors.

In December 2013 Freeport LNG submitted to FERC results showing that maximum predicted offsite impacts of the $PM_{2.5}$ emission from operation of the Project's stationary sources, nearby influential sources, and vessels, plus the background concentrations (31.2 μg/m^3 24-hour average and 11.7 μg/m^3 annual average), would not exceed the applicable National Ambient Air Quality Standards (NAAQS) (35 μg/m^3 24-hour average and 12 μg/m^3 annual average).

As discussed previously, Freeport LNG December 2013 analysis did not properly account for all the reasonably expected vessel emissions. Using these erroneous vessel emission rates, the $PM_{2.5}$ maximum predicted offsite impacts plus background concentrations were 89% to 98% of the 24-hour average and annual average NAAQS. Therefore, FERC decided to redo the air dispersion modeling using the corrected vessel emissions

FERC obtained from Freeport LNG the input files for December 2013 modeling of the Project's stationary sources, nearby influential sources, and vessels. As a first step, FERC ran AERMOD to benchmark the December 2013 analyses, and successfully reproduced their results for both the $PM_{2.5}$ 24-hour average and annual average impacts for both the Significance Analysis and the Refined Multi-source Analysis. The December 2013 input files were then revised with the corrected vessel emission rates (retaining same source inventories, source parameters, source groups, receptor arrays, meteorology, and AERMOD model version). This is referred to as the "January 2014 analysis".

Modeling with the increased vessel emission resulted in modest increases (2 and 0.01 μg/m^3 for 24-hour and annual averaging periods, respectively) of the predicted impacts to Project stationary source plus vessel emissions. However, the significant impact area (i.e., the area for which impacts are calculated for the multi-source modeling) substantially increased. In other words, it became necessary to include in the multi-source receptors not considered in the December 2013 multi-source analysis, including receptors in the vicinity of the Liquefaction Plant.

As shown in Table D-3, the multi-source runs did not demonstrate compliance for either averaging time (24-hour and annual), due to the significant receptors adjacent to the Liquefaction Plant. These receptors were outside the impact area for the December 2013 submittal. Since the significance runs predict only modest increases in ambient impacts due to the increased vessel emissions, these large impacts predicts by the revised multi-source modeling are due to sources which are not part of the Freeport LNG Project.

Table D-3

$PM_{2.5}$ Predicted Cumulative Impacts

Averaging Period	Model Runs	$PM_{2.5}$ Concentration (ug/m^3)			
		Multi-Source Maximum Predicted	Background	Multi-Source Maximum Predicted + Background	NAAQS
24 hour	December 2013 Analysis	10.5	20.7	31.2	35
24 hour	January 2014 Analysis	227.8	20.7	248.5	35
Annual	December 2013 Analysis	2.4	9.3	11.7	12
Annual	January 2014 Analysis	5.2	9.3	14.5	12

APPENDIX G

Major Recent or Proposed Developments in Brazoria County

Table G-1

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Environmental Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		ENVIRONMENTAL IMPACT EVALUATION						
		Const. Start-up	In- Service	Wetlands	Waterbodies	Threatened & Endangered Species	EFH	Air	Noise	Water Quality
INDUSTRIAL DEVELOPMENTS										
Manufacturing/Chemical Production										
BASF – Ammonium Sulfate Crystallizer Freeport – Existing Plant Site	7	2012	2012	No impacts (per NWI)	No impacts (per NWI)	No impacts (at existing industrial plant)	No impacts (no estuarine/ marine habitat)	Unknown	Profile unknown	No in-stream construction impacts assumed Operational discharge impacts (if any) unknown
Chevron Phillips - Two Plastic Resin-Producing Facilities Old Ocean at SH 35 / FM 524	27	2014	2017	No impacts (per NWI)	No impacts (per NWI)	No impacts (at existing industrial plant)	No impacts (no estuarine/ marine habitat)	Unknown	Profile unknown	No in-stream construction impacts assumed Operational discharge Impacts (if any) unknown
Cyanco – Sodium Cyanide Plant Chocolate Bayou	22	Not known	2012	No impacts (per NWI)	No impacts (per NWI)	No impacts (at existing industrial plant)	No impacts (no estuarine/ marine habitat)	Unknown	Profile unknown	No in-stream construction impacts assumed Operational discharge impacts (if any) unknown
Dow - Chlorine Plant Freeport – Existing Plant B	5	2011	2013	No impacts (per NWI)	No impacts (per NWI)	No impacts (at existing industrial plant)	No impacts (no estuarine/ marine habitat)	Unknown	Profile unknown	No in-stream construction impacts assumed Operational discharge impacts (if any) unknown
Dow - Propane Dehydrogenation Plant Freeport – Existing Oyster Creek Plant	4	2011	2015	No impacts (per NWI)	No impacts (per NWI)	No impacts (at existing industrial plant)	No impacts (no estuarine/ marine habitat)	Unknown	Profile unknown	No in-stream construction impacts assumed Operational discharge impacts (if any) unknown
Dow – Ethylene Plant Freeport – Existing Plant B	5	2013	2017	No impacts (per NWI)	No impacts (per NWI)	No impacts (at existing industrial plant)	No impacts (no estuarine/ marine habitat)	Unknown	Profile unknown	No in-stream construction impacts assumed Operational discharge impacts (if any) unknown
Dow – AgroSciences Plant Existing Oyster Creek Plant	4	Not known	2015	No impacts (per NWI)	No impacts (per NWI)	No impacts (at existing industrial plant)	No impacts (no estuarine/ marine habitat)	Unknown	Profile Unknown	No in-stream construction impacts assumed Operational discharge impacts (if any) unknown
Ineos – Cracking Furnace Existing Chocolate Bayou Plant	22	2012	2013	No impacts (per BA)	No impacts (per BA)	BA for PSD GHG Permit – no impacts	No impacts (no estuarine/ marine habitat)	Unknown	No impact beyond site boundary (per BA)	No construction or operational impacts (per BA)

Table G-1

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Environmental Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		ENVIRONMENTAL IMPACT EVALUATION						
		Const. Start-up	In- Service	Wetlands	Waterbodies	Threatened & Endangered Species	EFH	Air	Noise	Water Quality
Shin-Etsu –Silicon Production Plant Freeport Existing Plant	3	2013	2014	No impacts	No impacts	No impacts	No impacts (no estuarine/ marine habitat)	Unknown	No in-stream construction impacts assumed Operational discharge Impacts (if any) unknown	Unchanged from current industrial use – existing plant site
PORT DEVLEOPMENTS										
Port Freeport & Local interests -Non-Federal Channel Widening Project Freeport Harbor Channel	Adjacent to Terminal and in Gulf of Mexico	2013	2018	No adverse effect on wetlands *per se* (USACE, 2012 3.9 acres loss of scrub-shrub vegetation, beach, tidal mud flats (USACE, 2012)	6.1 miles of FHC widened from 400' up to 600' (USACE, 2012) 2.9 million yds^{3}, of clay/silt dredged; 300,000 yds^{3} silty sand dredged (USACE, 2012)	May affect, but not likely to adversely affect, piping plover, 2 injury or mortality sea turtle takes, 32 non-injurious sea turtle takes allowed per NOAA Fisheries Biological Opinion (USACE, 2012)	Project footprint crosses EFH but effects not documented	NOx exceedance; coordination regarding SIP compliance is ongoing (COE, 2012) It is anticipated that the increase in NOx and VOC emissions will be conformant with the SIP.	No adverse effects (USACE, 2012)	Groundwater – No adverse effects (USACE, 2012) Surface water – No adverse effects (USACE, 2012)
Port Freeport & USACE – Federal Channel Deepening Project Freeport Harbor Channel	Adjacent to Terminal and In Gulf of Mexico	2015	2021	39 acres emergent wetlands loss at spoil placement site Mitigated by 3 acre pond w/ plantings & 12-acre protected/ enhanced forest (USACE, 2012)	17.3 million yds^{3} of dredged material generated (USACE, 2012 176 million yds^{3} of additional dredged material generated by maintenance over 50 years (USACE, 2012	Likely to affect sea turtles during dredging; may affect; not likely to adversely affect piping plover (USACE, 2012)	No adverse effect (USACE, 2012)	NOx exceedances (COE, 2012) It is anticipated that the increase in NOx and VOC emissions would be conformant with the SIP.	No adverse effects (USACE, 2012)	GW – No adverse effects (EIS 2012) SW – No adverse effects (USACE, 2012)
Port Velasco Terminal Development Freeport – existing Port property	1	2008	2016	6 acres (NWI) 16 acres mitigated for 2-acre loss assoc. w/ Berth 7	New 2,400' berth – dredging impacts	Not known	No adverse effect assumed based on Channel Deepening Project conclusion	Unknown	Not known	No adverse effect assumed based on Channel Deepening Project conclusion

Table G-1

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Environmental Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		ENVIRONMENTAL IMPACT EVALUATION						
		Const. Start-up	In- Service	Wetlands	Waterbodies	Threatened & Endangered Species	EFH	Air	Noise	Water Quality
PIPELINE DEVLOPMENTS										
Enterprise -48.9 mile, 24-inch NGL pipeline Alvin and Mont Belvieu (~2 miles in Brazoria County)	34	2012	2012	Assume temporary impacts and/or type conversion during trenching – not quantified	Assume temporary impacts during trenching – not quantified	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Kinder Morgan/ Phillips 66 - 27-mile, 12-inch Sweeny Lateral - Crude Oil/Condensate Pipeline Southwards to Phillips 66 Sweeny refinery	27	2012	2014	Assume temporary impacts and/or type conversion during trenching – not quantified	Assume temporary impacts during trenching – not quantified	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Seaway (Enterprise & Enbridge) - 500- mile, 30-inch Seaway Crude Oil Pipeline Jones Creek northwards to Cushing, Oklahoma	6	2012	2014	Assume temporary impacts and/or type conversion during trenching – not quantified	Assume temporary impacts during trenching – not quantified	Not known	Not known	Unknown	Not known	Not known
Seaway (Enterprise & Enbridge) 65-mile, 36-inch Crude Oil Extension Pipeline Jones Creek northeastwards to southeast Houston	6	2012	2014	Assume temporary impacts and/or type conversion during trenching – not quantified	Assume temporary impacts during trenching – not quantified	Not known	Not known	Unknown	Not known	Not known
OIL & GAS FIELD DEVELOPMENTS										
Suemar – 1 new well Chevron Unit - 12 miles southeast of Angleton	9	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	Not known	Unknown	Not known	Not known

Table G-1

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Environmental Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		ENVIRONMENTAL IMPACT EVALUATION						
		Const. Start-up	In- Service	Wetlands	Waterbodies	Threatened & Endangered Species	EFH	Air	Noise	Water Quality
Denbury – 31 new/reentered/ recompleted wells West Hastings Unit - between Pearland & Alvin	38	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Maverick – 18 new wells Wisdom, Groce A/B Units - 5 miles southeast of Damon	32	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Hilcorp – 4 new/ recompleted wells Old Ocean Unit - Sweeny	24	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Jetta - 3 new wells Phillips & Abrams Units - 2.0 miles north of West Columbia	26	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Chalker - 6 new wells Bennett Estate - 2.5 miles northeast of Danbury	23	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
LINC Gulf Coast Petroleum – 3 new/recompleted wells Welch - 12.0 miles east of Angleton	15	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known

Table G-1

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Environmental Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		ENVIRONMENTAL IMPACT EVALUATION						
		Const. Start-up	In- Service	Wetlands	Waterbodies	Threatened & Endangered Species	EFH	Air	Noise	Water Quality
Texas Standard Oil – 1 new well HRI - 3.2 miles west of Liverpool	25	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Sandalwood – 2 new wells Charles Duke Unit - 5.1 miles southwest of Alvin	28	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Quantum - 1 new ell Old - 6.7 miles southeast of Alvin	30	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Hall-Houston – 1 new well S.T. 310 - LN/2 NE/4 - 10.5 miles southeast of Freeport	11	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Cobra – 1 new well Astro - 7.3 miles northwest of Rosharon	37	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Houston Energy – 1 new well Powell - 5.3 miles northwest of Brazoria	23	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known

Table G-1 Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Environmental Impacts) Major Recent or Proposed Developments in Brazoria County											
Sponsor/Project & Location	**Distance from Terminal (miles)**	**Project Timeframe**		**ENVIRONMENTAL IMPACT EVALUATION**							
		Const. Start-up	**In- Service**	**Wetlands**	**Waterbodies**	**Threatened & Endangered Species**	**EFH**	**Air**	**Noise**	**Water Quality**
Sage Energy – 1 new well Ramsay State Prison Farm – B -3.0 miles west of Bonney	29	2012	2012	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known – assumed minor, if any, based on well pad siting flexibility for new wells	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
LAND & AIR TRANSPORTATION FIELD DEVELOPMENTS										
Brazoria County/Port Freeport - Grade Separation at Intersection of FM 1495 and SH 36 Freeport	1.3	Initial design - 2011	2014	~30 acres PEM wetlands fringing intersection (per NWI)	Not known	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
TxDOT - Toll-way development on SH 288 Pearland	46	By 2016	By 2016	Not known	Not known	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
TxDOT – SH288 improvements Lake Jackson/ Clute	6	Not known	2012	Not known	Not known	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
TxDOT – General road improvements – 23 currently active projects Brazoria County	-	Not known	Not known	Not known	Not known	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Brazoria County w/ State and Federal Funding - Texas Gulf Coast Regional Airport Expansion 5 miles south of Angleton	14	2012	2013	No impact (per NWI)	No impact (per NWI)	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
COMMERCIAL DEVELOPMENTS										
Kelsey-Seybold – New Admin Building Pearland	45	2012	2013	No impact (per NWI)	No impact (per NWI)	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Ref-Chem, LP – New Office Building Pearland	45	2012	Not known	Not known	Not known	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Angleton/Danbury Medical Center – New Medical Pavilion Angleton	18	2012	Not known	No impact (per NWI)	No impact (per NWI)	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known

Table G-1

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Environmental Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		ENVIRONMENTAL IMPACT EVALUATION						
		Const. Start-up	In- Service	Wetlands	Waterbodies	Threatened & Endangered Species	EFH	Air	Noise	Water Quality
RESIDENTIAL DEVELOPMENTS										
Aplin Homes - Oyster Bend Subdivision – 250 New Houses Lake Jackson	10	2013+	Not known	Not known	Not known	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Aplin Homes – Northwoods Estates Subdivision – 120 New Houses	12	2013+	Not known	Not known	Not known	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
Cresco – Alden Lakes Master Planned Community – 1,800 New Houses	12	2013+	Phased over 15 years	Not known	Not known	Not known	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
MISCELLANEOUS DEVELOPMENTS										
Lake Jackson - Downtown revitalization Lake Jackson	11	2011	2012	No impact	No impact	No impact	None (no marine/ estuarine habitat)	Unknown	Not known	Not known
City of Surfside - Walking Trail Surfside Beach	?	2012	2014	Not known	Not known	Not known	Not known	Unknown	Not known	No impact anticipated based on project scope
GLO/ Coastal Impact Assessment Program - Surfside Beach re- nourishment Surfside Beach	2	2012	2012	Not known	Open water conversion to beach	Not known	Not known	Unknown	Not known	No impact anticipated based on project scope

Table G-2

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Socioeconomic Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		SOCIOECONOMIC IMPACT EVALUATION						
		Const. Start-up	In- Service	Land Use	Visual Impacts	Traffic / Roads	Housing	Public Services	Water Supply	New Jobs
INDUSTRIAL DEVELOPMENTS										
Manufacturing/Chemical Production										
Airgas Carbonic CO_2 Production Plant Alvin	40	2013	2013/2014	Potential change from open land to industrial land	Unknown	No significant impacts – based on low worker numbers	No significant impacts anticipated – based on low worker numbers	No significant impacts anticipated – based on low worker numbers	No significant impacts anticipated	10 (construction) 14 (operation)
Artland Louisiana & Performance Contractors – Pipe Fabrication Facility Rosharon	27	2013	2014	Potential change from open land to industrial land	Unknown	No significant impacts – based on low worker numbers	Temporary housing required for up to 60 construction workers Permanent housing required for up to 45 operational workers	No significant impacts anticipated	No significant impacts anticipated	60 (construction) 45 (operation)
Ascend Performance Materials – Propane Dehydrogenation Plant Chocolate Bayou – Existing Plant Site	22	2013	2015	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts assumed localized in Chocolate Bayou SH35/ FM 2917 area	Temporary housing required for up to 1,500 construction workers; Permanent housing required for up to 100 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	No significant impacts anticipated	1,500 (construction) 100 (operation)
BASF – Ammonium Sulfate Crystallizer Freeport – Existing Plant Site	7	2014	2016	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts assumed low based on worker numbers and ready access to SH 288	Temporary housing required for up to 20 construction workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from Brazos River	20 (construction)
BASF – Emulsion Polymers Plant Freeport Existing Plant Site	7	2013	2014	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts assumed low based on worker numbers and ready access to SH 288	Temporary housing required for up to 200 construction workers Permanent housing required for up to 20 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from Brazos River	200 (construction) 20 (operation)
Chevron Phillips - Two Plastic Resin-Producing Facilities Old Ocean at SH 35 / FM 524	27	2014	2017	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts assumed localized in Old Ocean / Sweeny / SH35 area	Temporary housing required for up to 1,000 construction workers Permanent housing required for up to 92 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from San Bernard River	1,000 (construction) 92 (operation)

Table G-2

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Socioeconomic Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		SOCIOECONOMIC IMPACT EVALUATION						
		Const. Start-up	In- Service	Land Use	Visual Impacts	Traffic / Roads	Housing	Public Services	Water Supply	New Jobs
Cyanco – Sodium Cyanide Plant Chocolate Bayou	22	Unknown	2012	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts assumed localized in Chocolate Bayou / FM 2917 / FM 2004 area	Permanent housing required for up to 20 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from Gulf Coast Water Authority canal	20 (operation)
Dow - Chlorine Plant Freeport – Existing Plant B	5	2011	2013	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts anticipated in Freeport area based on number of workers	Temporary housing required for up to 1,000 construction workers Permanent housing required for up to 50 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from Brazos River	1,000 (construction) 50 (operation)
Dow - Propane Dehydrogenation Plant Freeport – Existing Oyster Creek Plant	4	2013	2015	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts anticipated in Freeport area based on number of workers	Temporary housing required for up to 1,500 construction workers Permanent housing required for up to 120 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from Brazos River	1,300 (construction) 120 (operation)
Dow – Ethylene Plant Freeport – Existing Plant B	5	2014	2017	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts anticipated in Freeport area based on number of workers	Temporary housing required for up to 2,000 construction workers Permanent housing required for up to 150 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from Brazos River	2,000 (construction) 150 (operation)
Dow – AgroSciences Plant Existing Oyster Creek Plant	4	2013	2014	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts anticipated in Freeport area based on number of workers	Temporary housing required for up to 150 construction workers Permanent housing required for up to 100 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from Brazos River	150 (construction) 10 (operation)
Dow – Performance Plastic Plants (Alpha & Beta) Freeport – Existing Plant A	1	2015	Alpha 2016 Beta 2017	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts anticipated in Freeport area based on number of workers	Temporary housing required for up to 2,000 construction workers Permanent housing required for up to 100 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from Brazos River	2,000 (construction) 100 (operation)

Table G-2

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Socioeconomic Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		SOCIOECONOMIC IMPACT EVALUATION						
		Const. Start-up	In- Service	Land Use	Visual Impacts	Traffic / Roads	Housing	Public Services	Water Supply	New Jobs
Idem-Itsu Kosan Co. & Mitsui Co. – Linear Alpha Olefins Unit Dow Freeport – Existing Plant A	1	2014	2016	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts anticipated in Freeport area based on number of workers	Temporary housing required for up to 2,200 construction workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from Brazos River	2,200 (construction)
Ineos – Cracking Furnace Existing Chocolate Bayou Plant	22	2012	2013	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Traffic impacts assumed localized in Chocolate Bayou / FM 2917/ FM 2004 area	No housing requirements identified	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from GCWA canal – 0.5 % increase in water use above current levels (per BA)	5 (operation)
Phillips 66 – LPG Export Terminal Freeport – Existing Plant Site	1	2016	Unknown	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts anticipated in Freeport area	No housing requirements identified	No over-burden on existing emergency services anticipated – project at existing plant	Unknown	Unknown
Phillips 66 – NGL Fractionator	27	2014	2015	Unchanged from current industrial use – existing plant site	At existing industrial plant – no material change to view-shed	Construction traffic impacts assumed localized in Old Ocean / Sweeny / SH35 area	Temporary housing required for up to 300 construction workers Permanent housing required for up to 25 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Unknown	200 - 300 (construction) 25 (operation)
Sabar Power Services – Electrical Equipment Fabrication Facility Iowa Colony	36	2013	2013	Potential change from open land to industrial land	Unknown	Traffic impacts assumed low based on worker numbers	Permanent housing required for up to 40 operational workers	No over-burden on existing emergency services anticipated	Unknown	40 (operation)
Shin-Etsu –Silicon Production Plant Freeport Existing Plant	3	2013	2014	At existing industrial plant – no material change to view- shed	Construction traffic impacts assumed low based on worker numbers and ready access to SH 332	Temporary housing required for up to 80 construction workers Permanent housing required for up to15 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Process water supplied from Brazos River	80 (construction) 15 (operation)	

Table G-2

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Socioeconomic Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		SOCIOECONOMIC IMPACT EVALUATION						
		Const. Start-up	In- Service	Land Use	Visual Impacts	Traffic / Roads	Housing	Public Services	Water Supply	New Jobs
City of Sweeny – Industrial Park (including Phillips 66 Admin Building & Apache Oil Admin Building and Tank Farm Sweeny	26	2014	Unknown	Potential change from open land to industrial land	Unknown	Traffic impacts assumed low based on worker numbers	No housing requirements identified	No over-burden on existing emergency services anticipated – project at existing plant	Unknown	10 (operation) – Phillips 66
Mitsubishi Heavy Industries – Manufacturing Site Pearland	46	2013/14	2014	Potential change from open land to industrial land	Unknown	Traffic impacts assumed low based on ready access to major roads/highways	Permanent housing required for up to 100 operational workers	No over-burden on existing emergency services anticipated – project at existing plant	Unknown	100 (operation)
PORT DEVLEOPMENTS										
Port Freeport & Local interests -Non-Federal Channel Widening Project Freeport Harbor Channel	Adjacent to terminal and in Gulf of Mexico	2013	2018	3.9 acres of shoreline converted to open water	No significant impacts anticipated	No significant impacts anticipated	No significant impacts anticipated	No significant impacts anticipated	No significant impacts anticipated	Limited to offshore dredging – worker numbers unknown
Port Freeport & USACE – Federal Channel Deepening Project Freeport Harbor Channel	Adjacent to terminal and In Gulf of Mexico	2015	2021	No change in land use	No significant impacts anticipated	No significant impacts anticipated	No significant impacts anticipated	No significant impacts anticipated	No significant impacts anticipated	Limited to offshore dredging – worker numbers unknown
Port Velasco Terminal Development Freeport – existing Port property	1	2008	2016	Unchanged – existing port site	No significant impacts – within existing port setting	Un-quantified increase in road and rail traffic anticipated	No significant impacts anticipated	No significant impacts anticipated	No significant impacts anticipated	Unknown
PIPELINE DEVELOPMENTS										
Dow - 2.3-mile, 30-inch hydrogen pipeline Freeport - between Plant B & Oyster Creek Plant	4	2012	2012	No change in land use anticipated	No significant impacts anticipated	No significant impacts anticipated	No significant impacts anticipated	No significant impacts anticipated	No significant impacts anticipated	Unknown
Enterprise -48.9 mile, 24-inch NGL pipeline Alvin and Mont Belvieu (~2 miles in Brazoria County)	34	2012	2012	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

Table G-2

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Socioeconomic Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		SOCIOECONOMIC IMPACT EVALUATION						
		Const. Start-up	In- Service	Land Use	Visual Impacts	Traffic / Roads	Housing	Public Services	Water Supply	New Jobs
Kinder Morgan/ Phillips 66 - 27-mile, 12-inch Sweeny Lateral - Crude Oil/Condensate Pipeline Southwards to Phillips 66 Sweeny refinery	27	2013	2014	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Seaway (Enterprise & Enbridge) - 500- mile, 30-inch Seaway Crude Oil Pipeline Jones Creek northwards to Cushing, Oklahoma	6	2012	2014	Unknown Crosses Justin Hurst WMA by HDD	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Seaway (Enterprise & Enbridge) 65-mile, 36-inch Crude Oil Extension Pipeline Jones Creek northeastwards to southeast Houston	6	2012	2014	Unknown Crosses Justin Hurst WMA by HDD	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
OIL & GAS FIELD DEVELOPMENTS										
Suemar – 1 new well Chevron Unit - 12 miles southeast of Angleton	9	2012	2012	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Denbury – 78 new/reentered/ recompleted wells West Hastings Unit - between Pearland & Alvin	38	2012	2013	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Maverick – 18 new wells Wisdom, Groce A/B Units - 5 miles southeast of Damon	32	2012	2012	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Hilcorp – 10 new/ recompleted wells Old Ocean Unit - Sweeny	24	2012	2013	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on site workers -

Table G-2

Freeport LNG – Liquefaction Project and Phase II Developments Cumulative Impacts Analysis (Socioeconomic Impacts)
Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		SOCIOECONOMIC IMPACT EVALUATION						
		Const. Start-up	In- Service	Land Use	Visual Impacts	Traffic / Roads	Housing	Public Services	Water Supply	New Jobs
Jetta - 3 new wells Phillips & Abrams Units - 2.0 miles north of West Columbia	26	2012	2012	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Chalker - 6 new wells Bennett Estate - 2.5 miles northeast of Danbury	23	2012	2012	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
LINC Gulf Coast Petroleum – 7 new/recompleted wells Welch - 12.0 miles east of Angleton	15	2012	2013	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Texas Standard Oil – 4 new wells HRI - 3.2 miles west of Liverpool	25	2012	2013	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Sandalwood – 2 new wells Charles Duke Unit - 5.1 miles southwest of Alvin	28	2012	2012	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Quantum - 1 new well Old - 6.7 miles southeast of Alvin	30	2012	2012	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Hall-Houston – 1 new well S.T. 310 - LN/2 NE/4 - 10.5 miles southeast of Freeport	11	2012	2012	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Cobra – 1 new well Astro - 7.3 miles northwest of Rosharon	37	2012	2012	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Houston Energy – 1 new well Powell - 5.3 miles northwest of Brazoria	23	2012	2012	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers

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Major Recent or Proposed Developments in Brazoria County

Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		SOCIOECONOMIC IMPACT EVALUATION						
		Const. Start-up	In- Service	Land Use	Visual Impacts	Traffic / Roads	Housing	Public Services	Water Supply	New Jobs
Sage Energy – 1 new well Ramsay State Prison Farm – B -3.0 miles west of Bonney	29	2012	2012	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil field	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
Various companies – 37 new/reentered/ recompleted wells Other units to those identified above	-	2012	2013	Minor land use change at new well pad sites, but in existing oil field	No significant long-term visual impacts – in existing oil fields	No significant impacts – based on low worker numbers	No significant impacts – small drilling crews & typically locally based	No significant impacts – relatively low worker numbers	Unknown	Assumed small drilling crew and no permanent on-site workers
LAND & AIR TRANSPORTATION FIELD DEVLEOPMENTS										
Brazoria County/Port Freeport - Grade Separation at Intersection of FM 1495 and SH 36 Freeport	1.3	Initial design - 2011	2014	Minor loss of open space for road right-of-way	Elevated road section would change view - shed but in industrial setting with no residential views	Temporary traffic restrictions during construction – improved traffic flow when complete	No significant impacts – relatively low worker numbers	No significant impacts – relatively low worker numbers	No significant impacts	Unknown
TxDOT - Toll-way development on SH 288 Pearland	46	2015	2017	Use of existing open median on SH288 for additional lanes	Toll booths & additional traffic lanes would change local view-shed	Temporary traffic restrictions during construction – improved traffic flow when complete	Unknown	Unknown	No significant impacts	Unknown
TxDOT – SH288 improvements Lake Jackson/ Clute	6	2010	2012	No significant change	Elevated road section has changed viewshed	Significant improvement in traffic flow through Clute & Lake Jackson	No significant impacts	Improved mobility for emergency vehicles	No significant impacts	Unknown (but project complete)
TxDOT – General road improvements – 23 currently active projects Brazoria County	-	2012	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Brazoria County w/ State and Federal Funding - Texas Gulf Coast Regional Airport Expansion 5 miles south of Angleton	14	2012	2013	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

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		Const. Start-up	In- Service	Land Use	Visual Impacts	Traffic / Roads	Housing	Public Services	Water Supply	New Jobs
COMMERCIAL DEVELOPMENTS										
Kelsey-Seybold – New Admin Building Pearland	45	2012	2014	4 acres open land converted to commercial use for office building	4-story office building in commercial setting	No change in existing traffic patterns anticipated	Unknown	Unknown	Unknown	800
Ref-Chem, LP – New Office Building Pearland	45	2012	2013	1 acre open land converted to commercial use for office building	Office building in commercial setting	No change in existing traffic patterns anticipated	Unknown	Unknown	Unknown	100 (operation)
Angleton/Danbury Medical Center – New Medical Pavilion Angleton	18	2012	Unknown	Open land on existing hospital site would be developed for building	Adjacent to existing hospital	No change in existing traffic patterns anticipated	Unknown	Unknown	Unknown	Unknown
HCA Gulf Coast – New Hospital Pearland	45	2013	2014	Open land will be developed in mixed use area	Hospital building in mixed use setting	No change in existing traffic patterns anticipated	Unknown	Unknown	Unknown	288 (operation)
Dow – New Office Building Lake Jackson	11	2014	2014	Open land will be developed in mixed use area	Office building in mixed use setting	No change in existing traffic patterns anticipated	Unknown	Unknown	Unknown	1,200 (operation)
RESIDENTIAL DEVELOPMENTS										
Aplin Homes - Oyster Bend Subdivision – 250 New Houses Lake Jackson	10	2013+	Unknown	Conversion from open land to residential	Unknown	Unknown	Increased housing availability	Unknown	Increased residential demand	None - no overlap in construction worker needs anticipated
Aplin Homes – Northwoods Estates Subdivision – 120 New Houses	12	2013+	Unknown	Conversion from open land to residential	Unknown	Unknown	Increased housing availability	Unknown	Increased residential demand	None - no overlap in construction worker needs anticipated
Cresco – Alden Lakes Master Planned Community – 1,800 New Houses	12	2013+	Phased over 15 years	Conversion from open land to residential	Unknown	Unknown	Increased housing availability	Unknown	Increased residential demand	None - no overlap in construction worker needs anticipated
Alden Subdivision – New Houses Angleton	14	2013+`	Unknown	Conversion from open land to residential	Unknown	Unknown	Increased housing availability	Unknown	Increased residential demand	None - no overlap in construction worker needs anticipated
Audubon Woods III- 60 New Houses Richwood	11	2012/13	Unknown	Conversion from open land to residential	Unknown	Unknown	Increased housing availability	Unknown	Increased residential demand	None - no overlap in construction worker needs anticipated

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Sponsor/Project & Location	Distance from Terminal (miles)	Project Timeframe		SOCIOECONOMIC IMPACT EVALUATION						
		Const. Start-up	In- Service	Land Use	Visual Impacts	Traffic / Roads	Housing	Public Services	Water Supply	New Jobs
College Park – 71 New Houses Clute	9	2013	Unknown	Conversion from open land to residential	Unknown	Unknown	Increased housing availability	Unknown	Increased residential demand	<u>None</u> - no overlap in construction worker needs anticipated
Ponoma – Planned Community – 2,100 lots Manvel	37	2013	2023	Conversion from open land to residential	Unknown	Unknown	Increased housing availability	Unknown	Increased residential demand	<u>None</u> - no overlap in construction worker needs anticipated
Lakewood – 650 New Houses Manvel	38	2013	Unknown	Conversion from open land to residential	Unknown	Unknown	Increased housing availability	Unknown	Increased residential demand	<u>None</u> - no overlap in construction worker needs anticipated
Bluewater Lakes – 300 New Houses Manvel	38	2013	Unknown	Conversion from open land to residential	Unknown	Unknown	Increased housing availability	Unknown	Increased residential demand	<u>None</u> - no overlap in construction worker needs anticipated
Newport Lakeside Estates – 200 New Houses Manvel	41	2013	Unknown	Conversion from open land to residential	Unknown	Unknown	Increased housing availability	Unknown	Increased residential demand	<u>None</u> - no overlap in construction worker needs anticipated
MISCELLANEOUS DEVELOPMENTS										
Lake Jackson - Downtown revitalization Lake Jackson	11	2011	2013+	Unchanged	Improved aesthetics	Traffic flow improved	Unknown	Improved	Unknown	Unknown
City of Surfside - Walking Trail Surfside Beach	?	2012	2014	Unknown	Will improve local aesthetics	Unknown	Unknown	Unknown	Unknown	Unknown
GLO/ Coastal Impact Assessment Program - Surfside Beach re-nourishment	2	2012	2012	Open water conversion to beach	Restoration would improve beach aesthetics	Unknown	Unknown	No impact anticipated based on project scope	No impact anticipated based on project scope	Unknown
OVERALL CUMULATIVE IMPACTS ASSOCIATED WITH LIQUEFACTION PROJECT:				None	None - all developments are spatially dis-contiguous and do not have any collective effect on individual view-sheds	Additive impact only - potential for increased traffic congestion in Port Freeport area.	Additive impact only – potential for increased short- term housing demand during construction.	Additive impact only – potential for increased school enrollment where construction workers' families relocate to area	Additive impact only - Freeport LNG projects and concurrent industrial and residential developments would Increase regional water supply demand	Additive impact only -Projects in southern Brazoria County would create 9,950 construction jobs and 625 permanent jobs Concurrent construction may create competition for jobs

APPENDIX H

References

APPENDIX H
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APPENDIX I

List of Preparers

Appendix I
List of Preparers

The following presents the names of individuals who prepared and/or reviewed this draft EIS and their area or areas of responsibility.

Table I-1
Preparers/Reviewers for FERC

Name	Education	Responsibility
Tomasi, Eric	B.S., Aerospace Engineering, 1994, Boston University	FERC Project Manager – Air Quality, Noise, Socioeconomics, Land Use, Cumulative Impacts, Alternatives
Allen, Christine	B.S., Marine Biology, 2005, University of North Carolina, Wilmington	Water Resources
Busch, Steven	M.E., Environmental Engineering, 2003, University of Maryland, College Park B.S., Mechanical Engineering, 1999, University of Maryland, College Park	LNG Reliability & Safety – Liquefaction Project
Cefalu, Janine	Masters of Environmental Studies, 2005, The Evergreen State College B.A., International Relations, 1996, San Francisco State University	Wildlife, Vegetation, Threatened & Endangered Species
Ferree, Heather	M.S., Mechanical Engineering, 2002, Pennsylvania State University B.S., Mechanical Engineering, 2006, Pennsylvania State University	LNG Reliability & Safety – Liquefaction Project
Friedman, Paul	M.A., History, 1980 University of California, Santa Barbara B.A., Anthropology and History, 1976, University of California, Santa Barbara	Cultural Resources
Glaze, James	B.S., Geology, 1975, California Lutheran University	Geology, Geologic Hazards
Silvera, Liliana	B.S., Chemical Engineering, 2003, University of Maryland -College Park	LNG Reliability & Safety – Liquefaction Project
White, Sentho	M.S., Environmental Engineering, 2001, Johns Hopkins University B.S., Civil Engineering, 2000, Georgia Institute of Technology	LNG Reliability & Safety – Phase II Modification Project

Preparers/Reviewers for TRC

Name	Education	Responsibility
Brandt, Jeffrey	M.A., Environmental Studies, 1997, Brown University B.S., Industrial Engineering, 1984, Worcester Polytechnic Institute	TRC Project Manager – Alternatives, Land Use, Cumulative
Niles, Ryan	B.A., Geological Sciences, 2001, State University of New York, College at Geneseo	Geology and Soils

Table I-1
Preparers/Reviewers for FERC

Name	Education	Responsibility
Walker, Jaime	B.S., Conservation Biology, 2009, SUNY College of Environmental Science and Forestry	Water Resources
Saxton, Elizabeth	M.E.M., Environmental Studies Industrial Ecology, 1998, School of Forestry and Environmental Studies, Yale University, New Haven, Connecticut B.A., Majors: Biology and Sociology, 1990, University of Richmond, VA	Deputy Project Manager, Wildlife, Vegetation, Threatened & Endangered Species
Slayton, Adam	B.S., Physics, 1998, University of Maine, Orono	Socioeconomics
Webb, Paul	A.B.D. (Ph.D. coursework), 1983-1989, Anthropology, Southern Illinois University B.A., Anthropology, 1979, University of Georgia	Cultural Resources
Thomas, Brian	Ph.D., Anthropology, 1995, State University of New York at Binghamton M.A., Anthropology, 1991, Wake Forest University B.A., History and Philosophy, 1983, Wofford College	Cultural Resources
Fennel, Patrick	M.E., Environmental Engineering, 1997, University of Hartford M.S., Civil Engineering, 1977, University of Illinois at Urbana B.S., Civil Engineering, 1975, University of Missouri at Columbia	Air Quality
Newman, Michael	B.S., Chemical Engineering, 2001, University of Connecticut	Air Modeling
Agresti, Anthony	B.A., Meteorology, 1984, Kean College of New Jersey	Noise
Preparers/Reviewers for Bachman Consulting Structural Engineers		
Bachman, Robert R.E.	M.S., Structural Engineering, 1968, University of California at Berkeley B.S., Civil Engineering, 1967,University of California at Berkeley	Geologic Conditions, Hazards, Structural Engineering
Preparers/Reviewers for Group Delta Consultants, Inc.		
Bhushan, Kul	Ph.D., Geotechnical Engineering, 1970, Duke University M.S., Highway Engineering, 1963,Panjab University, Chandigarh, India B.S., Civil Engineering, 1962,Panjab University, Chandigarh, India	Subcontractor - Geologic Conditions, Hazards, Geotechnical Engineering

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