Federal Energy Regulatory Commission

Office of Energy Projects

November 2018

Freeport LNG Development, L.P.
FLNG Liquefaction 4, LLC

Docket No. CP17-470-000

Freeport LNG Train 4 Project

Environmental Assessment

Cooperating Agencies:

U.S. Department of Transportation
U.S. Department of Energy
U.S. Environmental Protection Agency

Washington, DC 20426

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas Branch 3
Freeport LNG
Freeport LNG Train 4 Project
Docket No. CP17-470-000

TO THE INTERESTED PARTY:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared an Environmental Assessment (EA) for the Freeport LNG Train 4 Project (Project). Freeport LNG Development, L.P. (Freeport LNG Development) and FLNG Liquefaction 4, LLC, collectively referred to as Freeport LNG, request authorization (FERC Docket No. CP17-470-000) to site, construct, and operate pipeline, natural gas liquefaction and export facilities near Freeport in Brazoria County, Texas. The Project would be constructed as an expansion of Freeport LNG Development's existing Quintana Island Terminal (Terminal), as well as associated pretreatment and pipeline facilities, for the purpose of liquefying domestic natural gas for export.

The EA assesses the potential environmental effects of the construction and operation of the Project in accordance with the requirements of the National Environmental Policy Act (NEPA). The FERC staff concludes that approval of the proposed Project, with appropriate mitigating measures, would not constitute a major federal action significantly affecting the quality of the human environment.

The U.S. Department of Transportation, U.S. Department of Energy, and U.S. Environmental Protection Agency participated as cooperating agencies in the preparation of the EA. A cooperating agency has jurisdiction by law or special expertise regarding environmental impacts involved with the proposal, and is involved in the NEPA analysis.

The EA addresses the potential environmental effects of the construction and operation of the following project facilities:

- one natural gas liquefaction train;
- one natural gas pretreatment unit;
- minor modifications to existing facilities; and
- 10.6 miles of 42-inch-diameter pipeline.

The Commission mailed a copy of the *Notice of Availability* 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 groups; and newspapers and libraries in the project area. The EA is only available in electronic format. It may be viewed and downloaded from the FERC's website (www.ferc.gov), on the Environmental Documents page (https://www.ferc.gov/industries/gas/enviro/eis.asp). In addition, the EA may be accessed by using the eLibrary link on the FERC's website. Click on the eLibrary link (https://www.ferc.gov/docs-filing/elibrary.asp), click on General Search, and enter the docket number in the "Docket Number" field, excluding the last three digits (i.e., CP17-470). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676, or for TTY, contact (202) 502-8659.

Any person wishing to comment on the EA may do so. Your comments should focus on the EA's disclosure and discussion of potential environmental effects, reasonable alternatives, and measures to avoid or lessen environmental impacts. The more specific your comments, the more useful they will be. To ensure that the Commission has the opportunity to consider your comments prior to making its decision on this Project, it is important that we receive your comments **on or before December 3, 2018**.

For your convenience, there are three methods you can use to submit your comments to the Commission. The Commission encourages electronic filing of comments and has staff available to assist you at (866) 208-3676 or FercOnlineSupport@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 the 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; or

3) You can file a paper copy of your comments by mailing them to the following address. Be sure to reference the Project docket number (CP17-470-000) with your submission: Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission, 888 First Street NE, Room 1A, Washington, DC 20426

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 385.214). Motions to intervene are more fully described at http://www.ferc.gov/resources/guides/how-to/intervene.asp. Only intervenors have the right to seek rehearing or judicial review of the Commission's decision. The Commission may grant 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 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. The eLibrary link also provides access to the texts of all 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 www.ferc.gov/docs-filing/esubscription.asp.

ENVIRONMENTAL ASSESSMENT
FREEPORT LNG
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TECHNICAL ABBREVIATIONS AND ACRONYMS

AAQS	ambient air quality standards
ACHP	Advisory Council on Historic Preservation
ACIP	Auger Cast-in-Place
AirData	USEPA AirData database
amsl	above mean sea level
ANSI	American National Standards Institute
APE	Area of Potential Effect
API	American Petroleum Institute
AQCRs	Air quality control regions
ARM2	Tier 2 ambient ratio method
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATWS	additional temporary workspace
BACT	Best Available Control Technology
bcf/d	billion cubic feet per day
BCGCD	Brazoria County Groundwater Conservation District
bgs	below ground surface
BLEVE	boiling liquid expanding vapor explosion
BOG	boil-off gas
BPVC	Boiler and Pressure Vessel Code
Btu/ft^2-hr	British thermal units per square foot per hour
CAA	Clean Air Act
CAER	Community Awareness & Emergency Response
CCC	Coastal Coordination Council
CenterPoint	CenterPoint Energy
CFATS	Chemical Facility Anti-Terrorism Standards
CFR	Code of Federal Regulations
CH_4	methane
CI	Chief Inspector
CMMS	Computerized Maintenance Management System
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
COE	U.S. Army Corps of Engineers
COTP	Captain of the Port
CPT	cone penetration testing
CR	County Road
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
dB	decibels
dBA	decibels on the A-weighted scale
DC	drainage channel
DCS	Distributed Control System
DMPA	Dredge Material Placement Area
DOE/FE	USDOE's Office of Fossil Energy
EA	Environmental Assessment

TECHNICAL ABBREVIATIONS AND ACRONYMS

EDA	Economic Development Alliance
EEM	Estuarine emergent
EFH	Essential Fish Habitat
EI	Environmental Inspector
EIS	Environmental Impact Statement
ERP	Emergency Response Plan
ESA	Endangered Species Act
ESCP	Erosion & Sedimentation Control Plan
ESD	Emergency Shutdown
ESS	Estuarine scrub-shrub
FEED	Front End Engineering and Design
FEMA	Federal Emergency Management Agency
FERC or Commission	Federal Energy Regulatory Commission
FHC	Freeport Harbor Channel
FIRM	Flood Insurance Rate Map
FM	Farm-to-Market
Freeport LNG Development	Freeport LNG Development L.P.
FR	Federal Register
FTA	Free Trade Agreement
ft/s	Feet per second
FWS	U.S. Fish and Wildlife Service
g	acceleration due to gravity
GCBO	Gulf Coast Bird Observatory
GHG	greenhouse gas
gpm	gallons per minute
GMD	Geomagnetic disturbance
H_2S	hydrogen sulfide
H_2SO_4	sulfuric acid mist
HAPs	Hazardous Air Pollutants
HAZID	hazard identification
HAZOP	hazard and operability review
HCA	High Consequence Area
HDD	horizontal directional drill
HG-AQCR	Metropolitan Houston-Galveston Intrastate AQCR
HGB	Houston-Galveston-Brazoria
HUC	Hydrologic Unit Code
Hz	Hertz
IBC	International Building Code
ICW	Intracoastal Waterway
IPCC	Intergovernmental Panel on Climate Change
ISA	International Society for Automation
ISD	Independent School District
ISR	In-stack Ratio
km	Kilometers
kW/m^2	kilowatts per square meter
LAER	Lowest Achievable Emission Rate
L_d	daytime sound level
L_{dn}	day-night sound level
L_{eq}	equivalent sound level

TECHNICAL ABBREVIATIONS AND ACRONYMS

LNG	liquefied natural gas
L_n	night sound level
LOD	Letter of Determination
LOS	Level of Service
m^3	cubic meter
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MAOP	maximum allowable operating pressure
MBTA	Migratory Bird Treaty Act
MCE	Maximum Considered Earthquake
MEOW	maximum envelope of water
MOU	Memorandum of Understanding
mph	miles per hour
MP	milepost
MTSA	Marine Transportation Security Act
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
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-59A	National Fire Protection Association Standard 59A
NGL	natural gas liquids
NHPA	National Historic Preservation Act
NNSR	Nonattainment New Source Review
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	NOAA's National Marine Fisheries Service
NOI	Notice of Intent
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resources Conservation Services
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
OBE	Operating Basis Earthquake
OEP	Commission’s Office of Energy Projects
OPR	NOAA’s Office of Protected Resources
OPS	Office of Pipeline Safety
Order	Commission’s Order Granting Authorization
P&ID	piping and instrument diagrams
PEM	Palustrine emergent
PHMSA	Pipeline and Hazardous Materials Safety Administration
PGA	peak ground acceleration
PIR	potential impact radius
PM_{10}	respirable particulate
$PM_{2.5}$	fine particulate

TECHNICAL ABBREVIATIONS AND ACRONYMS

ppm	parts per million
ppmv	parts per million on a volume basis
Project-specific Plan	Freeport LNG *Upland Erosion Control, Revegetation & Maintenance Plan*
Project-specific Procedures	Freeport LNG *Wetland & Waterbody Construction & Mitigation Procedures*
PSD	Prevention of Significant Deterioration
psig	pounds per square inch gauge
PSS	Palustrine scrub-shrub
PVMRM	Plume volume molar ratio method
RFFA	Reasonably Foreseeable Future Action
RHA	Rivers and Harbors Act of 1899
RMP	Risk Management Plan
RRC	Railroad Commission of Texas
RSLR	Relative Sea Level Rise
S_{D1}	1.0-second design spectral acceleration
S_{DS}	0.2-second spectral acceleration
SH	State Highway
SHPO	State Historic Preservation Office
SIS	safety instrument system
SLOSH	Sea, Lake, and Overland Surge from Hurricanes
SO_2	sulfur dioxide
SPCC Plan	Spill Prevention, Control and Countermeasure Plan
SSE	Safe Shutdown Earthquake
SWEL	Stillwater elevation
SWPPP	Stormwater Pollution Prevention Plan
TAC	Texas Administrative Code
Terminal	Quintana Island Terminal
TCEQ	Texas Commission for Environmental Quality
TCMP	Texas Coastal Management Program
TDCJ	Texas Department of Criminal Justice
TPWD	Texas Parks and Wildlife Department
tpy	tons per year
Train 4	Train 4 liquefaction train and support facilities
TRRP	Texas Risk Reduction Program
TWIC	Transportation Worker Identification Credential
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 Agency
USGS	U.S. Geological Survey
VOC	volatile organic compound
WMA	Wildlife Management Area

A. PROPOSED ACTION

1. Introduction

The staff of the Federal Energy Regulatory Commission (FERC or Commission) prepared this environmental assessment (EA) to assess the environmental impacts associated with the construction and operation of facilities proposed by Freeport LNG Development, L.P. (Freeport LNG Development) and FLNG Liquefaction 4, LLC (collectively referred to as Freeport LNG) in accordance with the requirements of the National Environmental Policy Act (NEPA).

Freeport LNG has filed an application with the FERC for authorization under Section 3 of the Natural Gas Act (NGA) to site, construct, and operate pipeline, natural gas liquefaction and export facilities near Freeport in Brazoria County, Texas (figure A 1-1). The project, referred to as the "Train 4 Project" or "Project," would be constructed as an expansion of Freeport LNG Development's existing Quintana Island Terminal (Terminal), as well as associated pretreatment and pipeline facilities, for the purpose of liquefying domestic natural gas for export to foreign countries.

Terminal History

The existing Terminal) was originally authorized by the FERC as a liquefied natural gas import and regasification facility in Docket No. CP03-75-000 on June 18, 2004 (referred to as the Phase I Project). The Commission's Order Granting Authorization (Order) authorized Freeport LNG Development to site, construct, and operate an LNG import terminal, as well as a 9.6-mile-long, 36-inch-diameter, send-out pipeline and meter facilities. The Environmental Impact Statement (EIS) for the Phase I Project was issued in May 2004. Construction was initiated in January 2005 and completed in June 2008.

An expansion of the capacity of the import Terminal was authorized by the FERC in Docket No. CP05-361-000 in an Order issued September 26, 2006 and was known as the Phase II Project. This Order authorized Freeport LNG Development to site, construct, and operate the Phase II Project, which included an additional LNG carrier berth, additional vaporizers, and an additional LNG storage tank. The EA for the Phase II Project was issued in June 2006.

A modification to the Phase II Project facilities was authorized as the Phase II Modification Project in Docket No. CP12-29-000, concurrent with the addition of natural gas liquefaction facilities as the Liquefaction Project in Docket No. CP12-509-000 for export of LNG. The Phase II Modification Project included an additional LNG carrier berth and an additional LNG storage tank; the originally authorized additional LNG vaporizers were deleted from the modified project. The Liquefaction Project included three liquefaction trains (Trains 1 through 3) at the Terminal and a natural gas Pretreatment Facility with three pretreatment units (Units 1 through 3) located about 2.5 miles north of the Terminal. This would allow pretreatment and liquefaction of natural gas for eventual loading into the LNG carriers at the LNG carrier berth. The EIS for these projects was issued in June 2014; the Order authorizing these projects was issued July 30, 2014; and they are currently under construction.

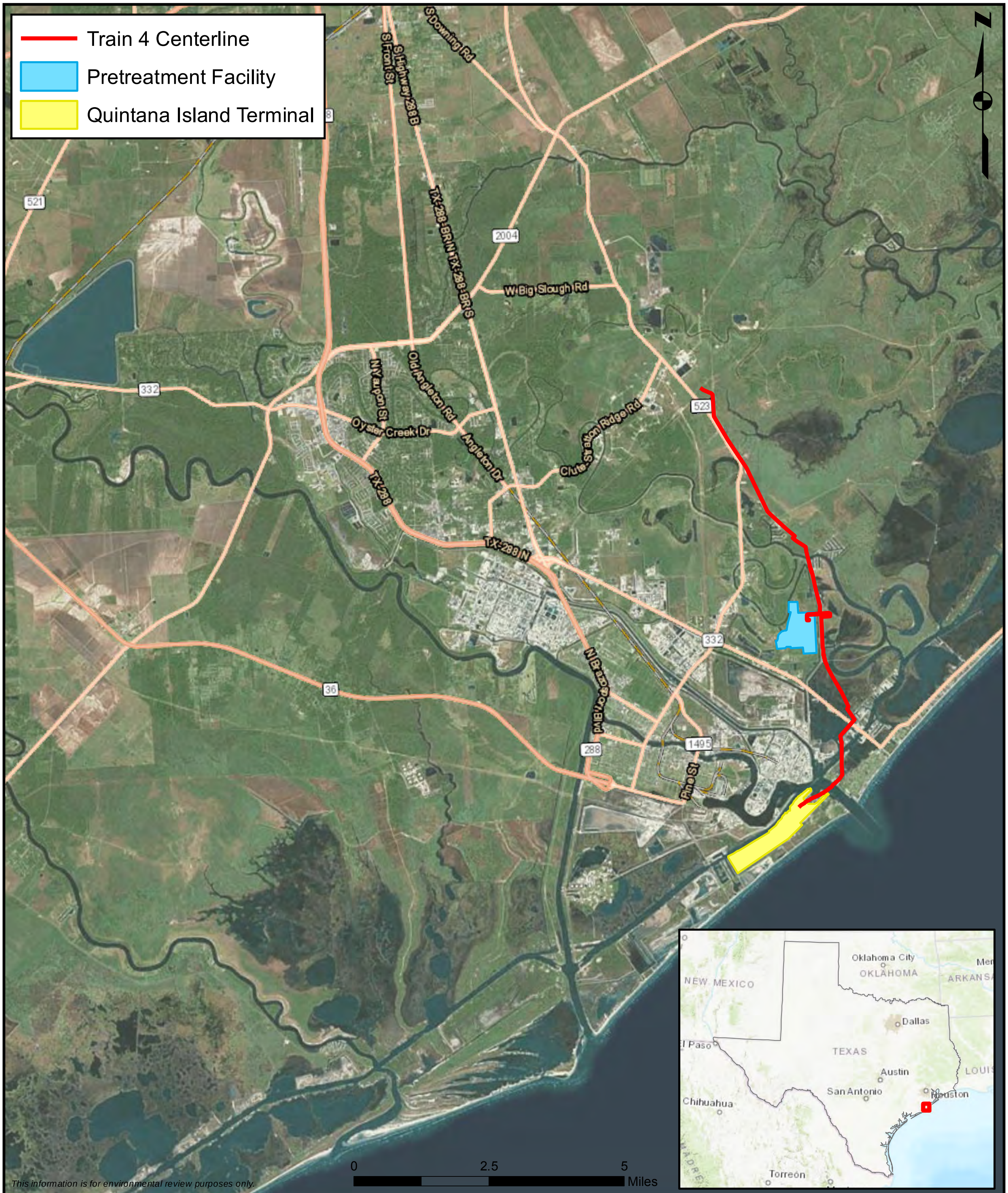

Figure A 1-1
Freeport LNG - Train 4 Project
Regional Project Map - Aerial
Brazoria County, Texas

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The Train 4 Project would add additional liquefaction capacity to the existing Terminal and expand the Pretreatment Facility, minimally modify certain components of the previously-authorized facilities within these sites, and add natural gas pipeline capacity. The Train 4 Project would not increase the previously authorized frequency or size of LNG carriers calling on the Terminal

When the Train 4 Project initially entered the Pre-filing Process (June 3, 2015), the proposed Project facilities included a fourth propane pre-cooled mixed refrigerant liquefaction unit (Train 4), a feed gas receiving and metering station, and appurtenant facilities, within the footprint of the existing Terminal, and a non-jurisdictional, 3,000-foot-long, 36-inch-diameter feed-gas pipeline.

On August 17, 2016, Freeport LNG modified the planned Train 4 Project by removing the non-jurisdictional feed-gas pipeline and adding a jurisdictional, 10.6-mile-long, 42-inch-diameter pipeline between the existing Stratton Ridge meter station, the Pretreatment Facility, and the Terminal and a fourth pretreatment unit at the Pretreatment Facility (Unit 4).

2. Purpose and Need

Freeport LNG indicates in its application that the proposed Train 4 Project would allow for the conversion of an increased volume of domestically produced natural gas to LNG for export. Freeport LNG further indicates that the Project would provide greater system reliability, improve operating flexibility, and enable a favorable and proactive response to short- and long-term fluctuations in domestic and global gas markets.

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.

3. Scope of this Environmental Assessment

Our[1] principal objectives in preparing this EA 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.

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

The topics addressed in this EA include alternatives; geology; soils; groundwater; surface waters; wetlands; vegetation; wildlife and aquatic resources; special status species; land use, recreation, special interest areas, and visual resources; socioeconomics (including transportation and traffic); cultural resources; air quality; noise; reliability and safety; and cumulative impacts. The EA describes the affected environment as it currently exists, discusses the environmental consequences of the Project, and compares the Project's potential impact with that of various alternatives. The EA also presents our recommended mitigation measures.

The Commission will consider the findings of this EA as well as non-environmental issues in its review of these proposals to determine whether to authorize the Project.

4. Cooperating Agencies

The U.S. Department of Transportation (USDOT), U.S. Department of Energy (USDOE) and U.S. Environmental Protection Agency (USEPA) were cooperating agencies for the development of the EA. A cooperating agency has jurisdiction by law or special expertise regarding environmental impacts involved with the proposal, and is involved in the NEPA analysis.

4.1. U.S. Department of Transportation

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 Standard 59A, (NFPA-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. On August 31, 2018, FERC and USDOT signed a Memorandum of Understanding to improve agency coordination on LNG project reviews and eliminate duplicative efforts.[2] The USDOT will issue a Letter of Determination to FERC on the 49 CFR 193 Subpart B regulatory requirements. The Letter of Determination will provide the Pipeline and Hazardous Materials Safety Administration's (PHMSA) analysis and conclusions on the Subpart B regulatory requirements which would be one of the considerations for the Commission to deliberate in its decision-making process. If the facilities are approved and constructed, final compliance with the requirements of 49 CFR Part 193 will be subject to USDOT's inspection and enforcement programs.

4.2. U.S. Department of Energy

The USDOE's Office of Fossil Energy (DOE/FE) 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 DOE/FE

[2] https://www.ferc.gov/legal/mou/2018/FERC-PHMSA-MOU.pdf

action is to respond to Freeport LNG's application for authority to export LNG from the Terminal. Freeport LNG seeks to export the LNG to any country: (1) with which the United States does not have a free trade agreement (FTA) 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.

Freeport LNG Expansion, L.P., FLNG Liquefaction, LLC, FLNG Liquefaction 2, LLC, and FLNG Liquefaction 3, LLC have authorizations from DOE/FE to export a total of 2.8 Bcf/d of LNG to FTA nations[3] and 2.14 Bcf/d to Non-FTA nations.[4] Freeport LNG Expansion, L.P. and FLNG Liquefaction 4, LLC, have submitted an application to DOE/FE for authorization to export additional volumes to non-FTA nations, to align the export authorization with the capacity produced from the Train 4 Project.[5]

In the case of LNG export applications to non-FTA countries, Section 3(a) of the NGA requires the DOE/FE to conduct a public interest review and to grant the authorization unless the DOE/FE finds that the proposed exports would not be consistent with the public interest. The DOE/FE is conducting its review under Section 3(a) of the NGA to evaluate Freeport LNG's application for authorization to export the equivalent of 262.8 billion cubic feet (Bcf) of natural gas per year for 20 years.

[3] Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC, Order Granting Long-Term Authorization to Export Liquefied Natural Gas from Freeport LNG Terminal to Free Trade Nations, DOE/FE Order No. 2913, FE Docket No. 10-160-LNG (February 10, 2011); Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC, Errata Notice to DOE/FE Order No. 2913, FE Docket No. 10-160-LNG (February 17, 2011); Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC, Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Freeport LNG Terminal to Free Trade Agreement Nations, DOE/FE Order No. 3066, FE Docket No. 12-06-LNG (February 10, 2012); Freeport LNG Expansion, L.P., et al., Order Amending Applications in Docket Nos. 10-160-LNG, 10-161-LNG, and 12-06-LNG and Granting Request in Docket No. 11-61-LNG to Add FLNG Liquefaction 2, LLC and FLNG Liquefaction 3, LLC as Applicants and Authorization Holders, DOE/FE Order Nos. 2913-A, 3066-A, & 3282-A, FE Docket Nos. 10-160-LNG, 10-161-LNG, 11-161-LNG & 12-06-LNG (February 7, 2014) [hereinafter 2014 Amendment Order].

[4] 2014 Amendment Order; Freeport LNG Expansion, L.P., et al., Order Amending DOE/FE Order Nos. 3282 and 3357, DOE/FE Order Nos. 3282-B & 3357-A, FE Docket Nos. 10-161-LNG & 11-161-LNG (June 6, 2014); Freeport LNG Expansion, L.P., et al, Final Opinion and Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Freeport LNG Terminal on Quintana Island, Texas, to Non-Free Trade Agreement Nations, DOE/FE Order No. 3282-C, FE Docket No. 10-161-LNG (November 14, 2014); Freeport LNG Expansion, L.P., et al., Final Opinion and Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Freeport LNG Terminal on Quintana Island, Texas, to Non-Free Trade Agreement Nations, DOE/FE Order No. 3357-B, FE Docket No. 11-161-LNG (November 14, 2014); Freeport LNG Expansion, L.P., et al., Opinion and Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Freeport LNG Terminal on Quintana Island, Texas, to Non-Free Trade Agreement Nations, DOE/FE Order No. 3957, FE Docket No. 16-108-LNG (December 19, 2016).

[5] DOE/FE Docket No. 18-26-LNG

4.3. Environmental Protection Agency

The USEPA has delegated water quality certification, under section 401 of the CWA, to the jurisdiction of individual state agencies. The USEPA also oversees the issuance of a National Pollutant Discharge Elimination System (NPDES) permit by the state agency, under section 402 of the CWA, for point-source discharge into waterbodies. In addition to its authority under the CWA, the USEPA has jurisdictional authority under the Clean Air Act of 1970 (CAA) to control air pollution by developing and enforcing rules and regulations for all entities that emit toxic substances into the air. Under this authority, the USEPA has developed regulations for major sources of air pollution and has delegated the authority to implement these regulations to state and local agencies. State and local agencies also develop and implement their own regulations for nonmajor sources of air pollutants.

5. Public Review and Comment

On June 3, 2015, 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 Project an individual Pre-filing Docket No. PF15-25-000. During the Pre-filing Process, we worked with Freeport LNG and stakeholders to identify and resolve issues, where possible, prior to Freeport LNG's filing of a formal application with the FERC.

During the open house (discussed in section A.5.1) and the original scoping period (discussed in section A.5.2), the FERC-jurisdictional facilities were limited to a single liquefaction train (Train 4) within the boundary of the existing Terminal, and did not include the currently proposed Project facilities within the boundary of the Pretreatment Facility, nor the associated natural gas pipeline. As previously described, Freeport LNG updated its planned Project on August 17, 2016; subsequent public-review documents reflect the complete Project.

5.1. Public Open House for the Project

As part of the Pre-filing Process, Freeport LNG sent notification letters to landowners, government officials, and the general public informing them about the Project and inviting them to attend a Freeport LNG-sponsored open house to acquire background information on Freeport LNG and the FERC process, view maps and Project materials, learn about the construction activities currently taking place on Quintana Island and how the Train 4 Project would fit into the overall timeline, ask questions, and to express their comments and concerns. Notification of the open house was also published in local newspapers. Freeport LNG held the public open house for the Project on July 7, 2015 at the Terminal. Three FERC representatives and over 30 members of the public attended the open house. Three written comments were received.

5.2. Public Scoping Periods for the Project

On August 19, 2015, we issued a *Notice of Intent to Prepare an Environmental Assessment for the Planned Freeport LNG Train 4 Project and Request for Comments on Environmental Issues* (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. During the 30-day comment period, one member of the public provided comments.

On August 31, 2016, in response to changes in the Project, we issued a *Supplemental Notice of Intent to Prepare an Environmental Assessment for the Planned Freeport LNG Train 4 Project and Request for Comments on Environmental Issues* (Supplemental NOI). The Supplemental NOI was mailed to interested parties, which included those listed above plus additional property owners along the additional Project area. In the Supplemental NOI, the description of the FERC-jurisdictional facilities was expanded to include a new natural gas supply pipeline (generally collocated with the pipeline authorized under CP12-29-000) and a fourth pretreatment unit (within the boundary of the pretreatment facility authorized under CP12-509-000). During the 30-day comment period, seven members of the public provided comments.

Additional comments were filed by members of the public and the Sierra Club, following the formal comment periods. Issues identified by the commenters are summarized in table 1 and addressed in the applicable sections of this EA.

TABLE 1

Issues Identified During the Scoping Period

Issue	Comments	EA Section(s) Where Comments are Addressed
Alternatives	Consideration of alternatives to avoid existing and planned residences or permitted structures, avoid the local U.S. Coast Guard facility, and increase collocation of the pipeline with existing facilities.	C.4.3
Water Use and Quality	Impacts of increased vessel traffic on water quality; ensuring proper floodplain permitting.	B.3
Surface Waters	Effect of increased shipping traffic on frequency and volume of maintenance dredging and disposal of spoils.	B.3.2
Wetlands	Effects on wetlands during pipeline construction; loss of wetlands.	B.3.7
Vegetation	Effects on vegetation during construction and operation of the pipeline.	B.4
Fish and Wildlife	Effects on wildlife during pipeline construction; loss of habitat.	B.5
Threatened, Endangered, and Special-Status Species	Effects on threatened and endangered species and their habitats.	B.6
Land Use, Recreation, and Visual Resources	Interaction of recreational boat traffic and LNG vessels; visual impacts on nearby residents (including light pollution); impacts on estuarine recreation (including businesses). Increased collocation	B.7
Socioeconomics	Effects of construction truck traffic on traffic levels on Quintana Island and bridge traffic; access along roads during pipeline crossing or parallel construction; reduction 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; effects of increased shipping and marine traffic; adequacy of local gas supplies for industry.	B.8
Cultural Resources	Effects on cultural resources during construction.	B.9

TABLE 1 **Issues Identified During the Scoping Period**		
Issue	**Comments**	**EA Section(s) Where Comments are Addressed**
Reliability and Safety	Safety of the Terminal with regard to vibration, material fatigue, and soil liquefaction; monitoring of the integrity of the existing Terminal; safety of the pipeline, including pipeline integrity; adequacy of emergency-response personnel and training. Safety of the Marine traffic	B.10
Air Quality and Noise	Noise and air pollution during construction and operation; air emissions from LNG carriers; construction and operational noise, vibration, and air pollution impacts on nearby residents.	B.11

6. Proposed Facilities

About 95 percent of the permanent Train 4 Project footprint would be located within areas previously disturbed by the Phase I, Phase II Modification, and/or Liquefaction Projects. The major Project components are summarized below according to location.

6.1. Quintana Island Terminal Facilities

The proposed liquefaction facilities associated with the Train 4 Project would be located entirely within the footprint of the existing Terminal (figure A 6-1), immediately adjacent to facilities currently under construction. The major Project component to be constructed at the Terminal would be Train 4, which would be identical to the Liquefaction Project's three previously authorized liquefaction trains (Trains 1 through 3), along with ancillary support facilities and infrastructure. While Train 4 would be identical to the three previously authorized liquefaction trains, its 5.1-million metric tons per annum nominal capacity would reflect updated design information and operating assumptions.

The following is a list of components associated with the proposed Train 4 Project located within the existing Terminal:

- Train 4 propane pre-cooled mixed refrigerant LNG train;
    - multi-stage mixed refrigerant compressor with electric motor drivers;
    - multi-stage propane compressor with electric motor drivers;
    - heat exchangers;
- spill containment systems;
- firewater system;
- utility and auxiliary area (potable and service water, plant and instrument air);
- pipe racks and plant piping;
- electrical high-voltage substation; and
- plant roads.

The following is a list of existing/authorized facilities located within the existing Terminal that the Train 4 Project would tie into, modify, and/or expand:

- control room/buildings;
- gas detection and safety systems;
- control systems and electrical infrastructure;
- utilities and distribution systems (nitrogen, mixed refrigerant make-up);
- security and perimeter control systems;
- lighting systems;
- emergency shutdown (ESD) systems;
- gas distribution header for Trains 1 through 3;
- LNG recirculation header for Trains 1 through 3;
- boil-off gas (BOG) system;
- stormwater management system;
- construction storage and laydown areas;
- firewater intake structure on the Intracoastal Waterway (ICW);
- refrigerant sump;
- flare system;
- existing roads;
- fire and gas detection and safety systems;
- telecommunications, information technology, closed-circuit television, and other ancillary systems; and
- minimally modify certain components Trains 1-3 including increasing the allowable fugitive emission rates for piping components; updating horsepower ratings and emission profiles for diesel-fired emergency generator engines, backup air compressor, and firewater pumps; and updating the MSS emissions to the flare.

The following is a list of existing/authorized facilities located within the existing Terminal that would be utilized without modification:

- storage tanks for propane and ethylene refrigerants;
- truck unloading and turning areas;
- three LNG storage tanks;
- two LNG berthing docks;
- LNG transfer lines from LNG storage tanks to LNG berthing docks;
- temporary concrete batch plant;
- construction dock on the ICW; and
- aggregate barge dock on the ICW.

Figure A 6-1
Freeport LNG - Train 4 Project
Proposed Facilities at the Quintana Island Terminal - Aerial
Brazoria County, Texas

| REVISED: 03/01/2017 | SCALE: 1:9,600 DRAWN BY: 0239

6.2. Pretreatment Facility

The proposed Train 4 Project pretreatment facilities would be located entirely within the footprint of the Pretreatment Facility, adjacent to the facility currently under construction (figure A 6-2). The major Project component to be constructed at the Pretreatment Facility would be one natural gas pretreatment unit (Unit 4), which would be identical to the Liquefaction Project's three authorized pretreatment units, along with ancillary support facilities and infrastructure.

The following is a list of components located within the Pretreatment Facility associated with the proposed Train 4 Project:

- Unit 4 natural gas pretreatment unit;
  - inlet feed gas filtering and mercury removal unit;
  - amine sweetening system to remove CO_2 and sulfur compounds;
  - molecular sieve dehydration system to remove water;
  - natural gas liquids (NGL) extraction unit;
  - electric compression units;
  - miscellaneous storage vessels;
- spill containment systems;
- tank storage area;
  - amine solution;
  - aqueous ammonia;
  - heating medium;
  - treated (demineralized), potable, and utility water;
- inlet and outlet compression;
- emergency electric generator;
- utility area (instrument and plant air, hot oil heaters, nitrogen and fuel gas systems);
- pipeline metering facilities;
- pipe racks and plant piping;
- electric substation; and
- plant roads.

The following is a list of existing/authorized facilities located within the Pretreatment Facility that the Train 4 Project would tie into, modify, and/or expand:

- flare system;
- firewater pump system;
- water supply system;
- NGL pipeline;
- nitrogen pipeline;
- stormwater management system; and
- existing roads.

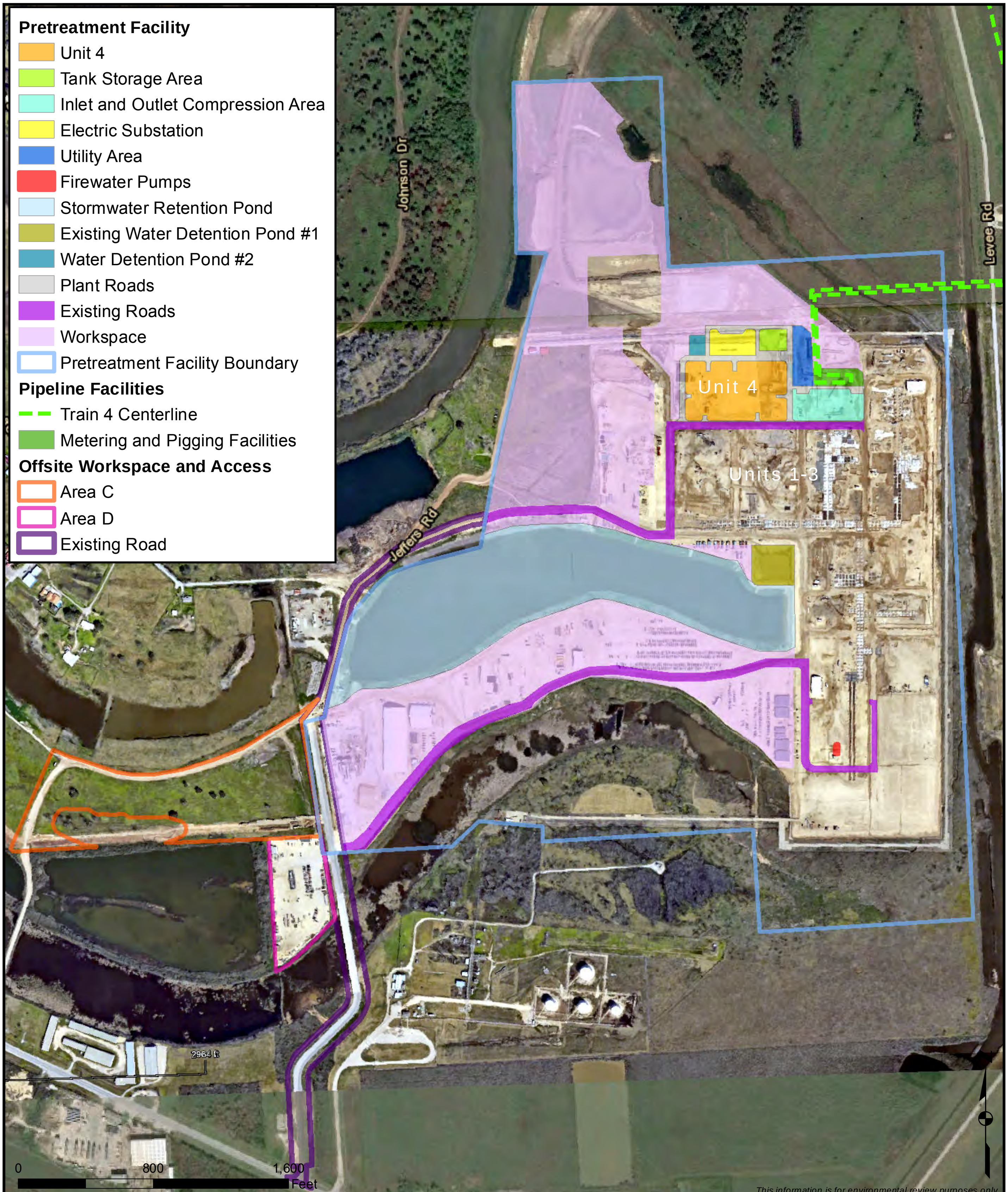

Figure A 6-2
Freeport LNG - Train 4 Project
Proposed Facilities at the Pretreatment Facility - Aerial
Brazoria County, Texas

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6.3. Pipeline Corridor

A new, approximately 10.6-mile-long, 42-inch-diameter natural gas pipeline would be constructed between the Terminal, Pretreatment Facility, and Stratton Ridge Meter Station (figure A 6-3 in appendix E). In addition, Freeport LNG would install fiber optic bundles within the pipeline trench and make minor modifications at three existing or authorized aboveground facilities along the pipeline route (Terminal, Pretreatment Facility, and Stratton Ridge Meter Station).

Within the EA, the pipeline and fiber optic bundles are referred to collectively as the "Underground Facilities." The pipeline and aboveground facilities are referred to collectively as the "Pipeline Facilities." The construction right-of-way during construction and the permanent easement during operation are referred to as the "Pipeline Corridor."

About 87 percent of the proposed route would be located within existing aboveground facility sites or collocated with the Liquefaction Project's existing pipeline/utility corridor. The proposed permanent easement would be 50 feet wide (except in the entry-exit loop for the Pretreatment Facility, where it would be 80 feet wide). Within the collocated segments, about 0.1 mile would overlap an existing 50-foot-wide permanent easement by 30 feet, about 3.8 miles would overlap existing 30-foot permanent easements by 20 feet, about 1.5 miles would overlap existing 30- and 50-foot permanent easements by 10 feet, and 0.6 mile would abut existing 50-foot permanent easements. See table in Appendix D for mile-by-mile easement widths.

The proposed Underground Facilities would be constructed within one trench. The following is a list of components associated with the proposed Underground Facilities:

- 42-inch-diameter natural gas pipeline, maximum allowable operating pressure 1,440 psig;
- non-jurisdictional fiber optic bundles (discussed in section A.7) would be installed concurrently:
  - MPs 0.0 to 5.0: three bundles would be installed; and
  - MPs 5.0 to 10.6: two bundles would be installed.

The following is a list of aboveground facilities associated with the proposed Pipeline Corridor:

<u>Pipeline-related Aboveground Facilities at the Terminal</u>

- one 42-inch-diameter pig launcher/receiver;
- one 42-inch-diameter valve;
- three 36-inch-diameter valves;
- one 16-inch-diameter valve;
- aboveground plant piping to connect proposed pipeline with authorized facilities; and
- associated bypass piping.

The proposed aboveground facilities within the Terminal would occupy a 100-foot by 100-foot area at MP 0.0 of the Pipeline Corridor. Modifications would take place within existing developed areas.

<u>Pretreatment Facility</u>

- two 42-inch-diameter pig launcher/receivers;
- seven 42-inch-diameter valves;
- two 16-inch-diameter valves; and
- associated bypass piping.

The proposed aboveground facilities within the authorized Pretreatment Facility (located at MP 5.0 of the Pipeline Corridor) would be within an area about 285 feet by 100 feet. Modifications would take place within existing developed areas.

<u>Stratton Ridge Meter Station</u>

- one 42-inch-diameter pig launcher/receiver;
- one 42-inch-diameter valve;
- three 36-inch-diameter valves;
- one 16-inch-diameter valve; and
- associated bypass piping.

The proposed aboveground facilities within the existing Stratton Ridge Meter Station (located at MP 10.6 of the Pipeline Corridor) would occupy an area about 200 feet by 400 feet. Modifications would take place within existing developed areas.

7. Non-jurisdictional Facilities

Occasionally, projects have associated facilities not under the jurisdiction of the FERC. Non-jurisdictional facilities may be integral to the 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 Train 4 Project identified two non-jurisdictional facilities: 1) the fiber optic bundles to be installed alongside the pipeline and 2) a new electric transmission line.

The fiber optic bundles are considered part of the "Underground Facilities" that would be installed at the same time and in the same trench as the pipeline. The fiber optic bundles would have no independent impacts.

The new, 300-foot-long electric transmission line would provide a utility service connection to the local electric power transmission system (figure A 7-1). CenterPoint Energy (CenterPoint) would design, construct, and operate a new 138-kilovolt electric transmission line to supply up to 300 megawatts of power to the Project's liquefaction train. The transmission line would run from CenterPoint's existing line at Lamar Street about 300 feet north to the proposed, electrical high-voltage substation located just west of the Terminal. CenterPoint would incorporate the U.S. Fish & Wildlife Service (FWS) Avian Protection Plan Guidelines into the design of the electric transmission line. The workspace for this non-jurisdictional facility would be about 0.6 acre. The electric transmission line may be authorized and regulated by federal, state, and local agencies other than the FERC, such as the Town of Quintana, the Texas Public Utility Commission, and, if waters of the U.S. are affected, the U.S. Army Corps of Engineers (COE).

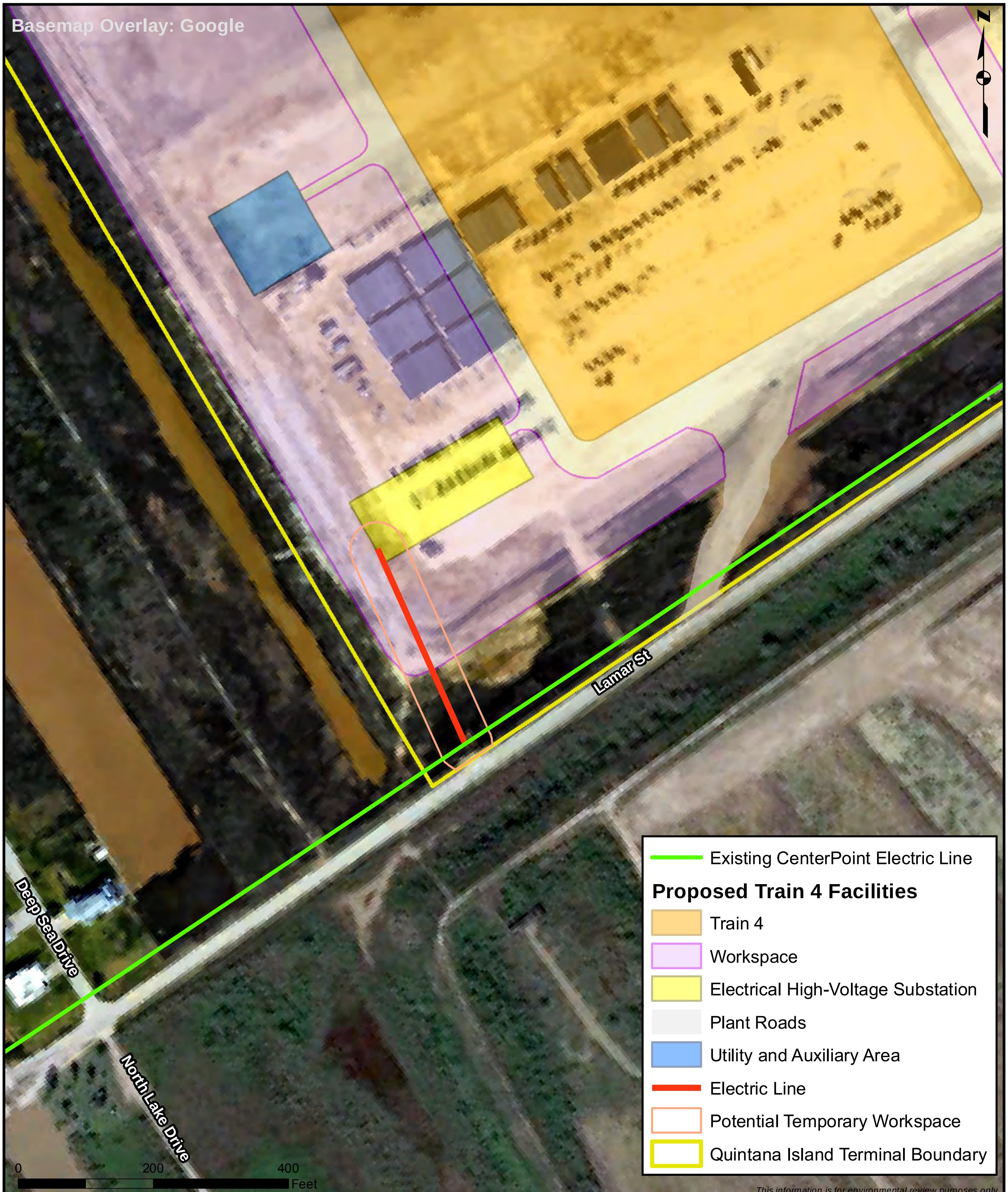

Figure A 7-1
Freeport LNG - Train 4 Project
Non-Jurisdictional Electric Line and Potential Workspace at the Quintana Island Terminal
Brazoria County, Texas

| REVISED: 03/01/2017 | SCALE: 1:2,400 DRAWN BY: 0239

8. Construction, Operation, and Maintenance Procedures

All Train 4 Project facilities would be designed, installed, tested, operated, and maintained in accordance with applicable laws, regulations, and standards that are intended to prevent facility accidents and failures, ensure public safety, and protect the environment. Additional information on these measures can be found in section B.10.

Freeport LNG would follow its Project-specific Plan (accession number[6]: 20170629-5285, based on the *FERC Upland Erosion Control, Revegetation & Maintenance Plan* [FERC, 2013a]), its Project-specific Procedures (accession number: 20170629-5285, based on the *FERC Wetland & Waterbody Construction & Mitigation Procedures* [FERC, 2013b] with requested alternative measures), the Project-specific Erosion & Sedimentation Control Plan (ESCP) during construction to ensure that ground disturbance and site stabilization activities are managed in an environmentally sensitive manner. Freeport LNG would follow the measures in its Project-specific Facility Lighting Design Plan to minimize light impacts and our recommendation for an updated Project-specific Transportation Management Plan.

Freeport LNG intends to incorporate the Train 4 Project into the Liquefaction Project's National Pollutant Discharge Elimination System (NPDES) Permit; Stormwater Pollution Prevention Plan (SWPPP); and Spill Prevention, Control, and Countermeasure Plans (SPCC Plans). These plans were previously filed with FERC as part of the Liquefaction Project and were found to be acceptable.

Freeport LNG would incorporate relevant environmental requirements and environmental mitigation plans into specifications and construction drawings issued with construction bid documents for the Train 4 Project. During construction, if a contractor does not comply with environmental requirements, as soon as Freeport LNG becomes aware of the issue, it would direct the contractor to comply, and would immediately notify the appropriate agencies and take corrective actions as necessary, including issuance of stop-work orders. FERC staff would conduct inspections throughout construction, commissioning, and restoration of the Project.

For the purposes of quality assurance and compliance with mitigation measures, other applicable regulatory requirements, and Project specifications, Freeport LNG would be represented by one onsite Chief Inspector (CI). One or more craft inspectors and three Environmental Inspectors (EI) would assist the CI. The CI, craft inspectors, and EIs currently employed for the Liquefaction Project would be utilized for the Train 4 Project, as they would be most familiar with relevant compliance specifications and other documents contained in the construction contracts. The EIs' duties would be fully consistent with those contained in section II.B (Responsibilities of Environmental Inspectors) of Freeport's Plan to ensure that the environmental conditions associated with other permits or authorizations are satisfied. The EIs would have authority to stop work or require other corrective actions to achieve environmental compliance. In addition to monitoring compliance, the EIs' duties would include training Project

[6] To access documents by accession number, navigate to www.ferc.gov and access eLibrary via the Documents & Filings dropdown menu. Select Advanced Search and input the accession number in the format xxxxxxxx-xxxx in the cell marked "Accession Number." Click submit.

personnel about environmental requirements and reporting compliance status to the contractors, Freeport LNG, the FERC, and other parties, as required.

Freeport LNG would utilize the approved environmental training program currently in place for the Liquefaction Project. The program is designed to ensure that:

- qualified environmental training personnel provide thorough and well-focused training sessions regarding the environmental requirements applicable to the trainees' activities;
- all individuals receive environmental training before they begin work;
- adequate training records are kept; and
- refresher training is provided as needed to maintain high awareness of environmental requirements.

8.1. Alternative Measures to FERC's Plan and Procedures

Requested modifications to FERC's Procedures, including site-specific justification for each modification and our review and conclusions, are provided in table 2.

TABLE 2

Requested Modifications to FERC's Wetland and Waterbody Construction and Mitigation Procedures

FERC Procedure No.	FERC Requirement	Requested Modifications	Justification	Acceptable? Yes/No
V.B.1.b	Instream work in warmwater fisheries must occur between June 1 and November 30.	Allow open-cut construction outside warmwater fisheries time window.	Given the low elevation and coastal setting on the Gulf of Mexico, the Project area is subject to potential hurricane-related storm impacts. To accommodate potential weather impacts/delays, instream activities associated with waterbody crossings may occur outside the time window.	No – see discussion in section B.5.1.2.
VI.A.3	In wetlands, limit the width of the construction right-of-way to 75 feet or less.	Allow a 100-foot nominal-width construction right-of-way in wetlands.	A 100-foot-wide construction workspace is required within wetlands to safely install the 42-inch-diameter natural gas pipeline within large wetland complexes with saturated soils.	No – see discussion in section B.3.3.2.
VI.A.3	In wetlands, limit the width of the construction right-of-way to 75 feet or less.	Allow a 150-foot nominal-width construction right-of-way in EEM wetland between MPs 1.0 and 1.3.	Based on previous pipeline installation through this area, soil conditions and the size of the pipeline require a 150-foot construction workspace for the push-pull method.	No – see discussion in section B.3.3.2.
V.B.2.a VI.B.1.a	Locate extra work areas at least 50 feet away from water's edge/wetland boundaries.	Allow additional temporary workspace (ATWS) located less than 50 feet from a	Of the 51 ATWS, 42 are located less than 50 feet from a waterbody or wetland. These locations were necessarily because: 1. Several large wetland/waterbody complexes are present along the proposed route, upland areas for additional temporary workspaces are not present nearby.	Yes

TABLE 2 **Requested Modifications to FERC's Wetland and Waterbody Construction and Mitigation Procedures**				
FERC Procedure No.	**FERC Requirement**	**Requested Modifications**	**Justification**	**Acceptable? Yes/No**
		waterbody or wetland.	2. HDD, Direct Pipe, and conventional-bore methods would be used for about 4.0 miles of Pipeline installation. Although these crossing methods avoid impacts on wetlands and waterbodies between the entry and exit locations, the requisite workspaces associated with these crossing methods could not avoid wetland or waterbody impacts in some instances.	

With regard to Freeport LNG's request for an alternative measure to allow open-cut construction outside the warmwater fisheries time window of June 1 through November 30, we find that the requested alternative measure is not sufficiently justified. See section B.5.1.2 for our discussion of this proposed alternative measure and recommendation.

With regard to Freeport LNG's request for alternative measures to allow a 100-foot nominal-width construction right-of-way in wetlands and a 150-foot nominal-width construction right-of-way for the push-pull method in EEM wetland between MPs 1.0 and 1.3, we find that site-specific justification for each crossing location has not been provided. See section B.3.3.2 for our discussion of this proposed alternative measure and recommendation.

8.2. Quintana Island Terminal

Quintana Island is reached from the mainland and the City of Freeport by Farm-to-Market Route (FM) 1495, also known as Navigation Boulevard. Major roads connecting to FM 1495 in the Freeport area are SH 36 and FM 523. The Terminal is approached by turning left (east) from FM 1495 onto County Road (CR) 723, which becomes Lamar Street parallel with and just south of the ICW and the Terminal. Construction traffic would access the Project area directly through the existing access roads on Lamar Street, which are currently being used for construction of the Liquefaction Project. Freeport LNG would coordinate with Brazoria County and the town of Quintana, as needed, regarding continued use of the existing/authorized access roads during construction of the Train 4 Project. Once at the Terminal, construction traffic would utilize existing roads and new plant roads.

Construction will proceed in five phases. Construction workers are expected to number around 150 workers during Phase 1, temporary facilities development. This number would expand to 400 workers during Phase 2, 1,100 workers during Phase 3, before topping out at 1,800 workers during Phase 4, and declining to 350 workers over the course of Phase 5. Typical construction would occur 24 hours per day, excepting certain activities (e.g. pile-driving) which would occur during much more limited daytime hours. Workers would be split among three shifts: day shift (6:30 a.m. to 5:00 p.m.), night shift (6:30 p.m. to 5:00 a.m.), and swing shift (2:00 p.m. to 12:30 a.m.). Construction crews on average would work six days a week, taking Sundays off, although some skeleton crews and select craft disciplines would work on Sundays. With some minor exceptions, work would not occur on major holidays.

Delivery of local supplies of construction consumables and smaller volume freighted material such as soil, cement, and rock/limestone would be transported to the Project area by truck. Road transportation of materials and equipment associated with the Project would generate between 90 and 160 deliveries (and an additional 90 to 160 corresponding return trips) per day during construction. Deliveries would be comprised of between 30 and 50 light commercial trucks, between 30 and 50 single unit tandem trucks, and between 30 and 60 long-haul tandem trucks.

Freeport LNG conducted a Traffic Impact Study of the Liquefaction and Phase II Modification Projects (which includes the Train 4 Project area) in May 2017 (accession number: 20170629-5285). Based on the results of the study, a Transportation Management Plan for the Liquefaction and Phase II Modification Projects was developed, which outlined traffic and transportation mitigation measures both for road and barge traffic; this plan is being implemented during construction of the Liquefaction and Phase II Modification Projects. Given that the construction workforce associated with the Train 4 Project would be about one-third the size of that associated with the Liquefaction and Phase II Modification Projects, traffic levels would be less than those associated with the Liquefaction and Phase II Modification Projects. We are recommending that Freeport LNG update the Transportation Management Plan for the Liquefaction and Phase II Modification Projects to include the Train 4 Project; and it is addressed further in section A.8.5.

8.2.1. Site Security and Access

Due to ongoing operations at the Terminal, all contractor personnel would be required to access the Train 4 construction area within the Terminal through a controlled access point. Security fencing and gates would be used to control construction access to restricted and operating portions of the Terminal, in accordance with the Facility Security Plan as approved and amended in accordance with U.S. Coast Guard (USCG) regulations (33 CFR Part 105), as applicable.

A single off-site parking area was identified for the Terminal location. During Phase 1 and 2 construction activities, workers would arrive to the pre-determined off-site parking area utilizing their personal vehicles. The anticipated increase in workers during construction phases 3 through 5 (as discussed in section A.8.1) would result in workers parking offsite at the predetermined parking location and utilizing busses to and from the Project site. Additional site-specific transportation management actions are detailed in Freeport LNG’s Transportation Management Plan for the Liquefaction and Phase II Projects (accession number: 20170629-5285); Freeport LNG would include similar site-specific management actions in the updated Transportation Management Plan for the Train 4 Project.

8.2.2. Temporary Construction Facilities

The proposed Train 4 area is currently being used as construction workspace for the Liquefaction Project; therefore, temporary fencing has already been installed. Existing temporary construction offices and worker facilities associated with the Liquefaction Project would be relocated from the Train 4 area at the Terminal to offsite workspace Area A before construction of the Train 4 Project begins. Relocation of the temporary facilities would take place in accordance with applicable regulations. Following relocation of temporary construction facilities associated with the Liquefaction Project, temporary support facilities (e.g., construction offices, warehouses, lunch tents, parking lots, portable toilets) for the Train 4 Project would be installed. Any electrical, communications, and water systems needed for subsequent construction would be installed.

8.2.3. Site Preparation

Clearing, grubbing, backfilling, grading, and soil-stabilization activities have been performed at the Terminal, the Pretreatment Facility, and offsite workspace Areas A, C, D, E, F, G, and H (discussed in section A.9.2) in association with the Liquefaction Project. The Project would require no additional improvements within Areas A, C, D, E, F, G, and H. Within offsite workspace Area B, temporary erosion controls (e.g., silt fences, check dams, fiber rolls, and sediment traps) would be installed prior to ground disturbance.

However, because ground improvements within portions of the Train 4 process areas at the Terminal and Unit 4 process areas within the Pretreatment Facility were completed to support construction equipment for the Liquefaction Project, and not to support permanent facilities, additional grading, and soil stabilization activities would be required.

General fill material would be brought to the site to raise the elevation of the process areas to facilitate stormwater management and gravity flow within plant piping. The fill and underlying material would be improved and stabilized to provide a load-bearing surface for the proposed facilities, as well as crane access during construction. The techniques used to improve the soils would be similar to those adopted during Liquefaction Project construction. Various stabilizers would possibly 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 construction and operational areas. The area would be paved as soon as practicable to keep it clean and to avoid dirt entering the pipes during field assembly.

8.2.4. Site Drainage

The stormwater management system (including the stormwater pond and conveyance channels) associated with the Liquefaction Project at the Terminal and the Pretreatment Facility is currently in operation as part of the Liquefaction Project. At the Terminal, due to site constraints and to incorporate stormwater runoff within the Train 4 area, the existing stormwater management system would be modified during construction of the Train 4 Project. Modifications would include reconfiguring the existing stormwater pond, reconfiguring and adding conveyance channels within the site, and adding one dedicated outfall. At the Pretreatment Facility, to incorporate stormwater runoff within the Unit 4 process areas, the existing stormwater management system would be expanded to add conveyance channels and a second water detention pond. No modifications to the existing stormwater retention pond or water detention pond are proposed as part of the Train 4 Project.

Terminal

The existing stormwater management system associated with the Liquefaction Project is designed to accommodate stormwater runoff from the open area within the Terminal that would contain the proposed Train 4 Project facilities. However, because stormwater from the Train 4 process areas would be collected, passed through oil/water separators, and then discharged to the ICW, the stormwater pond would be reconfigured to be smaller than it is currently. Modification of the stormwater management system would occur early in Train 4 Project construction as part of site preparation activities. The modified stormwater pond would meet the requirement for stormwater collection during both construction and operation of the Train 4 Project.

The existing stormwater pond is in the northwest corner of the Terminal site and occupies about 7.9 acres: about 650 feet in length, 475 feet in width, and from 8.6 to 11.5 feet in depth (the pond is shallowest at the southern side). The modified stormwater pond would be about 6.7 acres: 360 feet in length, 810 feet in width, and 10 feet in depth. The modified stormwater pond would discharge to the ICW through the existing 36-inch-diameter outfall.

The existing conveyance channels within the Train 4 Project area at the Terminal would be modified to include the proposed Project facilities. Stormwater runoff from non-process areas would enter a constructed conveyance system of shallowly sloped concrete troughs that would collect and carry the stormwater to the reconfigured stormwater pond. Stormwater from the Train 4 process areas would be collected into a new oily water containment sump, pass through oil/water separators, and then discharge to the ICW through a new outfall, in accordance with NPDES permit requirements. Additional stormwater controls (including placement of gravel or other suitable material to provide a stable, well-drained surface) would be installed during site preparation activities as necessary.

Under normal operating conditions, stormwater collected in the LNG spill containment system would be routed: 1) east to an authorized LNG spill containment sump, which discharges into the canal located to the east of authorized liquefaction train 1 and 2) north and west to a new LNG spill containment sump, which discharges to the new and reconfigured conveyance channels that connect to the reconfigured stormwater pond. The LNG spill containment sump water removal systems are designed for a 10-year, 1-hour rainfall rate of 3.4 inches per hour. The sump pumps would be instrumented with a low-temperature cut-off switch to inhibit pump operation in the event of an LNG spill.

Pretreatment Facility

Stormwater runoff would drain to a new conveyance channel, which would connect to the existing water retention pond. Stormwater from the Unit 4 process areas would be collected into a new detention pond north of Unit 4 (water detention pond 2 as depicted in figure A 8-1), pass through an oil/water separator, and then discharge to the existing stormwater retention pond. Stormwater from the firewater pump area would be conveyed to the existing water detention pond (water detention pond 1 as depicted in figure A 8-1), pass through an oil/water separator, and then discharged to the existing stormwater retention pond.

The design and operation of all stormwater discharge and treatment facilities would be in accordance with applicable regulations and permits, including NPDES regulations under the CWA and the permit requirements of the Velasco Drainage District and the Brazoria County Floodplain Administrator.

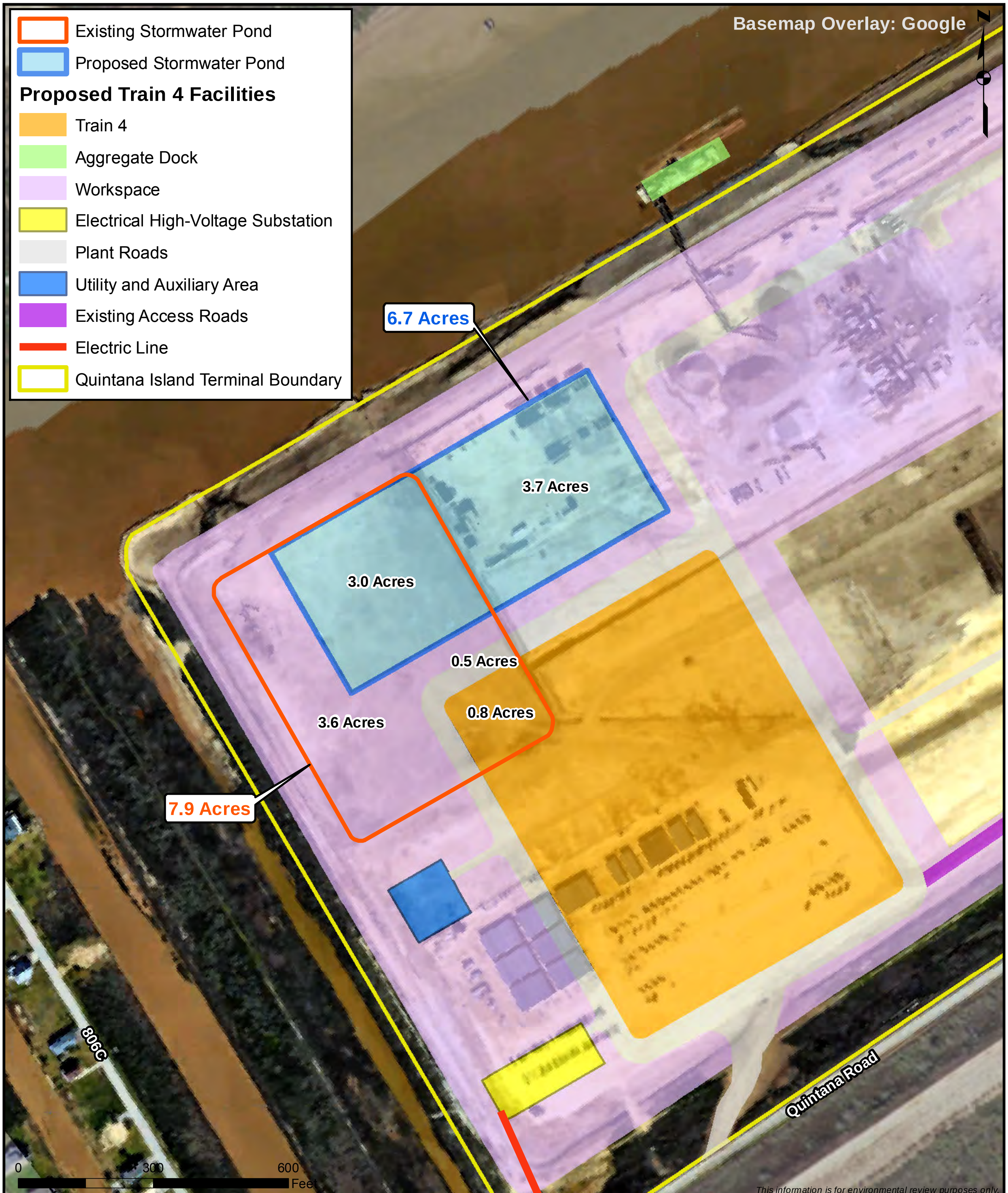

Figure A 8-1
Freeport LNG - Train 4 Project
Existing and Proposed Stormwater Pond Configuration
at the Quintana Island Terminal
Brazoria County, Texas

| REVISED: 03/01/2017 | SCALE: 1:3,600 DRAWN BY: 0239

8.2.5. Facility Foundations

Following soil stabilization, foundation construction would initially involve the installation of drilled soil displacement concrete piles (also known as DeWaal piles or cast-in-place piles). These piles would provide a firm base for the concrete pads on which heavy equipment components of Train 4 at the Terminal, Unit 4 at the Pretreatment Facility, and associated pipe racks would be set with minimum noise impacts. Pile design in terms of number, dimensions, and spacing would be based on guidance in the FERC's latest draft seismic guidelines (FERC, 2007) and Section7.2.2 of NFPA-59A (2006). After the piles have been positioned, caps on the piles would be installed, with each pad sized, located, and configured to accommodate the specific piece of equipment for which it would provide support. To produce the large amounts of concrete required, the Train 4 Project would utilize the concrete batch plant authorized for use during construction of the Liquefaction Project.

8.2.6. Construction of Proposed Facilities

Once foundations are in place, work on the Train 4 components at the Terminal, Unit 4 components at the Pretreatment Facility, interconnecting pipeline sections and racks, and major utility equipment would occur simultaneously but would be coordinated and sequenced such that electrical and instrument contractors install and test their equipment according to their respective schedules. Work would also be coordinated to ensure that construction activities within the Terminal, Pretreatment Facility, and the Pipeline Corridor are synchronized.

When practical, large equipment units would arrive at the site in preassembled packages to facilitate final hook-up and testing. These units would be barged to the Project site, off-loaded at the existing construction and/or aggregate docks by crane, and transported to their foundations on multi-wheeled transport crawlers. Other material and equipment would be shipped to the Project site by truck. All equipment would be designed, fabricated, and rigorously tested by highly qualified specialist suppliers at their respective facilities, overseen by Freeport LNG inspectors, and shipped to site only after the necessary inspections have taken place and the equipment has been approved for release. Inspections of all equipment would be conducted upon arrival at the Project site.

Freeport LNG would coordinate the timing of the arrival of the large units at the existing construction and/or aggregate docks with completion of the foundation pads to ensure that the units can be off-loaded from barges, transported to the Train 4 area, and positioned on the foundation pad without any double handling or delay associated with intermediate storage.

Train 4 would occupy an approximately 870-foot-long by 700-foot-wide rectangular footprint and would be connected to existing and authorized facilities via pipeline interconnects, involving sections of variously sized underground and aboveground pipelines, the latter on steel-framed support racks. The individual frame members for the support racks would arrive at the Project site prefabricated, after which the racks would be assembled on site. The aboveground plant piping would be installed after site foundations have been completed and the racks have been erected. Pipe installation on the racks would be implemented from multiple directions, and a pre-insulated approach may also be considered.

Pipe spool fabrication would be undertaken in a covered area on or off site. The spools delivered to the Project site would be as large as can be practically and safely trucked, to minimize site work and the number of deliveries. The majority of the straight-run pipe would be field fabricated prior to placement on the pipe racks. Pipe expansion loops (bellows) would be prefabricated in a shop, transported to position, and then erected with the straight-run plant piping. As required, pipes would be painted, coated, or insulated after shop welds have been tested in accordance with applicable codes.

8.3. Pretreatment Facility

The Pretreatment Facility is located on the west side of CR 690 (Levee Road), about 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. Construction traffic would access the Pretreatment Facility from SH 332 using the existing Heavy Haul Road, which leads to the western side of the property.

In general, the construction workforce for each phase of construction will be smaller at the Pretreatment Facility than that at the Terminal. Construction crews on average would work six days a week, taking Sundays off, although some skeleton crews and select craft disciplines would work on Sundays. With some minor exceptions, work would not occur on major holidays.

8.3.1. Site Security and Access

During construction of Unit 4 within the Pretreatment Facility, facilities authorized under the Liquefaction Project would be entering operations. As such, all contractor personnel would be required to access the Pretreatment Facility through a controlled access point. Security fencing and gates would be used to control construction access to restricted and operating portions of the Pretreatment Facility in accordance with the Facility Security Plan.

The number of construction workers at the Pretreatment Facility can be accommodated by onsite parking, so workers would not be bussed to and from the Project site but would utilize their personal vehicles.

8.3.2. Temporary Construction Facilities

The Unit 4 area within the Pretreatment Facility is currently being used as construction workspace for the Liquefaction Project. Materials associated with the Liquefaction Project within this area would be relocated to peripheral workspaces before construction of Unit 4 begins. Following this relocation, temporary support facilities (e.g., construction offices, warehouses, lunch tents, parking lots, portable toilets) for Unit 4 construction would be installed. Because the Unit 4 area is currently being used as temporary workspace, perimeter fencing has been installed in this area. Additional temporary fencing would be installed to isolate Unit 4 construction activities from soon-to-be operational areas within the Pretreatment Facility. All construction workspaces would be fenced, including temporary workspaces and those within operational footprints.

Access to the Pretreatment Facility would be via existing roads on the western side of the site. Plant roads within the site would be extended and paved, and any electrical, communications, and water systems needed for subsequent construction would be installed.

Temporary fencing would be installed at offsite workspace Area B (figure A 8-2). Temporary fencing at the other offsite workspaces (Areas C, D, E, F, G, and H, discussed in section A.9.2) has been installed for the Liquefaction Project.

Figure A 8-2

Freeport LNG - Train 4 Project

Offsite Workspace Area B - Aerial

Brazoria County, Texas

| REVISED: 10/11/2017 | SCALE: 1:7,200

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8.4. Pipeline Corridor

Access to the Pipeline Corridor construction areas will 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.

Typical Figures 1 through 29 (appendix D) show right-of-way construction configurations. A comprehensive set of right-of-way configurations can be accessed on the FERC Docket, accession number: 20171108-5163.

8.4.1. General Construction Procedures

In general, Freeport LNG would use conventional construction techniques for buried pipelines and would follow the Project-specific Plan and Procedures. Construction specifications would also require adherence to the SWPPP for construction stormwater discharges, SPCC Plans, ESCP, best management practices, and plans and procedures for unique construction techniques (e.g., Horizontal Directional Drill [HDD], Direct Pipe).

Right-of-Way Surveying

The pipeline alignment would be identified and surveyed prior to construction. This would include staking the proposed pipeline centerline, workspace limits, as well as foreign line crossings, COE-approved wetland boundaries, and other environmentally sensitive areas.

Clearing and Grading

Prior to clearing of the construction workspace, appropriate temporary erosion controls would be installed, as described in Freeport's ESCP (accession number: 20170629-5285).

Prior to trench excavation in upland areas, vegetation would be cut and removed from the construction workspace. Although no forested areas are present within the Project footprint, any trees present within the workspace would be cut flush with the ground surface and the tree stump left in place, except where their removal is necessary to create a safe and level work surface.

After clearing, the upland portions of the construction right-of-way would be graded with a bulldozer or similar equipment as necessary to create a safe and level work surface.

Clearing and grading operations would incorporate procedures to: 1) minimize vegetation removal from slopes, wetlands, and channel banks; 2) prevent undue soil profile disturbance; 3) restore preconstruction ground contours; and 4) prevent topsoil erosion. In wetland areas, clearing would be limited to directly over the trenchline unless the CI or EI determines that safety-related construction constraints require grading or removal of stumps from the working side. In emergent wetlands, vegetation within the construction workspace would be flattened during construction but would not be purposely cleared, other than through trench excavation.

Trenching

Trenching involves 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 4 feet of cover over the pipe.

In residential areas and/or at the landowner's discretion, topsoil is routinely segregated from subsoil during trenching, and remains segregated during storage to avoid loss though mixing with stockpiled subsoil.

If trench dewatering is necessary, discharge to the ground is generally 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. Trench dewatering would be performed in accordance with permit specifications.

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. Welding would be performed in accordance with 49 CFR 192, Subpart E "Welding of Steel in Pipelines" and API Standard 1104.

Cathodic Protection

Cathodic protection systems would be installed at various points along the pipeline to prevent corrosion, by applying a low voltage current to offset natural soil and groundwater corrosion potential.

Backfilling and Grade Restoration

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 settling, unless the landowner 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 preconstruction conditions as practicable. Upon completion of trench backfilling, topsoil would be replaced as necessary and the preconstruction soil profile restored across the wider construction workspace.

Hydrostatic Testing and Tie-ins

After construction and prior to placement into service, the completed pipeline would be hydrostatically tested to ensure that the system is leak proof and to provide the necessary safety margin for high-pressure operation.

Once in-place, the pipeline would be filled with water and pressurized would be maintained throughout the test. Water for hydrostatic testing of the Pipeline would be obtained from the existing wells, the authorized municipal water line from the City of Freeport, and/or trucked to the Project site. Freeport LNG stated that it does not anticipate that any chemical agents would be added to the test water.

After the completion of a satisfactory test, the water would be discharged over land into containment structures in accordance with state permit requirements.

Water for hydrostatic testing of aboveground facilities at the Terminal, Pretreatment Facility, and Stratton Ridge Meter Station piping would be obtained from the existing wells at these locations, from an authorized municipal water line from the City of Freeport, and/or trucked in from the City of Freeport. Water used to hydrostatically test the aboveground facilities at these three locations would be discharged through a straw-bale dewatering structure or filter bag within an upland area and allowed to drain into the existing stormwater drainage systems.

Clean-up and Restoration

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. The construction workspace would be restored using site-specific contouring and reseeding with an approved seed mix.

8.4.2. Specialized Construction Procedures

Waterbody and Wetland Crossings

Freeport LNG would use the open-cut, push-pull, conventional-bore, HDD, and Direct Pipe methods to construct the pipeline across wetlands and waterbodies. These methods are described below. A complete list of the waterbodies along the proposed pipeline route and the construction method proposed for each crossing is provided in table 10. Site specific crossing figures are located in appendix D.

Typically, refueling and lubricating would take place in upland areas that are 100 feet or more from wetlands and waterbodies. The Liquefaction Project's SPCC Plans address, among other items, the handling of fuel and other materials associated with the Project.

Open Cut Method. 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.. Trench spoil would be placed bank-side above the high water mark for use as backfill. The pipeline would be installed below scour depth. 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.

Conventional Bore, HDD, and Direct Pipe. Where a waterbody lies adjacent to a road, a conventional bore is often used to avoid surface impacts on both the road and the waterbody. HDD and Direct Pipe crossings are generally used over longer distances than bores and also avoid surface impacts, including in-stream and riparian disturbance.

A conventional 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 the HDD method, electric grid wire guides are hand laid along the pipeline centerline between the proposed drill entry and exit locations. Only minimum ground and vegetation disturbance result from this procedure. Following guide wire installation, a slant drill unit is set up and a small diameter pilot hole is drilled under the wetland and/or waterbody along the prescribed profile. Electromagnetic sensors are used to guide the drill bit.

Once the pilot hole is completed, it is 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 fluid consisting of bentonite clay and water is 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 is 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. Where fiber optic bundles are to be included in the HDD pipeline installation, an approximate 4-inch conduit would be secured to the 42-inch natural gas pipeline during pipe pullback. The pullback of the "bundle" would be done simultaneously within the same bore.

As indicated in table 3, the ICW, which is a major waterbody (water channel width greater than 100 feet), would be crossed using the HDD method. In addition, the HDD method would be used to cross an extensive emergent wetland complex along the proposed route. The site specific crossing figures may be found in appendix D.

The Direct Pipe pipeline installation technique is a relatively new pipeline installation method in the United States that combines installation processes used in micro-tunneling and HDD installation methods. The process involves establishing the subsurface pipeline path using a specially designed cutting head and supporting machinery installed on the leading segment of the pipeline to be installed. A slurry of drilling fluid is pumped through a series of supply and return lines installed on specially designed carrier racks within the pipeline as the specific pipeline joints are welded and prepared for installation. As the cutting head advances, a new joint of pipe is installed on a roller mechanism and welded on to the back of the assembly. A hydraulic jacking assembly is used to advance the pipe and cutting head. This process is continued until the cutting head reaches the exit location. Once the cutting head reaches the exit point, the internal supply/return lines and associated carrier racks are removed from the inside of the installed pipeline. Where fiber optic bundles are to be included in the Direct Pipe pipeline installation, the cable would be attached directly to the 42-inch natural gas pipeline and installed within the same bore tunnel simultaneously with the 42-inch natural gas pipeline.

The Direct Pipe method can be launched from the ground surface or from a shallow installation pit, and can be accurately steered to navigate a precise route. Additionally, the Direct Pipe method uses significantly less drilling fluid than other trenchless methods, dramatically reducing the possibility of inadvertent fluid returns. The primary advantage to the Direct Pipe method is that the pipeline is installed as one continuous process, whereas the HDD method requires multiple steps to occur prior to pipeline installation.

TABLE 3

Conventional Bore, Horizontal Directional Drill, and Direct Pipe Crossing Locations

Primary Feature Name	MP		Crossing Length (feet) a/	Crossing Method	Site-specific Crossing Plan (Figures) Appendix D
	Start	End			
Freeport Harbor Channel	0.0	1.0	5,135	Direct Pipe	D-1
ICW	1.3	1.7	2,275	HDD	D-2
SH 332 (Including ramps and mainline)	2.0	2.1	800	Bore	D-3
Wetland Complex	2.5	3.6	5,982	HDD	D-4
CR 690 – Levee Road (Velasco Levee)	4.4	4.8	2,040	Direct Pipe	D-5
CR 690 – Levee Road (Velasco Levee)	5.1	5.5	2,040		
Eastern Velasco Ditch	5.8	6.4	~3,000	Push-pull	D-6
Oyster Creek	6.4	6.8	2,249	Direct Pipe	D-7
CR 792 – Suggs Road	7.2	7.3	238	Bore	D-8
Pipeline Crossing	10.4	10.4	178	Bore	D-9

a Crossing length equals the horizontal distance, per site-specific crossing plans.

The proposed Pipeline would be installed using the Direct Pipe method beneath the Freeport Harbor Channel (FHC) and beneath Oyster Creek, both of which are major waterbodies. In addition the Pipeline would be installed beneath the Velasco Levee and CR 690 (Levee Road) in two locations; the first crossing (MPs 4.4 to 4.8 – the inflow pipeline) would transport pipeline-quality natural gas westward into the Pretreatment Facility and the second crossing (MPs 5.1 to 5.5 – the outflow pipeline) would transport treated natural gas eastward before it is transported south to the Terminal.

The Velasco Drainage District requires that the entry and exit points for the Direct Pipe installation at the Velasco Levee (on which CR 690 – Levee Road is located) be set back at least 300 feet from the centerline of the levee, to ensure that the levee structure is not compromised by drilling activity. On the east side of the levee, a setback distance of a 950 feet is required to achieve the minimum depth required under the toe of the levee. On the west side of the levee, a setback distance of about 900 feet is proposed to minimize effects on wetlands while ensuring the minimum depth required under the toe of the levee.

Push-pull Method. Freeport LNG would use the push-pull method to install the Underground Facilities beneath a wetland complex located between MPs 1.0 and 1.3 and beneath the Eastern Velasco Ditch, which is adjacent to and east of CR 690 (Levee Road) between MPs 3.6 and 4.2 and MPs 5.8 and 6.4. The trench would be excavated in the bed of the ditch with a barge-mounted backhoe. Spoil from the trench would be placed adjacent to the excavation within the ditch. Pipe joints would be welded, inspected, and coated one at a time and, as the pipeline is fabricated into a continuous floating string, it would be pushed or pulled through the canal, weighted as necessary, and lowered into the trench. A site specific crossing plan depicting the push-pull crossing of Velasco Ditch between MPs 5.8 and 6.4 is provided as figure D-1 in appendix D.

Road Crossings

Table 4 lists the roads crossed by the Underground Facilities. The proposed route does not cross any railroads. For most road crossings, the conventional bore, HDD, or Direct Pipe installation method are proposed. The minimum pipeline clearance for both unsurfaced and paved public roads would be 5 feet under the roadbed and 4 feet under any side borrow/drainage ditches. Pipeline warning signs/markers would be installed at each crossing location.

TABLE 4

Road Crossing Locations

Road	MP	Approximate Crossing Length (feet)	Crossing Method
Thunder Road	1.0	60	Open Cut
Canal Drive	1.4	47	HDD
SH 332 Feeder (south)	2.0	45	Bore
SH 332	2.1	318	Bore
SH 332 Feeder (north)	2.1	54	Bore
CR 891 – Cone Island Road	3.4	56	HDD
CR 690 – Levee Road	4.6	50	Direct Pipe
CR 690 – Levee Road	5.3	50	Direct Pipe
CR 690A – Galleywax Way	6.5	31	Direct Pipe
CR 792 – Suggs Road	7.2	71	Bore
Unnamed Gravel Road	7.4	31	Open Cut
Unnamed Gravel Road	7.9	86	Open Cut
Unnamed Gravel Road	9.1	20	Open Cut

Utility Crossings

Table 5 lists the utility crossings and installation procedures along the proposed route, all of which are pipeline crossings.

TABLE 5

Utility Crossing Locations

Utility	MP	Crossing Method
Pipeline (16-inch natural gas)	1.3	HDD
Pipeline (42-inch natural gas)	3.3	HDD
Pipeline (8-inch nitrogen)	3.3	HDD
Pipeline (12-inch BOG)	3.3	HDD
Pipeline (20-inch natural gas)	3.4	HDD
Pipeline (8-inch crude)	3.4	HDD
Pipeline (12-inch natural gas)	4.6	Direct Pipe
Pipeline (42-inch natural gas)	4.6	Direct Pipe
Pipeline (42-inch natural gas)	5.3	Direct Pipe
Pipeline (12-inch natural gas)	5.4	Direct Pipe
Pipeline (42-inch natural gas)	6.5	Direct Pipe
Pipeline (12-inch natural gas)	6.5	Direct Pipe
Pipeline (12-inch natural gas)	6.9	Open Cut
Pipeline (12-inch natural gas)	7.3	Bore
Pipeline (42-inch natural gas)	7.3	Bore
Pipeline (12-inch natural gas)	8.3	Open Cut
Pipeline (4-inch natural gas)	9.5	Open Cut
Pipeline (40-inch crude)	9.7	Open Cut
Pipeline (40-inch crude)	10.0	Open Cut
Pipeline (4-inch highly volatile liquid)	10.4	Bore
Pipeline (40-inch crude)	10.4	Bore
Pipeline (42-inch crude)	10.4	Bore
Pipeline (4-inch highly volatile liquid)	10.4	Bore
Pipeline (12-inch natural gas)	10.6	Open Cut
Pipeline (12-inch natural gas)	10.6	Open Cut

Residential Areas

Three residential areas are present along the proposed Underground Facilities route, including the periphery of the City of Surfside Beach, Bridge Harbor Yacht Club, and Turtle Cove. Within residential areas, construction activities would be completed as expediently as practicable to minimize disturbance to residents. While constructing within these areas, Freeport LNG would maintain access to the residences for the duration of construction activities. Roads necessary for access to residential properties would be crossed using the HDD or bore method, thereby maintaining passage for landowners and emergency vehicles.

One residence is located within 50 feet of the Underground Facilities, near MP 6.6. This residence is about 35 feet east of the permanent easement at its closest point. Within this area, the Underground Facilities would be collocated with the existing 42-inch-diameter send-out pipeline, and would be installed using the Direct Pipe method. The proposed entry and exit locations for the Direct Pipe are each about 0.2 mile from this residence.

Aboveground Facilities

At the sites for the proposed aboveground facility modifications (Terminal, Pretreatment Facility, and Stratton Ridge Meter Station), all of which would be within existing fence lines, the principal sequential construction steps would be clearing and grading (Stratton Ridge Meter Station only), placement of a concrete pad foundation, installation of equipment, erection of equipment housing, and surface clean-up, during which open areas would be covered with gravel, limestone or similar material (Stratton Ridge Meter Station). Where pigging equipment is installed, a concrete liquids containment area would be constructed below the barrel of the pig launcher or receiver.

8.5. Construction Schedule

Construction of the Train 4 Project would occur over about 42 months. During this period, Project components at the Terminal and Pretreatment Facility would be constructed concurrently. The Underground Facilities would be constructed and commissioned prior to operation and would take a shorter time period.

8.6. Operations and Maintenance

8.6.1. Operations

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. The standards and regulations that apply to the liquefaction facilities within the Terminal and pretreatment facility include the USDOT Liquefied Natural Gas Facilities: Federal Safety Standards (49 CFR 193), NFPA-59A, and applicable sections of the USCG regulations for Waterfront Facilities Handling LNG (33 CFR 127 and Executive Order 10173, as amended), as further discussed in section B.10. For the Pipeline Facilities and the Pipeline Corridor, applicable standards and regulations include, but are not limited to, the standards and regulations set forth by the USDOT in 49 CFR 192 and the RRC pipeline safety regulations found in TAC Title 16, Part 1, Chapter 8.

Operating procedures for the Train 4 Project would be identical for those in place for the Liquefaction Project. Operation of the Train 4 Project would require the addition of about 106 personnel. These staff would be trained extensively to gain familiarity with, and adhere to, the operating and safety procedures of the new facilities.

8.6.2. Maintenance

The Train 4 Project would be operated and maintained in accordance with federal safety standards and regulations as identified in section B.10, Reliability and Safety. Full-time staff would be on site 24 hours per day, and would conduct routine maintenance and minor overhauls. Major overhauls and non-routine maintenance would be supplemented by trained contract personnel with oversight and support from Freeport LNG's staff.

The Pipeline Facilities would be maintained in accordance with all applicable federal and state requirements, including the minimum federal safety standards identified in 49 CFR 192. The regulations found at 49 CFR §§ 192.613, 192.703, 192.705, and 192.709 address aerial and ground patrols of pipeline facilities. Regular aerial and ground patrols of the pipeline would be conducted in accordance with these regulations. As required under 49 CFR § 192.705, patrols would be conducted once every 4.5 to 15 months, depending on class location (i.e., population density) and the location of the pipeline.

To maintain accessibility of the right-of-way and accommodate pipeline integrity surveys, vegetation along the right-of-way would be cleared periodically, and as necessary, following the Project-specific Plan and Procedures (except in areas crossed by HDD where vegetation maintenance would not be required). Routine vegetation mowing or clearing would occur outside of the migratory bird nesting season (April 15 through August 1), unless specifically approved in writing by the FWS. In non-cultivated uplands, the permanent easement for the pipeline would be maintained in an herbaceous state. In wetlands, the Procedures allow for a 10-foot-wide corridor centered over the pipeline to be permanently maintained in an herbaceous state. In addition, trees within 15 feet of the pipeline with roots that could compromise the integrity of pipeline coating may be selectively cut and removed from the permanent right-of-way. Where necessary and when required, mechanical mowing or cutting would occur along the permanent easement for normal vegetation maintenance.

9. Land Requirements

Land requirements in terms of operational footprint and construction workspace are provided in table 6, are summarized below.

The majority of the area affected by construction of the Train 4 Project (87 percent of the area) would be located within areas previously disturbed by the Phase I, Phase II Modification, or Liquefaction Projects, American Midstream Partners, LP's existing 12-inch-diameter natural gas pipeline, or Enterprise Products Partners, L.P.'s natural gas pipeline (which is currently under construction). The majority of the operational footprint (95 percent) would also be within areas previously disturbed by the Phase I, Phase II, Phase II Modification, and/or Liquefaction Projects. Where the Underground Facilities would be collocated, they would generally be installed with a 20-foot offset from the existing pipeline or utility line within the existing and additionally negotiated permanent easement. A nominal 50-foot permanent easement would be retained during operation, however right-of-way wide and overlap varies by milepost (see table in Appendix D).

TABLE 6

Summary of Land Requirements for the Project

Facilities	Operational Footprint (Acres) a/ b/ Total Operation	Construction Footprint (Acres) a/ b/ Total Construction
Quintana Island Terminal		
Proposed	74.3	74.3
Existing – to be modified	6.7	6.7
Existing – to be used without modification	0.0	15.3
Subtotal Quintana Island Terminal:	**81.0**	**96.3**
Pretreatment Facility		
Proposed	94.0	94.0
Authorized – to be used without modification	0.0	42.5
Subtotal Pretreatment Facility:	**94.0**	**136.5**
Pipeline Corridor	63.8	142.0
Subtotal Pipeline Corridor:	**63.8**	**142.0**
Offsite Workspace And Access	0.0	181.1
Subtotal Offsite Workspace and Access:	**0.0**	**181.1**
Project Total	**238.9**	**556.0**

a The numbers in this table have been rounded for presentation purposes; the totals may not reflect the sum of the addends.

b "Construction Footprint" includes all land affected by Project construction and operation. "Operational Footprint" is a subset of "Construction Footprint," and includes only land affected during Project operations.

9.1. Access Roads

Freeport LNG would utilize 15 access roads comprised of eight new temporary access roads and seven existing roads to access the proposed Pipeline Corridor. No new permanent access roads are proposed. Roads would typically be 20 feet in width and extend from the boundary of the nearest public road to the construction workspace.

9.2. Offsite Workspaces and Access

Use of one existing heavy haul road (Heavy Haul Road) and eleven offsite workspaces (Areas A; B; C; D; E; F; G; and H1, H2, H3, and H4 [collectively "Area H"]) are proposed for construction of the Train 4 Project (figure A 9-1).

These areas have undergone FERC review and are currently being utilized for the Liquefaction Project. Pending the extension of existing lease agreements, Freeport LNG intends to utilize these areas for offsite workspace during construction of the Train 4 Project.

Prior to their use for the Liquefaction Project, the majority of the offsite workspace areas were developed or disturbed. The existing conditions at each of these workspaces, prior to the Liquefaction Project, and the purpose for which each offsite workspace are currently or would be used, are as follows:

- Area A: dredged material placement area to be used for storage and laydown during construction;
- Area B: open pastureland to be used for construction storage, laydown, and parking;
- Area C: upland grassland/pastureland to be used for material storage and parking during construction;
- Area D: cleared, covered with limestone to be used as for temporary contractor trailers and equipment and for pipe laydown;
- Area E: rock/gravel parking lot/laydown yard to be used for laydown as well as equipment and tool storage and parking;
- Area F: rock/gravel parking lot/laydown yard to be used for laydown as well as equipment and tool storage and parking;
- Area G: paved parking lot/storage area to be used for laydown, equipment and tool storage, and parking;
- Area H: paved parking lots/storage areas to be used for equipment storage when other areas are full and for additional parking during training events; and
- Heavy Haul Road: asphalt paved road to be used for delivery of large/heavy equipment.

Each of the workspaces is authorized for use as construction storage, laydown, parking, or access in association with the Liquefaction and Phase II Modification Projects. Compacted fill material has been distributed across the whole of each of these areas, which would be maintained throughout construction of the Project.

Offsite workspace Area B is owned by FLNG Liquefaction 3, LLC. Area B is currently open pastureland. Following the completion of construction activities, Area B would be restored.

Figure A 9-1
Freeport LNG - Train 4 Project
Offsite Workspace and Access - Aerial
Brazoria County, Texas

| REVISED: 10/25/2017 | SCALE: 1:42,000 DRAWN BY: 0239

10. Consultation, Approvals, and Permits

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.[7] 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."

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.

Table 7 identifies all the federal, state and local permits, authorizations, or consultations for the Project.

[7] 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).

TABLE 7

Permits, Approvals, and Consultations for the Project

Agency	Permit/Approval – Regulatory Scope	Authorization/ Interaction Required	Status
FEDERAL			
U.S. Department of Energy, Office of Fossil Energy	NGA Section 3 Export Authorization	Long-Term Free Trade Agreement (FTA) Countries Export Authorizations Long-Term Non-FTA Countries Export Authorization	Existing authorizations to export 2.8 Bcf/d of LNG to FTA Nations (FTA) Countries (Order Nos. 2913, 3066, 2913-A, 3066-A, & 3282-A) Existing authorizations to export 2.14 Bcf/d of LNG to non-FTA countries (Order Nos. 3282, 3282-A, 3282-B 3282-C, 3357, 3357-A, 3357-B, 3957) Application to Export LNG to non-FTA nations Filed: March 6, 2018 (DOE/FE Docket No. 18-26-LNG) Anticipated Authorization: Pending
Federal Energy Regulatory Commission	NGA Section 3 Authorization	Authorization	Formal Application Filing: June 29, 2017 Anticipated Authorization: Pending
U.S. Army Corps of Engineers (COE) Galveston District Regulatory Branch	Section 404 – Clean Water Act and Section 10 – Rivers and Harbors Act	Permit	Anticipated Authorization: January 2019 Submitted Application for Modification of Existing Section 404/10 Individual Permit on January 2, 2018 Anticipated Approval of Modified Individual Permit: January 2019
COE Galveston District Operations Division	Section 14 – Rivers and Harbors Act (Section 408) for federal levee crossing	Permit	Section 408 Permit Application filed by Velasco Drainage District on behalf of Freeport LNG on January 24, 2018. Anticipated Permit: January 2019
COE Galveston District Real Estate Division	Real Estate Permit for use of federal lands and Section 14 – Rivers and Harbors Act (Section 408) for federal navigation channel crossings	Permit	Submitted Real Estate application, including Section 14 (408) clearance for federal navigation channels on January 2, 2018 Anticipated Authorization: January 2019

TABLE 7

Permits, Approvals, and Consultations for the Project

Agency	Permit/Approval – Regulatory Scope	Authorization/ Interaction Required	Status
U.S. Fish and Wildlife Service	Section 7 – Endangered Species Act Migratory Bird Treaty Act	Consultation	Pre-filing Participation Request Letter sent: May 11, 2015 Concurrence received October 26, 2015 Project update letter sent: August 22, 2016 Project update email sent: December 15, 2016 Migratory Bird Conservation and Compliance Plan sent: February 14, 2017
National Marine Fisheries Service	Magnuson-Stevens Fishery Conservation and Management Act	Consultation	Pre-filing Participation Request Letter sent: August 22, 2016 Project update email sent: December 15, 2016
U.S. Environmental Protection Agency – Region VI	Section 402 – Clean Water Act – NPDES	Storm Water Construction Permit Process Waste Water Discharge Permit	Anticipated submittal for NPDES Stormwater Construction Permit: January 2019 Anticipated Authorization: February 2019 Anticipated Process Water Discharge Permit Filing: September 2020 Anticipated Authorization: April 2021

TABLE 7 **Permits, Approvals, and Consultations for the Project**			
Agency	**Permit/Approval – Regulatory Scope**	**Authorization/ Interaction Required**	**Status**
		STATE	
Railroad Commission of Texas	Section 401 – Clean Water Act – Water Quality Certification	Certification	Section 401 Water Quality Certification and Coastal Management Plan Consistency Determination will be concurrent with COE Application submittal / review.
	Coastal Management Plan Consistency Determination	Review	Anticipated filing: September 2019 Anticipated Authorization: December 2019
	Hydrostatic Discharge Permit	Permit	Anticipated filing: December 2019 Anticipated Authorization: January 2019
	Organization Report and Operator Number (P-5)	Registration	Anticipated filing: January 2019 Anticipated Authorization: February 2019
	Permit to Operate a Pipeline (T-4)	Permit	Anticipated filing: February 2019 Anticipated Authorization: March 2019
	New Construction Report (PS-48)	Permit	Anticipated filing: January 2019 Anticipated Authorization: February 2019
	Texas Intrastate Pipeline Questionnaire (PS-8000A)	Questionnaire	
Texas Commission for Environmental Quality (TCEQ) – Air Permits Division	30 TAC Chapter 116 Permit to Construct	New Source Review Preconstruction Air Permit	Application for Amendment of TCEQ Air Quality Permit No. 100114 for updates to Trains 1 through 3 and addition of Train 4: January 31, 2017 Permit Amendment for updates to Trains 1 through 3 and addition of Train 4 issued: February 6, 2018 Application for Amendment of TCEQ Air Quality Permit No. 104840/N170 for updates to Units 1 through 3 and addition of Unit 4: January 31, 2017 Receipt of Permit Amendments for updates to Units 1 through 3 and addition of Unit 4: April 25, 2018

TABLE 7

Permits, Approvals, and Consultations for the Project

Agency	Permit/Approval – Regulatory Scope	Authorization/ Interaction Required	Status
Texas Commission or Environmental Quality (TCEQ) – Air Permits Division	30 TAC Chapter 122 Operating Permit	Title V Site Operating Permit	Submittal of Operating Permit Revision Application (Permit No. O2878) for Trains 1 through 3 and Train 4: March 30, 2017 Receipt of Operating Permit for Trains 1 through 3 and Train 4: August 31, 2017 Submittal of Initial Operating Permit Application for Freeport LNG Pretreatment Facility: February 28, 2017. Receipt of Operating Permit for Pretreatment Facility Units 1 through 3: February 15, 2018. Anticipated submittal of Operating Permit Application for Unit 4: January 2021 Anticipated receipt of Operating Permit for Unit 4: July 2021
Texas Commission for Environmental Quality – Water Permits Division	Temporary Water Use / Appropriation Permit	Permit	Anticipated Filing Date: February 2019 Anticipated Authorization Date: March 2019
Texas Historic Commission – State Historic Preservation Officer	Section 106 of the National Historic Preservation Act	Consultation	Cultural Resources Survey Report and request for clearance: • Submitted for Pipeline Corridor: August 26, 2016 • Clearance received for Pipeline Corridor: September 14, 2016 • Submitted for Area B: February 13, 2017 • Clearance received for Area B: February 17, 2017 • Submitted for revised Pipeline Corridor: February 17, 2017 • Clearance received for revised Pipeline Corridor: March 14, 2017 • Clearance received for Indirect/Visual Area of Potential Effects: November 11, 2017 Letter summarizing information relevant to area of potential effect (APE) analysis, sent on October 25, 2017.
Texas Parks and Wildlife Department	State-Listed Species	Coordination	Migratory Bird Conservation and Compliance Plan sent: February 14, 2017
		LOCAL	

TABLE 7 **Permits, Approvals, and Consultations for the Project**			
Agency	**Permit/Approval – Regulatory Scope**	**Authorization/ Interaction Required**	**Status**
Brazoria County	Building Permits	Permit	Anticipated submittal for Building Permit: January 2019 Anticipated receipt of Building Permit: February 2019
	Permit for Construction in a Zone "VE" or Variance as: functionally dependent use"	Permit or Variance	Anticipated submittal for Floodplain Construction Permit: January 2019 Anticipated receipt of Floodplain Construction Permit: February 2019
Port Freeport	Section 408 Clearance Freeport Harbor Channel crossing from COE (Port Freeport is non- federal sponsor)	Permit	Submitted Real Estate Outgrant application including Section 14 (408) clearance, for federal navigation channels on January 2, 2018 Anticipated Authorization: January 2019
Velasco Drainage District	Levee/Ditch Crossing Permit Section 408 Clearance for CR 690 (Velasco Levee) crossing from COE through Velasco Drainage District (non- federal sponsor) as a precursor to Levee/Ditch Crossing Permit	Permit	Final levee crossing design documentation presented to and approved by Velasco Drainage District Board on January 23, 2018. Section 408 Permit Application filed by Velasco Drainage District on behalf of Freeport LNG on January 24, 2018 Anticipated Authorization: August 2019

B. ENVIRONMENTAL ANALYSIS

The Project is located in Brazoria County, Texas, along the Gulf Coast. The Project's liquefaction train (Train is 4) would be within the existing Terminal on Quintana Island in the Town of Quintana, and the Project's pretreatment unit (Unit 4) would be within the authorized Pretreatment Facility, located about 3.5 miles northeast of the City of Freeport.

The Town of Quintana is on the west side of the mouth of the Brazos River and on FM 1495 and CR 723, directly across the Brazos River Harbor channel from the Village of Surfside Beach. Quintana was histrically 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 44 persons (U.S. Census Bureau, 2015a). 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, 42-inch-diameter gas pipeline to the Stratton Ridge Meter Station.

The City of Freeport is about 16 miles south of Angleton in southern Brazoria County. The city was founded by the Freeport Sulphur Company in 1912 and was the site of one 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 of Mexico's largest commercial shrimp trawler fleets and has over 600 businesses and about 12,118 inhabitants (U.S. Census Bureau, 2015a).

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. High humidity prevails throughout the year. The average annual precipitation is about 51 inches, varying from 2.8 inches per month in February, March, and April, to 7.8 inches per month in September. 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. 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.

1. Geology

1.1. Geology, Foundation Conditions and Natural Hazards

The Project is 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 Project 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 Pretreatment Facility and Pipeline Corridor 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 Corridor. The predominant structural feature under the northern portion of the pipeline route is the Stratton Ridge Salt Dome.

1.1.1. Mineral Resources

Underground mineral resources in proximity to the Project 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 about 1,250 to 10,560 feet bgs. It is about 2.8 miles northwest of the Pretreatment Facility. The margins of the salt dome, including a small oil and gas field (the Stratton Ridge Oil Field), have been explored for oil and gas development. Another salt dome, the Bryan Mound, is located about 3.1 miles southwest of the Terminal and serves as a storage site of the U.S. Strategic Petroleum Reserve. A commercial sand extraction operation existed at the Pretreatment Facility site up to 2005. This operation has since been closed and the associated equipment and structures removed. The Pretreatment Facility overlies the eastern section of a former abandoned borrow pit that was filled with about 20 feet of imported material as part of the Phase II Modification Project. There are no identified active surface mining operations within one mile of the Project.

The RRC Public GIS Map Viewer shows several oil and gas wells within 0.1 mile of the Pipeline Corridor; 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 Corridor, including the storage well associated with this Project – the Stratton Ridge underground storage site.

Existing mineral resources in the area are found at depths significantly greater than the depth of disturbance associated with facility and pipeline construction. The salt dome is about 1,250 feet 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.

1.1.2. Foundation Conditions

Freeport LNG has performed a geotechnical investigation of the Project's liquefaction train site within the existing Terminal, which consisted of a review of prior geotechnical investigations in the area and six new borings to depths up to 202 feet bgs. Soil profiles recorded during boring advancement indicate that the site is underlain by very stiff clay fill from about 0 to 5 feet, soft clay fill from 5 to 18 feet, soft clay from 18 to 30 feet, stiff clay from 30 to 62 feet, very stiff clay from 62 to 96 feet, dense sand from 96 to 110 feet, stiff clay from 110 to 142 feet, very stiff clay from 142 to 162 feet, stiff clay from 162 to 202 feet, and very dense sand below 202 feet.

Similarly, geotechnical investigation of the Pretreatment Facility site consisted of a review of prior geotechnical investigations in the area and five new borings to depths up to 128 feet bgs. Soil profiles recorded during boring advancement indicate that the Pretreatment Plan site is underlain by firm clay from about 0 to 8 feet, soft to firm clay from 8-20 feet, loose to medium dense sand from 20 to 30 feet, stiff clay from 30 to 110 feet, very dense sand from 110 to 128 feet; and very dense or stiff soils below 128 feet, bgs.

Surficial soils have been graded, graveled, and/or amended with concrete to support heavy construction equipment during the construction of the Liquefaction Project. Subsurface soils do not have sufficient bearing capacity to support the Project's components on shallow foundations. Freeport LNG plans to construct Train 4 and Unit 4 on deep foundations (cast-in-place piles, section A.8.2.5).

1.2. Natural and Geological Hazards for the Underground Facilities

Geologic and other natural hazards that could potentially affect the proposed Underground Facilities consist of earthquake ground motions, growth faults, soil liquefaction, and subsidence.

1.2.1. Seismic Environment and Risk

The Gulf Coastal Plain geomorphic province is characterized by a low seismic-hazard potential. Freeport LNG conducted a site-specific hazard evaluation (Probabilistic Seismic Hazard Analysis) of the Terminal and the Pretreatment Facility sites. The site-specific evaluation determined that the maximum peak ground accelerations within the soil profile, including site effects, are 0.02 g (where g is the acceleration due to gravity) with a 10 percent probability of exceedance in 50 years and 0.06 g with a 2 percent probability in 50 years. Significant earthquakes in the region are rare. 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. This database shows that there have been 32 seismic events recorded within 200 miles of Quintana Island that ranged from a magnitude of 2.1 to 4.8, with a mean average of 3.2. The nearest seismic events were a magnitude 3.1 event that was recorded in February 2015 about 105 miles northwest of the Train 4 site and a magnitude 4.8 event that occurred in 2011, about 165 miles west of Quintana Island. In accordance with 49 CFR 192.103, the Pipeline Facilities would be designed with sufficient wall thickness, or piping would be installed with adequate protection, to withstand the anticipated external pressures and loads, including seismic loads that would be imposed on the pipe after installation.

1.2.2. Ground Faults

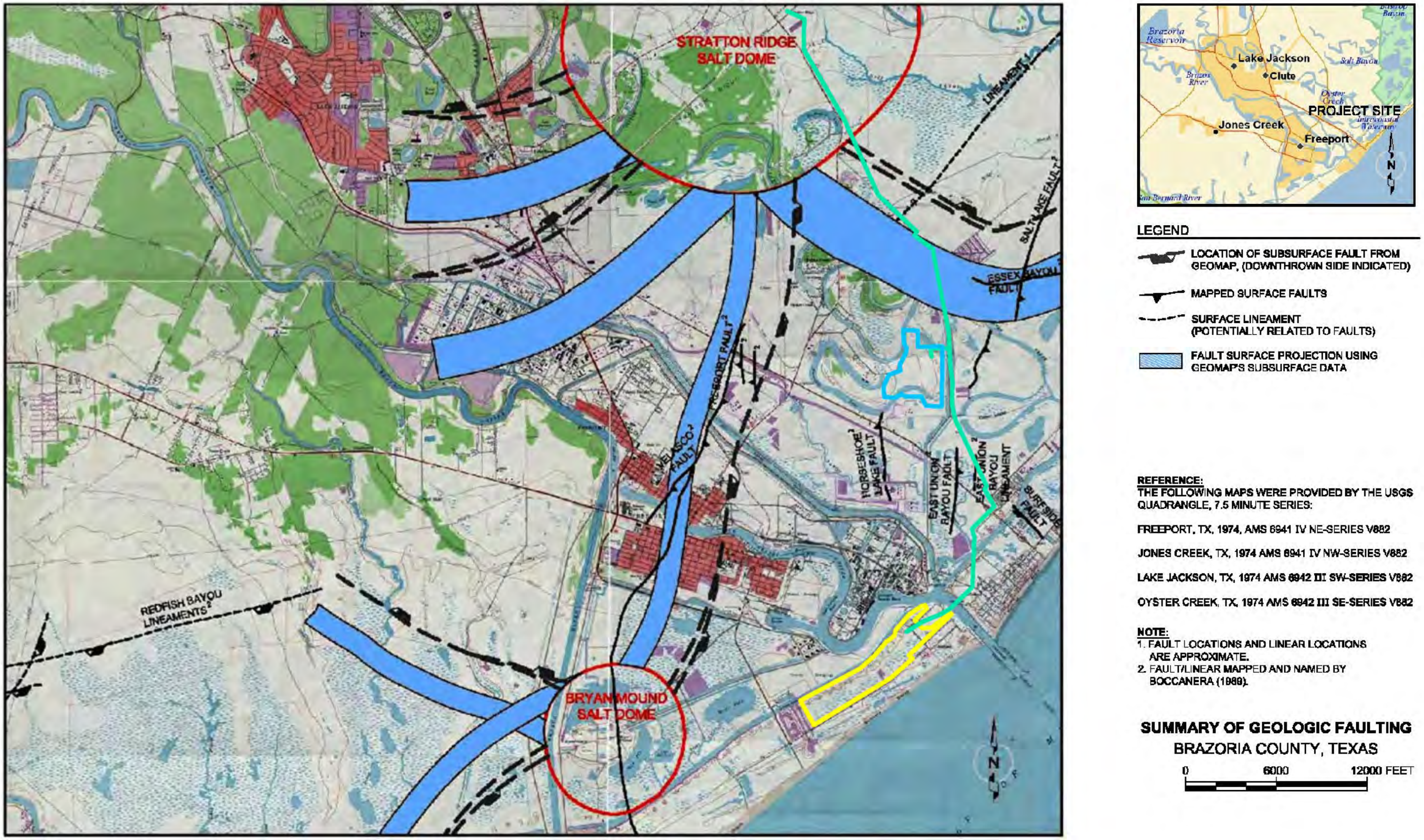
In the Gulf Coastal Plains, several hundred faults are known or suspected to be active. These faults are ancient, natural features, but in recent times, most modern fault activity in southern and eastern Texas appears to have been induced by anthropogenic actions and nearly all appreciable and accelerated fault movements in the past 70 years have occurred in areas where withdrawals of oil, natural gas, and groundwater have caused increased ground subsidence. Evidence of modern fault activity includes changes in ground surface elevations, sharp linear features on aerial photography, offsets in pavements, and damage to buildings and other structures.

There are several faults near the Project, including normal, listric, growth faults that generally dip toward the Gulf of Mexico along the Texas coast and faults around salt domes associated with diapirism (figure B 1-1). Slip rates along the normal growth faults in the Project area are anticipated to be less than 0.2 millimeter 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 prior to the Phase II Modification Project and this study was updated in January 2017 for the Train 4 Project.

The alignment for the Pipeline Corridor appears to cross several identified faults, including the East Union Bayou Fault, an extension of the Salt Lake Fault, Essex Bayou Fault, and fault surface projections due to the Stratton Ridge Dome. As noted above, the natural movements of these faults tend to be small and the movement rate is extremely slow.

Based on the design measures taken, potential effects on the Underground Facilities by faulting are not expected to be significant.



This information is for environmental review purposes only.

Figure B 1-1
Freeport LNG - Train 4 Project
Summary of Geologic Faulting in Southern Brazoria County

| REVISED: 01/18/2017

DRAWN BY: 0239

1.2.3. Soil Liquefaction

Soil liquefaction is the transformation of loosely packed cohesionless soil from a solid to a liquid state as a result of increased pore pressure and reduced effective stress due to intense and prolonged vibrations, such as ground shaking from seismic events. Although the low risk, as well as low magnitude, of seismic activity in this area minimizes the potential hazard to the Train 4 Project from soil liquefaction, there are cohesionless sediments underlying the Project area that are potentially liquefiable. Based on the results of the soil liquefaction analyses, it is unlikely that soil liquefaction would occur along the alignment for the Pipeline Corridor.

1.2.4. 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 about 1.5 feet and up to 2 feet in northern portions of the county, near Houston (Sandeen and Wesselman, 1973). 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 Chicot aquifer. Subsidence in the area of the Train 4 Project is estimated at up to one foot when projected through 2050 according to the Brazoria County Groundwater Conservation District (BCGCD). The subsidence would not affect the Underground Facilities.

1.3. Paleontology

There is some history of vertebrate fossil identification in Pleistocene sediments in south Texas, though no significant fossil discoveries are known to have been made near the Project. The highest potential for the Project to encounter such fossil remains would exist along the northernmost extent of the pipeline route, where the Beaumont Formation underlies the Project.

Although encounters with significant paleontological resources are not anticipated for the Project, Freeport LNG plans to manage such resources, if identified, in accordance with their Unanticipated Discoveries Plan for the Project.

1.4. Conclusion

In conclusion, the Underground Facilities are in an area that presents several potential challenges, relative to geology; however, these conditions can be effectively managed through proper engineering design or have been shown to be minimal through evaluation. We conclude that geological effects would not be significant.

1.5. Geologic Hazards and Mitigation Measures for the LNG Facility and Pretreatment Facility

Natural hazards including seismicity, faulting, soil liquefaction, flooding, storm surge, tsunami, seiche, settlement, scour, and erosion for the LNG Facility and Pretreatment Facility are discussed in detail in section B.10.1 of this EA.

2. Soil Resources

2.1. Existing Conditions

The areas that would be temporarily or permanently affected by the Train 4 facilities at the Terminal site and the Unit 4 facilities at the Pretreatment Facility site are currently serving as temporary construction workspace for the Liquefaction Project. Offsite workspace Areas A, C, D, E, F, G, and H are currently serving as offsite temporary construction workspace for the Liquefaction Project. The existing offsite heavy-haul road that currently provides access to the Pretreatment Facility site would continue to serve in the same role for the Train 4 Project, and the existing Stratton Ridge Meter Station would serve as the point of connection for the Project Pipeline. Soils in all of these previous developed areas have been graded, graveled, and/or amended (e.g., mixed with Portland cement) or otherwise stabilized. As a result, the soils have been altered from their original state and are significantly different from the natural soils present on the respective sites prior to development..

Natural soil conditions are present along most the Pipeline Corridor and at offsite workspace Area B.

Eleven soil types are represented in construction work space of the proposed Pipeline Corridor. One soil type, surfside clay, is present at offsite workspace Area B. Table 8 presents the acreage of each soil characteristic by Project facility.

TABLE 8

Characteristics of Affected Soils

Project Facility	Total Acres	Prime Farmland b/	Compaction Prone c/	Highly Erodible Wind e/	/
Quintana Island Terminal					
Train 4 Facilities i/	96.3	0.0	0.0	0.0	
Pretreatment Facility					
Unit 4 Facilities i/	136.5	0.0	0.0	0.0	
Pipeline Corridor					
Underground Facilities j/	129.8	16.0	84.4	4.2	
Terminal i/	0.2	0.0	0.0	0.0	
Pretreatment Facility i/	0.7	0.0	0.0	0.0	
Stratton Ridge Meter Station i/	9.2	0.0	0.0	0.0	
Access Roads	2.3	0.2	0.0	0.0	
Subtotal – Pipeline Corridor	**142.0**	**16.2**	**86.5**	**4.2**	
Offsite Workspace and Access					
Area A i/	84.0	0.0	0.0	0.0	
Area B	27.7	0.0	27.7	0.0	
Area C i/	17.0	0.0	0.0	0.0	
Area D i/	5.2	0.0	0.0	0.0	
Area E i/	5.2	0.0	0.0	0.0	
Area F i/	4.8	0.0	0.0	0.0	
Area G i/	24.6	0.0	0.0	0.0	
Area H i/	2.7	0.0	0.0	0.0	
Heavy Haul Road i/	9.9	0.0	0.0	0.0	
Subtotal – Offsite Workspace and Access	181.1	0.0	27.7	0.0	
Total	**556.0**	**16.2**	**114.2**	**4.2**	

a The numbers in this table have been rounded for presentation purposes; the totals may not reflect the sum of the addends.
b As designated by the Natural Resources Conservation Service. Prime farmland includes those soils that are considered prime if a limiting factor is mitigated
c Soils in somewhat poor to very poor drainage classes with surface textures of sandy clay loam and finer.
d Soils in land capability subclasses IVe through VIIIe and soils with an average slope greater than 8 percent.
e Soils with a wind erodibility group classification of 1 or 2.
f Soils with a surface texture of sandy loam or coarser that are moderately well to excessively drained, and soils with an average slope greater than 8 percent.
g Soils that have a cobbley, stony, bouldery, channery, flaggy, very gravelly, or extremely gravelly modifier to the textural class and/or contain greater than 5 % rocks larger than 3 inches.
h Soils identified as containing bedrock within 60 inches of the soil surface.
i Soils within the Terminal; Pretreatment Facility; Stratton Ridge Meter Station, Heavy Haul Road; and offsite workspaces Areas A, C, D, E, F, G, and H have been graded, graveled, and/or amended with concrete. Urban land is highly variable and likely has been altered sufficiently to no longer be considered prime farmland or hydric soil and likely has been compacted.
j The area affected includes the permanent pipeline easement, temporary workspace, and additional temporary workspace.

2.2. Impacts

The soils within the Terminal, the Pretreatment Facility site, and at offsite workspace Areas A, C, E, F, G, and H and the existing offsite haul road have been extensively modified as part of the Liquefaction Project. No natural soils are present and no effects on soils would occur.

Additional soil improvements would be required to the underlying soils and the fill material in the Train 4 area to provide a stable surface for the Train 4 process equipment and temporary crane pads. Soil improvements would be similar to those authorized for the Liquefaction Project (e.g., addition of hydrated lime, Portland cement, fly ash). About 8,550 cubic yards of general fill material sourced from Brazoria County would be brought to the site to raise the elevation of the Train 4 process areas, excluding plant roads, for stormwater management purposes, and to allow for gravity flow of piping. An additional 74,750 cubic yards of engineered fill sourced from offsite suppliers would be required to provide a stable base for the facility's roads. Because soil is needed to raise the grade at the site, soil currently on site may be moved within the site but Freeport LNG does not anticipate needing to remove any significant amount of soil. If offsite disposal, reuse, or recycling is required, all soils would be tested in accordance with the requirements of the receiving facility as well as all appropriate federal and state laws.

Fill material previously placed within the Unit 4 area would be left in place and covered with new fill, except in the location of the new detention pond, to establish the desired finished grade for the Unit 4 process areas. About 42,000 cubic yards of fill material would be required to raise process areas of the site to a uniform elevation of 6 feet 4 inches amsl. Once foundations are formed, an additional 54,000 cubic yards of fill would be placed in the process area, creating a uniform elevation of 8.0 feet amsl. Fill material would be sourced on site. No offsite fill material would be required, and no offsite disposal of excess soil, waste, or spoils is anticipated.

To minimize or avoid effects on adjacent soils during and after construction, Freeport LNG would follow the Project-specific Plan, Procedures, and ESCP and the SWPPP for the Liquefaction Project, and would perform all work in accordance with applicable permit requirements. These plans include measures such as minimizing the amount and length of soil exposure, slowing and/or diverting runoff, and installing and maintaining erosion and sedimentation control measures. Effects on soils would not be significant.

Temporary effects on soils would occur in additional temporary workspace (ATWS) and access roads and along those pipeline segments installed by open-cut or push-pull methods. Effects on soils in these areas would be temporary and all areas would be restored to preconstruction conditions. In pipeline segments crossed by Direct Pipe, HDD, and conventional-bore methods, the pipeline would be installed beneath the surface soils and the surface soils would not be affected.

In addition, modification of aboveground facilities at the Terminal, Pretreatment Facility, and Stratton Ridge Meter Station would temporarily affect soils; however, these soils have been modified, and no permanent effects would occur.

Offsite workspace Area B, which consists entirely of the soil type Surfside Clay would be temporarily affected during construction. Temporary erosion controls (e.g., silt fences, check dams, fiber rolls, and sediment traps) would be installed prior to ground disturbance. Following the installation of temporary erosion controls, site preparation activities would involve cutting and filling to rough grade and soil stabilization and improvement (e.g., placement of a gravel layer). At the completion of construction, the gravel layer would be removed and underlying soils would be regraded, seeded, and returned to preconstruction condition (e.g., primarily pastureland).

A majority of the soil types mapped for the Pipeline route are at least moderately erosive, with Narta fine sandy soils that exist along the final mile of the route leading into the meter station having a high erosive potential. The Surfside Clay present at the Area B site has a moderate erosive potential. To minimize erosion during construction and immediately thereafter, Freeport LNG would follow the Project-specific Plan and Procedures. All of the soils that would be disturbed by Pipeline construction activities and the soils at offsite workspace Area B have the potential to experience some level of soil compaction. Freeport LNG proposes to follow the Project-specific Plan and Procedures during construction work to minimize the potential compaction and rutting impacts. Mitigation measures for soil compaction would include testing subsoil and topsoil at regular intervals and plowing severely compacted agricultural areas with a paraplow or other deep tillage implement. Mitigation for rutting would include use of low-ground-weight construction equipment or operating equipment on timber riprap, prefabricated equipment mats, or terra mats.

Although prime farmland soil types (Asa, Norwood, and Pledger) would be temporarily affected by construction, none of the prime farmland is in active agricultural use. Freeport LNG proposes to minimize impacts on prime farmland by following the Project-specific Plan and Procedures, including restoration of agricultural drainage systems, topsoil segregation, and decompaction.

Investigations did not identify contaminated soils at the site (Texas Commission on Environmental Quality, 2016; U.S. Environmental Protection Agency, 2016), however contaminated groundwater was identified at the Freeport Oil Company site (see section 3.1.1). It is possible that previously undocumented sites with contaminated soils or groundwater could be discovered during construction of the Project. Freeport LNG would follow the Liquefaction Project's SPCC Plans in the event that signs of contaminated soil and/or groundwater are encountered during construction. Overall impacts on soils along the Pipeline route would not be significant, would be limited to areas necessary for construction, and would be minimized through the use of Freeport LNG's Project-specific Plan, Procedures, and ESCP and the SWPPP for the Liquefaction Project.

2.2.1. Summary of Impacts on Soils

Construction activities have the potential to affect soil characteristics adversely through temporary land clearing and use of heavy equipment, as well as actual facility installation. Potential soil impacts include increased water and/or wind erosion, soil compaction by heavy construction equipment, revegetation inhibition, and hydric-soil disruption. Consequently, the restoration potential of temporarily disturbed areas can be compromised.

Soils within the Terminal; Pretreatment Facility; Stratton Ridge Meter Station, Heavy Haul Road; and offsite workspaces Areas A, C, D, E, F, G, and H have been graded, graveled, and/or amended with concrete.

Soils along the pipeline, the temporary pipeline workspaces, and offsite workspace Area B would be affected by the Project. The Pipeline construction right-of-way would be restored following construction following the Project-specific Plan and Procedures. The gravel layer at Area B would be removed and underlying soils would be regraded, seeded, and returned to preconstruction condition (e.g., primarily pastureland). We conclude that no significant effects on soils would occur.

3. Water Resources

3.1. Groundwater Resources

3.1.1. Existing Conditions

The coastal lowlands aquifer system in southeastern Texas – often referred to as the "Gulf Coast Aquifer" – is the principal source of groundwater in the Train 4 Project area. It is used for public water supply, agricultural, and industrial needs.

The coastal lowlands aquifer system is comprised of the Chicot and Evangeline Aquifers. The Chicot Aquifer is the uppermost aquifer from which all public and private water supply wells in the Train 4 Project area are supplied [Texas Commission or Environmental Quality (TCEQ), 2017a]. The Evangeline Aquifer underlies the Chicot Aquifer and has not been developed as a water source due to high levels of total dissolved solids (TDS).

Near the Terminal, the Chicot Aquifer extends from ground surface to at least 1,200 feet bgs (TWDB 2017). In the Stratton Ridge area, the top of the Chicot Aquifer is at about 10 feet bgs and extends to about 1,100 feet bgs.

The USEPA has not designated any sole-source aquifers within the Train 4 Project area. In addition, no specially designated aquifer withdrawal areas, wellhead protection areas, or springs occur within 150 feet of the construction workspace for the Train 4 Project.

The town of Quintana's drinking water has experienced a total of 21 health-based water-quality violations since 2012. These violations included 17 exceedances associated with water supply disinfection byproducts (total trihalomethanes and total haloacetic acids), three for arsenic (likely naturally occurring), and one for total coliform (USEPA, 2018). While these violations occurred during a timeframe that the Terminal was in operation, none of them appear to be related to Terminal operations.

Quintana Island Terminal

Previous studies at the 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 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.

Three existing active wells, owned by Freeport LNG, are present within the Terminal, and are drilled to depths between approximately 200 and 245 feet bgs. These wells produce, at a maximum, between 30 and 300 gallons per minute (gpm).

A municipal water well (State Well Number 8106528) is located about 100 feet south of temporary workspace associated with Train 4, on the south side of the existing levee at the Terminal. Since the issuance of the Final EIS for the Liquefaction Project and Phase II Modification Project (FERC, 2014), the depth of this well has been increased from 265 feet to 500 feet.

Pretreatment Facility

Three water supply wells are present within the Pretreatment Facility. One well is known to be shallow and is not currently in use. A second well is about 223 feet deep, produces 250 gpm, and currently supplies water to the Pretreatment Facility. A third well was completed in March 2018 but has not yet been placed into service. This well is about 210 feet deep, is capable of producing up to 300 gpm, and when placed into service will also serve as a water supply for the Pretreatment Facility.

Pipeline Corridor

An abandoned public water supply well and two operating domestic water supply wells are within 150 feet of the Pipeline Corridor. A domestic water supply well (Well Report Number 215952) is near MP 7.4, about 120 feet southwest of the temporary access road. This well is drilled to a depth of about 225 feet and provides water for Oyster Creek Estates. A domestic water supply well (Well Report Number 333113) is near MP 8.2, about 25 feet west of additional temporary workspace. This well is drilled to a depth of about 215 feet and provides water to a local domestic user.

3.1.2. Impacts and Mitigation

The high groundwater table would require dewatering during construction and could present challenges with excavation stability, especially because of the structurally soft and weak sediments, and shallow ground faulting and subsidence associated with the sedimentary environment. However, no construction issues were encountered during the development of the Phase I Project, Phase II Modification Project, or Liquefaction Project associated with these conditions. The Train 4 Project would be constructed using similar foundation design, construction procedures, and mitigation measures. The majority of the construction activities associated with the Project would involve shallow, temporary, and localized excavation, with the exception of the installation of concrete piles needed to provide a firm base for the pads and the heavy equipment components of Train 4 at the Terminal.

The Upper Chicot aquifer could experience insignificant, indirect impacts from changes in overland water flow and recharge caused by the clearing, grading, and permanent conversion of the work areas to industrial use. The Upper Chicot aquifer could also experience, temporary, insignificant, indirect drawdown-related impacts associated with potential construction and operations phase groundwater withdrawals at the Terminal Facility and the Pretreatment Facility.

The greatest potential for groundwater impacts during construction of the Project would be through the accidental release of hazardous substances, such as lubricants or fuel. Freeport LNG would follow the Liquefaction Project's SPCC Plans, as revised to include the Train 4 Project, to minimize the potential of an accidental spill and mitigate the effects of a spill, were it to occur. The SPCC Plans address personnel training, secondary containment design, hazardous substance storage and disposal procedures, refueling areas, spill response procedures, mitigation measures, and other best management practices designed to reduce or eliminate potential adverse impacts on groundwater resources.

Quintana Island Terminal

The deep-seated piles for foundations could function as conduits for cross-zone groundwater migration; however, previous groundwater testing at the site does not indicate significant contamination (section B.3.1.1) and because the piles for Train 4 would be installed to a maximum depth of about 90 feet below mean sea level and lie completely within the 300-foot depth of the Upper Chicot aquifer, no cross-zone conduits would be created.

Only water to maintain potable and service-water tank capacity and for the initial and periodic routine testing of the firewater system would be required for the Train 4 Project. An additional 650 gallons per day (0.5 gpm) of potable water would be required during operation of the Project; however, this volume would have a negligible effect on groundwater demand.

Pretreatment Facility

There is no known contamination at the site and the 90-foot foundation piles would lie completely within the 300-foot depth of the Upper Chicot aquifer; no cross-zone conduits would be created.

Freeport LNG would require approximately 12,000 gallons per day of additional water for operations. This water would be obtained from Freeport LNG's existing onsite well, which has sufficient capacity to meet the Project's needs. If the existing water well is taken out of service for maintenance activities, sufficient capacity to provide water to Unit 4 would be available via the City of Freeport's municipal water line. The municipal water line is currently under construction for the Liquefaction Project and has a designed flow rate capacity that would meet the needs of both the Liquefaction Project and Train 4 Project, if necessary, and may provide resilience if climate change affects the availability of groundwater from the onsite well. Use of the onsite wells and contingency planning for use of the municipal water line provides water reliability.

Pipeline Corridor

In areas of shallow groundwater along the Pipeline Corridor, it may be necessary to dewater pipeline trenches, resulting in a temporary, localized lowering of groundwater elevation. 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.

To minimize potential impacts on the Upper Chicot aquifer, land disturbing activities would follow the Project-specific Plan, Procedures, and ESCP. Additionally, the Project would be incorporated into the Liquefaction Project's existing National Pollutant Discharge Elimination System (NPDES) permit.

Water for hydrostatic testing of the Pipeline and aboveground facilities (i.e., pigging facilities, valves, and bypass piping) associated with the pipeline within the Terminal, Pretreatment Facility, and Stratton Ridge Meter Station would be obtained from the existing wells at these locations, from an authorized municipal water line from the City of Freeport, and/or trucked in from the City of Freeport (table 9). Should an existing well or wells be used at a given location, withdrawals would be made at a rate consistent with current well withdrawal rates and low enough to avoid short- and long-term groundwater depletion and would result in temporary, insignificant, and indirect impact on the local aquifer.

Freeport LNG would coordinate with the owners of domestic water wells within 150 feet of the construction workspace to ensure wells are protected during construction and operation of the Project. If damage to a groundwater well occurs, temporary water sources would be provided and Freeport LNG would engage a certified well drilling contractor familiar with the wells in southern Brazoria County to evaluate the cause(s) of the damage, recommend remedial measures, and implement such measures as necessary. Remedial measures may range from simple flushing of well screens to installation of a new well. To ensure that domestic water wells are returned to pre-construction conditions, **we recommend that:**

<u>Before construction,</u> Freeport LNG should file with the Secretary the location by milepost of all private wells within 150 feet of pipeline construction activities. Freeport LNG should conduct, with the well owner's permission, pre- and post-construction monitoring of well yield and water quality for these wells. <u>Within 30 days of placing the facilities in service,</u> Freeport LNG should file a report with the Secretary discussing whether any complaints were received concerning well yield or water quality and how each was resolved.

Based on the construction methods, our recommendation, and mitigation measures that Freeport LNG has identified, we conclude that Train 4 Project would not have a significant effect on groundwater.

TABLE 9 **Water Requirements for Hydrostatic Testing**					
Facility	**Source**	**Uptake Rate (gpm)**	**Volume (thousand gallons)**	**Discharge Location**	**Approximate Discharge Rate (gpm)**
Pipeline					
Mainline	Existing wells, authorized municipal water line, and/ or trucked in from the City of Freeport	150	4,030	Pretreatment Facility	1,000
Direct Pipe – FHC	Trucked in from the City of Freeport	NA	366	Vegetated Upland	1,000
HDD – ICW	Trucked in from the City of Freeport	NA	161	Vegetated Upland	1,000
HDD – Wetland Complex	Trucked in from the City of Freeport	NA	454	Vegetated Upland	1,000
Direct Pipe – East Levee Road	Trucked in from the City of Freeport	NA	141	Pretreatment Facility	1,000
Direct Pipe – East Levee Road	Trucked in from the City of Freeport	NA	141	Pretreatment Facility	1,000
Direct Pipe – Oyster Creek	Trucked in from the City of Freeport	NA	153	Vegetated Upland	1,000
Quintana Island Terminal					
Aboveground facilities associated with the Pipeline	Existing wells, authorized municipal water line, and/or trucked in from the City of Freeport	NA	8	Quintana Island Terminal	100
Pretreatment Facility					
Aboveground facilities associated with the Pipeline	Existing wells, authorized municipal water line, and/or trucked in from the City of Freeport	NA	22	Pretreatment Facility	100
Stratton Ridge Meter Station					
Aboveground facilities associated with the Pipeline	Existing wells, authorized municipal water line, and/or trucked in from the City of Freeport	NA	8	Stratton Ridge Meter Station	100

3.2. Surface Water Resources

3.2.1. Existing Conditions

The Train 4 Project would be within the Austin-Oyster Creek watershed (USGS 8-digit Hydrologic Unit Code [HUC] 12040205). The major waterbodies within the Austin-Oyster Creek watershed near the Terminal site include the ICW, the Old Brazos River Channel, and the FHC (the final segment of the Old Brazos River Channel that extends from the ICW out into the Gulf of Mexico). Major waterbodies along the Pipeline Corridor and near the Pretreatment Facility site include the FHC, the ICW, East Union Bayou, Oyster Creek, and Salt Bayou. The Eastern Velasco

Ditch and Western Velasco Ditch are two additional surface water features along the Pipeline corridor that parallel the Velasco Levee (Levee Road - CR 690).

All major waterways within the Train 4 Project area are considered tidally influenced because of their proximity to the Gulf of Mexico. 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 Train 4 Project area. The Project area is not within source water protection areas, and there are no public water intakes within 3 miles downstream of the Project (TCEQ, 2017b).

Quintana Island Terminal

The Terminal is located adjacent to the intersection of the FHC and the ICW. The FHC provides access from Freeport LNG's berthing area to the Gulf of Mexico. 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.

The only waterbody within the Train 4 area of the Terminal is a stormwater pond that was created in association with construction of the Liquefaction Project. This stormwater pond, referred to as stormwater pond 2, currently occupies 7.9 acres. During construction of the Train 4 Project, the stormwater pond would be reconfigured and reduced to 6.7 acres to accommodate Train 4 facilities.

Pretreatment Facility

Two waterbodies are located within the footprint of the Unit 4 facilities at the Pretreatment Facility: the stormwater retention pond and water detention pond #1. The stormwater retention pond was constructed in association with the Liquefaction Project and occupies 32.7 acres in the center of the site. Water detention pond #1 is also associated with the Liquefaction Project, is immediately adjacent to and north of the stormwater retention pond, and occupies 1.4 acres.

Pipeline Corridor

The waterbodies within the Pipeline Corridor (including the associated construction work space) are summarized in table 10.

The majority of the waterbodies along the Pipeline Corridor are estuarine, including the FHC, ICW, unnamed tributaries to East Union Bayou, Oyster Creek and its tributaries, Eastern Velasco Ditch, and an unnamed pond.

Four waterbodies within the Pipeline Corridor are considered freshwater, including the Western Velasco Ditch, Drainage Channel D, and an unnamed tributary to Salt Bayou. Like the Eastern Velasco Ditch, the Western Velasco Ditch was created during the construction of the adjacent levee. However, it is not tidally influenced because it lies inside the levee, and its drainage connection to tidally influenced waters involves a one-way flow south through a box culvert under SH 332.

Under the TCEQ statewide water quality assessment program, the closest monitoring station to the Pipeline Corridor beyond Quintana Island is the tidal portion of Oyster Creek (Segment 1109), which is about 0.2 mile east of the Pretreatment Facility. The most recent data sets for the Oyster Creek Tidal segment assigned designations of fully supporting or no concern for the parameters assessed under aquatic life and general use. However, the Oyster Creek Tidal segment is assigned nonsupport for recreational use due to elevated levels of the bacteria enterococcus and has been assigned category 5c on the most recent (2014) Section 303(d) list of impaired waterbodies. For category 5c impaired waters, additional data or information would be collected and/or evaluated for bacteria before a management strategy is selected (TCEQ, 2017b).

3.2.2. Impacts and Mitigation

To avoid or minimize adverse impacts on water quality from construction and operation of the Project, protective measures similar to those described and approved for the Phase I, Phase II, and Liquefaction Project would be implemented. These include conformance with applicable federal, state, and local permit conditions and the additional measures described below. To minimize the potential for a release of hazardous materials, such as fuels or lubricants, and the resulting impacts on surface water, Freeport LNG would follow the Liquefaction Project's SPCC Plans. As necessary, Freeport LNG would update the SPCC Plans to include the Train 4 Project. To minimize erosion and sedimentation impacts on surface water, land disturbing activities would be conducted following the Project-specific Plan, Procedures, and ESCP. Additionally, the Project would be incorporated into the existing NPDES permit and SWPPP for the Liquefaction Project. The following sections discuss the potential impacts and mitigation measures.

Quintana Island Terminal

The only waterbody that would be directly affected by construction and operation of the Train 4 Project at the Terminal site is stormwater pond 2. As this is a man-made feature designed for stormwater management, the reconfiguration is not a significant impact.

The frequency and size of LNG carriers calling on the Terminal would not increase beyond the maximum number of ship visits reviewed by the Commission (400 LNG vessels per year) for the LNG import terminal expansion (Phase II Project; FERC, 2006). The analysis of potential ballast water discharge impacts on surface water from loading LNG vessels was provided in the Final EIS for the Liquefaction Project and Phase II Modification Project (FERC, 2014). Effective January 1, 2016, LNG carriers calling on the Terminal would be subject to USCG ballast water management requirements as specified in Navigation and Vessel Inspection Circular 01-18, including USCG regulations 33 CFR Part 151, Subpart D (Ballast Water Management for Control of Nonindigenous Species in Water of the U.S.) and 46 CFR Part 162.060 (Ballast Water Management Systems). Vessels equipped with ballast tanks that intend to discharge ballast water to waters of the U.S. must install and operate a USCG-approved ballast water management system designed to processes ballast water prior to discharge to meet the Ballast Water Discharge Standard specified in 33 CFR § 151.2030. USCG-approved ballast water management systems (or other approved Alternative Management Systems) are designed to processes ballast water prior to discharge and kill, render harmless, or remove harmful aquatic organisms and pathogens, while also preserving the physical and chemical quality of the discharge water. Based on the protections provided by these USCG regulation and other applicable federal laws governing the discharge of ballast water, potential impacts on surface water due to ballast water discharges would be expected to be negligible.

Based on our review of the Project activities and the design concepts, construction procedures, and mitigation measures associated with construction and operation of Train 4, we conclude that there would be no significant impacts on surface waters.

Pretreatment Facility

The stormwater management system at the Pretreatment Facility (including the stormwater retention pond, water detention pond #1, and conveyance channels) associated with the Liquefaction Project is currently in operation. To incorporate stormwater runoff near the Unit 4 area, new conveyance channels and water detention pond #2 would be constructed. No other impacts on surface water are expected from construction or operation of Unit 4.

Pipeline Corridor

Table 10 lists the 32 waterbody segments within the Pipeline Corridor by MP. Of these, 27 waterbody segments are crossed by the route, and 5 waterbody segments occur within the Pipeline Corridor but are not directly crossed by the pipeline. The activities affecting these five waterbodies are as follows:

- Drainage Channel B and the Pond near MP 0.0 are within Direct Pipe workspace within the Terminal. As new pipe joints are added to the pipeline, they would be positioned across these waterbodies, prior to being advanced under the FHC;
- The Eastern Velasco Ditch near MP 3.4 would be crossed by an access road through an existing culvert;
- The Pond and unnamed tributary to Oyster Creek near MP 4.4 are within Direct Pipe workspace for the Velasco Levee crossing. As new pipe joints are added to the pipeline, they would be positioned within these waterbodies, prior to being advanced under the Velasco Levee.

The HDD or Direct Pipe method would be used in six locations, spanning one or more waterbody segments at each location, as described below:

- FHC Crossing. This Direct Pipe installation would be located between MPs 0.0 and 1.0. The Direct Pipe installation would span two segments of the FHC (MPs 0.2 to 0.9), which are separated by a small peninsula of land at MP 0.8.

- ICW. The HDD method would be used to install the Pipeline between MPs 1.3 and 1.7. This HDD installation would span two segments of the ICW (MPs 1.4 to 1.7), which are separated by a small peninsula of land near MP 1.6.

- Large Estuarine Wetland Complex. The HDD method would be used to install the Pipeline beneath a large wetland complex between MPs 2.4 and 3.6. This HDD installation would span a total of four waterbody segments: an unnamed tributary to

East Union Bayou (MP 2.8), an unnamed tributary to Oyster Creek (MP 3.4), and two segments of the eastern Velasco Ditch (MP 3.4 and MPs 3.5 to 3.6).

- Velasco Levee into the Pretreatment Facility. The Direct Pipe method would be used to install the portions of the Pipeline going into the Pretreatment Facility between MPs 4.4 and 4.8. This Direct Pipe installation would span a total of three waterbodies: the Eastern Velasco Ditch (MP 4.6), the western Velasco Ditch (MP 4.7), and Drainage Channel D (MP 4.8).

- Velasco Levee out of the Pretreatment Facility. The Direct Pipe method would be used to install the portions of the Pipeline going out of the Pretreatment Facility between MPs 5.1 and 5.5. This Direct Pipe installation would span a total of three waterbodies: Drainage Channel D (MPs 5.1 to 5.2), the western Velasco Ditch (MP 5.3), and the eastern Velasco Ditch (MPs 5.3 to 5.4).

- Oyster Creek. The Direct Pipe installation method would be implemented between MPs 6.4 and 6.8. This Direct Pipe installation would include a portion of the Eastern Velasco Ditch (MPs 6.4 to 6.7) as well as Oyster Creek (MPs 6.7 to 6.8).

TABLE 10

Waterbodies Affected by Construction and Operation of the Pipeline Corridor

MP		Feature ID a/	Waterbody Name	Crossing Width b/ (feet)	Flow Regime	Crossing Method
0.0	0.0	DC B	Drainage Channel B	N/A	Intermittent	N/A - Workspace
0.0	0.0	DWA017	Pond	N/A		N/A - Workspace
0.2	0.8	WA003	FHC	3,452		Direct Pipe
0.8	0.9	WA003	FHC	136		Direct Pipe
1.0	1.0	WA016	Unnamed Tributary to ICW	6		Push-pull
1.4	1.6	WA002	ICW	748		HDD
1.6	1.7	WA002	ICW	262		HDD
2.8	2.8	WA005	Unnamed Tributary to East Union Bayou	18		HDD
3.4	3.4	WA006	Unnamed Tributary to Oyster Creek	51		HDD
3.4	3.4	WA007	Eastern Velasco Ditch	N/A		N/A - Access Road
3.4	3.4	WA007	Eastern Velasco Ditch	35		HDD
3.5	3.6	WA007	Eastern Velasco Ditch	786		HDD
3.6	3.6	WA007	Eastern Velasco Ditch	276		Push-pull
3.8	3.8	WA007	Eastern Velasco Ditch	212		Push-pull
3.9	3.9	WB004	Unnamed Tributary to Oyster Creek	54		Push-pull
3.9	4.0	WAA07	Eastern Velasco Ditch	739		Push-pull
4.1	4.2	WA007	Eastern Velasco Ditch	683		Push-pull
4.4	4.4	WB007	Pond	N/A		N/A - Workspace
4.4	4.4	WB011	Unnamed Tributary to Oyster Creek	N/A		N/A - Workspace
4.6	4.6	WA007	Eastern Velasco Ditch	118		Direct Pipe
4.7	4.7	WA013	Western Velasco Ditch	69		Direct Pipe
4.8	4.8	DC D	Drainage Channel D	182		Direct Pipe
5.1	5.1	DC D	Drainage Channel D	51		Direct Pipe c/
5.2	5.2	DC D	Drainage Channel D	81		Direct Pipe
5.3	5.3	WA013	Western Velasco Ditch	69		Direct Pipe
5.4	5.4	WA007	Eastern Velasco Ditch	118		Direct Pipe
5.7	5.7	WA007	Eastern Velasco Ditch	290		Push-pull
5.8	6.1	WA007	Eastern Velasco Ditch	1,805		Push-pull
6.1	6.4	WA007	Eastern Velasco Ditch	1.670		Push-pull
6.4	6.7	WA007	Eastern Velasco Ditch	1,692		Direct Pipe
6.7	6.8	WA012	Oyster Creek	312		Direct Pipe
9.6	9.6	WA010	Unnamed Tributary to Salt Bayou	82		Open Cut

a Feature ID is unique code designated to waterbodies identified during field surveys. Features that begin with a "D" prefix were delineated using aerial photography and other publically available data.

b Crossing width is measured from water's edge to water's edge as crossed by the centerline. N/A = the feature is not crossed by the centerline.

c Direct Pipe entry/exit locations occur at MP 4.8 and MP 5.1. Impacts on waterbodies would be limited to those areas associated with the entry and exit.

Effects on surface waters associated with use of the HDD method would be primarily limited to the potential for an inadvertent release of drilling fluid. During the drilling process, as the drill passes through geologic formations, drilling fluid can be released to fissures and lost into the formation. The release of drilling fluid in the drill hole is typically due to a situation where the fluid pressure along the drill hole exceeds the containment capacity of the surrounding overburden material. In most cases, the quantity of drilling fluid released is minor and it is absorbed by the formation. In certain cases, due to a combination of factors that can include the presence of unconsolidated geologic formations, low density soils, soft sands, and/or fractured overburden materials, the inadvertent release of drilling fluid may be forced to the surface, resulting in a release of drilling fluid either directly to the surface water or to the ground surface in the vicinity of the entry or exit pit. An inadvertent return within a waterbody would temporarily increase turbidity and sedimentation and decrease water quality.

Freeport LNG's Project-specific HDD and Direct Pipe Monitoring and Contingency Plan would both minimize the potential for the occurrence of an inadvertent releases and direct measures to respond to an inadvertent release, should one occur. Measures presented in the monitoring and contingency plan include preventative steps taken during the planning and development of the site-specific HDD and Direct Pipe profiles including the confirmation of suitable types and depths of soil and overburden materials and establishment of appropriate pipeline geology profiles. The monitoring and contingency plan also identifies the detection and monitoring procedures that would be implemented during drilling and the remedial steps that would be taken to address inadvertent releases and drill failures. Measures that would be implemented in response to a detected inadvertent release to a wetland or waterbody could include modification to drilling procedures to minimize further release, methods to cap or contain the released fluid such as deployment of containment piping, water filled bladders, straw bales, silt fencing, and turbidity curtains, and the subsequent use of mechanical or natural means to remove the drilling fluid.

While drilling fluid is still used in the Direct Pipe method, the risk for inadvertent releases would be less than for the HDD method, as the volume of drilling fluid used would be less and most of the drilling fluid used would be contained within the advancing product pipeline and would not be in direct contact with surrounding soils. With the effective implementation of the Project-specific HDD and Direct Pipe Monitoring and Contingency Plan at HDD and Direct Pipe crossing locations, no significant impacts on surface waters crossed using these methods along the Pipeline Corridor would be anticipated.

Crossing under the Velasco Levee (and associated drainage ditches) by the Direct Pipe method would require a permit from the Velasco Drainage District and Section 408 Clearance from the COE (see table 7). As demonstrated by the successful use of the Direct Pipe method to install the pipeline/utility line associated with the Liquefaction Project in this area, it is anticipated that the proposed Direct Pipe installation under the Velasco Levee would be achieved without affecting the levee or its associated drainage ditches.

The push-pull method is proposed for nine crossing segments of three waterbodies along the Pipeline Corridor, including crossings of an Unnamed Tributary to ICW, an Unnamed Tributary to Oyster Creek, and seven crossing segments of the Eastern Velasco Ditch. One additional segment of the eastern Velasco Ditch (MPs 3.9 to 4.2) and one pond (MP 6.0) are within ATWS associated with installation of the Underground Facilities using the push-pull method. Use of this method, in which the trench is pre-excavated within the bed of the drainage ditch and pipe joints are welded on-shore and pushed or pulled as a floating string through the water channel, causes less in-stream disturbance than that associated with an open cut excavation with the installation of individual pipe joints. The primary surface-water effects resulting from the push-pull method would be a temporary increase in turbidity during construction. These potential effects would be minor and temporary.

The Underground Facilities would be installed beneath one waterbody (an unnamed tributary to Salt Bayou) using the open-cut wet trench method with equipment operating from the banks. In addition, two waterbodies would be within the workspace used for pipe-stringing associated with the Direct Pipe installations across the Velasco Levee, and two waterbodies within the Terminal would be utilized for workspace associated with the Direct Pipe installation beneath the FHC. The primary impacts on these waterbodies would be similar to those associated with the push-pull method: a temporary increase in turbidity during construction, and water chemistry.

Following installation of the Underground Facilities, affected waterbodies would be stabilized, banks would be returned to preconstruction contours, sediment barriers would be installed, and riparian areas would be revegetated as described in the Procedures.

After construction and prior to placement into service, the Pipeline would be hydrostatically tested to ensure that pipe sections are free from leaks and that the required margin of safety is provided for operation at anticipated pressures. Water for hydrostatic testing of the pipeline would be obtained from groundwater. The source, uptake rate, discharge rate, discharge location, and estimated volume of groundwater needed for the hydrostatic testing of the pipeline is included in section A.3.1.2.

Operation of the pipeline would not be expected to have any significant effects on waterbodies. No new impervious areas outside of existing facility fence lines would be developed.

No long-term or significant impacts on surface waters are anticipated as a result of the Project, because Freeport would not permanently affect the designated water uses, they would bury the pipeline beneath the bed of all waterbodies, implement erosion and sedimentation controls, adhere to crossing guidelines in the Project-specific Procedures, and restore the streambanks and streambed contours as close as practical to pre-construction conditions.

Operation of the Project would not cause impacts on any surface waters, unless maintenance activities involving pipe excavation and repair in or near streams are required in the future. For maintenance activities, if needed, Freeport would employ protective measures similar to those proposed for use during construction. As a result, we conclude that any impacts derived from maintenance would be short-term and similar to those discussed above for the initial pipeline construction.

3.3. Wetlands

The CWA defines wetlands as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (COE, 1987).

3.3.1. Existing Conditions

Wetland delineation surveys for the Train 4 Project were conducted in May, June, and November 2016, and January 2107, within the portions of the Project area where survey access was granted. In areas that were not accessible at the time of survey, National Wetland Inventory, National Hydrography Dataset, visual surveys from adjacent areas, aerial photography, historical imagery, and elevation models were used to estimate and digitally map the perceived spatial extent of these wetlands.

No wetlands are present within the Terminal, the Pretreatment Facility, within the Offsite Workspace Areas A, B, C, D, E, F, G, and H, or along the Heavy Haul Road.

Pipeline Corridor

Estuarine emergent (EEM) wetlands, palustrine emergent (PEM) wetlands, and to a lesser extent, palustrine scrub-shrub (PSS) wetlands and estuarine scrub-shrub (ESS) wetlands would be affected during construction activities along the Pipeline Corridor. Appendix A lists wetland impacts within the Pipeline Corridor by milepost associated with construction of the pipeline and associated access roads. These impacts are summarized in table 11

TABLE 11

Summary of Wetland Impacts

Cowardin Classification [a]	Construction Impacts [b]	Operational Impacts [b]
E2EM	25.5	0.0
E2SS	0.7	0.04
E2US	2.3	0.0
PEM	22.9	0.0
PSS	2.0	0.07
Total	53.4	0.11

a Wetland types according to Cowardin et al (1979): E2EM = Estuarine emergent; E2SS = Estuarine scrub-shrub; E2US = Estuarine unconsolidated shore; PEM = Palustrine emergent; PSS = Palustrine scrub-shrub. Note: For the purposes of determining impacts, E2US wetlands were considered emergent wetlands.

b The numbers in the table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends.

EEM wetlands occur along the Pipeline Corridor from Follett's Island to just south of Oyster Creek at MP 6.7. Several small PEM wetlands occur south of Oyster Creek; however, most of the PEM wetlands, including small PSS wetland inclusions, occur north of Oyster Creek. The primary factor influencing species composition in estuarine wetlands is the salinity. Plant species observed in EEM wetlands include saltgrass (*Distichlis spicata*), smooth cordgrass (*Spartina alterniflora*), and gulf cordgrass (*Spartina spartinae*). Plant species observed in PEM wetlands include common spikerush (*Eleocharis palustris*), sea oxeye daisy (*Borrichia frutescens*), and saltmeadow cordgrass (*Spartina patens*). Plant species observed in PSS wetlands include bigleaf marsh-elder (*Iva frutescens*), eastern baccharis, and rattlebush (*Sesbania drummondii*).

3.3.2. Impacts and Mitigation

No wetlands are present within the Terminal, the , Pretreatment Facility, within the Offsite Workspace Areas A, B, C, D, E, F, G, and H, or along the Heavy Haul Road; therefore, direct impacts on wetlands from construction and operation of the Train 4 facilities are not anticipated.

Freeport LNG would follow the permit conditions; the Project-specific Plan, Procedures, and ESCP; and the SWPPP for the Liquefaction Project, which would avoid indirect impacts (e.g., from stormwater runoff) on the wetlands that lie beyond the construction workspace.

Pipeline Corridor

Ground-disturbing activities, including clearing, grading, and excavation activities, could temporarily affect the rate and direction of water movement within wetlands. If contours and elevations are not properly restored, these effects could adversely and permanently affect wetland hydrology and revegetation by creating soil conditions that may not support wetland communities and hydrophytic vegetation at pre-construction levels. If soils are not properly segregated during construction, the resulting mixed soil layers could alter biological components of the wetland and affect the reestablishment of native wetland vegetation. The temporary stockpiling of soil and movement of heavy machinery across wetlands could also lead to inadvertent compaction and furrowing of soils, which could alter natural hydrologic patterns, inhibit seed germination, and increase seedling mortality. Movement of equipment could also introduce non-native and invasive species to the disturbed soil. Altered surface drainage patterns, stormwater runoff, runoff from disturbed areas, and accidental spills could also negatively affect wetland restoration.

Freeport LNG would segregate topsoil during construction, where possible. During backfilling, subsoil would be placed in the bottom of the trench, followed by the replacement of topsoil over the subsoil layer. 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. Wetlands would be allowed to revegetate through the existing seed bank and rootstock contained in the topsoil. Within one to two years, wetlands would be expected to transition back into a community similar to that of the wetland prior to construction. Revegetation would be evaluated during the growing season, and if established success criteria have not been met, Freeport LNG would determine seeding and/or planting options on a case-by-case basis depending on the condition of each wetland in coordination with the appropriate agencies.

Following the Project-specific Procedures, a 10-foot-wide corridor, centered along the pipeline, would be maintained in an herbaceous state to allow for routine inspection and maintenance of the pipeline. Impacts on wetlands would be limited to the conversion of 0.1 acre of PSS wetland to PEM wetland and less than 0.1 acre of ESS wetland to EEM wetland.

During and following construction, Freeport LNG would address temporary wetland impacts by following permit conditions and the protective measures in the Project-specific Plan, Procedures, and ESCP. Measures to be implemented to minimize impacts on wetlands 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.

Freeport LNG has requested alternative measures (section A.8.1) allowing a 100-foot-wide construction right-of-way in wetlands to provide adequate construction workspace to safely install the 42-inch-diameter natural gas pipeline within large wetland complexes with saturated soils and a 150-foot nominal-width construction right-of-way for the push-pull method in EEM wetland between MPs 1.0 and 1.3. Although we acknowledge that a wider right-of-way may be justified in certain situations based on pipe size, trench stability, soil limitations, and other factors, Freeport LNG has not provided site-specific justification for each crossing location. Our Procedures require site-specific justification for the use of a construction right-of-way greater than 75 feet within the boundaries of a federally delineated wetland. **We recommend that:**

<u>Prior to construction of the Pipeline facilities</u>, Freeport LNG should file with the Secretary of the Commission (Secretary), for review and written approval by the Director of OEP, site-specific justification for each location where topographic conditions or soil limitations require that the construction right-of-way width within the boundaries of a federally delineated wetland be expanded beyond 75 feet.

In addition to the aforementioned mitigation measures, Freeport LNG would be required to follow the permit conditions contained in the COE's Section 404 and TCEQ's Section 401 Permits. In Freeport LNG's application to the COE, it must demonstrate that it has taken appropriate and practicable steps to avoid and 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 practicable alternative exists.

Freeport LNG would coordinate with the COE to mitigate for the permanent conversion of 0.1 acre of PSS wetlands to PEM wetlands and less than 0.1 acre of ESS wetlands to EEM wetlands. Mitigation may include a combination of the following: purchase of credits in a wetland mitigation bank; placement of other wetlands (on or off site) in a long-term conservation agreement; or creation, extension, or restoration of other wetlands. The inclusion of a wetland mitigation plan is not necessary for this very small level of impacts.

Given the previously disturbed nature of the wetlands that would be affected, prevalence of similar wetland habitat throughout the region, implementation of the impact avoidance and minimization measures, and compliance with our recommendation above, we conclude that effects on wetlands associated with construction and operation of the Project would not be significant.

4. Vegetation

4.1. Existing Conditions

The areas proposed for development within the Terminal, Pretreatment Facility, and Offsite Workspace Areas A, C, E, F, G and H and Heavy Haul Road have been graded, graveled, and/or amended with concrete as part of the Liquefaction Project. As a result, no vegetation is present within these areas.

4.1.1. Pipeline Corridor and Offsite Workspace Area B

Vegetation communities within the Pipeline Corridor and offsite workspace Area B include upland herbaceous, upland scrub-shrub, and both herbaceous and scrub-shrub wetlands. Emergent and submerged aquatic vegetation is be limited to perennial waterbodies and wetland complexes along the Pipeline Corridor.

Upland herbaceous plant species observed during field surveys include ragweed (*Ambrosia* spp.), bahiagrass (*Paspalum notatum*), barnyard grass (*Echinochloa crus-galli*), Bermuda grass, evening primrose (*Oenothera speciosa*), false indigo (*Baptisia australis*), fine-leaved sneezeweed (*Helenium amarum*), frog-fruit (*Phyla nodiflora*), fox-tail bristle grass (*Setaria italica*), goldenmane tickseed (*Coreopsis basalis*), hogwort (*Croton capitatus*), Indian blanket (*Gaillardia pulchella*), Mexican hat (*Chiranthodendron pentadactylon*), perennial ryegrass (*Lolium perenne*), powderpuff (*Mimosa strigillosa*), prickly pear cactus (*Opuntia stricta*), scarlet pimpernel (*Lysimachia arvensis*), spotted beebalm (*Monarda punctate*), St. Augustine grass (*Stenotaphrum secundatum*), Texas star (*Sabatia campestris*), Vasey's grass (*Paspalum urvillei*), and windmill grass (*Chloris* spp.).

Upland scrub-shrub plant species observed during field surveys include bigleaf marsh-elder, eastern baccharis, prickly pear cactus, rattlebush, and sweet acacia (*Vachellia farnesiana*). Vine species observed in upland locations included peppervine (*Ampelopsis arborea*) and southern dewberry (*Rubus trivialis*).

Representative plant species observed within the herbaceous and scrub-shrub wetlands are presented in section B.3.7.

4.2. Invasive Species

Invasive or exotic plant species may alter natural systems by out-competing native plants for habitat resources and replacing native plants within the plant community composition. These plants can negatively affect ecosystems and may decrease biodiversity by threatening the survival of native plants. Invasive plants and some native plants can be classified as noxious weeds by federal, state, county, or local agencies. A noxious weed is a plant that has been designated as one that is injurious to agricultural or horticultural crops, natural habitats or ecosystems, or humans or livestock.

Two noxious and invasive plant species were observed within the Project area: Chinese tallow tree (*Triadica sebifera*) and torpedograss (*Panicum repens*). Observation of Chinese tallow tree was limited to an area near the Stratton Ridge Meter Station, near MP 10.6 of the Pipeline Corridor. Torpedograss was documented in several locations along the Pipeline Corridor, including within several wetlands between MP 9.3 and MP 9.9 and near the Stratton Ridge Meter Station at MP 10.6.

4.3. Impacts and Mitigation

4.3.1. Pipeline Corridor and Offsite Workspace Area B

In total, construction activities would affect 116.4 acres of vegetation. Vegetation communities affected by construction of the Pipeline include 50.2 acres of wetland herbaceous communities (57 percent), 35.8 acres of upland herbaceous communities (40 percent), 2.6 acres of wetland scrub-shrub communities (3 percent), and <0.1 acre of upland scrub-shrub communities (less than 1 percent). Impacts on vegetation in areas where the Pipeline would be installed using the HDD or Direct Pipe method would be mostly avoided, as impacts would be limited to those necessary to install guide wires along the centerline.

Vegetation communities affected by construction of Offsite Workspace Area B include 27.7 acres of upland herbaceous communities (100 percent). Upon completion of construction, the gravel layer would be removed at Offsite Workspace Area B and underlying soils would be regraded, seeded, and returned to preconstruction condition.

Direct effects on vegetation include the removal of surface vegetation and grading to allow pipeline installation and to allow for safe operation of equipment. During grading, the root systems of herbs, shrubs, and small trees would be disturbed. Construction activities would result in the short-term alteration and loss of vegetation, and could result in increased soil erosion. The degree of construction impacts would depend on the type and amount of vegetation affected and the rate at which the vegetation would regenerate after construction.

Following construction, 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 Plan and Procedures. Woody shrubs and trees would be allowed to naturally revegetate within temporary workspaces. Because of these mitigation measures, we conclude that impacts on vegetation along the Pipeline Corridor would not be significant.

Operation and maintenance of the Pipeline would have a minimal effect on the naturally occurring vegetation communities. Active maintenance of vegetation within the permanent right-of-way (e.g., mowing and brush-hogging) would be used as necessary to keep the permanent right-of-way clear of excessive woody vegetation.

The potential for Project-related activities along the Pipeline Corridor to spread noxious and invasive species is expected to be low due to the localized nature of invasive species within the Project area (limited to occurrences between MPs 9.3 and 9.9, and MP 10.6). Freeport LNG would incorporate the following measures to reduce the potential introduction or spread of invasive species, noxious weeds, and soil pests resulting from construction and restoration activities:

- All construction equipment would be cleaned prior to beginning Project work.
- Areas containing Chinese tallow tree or torpedograss would be identified and clearly marked prior to construction.
- An EI or biological monitor would be on site at all times while construction activity is occurring in marked areas, to ensure appropriate preventative measures are implemented during clearing, construction, and restoration activities.
- The upper 12 inches of topsoil would be isolated and stockpiled within the marked area to prevent root structure from being exposed to outside areas. The stockpile would be surrounded by a silt curtain or other barrier to prevent contamination with outside areas. If used as part of sediment barriers or post-construction landscaping, straw or hay bales or mulch would be certified weed free.
- Following completion of construction, stockpiled topsoil within the marked area would be carefully placed back in its original location.
- Construction techniques would minimize the time bare soil is exposed, and thus minimize the opportunity for invasive species to become established.
- Freeport LNG would follow the Project Erosion and Sediment Control Plan to ensure that soil movement and the associated movement of non-native seeds is minimized.
- Following restoration, Freeport LNG would monitor disturbed sites to ensure that revegetation with suitable plant species has been successful and that invasive or non-native species have not become established outside areas where they were originally located.

Based on the Project's restoration and mitigation measures at Offsite Workspace Area B and the Pipeline Corridor, we conclude that there would be no significant impacts on vegetation.

5. Wildlife

5.1. Fisheries/Aquatic Resources

5.1.1. Existing Conditions

The fisheries in and near the Project area can be divided into marine (tidal), estuarine (tidal), and inland freshwater (non-tidal) aquatic habitats. The Terminal is situated close to the marine coastal waters of the Gulf of Mexico and of the Brazos River Estuary system, which includes the ICW, Brazos River, and FHC. The Brazos River Estuary system includes the tidally influenced wetlands and waterbodies that predominate along the Pipeline route, south of the Velasco Levee crossing (MP 5.7). Freshwater wetlands and waterbodies are prevalent along the

Pipeline route, north of the Velasco Levee crossing (MP 5.7). The waterbodies near the Pretreatment Facility site on the west side of the Velasco Levee, where the levee itself provides a physical barrier from estuarine tidal influences to the east, are freshwater (waterbody classifications are provided in EA section B.3, Water Resources).

The inland waters near the Terminal and along most of the Pipeline Corridor are considered part of the Brazos River Estuary, which encompasses the ICW and the tidal sections of various rivers, creeks, dredged waterways, and wetlands. In the Brazos River drainage, 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. Other common species include bullhead minnow (*Pimephales vigilax*), gizzard shad (*Dorosoma cepedianum*), Gulf killifish (*Fundulus grandis*), sailfin molly (*Poecilia latipinna*), saltmarsh topminnow (*Fundulus jenkinsi*), sheepshead (*Archosargus probatocephalus*), silver perch (*Bairdiella chrysoura*), southern flounder (*Paralichthys lethostigma*), spotted seatrout (*Cynoscion nebulosus*), and striped mullet (*Mugil cephalus*) (Linam, 2002).

The waterbodies within the footprint of Train 4 facilities at the Terminal (one stormwater pond and one drainage channel) and the Unit 4 facilities at the Pretreatment Facility (one stormwater retention pond and one water detention pond) do not contain significant fishery resources.

The Magnuson-Stevens Fishery Conservation and Management Act, as amended (16 United States Code [USC] Section 1801 et seq.) 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 Magnuson-Stevens Fishery Conservation and Management Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC § 1802(10)).

The Gulf of Mexico Fishery Management Council designated the Gulf of Mexico, ICW, and surrounding Brazos River Estuary as EFH for red drum (*Sciaenops ocellatus*), reef fish, coastal migratory pelagics, and shrimp (Gulf of Mexico Fishery Management Council, 2005) (figure B 5-1). Life stage information for species with nearshore EFH (Gulf of Mexico Fishery Management Council, 2016) in the Project area (brown shrimp, white shrimp, red drum, king mackerel, Spanish mackerel, cobia, red snapper, gray snapper, lane snapper, and yellowedge grouper) is summarized in table 12. The Gulf of Mexico is additionally designated as EFH for Atlantic highly migratory species such as tuna, sharks, swordfish, and billfish (NMFS, 2009); however, the Project would not affect offshore habitats. The categories of EFH present include mud substrates, estuarine water column, and estuarine wetlands.

TABLE 12

Life Stage Occurrence for Species with EFH Designated Near the LNG Facility

Species	Life Stage	Zone	Essential Fish Habitat	Seasons
Brown Shrimp	Eggs	Marine	59-360 feet; benthic, soft bottom, sand/shell	Fall and spring
	Larvae/Neonate	Marine/Estuarine	0-269 feet; planktonic, sand/shell/soft bottoms, submerged aquatic vegetation (SAV), emergent marsh, oyster reef	Year Round/October through July
	Juvenile	Estuarine	0-59 feet; sand/shell/soft bottoms, SAV, emergent marsh, oyster reef	March through July
	Sub-adults	Estuarine	3-60 feet; soft bottom, sand/shell	Spring through fall
	Adults	Marine	Offshore; 46-360 feet; soft bottom, sand/shell	Fall and spring
White Shrimp	Fertilized Eggs	Estuarine/Marine	30-111 feet; nearshore, offshore, estuarine	Spring through fall
	Larvae/Neonate	Marine/Estuarine	1-269 feet; soft bottoms, emergent marsh	Year Round/June through September
	Juvenile	Estuarine	1-98 feet; soft bottoms	September through June
	Adults	Estuarine/Marine	Nearshore, offshore, estuarine; soft bottoms; less than 89 feet	Late summer and fall
Red Drum	Eggs	Marine	Coastal waters frequently near tidal inlets	August through October
	Larvae/Neonate	Estuarine	emergent marsh Planktonic, sand/shell bottoms, SAV, soft bottoms, emergent marshes	October through January
	Juvenile	Estuarine/Marine	0-16 feet; emergent marshes, SAV, soft bottoms, hard bottoms, sand/shell bottoms	Year Round
	Adult	Estuarine/Marine	1-230 feet; hard bottoms, pelagic, emergent marshes, sand/shell bottoms, SAV, soft bottoms	Year Round
King Mackerel	Juvenile	Marine	Nearshore waters up to 30 feet; water column associated (WCA)	May – October peak: July, October
	Adult	Marine	Nearshore, offshore; 0-656 feet; WCA	May through October
Spanish Mackerel	Eggs	Marine	Nearshore, offshore 0-164 feet; WCA	Spring, Summer
	Larvae	Marine	Nearshore, offshore; 30-285 feet; WCA	May through October

TABLE 12

Life Stage Occurrence for Species with EFH Designated Near the LNG Facility

Species	Life Stage	Zone	Essential Fish Habitat	Seasons
	Juveniles	Estuarine/Marine	Estuarine, nearshore, offshore; 6-30 feet; WCA	March through November
	Adults	Estuarine/Marine	Estuarine, nearshore, offshore; 10-246 feet; WCA	North Gulf in spring, South Florida and Mexico in fall
Cobia	Eggs	Estuarine/Marine	Estuarine, nearshore; top 3 feet of the water column; WCA	Summer
	Larvae	Estuarine/Marine	Estuarine, nearshore, offshore; 36-173 feet; WCA	May through July
	Juvenile	Marine	Nearshore, offshore; 16-984 feet, primarily near the surface, WCA	April through July (early); May through October (late)
	Adult	Marine	Nearshore, offshore; 3-230 feet, hard bottoms and WCA	Year Round
Red Snapper	Eggs	Marine	Offshore; 59- 413 feet, WCA	April through October
	Larvae	Marine	Offshore; 59-413 feet, WCA	July through November
	Juveniles	Marine	Nearshore, offshore; 55-600 feet, reefs, hard bottom, banks/shoals, soft bottom, sand/shell habitats	July through November (Early Juveniles) Year Round (Late Juveniles)
	Adult	Marine	Nearshore, offshore; 23-480 feet; reefs, hard bottom, and banks/ shoal habitats	Year Round
Gray Snapper	Eggs	Marine	Offshore; 0-590 feet; WCA	June through September
	Larvae	Marine	Offshore, 0-590 feet; WCA	April through November; Peak: June through August
	Juvenile	Estuarine	3-10 feet; SAV, mangrove, emergent marsh	Year Round
	Adults	Estuarine/Marine	0-590 feet; hard bottom, soft bottom, reef, sand/shell, bank/shoal, and emergent marsh habitats	Year Round
Lane Snapper	Eggs	Marine	Offshore, 13-433 feet; WCA	March through September, peak: July through August
	Larvae	Estuarine/Marine	Estuarine, nearshore, offshore; 0-164 feet; WCA	June through August
	Postlarvae	Estuarine/Marine	Estuarine, nearshore, offshore; 0-164 feet; WCA, SAV	June through August

TABLE 12 **Life Stage Occurrence for Species with EFH Designated Near the LNG Facility**				
Species	**Life Stage**	**Zone**	**Essential Fish Habitat**	**Seasons**
	Juveniles	Estuarine/Marine	Estuarine, nearshore, offshore; 0-79 feet; SAV, sand/shell, reefs, soft bottom, banks/shoals, mangrove	Late summer- through early fall
	Adults	Marine	Nearshore, offshore; reef, sand/shell, banks/shoals, hard bottom; 13-433 feet	Year Round
Yellowedge Grouper	Eggs	Marine	Offshore; 115-1214 feet; WCA	Year Round
	Larvae	Marine	Offshore; 115-1214 feet; WCA	July through October
	Juveniles	Marine	Nearshore, offshore, hard bottom; 30-361 feet	Year Round
	Adults	Marine	Offshore, hard bottom, soft bottom, shelf, edge/slope; 115-1214 feet	February through September, November; peak: March through September

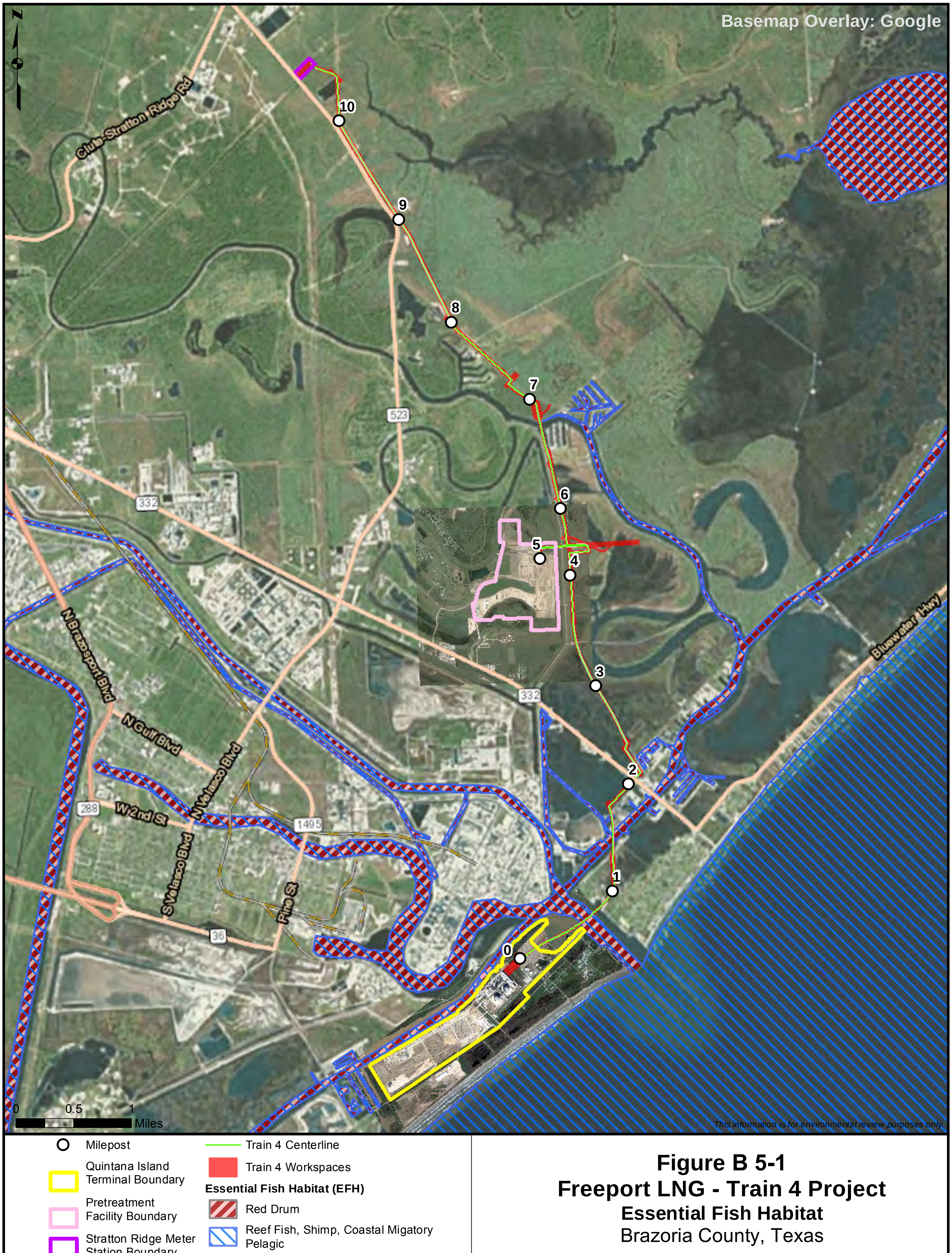


Figure B 5-1
Freeport LNG - Train 4 Project
Essential Fish Habitat
Brazoria County, Texas

| REVISED: 10/11/2017 | SCALE: 1:70,000

DRAWN BY: 0239

5.1.2. Impacts on Fisheries/Aquatic Resources

Quintana Island Terminal and Pretreatment Facility

Adjacent fishery resources could be affected during construction by the accidental spill of fuel, lubricants, or other chemicals required for construction equipment. Impacts on fisheries due to nighttime construction activities at the Terminal could include avoidance of the area, attraction to lighted areas, or modification of the rates of stress, injury, and mortality experienced by fishes. However, the Terminal currently utilizes nighttime lighting for ongoing night construction, and is in an existing industrial area, where nighttime lighting and noise is common. Fisheries in this area are likely to be at least somewhat accustomed to nighttime lighting and noise.

To avoid and minimize impacts on fisheries, Freeport LNG would follow the SPCC Plans that are currently being used during construction of the Liquefaction Project. Freeport LNG would update the SPCC Plans to include the Train 4 Project, and would file them with FERC prior to construction. During Project operation, the potential for a chemical spill that could adversely affect fisheries resources near the Terminal is low, and would be similarly minimized by adherence to established spill control procedures.

Potential direct impacts on EFH during construction and operation of the Project facilities within the Terminal and Pretreatment Facilities would be limited to the potential for increased suspended sediment concentrations from erosion and stormwater runoff from construction areas, lighting and noise levels, barge traffic during construction (section A.8.5.2), and accidental spills. The Project would not affect other nearshore habitats, would not include offshore work, and would not change the intensity or nature of LNG Carrier traffic. As discussed in section B.3.2, Project impacts would not be significant.

Pipeline Corridor

Impacts on open water, estuarine wetland, and unvegetated shallow water habitats, which provide essential forage and refuge for many coastal fishery species, may result from construction and operation of the Pipeline. Freeport LNG would use the open-cut, push-pull, conventional-bore, HDD, and Direct Pipe methods to construct the pipeline across wetlands and waterbodies (section A.8.3.3). Open-cut construction would cause temporary streambank disturbance and produce elevated levels of turbidity during and shortly following construction. Streambanks would generally be restored within 24 hours of construction and monitored for recovery and revegetation, according to the Project-specific Procedures. In-stream work for open-cut crossings would be limited to 24 hours in minor waterbodies (48 hours in intermediate waterbodies) per the Project-specific Procedures (section A.8.3.3). The FERC Procedures require that instream work, except that required to install or remove equipment bridges, occur during a construction time window of June 1 through November 30 for warmwater fisheries. Freeport LNG has requested an alternative measure (section A.8.1) allowing construction outside this time window. The FERC Procedures require adherence to the crossing time windows unless expressly permitted or further restricted by the appropriate federal or state agency in writing, on a site-specific basis. To date, Freeport LNG has not provided such documentation. To ensure that warmwater fisheries are adequately protected, **we recommend that:**

<u>Prior to construction of the Pipeline facilities</u>, Freeport LNG should file with the Secretary written documentation of consultation with the TPWD expressly permitting the requested construction time windows for waterbody crossings on a site-specific basis or confirmation that it will adhere to the warmwater fishery crossing time windows in the FERC Procedures.

The increased turbidity may inhibit visual feeding and in extreme cases, could impair the function of fishes' gills and/or cover existing benthic environments with a thick layer of sediment, potentially smothering benthic organisms; however, the anticipated impact on fish and benthic organisms is minor and short term. The impacts of the push-pull method would be similar to those of the open-cut method.

Successful implementation of the conventional-bore, HDD, and Direct Pipe methods would avoid impacts on the waterbody. The typical failure mode, should it occur, would be an inadvertent release of drilling fluid, as discussed in section A.8.3.3. Freeport LNG's Project-specific HDD and Direct Pipe Monitoring and Contingency Plan would be used to minimize the potential for occurrence of inadvertent releases and in response to an inadvertent release, should one occur. Drilling fluid consists primarily of a slurry of non-toxic bentonite clay in water, and impacts on fish and benthic organisms would be similar to those for the open-cut method.

Fisheries may experience increased rates of stress, injury, or mortality. Construction could also affect migration. Indirect impacts can include long-term habitat modification and consequent community changes through vegetation removal, and physical or chemical alteration of the substrate. Impacts on fisheries can be associated with a reduction in foraging success resulting from the loss of benthic species during construction.

Although fishery resources present at the time of construction may experience short-term, localized effects, these effects would be minimized by adherence to the Project-specific Procedures. Although localized increases in sedimentation and turbidity may occur, impacts on aquatic resources would be temporary and insignificant. Population-level impacts on fisheries and other aquatic life are not anticipated.

The Underground Facilities would be installed beneath waters designated as EFH within the FHC (MP 0.2 to 0.8) and ICW (MP 1.4 to 1.7). In addition, the crossing of Oyster Creek (MP 6.7 to 6.8) would be about 140 feet west of designated EFH. The Underground Facilities would be installed beneath the FHC using the Direct Pipe method, beneath Oyster Creek using the Direct Pipe method, and beneath the ICW using the HDD method, thus avoiding impacts on designated EFH.

As noted previously, the Pipeline would be constructed in estuarine wetlands via open cut, push-pull, HDD, and Direct Pipe methods. Where surface disturbance would occur, the construction right-of-way would be restored following the Project-specific Procedures.

Based on the use of HDD or Direct Pipe methods to cross beneath major waterbodies containing EFH, potential impacts would be restricted to the open cut construction in estuarine wetlands (as discussed in section B.3.3). As indicated previously, we expect these impacts to be temporary and limited to a small area. Therefore, we conclude that designated EFH would not be adversely modified during construction or operation of the Project.

Federal agencies that authorize, fund, or undertake activities that may impact EFH must consult with NMFS about potential impacts. Although NMFS has not established specific criteria for conducting EFH consultations, NMFS recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as NEPA or the ESA, to reduce duplication and improve efficiency. We request that NMFS consider this EA as the EFH Assessment.

NMFS may respond with additional Conservation Recommendations. We (as well as Freeport LNG) will assess any such measures at that time. In accordance with the Magnuson-Stevens Fishery Conservation and Management Act, we will provide a written response regarding to what extent any such Conservation Recommendations can or will be implemented within 30 days of receiving the recommendations. If we cannot respond completely to the NMFS recommendations during this timeframe, the action agency may notify NMFS that a full response to the conservation recommendations would be provided by a specified completion date agreeable to all parties. The response must include a description of measures proposed by the agency to avoid, mitigate, or offset the impact of the activity on EFH. For any conservation recommendation that is not adopted, the action agency must explain its reason to NMFS for not following the recommendation.

5.2. Wildlife

5.2.1. Existing Resources

Habitats in the Project area are diverse and include highly productive estuaries and marshes, and woodlands (TPWD, 2015). The area contains a diverse range of wildlife species, as identified in table 13.

The portions of the Project at the Terminal; Pretreatment Facility; Stratton Ridge Meter Station; Heavy Haul Road; and offsite workspaces Areas A, C, D, E, F, G, and H have been graded, graveled, and/or amended with concrete. These areas no longer provide natural wildlife habitat. However, despite ongoing construction and operational activities within the Terminal, Freeport LNG states that there is continued use of the site by area wildlife, including numerous avian species, a bobcat, a pair of coyotes, rattlesnakes, and alligators. These animals, and other wildlife resources that were well-established on Quintana Island, continue to use the area for foraging/hunting, nesting/denning, and as a passageway through the site.

TABLE 13 **Train 4 Project Representative Wildlife Species Near the Project**	
Common Name	**Scientific Name**
Amphibians	
Cricket frog	*Acris crepitans*
American bullfrog	*Lithobates catesbeianus*
Green frog	*Lithobates clamitans*
Reptiles	
American alligator	*Alligator mississippiensis*
Green anole	*Anolis caroliniensis*
Six-lined racerunner	*Aspidoscelis sexlineatus*
Snapping turtle	*Chelydra serpentina*
Timber rattlesnake	*Crotalus horridus*
Eastern mud turtle	*Kinosternon subrubrum*
Skink	*Plestiodon spp.*
Birds	
Hawk	*Accipiter spp.*
Owl	*Aegolius spp.*
Turkey vulture	*Cathartes aura*
American crow	*Corvus brachyrhynchos*
Oriole	*Icterus spp.*
Indigo bunting	*Passerina cyanea*
Mammals	
Coyote	*Canis latrans*
Bobcat	*Lynx rufus*
Striped skunk	*Mephitis*
White-tailed deer	*Odocoileus virginianus*
Raccoon	*Procyon lotor*
Eastern gray squirrel	*Sciurus carolinensis*
Feral hog	*Sus scrofa*

Pipeline Corridor

The majority of the Pipeline Corridor south of the Pretreatment Facility has been recently disturbed during installation of the authorized pipelines/utility lines associated with the Liquefaction Project. Wildlife habitats along the portion of the Pipeline Corridor north of the Pretreatment Facility include herbaceous upland, scrub-shrub upland, emergent wetland, and scrub-shrub wetland (see additional discussion in sections B.3 and B.4). Much of the herbaceous upland and drier emergent wetland areas support cattle grazing and can be categorized also as pasture land.

5.2.2. Impacts on Wildlife

Wildlife near the Terminal and Pretreatment Facility are acclimated to the operation of the existing Terminal and ongoing construction activities associated with the Liquefaction Project. Noise, lighting, and human activity during construction would result in minor disruptions to breeding and/or feeding behaviors during construction. Additionally, movement of equipment and vehicles during construction and operation could result in direct mortality of some small, less mobile mammals, reptiles, and amphibians that are unable to leave the area.

Because the activities associated with Train 4 at the Terminal and with Unit 4 at the Pretreatment Facility would be entirely within disturbed areas assessed previously, we conclude that there would be minimal impacts on wildlife.

Pipeline Corridor and Offsite Workspace Area B

Potential impacts on wildlife due to construction activities within the Pipeline Corridor and Offsite Workspace Area B include reduction in available habitat; increased noise and visual disturbance; and increased rates of stress, injury, and mortality. Construction activities and noise could result in temporary avoidance of the 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.

Because about 87 percent of the Pipeline Corridor would be within existing aboveground facility sites or collocated with the existing pipeline/utility corridor, impacts on undisturbed habitat would be minimized, thereby reducing impacts on and displacement of wildlife. Further, because the habitats affected by construction are widespread and common near the Project, it is expected that the small numbers of wildlife displaced during construction would relocate, either temporarily or permanently, to suitable habitat nearby.

5.3. Managed and Sensitive Wildlife Areas

The managed and sensitive wildlife areas near the Project include two NWRs (Brazoria NWR and San Bernard NWR); the Justin Hurst Wildlife Management Area (WMA); and two sensitive wildlife areas (Quintana Neotropical Bird Sanctuary [NBS] and the town of Quintana's Xeriscape Park).

Due to the distances between the Project and Brazoria NWR (1.5 miles), San Bernard NWR (7.5 miles), and Justin Hurst WMA (3.5 miles), impacts on wildlife at these locations are not anticipated. Given the existing industrial development near the Quintana NBS and the adjacent Xeriscape Park, and the presence of the existing 21-foot-high storm levee between much of the Project area and managed areas, we conclude that the incremental increases in noise and lighting associated with operation of Train 4 would not result in significant impacts on birds or other wildlife within managed and sensitive areas.

6. Threatened, Endangered, and Other Special Status Species

6.1. Federally Listed Species

Section 7 of the ESA (16 USC § 1531 et seq.) requires each federal agency to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed endangered or threatened species or result in the destruction or adverse modification of the designated critical habitat of a federally listed species. The FWS, which is responsible for terrestrial and freshwater species, and NMFS, which is responsible for marine species, jointly administer the ESA. Additionally, the FWS oversees implementation of the Bald and Golden Eagle Protection Act and NMFS oversees the implementation of the Magnuson-Stevens Fishery Conservation and Management Act and the Marine Mammal Protection Act.

Freeport LNG conducted field surveys in May and June 2016 to determine suitable habitat for federally listed species. These surveys identified one active waterbird rookery (section B.6.5.1); no other protected-species observations were reported. Details on the habitat for these species and an effects determination for each species is included in appendix B.

Acting as FERC's non-federal representative, Freeport LNG submitted a Project introduction letter to the FWS on May 11, 2015. Freeport LNG received concurrence from the FWS on October 26, 2015, that the proposed Project is *not likely to adversely affect* the federally listed Kemp's ridley sea turtle, loggerhead sea turtle, piping plover, whooping crane, and red knot. Freeport LNG submitted a Project-update letter on August 22, 2016; and provided an update on the Project via email on December 15, 2016. Concurrence for the updated Project has not been received.

Freeport LNG sent a letter introducing the Project to the NMFS on August 22, 2016, and provided an update on the Project via email on December 15, 2016. Concurrence for the updated Project has not been received.

6.1.1. Terminal; Pretreatment Facility; Stratton Ridge Meter Station; Heavy Haul Road; and offsite workspaces Areas A, C, D, E, F, G, and H

Based on the lack of vegetation and wildlife habitat at the Terminal; Pretreatment Facility; Stratton Ridge Meter Station; Heavy Haul Road; and offsite workspaces Areas A, C, D, E, F, G, and H, we determined that construction and operation of these facilities would have ***no effect*** on protected species.

Also, because the Train 4 Project does not propose a change in shipping volume or procedures at the Terminal and LNG carrier transit routes and barge traffic during construction would be similar to current levels (section A.8.5.2), we determined that this Project would have ***no effect*** on open-ocean species.

6.1.2. Pipeline Corridor and Offsite Workspace Area B

We assessed the potential for federally protected species to be present within the Pipeline Corridor and Offsite Workspace Area B and for construction and operation of the Project to affect them, as summarized in appendix B, and determined that the Project would have ***no effect*** or ***may affect but not likely to adversely affect*** federally protected species.

6.2. Critical Habitat

Critical habitat has been designated for the overwintering population of the piping plover in Texas (74 FR 23,476). The closest critical habitat unit (TX-33) is a 3.5-mile-long section of

Gulf-side sandy beach about 0.4 mile southwest of the Project area. This habitat would not be affected by the Project.

6.3. State-listed Species

Freeport LNG conducted field surveys to determine suitable habitat for state-listed species. Details on the habitat for these species and an effects determination for each species is included in appendix B.

Freeport LNG submitted a Project introduction letter to the TPWD on May 11, 2015; a Project-update letter on August 22, 2016; and email correspondence on December 15, 2016. Freeport LNG will continue agency communications as appropriate during Project development. Additional correspondence with the TPWD will be filed with the Commission following issuance or receipt by Freeport LNG.

6.4. Federally and State-listed Species Conclusions

As detailed in appendix B, we have determined that the Train 4 Project would have ***no effect*** or ***may affect but not likely to adversely affect*** federally listed species and critical habitat.

Because consultation with FWS and NMFS has not been completed, **we recommend that**:

Freeport LNG shall <u>not begin</u> Project construction activities <u>until</u>:

a. **FERC staff receives comments from the FWS and NMFS regarding the proposed action;**
b. **FERC staff completes any necessary Section 7 ESA consultation with the FWS and NMFS; and**
c. **Freeport LNG has received written notification from the Director of OEP that construction or use of mitigation may begin.**

6.5. Migratory Birds

The Migratory Bird Treaty Act (MBTA) generally prohibits the take or killing of individual migratory birds, their eggs and chicks, and active nests. The MBTA provides 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 to pursue, hunt, shoot, wound, kill, trap, capture, or collect (50 CFR § 10.12). Executive Order 13186 (January 2001) directs federal agencies to consider the effects of agency actions on migratory birds, with emphasis on species of concern, priority habitat, and key risk factors.

6.5.1. Existing Conditions

Migratory birds follow broad routes or "flyways" between breeding grounds in Canada and the U.S. and wintering grounds in Central and South America. The Upper Coast of Texas (which includes Quintana Island) is within the Central Flyway, and may also be transited by birds of the Atlantic, Mississippi, and Pacific Flyways (Shackelford et al., 2005). It provides habitat for more than 300 bird species, including both non-migratory (resident) and migratory species.

The FWS lists 44 Birds of Conservation Concern within the Gulf Coastal Prairie Bird Conservation Region (FWS, 2008). Birds of Conservation Concern, and their preferred habitats, potentially occurring within the Project area are described in in appendix C.

During field surveys in May 2016, an active colonial waterbird rookery was documented about 435 feet west of the Pipeline Corridor near MP 6.4, as depicted in figure B 6-1. The rookery includes several trees and encompasses an estimated 3.8 acres on the opposite (west) side of the Velasco Levee (CR 690 – Levee Road) from the Project, adjacent to the western Velasco Ditch. Several species of colonial waterbirds were observed during field surveys in 2016 and 2017, including great egrets (*Ardea alba*), great blue herons (*A. herodias*), black-crowned night herons (*Nycticorax nycticorax*), double-crested cormorants (*Phalacrocorax auritus*), and roseate spoonbills (*Platalea ajaja*).

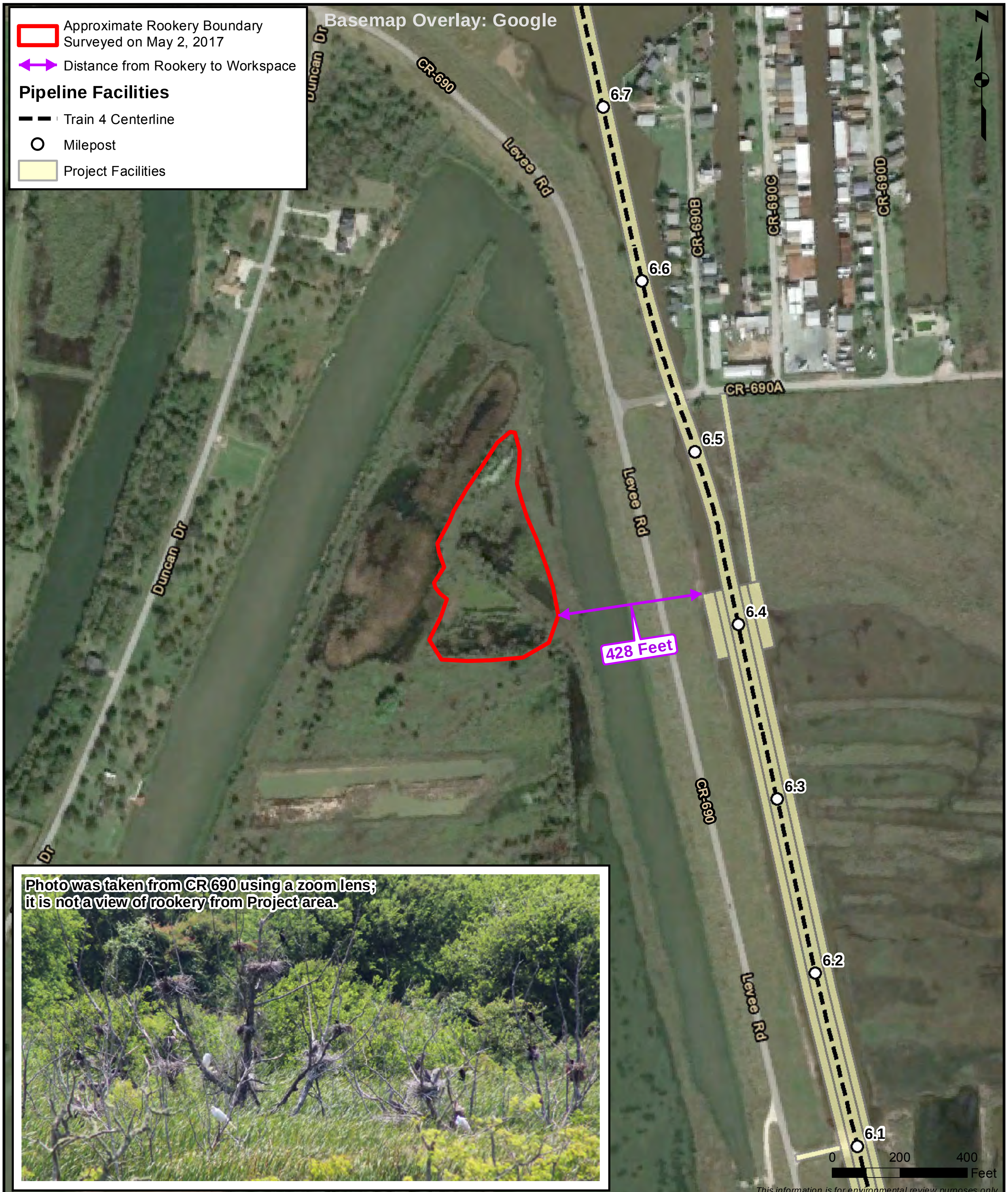


Figure B 6-1

Freeport LNG - Train 4 Project

Active Colonial Waterbird Rookery along the Train 4 Pipeline

Brazoria County, Texas

| REVISED: 10/11/2017 | SCALE: 1:4,800 DRAWN BY: 0239

6.5.2. Impacts and Mitigation

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. Avian fatalities can be associated with attraction to light sources, especially in low light, fog, and when there is a low cloud ceiling (Orr et al., 2013), causing collisions with facility components. To address this concern, Freeport LNG conducted a four-year bird-strike study at the Terminal, during 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 attributed to these structures. None of the birds were migratory Birds of Conservation Concern. Further, no migratory bird collisions have been documented since construction of the Phase II Modification Project and Liquefaction Project began. Based on the results of this study, the Train 4 Project components do not pose a significant potential for bird strikes.

Direct, indirect, and cumulative effects on migratory birds were evaluated in the Final EIS for the Phase I Project (FERC, 2004), the EA for the Phase II Project (FERC, 2006), and the Final EIS for the Phase II Modification Project and Liquefaction Project (FERC, 2014). Mitigation measures were developed through discussions with the FWS's Clear Lake Ecological Service Office and Albuquerque Migratory Bird Permit Office. During construction, Freeport LNG would follow the Liquefaction Project's Migratory Birds Conservation and Compliance Plan and Facility Lighting Design Plan, updated to include the Train 4 Project.

The species identified in the rookery near MP 6.4 are typically wary of human activity; however, this rookery is about 300 feet west of CR 690, 600 feet southwest of a residential community (Turtle Cove), and 0.5 mile north of the Pretreatment Facility. The rookery is separated from the Project area by the 20-foot-high Velasco Levee (on which CR 690 is located); this levee forms a barrier that reduces potential impacts from elevated noise and lighting levels during construction.

The greatest potential to affect this rookery would be associated with the Direct Pipe installation of the pipeline beneath Oyster Creek (installation would occur between MPs 6.4 and 6.8). Because activities would occur within 1,000 feet of this rookery, Freeport LNG has coordinated with the FWS to develop the following avoidance measures. Measures to be implemented include the following:

- With the exception of Project-related traffic along CR 690, construction activities would be avoided within 1,000 feet of the rookery while it is active (typically March 1 through late August).
- The Direct Pipe installation beneath Oyster Creek, between MPs 6.4 and 6.8, would be scheduled to occur when the rookery is inactive (typically September 1 through February 28).
- No construction activities would begin within 1,000 feet of the rookery while it is active. Although Freeport LNG would schedule activities to avoid the active rookery season (as described above), if an ongoing activity cannot be completed prior to the rookery becoming active, the activity would be allowed to continue to completion.

- Vegetation clearing would be scheduled to occur outside of the primary nesting season.

Based on our analysis, Freeport LNG's use of the Liquefaction Project's Migratory Birds Conservation and Compliance Plan and Facility Lighting Design Plan, and the specific measures associated with the rookery, we conclude that construction and operation of the Project would not have significant effects on migratory birds.

7. Land Use

The existing land use setting and the proposed changes to that setting for the Terminal, Pretreatment Facility, and Pipeline Corridor are described below.

7.1. Existing Conditions

7.1.1. Quintana Island Terminal

The Train 4 Project would be located within the existing Terminal, which is within the Port Freeport Industrial District and zoned for industrial development. As depicted in figure B 7-1, land use within the Terminal is classified exclusively as industrial/developed land. The Terminal site is bounded by open water to the north (ICW) and east (FHC), open land that was previously used for dredged material placement to the west and south, industrial land to the south that is currently being used for temporary workspace associated with the Liquefaction Project (Area A), and a combination of residential land (town of Quintana) and open land (coastal grass/scrub upland) to the southeast.

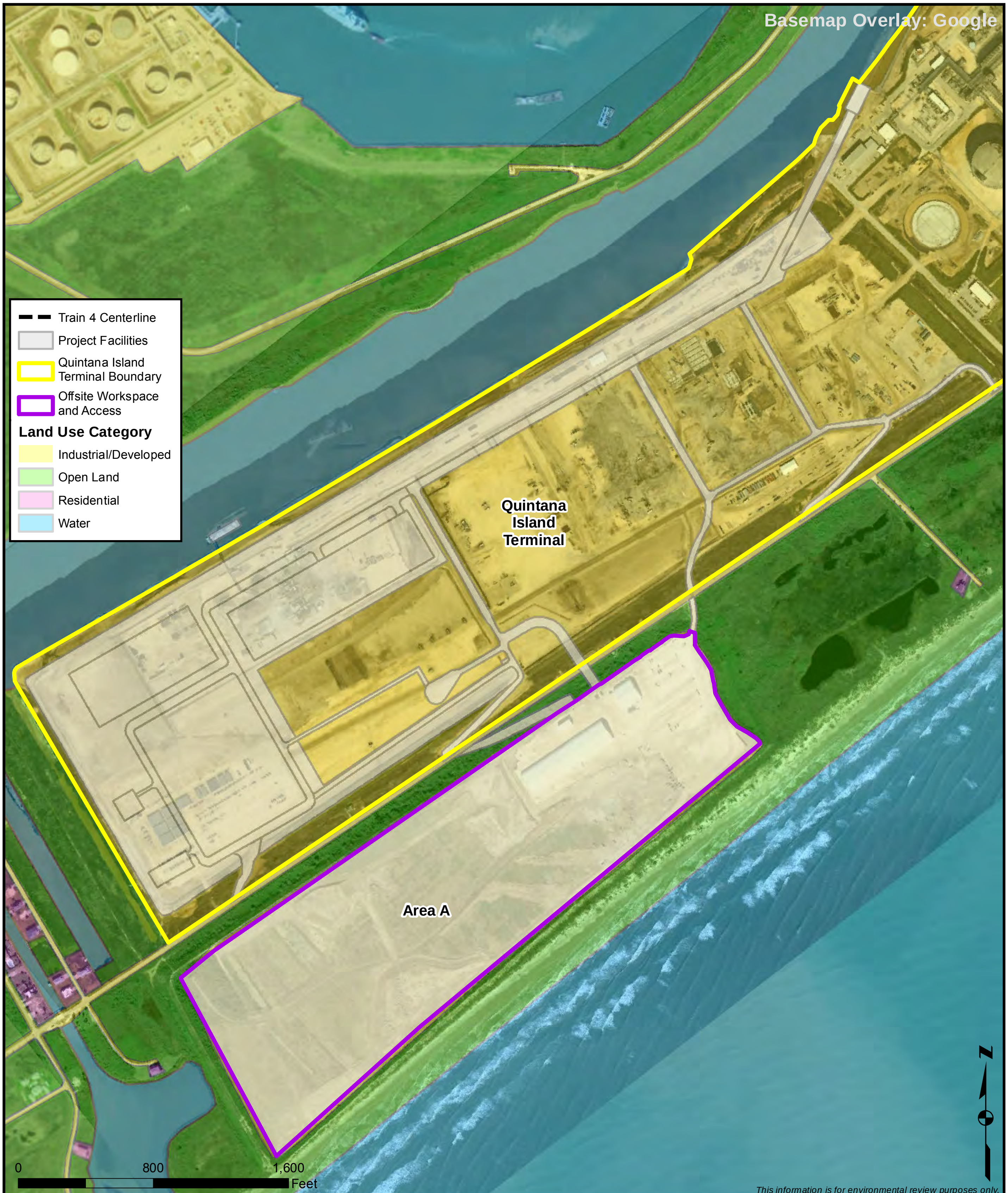


Figure B 7-1
Freeport LNG - Train 4 Project
Existing Land Use Types at and Adjacent to the Quintana Island Terminal
Brazoria County, Texas

| REVISED: 03/06/2017 | SCALE: 1:9,600 DRAWN BY: 0239

7.1.2. Pretreatment Facility

The Pretreatment Facility is in a semi-rural area where cattle grazing is the primary land use. The area also includes residential and commercial development, roads, and oil and gas production and storage infrastructure. As depicted in figure B 7-2, land use within the Pretreatment Facility is classified as industrial/developed or open land, with areas of open land and water present along the northeastern and southern portions of the Facility.

The Pretreatment Facility is bounded to the east by the Velasco Levee, to the east and north by a relict oxbow of Oyster Creek, and to the northwest by another relict oxbow of Oyster Creek along the site's boundary. East of the Levee exists an expanse of intertidal EEM wetlands that extends into the Brazoria NWR, located about 0.7 mile northeast of the Facility. Open pasture land occurs both north and southeast of the Pretreatment Facility. A cellular telephone tower is located 0.5 mile south of the Pretreatment Facility.

Figure B 7-2
Freeport LNG - Train 4 Project
Existing Land Use Types at and Adjacent to the Pretreatment Facility
Brazoria County, Texas

| REVISED: 03/06/2017 | SCALE: 1:9,600 DRAWN BY: 0239

7.1.3. Pipeline Corridor

About 8.5 miles of the 10.6-mile-long Pipeline Corridor would be located within existing aboveground facility sites or collocated with existing pipeline/utility corridors. The portions of the Pipeline Corridor located within the existing Terminal, authorized Pretreatment Facility, and existing Stratton Ridge Meter Station would be constructed in land that is predominantly classified as industrial/developed, with a small portion of open land located within the Pretreatment Facility boundary.

Land uses associated with portions of the Pipeline Corridor outside of the boundaries of existing or authorized aboveground facilities include open lands comprised of emergent wetland and pastureland used for cattle grazing and industrial/developed land. The Project would not directly affect any lands classified as residential. Residential areas are present near the Pipeline Corridor at the periphery of the City of Surfside Beach (between MPs 0.8 and 1.2), near Bridge Harbor Yacht Club (between MPs 2.1 and 2.3), and near Turtle Cove (between MPs 6.5 and 6.7).

Five segments of the route are not collocated or within existing facility fence lines. For the portion of the route that is collocated with the existing pipeline/utility corridor, the new facilities would be installed within the existing and additionally negotiated permanent easement.

7.1.4. Offsite Work Areas

Construction of the Train 4 Project would require the use of offsite workspaces (Areas A, B, C, D, E, F, G, and H) and Heavy Haul Road.

Areas A, C, D, E, F, G, and H are classified as industrial/developed. They have undergone prior FERC review and are currently being utilized for laydown and construction workspace areas associated with the Liquefaction Project. Land use within Area B, located across CR 690 (Levee Road) to the east of the Pretreatment Facility and owned by subsidiaries of Freeport LNG Development, is currently open pastureland.

7.2. Impacts from the Train 4 Project

Table 14 shows the acreage impacts associated with construction and operation of the Train 4 Project for the three land uses present within the Project area (open land, industrial/developed land, and open water). Construction of the Project would affect a total 556.4 acres of land, about 57 percent (316.6 acres) of which would consist of temporary impacts associated with construction of the Project, while the remaining 43 percent (239.8 acres) would be permanently affected.

7.2.1. Quintana Island Terminal

Construction of Train 4 and the ancillary facilities would require 96.3 acres of land within the Terminal, which occupies 399.5 acres of land. The existing construction dock, aggregate dock, and roads, which occupy a total of 15.3 acres within the Terminal boundary, would be utilized during construction of the Train 4 Project; however, these are existing facilities associated with the Liquefaction Project and would not be considered part of the operational footprint for the Train 4 Project.

Operation of the Train 4 Project facilities at the Terminal would affect a total of 81.0 acres of land. Of this total, Train 4 and the ancillary facilities would permanently occupy a total of 22.1 acres of land. The remaining 52.2 acres is comprised of land that would be used as workspace during construction and then maintained as industrial/developed land during operation of the Project.

All areas within the Terminal are classified as industrial/developed. Effects on land use associated with the Train 4 Project within the Terminal would be insignificant, as they would be consistent with the existing land use classification.

7.2.2. Pretreatment Facility

Construction of Unit 4 and ancillary facilities would be entirely within the authorized Pretreatment Facility, which is currently under construction, and would affect 136.5 acres of land. Of this, 42.5 acres of land are currently occupied by the existing stormwater retention pond, water detention pond #1, and existing roads associated with the authorized Liquefaction Project. As such, these areas would not be considered part of the operational footprint for the Train 4 Project.

Operation of Unit 4 would affect a total of 94.0 acres of land. Of this, Unit 4 and ancillary facilities (tank storage area, inlet and outlet compression area, electric substation, utility area, firewater pumps, water detention pond #2, and plant roads) would permanently occupy a total of 11.3 acres of land. The remaining 82.7 acres is comprised of land to be used as workspace during construction. After construction, these areas would be maintained as industrial/developed land during operation of the Project.

All areas within the Pretreatment Facility boundary have been affected by construction of the Liquefaction Project and are currently classified as industrial/developed. Impacts on land use associated with the Train 4 Project within the Pretreatment Facility would be insignificant, as they would be consistent with the existing land use classification.

TABLE 14

Land Use Impact Acreage

Facilities	Open Land a/ b/		Industrial/Developed a/ c/		Open Water a/ d/		Total a/	
	Const	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.
Quintana Island Terminal								
Proposed	0.0	0.0	74.3	74.3	0.0	0.0	74.3	74.3
Existing – to be modified	0.0	0.0	6.7	6.7	0.0	0.0	6.7	6.7
Existing – to be used without modification	0.0	0.0	15.0	0.0	0.2	0.0	15.3	0.0
Subtotal Quintana Island Terminal:	**0.0**	**0.0**	**96.0**	**81.0**	**0.2**	**0.0**	**96.3**	**81.0**
Pretreatment Facility								
Proposed	0.0	0.0	94.0	94.0	0.0	0.0	94.0	94.0
Authorized – to be used without modification	0.0	0.0	42.5	0.0	0.0	0.0	42.5	0.0
Subtotal Pretreatment Facility:	**0.0**	**0.0**	**136.5**	**94.0**	**0.0**	**0.0**	**136.5**	**94.0**
Pipeline Corridor								
Subtotal Pipeline Corridor:	**100.5**	**43.6**	**21.0**	**6.2**	**20.6**	**14.0**	**142.0**	**63.8**
Offsite Workspace and Access Roads								
Subtotal Offsite Workspace and Access Roads:	**27.7**	**0.0**	**153.4**	**0.0**	**0.0**	**0.0**	**181.1**	**0.0**
Project Total	**128.2**	**43.6**	**407.0**	**181.3**	**20.8**	**14.0**	**556.0**	**238.9**

a The numbers in this table have been rounded for presentation purposes; the totals may not reflect the sum of the addends.
b Open land – non-forested lands used for open space or pasture.
c Industrial/developed land – electric power or gas utility stations, manufacturing or industrial plants, landfills, mines, quarries, commercial or retail facilities, residential yards and subdivisions, and roads.
d Open water – water crossings greater than 100 feet

7.2.3. Pipeline Corridor

The Underground Facilities would be constructed partially within the existing Terminal (0.2 mile), authorized Pretreatment Facility (0.6 mile), and existing Stratton Ridge Meter Station (< 0.1 mile). The Pipeline Corridor would both start and end within existing aboveground facilities and would maximize collocation with the Liquefaction Project and other existing pipeline/utility corridors (7.7 miles). Five segments of the route are not collocated or within existing facility fence lines. The segments that are not collocated would be installed by HDD or Direct Pipe methods with no anticipated impacts on natural resources, except for one segment between MP 6.8 to 7.3, which was routed which was routed away from the existing pipeline/utility corridor at the request of the Brazoria NWR to avoid a newly acquired tract. Where the Underground Facilities would be collocated, they would generally be installed with a 20-foot offset from the existing pipeline or utility line within the existing and additionally negotiated permanent easement. A nominal 50-foot permanent easement would be retained during operation. A detailed milepost-by-milepost identification of right-of-way widths and overlap with existing rights-of-way is located in the table in Appendix D.

Pipeline

As proposed, construction of the Underground Facilities would use a nominal 100-foot-wide construction right-of-way in most areas, except for 130-foot widths along an open-cut segment from MP 4.8 to MP 5.1 within the Pretreatment Facility and a 150-foot width along a push-pull wetland crossing segment MP 1.0 to MP 1.3. These construction rights-of-way would encompass the existing permanent easement (generally 30 or 50 feet wide) associated with the existing Freeport pipeline. We have recommended that Freeport LNG provide additional justification of construction right-of-way widths greater than 75 feet in wetlands. The construction right-of-way acreage would include 130.0 acres of land (98.2 acres of open land, 11.8 acres of industrial/developed land, and 20.0 acres of open water). Of the 20.0 acres of open water, 8.3 acres would be within areas to be crossed using the HDD or Direct Pipe installation method; therefore, effects on these areas would not be anticipated.

Operation of the Pipeline would require a 50-foot-wide permanent easement, generally overlapping or adjacent to the existing 30- or 50-foot-wide easement, that would affect 62.1 acres of land. Land use classifications within the permanent easement would not change because of the Project.

ATWS would be required for road crossings, parking areas, and wetland and waterbody crossings. The location, size, existing land use, and reason each ATWS is needed are listed in table 15. Following construction these areas would be restored and returned to preconstruction land use.

TABLE 15

Land Use Acreages for ATWS

Starting MP	Reason Needed	Number of Additional Temporary Workspaces	Total Land Required (acres)	Existing Land Use (acres)		
				Industrial/ Developed	Open Land	Open Water
0.0	Direct Pipe entry, drilling rig staging	3	6.2	6.2	0.0	0.0
1.0	Direct Pipe exit, road crossing	3	0.5	0.0	0.5	0.0
1.0	Push/pull workspace, HDD exit (MP 1.3)	1	1.8	0.0	1.8	0.0
1.7	HDD entry	1	0.7	0.0	0.7	0.0
1.8	Construction parking	1	0.2	0.0	0.2	0.0
2.0	Bore exit	2	0.2	0.1	0.1	0.0
2.1	Bore entry, PI	2	0.2	0.0	0.2	0.0
2.4	PI, extra spoil storage	2	0.3	0.0	0.3	0.0
2.4	HDD entry, PI	1	0.2	0.0	0.2	0.0
2.4	PI	1	<0.1	0.0	<0.1	0.0
2.4	HDD entry	1	0.2	0.0	0.2	0.0
3.6	HDD exit	2	0.3	0.0	0.2	0.2
3.9	Push/pull workspace, PI	1	1.5	0.0	1.5	0.0
4.2	Push/pull workspace, PI	1	0.5	0.0	0.4	0.1

TABLE 15

Land Use Acreages for ATWS

Starting MP	Reason Needed	Number of Additional Temporary Workspaces	Total Land Required (acres)	Existing Land Use (acres)		
				Industrial/ Developed	Open Land	Open Water
4.3	PI	1	<0.1	0.0	<0.1	0.1
4.4	Direct Pipe exit, pipe stringing, drill rig staging	1	8.5	0.0	7.1	1.4
4.8	Direct Pipe entry, PI	1	0.1	0.0	0.1	0.0
5.1	Direct Pipe entry, PI	1	0.2	0.0	0.1	<0.1
5.6	Push/pull workspace	1	0.3	0.0	0.3	<0.1
5.7	Road crossing	2	0.1	<0.1	0.1	<0.1
6.4	Direct Pipe exit	2	0.3	0.0	0.1	0.2
6.8	Direct Pipe entry, drill rig and pipe staging	1	2.8	0.0	2.8	0.0
6.8	Direct Pipe entry, pipe stringing	1	2.1	0.0	2.1	0.0
7.2	Bore entry, PI	2	0.3	0.0	0.3	0.0
7.2	Bore exit, PI	1	1.4	0.0	1.4	0.0
7.3	Road crossing	2	0.1	0.0	0.1	0.0
7.9	Road crossing	1	0.1	0.0	0.1	0.0
7.9	PI	1	0.1	0.0	0.1	0.0
8.3	Utility crossing	1	0.1	0.0	0.1	0.0
9.1	Road crossing	2	0.1	0.0	0.1	0.0
9.4	Utility crossing	1	0.1	0.0	0.1	0.0
9.6	Waterbody crossing	2	0.1	0.0	0.1	0.0
9.7	Utility crossing	1	0.1	0.0	0.1	0.0
9.9	PI	1	0.1	0.0	0.1	0.0
10.3	Bore exit, PI	1	0.5	0.0	0.5	0.0
10.4	Bore entry, PI	1	0.4	0.0	0.4	0.0
TOTAL			**30.7**	**6.3**	**22.5**	**2.0**

PI Point of inflection in the pipeline

Aboveground Facilities

Minor modifications associated with the Pipeline within existing aboveground-facility fence lines would include 2.7 acres of land classified exclusively as industrial/developed. Proposed modifications within the Terminal and Pretreatment Facility would include the addition of pigging facilities. Proposed modifications at the Stratton Ridge Meter Station would include the installation of one pig launcher/receiver, five valves, and associated bypass piping.

Access Roads

Construction of the Underground Facilities would require eight new temporary access roads and use of seven existing roads to access the construction right-of-way (table 16). Existing roads used for access would be widened and/or graveled; new access roads would be returned to preconstruction condition following construction of the Project.

TABLE 16

Temporary Access Roads Along the Pipeline Corridor

MP	Width x Length (feet)	New or Existing Road	Improvements	Total Land Required (acres)	Existing Land Use (acres)		
					Industrial/ Developed	Open Land	Open Water
1.3	20 x 123	New	Grade, add gravel	0.1	<0.1	<0.1	0.0
1.7	20 x 44	New	Grade, add gravel	<0.1	<0.1	<0.1	0.0
2.0	20 x 24	New	Grade, add gravel	<0.1	<0.1	<0.1	0.0
2.1	20 x 109	New	Grade, add gravel	0.1	<0.1	<0.1	0.0
3.4	20 x 904	Partially existing; Cone Island Road, partially new	Widen, add gravel; grade, add gravel	0.4	0.1	0.3	<0.1
5.7	20 x 2,504	New	Grade, add gravel	1.2	<0.1	1.2	0.0
6.1	20 x 137	Existing – private road	Widen, add gravel	0.1	<0.1	0.0	0.0
6.5	20 x 566	New	Grade, add gravel	0.3	<0.1	0.3	0.0
6.8	20 x 600	Existing – two-track	Grade, add gravel	0.3	<0.1	0.3	0.0
7.4	20 x 49	Existing – private road	Widen, add gravel	<0.1	<0.1	<0.1	0.0
7.9	20 x 58	Existing – unnamed gravel road	Widen, add gravel	<0.1	<0.1	<0.1	0.0
8.0	20 x 211	Existing – two-track	Grade, add gravel	0.1	<0.1	0.1	0.0
9.1	20 x 118	Existing – unnamed gravel road	Widen, add gravel	0.1	<0.1	<0.1	0.0
9.4	20 x 165	Existing – unnamed gravel road	Widen, add gravel	0.1	<0.1	<0.1	0.0
9.7	20 x 138	New	Grade, add gravel	0.1	0.0	0.1	0.0
TOTAL				**2.3**	**0.5**	**1.8**	**<0.1**

Construction of the Underground Facilities would affect a total 142.5 acres of land (70 percent open land, 16 percent industrial/developed land, and 14 percent open water). Operational impacts would include 62.1 acres of land within the permanent pipeline easement and 2.8 acres of land associated with the aboveground facility modifications.

7.2.4. Offsite Workspace and Access

Offsite workspaces would include a total of 181.1 acres of land. Table 14 identifies the acreage by land use that each workspace would affect, and descriptions of each offsite workspace and access area are provided in section A.9.6.

Areas A, C, D, E, F, G, and H have been previously improved and stabilized to provide a suitable surface for temporary construction workspaces associated with the authorized Liquefaction Project and would remain classified as industrial/developed following construction of the Train 4 Project. Area B (27.7 acres) is classified as open land and would be restored to its original land use of pastureland following construction of the Project.

Heavy Haul Road is classified as industrial/developed land. No improvements to the road would be required.

7.3. Recreation and Special Interest Areas

7.3.1. Existing Conditions

Recreational resources and activities near the Terminal and Pretreatment Facility include boating and fishing in the Gulf of Mexico and adjoining waterbodies, camping, hunting, bird watching, and public beach use.

Quintana Island Terminal

Designated recreational areas on and near Quintana Island include Morrison Park, the Bryan Beach unit of the Justin Hurst WMA, Quintana Beach County Park, Quintana NBS, and Xeriscape Park. The closest designated recreational area to the Project is Morrison Park, which is located on CR 723 (Lamar Street) about 0.2 mile southwest of 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 FM 1495 and about 2.6 miles southwest of the Terminal. Quintana Beach County Park is a 52-acre park with amenities such as recreational vehicle campsites, self-contained cabins, 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. The campground associated with the Quintana Beach County Park is located more than 0.5 mile from the Terminal. The Quintana NBS and Xeriscape Park are discussed more fully in section B.5.3.

Pretreatment Facility

The closest recreational area to the Pretreatment Facility is the Brazoria NWR, which is located about 0.7 mile 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 Facility 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.

Pipeline Corridor

No significant recreational or special interest areas beyond those discussed already for the Terminal site and the Pretreatment Facility site.

7.3.2. Impacts and Mitigation

Quintana Island Terminal

None of the designated recreational areas on and near Quintana Island would be directly affected by construction or operation of the Project. Visitor traffic for both areas would be addressed as necessary in Freeport LNG's updated Transportation Management Plan.

Based on experience with the previous and ongoing activities at the Terminal, safety or security exclusion zones implemented around the Terminal would not affect recreational uses in the area; however, the additional barge traffic during construction may lead to minor delays or inconvenience for boating and fishing.

Pretreatment Facility

While the nearest section of the Brazoria NWR is relatively near the Pretreatment Facility 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 Facility and the fact that the only public road entrance to the NWR is far removed geographically from the site, the Project would not have any significant effect on the NWR or its visitors. Further, no impacts have been reported resulting from the previous and ongoing activities at the facility.

Pipeline Corridor

No significant recreational or special interest areas beyond those discussed already for the Terminal site and the Pretreatment Facility site.

7.4. Residential Areas

No residential areas would be directly affected by the Project; however, residential areas near the Project could be indirectly and/or temporarily affected.

7.4.1. Existing Conditions

Quintana Island Terminal

The town of Quintana is located south of and adjacent to the Terminal site at the east end of Quintana Island. According to the U.S. Census Bureau, as of 2010 there were 82 residents on Quintana Island (U.S. Census Bureau, 2010). Most residences are located over 1.5 miles east-northeast of the Train 4 Project areas, which are in the southwest end of the Terminal. One residential area, the Bryan Beach subdivision, is located less than 0.2 mile west of the Train 4 Project facilities at its closest point; however, Freeport LNG and/or affiliated companies have purchased these residences (section B.12.2), so they are no longer considered to be residences for purposes of this analysis.

Pretreatment Facility

Three sparsely populated residential communities are near the Pretreatment Facility. Two of the communities are located 0.2 mile from the Pretreatment Facility site boundary at the closest point; one of the communities is located west of the facility along CR 230 (Stringfellow Road) and the other is located north of the facility along Duncan Drive. The third residential community is located about 0.4 mile west of the site boundary at its closest point along Elm Street. The residential community of Turtle Cove is about 1 mile north of the Pretreatment Facility along Levee Road. Within these communities, the closest houses to the Train 4 Project facilities are within the geographic boundary of the City of Freeport. Although these communities are near the Pretreatment Facility boundary, the nearest residence is located more than 0.5 mile from the Train 4 Project facilities.

Pipeline Corridor

Residential areas present along the Pipeline Corridor, beyond Quintana Island, include the periphery of the City of Surfside Beach (between MPs 0.8 and 1.2), Bridge Harbor Yacht Club (between MPs 2.1 and 2.3), and Turtle Cove (between MPs 6.5 and 6.7).

There are no residences located within 25 feet of the pipeline workspace. One residence is located within 50 feet of the proposed pipeline centerline near MP 6.6 and about 35 feet east of the permanent easement at its closest point. Within this area, the pipeline would be collocated with the existing 42-inch-diameter natural gas pipeline and would be installed using the Direct Pipe method. The entry and exit locations for the equipment would be located about 0.2 mile from the nearest residence.

Offsite Workspace and Access

Offsite Workspace Areas A, B, C, D, E, F, G, and Heavy Haul Road are more than 0.5 mile from residential areas.

Offsite Workspace Area H is located within a residential portion of Freeport. Prior to the Liquefaction Project, this area consisted of paved parking lots and storage areas. It is currently being used for equipment storage when other offsite workspace areas are full and for additional parking during training events. Pending the extension of existing lease agreements, Freeport LNG would continue use of this area consistent with existing uses and lease agreements. Following construction, it would be returned to the original landowner without restoration. Although it is adjacent to residential areas, the proposed uses are consistent with the current uses and no significant impacts would occur.

7.4.2. Impacts and Mitigation

Quintana Island Terminal and Pretreatment Facility

The Project facilities at the Terminal and Pretreatment Facility would be similar to those authorized and currently under construction in association with the Liquefaction Project and would be located within the existing Terminal and Pretreatment Facility boundaries. Temporary construction impacts on residential areas can include inconveniences caused by noise and traffic, while permanent operational impacts can include changes in the visual setting. Impacts on residences associated with the Project activities within the Terminal and Pretreatment Facility would be insignificant and similar to impacts evaluated for the previously authorized Phase II Modification and Liquefaction Projects.

Pipeline Corridor

Temporary effects on the residential areas described above, including increased noise and traffic levels could occur during construction of the Underground Facilities. However, impacts would be expected to be limited to the period of construction and insignificant. Operation of the Underground Facilities would not affect these residential areas.

7.5. 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 from a project is typically determined by the general character of the existing landscape and the visually prominent features of the facilities. A Visual Simulation Study was conducted for the Train 4 Project from seven locations near the Terminal (accession number: 20171026-5273).

7.5.1. Existing Conditions

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 Project at the Terminal site, there would likely be temporary visual impacts on residences on Beach Lake Drive, located directly south of the Train 4 Project, and to other residences in the Town of Quintana. Construction of the Train 4 Project facilities at the Terminal would coincide with and sequentially follow construction of the previously evaluated Liquefaction and Phase II Modification Projects (FERC 2014).

The area surrounding the Terminal is subject to a substantial amount of industrial lighting from nearby industrial facilities, including the Terminal, which has been operational since 2008. In addition, nighttime facility lighting associated with both construction and operation of the Liquefaction Project would be in place prior to construction and operation of the Train 4 Project.

During construction and operation of Unit 4, which would be located within the boundary of the existing Pretreatment Facility, the greatest potential visual impacts would likely involve residences along CR 230 and Elm Street, located west of the Pretreatment Facility site. The closest of these residences is situated over 0.5 mile from the Train 4 Project facilities. Views of the site from other directions would be much more distant and from unpopulated areas across open land. We previously conducted visual simulations across the Pretreatment Facility site that showed the Pretreatment Facility added an industrial dimension to the otherwise open landscape, though the distance of separation between the Facility and the closest residence helped to minimize visual impacts (FERC, 2014).

To minimize the effects of Pretreatment Facility lighting on local residents, Freeport LNG developed a Facility Lighting Design Plan for the Liquefaction Project. 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 API's Recommended Practice 540 *Recommended Practice for Electrical Installations in Petroleum Processing Plants*.

During operation, the greatest potential visual impacts would be associated with permanent structures and likely involve residences along Duncan Drive, located north of the Pretreatment Facility.

For the Pipeline Corridor, 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 modifications proposed at existing aboveground facilities and pipeline markers, no permanent visual impacts would be associated with operation of the Underground Facilities.

With the exception of Area B, each of the offsite workspaces and access areas is already in use for the Liquefaction Project. As such, visual impacts of these offsite workspaces would be expected to be minimal, because residents and the public would be accustomed to seeing similar construction equipment and activities in these areas. Activities at Area B would be unique to this location but similar to the current construction activities in the area.

7.5.2. Impacts and Mitigation

Quintana Island Terminal

Residents and the public would be accustomed to seeing similar construction equipment and activities at the Terminal, and the distinction between the visual effects of previously evaluated Liquefaction and Phase II Modification Projects (FERC 2014), and Train 4 Project construction would be minimal. The Visual Simulation Study for the Train 4 Project illustrates that the proposed facilities are similar to the surrounding industrial infrastructure, and given the distance of separation between the proposed facilities and nearby residences, visual impacts during construction of the Train 4 Project would be minimal.

All viewpoints that would be potentially affected by operation of the Train 4 Project already have a substantial amount of industrial lighting via the lighting from the existing Freeport LNG terminal, and from other industrial facilities in the area. In addition, Freeport LNG would follow its Project-specific Facility Lighting Design Plan. Given the industrial lighting already existing in the area and Freeport LNG's mitigation efforts that help minimize glare and extension of lighting off site, the additional lighting impacts would not be expected to be significant.

Pretreatment Facility

The Visual Simulation Study (discussed above) was conducted from three locations near the Pretreatment Facility (to the northwest, south, and east). Based on results of the Visual Simulation Study and mitigation measures, we conclude that although the viewshed for some portion of the local population would be affected, this impact would not be significant because only a portion of the Facility would be visible above the levee and only by a limited number of people. Further, Freeport LNG would follow the measures outlined in the Facility Lighting Design Plan to minimize impacts associated with the additional lighting required for the Unit 4 facilities at the Pretreatment Facility. Based on results of the Visual Simulation Study and proposed mitigation measures, and because the Unit 4 facilities would be located within the fence line of the Pretreatment Facility and would be consistent in appearance with the authorized facilities, it is anticipated that operation of the Train 4 Project would have an insignificant effect on visual character and aesthetic quality.

Offsite Workspace and Access

Offsite Workspace Areas A, C, D, E, F, G, and H, (153.4 acres, total) have undergone prior FERC review and are currently being used for the Liquefaction Project. Pending the extension of existing lease agreements, Freeport LNG would use these areas in a manner consistent with current uses for offsite workspace during construction of the Train 4 Project. Following construction, these areas would be returned to the original landowner without restoration. Visual impacts associated with these areas would be insignificant because residents are accustomed to the existing construction equipment and activities in these areas.

Area B would be located within open land across CR 690 from the Pretreatment Facility. Construction activities and equipment movement may have temporary impacts on the viewshed in this area. In particular, the use of nighttime lighting within Area B could affect nighttime views, particularly for nearby residents. Nighttime lighting used within Area B would be down-shielded to minimize stray light to the surrounding environment, consistent with the Facility Lighting Design Plan. Further, because of its proximity to the Pretreatment Facility, which would also utilize nighttime lighting for safety and security, potential impacts on visual resources would be expected to be temporary and insignificant.

Based on results of the Visual Simulation Study and proposed mitigation measures, and given the surrounding similar industrial infrastructure and the distance of separation between the proposed facilities and nearby residences, we conclude that the impact of the Train 4 Project on visual character and aesthetic quality would not be significant.

7.6. Coastal Zone Management

The Coastal Zone Management Act (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 Project is consistent with the state's coastal management program. Because the Train 4 Project would be 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. To obtain a federal permit in Texas, an applicant must document consistency with the TCMP. 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.

Proposed actions subject to the TCMP must be deemed consistent with the program to be authorized. Freeport LNG would seek confirmation of consistency through consultation with the CCC and the RRC as part of the COE Section 404/10 permitting effort for the Train 4 Project. A determination from the CCC that the Train 4 Project is consistent with the laws and rules of the TCMP must be received before FERC issues a notice to proceed for construction of any Train 4 Project facilities. Therefore, **we recommend that:**

> **Prior to construction of the Project, Freeport LNG should file with the Secretary a copy of concurrence from the Coastal Coordination Council that the Project is consistent with the Texas Coastal Management Program.**

7.7. Planned Developments

No commercial or residential developments are proposed on Quintana Island or near the Train 4 Project. Planned individual residences were identified during public-comment periods (section A.5.2) and avoided through rerouting of the Pipeline alignment, as discussed in section C.4.3.

7.8. Land Ownership

The Terminal (including the Train 4 Project area) is currently under long-term lease agreements with Port Freeport. The Pretreatment Facility and Stratton Ridge Meter Station are owned or leased by Freeport LNG or an affiliated entity. As described above, about 87 percent of the proposed Pipeline route would be located within existing aboveground facility sites or collocated with the existing pipeline/utility corridors. Easement agreements are currently in place with private landowners for the existing pipelines, and Freeport LNG would work with property owners to secure any new or modified easement agreements.

8. Socioeconomics

The assessment of socioeconomics includes an evaluation of the Project's effects on local population, employment, the economy, housing, public services, traffic, property values, tax revenue, and environmental justice. The Project would be constructed on Quintana Island, which is immediately south of the City of Freeport and near the City of Oyster Creek in Brazoria County.

8.1. Existing Conditions

Socioeconomically, Brazoria County contains two defined regions: Brazosport and northeast Brazoria County. The Project is in Brazosport, which is a multi-city Gulf Coast region about 50 miles south of Houston at the mouth of the Brazos and San Bernard Rivers. The Brazosport community is comprised of the cities of Clute, Freeport, Jones Creek, Lake Jackson, Oyster Creek, Richwood, Surfside Beach, and Quintana.

8.1.1. Population

As indicated in table 17, the populations of the State of Texas, Greater Houston (Houston-The Woodlands-Sugar Land Metropolitan Statistical Area [MSA] or Houston MSA),[8] Brazoria County, and Brazosport increased (5, 7, 6, and 8 percent, respectively) between 2000 and 2015. At the same time, the population of the City of Freeport increased less than 1 percent and Oyster Creek decreased slightly (2.1 percent), while the much smaller population of the Town of Quintana decreased by 21 percent (from 56 to 44 persons).

[8] Houston-The Woodlands-Sugar Land Metropolitan Statistical Area (MSA) is a 9-county area defined by the U.S. Office of Management and Budget for collecting, tabulating, and publishing federal statistics. The MSA was renamed in February 2013 by the census, when San Jacinto County was no longer included in the MSA.

TABLE 17 **Existing Population Characteristics**							
Geographic Area	**Population**		**Percent Change**	**Population Density 2015 b/ (square mile)**	**Population 2017 Estimates**	**Unemployment Rate 2015 e/ (percent)**	**Unemployment Rate 2017 (Percent) Estimates**
	2010 a/	**2015 b/**					
Texas	25,145,561	26,538,614	4.8	101.6	28,304,596	7.0	4.3 **f**/
Greater Houston	5,920,416	6,346,653	7.2	768.6	6,928,233 **c**/	5.6	5.0 **f**/
Brazoria County	313,166	331,741	5.9	244.3	362,457 **c**/	5.4	5.3 f/
Brazosport Census County Division	57,288	61,663	7.6	343	g/	7.5	**g**/
City of Freeport	12,049	12,118	0.6	810.6	12,169 d/	12.0	**g**/
City of Oyster Creek	1,111	1,088	-2.1	575.7	1,156 d/	9.8	**g**/
Town of Quintana	56 **h/**	44	-21.4	68.8	95 d/	54.2	**g**/

a. U.S. Census Bureau, 2010
b. U.S. Census Bureau, 2015a
c. U.S. Census Bureau 2018
d. Brazoria County Profile, County Information Program, Texas Association of Counties
e. U.S. Census 2015b
f. U.S. Bureau of Labor Statistics 2018
g. Recent employment data not available
h. Population of Quintana Island in 2010: 82 (accession number: 20180425-5132)

8.1.2. Economy and Employment

The top employment sectors for Brazoria County in terms of employee numbers are: educational services, health care, and social assistance (36,995 persons); manufacturing (22,244 persons); and professional, scientific, management, administrative, and waste management services (16,337 persons) (U.S. Census Bureau, 2015b). The largest employers within the county include Dow Chemical Company, Independent School Districts (ISDs), Texas Department of Criminal Justice (TDCJ), Infinity Group, Brazoria County, and Olin Corporation (Economic Development Alliance for Brazoria County [EDA], 2017a).

The top employment industries within the City of Freeport are mostly similar to Brazoria County as a whole. The top employment industries within the City of Freeport include: construction (1,098 persons); educational services, health care, and social assistance (751 persons); and manufacturing (710 persons) (U.S. Census Bureau, 2015b). Top employers include Dow Chemical Company, U.S. Contractors, TDCJ, and Brazosport ISD (City of Freeport, 2017). Freeport LNG's existing terminal provides the major source of employment on Quintana Island – currently about 174 full-time operations personnel work at the facility (EDA, 2017a). The adjacent

Town of Quintana provides limited employment (11 persons) in the areas of professional, scientific, management, administrative, and waste management services; construction; and educational services, healthcare, social assistance.

Table 17 provides the unemployment rates for Greater Houston and Brazoria County in 2015, which were 5.6 percent and 5.4 percent, respectively, and the corresponding unemployment rates for the City of Freeport and City of Oyster Creek, which were 12.0 and 9.8 percent, respectively. Estimated unemployment rates for Greater Houston and Brazoria County increased in 2016 to 6.4 percent and 5.7 percent, respectively, showing a slight retrenchment in the area. Currently, the City of Freeport's annual rate of job growth is 0.74 percent. Based on leading economic indicators, the Brazoria County economy appears to be in a period or about to enter a period of positive economic growth (Brazosport College Economic Forecasting Center 2017), and job growth over the next 10 years is predicted to be 36.07 percent (Sperling's Best Places 2017). With the growth in Port Freeport, and petrochemical sector investing in new capital, Brazoria County is one of the fastest growing counties in Texas (EDA, 2017b). Greater Houston has had 11 consecutive months of job gains, with the largest number of jobs added in professional and business services, education and health services, manufacturing employment, leisure and hospitality, and government employment from July 2016 to July 2017 (Bureau of Labor Statistics 2017).

8.2. Impacts and Mitigation

8.2.1. Employment

Development of the Train 4 Project would create an overall average of 1,390 onsite construction jobs over the 42-month construction period; however, the number of workers present during construction would vary through time. The number of workers for construction of the Terminal, Pretreatment Facility, and Pipeline would range from 120 to 1,400 during the early construction period (one to six months), averaging 2,370 workers a month after initial startup work, and peaking at approximately 2,800 to 3,025 workers.

The Train 4 Project construction would be scheduled to occur within and sequential to the proposed construction of the Phase II Modification and Liquefaction Projects. It is assumed that some of the workers for the Project would be retained from the Liquefaction Project, as both projects would require a similar number of workers with similar skillsets and the construction of the Project is proposed to start as the construction of the Liquefaction Project would be completed. It is assumed that many of the workers would be able to extend their contracts for the construction of the Project.

Therefore, this analysis conservatively assumes that 50 percent of the construction workforce for the Project would be local. Based on current commuter data for Brazoria County, it is anticipated that an additional 25 percent of the construction workforce would commute daily from outside of Brazosport (from Matagorda County and the Houston Metropolitan Area). The remaining 25 percent of the construction workforce is expected to be non-local workers who temporarily relocate to the Project area. It is assumed that many of these workers would already be working on the Liquefaction and Phase II Modification Projects and would extend their current contracts to continue to work on the Train 4 Project.

Assuming 25 percent of the peak workforce (i.e., 750 personnel) would be non-local and that they all would temporarily reside in Brazosport during Project construction, the associated influx represents about 0.2 percent of the total population of this area. However, this is a conservative estimate, as many of the non-local workers may already be working on the Liquefaction and Phase II Modification Projects and living in the area. Should nonlocal workers be accompanied by family members, and based on an average family size of 3.4 persons in the State of Texas, up to 2,550 persons could temporarily relocate to the area.

Operation of the Train 4 Project would require the addition of about 106 permanent workers to Freeport LNG's existing staff (in addition to those needed for operation of the existing facilities): 24 terminal administration staff, 43 operations and maintenance staff for the Terminal; and 1 administration staff, and 38 operations and maintenance staff for the Pretreatment Facility. This increase in permanent workers represents an approximate doubling of the permanent workforce. Freeport LNG stated that the current permanent workforce was sufficient for operation of three liquefaction trains but would be exceeded by the addition of a fourth train. As such, a second full-time equivalent for each of the positions would be required for the additional train.

Freeport LNG intends to hire and train local residents, where possible, for operational positions; and therefore, it is anticipated that many of the additional full-time employees would come from the Brazosport area and impacts on local population from the facility's operation would be negligible.

8.2.2. Displacement of Businesses or Residences

Construction and operation of the Train 4 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. In association with the Liquefaction Project and the Train 4 Project, Freeport LNG or affiliate companies purchased about 59 homes near the Terminal. The population on Quintana Island has decreased since 2010 to present. Freeport LNG has offered to purchase additional existing properties near the Terminal. The purchase of existing properties by Freeport LNG could further decrease the population, depending on how many existing property owners choose to sell their properties.

8.2.3. Property Values

The main operational footprint of the Project facilities in the Terminal would be at least 0.4 mile from the nearest residence, while Unit 4 components within the Pretreatment Facility would be more than 0.5 mile from the nearest residence. One study on the effect of the construction of industrial facilities on property values showed that the construction of industrial facilities (e.g. fossil fuel generation plants) near residential areas may have a minor negative effect on property values in those residential areas (Davis, 2010); however, the Project represents an expansion within an existing facility, and the general area is already used for LNG import and other industrial activities. Property values on Quintana Island could experience downward pressure from the presence of industrial facilities relatively near residential properties and increased traffic during construction and upward pressure from the increased economic opportunities associated with the Liquefaction, Phase II Modification, and Train 4 Projects and from the purchase of existing properties by Freeport LNG and affiliates.

8.2.4. Payroll and Material Purchases

The Project would have an estimated total construction payroll of about $400 million over the 42-month construction timeframe and an annual operational payroll of $90 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 Project's spending profile would be similar to that for the Liquefaction Project, where about 18 percent ($612 million) of the total Project construction outlay ($3.4 billion) was within Brazoria County.

8.2.5. Tax Revenues

Construction of the Project would result in increased sales tax revenues for local communities, Brazoria County, and the State of Texas. Freeport LNG estimated that they would pay about $24,000,000 in sales/use tax over the four years of construction. Freeport estimated Property Taxes for the four years of construction of the Train 4 Project to be approximately $32,000,000 according to the following:

- Brazoria County
  - Land and Inventory: Estimated at approximately $900,000
  - Economic Development Payments: $60,000
- Brazosport College:
  - Land and Inventory: Estimated at approximately $540,000
  - Economic Development Payments: $60,000
- Velasco Drainage District: Land and Inventory: Estimated at approximately $140,000
- Port of Freeport: Land and Inventory: Estimated at approximately $60,000
- Brazosport ISD:
  - Land and Inventory: Estimated at approximately $1.8 million.
  - Realty: Estimated at approximately $25 million (note $16 million of this amount is taken as tax credits over the first seven years of operations)
  - Supplemental Payments: $3.5 million.
  - Note: the Hold Harmless Payment of $13 million is expected to be paid the January following the year operations begin.

Freeport LNG, through the operation of the Terminal, paid about $23,800,000 in taxes or other payments to city, county, and state agencies that support local communities, schools, and transportation infrastructure in 2015. Specific tax revenues generated from operation of the Train 4 Project cannot be readily calculated at this time; however, the Economic Development Alliance of Brazoria County (2016), found that that the Train 4 Project would result in substantial net fiscal benefits through 2026, including:

- $262.0 million from taxes and utility revenues; and,

- $201.7 million in county and municipal services and utilities costs.

Freeport LNG has identified a number of tax abatement agreements in place with local governments, including:

- Brazosport Independent School District Chapter 313 Value Limitation Agreement:
- Brazoria County Chapter 312 Tax Abatement Agreement:
- Brazosport College Chapter 312 Tax Abatement Agreement:
- Velasco Drainage District Chapter 312 Tax Abatement Agreement:
- Port of Freeport Chapter 312 Tax Abatement Agreement:

Freeport LNG has estimated a tangible property value of $18-20 million that is subject to local property tax each year. Under an existing agreement between Freeport LNG's construction contractor and the City of Quintana and Brazoria County for the Phase II and Liquefaction Projects, Freeport LNG's construction contractor is responsible either for returning public roads to pre-construction condition, or to pay for such repairs in the form of the posted bonds.

8.3. Public Services

8.3.1. Emergency Response

The Project resides in an area of longstanding petrochemical, port, and urban activity which has a well-developed ability to handle large-scale emergencies.

The Brazoria County Local Emergency Planning Committee meets monthly at the Brazoria County Sheriff's office to provide updates on right-to-know related topics, public information on emergency planning and preparedness, reportable spills and releases, and reviews of any drills/exercises that have been conducted by various entities and also upcoming ones. Typically in attendance at this meeting are the 18 Community Awareness & Emergency Response (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.

The Brazosport Industrial 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.

Freeport LNG would update the Emergency Response Plan (ERP) developed for the Liquefaction Project to include the Train 4 Project. The ERP was developed and updated in accordance with all applicable federal, state, and local laws and regulatory requirements. Freeport LNG reviews the ERP annually and would make any required changes to ensure that the plan reflects current facilities, practices, and operating conditions. Coordination with relevant response agencies and stakeholders would occur for any updates to the ERP that would affect those relevant agencies and stakeholders.

The Texas Department of Public Safety maintains offices in the nearby towns of Alvin, Angleton, and Texas City with statewide access to personnel in the event of a large-scale emergency.

The Brazoria County Sheriff's Department is in Angleton, about 30 road miles from the Terminal and 29 road miles from the Pretreatment Facility. 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, some of which have industrial firefighting capabilities, are within 30–40 minutes from Quintana Island. 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 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, and port facilities, as well as the Quintana Island Terminal.

Medical facilities in or near Brazosport include three hospitals (Catholic Health Initiatives (CHI) St. Luke's Health Brazosport, Sweeny Community Hospital, and University of Texas Medical Branch (UTMB) Health Angleton Danbury Campus). The closest of these, CHI St. Luke's Health Brazosport, is an acute-care, not-for-profit hospital with 175 beds and the only Level III Trauma Center in Brazoria County. The hospital is in Lake Jackson, 15 road miles from the Terminal and 11 road miles from the Pretreatment Facility. Sweeny Community Hospital, in Sweeny, is 37 miles from the Terminal and 30 miles from the Pretreatment Facility. Sweeny Community Hospital has 20 beds. UTMB Health Angleton Danbury Campus, in Angleton, is 23 miles from the terminal site and 17 miles from the Pretreatment Facility site. UTMB Health Angleton Danbury Campus has 62 beds. The above hospitals, along with Matagorda Regional Medical Center in Matagorda County (within 50 miles of the Project) all have trauma centers and together serve over 70,000 emergency patients annually.

Freeport LNG filed an Evacuation Plan for the Phase II Modification Project with the FERC on May 14, 2014, in response to our data request associated with that Project. The initial Evacuation Plan describes Freeport LNG's public notification procedures, public evacuation procedures, potential available evacuation routes, including assembly areas, marine pickup points, land evacuation routes and marine evacuation routes as well as vessel transit routes. Additional information for the ERP, which includes evacuation procedures, is discussed in section B.10. Freeport LNG would update the Evacuation Plan and ERP to incorporate the modifications to the facility associated with the Project.

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 2016, the Brazosport ISD was rated as "Met Standard" by the Texas Education Agency, which indicates that the district has met the targets on all required indices for which they have performance data (Texas Education Agency 2017).

The district has 20 schools (10 elementary, three middle, three intermediate, three high, and one alternative) and 12,342 students for the 2015–2016 school year, increasing to 12,288 students for the 2017-2018 school year (Brazosport ISD, 2017, Pelton 2017). Within the district, the student-to-teacher ratio is 16:1 (Brazosport ISD, 2016). Enrollment was at its peak four years ago in the 2012–2013 school year when 12,542 students were enrolled. Current capacity within the Brazosport ISD is 13,586 students (Pelton 2017). One intermediate school, Lake Jackson Intermediate, and one elementary school, Bess Brennen Elementary, have more students enrolled than their design capacity; however, based on current enrollment, the school district overall has capacity for a ten-percent increase in the student population. Additionally, in 2014, a $175 million bonding measure was approved to fund improvements within Brazosport ISD, including upgrades to technology resources, improvements to athletic facilities and fine arts programs, and the replacement of five elementary schools to increase capacity. Several campuses are being converted into science, technology, engineering, and math academies (Brazosport ISD, 2016).

8.3.3. Public Service Impacts and Mitigation

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 Project would result in insignificant, temporary, or no effect 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 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 effect on its electric, water, gas, and sewage-disposal requirements. The Brazosport ISD has the capacity for a 10-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 construction workers bringing their families to the area.

8.4. Housing

8.4.1. Existing Conditions

In Brazoria County, there are more than 4,016 vacant housing units for rent and more than 3,398 vacant units defined by the census as seasonal, recreational, occasional, or migrant use, (U.S. Census Bureau, 2016b). In addition, the county offers more than 2,999 motel/hotel rooms with an estimated 67-percent occupancy rate (Source Strategies, 2016). In addition, there are 26 recreational vehicle/trailer parks in Brazoria County, offering an additional option for temporary housing (RVparking.com, 2017).

As of May 31, 2018, there were about 3,486 homes/condos for sale in Brazoria County.[9] Freeport LNG provided data on new housing projects proposed indicating a fair number of homes are or would be built in Brazoria County. However, the timing by which these homes would be available, their affordability for construction workers, and whether construction workers would be willing to relocate to the area is uncertain. Table 18 shows additional information on housing units in Brazoria County as compared to the State of Texas, and indicates that, while the vacancy rate for housing units is lower in Brazoria County than the overall State, median home, and rental contract values are higher.

TABLE 18

2016 Housing Characteristics in Brazoria County (2016 Estimates)

State/County	Owner Occupied (percent)	Renter Occupied (percent)	Median Value, Owner Occupied Units ($)	Median Contract Monthly Rent ($)	Vacancy Rate (percent)
Texas	55	34	161,500	809	7.8
Brazoria County	66	26	174,800	829	7.2

Source: U.S. Department of Commerce, Bureau of the Census, 2016 Census of Population and Housing and American Community Survey 1-year Estimates, (www.census.gov).

8.4.2. Housing Impacts and Mitigation

The peak workforce for the Train 4 Project is estimated to be approximately 2,800 to 3,025 workers, compared to the peak workforce of 9,100 workers for the Liquefaction and Phase II Modification Projects. As described in section B.8.2, some of the construction workers for the Project would be those currently working on the Liquefaction and Phase II Modification Projects. These workers have already addressed their housing needs and would not affect local housing requirements.

As indicated in table 18, the vacancy rate of rental housing units in Brazoria County is lower than the overall State of Texas; however, the comparative lack of vacant rental housing units available for non-local construction workers will be offset by the 3,398 vacant seasonal,

[9] Realtor.com Search www.realtor.com. May 31, 2018.

recreational, occasional, or migrant use units, estimated 990 vacant motel/hotel rooms, and 26 recreational vehicle/trailer parks available for rent in Brazoria County. Based on the vacancy rates and the conservative assumption that 25 percent of the work-force (i.e., 750 workers) would be non-local, we conclude that existing rental unit availability may be slightly affected and prices may rise, but the supply in Brazoria County would be adequate.

8.5. Traffic

8.5.1. Existing Conditions

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 on weekends and during special events.

The Project would generate roadway traffic related to deliveries of construction supplies, and traffic generated by construction workers along roadways to the Terminal, the Pretreatment Facility, and along the Pipeline Corridor.

Quintana Island is reached from the mainland and the City of Freeport by FM 1495, also known as Navigation Boulevard. Major roads connecting to FM 1495 in the Freeport area are SH 36 and FM 523. The Terminal is approached by turning left (east) from FM 1495 onto CR 723, which becomes Lamar Street parallel to and just south of the ICW and the Terminal.

The Pretreatment Facility is located on the west side of CR 690 (Levee Road), about 0.7 mile north of the intersection of CR 690 and SH 332. Current road access to the site property is provided by three roads: a private haulage road that runs for about 0.6 mile between an entrance on SH 332 (located about 0.9 mile southeast of the SH 332/FM 523 intersection) and the west side of Freeport LNG's property (located to the northeast of the intersection); a private haulage road that runs for 0.6 mile between an entrance on SH 332 (located 0.7 mile northwest of the SH 332/CR690 intersection) and the west side of Freeport LNG's property (located to the northeast of the intersection; and CR 230, which runs for about 1.3 miles between an intersection with FM 523 to an intersection with the above-referenced haulage road adjacent to and west of Freeport LNG's property.

Access to the Pipeline Corridor 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 523 in the Stratton Ridge area. Access roads (table 16) would allow vehicular access from the public roads to the workspace.

8.5.2. Traffic Impacts and Mitigation

Quintana Island Terminal Deliveries

Materials and equipment would be delivered to the Terminal site during construction by the following 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 job site and off-loaded at the Terminal's existing construction and/or aggregate docks; and
- local supplies of construction consumables and smaller-volume freighted materials would be transported to the site by truck.

A construction dock and an aggregate barge dock were built and are currently being used for the Phase II Modification and Liquefaction Projects. The construction dock is located on the south shore of the ICW near the Phase I Process Area, while the aggregate barge dock is located on the south shore of the ICW near the northwest corner of the Liquefaction Project site. During construction of the Project, barges calling on either dock would be tied up to the spud breasting barge (unloading barge). If loaded barges arrive ahead of schedule, they would be moored in the existing berthing area on the east side of the Terminal until they can be moved into position for unloading. Freeport LNG estimates that 13 to 20 barge visits would occur during facility construction. Vessel traffic levels are not expected to substantially increase above those associated with the Liquefaction Project.

In December 2017, Freeport LNG requested authorization to deliver and unload 120-foot-long plant piping segments for the Liquefaction Project during evening hours (accession number 20171222-5202), which we approved (accession number 20180105-3016). Freeport LNG has further indicated that the need for nighttime delivery of 120-foot-long piping segments may be necessary for the construction of the Train 4 Project.

Road transportation of materials, earthen fill, and equipment to the terminal site would generate at least 40 to 90 deliveries via light commercial trucks and single-unit and long-haul tandem trucks per day during construction. 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 FM 1495 Bridge and CR 723, Lamar Street.

Quintana Island Terminal Construction Worker Traffic

Parking would not be permitted on Quintana Island, with the exception of a limited number of contractor staff. 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. The offsite parking for the Project construction workers would occur at regional offsite parking locations provided by the contractor for the Project. Many of these regional offsite parking locations are currently being utilized for various ongoing projects by regional contractors in the area. The location of these offsite parking areas is currently unknown and would be determined prior to workers mobilizing to the Project site. The length of time to travel to the construction site and the number of buses required for transporting the construction workers is currently unknown as the parking locations have not been identified. 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 II Modification and Liquefaction Projects, the cost of police assistance with traffic control for the Project would be borne by Freeport LNG.

The Transportation Management Plan for the Liquefaction and Phase II Projects would be updated to include the Train 4 Project and would be implemented during construction of the Project to minimize potential impacts resulting from increases in barge traffic, roadway truck traffic, and construction worker traffic.

Because Freeport LNG has not provided an updated Transportation Management Plan for the Train 4 Project, **we recommend that:**

> **Prior to construction of the Project, Freeport LNG should provide an updated Transportation Management Plan for the Train 4 Project, for review and written approval by the Director of OEP. The plan should include provisions for accommodating and mitigating impacts related to evening delivery of 120-foot-long piping segments, and the locations of offsite parking areas for busing of workers to the construction sites.**

Pretreatment Facility Site Deliveries

Direct deliveries of materials and equipment to the Unit 4 construction site at the Pretreatment Facility would be by truck. Road transportation of materials and equipment to the Pretreatment Facility site would generate at least 50 to 70 deliveries per day via light commercial trucks and single-unit tandem truck during construction. In addition, an average of 12 long-haul tandem-truck deliveries to the Pretreatment Facility would be expected each day. During construction, the additional fill required for the Pretreatment Facility would necessitate the delivery of large amounts of fill by truck. These trips, along with other deliveries, could potentially have an adverse effect on local roadway traffic and inconvenience nearby residents, as well as create issues with road dust and debris. Freeport LNG Project traffic management personnel will be stationed at the site entrance, as needed, to ensure the vehicles turning requirements do not impair other vehicular traffic. Additionally, personal vehicle transportation traffic control measures would be in place during the morning arrivals and evening leaving to ensure safe and efficient transit. Site-specific transportation management actions would be detailed in Freeport LNG's updated Transportation Management Plan.

Pipeline Corridor

Road transportation of materials and equipment for the Pipeline Corridor would be transitory and would predominantly involve pipe deliveries and deliveries associated with HDD and Direct Pipe method installation. These deliveries would result in about 130 to 150 tandem-truck deliveries to various points along the Corridor. As with construction of the Phase I sendout pipeline and the Pipeline/Utility Line Systems associated with the Liquefaction Project, 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- and Direct Pipe-associated deliveries.

Access to the Pipeline Corridor 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 523 in the Stratton Ridge area. Access is also available at several of the road crossing locations and via 15 temporary access roads. Area roads generally do not provide sufficient room and/or suitable traffic flow conditions for the temporary parking of personal vehicles during construction.

Modeled Traffic Impacts

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 affect the quality of traffic flow, including speed, travel time, vehicular delays, traffic interruptions, and the freedom to maneuver.

There are six LOS designations 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.

As described in the 2014 EIS, Freeport LNG modeled existing traffic flow patterns in the Phase II Modification and Liquefaction Project area and the changes in these patterns that might be anticipated during facility construction and operation. In 2017, additional modeling was conducted for 15 intersections for increased traffic volumes associated with the authorized workforce increase requested in spring of 2017 by Freeport LNG for the Phase II Modification and Liquefaction Projects.

The modeling identified a number of problem intersections but identified traffic mitigation strategies that can reduce impacts at these intersections. These mitigation strategies consist of:

- uniformed traffic control (flaggers and uniformed police officers to direct traffic) at intersections where the construction traffic causes the failing operations;
- temporary signalization at intersections where all movements experience additional delay due to the construction traffic;
- temporary traffic control, using barriers or cones, at intersections where future improvements are not necessary, but temporary traffic control measures could be easily implemented and would reduce delay and improve operations; and
- striping changes at intersections where there appears to be sufficient pavement width to allow for the addition of a turn lane to reduce delay and improve operations.

These modeled impacts exceeded those predicted for the Train 4 Project, which has a smaller project construction workforce than the combined workforce for the Phase II Modification and Liquefaction Projects. Freeport LNG would continue to follow the Liquefaction Project traffic mitigation measures listed above during Project construction.

Freeport LNG has previously requested authorization in the form of temporary variances for increased workforce and work to be conducted during evening hours for the Liquefaction and Phase II Modification Projects, which has resulted in increased noise complaints from the community. To address the complaints, Freeport LNG replaced single-tone backup alarms with "white-noise" backup alarms on vehicles regularly active at night, relocated nighttime parking and material storage away from nearby residences, and prevented equipment from backing up on the levee, whenever possible. If nighttime construction would continue during the Train 4 Project, these measures would remain in place; however, Freeport LNG has indicated that increased workforces and evening work will not be required for the Train 4 Project based on the currently proposed schedule.

The construction traffic for the Project would result in unavoidable impacts on the residents of the Town of Quintana during construction of the Project; however, this impact would be perceived as an extension of the duration of the existing traffic impacts of the Liquefaction and Phase II Modification Projects, rather than a new impact. For the wider Brazoria County, Freeport LNG's updated Transportation Management Plan would mitigate these impacts and traffic would not be significant.

8.6. Environmental Justice

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, 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.

As described below and consistent with our understanding of Executive Order 12898, we reviewed the Project to determine if its resulting impacts would be disproportionately high and adverse on minority and low-income populations and appreciably exceed impacts on the general population or other comparison group. The Project would include facilities located entirely within Brazoria County, which is defined as the "Project area" for the evaluation of environmental justice impacts.

Review Methodology

In consultation with the EPA and based on published EPA guidance concerning environmental justice reviews (1998), and incorporating the EPA's *Promising Practices for EJ Methodologies in NEPA Reviews* (EPA, 2016b), we used a three-step approach to conduct our review. These steps are:

1. Determine the existence of minority and low-income populations.
2. Determine if the impacts are high and adverse.
3. Determine if the impacts fall disproportionately on environmental justice populations.

Minority and Low-Income Populations

A minority population exists when:

1. the total racial minorities in a U.S. Census Bureau-defined census tract (U.S. Census Bureau, 2012b) are more than 50 percent of the tract's population;
2. the percentage of a racial minority in a census tract is "meaningfully greater" than in the comparison group;
3. the total ethnic minorities in a census tract are more than 50 percent of the tract's population; or
4. the percentage of ethnic minorities in a census tract is meaningfully greater than in the comparison group.

Racial and ethnic minorities include: African American/Black, Native American or Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, two or more races, and other races; and the Hispanic or Latino ethnicity.

A low-income population exists when:

1. the percentage of all persons living below the poverty level is more than the percentage for the state where the census tract is located; or
2. the median household income for the census tract is lower than the median household income for the state where the census tract is located.

8.6.1. Existing Conditions

Racial/ethnic population and income statistics for the Project, based on data from the U.S. Census Bureau (2015), are presented at state, county, and local levels in table 19.

As shown in table B 19, Brazoria County has a slightly higher percentage (0.2%) of minority population than the State of Texas. All of the localities have a much lower percentage than the state. The three localities, however, have higher poverty rates than the respective county or State of Texas.

TABLE 19 **Existing Ethnic and Economic Conditions**									
State/ County	**Race/Ethnicity (percent)**						**Total Minorities b/**	**Annual Per Capita Income**	**Percent Below Poverty Level**
	White	**Black**	**Native American**	**Asian**	**Hispanic or Latino a/**	**Other**			
Texas	74.9	11.9	0.5	4.2	38.4	8.6	25.1	$26,999	13.4
Brazoria County	74.7	13.0	0.3	5.9	28.9	6.1	25.3	$30,634	8.3
City of Freeport	81.3	11.4	0.4	0.1	58.4	6.8	18.7	$18,514	22.0
City of Oyster Creek	89.7	3.4	0.8	0.0	24.3	6.0	10.3	$19,071	19.8
Town of Quintana	100.0	0.0	0.0	0.0	4.5	0.0	0.0	$16,373	55.6

Source: U.S. Census Bureau, 2015c

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. Total minorities is calculated as total population minus white non-Hispanic population

To evaluate information more specific to the area affected by the Project, we 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 for Train 4 in the Terminal, Unit 4 in the Pretreatment Facility, and the Pipeline Corridor.

Train 4

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 Train 4 in the Terminal. Table 20 shows the poverty and minority data for this area.

TABLE 20 **Poverty and Minority Populations in Census Block Groups within ½-mile of the Train 4 Plant within the Terminal**			
Census Tract	**Block Group**	**Percent Below Poverty a/**	**Percent Minority b/**
Census Tract 6644	Block Group 2	6.7	63.4
Census Tract 6642	Block Group 3	9.5	10.8
Census Tract 6642	Block Group 2	24.9	32.9

a U.S. Census America Community Survey 5-Year Estimates 2011 – 2015

b U.S. Decennial Census, 2010

Pretreatment Facility

The study area for Unit 4 within the Pretreatment Facility extends 0.5 mile from the Pretreatment Facility site and includes a single census block group (Census Tract 6642, Block Group 2). In that group, 24.9 percent of population lives below the poverty level (U.S. Census 2015c) and minorities represent 32.9 percent of the population (U.S. Census, 2010).

Pipeline Corridor

The study area for the Pipeline Corridor extends 0.5 mile from the pipeline centerline and includes six census block groups (table 21). The percent of the population that lives below the poverty line here ranges from 6.3 to 24.9 percent, and the percentage of the population represented by minorities ranges from 10.8 to 63.4 percent.

TABLE 21

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	6.7	63.4
Census Tract 6642	Block Group 3	9.5	10.8
Census Tract 6641	Block Group 5	8.2	27.5
Census Tract 6642	Block Group 1	18.3	23.7
Census Tract 6642	Block Group 2	24.9	32.9
Census Tract 6640	Block Group 2	14.8	41.4

a U.S. Census America Community Survey 5-Year Estimates 2011 – 2015
b U.S. Decennial Census, 2010

Texas currently has no defined state-specific criteria for an environmental justice community; therefore, impacts are those defined by the EPA, which considers an environmental justice area or community to be a location with a "meaningfully greater" percentage of minority population than the general population, or locations in which minority populations comprise more than 50 percent of the affected area's population. As shown above, Census Tract 6644, Block Group 2, which would be crossed by 0.7 mile of the Pipeline Corridor and is within ½ mile of Train 4, is the only affected Census Block Group that exceeds the environmental justice community threshold identified by the EPA for minority populations; however, Census Tract 6644, Block Group 2 also has the lowest population percentage below poverty of all affected census blocks. Accordingly, we considered this census block group to be an environmental justice community; however, the portion of the pipeline within Census Tract 6644, Block Group 2 is located either within the Terminal or underwater and would not affect the public. Additionally, Census Tract 6642, Block Groups 1 and 2, as well as Census Tract 6640 Block Group 2 contain poverty populations that are above the state average and therefore are considered to be environmental justice communities. It is anticipated that the Project will generate income in the region and will create on-going sales- and property-tax income for the affected area as well as employment opportunities, ultimately benefiting low-income populations, outweighing any potential adverse effects. Therefore, we have determined that the Project will not disproportionately impact environmental justice populations.

8.6.1. Impacts and Mitigation

The Project would occur within and sequential to the proposed construction schedule for the Phase II Modification and Liquefaction Projects, and construction would start as the

Liquefaction Project is being completed. Based on this sequencing, impacts would be less for the Train 4 Project due to its smaller construction workforce and construction schedule. The same mitigation applied for the Phase II Modification and Liquefaction Projects would be applied. In general, construction and operation of the Project would not have a significant socioeconomic effect on the local population, including public services, property values, or disadvantaged communities. Although construction activity can present a potential safety risk, Freeport LNG would use appropriate security measures to prevent unauthorized entry into construction sites and implement the Project-specific Transportation Management Plan, and thus this risk would not be significant.

While a relatively high percentage of the City of Freeport's and the Town of Quintana's population lives below the poverty level, Freeport LNG's continued payment of significant local taxes would help to support these areas economically. Given the only environmental justice community to be potentially impacted by the Project also has the lowest poverty rate of all impacted communities, that the section of the Pipeline located within the identified environmental justice community is located entirely within the Terminal or underwater, and given the expected increase to economic activity in the Project Area, we conclude that construction and operation of the Project would not disproportionately affect any population group, and no environmental justice issues are anticipated as a result of construction or operation of the Projects.

9. Cultural Resources

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, requires that federal agencies consider the effect that their undertakings would have on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. An undertaking includes any activity for which a federal agency has jurisdiction, including licensing or certification. Historic properties are pre-contact or historic districts, sites, buildings, structures, objects, landscapes, or properties of traditional, religious, or cultural importance that are listed or eligible for listing on the NRHP. Freeport LNG, as a non-federal party, has assisted 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 Project's 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.

FERC sent copies of its NOI for the Project to a wide range of stakeholders, including the Texas Historic Commission State Historic Preservation Office (SHPO), and Federally Recognized Tribes (tribes) that may have an interest in the Project area on July 27, 2015, and a supplemental NOI on August 23, 2016. The NOI contained a paragraph about Section 106 of the NHPA and stated that we use the NOI to initiate consultations with SHPOs, and to solicit their views and those of other government agencies, interested tribes, and the public on the Projects' potential effects on historic properties.

Executive Order 13007 instructs federal agencies to promote accommodation of access to and protect the physical integrity of American Indian sacred sites. An Indian tribe or an Indian individual determined to be an appropriately authoritative representative of an Indian religion must identify a site as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriate authoritative representative of an Indian religion has informed the agency of the existence of such a site [EO 13007, Section 1 (b) (iii)]. The Project will not restrict access to nor prohibit ceremonial us of Indian sacred sites by Indian religious practitioners to extent practicable. Neither will it adversely affect, to any practicable extent, the physical integrity of such sacred sites.

9.1. Consultations

Freeport LNG sent an introductory letter describing the Project to the SHPO on May 11, 2015. This letter stated that Freeport LNG would abide by applicable conditions and authorizations associated with the FEIS for the Liquefaction Project and Phase II Modification Project (FERC 2014), and requested the participation of the SHPO in the Pre-filing Process for the Train 4 Project. A letter was received from the SHPO on May 20, 2015, indicating that no historic properties would be affected by the Project and that the Project may proceed.

In addition to the FERC's consultation program, Freeport LNG also communicated with the SHPO through its cultural consultants (Gray & Pape and Environmental Resources Management [ERM]). On August 26, 2016, Gray & Pape sent a letter detailing the cultural work associated with the pipeline utilizing approximately 173.5 acres of workspace associated with the Project. This letter documented the negative results of the archaeological survey and ineligibility recommendations for identified structures. A concurrence was received from the SHPO on September 14, 2016.

Additional or supplemental cultural work necessitated by changing Project needs was documented to the SHPO in 2017. On February 13, 2017, ERM sent a letter to the SHPO documenting the cultural work and negative cultural findings associated with offsite workspace Area B. A letter was received from the SHPO on February 17, 2017, indicating that no historic properties would be affected by the Project and that the Project may proceed. On February 17, 2017, Gray & Pape presented the negative findings of supplemental cultural surveys associated with 8.7 acres of new workspace. A concurrence was received from the SHPO on March 14, 2017.

Through a review of Freeport LNG's application and independent research, we identified Federally Recognized 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. A letter *Information Request for Cultural Resource Sites* was sent on June 24, 2015, to the Alabama-Coushatta Tribe of Texas, Caddo Nation, Tonkawa Tribe of Oklahoma, and Wichita and Affiliated Tribes, describing the Train 4 Project and requesting comments. On August 22, 2016, a second set of letters was sent to the four tribes providing an update on the Train 4 Project. To date, no tribes have responded to these letters.

Freeport LNG's cultural consultants also communicated with Federally Recognized Tribes regarding the Project. An email was sent by ERM on February 1, 2017, to the Alabama-Coushatta Tribe of Texas, the Caddo Nation, the Tonkawa Tribe of Oklahoma, and the Wichita and Affiliated

Tribes that sought to confirm receipt of the original letters from 2016. Electronic read receipts were received on February 1, 2017, from the Alabama-Coushatta Tribe of Texas and the Tonkawa Tribe of Oklahoma. A request for an update of contact information was received in response to the email on February 2, 2017, from the Caddo Nation of Oklahoma. To date, no additional comments were received. FERC sent its NOI to the Alabama-Coushatta Tribe of Texas, Caddo Nation, Tonkawa Tribe of Oklahoma, and Wichita and Affiliated Tribes in August 2016. No responses have been filed.

In addition to the emailed updates, on February 1, 2017, ERM sent a letter to the Alabama-Quassarte Tribal Town, the Coushatta Tribe of Louisiana, and the Mescalero Apache Tribe. These letters described the Project and contained a paragraph about Section 106 of the NHPA; in addition, the letters served to initiate consultations with tribes and requested comments from them. To date, no Tribes have not responded to these letters.

9.2. Overview and Survey Results

Area of Potential Effect

Based on the previously disturbed character at the Terminal; Pretreatment Facility; Stratton Ridge Meter Station; Heavy Haul Road; and offsite workspaces Areas A, C, D, E, F, G, and H, we determined that construction and operation of these facilities would not affect cultural resources. Given the Train 4 Project contains two distinct components (i.e., a Pipeline Corridor and an offsite workspace [Area B]), the APE and cultural resources survey results for each is discussed separately below. Portions of the APE for the Project were previously investigated for cultural resources during the prior Freeport LNG Phase I Project and Phase II Project overviews and surveys, and results can be found in the corresponding NEPA documents (FERC, 2006; FERC, 2014). A portion of the proposed Pipeline Corridor and offsite workspace Area B are outside of the footprints of previously authorized projects and are discussed below.

Pipeline Corridor

The APE for the Pipeline Corridor consists of an approximately 10.6-mile-long, 200-foot-wide corridor within which the proposed Underground Facilities and construction workspace would be located. The pipeline buried to a minimum depth that allows at least 4 feet of cover over the pipeline. An approximately 8.3-mile-long portion of the proposed APE has been previously surveyed for cultural resources, or the APE was excluded from survey because the proposed Underground Facilities would be installed using the HDD, Direct Pipe, or conventional-bore methods, which would result in no ground surface disturbance to these areas. Of the remaining approximately 2.3-mile-long portion of the APE, a total of approximately 2.1 miles was surveyed for cultural resources during May and June 2016 and January 2017 by Freeport LNG's cultural resources survey consultant, Gray & Pape. The remaining approximately 0.2-mile-long portion of the APE was not surveyed due to lack of landowner permission.

A review of online data available on the Texas Archeological Sites Atlas, an online resource maintained by the Texas Historical Commission (THC), to identify all previously recorded archaeological sites, historic standing structures, and previous cultural resources investigations within a one-mile radius of the APE, did not result in the identification of any previously recorded cultural resources within the proposed APE. Upon completion of the records review, Gray & Pape completed a Phase I cultural resources survey of all portions of the Project APE where landowner permission had been obtained, and which had not been previously surveyed; were not previously disturbed or currently inundated; and were not within an area planned for installation using the HDD, Direct Pipe, or conventional-bore methods.

The cultural resources survey, which consisted of a combination of surface reconnaissance and intensive pedestrian survey with shovel testing, did not result in the identification of any cultural resources within the APE for the proposed Underground Facilities, and no additional testing is recommended. No additional testing of the previously surveyed sections of the APE is recommended. In addition, it is Gray & Pape's and Freeport LNG's opinion that, based on adjacent survey results and a review of historic topographic maps and historic aerial imagery, the 0.2-mile-long section of APE that has not been surveyed due to lack of landowner permission is not likely to contain intact and significant archaeological sites or historic structures. The SHPO concurred with this assessment on September 14, 2016; therefore, it is recommended that survey of this segment is not required.

A draft Phase I cultural resources survey report (Valenti and Scott 2016) describing the results of the survey was submitted to the THC on August 26, 2016. As described above, the THC responded on September 14, 2016, with concurrence that no historic properties would be affected by the Train 4 Project. Subsequently, due to changes to the route of the proposed pipeline, a supplemental Phase I cultural resources survey letter report (Scott 2017) was submitted to the THC on February 17, 2017. The THC responded on March 14, 2017, with concurrence that no historic properties would be affected by the additional areas along the Pipeline Corridor.

Offsite Workspace Area B

Proposed offsite workspace Area B, which is located across County Road 690 (Levee Road) from the Pretreatment Facility, was surveyed for cultural resources in February 2016 by ERM (Brignac Jr. et al., 2017). The direct APE for proposed offsite workspace Area B would consist of an area that measures approximately 2,270 feet north-south by 1,008 feet east-west. Area B would be utilized for the temporary storage of materials during Project construction, and it is anticipated that no subsurface ground disturbance would occur within Area B. As discussed in the report (Resource Report 4, appendix 4C), the indirect APE for Area B included a 0.5-mile-buffer surrounding the boundary of the proposed workspace. As much of the Project area has been previously surveyed for archaeological resources, and/or subject to prior construction disturbance, the surveyed area focused on an approximately 10.33-acre area that had not been previously assessed.

A review of the THC's Texas Archeological Sites Atlas did not identify any previously recorded cultural resources within offsite workspace Area B. Pedestrian survey of Area B did not result in the identification of any archaeological sites and no additional testing is recommended by Freeport LNG. A draft Phase I cultural resources survey report (Resource Report 4, appendix 4C) describing the results of the offsite workspace Area B survey was submitted to the THC on February 13, 2017. The THC responded to this letter on February 17, 2017, with concurrence that no historic properties would be affected by the utilization of offsite workspace Area B for the Train

4 Project (Brignac Jr. et al., 2017). We concur with this assessment; therefore, it is recommended that survey of this segment is not required.

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*, which was accepted April 20, 2012 letter with a concurrence stamp dated May 8, 2012. The *Unanticipated Discoveries Plan* that was prepared and approved for the Liquefaction Project has been updated to include the Train 4 Project.

The Quintana Cemetery (41BO123), a burial ground associated with the Quintana townsite, was documented adjacent to, but outside of, the APE for the Phase I Project. Because the site would not be affected by the Train 4 Project, no additional archaeological investigations were recommended. To ensure that the site would be adequately protected during construction of the Liquefaction Project, a Cemetery Avoidance Plan was developed and subsequently implemented. As a result, the cemetery has a chain-link fence surrounding the main grave concentration, though there is one partially fenced headstone outside of the main enclosure. The Quintana Cemetery now lies within the secure area of the existing Terminal. This being the case, through an agreement with the town of Quintana, Freeport LNG and its affiliate companies have taken over the duty of escorting visitors to the cemetery.

At its nearest point, the cemetery is approximately 800 feet south-southeast of the Train 4 Project facilities (the nearest point is milepost 0.2 of the Underground Facilities). During construction of the Project, Freeport LNG and its construction contractors would preclude any construction personnel from entering the cemetery and would require contractor and Freeport LNG employees to complete extensive environmental training that includes a discussion of the importance of the cemetery. With the implementation of these measures, no impacts on the Quintana Cemetery are anticipated.

9.4. Status of Compliance with the NHPA

No traditional cultural properties, burials, or sites of religious significance to Federally Recognized Tribes were identified in the APE by the SHPO, Freeport LNG and its consultants, or the tribes contacted by the FERC and by Freeport LNG's consultants, and the SHPO has concurred that the 0.2 mile of unsurveyed Pipeline Corridor is not likely to contain intact and significant archaeological sites or historic structures. We agree with the SHPO that no historic properties would be adversely affected in areas that have been inventoried.

10. Reliability and Safety

10.1. LNG Facility Reliability, Safety, and Security Regulatory Oversight

LNG facilities handle flammable and sometimes toxic materials that can pose a risk to the public if not properly managed. These risks are managed by the companies owning the facilities, through selecting the site location and plant layout as well as through suitable design, engineering, construction, and operation of the LNG facilities. Multiple federal agencies share regulatory authority over the LNG facilities and the operator's approach to risk management. The safety, security, and reliability of Freeport LNG's Train 4 Project would be regulated by the USDOT, the USCG, and the FERC; the Department of Homeland Security (DHS), Occupational Safety and Health Administration (OSHA), and the USEPA may also have jurisdiction of certain parts of the Pretreatment Facility located several miles away on a separate property upstream of the proposed Liquefaction Facility.

In February 2004, the USDOT, the USCG, and the 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 and LNG vessel 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 the USCG participate as cooperating agencies but remain responsible for enforcing their regulations covering LNG facility siting, design, construction, and operation. All three agencies have some oversight and responsibility for the inspection and compliance during the LNG facility's operation.

The USDOT establishes and has the authority to enforce the federal safety standards for the siting, design, construction, operation, and maintenance of onshore LNG facilities, as well as for the siting of marine cargo transfer systems at waterfront LNG facilities, under the Natural Gas Pipeline Safety Act (49 USC. 1671 *et seq.*). The USDOT's LNG safety regulations are codified in 49 CFR 193, which prescribes safety standards for LNG facilities used in the transportation of gas by pipeline that are subject to federal pipeline safety laws (49 USC 60101 *et seq.*), and 49 CFR 192. On August 31, 2018, USDOT and FERC signed an MOU regarding methods to improve coordination throughout the LNG permit application process for FERC jurisdictional LNG facilities. In the MOU, USDOT agreed to issue a Letter of Determination (LOD) stating whether a proposed LNG facility would be capable of complying with location criteria and design standards contained in Subpart B of Part 193. The Commission committed to rely upon the USDOT determination in conducting its review of whether the facilities would be consistent with the public interest. The issuance of the LOD does not abrogate USDOT's continuing authority and responsibility over a proposed project's compliance with Part 193 during construction and future operation of the facility. The USDOT's conclusion on the siting and hazard analysis required by Part 193 would be based on preliminary design information which may be revised as the engineering design progresses to final design. USDOT regulations also contain requirements for the design, construction, installation, inspection, testing, operation, maintenance, qualifications and training of personnel, fire protection and security for LNG facilities, which would be completed during later stages of the Project. If the project is constructed and becomes operational, the LNG facilities, as defined in 49 CFR 193[10], would be subject to the USDOT's inspection program to ensure compliance with the requirements of 49 CFR 193.

USDOT has indicated the Pretreatment Facility would not be subject to USDOT's 49 CFR 193, Liquefied Natural Gas Facilities: Federal Safety Standards because the Pretreatment Facility does not meet the definition of LNG facilities as defined in 49 CFR 193, and the natural gas treatment meets the exemption under 49 CFR 193.2001(b)(2) in that it does not store any LNG. However, USDOT indicates that the entire Pretreatment Facility would be subject to USDOT's 49 CFR 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards.

Along with Part 192 regulations, OSHA's Process Safety Management regulations under 29 CFR 1910.119 and USEPA's Risk Management Plan (RMP) regulations under 40 CFR 68 would apply to certain portions of the Pretreatment Facility, including the process piping, process vessels and tanks, and associated auxiliary equipment at the Pretreatment Facility. Freeport LNG states that USEPA's 40 CFR 68, OSHA's 29 CFR 1910 and NFPA 59A would also be used in the design, construction, and operation of the Project.

The USCG has authority over the safety of an LNG terminal's marine transfer area and LNG marine traffic, as well as security plans for waterfront facilities handling LNG and LNG marine traffic. The USCG regulations for LNG facilities are codified in 33 CFR 105 and 33 CFR 127. As a cooperating agency, the USCG assists the FERC staff in evaluating whether an applicant's proposed waterway would be suitable for LNG marine traffic and whether the waterfront facilities handling LNG would be operated in accordance with 33 CFR 105 and 33 CFR 127. If the facilities are constructed and become operational, the facilities would be subject to the USCG inspection program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

The DHS would have authority over the security of the Pretreatment Facility. The DHS regulations are codified in 6 CFR 27 Chemical Facility Anti-Terrorism Standards (CFATS). If the Pretreatment Facility is constructed and become operational, the facilities would be subject to the DHS inspection program to ensure compliance with the requirements of 6 CFR 27.

In addition, the Energy Policy Act of 2005 requires FERC to coordinate and consult with the Department of Defense (DOD) on the siting, construction, expansion, and operation of LNG terminals that would affect the military. On November 21, 2007, the FERC and the DOD (http://www.ferc.gov/legal/mou/mou-dod.pdf) entered into a MOU formalizing this process. In accordance with the MOU, for the previous Freeport LNG Liquefaction Project we sent letters to the DOD on September 19, 2012 and March 7, 2013 requesting comments. We did not receive an objection from the DOD that the Liquefaction Project facilities would have negative impacts on testing, training, or operational activities of any active military installations. Similarly, the FERC sent a letter to the DOD on August 28, 2018, requesting their comments within 30 days on whether

[10] Per DOT's 49 CFR 193.2007 Definitions, LNG facility means a pipeline facility that is used for liquefying natural gas or synthetic gas or transferring, storing, or vaporizing LNG.

the proposed Train 4 Project could potentially have an impact on the test, training, or operational activities of any active military installation. To date, we have not received a response. However, the Train 4 facilities at the LNG Terminal and at the Pretreatment site would be within the existing property and immediately adjacent to the currently under construction Freeport LNG Liquefaction Project facilities. In addition, the Train 4 project would not increase the number of carrier-calls over the number identified in the Water Suitability Assessment and no new Letter of Intent is required from USGS as stated in Section B.10.3 below.

The FERC authorizes the siting and construction of LNG terminals, including the pretreatment facilities necessary for the liquefaction facilities, under the NGA and delegated authority from the DOE. The FERC requires standard information to be submitted to perform safety and reliability engineering reviews. FERC's filing regulations are codified in 18 CFR 380.12 (m) and (o), and requires each applicant to identify how its proposed design would comply with the USDOT's siting requirements of 49 CFR 193 Subpart B. The level of detail necessary for this submittal requires the project sponsor to perform substantial front-end engineering of the complete project. The design information is required to be site-specific and developed to the extent that further detailed design would not result in significant changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs. As part of the review required for a FERC order, we use this information from the applicant to assess whether the proposed facilities would have a public safety impact and to suggest additional mitigation measures for the Commission to consider for incorporation as conditions in the order. If the facilities are approved and the suggested mitigation measures are incorporated into the order as conditions, FERC staff would review material filed to satisfy the conditions of the order and conduct periodic inspections throughout construction and operation.

10.2. USDOT Safety Regulatory Requirements and 49 CFR 193 Subpart B Determination

Siting the LNG facilities, as defined in 49 CFR 193, with regard to ensuring that the proposed site selection and location would not pose an unacceptable level or risk to public safety is required by USDOT's regulations in 49 CFR 193, Subpart B. The Commission's regulations under 18 CFR 380.12 (o) (14) require Freeport LNG to identify how the proposed design complies with the siting requirements in USDOT's regulations under 49 CFR 193, Subpart B. The scope of USDOT's siting authority under 49 CFR 193 applies to LNG facilities used in the transportation of gas by pipeline subject to the federal pipeline safety laws and 49 CFR 192.[11]

The requirements in 49 CFR 193 Subpart B state that an operator or government agency must exercise legal control over the activities as long the facility is in operation 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 LNG vapor. Approved mathematical models must be used to calculate the dimensions of these exclusion zones. The siting requirements specified in NFPA 59A (2001), an industry

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[11] 49 CFR 193.2001(b)(3), Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the LNG vessel and the last manifold or valve immediately before a storage tank.

consensus standard for LNG facilities, are incorporated into 49 CFR 193, Subpart B, by reference, with regulatory preemption in the event of conflict. The following sections of 49 CFR 193 Subpart B specifically address siting requirements:

- Section 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 (2001). In the event of a conflict with NFPA 59A (2001), the regulatory requirements in Part 193 prevail.
- Section 193.2057, Thermal radiation protection, requires that each LNG container and LNG transfer system have thermal exclusion zones in accordance with Section 2.2.3.2 of NFPA 59A (2001).
- Section 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 (2001).
- Section 193.2067, Wind forces, requires that shop fabricated containers of LNG or other hazardous fluids less than 70,000 gallons must be designed to withstand wind forces based on the applicable wind load data in American Society of Civil Engineers (ASCE) 7 (2005). All other LNG facilities must be designed for a sustained wind velocity of not less than 150 mph unless the USDOT Administrator finds a lower wind speed is justified or the most critical combination of wind velocity and duration for a 10,000-year mean return interval.

As stated in section 193.2051, LNG facilities must meet the siting requirements of NFPA 59A (2001), Chapter 2, and include but may not be limited to:

- NFPA 59A (2001) section 2.1.1(c) requires consideration of protection against forces of nature. Section 2.1.1(d) 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 (2001) 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 British thermal units per square foot per hour (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 LNGFIRE3 or with models that have been validated by experimental test data appropriate for the hazard to be evaluated and that have been approved by USDOT.
- NFPA 59A (2001) 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 approved alternative models that take into account physical factors influencing LNG vapor dispersion. [12]

Taken together, 49 CFR 193, Subpart B, and NFPA 59A (2001) require that flammable LNG vapors from design spills do not extend beyond areas in which the operator or a government agency legally controls all activities.

Title 49 CFR 193, Subpart B, and NFPA 59A (2001) also specify three radiant heat flux levels. For LNG spills from process and transfer areas, the 1,600 Btu/ft^2-hr flux level cannot extend beyond the plant property line onto a property that can be built upon. [13]

In addition, Section 2.1.1 of NFPA 59A (2001) requires that factors applicable to the specific site with a bearing on the safety of plant personnel and the surrounding public must be considered, including an evaluation of potential incidents and safety measures incorporated into the design or operation of the facility. USDOT has indicated that potential incidents, such as vapor cloud explosions and toxic releases should also be considered to comply with Part 193, Subpart B.[14]

The Project LNG facilities, as defined by 49 CFR 193, met 49 CFR 193, Subpart B, regulatory requirements, the USDOT issued a LOD to FERC and filed with the Commission as part of the consolidated record for the Project and would be one of the considerations for the Commission to deliberate in its decision to authorize, with or without modification or conditions, or deny an application. The LOD provides PHMSA's analysis and conclusions regarding 49 CFR 193 Subpart B regulatory requirements.

10.3. USCG Safety and LNG Carrier Regulatory Discussion

The Freeport LNG terminal commenced service in July 2008 and has been receiving LNG shipments for import and re-export purposes. Marine safety and vessel maneuverability studies were submitted for the Freeport LNG terminal under FERC docket numbers CP03-75-000 and CP05-361-000. Also, in accordance with 33 CFR 127, the Coast Guard previously provided FERC with a Letter of Recommendation regarding the suitability of the waterway for the type and frequency of the Liquefaction and Phase II Modification Projects (docket numbers CP12-509-000 and CP12-29-000) LNG carrier traffic and noted that these Projects would not result in an increase

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12 DOT has approved two additional models for the determination of vapor dispersion exclusion zones in accordance with 49 CFR 193.2059: FLACS 9.1 Release 2 (Oct. 7, 2011) and PHAST-UDM Version 6.6 and 6.7 (Oct. 7, 2011).

13 The 1,600 Btu/ft^2-hr flux level is associated with producing pain in less than 15 seconds, first degree burns in 20 seconds, second degree burns in approximately 30-40 seconds, 1 percent mortality in approximately 120 seconds, and 100 percent mortality in approximately 400 seconds, assuming no shielding from the heat, and is typically the maximum allowable intensity for emergency operations with appropriate clothing based on average 10 minute exposure.

14 The US DOT PHMSA's "LNG Plant Requirements: Frequently Asked Questions" item H1, https://www.phmsa.dot.gov/pipeline/liquified-natural-gas/lng-plant-requirements-frequently-asked-questions, accessed Aug 2018.

in the size and/or frequency of the LNG marine traffic (i.e., a maximum of 400 LNG carrier visits per year). While the Train 4 Project will result in an additional 75 ship visits per year above the current level expected for the Liquefaction Project, the frequency and size of LNG carriers calling on the Quintana Island Terminal will not increase beyond the maximum of 400 ship visits reviewed and authorized by the Coast Guard. Furthermore, in an email dated March 19, 2015, the Coast Guard indicated that the construction and operation of the Train 4 Project would not require submission of a new Letter of Intent or revision to the existing WSA.

The USCG would assess each transit on a case by case basis to identify what, if any, safety and security measures would be necessary to safeguard the public health and welfare, critical infrastructure and key resources, the port, the marine environment, and the LNG carrier. Under the Ports and Waterways Safety Act, the Magnuson Act, the Marine Transportation Security Act (MTSA), and the Security and Accountability For Every (SAFE) Port Act, the Captain of the Port (COTP) has the authority to prohibit LNG transfer or LNG carrier movements within his or her area of responsibility if he or she determines that such action is necessary to protect the waterway, port, or marine environment. If appropriate resources are not in place prior to LNG carrier movement along the waterway, then the COTP would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

10.4. Security Requirements

The security requirements for the proposed Pretreatment Facility and Liquefaction Facility are governed by 33 CFR 105, 33 CFR 127, 49 CFR 193 Subpart J, and 6 CFR 27.

Title 33 CFR 105, as authorized by the MTSA, requires all owners and operators of waterfront LNG facilities regulated under 33 CFR 127 to submit a Facility Security Assessment and a Facility Security Plan to the USCG for review and approval before commencement of operations of the proposed project facilities. The existing facility has a Facility Security Plan, as required by 33 CFR 105, which has been approved by the USCG. In addition, an LNG facility regulated under 33 CFR 105 and 33 CFR 127 would be subject to the Transportation Worker Identification Credential (TWIC) Reader Requirements Rule issued by the USCG on August 23, 2016. This rule requires owners and operators of certain vessels and facilities regulated by the USCG to conduct electronic inspections of TWICs (e.g., readers with biometric fingerprint authentication) as an access control measure. The final rule would also include recordkeeping requirements and security plan amendments that would incorporate these TWIC requirements. The implementation of the rule was first proposed to be in effect by August 23, 2018. In a subsequent notice issued on June 22, 2018, USCG indicated delaying the effective date for certain facilities by 3 years, until August 23, 2021. On August 2, 2018, the President of the United States signed into law the Transportation Worker Identification Credential Accountability Act of 2018 (H.R. 5729). This prohibits the USCG from implementing the rule requiring electronic inspections of TWICs until after the DHS has submitted a report to the Congress. Although the implementation of this rule has been postponed, the company may need to consider the rule when developing access control and security plan provisions for the facility.

Title 49 CFR 193 Subpart J also specifies security requirements for the onshore components of LNG facilities, as defined in 49 CFR 193, including 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. The existing LNG facilities, as defined in 49 CFR 193, are subject to these requirements already and Freeport would augment their security program to take into account the Train 4 Project facilities subject to 49 CFR 193.

Title 6 CFR 27, as authorized under Section 550 of the Homeland Security Appropriations Act of 2007 and as extended under the CFATS Act of 2014, requires risk-based performance standards related to plant security that would cover the pretreatment facilities, which are not covered by the MTSA. The existing quantities of methane and other products that would be located at the existing pretreatment facilities exceed the screening threshold quantities specified in Appendix A to 6 CFR 27. Under CFATS, DHS determines if a facility is considered a covered facility based on a report of chemical holdings. In accordance with 6 CFR 27.215, covered facilities must complete a security vulnerability assessment. Based on the chemical holdings and security vulnerability assessment, DHS would assign the covered facilities to one of four risk-based tiers, ranging from the highest risk in Tier 1 to lowest risk in Tier 4, and a site security plan is developed based on the security vulnerability assessment and tier. Freeport LNG is already be subject to these rules based on the existing pretreatment facilities. Freeport LNG stated that the pretreatment facility's security system would meet all applicable requirements including CFATS. In accordance with 6 CFR 27.210(d), the proposed Project pretreatment facilities would be required to submit a revised Top Screen to the department within 60 calendar days of the modification, and DHS would notify Freeport LNG as to whether they must submit a revised security vulnerability assessment, site security plan, or both.

In addition, Freeport LNG provided preliminary information on its security features and indicated additional details would be completed in the final design. In accordance with the February 2004 Interagency Agreement among FERC, USDOT, and USCG, FERC staff would collaborate with USCG and USDOT on the Project's security features. FERC staff would also collaborate with DHS, as appropriate. If the Project is constructed and operated, compliance with the security requirements of 33 CFR 105, 33 CFR 127, 49 CFR 193 Subpart J, and 6 CFR 27 would be subject to the respective USCG, USDOT, and DHS inspection and enforcement programs.

10.5. FERC Engineering and Technical Review of the Preliminary Engineering Designs

10.5.1. LNG Facility Historical Record

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 with the exception of the October 20, 1944, failure at an LNG plant in Cleveland, Ohio. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200 to 400 more people.[15] The failure of the LNG storage tank was due to the use of materials not suited for cryogenic temperatures. LNG migrated through streets

15 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.

and into underground sewers due to inadequate spill impoundments at the site. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used in the design and that spill impoundments are designed and constructed properly to contain a spill at the site. To ensure that this potential hazard would be addressed for proposed LNG facilities, we evaluate the preliminary and final specifications for suitable materials of construction and for the design of spill containment systems that would properly contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG plant in Lusby, Maryland. A pump electrical seal located on a submerged electrical motor LNG pump leaked causing flammable gas vapors to enter an electrical conduit and settle in a confined space. When a worker switched off a circuit breaker, the flammable gas ignited, causing severe damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident led to changes in the national fire codes to better ensure that the situation would not occur again. To ensure that this potential hazard would be addressed for proposed facilities that have electrical seal interfaces, we evaluated the preliminary designs and recommend in section B.10.6 that Freeport LNG provide, for review and approval, the final design details of the electrical seal design at the interface between flammable fluids and the electrical conduit or wiring system, details of the electrical seal leak detection system, and the details of a downstream physical break (i.e., air gap) in the electrical conduit to prevent the migration of flammable vapors.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction plant that killed 27 and injured 56 workers. No members of the public were injured. The investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced into a 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 proposed facilities, we evaluate the preliminary design for mitigation of flammable vapor dispersion and ignition in buildings and combustion equipment to ensure they are adequately covered by hazard detection equipment that could isolate and deactivate any combustion equipment whose continued operation could add to or sustain an emergency. We also recommend in Section B.10.6 that Freeport LNG provide, for review and approval, the final design details of hazard detection layout and devices.

On March 31, 2014, a detonation occurred within a gas heater at Northwest Pipeline Corporation's LNG peak-shaving plant in Plymouth, Washington.[16] This internal detonation subsequently caused the failure of pressurized equipment, resulting in high velocity projectiles. The plant was immediately shut down, and emergency procedures were activated, which included notifying local authorities and evacuating all plant personnel. No members of the public were injured, but one worker was sent to the hospital for injuries. As a result of the incident, the liquefaction trains and a compressor station located onsite were rendered inoperable. Projectiles

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16 For a description of the incident and the findings of the investigation, see Root Cause Failure Analysis, Plymouth LNG Plant Incident Investigation under CP14-515.

from the incident also damaged the control building that was located near the pre-treatment facilities and penetrated the outer shell of one of the LNG storage tanks. All damaged facilities were ultimately taken out of service for repair. The accident investigation showed that an inadequate purge after maintenance activities resulted in a fuel-air mixture remaining in the system. The fuel-air mixture auto-ignited during startup after it passed through the gas heater at full operating pressure and temperature. To ensure that this potential hazard would be addressed for proposed facilities, we recommend in Section B.10.6 that Freeport LNG provide a plan for purging, for review and approval, which addresses the requirements of the American Gas Association *Purging Principles and Practice* and to provide justification if not using an inert or non-flammable gas for purging. In evaluating such plans, we would assess whether the purging could be done safely based on review of other plans and lessons learned from this and other past incidents. If a plan proposes the use of flammable mediums for cleaning, dry-out or other activities, we would evaluate the plans against other recommended and generally accepted good engineering practices, such as NFPA 56, *Standard for Fire and Explosion Prevention during Cleaning and Purging of Flammable Gas Piping Systems*.

We also recommend in Section B.10.6 that Freeport LNG provide, for review and approval, operating and maintenance plans, including safety procedures, prior to commissioning. In evaluating such plans, we would assess whether the plans cover all standard operations, including purging activities associated with startup and shutdown. Also, in order to prevent other sources of projectiles from affecting occupied buildings and storage tanks, we recommend in Section B.10.6 that Freeport LNG incorporate mitigation into their final design with supportive information, for review and approval, that demonstrates it would mitigate the risk of a pressure vessel burst or boiling liquid expanding vapor explosion (BLEVE) from occurring.

10.5.2. Engineering Review

FERC requires an applicant to provide safety, reliability, and engineering design information as part of its application, including hazard identification (HAZID) studies and front-end-engineering-design (FEED) information for its proposed Project. FERC staff evaluates this information with a focus on potential hazards from within and nearby the site, including external events, which may have the potential to cause damage or failure to the Project facilities, and the engineering design and safety and reliability concepts of the various protection layers to mitigate the risks of potential hazards.

The primary concerns are those events that could lead to a hazardous release of sufficient magnitude to create an offsite hazard or interruption of service. In general, FERC staff considers an acceptable design to include various layers of protection or safeguards to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public. These layers of protection are generally independent of one another so that any one layer would perform its function regardless of the initiating event or failure of any other protection layer. Such design features and safeguards typically include:

- a facility design that prevents hazardous events, including the use of inherently safer designs; suitable materials of construction; adequate design margins from operating limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;

- control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure that the facility stays within the established operating and design limits;

- safety instrumented prevention systems, such as safety control valves and ESD systems, to prevent a release if operating and design limits are exceeded;

- physical protection systems, such as appropriate electrical area classification, proper equipment and building spacing, pressure relief valves, spill containment, and cryogenic, overpressure, and fire structural protection, to prevent escalation to a more severe event;

- site security measures for controlling access to the plant, including security inspections and patrols, response procedures to any breach of security, and liaison with local law enforcement officials; and

- onsite and offsite emergency response, including hazard detection, hazard 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 inclusion of such protection systems or safeguards in a plant design can minimize the potential for an initiating event to develop into an incident that could impact the safety of the offsite public. The review of the engineering design for these layers of protection is initiated in the application process and carried through to the next phase of the proposed project in final design if authorization is granted by the Commission.

The reliability of these layers of protection is informed by occurrence and likelihood of root causes and the potential severity of consequences based on past incidents and validated hazard modeling. As a result of the continuing engineering review, we recommend mitigation measures and continuous oversight to the Commission for consideration to include as conditions in the order. If a facility is authorized and recommendations are adopted as conditions to the order, FERC staff would continue its engineering review through final design, construction, commissioning, and operation.

Process Design

The Train 4 Project would be constructed as an expansion of the Liquefaction Project. The major Project components would be installed in either the Pretreatment Facility or the Liquefaction Facility as summarized below. These two facilities would be connected via an approximately 5-mile-long pipeline.

Pretreatment Facility

In order to liquefy natural gas, most liquefaction technologies require that the feed gas stream be pre-treated to remove components that could freeze out and clog the liquefaction equipment or would otherwise be incompatible with the liquefaction process or equipment, including mercury, H_2S, CO_2, water, and heavy hydrocarbons. For example, mercury is typically limited to concentrations less than 0.01 micrograms per normal cubic meter because it can cause embrittlement and corrosion resulting in catastrophic failure of equipment.

The Pretreatment Facility would be located entirely within the footprint of the existing Pretreatment Facility, which is currently under construction. The major Project components to be constructed for Train 4 would be identical to the Liquefaction Project's three authorized pretreatment units, along with auxiliary support facilities and infrastructure. Specifically, inlet feed gas would enter the inlet separator to remove any entrained liquids that may be present in the gas. Then the feed gas would enter the mercury removal system to reduce the mercury concentration in the feed gas. Once mercury is removed, the feed gas would pass through the booster compressor to raise the feed gas pressure. The feed gas is then sent to the acid gas removal unit consisting of an acid gas absorber and amine regenerator to reduce CO_2 and H_2S present in the feed gas. The amine regenerator would separate the CO_2 and H_2S from the amine solvent and would be routed to a thermal oxidizer, where CO_2, H_2S, and trace amounts of hydrocarbons would be incinerated. Water would be removed from the feed gas by a dehydration unit using molecular sieve beds to prevent hydrate formation in downstream equipment. After dehydration, the feed gas would be sent to the NGL extraction unit to remove heavier hydrocarbon components that could freeze out and clog liquefaction equipment. The removed heavy hydrocarbons would be routed via an existing 8-inch pipeline to an offsite NGL storage and trucking facility. The treated feed gas would be compressed and combined with treated gas from Units 1 through 3 and would be routed to the underground pipeline corridor. The treated gas exiting the Pretreatment Facility would be split between the existing 42-inch or to the proposed 42-inch-pipeline that would be constructed between the Pretreatment Facility and the Liquefaction Facility.

Liquefaction Facility

The proposed Liquefaction Facility would be located entirely within the footprint of the previously authorized Quintana Island Terminal, which is under construction. The major Project components proposed for Train 4 would be identical to the Liquefaction Project's three previously authorized liquefaction trains (Trains 1 through 3). Specifically, Train 4 would utilize a liquefaction process designed by Air Products and Chemicals Inc. to precool feed gas with propane and further cool it using a mixed refrigerant stream to condense the natural gas into a liquid at -260ºF. The mixed refrigerant stream would be comprised of nitrogen, methane, ethylene, propane, and small concentrations of butane and pentane. The LNG would enter a transfer drum and be pumped to the existing LNG storage tanks.

LNG from the existing LNG storage tanks would be sent out through in-tank pumps to existing marine transfer lines and existing marine transfer arms that would connect to LNG carriers. The LNG transferred to the LNG carriers would displace vapors from the LNG carriers, which would be sent back to the LNG storage tanks via existing equipment. Once loaded, the LNG carriers would be disconnected and leave for export.

In addition, the Project would include new or tie into existing utilities and associated auxiliary equipment. New auxiliary systems required for the operation of the Unit 4 at the Pretreatment Facility and Train 4 at the Liquefaction Facility include fuel gas, hot oil, instrument and utility air supply, potable and service water supply, demineralized water, and backup power. Existing auxiliary systems required for the operation of the Pretreatment Facility and the

Liquefaction Facility include BOG, flares, and nitrogen. In addition, refrigerants required for Train 4 would be supplied from propane, ethylene, and nitrogen storage tanks authorized with Trains 1 through 3.

The failure of process equipment could pose potential harm if not properly safeguarded through the use of appropriate engineering controls and operation. Freeport LNG would install process control valves and instrumentation to safely operate and monitor the facilities. 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 develop facility operation procedures after completion of the final design; this timing is fully consistent with accepted industry practice. Freeport LNG would design their control systems and human machine interfaces to the International Society for Automation (ISA) Standards 5.3, 5.5, 60.1, 60.3, 60.4, and 60.6, and other standards and recommended practices. We recommend in Section B.10.6 that Freeport LNG provide more information, for review and approval, on the operating and maintenance procedures, including safety procedures, hot work procedures and permits, abnormal operating conditions procedures, and personnel training prior to commissioning. We would evaluate these procedures to ensure that an operator can operate and maintain all systems safely, based on benchmarking against other operating and maintenance plans and comparing against recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers, *Guidelines for Writing Effective Operating and Maintenance Procedures*. In addition, we recommend in Section B.10.6 that Freeport LNG tag and label instrumentation and valves, piping, and equipment and providing car-seals/locks to address human factor considerations and improve facility safety and prevent incidents. We also recommend in Section B.10.6 that Freeport LNG develop and implement an alarm management program, for review and approval to ensure the effectiveness of the alarms. FERC staff would evaluate the alarm management program against recommended and generally accepted good engineering practices, such as ISA Standard 18.2.

In the event of a process deviation, ESD valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. Both the Pretreatment Facility and the Liquefaction Facility would have ESD systems that shutdown the entire Pretreatment Facility and the entire Liquefaction Facility as well as various process units within each Facility to initiate closure of valves and shutdown of the processes during emergency situations. Safety-instrumented systems would comply with ISA Standard 84.01 and other recommended and generally accepted good engineering practices. We also recommend in Section B.10.6 that Freeport LNG file information, for review and approval, on the final design, installation, and commissioning of instrumentation and ESD equipment to ensure appropriate cause-and-effect alarm or shutdown logic and enhanced representation of the ESD system in the plant control room and throughout the plant.

In developing the FEED, Freeport LNG conducted HAZID analyses for both the Pretreatment Facility and the Liquefaction Facility to identify potential hazards in the early stage of a Project's design that can produce undesirable consequences through the occurrence of an incident by evaluating the materials, system, process, and plant design. A more detailed hazard and operability review (HAZOP) analysis would be performed by Freeport LNG during the final design to identify the major process hazards that may occur during the operation of the facilities. The HAZOP study would provide a qualitative evaluation of a range of possible safety, health, and environmental consequences that may result from process deviations, and identify whether there are adequate safeguards (e.g., engineering and administrative controls) to prevent or mitigate the risk (i.e., likelihood and/or consequence severity) from such events. Where insufficient engineering or administrative controls are identified, recommendations to further mitigate these risks would be generated from the results of the HAZOP review. We recommend in section B.10.6 that Freeport LNG file the HAZOP study on the completed final design for review and approval. We would evaluate the HAZOP to ensure all systems and process deviations are addressed appropriately based on likelihood, consequence severity, and resultant risk values with commensurate layers of protection in accordance with recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers, *Guidelines for Hazard Evaluation Procedures*. We also recommend in section B.10.6 that Freeport LNG file the resolutions of the recommendations generated by the HAZOP review for evaluation and approval. Once the design has been subjected to a HAZOP review, the design development team would track, manage and keep records of changes in the facility design, construction, operations, documentation, and personnel. Freeport LNG would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled based on its management of change procedures. If our recommendations are adopted into the order, resolutions of the recommendations generated by the HAZOP review would be monitored by FERC staff. We also recommend in section B.10.6 that Freeport LNG file all changes to their FEED for review and approval. However, major modifications could require an amendment or new proceeding.

If a project is authorized and constructed, Freeport LNG would install equipment in accordance with its design. We recommend in Section B.10.6 that Project facilities be subject to construction inspections and that Freeport LNG provide, for review and approval, commissioning plans, procedures and commissioning demonstration tests that would verify the performance of equipment. In addition, we recommend in Section B.10.6 that Freeport LNG provide semi-annual reports that include abnormal operating conditions and planned facility modifications. Furthermore, we recommend in Section B.10.6 that the Project facilities be subject to regular inspections throughout the life of the facilities to verify that equipment is being properly maintained and to verify basis of design conditions, such as feed gas and sendout conditions, do not exceed the original basis of design.

Mechanical Design

Freeport LNG provided codes and standards for the design, fabrication, construction, and installation of piping and equipment and specifications for the Train 4 Project. The design specifies materials of construction and ratings suitable for the pressure and temperature conditions of the process design. We also recommend where piping and equipment would be cooled with liquid nitrogen that they be designed for liquid nitrogen temperatures, with regard to allowable movement and stresses. Piping would be designed, fabricated, assembled, erected, inspected, examined, and tested in accordance with the American Society of Mechanical Engineers (ASME) Standards B31.3, B31.4, B31.8, B36.10, and B36.19. Pressure vessels would be designed, fabricated, inspected, examined, and tested in accordance with ASME Boiler and Pressure Vessel

Code (BPVC) Section VIII per 49 CFR 193, Subparts B, C, D, and E, and by incorporation NFPA 59A (2001 edition).

Low-pressure storage tanks (such as the amine, heating medium, aqueous ammonia, etc.), would be designed, inspected, and maintained in accordance with API Standard 650. Heat exchangers would be designed to ASME BPVC Section VIII standards; API Standards 661 and 662; and the Tubular Exchanger Manufacturers Association standards. Rotating equipment would be designed to standards and recommended practices, such as API Standards 610, 614, 617, 618, 619, 670, 671 674, 676, and 682; and ASME Standards B73.1, B73.2 and B73.3. Valves and flanges would be designed to standards and recommended practices such as API Standards 598, 600, 602, 607, and 609; ASME Standards B16.5, B16.9, B16.10, B16.11, B16.20, B16.34, B16.36, B16.47, and B16.48; and MSS SP-97.

Pressure and vacuum safety relief valves would be installed to protect the storage containers, pressure vessels, process equipment, and piping in the event of an unexpected pressure excursion. In addition, Train 4 Project piping and equipment would connect into the flare system authorized with Trains 1 through 3. The safety relief valves would be designed to handle process upsets and thermal expansion, per NFPA 59A (2001), ASME Standard B31.3, and ASME BPVC Section VIII; and would be designed in accordance with API Standards 520, 521, 526, 2000 and other recommended and generally accepted good engineering practices. In addition, we recommend in Section B.10.6 that Freeport LNG provide final design information on pressure and vacuum relief devices, for review and approval, to ensure that the final sizing, design, and installation of these components are adequate and in accordance with the standards reference and other recommended and generally accepted good engineering practices.

If the Project is authorized and constructed, Freeport LNG would install equipment in accordance with its design and FERC staff would verify equipment nameplates to ensure equipment is being installed based on the approved design and would conduct construction inspections including reviewing quality assurance and quality control plans to ensure construction work is being performed according to proposed project specifications, procedures, codes and standards. We recommend in Section B.10.6 that Freeport LNG provide semi-annual reports that include equipment malfunctions and abnormal maintenance activities. In addition, we recommend in Section B.10.6 that the Project facilities be subject to inspections throughout the life of the facility to verify that the plant equipment is being properly maintained.

Hazard Mitigation Design

If operational control of the facilities were lost and operational controls and ESD systems failed to maintain the Project within the design limits of the piping, containers, and safety relief valves, a release could potentially occur. FERC regulations under 18 CFR 380.12 (o) (1) through (4) require applicants to provide information on spill containment, spacing and plant layout, hazard detection, hazard control, and firewater systems. In addition, 18 CFR 380.12 (o) (7) require applicants to provide engineering studies on the design approach and 18 CFR 380.12 (o) (14) requires applicants to demonstrate how they comply with 49 CFR 193 and NFPA 59A. As required by 49 CFR 193, Subpart I, and by incorporation Section 9.1.2 of NFPA 59A (2001), fire protection must be provided for all USDOT regulated LNG plant facilities based on an evaluation of sound fire protection engineering principles, analysis of local conditions, hazards within the facility, and exposure to or from other property. NFPA 59A (2001) also requires the evaluation to determine the type, quantity, and location of hazard detection and hazard control, passive fire protection, ESD and depressurizing systems, and emergency response equipment, training, and qualifications. All of the LNG facilities, as defined in 49 CFR 193, once constructed, must comply with the requirements of 49 CFR 193, Subpart I, and would be subject to USDOT's inspection and enforcement programs. However, NFPA 59A (2001) also indicates a wide range in size, design, and location of LNG facilities, precludes the inclusion of detailed fire protection provisions that apply to all facilities comprehensively. In addition NFPA 59A (2001 and later editions), includes subjective performance-based language on where ESD systems and hazard control are required, does not provide any additional guidance on placement or selection of hazard detection equipment, and provides minimal requirements on firewater. Moreover, the Pretreatment Facility would not be subject to the regulations in 49 CFR 193, and the regulations in 49 CFR 192 contain fire protection requirements that are mostly required for compressor stations only. Regulations under OSHA Process Safety Management require adherence to recognized and generally accepted good engineering practices, but does not define them for any specific or set of facilities. Therefore, for both the Pretreatment Facility and the Liquefaction Facility, FERC staff conducted a preliminary evaluation of the proposed spill containment and spacing, hazard detection, ESD and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response, described more fully below, to evaluate whether they would provide adequate protection.

Freeport LNG performed a preliminary fire protection evaluation to determine that adequate mitigation would be in place, including spill containment and spacing, hazard detection, ESD and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response. We recommend in Section B.10.6 that Freeport LNG provide a final fire protection evaluation for review and approval, and to provide more information on the final design, installation, and commissioning of spill containment, hazard detection, hazard control, firewater systems, structural fire protection, and onsite and offsite emergency response procedures for review and approval.

Spill Containment

In the event of a release, sloped areas at the base of process facilities would direct a spill away from equipment and into the impoundment system. This arrangement would minimize the dispersion of flammable vapors into confined, occupied, or public areas and minimize the potential for heat from a fire to impact adjacent equipment, occupied buildings, or public areas if ignition were to occur.

Pretreatment Facilities

Freeport LNG indicates that it would install a Containment Area Sump to collect releases from the curbed and paved areas around all equipment that could contain NGL. Freeport LNG also indicates that curbed containment areas would be provided for other equipment areas at the Pretreatment Facility site. An Amine Drain Drum sump is proposed to contain a spill from this drum. Freeport LNG also indicated that the Pretreatment Facility storage tanks for aqueous ammonia, slop oil, oily water, heating medium, and amine would be located in a common impoundment that would be designed to contain the maximum combined contents of the storage tanks. In addition, the proposed NGL product line would enter a previously authorized pretreatment area, and a spill from this portion of the line would be collected by a previously authorized impoundment in that area that is under construction.

As part of our preliminary engineering review, we evaluated whether impoundment systems would be sized based on the largest flow capacity from a single pipe for 10 minutes plus de-inventory or the capacity of the largest vessel (or total of impounded vessels) served, whichever is greater. Clarifications and potential design revisions would be needed during the final design phase, including, but not limited to, hot oil containment dimensions, truck transfer spill containment, spill containment for certain containers, and liquid levels in certain containers. These would be verified during our final design review. We recommend in Section B.10.6 that Freeport LNG provide additional information on the final design of the impoundment systems for review and approval. Manually started sump pumps are proposed to remove storm water in the NGL Collection Area Sump and the Amine Drain Drum Sump. Other impounding areas at the Pretreatment Facility would have gravity drains for removal of storm water.

Liquefaction Facility

Freeport LNG indicates it would install one new spill containment sump near Train 4 for all flammable liquid spills that could occur in Train 4 as well as from portions of the LNG rundown and recirculation lines. Further spills from the LNG rundown and recirculation lines that could occur west of a pipe rack bridge, which carries the piping into the LNG storage tank area, would be directed into the spill containment sump in the previously authorized liquefaction area. Spills from the LNG rundown line that could occur east of the pipe rack bridge would be collected in the existing LNG sump in the LNG storage tank area.

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. All LNG facilities, as defined by 49 CFR 193, once constructed, must comply with the requirements of 49 CFR 193, Subpart C, and would be subject to USDOT's inspection and enforcement programs. As part of our preliminary engineering review, we evaluated whether impoundment systems would be sized based on the largest flow capacity from a single pipe for 10 minutes plus de-inventory or the capacity of the largest vessel served, whichever is greater. Clarifications and potential design revisions would be needed during the final design phase including, but not limited to, spill containment for the propane make up line, LNG pipe rack/bridge trough sizing and dimensions, details of how increased flows would be accommodated from tie-ins, and details of intersections of LNG troughs and storm water ditches. These would be verified during our final design review, based on our recommendation for review and approval of the final details of the impoundment system.

Freeport LNG indicated that the storm water removal pumps in the proposed Train 4 liquefaction impoundment would be started manually and would have temperature detection and controls to inhibit pump operation in the event of an LNG spill. Freeport LNG would need to verify that the sump pumps in the proposed impoundment meet the water removal requirements specified in 49 CFR 193 Subpart C. If the facilities are approved and constructed, final compliance with the requirements of 49 CFR 193, Subpart C would be subject to USDOT's inspection and enforcement programs.

If the Project is authorized and constructed, Freeport LNG would install all proposed spill impoundments in accordance with its design, and FERC staff would verify during construction inspections that the spill containment system including dimensions, and slopes of curbing and trenches, and capacity matches final design information. In addition, we recommend in Section B.10.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify that impoundments are being properly maintained.

Spacing and Plant Layout

The spacing of the Liquefaction Facility vessels and equipment between each other, from ignition sources, and to the property line would need to meet the requirements of 49 CFR 193 Subparts C, D, and E, which incorporate NFPA 59A (2001). NFPA 59A (2001) includes requirements for spacing and plant layout further references NFPA Standards 30, NFPA 58, and NFPA 59 for additional spacing and plant layout requirements. If the facilities are approved and constructed, final compliance with the requirements of 49 CFR 193 would be subject to USDOT's inspection and enforcement programs.

FERC staff evaluated that appropriate equipment spacing would be provided for the Pretreatment Facility. The company indicates that the layout of the proposed pretreatment process facilities would be identical to the authorized units currently under construction. The proposed pretreatment process and storage facilities are also depicted on plot plans as not being located significantly closer to a property line than those previously authorized units under construction, which were discussed in the final EIS for the Freeport LNG Liquefaction Project issued on June 16, 2014 (FERC, 2014).

In addition, FERC staff evaluated the spacing of the Pretreatment and Liquefaction Facility to determine if there could be cascading damage and to inform what fire protection measures may be necessary to reduce the risk of cascading damage. A pool fire at the proposed LNG Containment Sump Basin located at the Liquefaction Facility site would result in high radiant heats only at the spill trenching leading to the impoundment. A pool fire due to a release from proposed piping into one of the previously authorized liquefaction facility impoundments or pretreatment Unit 61 NGL impoundment, if it was unmitigated, could potentially impact an adjacent LNG storage tank, elevated troughs and piping, process vessels, and/or other equipment. In addition, we note that radiant heats greater than 4,000 Btu/ft^2-hr from a fire in a proposed Pretreatment Facility impoundment could impact hazardous liquid storage vessels, process vessels, and other equipment. To mitigate against impoundment and jet fires for Project facilities, Freeport LNG proposes thermal radiation mitigation measures to prevent cascading events, including fire-safe ESD valves, depressurization systems, fire and gas detectors, fire proofing of structural steel columns supporting critical equipment, thermal insulation on vessels, deluge systems, minimizing nozzles below normal liquid levels, minimizing flanges under vessels, using a minimum nozzle size of 2 inches (50 mm) nominal, orienting flanges properly such that flange jet fires would not impact vessels, high expansion foam systems, and fire monitors and hydrants, and other mitigation. However, details of these systems would be developed during the final design phase. We recommend in Section B.10.6 that Freeport LNG provide the final design of these thermal mitigation measures, for review and approval, to demonstrate cascading events would be mitigated, including for the three previously authorized impoundments that could collect spills from this Project's facilities.

We also recommend in Section B.10.6 that Project facilities be subject to periodic inspections during construction to verify flammable/toxic gas detection equipment is installed in heating, ventilation, and air condition intakes of buildings at appropriate locations. In addition, we recommend in Section B.10.6 that Project facilities be subject to regular inspections throughout the life of the facilities to continue to verify that flammable/toxic gas detection equipment installed in building air intakes function as designed and are being maintained and calibrated.

If the Project is authorized, Freeport LNG would finalize the plot plan, and we recommend in Section B.10.6 that Freeport LNG provide any changes for review and approval to ensure capacities and setbacks are maintained. If the facilities are constructed, Freeport LNG would install equipment in accordance with the spacing indicated on the plot plans, and we recommend in Section B.10.6 that Project facilities be subject to periodic inspections during construction to verify equipment is installed in appropriate locations and the spacing is met in the field. In addition, we recommend in Section B.10.6 that Project facilities be subject to regular inspections throughout the life of the facilities to continue to verify that equipment setbacks from other equipment and ignition sources are being maintained during operations.

Ignition Controls

All Project facilities at the Liquefaction Facility, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to USDOT's inspection and enforcement programs, which require compliance, by incorporation by reference, with NFPA 59A (2001) and NFPA 70. Freeport LNG indicated in its application that Project areas would be designated with an appropriate hazardous electrical classification and process seals commensurate with the risk of the hazardous fluids being handled in accordance with NFPA 59A, 70, 497, and API RP 500. Depending on the risk level, the Project areas in both the Pretreatment Facility and Liquefaction Facility would either be unclassified or classified as Class 1 Division 1 or Class 1 Division 2. Electrical equipment located in these areas would be designed such that in the event a flammable vapor is present, the equipment would have a minimal risk of igniting the vapor. FERC staff evaluated the Freeport LNG electrical area classification drawings to determine whether that the project would meet electrical area classification requirements and good engineering practices. We found that some revisions would be needed to properly implement these classification areas, including, but not limited to clarifying compliance with NFPA 497 and API 500 and classification of areas handling fluids above their flash point. If the Project is authorized, Freeport LNG would finalize the electrical area classification drawings and would describe changes made from the FEED design. We recommend in Section B.10.6 that Freeport LNG file the final design of the electrical area classification drawings for review and approval. If facilities are constructed, Freeport LNG would install appropriately classed electrical equipment, and we recommend in Section B.10.6 that Project facilities be subject to periodic inspections during construction for FERC staff to spot check electrical equipment and verify equipment is installed per classification and are properly bonded or grounded in accordance with NFPA 70. In addition, we recommend in Section B.10.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical equipment is maintained (e.g., bolts on explosion proof equipment properly installed and maintained, panels provided with purge, etc.), and electrical equipment are appropriately de-energized and locked out and tagged out when being serviced.

In addition, submerged pumps, LNG and mixed refrigerant turbines, and other pressure boundary instrumentation would be equipped with electrical process seals and leak detection in accordance with NFPA 59A (2001) and NFPA 70. We recommend in Section B.10.6 that Freeport LNG provide, for review and approval, final design drawings showing process seals installed at the interface between a flammable fluid system and an electrical conduit or wiring system that meet the requirements of NFPA 59A (2001) and NFPA 70. In addition, Freeport LNG provided preliminary details of an air gap or vent equipped with a leak detection device that would continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. We recommend in section B.10.6 that Freeport LNG provide, for review and approval, the final design of this system. In addition, we recommend in Section B.10.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical process seals for submerged pumps and turbines continue to conform to NFPA 59A and NFPA 70 and that air gaps are being properly maintained.

Hazard Detection, Emergency Shutdown, and Depressurization Systems

Freeport LNG would also install hazard detection systems to detect cryogenic spills, flammable and toxic vapors, and fires throughout the Pretreatment Facility and Liquefaction Facility. The hazard detection systems would alarm and notify personnel in the area and control room to initiate an emergency shutdown, depressurization, or initiate appropriate procedures, and would meet NFPA Standard 72, ISA Standard 12.13, and other recommended and generally accepted good engineering practices. Additionally, Freeport LNG did not include a specification for the hazard detectors proposed for the Project. Therefore, we recommend in Section B.10.6 that Freeport LNG provide specifications, for review and approval, of the final design of fire safety specifications, including hazard detection, hazard control, and firewater systems.

We also evaluated the adequacy of the general hazard detection type, location and layout to ensure adequate coverage to detect cryogenic spills, flammable and toxic vapors, and fires near potential release sources (i.e., pumps, compressors, sumps, trenches, flanges, and instrument and valve connections). We reviewed the fire and gas cause and effect matrices to evaluate the detectors that would initiate an alarm, shutdown, depressurization, or other action based on the FEED. We recommend in Section B.10.6 that Freeport LNG provide additional information, for review and approval, on the final design of all hazard detection systems (e.g., manufacturer and model, elevations, etc.) and hazard detection layout drawings. If the Project is authorized and constructed, Freeport LNG would install hazard detectors according to its specifications, and we recommend in Section B.10.6 that Project facilities be subject to periodic inspections during construction to verify hazard detectors and ESD pushbuttons are appropriately installed per approved design and functional based on cause and effect matrixes prior to introduction of hazardous fluids. In addition, we recommend in Section B.10.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify hazard detector coverage and functionality is being maintained and are not being bypassed without appropriate precautions.

Hazard Control

If ignition of flammable vapors occurred, hazard control devices would be installed to extinguish or control incipient fires and releases, and would meet NFPA 59A (2001); NFPA 10, 12, 15, 17, and 2001; API 2218, and 2510A; as well as other recommended and generally accepted good engineering practices. We evaluated the adequacy of the number and availability of handheld, wheeled, and fixed fire extinguishing devices throughout the site based on the FEED. We also generally evaluated whether the spacing of the fire extinguishers meet NFPA 10. In addition, we evaluated whether clean agent systems would be installed in all instrumentation buildings in accordance with NFPA 2001. We recommend in Section B.10.6 that Freeport LNG file additional information on the final design of these systems, for review and approval, where details are yet to be determined (e.g., manufacturer and model, elevations, flowrate, capacities, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project. If the Project is authorized and constructed, Freeport LNG would install hazard control equipment, and we recommend in Section B.10.6 that Project facilities be subject to periodic inspections during construction to verify hazard control equipment is installed in the field and functional prior to introduction of hazardous fluids. In addition, we recommend in Section B.10.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify in the field that hazard control coverage and is being properly maintained and inspected.

Passive Cryogenic and Fire Protection

If a fire could not be separated, controlled, or extinguished to limit fire exposures or cryogenic releases onto facility components to insignificant levels, passive fire protection (e.g., fireproofing structural steel) would be provided to prevent failure of structural supports of equipment and pipe racks. The structural fire protection would comply with NFPA 59A (2001) and other recommended and generally accepted good engineering practices. We recommend passive cryogenic and fire protection be applied to pressure vessels and structural supports to facilities that could be exposed to cryogenic liquids or to radiant heats of 4,000 Btu/ft^2-hr or greater from fires with durations that could result in failures[17] and that they are specified in accordance with recommended and generally accepted good engineering practices with a fire protection rating commensurate to the radiant heat and duration. In addition, we recommend in Section B.10.6 that Freeport LNG provide additional information on the final design of these systems, for review and approval, where details are yet to be determined (e.g., calculation of structural fire protection materials, thicknesses, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project. Details were not provided for the cryogenic and fire protection or use materials of construction that would protect equipment and structural supports that could potentially be exposed to cryogenic releases or fires. Therefore, we recommend in Section B.10.6 that Freeport LNG file drawings and specifications, for review and approval, for the structural passive protection systems to protect equipment and supports from cryogenic releases and fires.

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17 Pool fires from impoundments are generally mitigated through use of emergency shutdowns, depressurization systems, structural fire protection, and firewater, while jet fires are primarily mitigated through the use of emergency shutdowns, depressurization systems, and firewater without structural fire protection.

If the Project is authorized and constructed, Freeport LNG would install structural cryogenic and fire protection according to its design, and we recommend in Section B.10.6 that Project facilities be subject to periodic inspections during construction to verify structural cryogenic and fire protection is properly installed in the field as designed prior to introduction of hazardous fluids. In addition, we recommend in Section B.10.6 that Project facilities be subject to regular inspections throughout the life of the facility to continue to verify that passive protection is being properly maintained.

Firewater Systems

Freeport LNG would also provide firewater systems, including remotely operated firewater monitors, sprinkler systems, fixed water spray systems, and firewater hydrants and hoses for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire. These firewater systems would be designed to meet NFPA 59A (2001), 13, 15, 20, 22, and 24 requirements. However, the Pretreatment firewater tank would be designed to API 650 with only the vent valve specified in accordance with NFPA 22. Therefore, we recommend Freeport LNG design the firewater tank in accordance with NFPA 22 or justify how API 650 provides an equivalent or better level of safety. In addition, the relief valve discharge design on the firewater pumps would not meet NFPA 20. Therefore, we recommend they revise the design to comply with NFPA 20 or demonstrate equivalency. We evaluated the adequacy of the general firewater or foam system coverage and verify the appropriateness of the associated firewater demands of those systems and worst-case fire scenarios to size the firewater and foam pumps. Freeport LNG provided drawings for the firewater monitors and fire hydrant locations, but did not provide firewater coverage drawings. We evaluated the firewater monitor and fire hydrant locations drawings, and determined that the site would likely be adequately covered based on the plot plans, but where coverage is impacted by pipe racks, large vessels or process equipment, the firewater coverage could be blocked, and the coverage should be modified to account for obstructions during the final design. Three-dimensional drawings and tests in the field prior to introduction of hazardous fluids would allow verification of the coverage. Therefore, we recommend in section B.10.6 that Freeport LNG complete and document the firewater monitor and hydrant coverage test to verify that actual coverage area from each monitor and hydrant as shown on facility plot plan(s).

We also assessed whether the reliability of the firewater pumps and firewater source or onsite storage volume are appropriate. In addition, we recommend in Section B.10.6 that Freeport LNG file an updated fire protection evaluation performed on the final design, for review and approval, where details are yet to be determined (e.g., manufacturer and model, nozzle types, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project. If the Project is authorized and constructed, Freeport LNG would install the firewater and foam systems as designed, and we recommend in Section B.10.6 that Project facilities be subject to periodic inspections during construction and that companies provide results of commissioning tests to verify the firewater and foam systems are installed and functional as designed prior to introduction of hazardous fluids. In addition, we recommend in Section B.10.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure firewater and foam systems are being properly maintained and tested.

Geotechnical and Structural Design

Once the preliminary process, mechanical, and hazard mitigation features are determined, the preliminary design of the supportive foundations and structures can be determined based on the estimated loads and size of equipment and underlying geological and soil conditions. Freeport LNG provided geotechnical and structural design information for its facilities to demonstrate the site preparation and foundation designs would be appropriate for the underlying geological and soil characteristics and to ensure the structural design of the Project facilities would be in accordance with federal regulations, standards, and recommended and generally accepted good engineering practices. The application focuses on the resilience of the Project facilities against natural hazards, including extreme geological, meteorological, and hydrological events, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism.

Geotechnical Evaluation

FERC regulations under 18 CFR 380.12 (h) (3) require geotechnical investigations to be provided. In addition, FERC regulations under 18 CFR 380.12 (o) (14) require an applicant to demonstrate compliance with regulations under 49 CFR 193 and NFPA 59A. All LNG facilities, as defined in 49 CFR 193, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to USDOT's inspection and enforcement programs. USDOT regulations incorporated by reference NFPA 59A (2001), which requires in section 2.1.4 soil and general investigations of the site to determine the design basis for the facility. However, no additional requirements are set forth in 49 CFR 193 or NFPA 59A on minimum requirements for evaluating existing soil site conditions or evaluating the adequacy of the foundations. In addition, the pretreatment facilities are precluded from 49 CFR 193 and there are no requirements for geotechnical investigations under 49 CFR 192 for aboveground facilities, However, we recognize a need to address the geotechnical design for all facilities. Therefore we evaluated the existing site conditions, geotechnical report, and proposed foundations to ensure they are adequate for both the Pretreatment Facility and Liquefaction Facility, as described more fully below.

The Liquefaction Facility site would be located within the existing Quintana Island LNG Terminal footprint on the western portion of the Dredge Material Placement Area (DMPA) immediately adjacent to Liquefaction Trains 1 through 3 that are currently under construction. Similarly, Unit 4 at the Pretreatment Facility would be located immediately adjacent to Pretreatment Units 1 through 3 currently under construction located about 2 miles north of the Liquefaction Facility. Freeport LNG contracted Fugro to conduct geotechnical investigations and report on the existing soil conditions and proposed foundation design for the Project facilities. The existing grade for the Liquefaction Facility is approximately +22 feet (average) North American Vertical datum 1988 (NAVD 88) and the Pretreatment Facility site is approximately +4 feet (average) NAVD 88. The sites would be cleared, grubbed, and prepared using standard earthmoving and compaction equipment. Site preparation would result in a final grade elevation being raised from +22 feet to +24 feet NAVD 88 for the Liquefaction Facility and from +4 to +8 feet NAVD 88 at the Pretreatment Facility. The Geotechnical study (Fugro 2016) identified the following classifications for site grade raising: 1) Structural Clay Fill, 2) Compacted Clay Fill, 3) Lime-Stabilized Fill, 4) Granular Fill, and 5) General Fill. The fill material would be compacted to 90 to 98 percent of maximum dry density for standard proctor tests in accordance with American Society for Testing and Materials (ASTM) D698 depending on the location.

In 2016, Fugro conducted 6 new soil borings for the Liquefaction Facility and 5 new soil borings for the Unit 4 facilities at the Pretreatment Facility. The soil borings ranged in depths ranging between 100 feet to 200 feet below existing grade. Also 12 new cone penetration tests (CPT) to depths ranging from 50 feet to 125 feet (or to refusal) below existing grade for the Liquefaction Facility and 50 feet to 200 feet (or refusal) below existing grade for the Pretreatment Facility were also conducted. Additionally, four borings and four CPTs from previous geotechnical investigations for the Liquefaction Facility and seven borings and three CPTs from previous geotechnical investigations for the Pretreatment Facility were utilized. Over 11 different tests on 250 recovered soil samples were conducted at the Liquefaction Facility and 11 different tests on 132 soil samples were conducted at the Pretreatment Facility. Laboratory tests include classification tests (water content, Atterberg liquid and plastic limits, sieve tests), compression tests, consolidation tests, shear tests, organic content tests, corrosion potential tests (pH, sulfate, chloride, electrical resistivity) in general accordance with pertinent ASTM standards. We evaluated the geotechnical investigation to ensure the adequacy in the number, coverage, and types of the geotechnical borings, CPTs, seismic CPTs, and other tests, and found them to adequately cover all major facilities of the Liquefaction Facility and Pretreatment Facility. We will continue our review of the results of the geotechnical investigation to ensure foundation designs are appropriate and have made recommendations to the Commission for consideration to include in the order and follow through during initial site preparation, construction of final design, commissioning, and throughout the life of the facilities.

Based on the test borings conducted, the Liquefaction Facility site consists of a layer of very soft dredged fill material to depth of 30 feet. There is considerable variation in the type, strength, and consistency of this material, which is consistent with dredged fill from this area of Texas. Very soft to very stiff clay and sandy clay underlies the surface layer to a depth of approximately 98 feet, followed by very dense silty sand to a depth of 105 feet and firm to hard clay and sandy clay to a depth of 200 feet (the maximum depth of the borings). The test borings conducted for Unit 4 at the Pretreatment Facility indicates the site is composed of approximately 0 to 12 feet of surficial soil consisting of unconsolidated soft clay underlain by very loose to loose sand from 12 to 22 feet bgs; firm to stiff clay, stiff clay, stiff to very stiff clay from 22 to 107 feet bgs; and very dense sand from depths of 102 feet to over 112 feet bgs. Corrosion tests of the Train 4 site indicate that the potential for corrosion of steel due to chloride ion concentration is high, the potential for corrosion of steel due to pH is mild, and the potential for corrosion of steel due to electrical resistivity is very high. Tests of the Train 4 site indicate that the potential for degradation of concrete due to sulfate ion concentrations is generally moderate to severe. Corrosion tests of the Pretreatment Facility indicate that the potential for corrosion of steel due to chloride ion concentration is moderate to high, the potential for corrosion of steel due to pH is mild, and the potential for corrosion of steel due to electrical resistivity ranges from high to very high. Corrosion tests of the Pretreatment Facility indicate that the potential for degradation of concrete due to sulfate ion concentrations is generally mild. Based on these results, the Project has indicated that the potential for corrosion for concrete and piles should be considered in the design.

Based on the subsurface conditions, shallow foundations would be suitable for some lightly loaded structures; however, as is common for heavier structures in areas with these types of soil conditions, the liquefaction facilities and many associated structures would require deep foundations. The Train 4 site is within the scour zone of the DMPA, therefore the proposed structures within the DMPA must be supported on deep foundations consisting of either DeWaal piles or Auger Cast-in-Place (ACIP) piles. At the Pretreatment Facility, Freeport LNG proposes the use of DeWaal Piles and pre-cast, pre-stressed square concrete piles for all settlement-sensitive structures, and to use shallow foundation systems consisting of slab-on-grade foundations, spread footings, or small mat foundations to support the lightly loaded structures and equipment. The top of the pile elevation was taken to be at final grade elevation of +19 NAVD 88 for the Train 4 site and at a final grade elevation of +8 feet NAVD 88 for Unit 4 at the Pretreatment Facility. Piles are proposed to be embedded between 31 and 39 feet below grade for the Train 4 site and between 30 and 34 feet below grade for Unit 4 at the Pretreatment Facility and depending on the equipment being supported and pile characteristics such as spacing, type, and diameter.

Subsidence is the sudden sinking or gradual downward settling of land with little or no horizontal motion, caused by movements on surface faults or by subsurface mining or pumping of oil, natural gas, or ground water. Large-scale subsidence has occurred in Brazoria County, starting around the turn of the last century. The assessment of regional subsidence indicated that the Quintana Island area has experienced 1 to 2 feet of subsidence since the early 1900s. By the 1970s the area around Freeport had subsided approximately 1.5 feet and up to 2 feet in northern portion of the county, near Houston (Sandeen and Wesselman, 1973). The 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. 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. Current predictions for the Quintana Island area through the year 2050 predict a subsidence rate of approximately 0.308 inches per year, which would be less than a 1-foot subsidence over a 30-year span. The subsidence would not affect improved facilities such as the Liquefaction Facility or the Pretreatment Facility, although it may have minor effects on appurtenant structures such as roads, stairs, etc. Mitigation for minor, ongoing settlement of these appurtenant facilities would require continued maintenance by Freeport LNG. Because subsidence is a recognized concern in the area of the Project, earth-supported elements, such as the storm surge barrier and plant roads, would require periodic maintenance to mitigate the long-term effects of settlements and differential movements. Because site-specific geotechnical mitigation has been incorporated into the Project design (e.g., pile-supported foundations) that would be designed in accordance with NFPA 59A (2001), subsidence would not be a significant hazard to the proposed facilities.

Port Freeport's levee around the former placement area was designed and constructed to retain dredged material and prevent surface water runoff into adjacent areas. The levee has been improved in association with the terminal prior to construction of the Train 4 Project. As a result, the structural integrity of this levee system would be sufficient to protect the proposed Train 4 Project. The existing shoreline erosion would be of concern on Quintana Island, but because of the shoreline improvements made by Freeport LNG, Project-related impacts on coastal and sedimentation would not be anticipated.

The results of Freeport LNG's geotechnical investigation at the Project sites indicate that subsurface conditions are generally suitable for the proposed facilities, if proposed site preparation, foundation design, and construction methods are implemented.

Structural and Natural Hazard Evaluation

FERC regulations under 18 CFR 380.12 (m) require applicants to address the potential hazard to the public from failure of facility components resulting from accidents or natural catastrophes, evaluate how these events would affect reliability, and describe the design features and procedures that would be used to reduce potential hazards. In addition, 18 CFR 380.12 (o) (14) require an applicant to demonstrate how they would comply with 49 CFR 193 and NFPA 59A. In addition, USDOT regulations under 49 CFR 193 have some specific requirements on designs to withstand certain loads from natural hazards and also incorporates by reference NFPA 59A (2001 and 2006) and ASCE 7-05 and ASCE 7-93 via NFPA 59A (2001). All LNG facilities, as defined in 49 CFR 193, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to USDOT's inspection and enforcement programs. Although the Pretreatment Facility would not be subject to Part 193 requirements, we assessed the Pretreatment Facility using an approach consistent to that in Part 193 as detailed below.

In addition, the facilities would be constructed to the requirements in the 2012 International Building Code (IBC), ASCE 7-05, and ASCE 7-10. These standards require various structural loads to be applied to the design of the facilities, including live (i.e., dynamic) loads, dead (i.e., static) loads, and environmental loads. We evaluated the engineering design to withstand impacts from natural hazards, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism. We recommend in Section B.10.6 that Freeport LNG file final design information (e.g., drawings, specifications, and calculations) and associated quality assurance and quality control procedures with the documents reviewed, approved, and stamped and sealed by a professional engineer of record registered in the state of Texas. If the Project is authorized and constructed, the company would install equipment in accordance with its final design.

Earthquakes, Tsunamis, and Seiche

Earthquakes and tsunamis have the potential to cause damage from shaking ground motion and fault ruptures. Earthquakes and tsunamis often result from sudden slips along fractures in the earth's crust (i.e., faults) and the resultant ground motions caused by those movements, but can also be a result of volcanic activity or other causes of vibration in the earth's crust. The damage that could occur as a result of ground motions is affected by the type/direction and severity of the fault activity and the distance and type of soils the seismic waves must travel from the hypocenter (or point below the epicenter where seismic activity occurs). To assess the potential impact from earthquakes and tsunamis, Freeport LNG evaluated historic earthquakes along fault locations and their resultant ground motions.

The USGS maintains a database containing information on surface and subsurface faults and folds in the United States that are believed to be sources of earthquakes of greater than

6.0 magnitude occurring during the past 1.6 million years (Quaternary Period).[18] The location of the Project is within the Gulf Coast Basin geologic tectonic province. The Gulf Coast Basin is characterized as having thick sedimentary rocks above basement rock structures. The province's sedimentary strata thickens toward the south, with salt domes and relatively shallow listric growth faults that run parallel to the Gulf of Mexico Coastline and extend outside of Texas. Movement within the fault system has been classified as a general creep as opposed to the breaking of rocks, which is often associated with earthquake events (Stevenson and McCulloh, 2001). Salt domes are prevalent throughout the Gulf Coast Basin and are characterized by having a system of faults arranged in a circular pattern around them (Gagliano, 1999).

Freeport LNG contracted Fugro to conduct a site-specific seismic risk analysis for the Project, involving field investigations and subsequent data evaluation. Freeport LNG's *Detailed Geologic Fault Study and Subsidence Assessment* report includes reviewing existing fault information including the detailed fault study report previously prepared by Fugro in 2003 and 2011 for the existing terminal and supplemented by the 2017 Seismic Studies for Freeport, Texas. The most comprehensive information regarding faulting for the site was compiled in site-specific study reports prepared by Fugro in 2003 for the original Freeport LNG Terminal, in 2011 for the Liquefaction Project (Trains 1 through 3), and in 2012 for the Pretreatment Facility (Trains 1 through 3). The 2003 Fugro report indicated that the site is in an area that has a high risk of surface faulting because of its proximity to the Brayan Mound Salt Dome. As described in the 2003 report, Boccanera (1989) shows a complex graben of faults extending generally northward from the Bryan Mound Salt Dome. Two faults that were mapped and named by Boccanera on the eastern side of the graben (the Horseshoe Lake Fault and the East Union Bayou Fault) were of interest to the site because of their locations and trends toward the site. A program of geophysically logged borings was conducted to study the possibility of geologic faulting in the expansion areas. Seven lines of borings were drilled and evaluated for the presence or absence of surface faulting that could impact the areas that have been considered for expansion. No faults have been identified that would impact the Project areas. However a fault has been identified in the northwest corner of the area that has been identified that, if extended to the surface, would terminate within 100 feet of the Liquefaction Facility site. Fugro concluded that the fault to the northwest of the Liquefaction Facility site would not have an impact on the Project.

The 2012 Fugro study conducted a site-specific seismic risk analysis for Units 1 through 3 at the pretreatment facilities and identified the Salt Lake Fault, in the northwest corner of the site as a geologically active fault. Due to the presence of the fault, Freeport LNG implemented a fault monitoring program, as well as relocated structures to minimize the impact of surface faulting. Fugro was contracted to reevaluate the impact of the fault on Unit 4 at the Pretreatment Facility, and concluded that the identified fault would not have an impact on the Project site.

To address the potential ground motions at the site, USDOT regulations in 49 CFR 193.2101 under Subpart C incorporate by reference of NFPA 59A (2001) Chapter 6, which require piping systems conveying flammable liquids and flammable gasses with service temperatures below -20ºF, be designed as required for seismic ground motions. The facilities, once constructed, are subject to the USDOT's inspection and enforcement programs.

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[18] USGS. Earthquake Hazards Program. Quaternary Fault and Fold Database of the United States. Available at: https://earthquake.usgs.gov/hazards/qfaults/ Accessed August 2018

We recognize this leaves a need to address hazardous fluid piping with service temperatures at -20ºF and higher and equipment other than piping and LNG storage containers. We also recognize the current FERC regulations under 18 CFR 380.12 (h) (5) continue to incorporate NBSIR 84-2833. NBSIR 84-2833 provides guidance on classifying stationary storage containers and related safety equipment as Category I and classifying the remainder of the LNG project structures, systems, and components as either Category II or Category III, but does not provide specific guidance for the seismic design requirements for them. Absent any other regulatory requirements, this guidance recommends that other LNG project structures classified as Seismic Category II or Category III be seismically designed to satisfy the Design Earthquake and seismic requirements of the ASCE 7-05 in order to demonstrate there is not a significant impact on the safety of the public ASCE 7-05 is recommended as it is a complete ANSI consensus design standard, its seismic requirements are based directly on the National Earthquake Hazards Reduction Program Recommended Provisions, and it is referenced directly by the IBC. Having a link directly to the IBC and ASCE 7 is important to accommodate seals by the engineer of record because the IBC is directly linked to state professional licensing laws while the National Earthquake Hazards Reduction Program Recommended Provisions are not.

The geotechnical investigations of the Liquefaction Facility and Pretreatment Facility sites performed by Fugro indicate the sites are classified as Site Class E[19] in accordance with ASCE 7-05, which is incorporated into 49 CFR 193 and in accordance with IBC 2006 based on a site average shear wave velocity (V_{s30}). Based on ASCE 7 and IBC standards, sites with V_{s30} of less than 600 feet per second (ft/s) would be classified as a Site Class E. A V_{s30} value of 475 ft/s was observed for the top 100 feet of soil at the Liquefaction Facility site, while a V_{s30} value of 539 ft/s was observed at the Pretreatment Facility site. Sites with soil conditions of this type would experience significant amplifications of surface earthquake ground motions. However, even with these amplifications, the seismic risk in the Project's area of Texas is still considered low.

Fugro performed a site-specific seismic hazard study for the site. The study concluded that the site would have an Operating Basis Earthquake (OBE) PGA of 0.024 g, a Safe Shutdown Earthquake (SSE) PGA of 0.073 g, a 0.2-second spectral acceleration (S_{DS}) of 0.100 g, and a 1.0-second design spectral acceleration (S_{D1}) of 0.073 g. We independently evaluated the OBE PGA, SSE PGA, S_{DS}, and S_{D1} for the site using the USGS Earthquake Hazards Program Seismic Design Maps[20], Unified Hazard[21], and Applied Technology Council Hazard[22] tools for all occupancy

19 There are six different site classes in ASCE 7-05, A through F, that are representative of different soil conditions that impact the ground motions and potential hazard ranging from Hard Rock (Site Class A), Rock (Site Class B), Very dense soil and soft rock (Site Class C), Stiff Soil (Site Class D), Soft Clay Soil (Site Class E), to soils vulnerable to potential failure or collapse, such as liquefiable soils, quick and highly sensitive clays, and collapsible weakly cemented soils (Site Class F).

20 USGS. U.S. Seismic Design Maps. https://earthquake.usgs.gov/designmaps/us/application.php. Accessed August 2018.

21 USGS. Unified Hazard Tool. https://earthquake.usgs.gov/hazards/interactive/. Accessed August 2018.

22 Applied Technology Council, Hazards by Location, https://hazards.atcouncil.org/#/, accessed October 2018.

categories (I through IV). When comparing Freeport LNG's OBE PGA, SSE PGA, S_{DS}, and S_{D1}, values to the USGS and Applied Technology Council Hazard tools, we determined that the values used by Freeport LNG are acceptable. These ground motions are relatively low compared to other locations in the United States. Based on the design ground motions for the site and the importance of the facilities, the facility seismic design is assigned Seismic Category I for LNG containers, systems required for isolation of LNG containers, and systems required for safe shutdown or fire protection. Seismic Category II structures include facilities and systems not included in Category 1 required for safe plant operation, which include LNG liquefaction trains, inlet facilities, pre-treatment area(s), power generation area(s), fuel gas system, interconnecting piping systems, metering systems, LNG pumps, and other items. Seismic Category III includes all other facilities that are not included in Categories I and II, including administration buildings, dock service equipment, waste treatment plant, and incoming electrical power supply. We also acknowledge that the Project does not involve any new structures, systems, or components that are classified as Seismic Category I.

ASCE 7-05 also requires determination of the Seismic Design Category based on the Occupancy Category (or Risk Category in ASCE 7-10 and 7-16) and severity of the earthquake design motion. The Occupancy Category (or Risk Category) is based on the importance of the facility and the risk it poses to the public.[23] We have identified the Project as a Seismic Design Category B based on the ground motions for the site and an Occupancy Category (or Risk Category) of III, this seismic design categorization would appear to be consistent with the 2006 IBC and ASCE 7-05 (and ASCE 7-10).

Seismic events can also result in soil liquefaction in which saturated, non-cohesive soils temporarily lose their strength/cohesion and liquefy (i.e., behave like viscous liquid) as a result of increased pore pressure and reduced effective stress when subjected to dynamic forces such as intense and prolonged ground shaking. Areas susceptible to liquefaction may include saturated soils that are generally sandy or silty. Typically, these soils are located along rivers, streams, lakes, and shorelines or in areas with shallow groundwater. At the Liquefaction Facility, the subsoil profiles developed from site-specific geotechnical investigations indicate the presence of layers of silty sands and sandy silts that are dense to very dense. These sand layers could be liquefiable under sufficiently strong ground motions. However, due to the low seismicity of the region, the potential for soil liquefaction to occur is low. In addition, Freeport LNG would address possible

23 ASCE 7-05 defines Occupancy Categories I, II, III, and IV. Occupancy Category I represents facilities with a low hazard to human life in even of failure, such as agricultural facilities; Occupancy Category III represents facilities with a substantial hazard to human life in the event of failure or with a substantial economic impact or disruption of day to day civilian life in the event of failure, such as buildings where more than 300 people aggregate, daycare facilities with facilities greater than 150, schools with capacities greater than 250 for elementary and secondary and greater than 500 for colleges, health care facilities with 50 or more patients, jails and detention facilities, power generating stations, water treatment facilities, telecommunication centers, hazardous facilities that could impact public; Occupancy Category IV represents essential facilities, such as hospitals, fire, rescue, and police stations, emergency shelters, power generating stations and utilities needed in an emergency, aviation control towers, water storage and pump structures for fire suppression, national defense facilities, and hazardous facilities that could substantially impact public; and Occupancy Category II represents all other facilities. ASCE 7-10 changed the term to Risk Categories I, II, III, and IV with some modification.

issues relating to the potential for soil liquefaction and loss of soil strength by using piles in the foundation design. Freeport LNG would utilize ground improvement techniques (e.g., cementitious strengthening) if required to counteract soil liquefaction.

Seismic events in waterbodies can also cause tsunamis or seiches by sudden displacement of the sea floors in the ocean or standing water. Tsunamis and seiche may also be generated from volcanic eruptions or landslides. Tsunami wave action can cause extensive damage to coastal regions and facilities. The Terminal site's low lying position would make it potentially vulnerable were a tsunami to occur. There is little evidence that the northern Gulf of Mexico is prone to tsunami events, but the occurrence of a tsunami is possible. Two did occur in the Gulf of Mexico in the early 20th century and had wave heights of 3 feet or less (USGS, 2009), which is not significantly higher than the average breaking wave height of 1.5 feet (Owen, 2008). Hydrodynamic modeling conducted off the coast of south Texas in 2004 indicated that the maximum tsunami run-up could be as high as 12 feet *amsl*. No earthquake generating faults have been identified that are likely to produce tsunamis, despite recorded seismic activity in the area.

The potential for tsunamis associated with submarine landslides remains a focus of government research (USGS, 2009). In addition, maximum considered tsunamis generated wave elevations within the Gulf of Mexico would be smaller than the anticipated storm surge elevations that are more probable to develop, thus the storm surge elevations would be the controlling factor. Freeport LNG's *Seismic and Fault Study* report included a Tsunami Hazard Assessment for the Project area. There are two main submarine landslides were evaluated by modeling as part of the ten Brink *et al.* (2009) study: the East Breaks Landslide, a historic event from within the Northwest Gulf of Mexico landslide province and a hypothetical landslide on the Campeche Escarpment. Based on modeling and limited historical data, it is estimated that tsunamis generated from landslides would be estimated to be larger than 2 feet and smaller than 13 feet, respectively. These tsunami run-up elevations are significantly less than the hurricane design storm surge elevations discussed below, so any tsunami hazard has been considered in the proposed design.

Hurricanes, Tornadoes, and other Meteorological Events

Hurricanes, tornadoes, and other meteorological events have the potential to cause damage or failure of facilities due to high winds and floods, including failures from flying or floating debris. To assess the potential impact from hurricanes, tornadoes, and other meteorological events, Freeport LNG evaluated such events historically. The severity of these events are often determined on the probability that they occur and are sometimes referred to as the average number years that the event is expected to re-occur, or in terms of its mean return/recurrence interval.

Because of its location, the Project site would likely be subject to hurricane force winds during the life of the Project. Freeport LNG states that all primary facilities would be designed to withstand a 150 mph sustained wind speed, which converts a 183 mph 3-second gust. Secondary facilities would be designed to a basic wind speed of 150 mph 3-second gust. Freeport indicated that these wind speeds would have an importance factor of 1.15, as well as the ASCE 7-05 wind load factor of 1.6, applied when converting wind speed to wind load. When the importance and load factors are applied to the wind load, and converted back to equivalent wind speeds, the adjusted 3-second gust wind speed for primary facilities would be approximately 248 mph, while for secondary facilities, it would be approximately 203 mph. Based on wind speed return period extrapolation equation provided in ASCE 7, these equivalent wind speeds both have mean return intervals greater than 10,000 years for this site. Structures and equipment designed to withstand these factored design wind speeds for both primary and secondary facilities would be sufficient to withstand strong Category 5 hurricane winds. Freeport LNG must meet 49 CFR 193.2067 under Subpart B for wind load requirements for LNG facilities. In accordance with the MOU, the USDOT will evaluate in its LOD whether an applicant's proposed project meets the USDOT siting requirements under Subpart B. If the Project is constructed and becomes operational, the facilities would be subject to the USDOT's final determination of whether the LNG facilities, as defined in 49 CFR 193, are in compliance with the requirements of 49 CFR 193. If the Project is constructed and becomes operational, the facilities would be subject to the USDOT's inspection and enforcement programs.

However, as noted in the limitation of ASCE 7-05, tornadoes were not considered in developing basic wind speed distributions. This leaves a potential need to assess potential impacts from tornadoes. Therefore, we evaluated the potential for tornadoes. Appendix C of ASCE 7-05 makes reference to American Nuclear Society 2.3 (1983 edition), *Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites*. This document has since been revised in 2011 and reaffirmed in 2016 and is consistent with NUREG/CR-4461, Tornado Climatology of the Contiguous U.S. Rev. 2 (NUREG2007). These documents provide maps of a 100,000 mean year return period for tornadoes using 2° latitude and longitude boxes in the region to estimate a tornado striking within 4,000 feet of an area. Figures 5-8 and 8-1 from NUREG/CR-4461 indicate a 100,000 year maximum tornado wind speeds would be approximately 140 mph 3-second gusts for the Project site location. Later editions of ASCE 7 (ASCE 7-10 and ASCE 7-16) make reference to International Code Council 500, Standard for Design and Construction of Storm Shelters, for 10,000 year tornadoes. However, the International Code Council 500 maps were conservatively developed based on tornadoes striking regions and indicate a 200 mph 3-second gust for a 10,000 year event, which is higher than the 140 mph 3-second gust in American Nuclear Society 2.3 and NUREG/CR-4461. As a result, we conclude the use of a of 150 mph sustained wind speed, 183 mph 3-second gust and 150 mph 3-second gusts (122 mph sustained wind speed) with a 1.15 Importance Factor, is adequate for the primary and secondary facilities.

ASCE 7-05, 7-10 and 7-16 also recognize the facility would be in a windborne debris region. Windborne debris has the potential to perforate equipment if not properly designed to withstand such impacts. The potential impact from a projectile could result in a release, but process piping and equipment would have ESD equipment that would allow for shutdown and isolation within 10 minutes, and the 10 minute release would be fully contained in the spill containment. Similarly, containers would have ESD equipment that would allow for shutdown and isolation within 10 minutes, and the full contents of a container would be fully contained in the spill containment.

In addition, we evaluated historical tropical storm, hurricane, and tornado tracks in the vicinity of the Project facilities using data from the DHS Homeland Infrastructure Foundation

Level Data and NOAA Historical Hurricane Tracker.[24,25] Since 1900, 35 tropical storms or hurricanes of varying intensity occurred within 60 miles of the Project site, including Unnamed Hurricane (Cat 4 peak and landfall) in 1900, Unnamed Hurricane (Cat 3 peak and landfall) in 1909, Unnamed Hurricane (Cat 4 peak and landfall) in 1915, Unnamed Hurricane (Cat 4 peak and landfall) in 1932, Unnamed Hurricane (Cat 3 peak and landfall) in 1941, and Hurricane Alicia (Cat 3 peak and landfall) in 1983. In addition, Hurricane Harvey (Cat 4 peak and initial landfall) in 2017 shifted back out to Gulf south of Freeport as a Tropical Storm and Hurricane Ike (Cat 4 peak and Cat 2 landfall near Galveston) in 2008. The maximum wind speed occurred at landfall was 150 mph sustained wind speed from the Unnamed Hurricane in 1932, which is the design wind speed of secondary facilities without consideration of importance factor.

While wind damage from hurricanes can be extensive, the flooding caused by coastal storm surge can be similarly catastrophic without proper mitigation. The storm surge associated with Hurricane Ike reached just over 6 feet in Freeport and 6 to 8 feet at Surfside Beach (National Weather Service Forecast Office, 2008). In addition, the Freeport area 100-year storm rainfall is 12.8 inches in 24 hours. During Hurricane Ike, the Terminal sustained only minor damage, involving two non-critical site buildings, and debris washed up against the perimeter barriers around the site. The facility remained fully staffed and operational throughout the event.

Potential flood levels may also be informed from the FEMA Flood Insurance Rate Maps (FIRM) are typically considered in the design for flooding. These maps identify Special Flood Hazard Areas (base flood) that have a 1 percent probability of exceedance in 1 year to flood (or a 100 year mean return interval) and more severe flood hazard areas that have a 0.2 percent probability of exceedance in 1 year to flood (or a 500 year mean return interval). The Terminal Facility lies within Zone VE per FEMA FIRM No. 48039C0790 J, dated November 17, 1993. Storm surge height is currently EL. +13 feet National Geodetic Vertical Datum of 1929 (NGVD 29) or +16.6 feet NAVD 88, based on the referenced FIRM map for the site. We also recognize that a 500-year-flood event has been recommended as the basis of design for critical infrastructure in publications, including ASCE 24, *Flood Resistant Design and Construction*. Therefore, it is our opinion that it is good practice to design critical energy infrastructure to withstand a 500-year-event from a safety and reliability standpoint for both stillwater elevation (SWEL) and wave crests. Freeport LNG's proposed design for the Project would be able to withstand a 500-year-flood event. Furthermore, we determined the use of intermediate values from NOAA for sea level rise and subsidence is more appropriate for design and higher projections are more appropriate for planning in accordance with NOAA 2017,[26] which recommends defining a central estimate or mid-range scenario as baseline for shorter-term planning, such as setting initial adaptation plans for the next two decades and defining upper bound scenarios as a guide for long-term adaptation strategies and a general planning envelope.

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24 DHS. Homeland Infrastructure Foundation Level Data. Available at: https://hifld-geoplatform.opendata.arcgis.com/. Accessed August 2018.

25 NOAA. Historical Hurricane Tracker. Available at: https://coast.noaa.gov/hurricanes/. Accessed August 2018.

26 Global and Regional Sea Level Rise Scenarios for the United States. U.S. Department of Commerce. National Ocean and Atmospheric Administration. National Ocean Service Center for Operational Oceanographic Products and Services. January 2017.

The Pretreatment Facility lies outside the 500-year floodplain and outside the 1 percent and 0.2 percent annual chance floodplains (FEMA, 1993). Storm water in and adjacent to the Pretreatment Facility and surrounding areas are managed through a pump station operated by Velasco Drainage District. The existing liquefaction site levee located south of the liquefaction facility was constructed to match the existing wave barrier elevation of +21 feet NAVD 88 to accommodate the highest known tidal surge (based on Hurricane Carla), plus wave heights and the anticipated revisions in the Texas Surge Model. The portion of Quintana Island abutting the ICW is not protected in this manner; however, Freeport LNG designed both the existing and authorized process areas within the Liquefaction Facility at an elevation of approximately +14 feet to keep flood waters from entering the site from the ICW. The Liquefaction Facility site and the authorized liquefaction process areas currently under construction would have site grades of approximately +24 feet NAVD 88, which is above the base 500-year flood elevation for the Project area (FEMA, 1993).

In addition, Freeport evaluated Relative Sea Level Rise (RSLR) as a function of two factors: global (eustatic) sea level sea level rise and local subsidence. Based on monthly mean sea level data from NOAA tidal gauge at Freeport between 1972 and 2008, Freeport LNG determined the mean sea level trend is an increase of 4.43 millimeters per year with a 95 percent confidence interval of +/- 1.05 mm per year, which is equivalent to a change of 0.174 inch per year (NOAA, 2018). An assessment conducted in 2011 indicated that the Quintana Island area is expected to experience less than 1 foot of subsidence through 2050, which equates to an average rate of subsidence of less than 0.308 inch per year. Assuming a eustatic sea level rise averaging 0.174 per year (NOAA, 2013) and an average subsidence rate of less than 0.308 inch per year (Fugro, 2011), Freeport LNG estimated an RSLR to be approximately 0.482 inch per year. Over the projected facility lifespan of 20 years, Freeport LNG anticipates that the RSLR at Quintana Beach would be less than 9.64 inches. We determined the RSLR to be approximately 1.41 feet over a 30-year span using NOAA 2017 intermediate values from 2020 to 2050, which is in line with the rate Freeport LNG estimates.

We generally evaluate the design against a 500-year SWEL with a 500-year wave crest and sea level rise and subsidence. Using maximum envelope of water (MEOW) storm surge inundation maps generated from the Sea, Lake, and Overland Surge from Hurricanes (SLOSH) model developed by NOAA National Hurricane Center, a 500-year event would equate to a Category 3 Hurricane and approximately 16-20 feet MEOW.[27, 28] However, given the uncertainty in the 500-year SWEL data, 500-year wave data, SLOSH maps, sea level rise and subsidence projections, and settlement projections and uncertainties, we agree that the +24 feet site elevation would provide adequate protection of the Freeport LNG site and should be periodically monitored and maintained. We recommend in Section B.10.6 that Freeport LNG provide the monitoring and maintenance plan that has been reviewed, approved, stamped, and sealed by the professional engineer of record registered in the state of Texas.

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27 U.S. Department of Commerce. NOAA. National Hurricane Center. National Storm Surge Hazard Maps. Available at: https://www.nhc.noaa.gov/nationalsurge/#pop. Accessed August 2018.

28 Masters, J. Weather Underground. Storm Surge Inundation Maps for the U.S. Coast. Available at: https://www.wunderground.com/hurricane/surge_images.asp. Accessed August 2018.

The Texas and Louisiana Gulf Coast area is experiencing the highest rates of coastal erosion and wetland loss in the United States (Ruple, 1993). The average coastal erosion rates is -1.2 meters per year between 2000 and 2012 along the Texas coastal shoreline, with the area between Sabine Pass and Rollover Pass experiencing a shoreline loss rate of -4.7 meters per year between 2000 and 2012 (McKenna, 2014). Between 1950 and 2012, the shoreline of Quintana Island has retreated at a rate between 4.9 to over 14.8 feet per year (Bureau of Economic Geology, 2014). Shoreline erosion could occur at the Liquefaction Facility and along the opposite shoreline as a result of waves, currents, and vessel wakes. In addition, based on local beach topography and using a web-based mapping tool (NOAA, 2015), a 12-inch rise in sea level translated as a shoreline retreat of about 30 feet, or less than 2 percent of the distance between the current shoreline and the levee system along the southern edge of the Liquefaction Facility site. To prevent erosion, new revetment in the form of sheet piling and rip rap would be installed on the water side of the storm protection berm. Even though shoreline erosion is a concern at the Liquefaction Facility site, the proposed mitigation measures would minimize erosion and scour impacts.

Landslides and other Natural Hazards

Due to the low relief across the Freeport LNG site, there is little likelihood that landslides or slope movement at the site would be a realistic hazard. Landslides involve the downslope movement of earth materials under force of gravity due to natural or human causes. The Project area has low relief, which reduces the possibility of landslides.

Volcanic activity is primarily a concern along plate boundaries on the West Coast and Alaska and also Hawaii. Based on our review of maps from USGS[29] and DHS[30] of the nearly 1,500 volcanoes with eruptions since the Holocene period (in the past 10,000 years) there are no known active or historic volcanic activity within several hundred miles of the site with the closest being approximately 635 miles away across the Gulf of Mexico in Los Atlixcos, Mexico.

Geomagnetic disturbances (GMD) may occur due to solar flares or other natural events with varying frequencies that can cause geomagnetically induced currents, which can disrupt the operation of transformers and other electrical equipment. USGS provides a map of GMD intensities with an estimated 100 year mean return interval.[31] The map indicates the Freeport LNG site could experience GMD intensities of 20-40 nano-Tesla (nT) with a 100-year mean return interval. However, Freeport LNG would be designed such that if a loss of power were to occur, the valves would move into a fail-safe position. In addition, Freeport LNG is an export facility that does not serve any U.S. customers.

[29] USGS, *U.S. Volcanoes and Current Activity Alerts*, https://volcanoes.usgs.gov/index.html, accessed Aug 2018.

[30] DHS, *Homeland Infrastructure, Foundation-Level data*, Natural Hazards, hifld-geoplatform.opendata.arcgis.com, accessed Aug 2018.

[31] USGS, *Magnetic Anomaly Maps and Data for North America*, https://mrdata.usgs.gov/magnetic/map-us.html#home, accessed Aug 2018.

External Impact Review

To assess the potential impact from external events, we conducted a series of reviews to evaluate transportation routes, land use, and activities within the facilities and surrounding the Project site, and the safeguards in place to mitigate the risk from events, where warranted. We review potential impacts from vehicles and rail; aircraft impacts to and from nearby airports and heliports; pipeline impacts from nearby pipelines; impacts to and from adjacent facilities that handle hazardous materials under the USEPA's RMP regulations and power plants, including nuclear facilities under the Nuclear Regulatory Commission regulations. Specific mitigation of impacts from use of external roadways, rail, helipads, airstrips, or pipelines are also considered as part of the engineering review done in conjunction with the NEPA review.

We use a risk-based approach to assess the potential impact of the external events and the adequacy of the mitigation measures. The risk-based approach uses data based on the frequency of events that could lead to an impact and the potential severity of consequences posed to the Project site and the resulting consequences to the public beyond the initiating events. The frequency data is based on past incidents and the consequences are based on past incidents and/or hazard modeling of potential failures.

<u>Road</u>

We generally review whether any truck operations would be associated with the Project and whether any existing roads would be located near the site. We use this information to evaluate whether the Project and any associated truck operations could increase the risk along the roadways and subsequently to the public and whether any pre-existing unassociated vehicular traffic could adversely increase the risk to the Project site and subsequently increase the risk to the public. In addition, Project facilities at the Pretreatment Facility and Liquefaction Facility, once constructed, must comply with the requirements of 49 CFR 192 and 49 CFR 193, respectively and would be subject to USDOT's inspection and enforcement programs. USDOT regulations under 49 CFR 193.2155 (a) (5) (ii) under Subpart C require that structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a tank truck that could reasonably be expected to cause the most severe loading if the liquefaction facility adjoins the right-of-way of any highway. Similarly, NFPA 59A (2001), Section 8.5.4, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the USDOT regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. We evaluated consequence and frequency data from these events to evaluate these potential impacts.

We evaluated the risk of the truck operations based on the consequences from a release, incident data from the USDOT Federal Highway Administration, National Highway Traffic Safety Administration, and PHMSA, and frequency of trucks and proposed mitigation to prevent or reduce the impacts of a vehicular incident from Freeport LNG.

Unmitigated consequences under worst-case weather conditions from catastrophic failures of trucks proposed at the site generally can range from 200-2,000 feet for flammable vapor dispersion, 850-1,500 feet for radiant heat of 5 kilowatts per square meter (kW/m^2) from fireballs, and 275-350 feet for radiant heat of 5 kW/m^2 from jet fires with projectiles from BLEVEs possibly extending farther. These values are also close to the distances provided by USDOT Federal Highway Administration for designating hazardous material trucking routes (0.5 mi for flammable gases for potential impact distance) and USDOT PHMSA for emergency response (0.5-1 mi for initial evacuation and 1 mi for potential BLEVEs for flammable gases).[32] Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in much more modest distances ranging from 25-200 feet for flammable vapor dispersion, and 75-175 feet for jet fires.

Incident data indicates hazardous material incidents are very infrequent (4e-3 incidents per lane-mile per year) and nearly 75-80 percent of hazardous material vehicular incidents occur during unloading and loading operations while the other 20-25 percent occur while in transit or in transit storage. In addition, approximately 99 percent of releases are 1,000 gallons or less and catastrophic events that would spill 10,000 gallons or more make up less than 0.1 percent of releases. In addition, less than 1 percent of all reportable hazardous material incidents with spillage result in injuries and less than 0.1 percent of all reportable hazardous material incidents with spillage result in fatalities.

The Liquefaction Facility site would be bound by existing CR 723 to the southern side of the proposed site. CR 723 would remain a two-lane highway with a speed limit of 45 miles per hour. The site is elevated above CR 723 which would separate the road from the process equipment and piping within the LNG facility. The Pretreatment Facility site would be bound by CR 690 to the eastern side of the pretreatment site. A canal between CR 690 and the Pretreatment Facility site boundary provides further protection from vehicle impacts to the site. There were no other major highways or roads within close proximity to piping or equipment containing hazardous materials at each site that would not be protected by the berm to raise concerns of direct impacts from a vehicle impacting the site. During operation of the Project, trucks or tanker trucks would deliver ammonia once per week, and makeup refrigerants once every 12 weeks. Transport of other commodities to or from the facility would occur even less frequently. The Project would utilize the same truck unloading facilities currently under construction for Trains 1 through 3 at the Liquefaction Facility. Distances from external roads to the Liquefaction Facility site boundary is approximately 200 feet with another approximate 100 feet to equipment. Distance from external roads to the Pretreatment Facility site boundary is approximately 350 feet with another approximate 450 feet to equipment.

As a result of the site topography and separation distances as well as the potential consequences, incident data, described above, we conclude that the proposed Project would not pose a significant risk or significant increase in risk to the public.

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32 USGS. Earthquake Hazards Program. Quaternary Fault and Fold Database of the United States. Available at: https://earthquake.usgs.gov/hazards/qfaults/ Accessed August 2018.

Rail

We generally review whether any rail operations would be associated with the Project and whether any existing rail lines would be located near the site. We use this information to evaluate whether the Project and any associated rail operations could increase the risk along the rail line and subsequently to the public and whether any pre-existing unassociated rail operations could adversely increase the risk to the Freeport LNG site and subsequently increase the risk to the public. In addition, all facilities, Pretreatment Facility and Liquefaction Facility, once constructed, must comply with the requirements of 49 CFR 192 and 49 CFR 193, respectively and would be subject to USDOT's inspection and enforcement programs. USDOT regulations under 49 CFR 193.2155 (a) (5) (ii) under Subpart C states if the LNG facility adjoins the right-of-way of any railroad, the structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a train or tank car that could reasonably be expected to cause the most severe loading. Section 8.5.4 of NFPA 59A (2001), incorporated by reference in 49 CFR 193, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the USDOT regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. In addition, NFPA 59A would not be required by 49 CFR 192 for the Pretreatment Facility and it is unclear whether the limited vehicular impact protections in 49 CFR 192 would be required. Therefore, we evaluated frequency and consequence data from potential vehicular incidents to evaluate these potential impacts. There would be no rail transportation associated with the Freeport LNG Train 4 Project. We evaluated the risk of the nearby rail operations based on the consequences from a release and incident data from the USDOT Federal Rail Administration and USDOT PHMSA.

Unmitigated consequences under worst-case weather conditions from catastrophic failures of rail cars containing various flammable products generally can range from 300-3,000 feet for flammable vapor dispersion, 1,250-2,100 feet for radiant heat of 5 kW/m^2 from fireballs, and 450-575 feet for radiant heat of 5 kW/m^2 from jet fires with projectiles from BLEVEs possibly extending farther. These values are also close to the distances provided by USDOT PHMSA for emergency response (0.5-1 mi for initial evacuation and 1 mi for potential BLEVEs for flammable gases). Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in much more modest distances ranging from 25-200 feet for flammable vapor dispersion, and 75-175 feet for jet fires.

Incident data indicates hazardous material incidents are very infrequent (6e-3 incidents per rail-mile per year). In addition, approximately 95 percent of releases are 1,000 gallons or less and catastrophic events that would spill 30,000 gallons or more make up less than 1 percent of releases. In addition, less than 1 percent of hazardous material incidents result in injuries and less than 0.1 percent of hazardous material incidents result in fatalities.

The closest rail line is located approximately 1.0 mile away from the Train 4 site at the Terminal and would be on the opposite side of the ICW that services the adjacent chemical facilities (DOW, etc.). The rail line closest to the Unit 4 Pretreatment Facility is 1.7 miles away. Given the distance and position of the closest rail lines serving other industrial facilities relative to the populated areas to the north of the LNG Liquefaction Facility and industrial facilities, we conclude that the proposed Project would not pose a significant increase in risk to the public as a result of the proximity of the Project to the rail lines.

Therefore, it is our determination that the proposed Project would not pose a significant risk or significant increase in risk to the public due to nearby rail operations as a result of the potential consequences, incident data, and distance and position of the closest rail lines serving other industrial facilities relative to the populated areas to the north of the Project site and industrial facilities.

Air

We generally review whether any aircraft operations would be associated with the Project and whether any existing aircraft operations would be located near the site. We use this information to evaluate whether the Project and any associated aircraft operations could increase the risk to the public and whether any pre-existing unassociated aircraft operations could adversely increase the risk to the Project site and subsequently increase the risk to the public. In addition, all facilities, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to USDOT's inspection and enforcement programs.

There would be no aircraft associated with the Project that would warrant a review that would increase in risk to the public from aircraft operations. The closest airport to the Freeport LNG Train 4 Project site is the Texas Gulf Coast Reginal Airport (LBX) located 15.0 miles away from the Liquefaction facility. We also identified 4 other airports within a 20 mile radius from the proposed site: Eagle Air Park Airport (2TE0) located 15.6 miles away, Bailes Airport (7R9) located 17.2 miles away, Phillips Corporation Airport (46TX) located 18.6 miles away, and Knape Airport (2XA2) located 20 miles away.

We analyzed existing aircraft operation frequency data based on the airports identified above and their proximity to the process areas, type and frequency of aircraft operations, take-off and landing directions, and non-airport flight paths using the DOE Standard, DOE-STD-3014-2006, *Accident Analysis for Aircraft Crash into Hazardous Facilities*. Based upon that review, we determined there was less than a 3e-5 year screening threshold identified for the LNG storage tanks and process areas. Furthermore, the regulations in 14 CFR 77 require Freeport LNG to provide notice to the FAA of its proposed construction. This notification should identify all equipment that are more than 200 feet above ground level or lesser heights if the facilities are within 20,000 feet of an airport (at 100:1 ratio or 50:1 ratio depending on length of runway) or within 5,000 feet of a helipad (at 100:1 ratio). In addition, mobile objects, including the LNG carrier that would be above the height of the highest mobile object that would normally traverse it would require notification to USDOT FAA.

The preliminary heights of permanent structures at the Liquefaction Facility and Pretreatment Facility are less than 200 feet and heights of temporary construction equipment for both facilities were not provided in the Application. Given the distance to the nearest airport exceeding 20,000 feet, Freeport LNG would need to file notice to the FAA for any structures exceeding 200 feet to initiate an aeronautical study for determining whether they would constitute obstructions to air navigation or navigational aids or facilities in accordance with 14 CFR 77. Because the Project site has received LNG carriers since July 2008, Freeport LNG would not need to file notice to the FAA for LNG carriers traversing the waterway. The FAA aeronautical study would identify which structures exceed obstruction standards and would indicate if the identified structures would be a hazard to air navigation. Based on this study, FAA would issue a determination for each structure that exceeds the obstruction standards.

The proposed liquefaction facilities may include temporary construction equipment taller than 200 feet and may require Freeport LNG to provide notice to the FAA of its proposed construction. The FERC would need a final determination from the FAA that the proposed facilities would not pose a hazard to air navigation. Therefore we recommend in Section B.10.6 that Freeport LNG indicate any temporary structures would exceed height requirements in 14 CFR 77 and file notice to FAA. In addition, we recommend in Section B.10.6 that Freeport LNG provide the determination by USDOT FAA or other approved methodology. Based on our review of aircraft operation and frequency data that determined less than a 3e-5 per year screening threshold identified for the LNG storage tanks and process areas, we conclude that the proposed Project would not pose a significant risk or significant increase in risk to the public due to nearby aircraft operations.

Pipelines

We generally review whether any pipeline operations would be associated with the project and whether any existing pipelines would be located near the site. We use this information to evaluate whether the project and any associated pipeline operations could increase the risk to the pipeline facilities and subsequently to the public and whether any pre-existing unassociated pipeline operations could adversely increase the risk to the project site and subsequently increase the risk to the public. Pipelines associated with this Project must meet USDOT regulations under 49 CFR 192. In addition, all facilities, once constructed, must comply with the requirements of 49 CFR Parts 192 and 193 and would be subject to USDOT's inspection and enforcement programs.

Freeport LNG identified zero pipelines located adjacent to the Liquefaction Facility Project site. We reviewed National Pipeline Mapping System and confirmed the gas pipelines nearest to the Liquefaction Facility and Pretreatment Facility sites would be the pipelines providing gas to the facilities. There are several crude oil pipelines approximately 0.4 mile north of the Liquefaction Facility. Therefore, we conclude that the proposed Project would not pose a significant increase in risk to the public as a result of the proximity of the Project to the pipelines.

Hazardous Material Facilities and Power Plants

We reviewed whether any USEPA RMP-regulated facilities handling hazardous materials and power plants were located near the Project sites to evaluate whether the facilities could adversely increase the risk to the Project sites and whether the Project sites could increase the risk to the USEPA RMP facilities and power plants and subsequently increase the risk to the public.

There were no adjacent facilities handling hazardous materials or power plants identified adjacent to the Freeport LNG Train 4 Project site. The closest facility handling hazardous materials would be the Phillips 66 Freeport Terminal located approximately 3,000 feet north of the Liquefaction Facility. The closest power plant identified was a gas power plant at a chemical plant approximately 4 miles north of the Liquefaction Facility and approximately 2 miles west of the Pretreatment Facility. The closest nuclear power plant is over 40 miles away.

Given the distances and locations of the facilities relative to the populated areas of the Freeport and Quintana Island communities, we conclude that the proposed Project would not pose a significant increase in risk to the public, nor that the hazardous material facilities and power plants would pose a significant risk to the Project and subsequently to the public.

Onsite and Offsite Emergency Response Plans

As part of its application, Freeport LNG indicated that the Project would expand the current Freeport LNG ERP to include the Train 4 facilities. The emergency procedures would continue to provide for the protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the Project facilities. The facilities would also provide appropriate personnel protective equipment to enable operations personnel and first responder access to the area.

In addition, we recommend in Section B.10.6 that Freeport LNG provide, for review and approval, an updated ERP prior to construction of final design. We also recommend in Section B.10.6 that Freeport LNG file three dimensional drawings, prior to construction of final design, for review and approval that demonstrate there is a sufficient number of access and egress locations. In addition, we recommend in Section B.10.6 that Project facilities be subject to regular inspections throughout the life of the facility and would continue to require companies to file updates to the ERP.

10.6. Recommendations from FERC Preliminary Engineering and Technical Review

Based on our preliminary engineering and technical review of the reliability and safety of the Freeport LNG Train 4 Project, we recommend the following mitigation measures to the Commission for consideration to incorporate as possible conditions to an order. These recommendations would be implemented prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout the life of the facility to enhance the reliability and safety of the facility and to mitigate the risk of impact on the public.

- **Prior to initial site preparation, Freeport LNG should file with the Secretary documentation demonstrating it has received a determination of no hazard (with or without conditions) by USDOT FAA for all permanent structures and temporary construction equipment that exceed the height requirements in 14 CFR 77.9.**

- **Prior to construction of final design, Freeport LNG should file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Texas:**

  a. site preparation drawings and specifications;

b. **Pretreatment Facility and Liquefaction Facility structures and foundation design drawings and calculations (including prefabricated and field constructed structures);**

c. **seismic specifications for procured equipment; and**

d. **quality control procedures to be used for civil/structural design and construction.**

In addition, Freeport LNG should file, in its Implementation Plan, the schedule for producing this information.

- **<u>Prior to commencement of service</u>, Freeport LNG should file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Texas, for the perimeter levee which ensures the crest elevation relative to mean sea level will be maintained for the life of the facility considering berm settlement, subsidence, and sea level rise.**

For Pretreatment and Liquefaction Facilities, information pertaining to these specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each recommendation. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See *Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information*, Order No. 833, 81 Fed. Reg. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). 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 file an overall project schedule, which includes the proposed stages of the commissioning plan.**

- **<u>Prior to initial site preparation</u>, Freeport LNG should update and file quality assurance and quality control procedures for construction activities.**

- **<u>Prior to initial site preparation</u>, Freeport LNG should file procedures for controlling access during construction.**

- **<u>Prior to initial site preparation</u>, Freeport LNG should file an updated Emergency Response Plan for the additional facilities of the Project.**

- **<u>Prior to initial site preparation</u>, Freeport LNG should file an updated Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. This comprehensive plan should include funding mechanisms**

for the capital costs associated with any necessary security/emergency management equipment and personnel base.

- **<u>Prior to construction of final design</u>, Freeport LNG should file change logs that list and explain any changes made from the front end engineering design 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.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file scaled plot plans of the final design showing all major equipment, structures, buildings, and impoundment systems.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications should include:**

    a. **Building Specifications (e.g., electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);**

    b. **Mechanical Specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage vessels, and other specialized equipment);**

    c. **Electrical and Instrumentation Specifications (e.g., power system specifications, control system specifications, safety instrument system [SIS] specifications, cable specifications, other electrical and instrumentation specifications);**

    d. **Security and Fire Safety Specifications (e.g., security, passive protection, hazard detection, hazard control, firewater).**

- **<u>Prior to construction of final design</u>, Freeport LNG should clarify the use, applicability, and priority of design codes used in piping specification R30A for natural gas pipelines.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file up-to-date process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) including vendor P&IDs. The PFDs should include heat and material balances. The P&IDs should include the following information:**

    a. **equipment tag number, name, size, duty, capacity, and design conditions;**

    b. **equipment insulation type and thickness;**

c. **valve high pressure side and internal and external vent locations;**

d. **isolation valves necessary for startup, operation, shutdown, restart, and maintenance procedures;**

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 size and set points; and**

i. **drawing revision number and date.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect Project facilities with the previously installed systems.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs.**

- **<u>Prior to construction of final design</u>, the engineering, procurement, and construction contractor should verify that the recommendations from the Front End Engineering Design Hazard Identification are complete and consistent with the requirements of the final design as determined by the engineering, procurement, and construction contractor.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file a hazard and operability review prior to issuing the P&IDs for construction. A copy of the review, a list of the recommendations, and actions taken on the recommendations should be filed.**

- **<u>Prior to construction of final design</u>, Freeport LNG should provide information/revisions pertaining to the response numbers 2, 7, 14, 19, 24, 25, 26, 28, 30, 31, 32, and 35 of their October 4, 2018, filing, and the response numbers 4, 5c, 6, 7b, 13a, 13c, 18, 19, 21, 25, 26, 27, 28, 30, 31, 33, 39, 46, 47a, 47b, 48, and 49 of their October 11, 2018, filling which indicated features to be included or considered in the detailed design.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (e.g., temperature, pressures, flows, and compositions).**

- **<u>Prior to construction of final design</u>, Freeport LNG should file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system for review and approval. The cause-and-**

effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and set points.

- **<u>Prior to construction of final design</u>, Freeport LNG should file an evaluation of emergency shutdown valve closure times. The evaluation should account for the time to detect an upset or hazardous condition, notify plant personnel, and close the emergency shutdown valve.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump operations.**

- **<u>Prior to construction of final design</u>, Freeport LNG should demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators.**

- **<u>Prior to construction of final design</u>, Freeport LNG should specify that all drains from high pressure hazardous fluid systems are to be equipped with double isolation and bleed valves.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file electrical area classification drawings.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file details of 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, alarm the hazardous condition, and shut down the appropriate systems.**

- **<u>Prior to construction of final design</u>, Freeport LNG should include layout and design specifications of the pig trap, inlet separation and liquid disposal, inlet/send-out meter station, and pressure control.**

- **<u>Prior to construction of final design</u>, Freeport LNG should specify that piping and equipment that may be cooled with liquid nitrogen is to be designed for liquid nitrogen temperatures, with regard to allowable movement and stresses.**

- **<u>Prior to construction of final design</u>, Freeport LNG should include the sizing basis and capacity for the pressure and vacuum relief valves for major process equipment and vessels.**

- **<u>Prior to construction of final design</u>, Freeport LNG should include pressure relieving protection for flammable liquid piping segments (i.e., refrigerants, liquid hydrocarbon products) that can be isolated by valves.**

- **<u>Prior to construction of final design</u>, Freeport LNG should specify that all emergency shutdown (ESD) valves are to be equipped with open and closed position switches connected to the Distributed Control System (DCS)/SIS.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons should be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency.**

- **<u>Prior to construction of final design</u>, Freeport LNG should install internal road vehicle protections, such as guard rails, barriers, and bollards to protect transfer piping, pumps, and compressors, etc. to ensure that they are protected from inadvertent damage from vehicles.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file security camera, intrusion detection, and lighting drawings. The security camera drawings should show the location, areas covered, and features of the camera (fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify camera coverage of the entire perimeter with redundancies for cameras interior to the facility to enable rapid monitoring of the LNG plant. The intrusion detection drawings should show or note the location of the intrusion detection to verify it covers the entire perimeter of the LNG plant. The lighting drawings should show the location, elevation, type of light fixture, and lux levels of the lighting system.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file an updated fire protection evaluation of the proposed liquefaction and pretreatment facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments. The spill containment drawings should show containment for all hazardous liquids, including all liquids handled above their flashpoint, from the largest flow from a single line for 10 minutes, including de-inventory, or the maximum liquid from the largest vessel (or total of impounded vessels) or otherwise demonstrate that providing spill containment would not significantly reduce the flammable vapor dispersion or radiant heat consequences of a spill. Where Project piping ties into previously authorized piping, the total flow capacity in the previously authorized piping should be considered.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file 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.

- **<u>Prior to construction of final design</u>, Freeport LNG should include a technical review of facility design that:**

  a. **identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and**

  b. **demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shut down any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, ethylene, propane, butane, and natural gas liquids.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as aqueous ammonia, natural gas liquids, and hydrogen sulfide.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan 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.**

- **<u>Prior to construction of final design</u>, Freeport LNG should file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings should clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. The drawings should also include piping and instrumentation diagrams of the firewater and foam systems.**

- **<u>Prior to construction of final design</u>, Freeport LNG should specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter should be connected to the DCS and recorded.**

- **<u>Prior to construction of final design</u>, Freeport LNG should specify that each Intracoastal Waterway Firewater Pump relief valve discharge piping is run independently back to the supply source.**

- **Prior to construction of final design, Freeport LNG should file detailed calculations to confirm that the final fire water volumes would be accounted for when evaluating the capacity of the impoundment system during a spill and fire scenario.**

- **Prior to construction of final design, Freeport LNG should provide the fire water required for foam generation in calculating the total fire water required for 2 hours of supply.**

- **Prior to construction of final design, Freeport LNG shall specify that the firewater pump building/shelter is designed to be able to remove the largest firewater pump or other component for maintenance with an overhead or external crane.**

- **Prior to construction of final design, Freeport LNG should include or demonstrate the firewater storage volume for its pretreatment facilities has minimum reserved capacity for its most demanding firewater scenario plus 1,000 gpm for no less than 2 hours. The firewater storage should also demonstrate compliance with NFPA 22 or demonstrate how API 650 provides an equivalent or better level of safety.**

- **Prior to construction of final design, Freeport LNG should file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases and fires with a minimum of 2-hour fire duration.**

- **Prior to construction of final design, Freeport LNG should file a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each significant component within the 4,000 BTU/ft^2-hr zone from an impoundment, including from the three previously authorized impoundments that could collect spills from this project and from proposed spill collection areas for all liquids handled above their flash point. Passive mitigation should be supported by calculations for the thickness limiting temperature rise and active mitigation should be justified with calculations demonstrating flow rates and durations of any cooling water will mitigate the heat absorbed by the vessel.**

- **Prior to construction of final design, Freeport LNG should file an evaluation of the voting logic and voting degradation for hazard detectors.**

- **Prior to commissioning, Freeport LNG should file 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 file detailed plans and procedures for: testing the integrity of onsite mechanical installation;**

functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.

- **<u>Prior to commissioning</u>, Freeport LNG should file 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, and should provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.**

- **<u>Prior to commissioning</u>, Freeport LNG should file the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3. The procedures should include a line list of pneumatic and hydrostatic test pressures.**

- **<u>Prior to commissioning</u>, Freeport LNG should file the updated operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms.**

- **<u>Prior to commissioning</u>, Freeport LNG should tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**

- **<u>Prior to commissioning</u>, Freeport LNG should maintain a detailed training log to demonstrate that operating staff has completed the required training.**

- **<u>Prior to introduction of hazardous fluids</u>, Freeport LNG should develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms.**

- **<u>Prior to introduction of hazardous fluids</u>, Freeport LNG should complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS and SIS that demonstrates full functionality and operability of the system.**

- **<u>Prior to introduction of hazardous fluids</u>, Freeport LNG should complete and document a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on facility plot plan(s).**

- **<u>Prior to introduction of hazardous fluids</u>, Freeport LNG should complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review should include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, should be filed.**

- **After production of first LNG, Freeport LNG should file weekly reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports should include a summary of activities, problems encountered, and remedial actions taken. The weekly reports should also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports should include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude should be reported to the FERC within 24 hours.**

- **Prior to commencement of service, Freeport LNG should label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001).**

- **Prior to commencement of service, Freeport LNG should provide updated plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring.**

- **Prior to commencement of service, Freeport LNG should update procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Freeport LNG staff.**

- **Prior to commencement of service, Freeport LNG should notify the FERC staff of any proposed revisions to the security plan and physical security of the plant.**

In addition, the following recommendations should apply throughout the life of the Pretreatment Facility and Liquefaction Facility:

- **The facilities 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 (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof.**

Abnormalities should include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite 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 within 45 days <u>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)" should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities.

- **The plant's incident report requirements should be updated to the following significant non-scheduled events, including safety-related incidents (e.g., LNG, heavier hydrocarbons, 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 that 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 liquefaction 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 5 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 facilities 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 facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for 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 from hazardous fluids transportation 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 liquefaction 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.

10.7. Conclusions on LNG Facility and Carrier Reliability and Safety

As part of the NEPA review and NGA determinations, Commission staff assesses the potential impact to the human environment in terms of safety and whether the proposed Train 4 Project facilities would be in the public interest based on whether it would operate safely, reliably, and securely.

As a cooperating agency, the USDOT assists the FERC by determining whether Freeport LNG's proposed design would meet the USDOT's 49 CFR 193 Subpart B siting requirements. On October 4, 2018, USDOT provided a LOD on the project's compliance with 49 CFR 193, Subpart

B. This is provided to the Commission as further consideration to the Commission on its decision and final action on the project application. If the facility is authorized and constructed, the facility would be subject to USDOT's inspection and enforcement program and final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the USDOT staff.

As a cooperating agency, the USCG also assisted the FERC staff by reviewing the proposed LNG facilities and the associated LNG vessel traffic. The USCG previously provided FERC with a Letter of Recommendation regarding the suitability of the waterway for the type and frequency of the Liquefaction and Phase II Modification Projects (docket numbers CP12-509-000 and CP12-29-000) LNG carrier traffic. While the Train 4 Project would result in an additional 75 ship visits per year above the current level expected for the Liquefaction Project, the frequency and size of LNG carriers calling on the Quintana Island Terminal would not increase beyond the maximum of 400 ship visits reviewed and authorized by the USCG. As a result, the Coast Guard indicated that the construction and operation of the Train 4 Project would not require submission of a new Letter of Intent or revision to the existing WSA. If the Project is authorized and constructed, the facilities would be subject to the USCG's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

FERC staff conducted a preliminary engineering and technical review of the Freeport LNG design, including potential external impacts based on the site location. Based on our review, we recommend the Commission consider incorporating into the order a number of proposed mitigation measures and continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the facility to enhance the reliability and safety of the facility to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, we conclude that the Train 4 Project design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

10.8. Pipeline Facilities

The transportation of natural gas by pipeline involves some incremental risk to the public due to the potential for accidental release of natural gas. The greatest hazard is a fire or explosion following a major pipeline rupture.

Methane, 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.

Methane has an auto-ignition temperature of 1,000 degrees Fahrenheit (ºF) and is flammable at concentrations between 5.0 percent and 15.0 percent in air. An unconfined mixture of methane and air is not explosive, however it may ignite and burn if there is an ignition source. A flammable concentration within an enclosed space in the presence of an ignition source can explode. It is buoyant at atmospheric temperatures and disperses rapidly in air.

10.8.1. Pipeline Safety Standards

The USDOT is mandated to prescribe minimum safety standards to protect against risks posed by pipeline facilities under Title 49, U.S.C. Chapter 601. The USDOT’s PHMSA administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards which set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. PHMSA’s safety mission is to ensure that people and the environment are protected from the risk of pipeline incidents. This work is shared with state agency partners and others at the federal, state, and local level.

Title 49, U.S.C. Chapter 601 provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards. A state may also act as USDOT's agent to inspect interstate facilities within its boundaries; however, the USDOT is responsible for enforcement actions.

The USDOT pipeline standards are published in Parts 190-199 of Title 49 of the CFR. Part 192 specifically addresses natural gas pipeline safety issues.

Under a Memorandum of Understanding on Natural Gas Transportation Facilities (Memorandum) dated January 15, 1993, between the USDOT and the FERC, the USDOT has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a)(9)(vi) of the FERC's regulations require that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a Certificate is requested in accordance with federal safety standards and plans for maintenance and inspection. Alternatively, an applicant must certify that it has been granted a waiver of the requirements of the safety standards by the USDOT in accordance with section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the Memorandum to promptly alert USDOT. The Memorandum also provides for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipelines under the Commission's jurisdiction.

The FERC also participates as a member of the USDOT's Technical Pipeline Safety Standards Committee which determines if proposed safety regulations are reasonable, feasible, and practicable.

The pipeline and aboveground facilities associated with the Project must be designed, constructed, operated, and maintained in accordance with the USDOT 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 USDOT specifies material selection and qualification; minimum design requirements; and protection from internal, external, and atmospheric corrosion.

The USDOT also defines area classifications, based on population density in the vicinity of the pipeline, and specifies more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline. The four area classifications are defined below:

Class 1 Location with 10 or fewer buildings intended for human occupancy.

Class 2 Location with more than 10 but less than 46 buildings intended for human occupancy.

Class 3 Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period.

Class 4 Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. For instance, pipelines constructed on land in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil and 18 inches in consolidated rock. Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require a minimum cover of 36 inches in normal soil and 24 inches in consolidated rock.

Class locations also specify the maximum distance to a sectionalizing block valve (*e.g.*, 10.0 miles in Class 1, 7.5 miles in Class 2, 4.0 miles in Class 3, and 2.5 miles in Class 4). Pipe wall thickness and pipeline design pressures; hydrostatic test pressures; maximum allowable operating pressure (MAOP); inspection and testing of welds; and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas.

Freeport LNG conducted a class-location study and prepared a high consequence area (HCA) report for the Train 4 Project. The study found that of the 10.6-mile-long pipeline route, 7.9 miles consist of Class 1 areas, 2.6 miles are within Class 2 areas, and 0.1 mile is within a Class 3 area. The results of the study reflect that buildings are sparse along 75 percent of the route (Class 1), and the remaining 25 percent of the route has clusters of buildings (Class 2 and 3 areas). Table 22 provides a summary of USDOT classifications by MP.

TABLE 22

Summary of USDOT Class Locations a/

Begin MP	End MP	Pipe Class 1 (feet)	Pipe Class 2 (feet)	Pipe Class 3 (feet)
0.0	0.7	3,840	--	--
0.7	1.6	--	4,690	--
1.6	2.1	2,331	--	--

TABLE 22

Summary of USDOT Class Locations a/

Begin MP	End MP	Pipe Class 1 (feet)	Pipe Class 2 (feet)	Pipe Class 3 (feet)
2.1	2.4	--	1,955	--
2.4	6.4	21,181	--	--
6.4	6.6	--	794	--
6.6	6.7	--	--	774
6.7	7.9	--	6,239	--
7.9	10.6	14,290	--	--
	TOTAL	**41,642**	**13,679**	**774**

a. The lengths (in feet) in this table have been rounded for presentation purposes; the totals may not reflect the sum of the addends.

If a subsequent increase in population density adjacent to the right-of-way results in a change in class location for the pipeline, Freeport LNG would reduce the MAOP or replace the segment with pipe of sufficient grade and wall thickness, if required to comply with the USDOT requirements for the new class location.

The USDOT Pipeline Safety Regulations require operators to develop and follow a written integrity management program that contain all the elements described in 49 CFR 192.911 and address the risks on each transmission pipeline segment. The rule establishes an integrity management program which applies to all high consequence areas (HCA).

The USDOT has published rules that define HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate for USDOT to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density- population area.

The HCAs may be defined in one of two ways. In the first method an HCA includes:

- current class 3 and 4 locations,
- any area in Class 1 or 2 where the potential impact radius[33] is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle[34], or
- any area in Class 1 or 2 where the potential impact circle includes an identified site.

[33] The potential impact radius is calculated as the product of 0.69 and the square root of: the MAOP of the pipeline in psig multiplied by the square of the pipeline diameter in inches.

[34] The potential impact circle is a circle of radius equal to the potential impact radius.

An identified site is an outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12-month period; a building that is occupied by 20 or more persons on at least 5 days a week for any 10 weeks in any 12-month period; or a facility that is occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate.

In the second method, an HCA includes any area within a potential impact circle which contains:

- 20 or more buildings intended for human occupancy, or
- an identified site.

Once a pipeline operator has determined the HCAs along its pipeline, it must apply the elements of its integrity management program to those segments of the pipeline within HCAs. The USDOT regulations specify the requirements for the integrity management plan at section 192.911.

HCAs along the proposed Train 4 Project are based on the relationship of the pipeline centerline to nearby structures and identified sites. Specifically, four areas along the pipeline route meet the definition of an HCA. These four areas constitute about 3.6 miles (34 percent) of the pipeline route. Table 23 summarizes the HCA areas along the pipeline route. The pipeline segments and/or facilities located within HCAs would be subject to enhanced operation and maintenance activities as required by Freeport LNG's Integrity Management Plan (see below). The pipeline integrity management rule for HCAs requires inspection of the pipeline HCAs every 7 years.

TABLE 23

Summary of HCAs

HCA	Begin MP	End MP	Rationale for HCA Designation
1	0.6	1.4	2 identified sites; Over 20 dwellings
2	1.8	2.6	3 identified sites; Over 20 dwellings
3	6.4	7.0	Class 3 area; Over 20 dwellings
4	7.3	7.7	Over 20 dwellings

The MAOP for the proposed pipeline is 1,440 psig. However, the Class Location Study and HCA Report used a slightly more conservative MAOP of 1,480 psig.

The USDOT prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Each pipeline operator is required to establish an emergency plan that includes procedures to minimize the hazards of a natural gas pipeline emergency. Key elements of the plan include procedures for:

- receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- establishing and maintaining communications with local fire, police, and public

officials, and coordinating emergency response;

- emergency system shutdown and safe restoration of service;
- making personnel, equipment, tools, and materials available at the scene of an emergency; and
- protecting people first and then property, and making them safe from actual or potential hazards.

The USDOT requires that each operator establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance. 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. Freeport LNG would provide the appropriate training to local emergency service personnel before the pipeline is placed in service.

Pipeline Accident Data

The USDOT requires all operators of natural gas transmission pipelines to notify the USDOT of any significant incident and to submit a report within 30 days. Significant incidents are defined as any leaks that:

- caused a death or personal injury requiring hospitalization; or
- involve property damage of more than $50,000 (1984 dollars)[35].

During the 20 year period from 1996 through 2015, a total of 1,310 significant incidents were reported on the more than 300,000 total miles of natural gas transmission pipelines nationwide.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 24 provides a distribution of the causal factors as well as the number of each incident by cause.

The top two causes of pipeline incidents are corrosion and pipeline material, weld or equipment failure collectively constituting 66.7 percent of all significant incidents. The pipelines included in the data set in Table 24 vary widely in terms of age, diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline. The frequency of significant incidents is strongly dependent on pipeline age. Older pipelines have a higher frequency of corrosion incidents and material failure, because corrosion and pipeline stress/strain is a time-dependent process.

[35] $50,000 in 1984 dollars is approximately $112,955.73 as of May 2015 (CPI, Bureau of Labor Statistics, 2015)

TABLE 24		
Natural Gas Transmission Pipeline Significant Incidents by Cause (1996-2015) [a]		
Cause	**Number of Incidents**	**Percentage**
Pipeline material, weld, or equipment failure	354	27.0
Corrosion	311	23.7
Excavation	210	16.0
All other causes [b]	165	12.6
Natural forces [c]	146	11.1
Outside force [d]	84	6.4
Incorrect operation	40	3.1
Total	**1,310**	**100**

a USDOT 2016a.
b All other causes include miscellaneous, unspecified, or unknown causes.
c Natural force damage includes earth movement, heavy rain, floods, landslides, mudslides, lightning, temperature, high winds, and other natural force damage.
d Outside force damage includes previous mechanical damage, electrical arcing, static electricity, fire/explosion, fishing/maritime activity, intentional damage, and vehicle damage (not associated with excavation).

The use of both an external protective coating and a cathodic protection system[36], required on all pipelines installed after July 1971, significantly reduces the corrosion rate compared to unprotected or partially protected pipe.

Outside forces, including excavations and natural events, are the cause in 33.5 percent of significant pipeline incidents nationwide from 1996 and 2015. Table 25 provides a breakdown of outside force incidents by cause. These mostly result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; weather effects such as winds, storms, and thermal strains; and willful damage.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, the older pipelines contain a disproportionate number of smaller-diameter pipelines; which have a greater rate of outside forces incidents. Small diameter pipelines are more easily crushed or broken by mechanical equipment or earth movement.

[36] Cathodic protection is a technique to reduce corrosion (rust) of the natural gas pipeline through the use of an induced current or a sacrificial anode (like zinc) that corrodes at faster rate to reduce corrosion.

TABLE 25 **Outside Forces Incidents by Cause (1996-2015)[a]**		
Cause	**Number of Excavation, Natural Forces, and Outside Force Incidents**	**Percentage of All Incidents [b,c]**
Third party excavation damage	172	13.1
Heavy rain, floods, mudslides, landslides	74	5.7
Vehicle (not engaged with excavation)	49	3.7
Earth movement, earthquakes, subsidence	32	2.4
Lightning, temperature, high winds	27	2.1
Operator/contractor excavation damage	25	1.9
Unspecified excavation damage/previous damage	13	1.0
Other or unspecified natural forces	13	1.0
Fire/explosion	9	0.7
Fishing or maritime activity	9	0.7
Other outside force	9	0.7
Previous mechanical damage	6	0.5
Electrical arcing from other equipment/facility	1	0.1
Intentional damage	1	0.1
Total	**440**	**33.5**

a USDOT 2016a.
b Percentage of all incidents was calculated as a percentage of the total number of incidents natural gas transmission pipeline significant incidents (i.e., all causes) presented in table 4.12.3-1
c Due to rounding, column does not equal 33.6 percent.

10.8.2. Impact on Public Safety

The service incident data summarized in table 26 include natural gas transmission system failures of all magnitudes with widely varying consequences. Table 26 presents the annual injuries and fatalities that occurred on natural gas transmission lines from incidents for the 5 year period between 2011 and 2015. The data has been separated into employees and nonemployees to better identify a fatality rate experienced by the general public.

The majority of fatalities from pipelines are due to local distribution pipelines (not included in table 24). These are natural gas pipelines that are not regulated by FERC and that distribute natural gas to homes and businesses after transportation through interstate natural gas transmission pipelines. In general, these distribution lines are smaller diameter pipes and/or plastic pipes, often made of plastic or cast iron rather than welded steel, and tend to be older pipelines which are more susceptible to damage. In addition, distribution systems do not have large rights-of-way and pipeline markers common to the FERC regulated natural gas transmission pipelines.

TABLE 26				
Injuries and Fatalities – Natural Gas Transmission Pipelines				
	Injuries[a]		**Fatalities[a]**	
Year	**Employees**	**Public**	**Employees**	**Public**
2011	1	0	0	0
2012	3	4	0	0
2013	0	2	0	0
2014	1	0	1	0
2015	12	2	6	0

a USDOT 2015.

The nationwide totals of accidental fatalities from various manmade and natural hazards are listed in table 27 in order to provide a relative measure of the industry-wide safety of natural gas transmission pipelines. Direct comparisons between accident categories should be made cautiously, however, because individual exposures to hazards are not uniform among all categories.

The available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. From 1996 to 2015, there were an average of 65.4 significant incidents, 9.1 injuries and 2.3 fatalities per year. The number of significant incidents over the more than 300,000 miles of natural gas transmission lines indicates the risk is low for an incident at any given location. The operation of the Pipeline Facilities of the Train 4 Project would represent a slight increase in risk to the nearby public.

TABLE 27	
Nationwide Accidental Fatalities by Cause	
Type of Accident	**Annual Number of Deaths**
Motor vehicle [a]	35,369
Poisoning [a]	38,851
Falls [a]	30,208
Drowning [a]	3,391
Fire, smoke inhalation, burns [a]	2,760
Floods [b]	81
Tornado [b]	72
Lightning [b]	49
Hurricane [b]	47
Natural gas distribution lines [c]	13
Natural gas transmission pipelines [c]	2

a Accident data presented for motor vehicle, poisoning, falls, drowning, fire, smoke inhalation, and burns represent the annual accidental deaths recorded in 2013 (CDC 2013).

b Accident data presented for floods, tornados, lightning, and hurricanes represent the 30 year average of accidental deaths between 1985 and 2014 (NOAA, 2016).

c Accident data presented for natural gas distribution lines and transmission pipelines represent the 20-year average between 1996 and 2015 (USDOT 2016b).

11. Air Quality

Air quality would be affected by construction and operation of the Project. Though air emissions would be generated by operation of equipment during construction of the Project facilities, most air emissions associated with the Project would result from the long-term operation of the Terminal and Pretreatment Facility. This section will identify the direct and indirect emissions from the Project and identify the associated impacts.

Combustion of natural gas would produce criteria air pollutants such as carbon monoxide (CO), sulfur dioxide (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 micrometers, and PM_{10} includes particles with an aerodynamic diameter less than or equal to 10 micrometers. Combustion of fossil fuels also produces the ozone (O_3) precursors volatile organic compounds (VOC), a large group of organic chemicals that have a high vapor pressure at room temperature, and oxides of nitrogen (NO_x). VOCs react with NO_x, typically on sunny days to form O_3. Another byproduct of combustion is Greenhouse Gases (GHG), and hazardous air pollutants (HAPs). HAPs are chemicals known to cause cancer and other serious health impacts.

GHG, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, and perfluorocarbons, are naturally occurring pollutants in the atmosphere and products of human activities, including burning fossil fuels. GHG produced by fossil-fuel combustion are CO_2, CH_4, and N_2O. GHGs are non-toxic and non-hazardous at normal ambient concentrations. GHGs emissions due to human activity are the primary cause of increased levels of all GHG since the industrial age. These elevated levels of GHGs are the primary cause of warming of the global climate system since the 1950s. These existing and future emissions of GHGs, unless significantly curtailed, will cause further warming and changes to the local, regional, and global climate systems. Emissions of GHGs are typically expressed in terms of CO_2 equivalents (CO_2e).

Other pollutants, not produced by combustion, are fugitive dust and fugitive emissions. Fugitive dust is a mix of $PM_{2.5}$, PM_{10}, and larger particles that become airborne due to vehicle travel, earth movement, or wind erosion. Fugitive emissions, in the context of this EA would be fugitive emissions of CH_4 from operational pipelines and aboveground facilities.

Construction and operation of the Project can potentially have effects on local and regional 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.

The climatic conditions in the area can influence how emissions of pollutants affect local air quality. The Brazoria area 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, and below-freezing temperatures are generally recorded only a few times per year. Normal monthly high temperatures range from about 63ºF 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 about 51 inches, varying on average from about 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 of Mexico.

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. Offshore 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.

11.1.1. Existing Air Quality and Regulations

The EPA has established the National Ambient Air Quality Standards (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. 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 TAC Title 30 (TAC 30) Part101.21.

Ambient Air Quality

The TCEQ maintains an extensive network of air-quality monitoring stations throughout the state for a variety of purposes. Data from these monitoring stations are reported to the EPA 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 measured concentrations are added used in the air dispersion modeling described in section B.11.1.2.

AQCRs and Attainment Status

The EPA has established AQCRs in accordance with the Clean Air Act of 1970, 42 USC 7401 *et seq.*, amended in 1977 and 1990, and codified at 40 CFR Parts 50-99 (CAA), 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 Project would be in Brazoria County, which is in the Metropolitan Houston-Galveston Intrastate AQCR (HG-AQCR).[37]

The EPA has designated a portion of the HG-AQCR, Houston-Galveston-Brazoria (HGB) area[38], as a moderate nonattainment area for the 2008 8-hour O_3 standard. The designation for the more stringent 2015 8-hour O_3 standard is pending as of October 2018. The designations for other criteria pollutants are attainment, unclassifiable, or better than national standards.

Federal Air Quality Requirements

The CAA codifies the basic federal statutes and regulations governing air pollution. Currently in Texas, the EPA 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 EPA'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 AQCR or portion thereof 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 an activity that does not conform to an approved State Implementation Plan. General Conformity is not applicable to activities at locations in attainment areas or operating emissions covered by an air-quality permit.

The Project would generate air emissions from its construction and long-term operation. 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 Terminal and Pretreatment Facility and during pipeline construction. Construction emissions would occur between 2019 through 2022, and ship emissions would commence in 2022. No additional LNG carrier calls would occur over what was analyzed in the Phase II Project (FERC, 2006). The analysis in the Phase II Project (FERC, 2006) analyzed the impact of 400 ship-calls for importation of LNG. The General Conformity Determination in the Phase I and II Projects expired so FERC staff was required under the CAA to prepare a new General Conformity Determination for the Freeport LNG Liquefaction Project and Phase II modification Project (2014).

[37] The HG-AQCR is comprised of Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton Counties.

[38] The HGB area is comprised of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties.

The June 2014 Freeport LNG Liquefaction Project FEIS (FERC, 2014), analyzed 400 carrier calls for export, with the exception of the analysis under General Conformity. For purposed of General Conformity, Freeport LNG indicated that only 250 LNG carrier calls were necessary for the liquefaction capacity of Trains 1-3. We coordinated with the TCEQ and USEPA to prepare and issue a final General Conformity Determination on July 10, 2014, which considered a maximum of 250 LNG carrier calls. However, for the 4th liquefaction train, Freeport LNG has indicated that they would require a maximum of 75 LNG additional carrier calls per year over the 250 already analyzed in the previous General Conformity Determination, for a total maximum of 325.

Freeport LNG reported discussing with TCEQ staff the applicability of General Conformity. Freeport LNG reported that TCEQ agreed that the Train 4 project would be treated as a new project subject to the thresholds for a moderate nonattainment area (i.e., 100 tpy thresholds for NO_x and VOC). As can be seen in tables 28 and 29, the operational ship emissions (the additional 75 ships) and the construction emissions, respectively, of NO_x and VOC would not exceed the General Conformity Applicability thresholds within the HGB, the Train 4 project would not be subject to General Conformity. The emissions estimates in Table 28 include ship emissions, detailed in table 31.

TABLE 28

Summary of Estimated Emissions for Project Operation
(Primarily Attributable to 75 LNG Carrier emissions)

Year	Estimated Indirect Emissions (tons)							
	VOC	PM_{10}	$PM_{2.5}$	CO	NO_x	SO_2	CO_2e	Total HAPs
Houston-Galveston-Brazoria Nonattainment Area								
Ship Emissions Commencing in 2022	7.5	1.1	0.9	50.4	88.4	0.3	53,958	0.3
Applicability a/	100	---	---	---	100	---	---	---

HAPs = Hazardous Air Pollutants
a. General Conformity applicability thresholds for O_3 moderate non-attainment area

New Source Review. The New Source Review (NSR) program is comprised of the Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review (NNSR) programs, which 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 its proposed location for each criteria pollutant.

The PSD program applies to 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 that violate the NAAQS.

NNSR applies to 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 that do not comply with one or more NAAQS attain compliance within prescribed timeframes.

Fugitive emissions are not counted when determining NSR applicability, except for the 28 source categories listed in 40 CFR 52.21(b)(1)(i). The Terminal and Pretreatment Facility operations do not include one of the listed 28 source categories. Therefore, the fugitive emissions from operation of the Project are not counted for NSR applicability.

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 a major stationary source under PSD if:

- 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 tons per year (tpy) or more of any regulated NSR pollutant; or

- it emits or has the potential to emit 250 tpy or more of any regulated NSR pollutant.

None of the Project's facilities are in one of the 28 source categories. 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).

If a project is a major source (or major modification), PSD applies to any attainment pollutant whose potential or actual emissions (or potential or actual emissions increase) equals or exceeds the significance level.

Table 30 lists the estimated operating emissions for the existing and proposed facilities. As can be seen, the proposed changes to the Liquefaction Trains 1 through 3 coupled with the addition of Train 4 would not result in potential emissions increases that would trigger PSD for the Terminal. Similarly, the proposed changes to the Units 1 through 3 coupled the addition of Unit 4 would not result in potential emissions increases that would trigger PSD for the Pretreatment Facility.

The Terminal was originally under Air Quality Permit No. 55464 and included vaporization facilities. Construction of Liquefaction Trains 1 through 3 was permitted by the TCEQ under Air Quality Permit No. 100114. Freeport LNG submitted to the TCEQ on January 31, 2017, an application to amend Permit No. 100114 to allow addition of Train 4 and to revise information for Trains 1 through 3. Similarly, construction of the Pretreatment Facility was permitted by the TCEQ under Air Quality Permit No. 104840/N170. On January 31, 2017, Freeport LNG also submitted to the TCEQ an application to amend Permit No. 104840/N170 to allow the addition of Unit 4 and to revise the information for Pretreatment Units 1 through 3.

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. Because the closest Class I area, Breton NWR, is located about 600 km east of Quintana Island, no Class I areas would be affected.

Nonattainment New Source Review. NNSR applies to a new major source 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 classified as attainment or the equivalent for all criteria pollutants except for O_3.

The proposed changes to the Liquefaction Trains 1 through 3, coupled with the addition of Train 4 would not result in potential NO_x or VOC emissions increases that would trigger NNSR for the Terminal. Similarly, the proposed changes to the Pretreatment Units 1 through 3, coupled with the addition of Unit 4 would not result in potential emissions increases that would trigger PSD for the Pretreatment Facility.

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 the Project.

- 40 CFR 60 Subpart A – General Provisions. The general provisions include the requirements for notification, record keeping, and performance testing of equipment subject to another NSPS.

- 40 CFR 60 Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units. The Pretreatment Facility's three new gas-fired heaters would each have a rated capacity of 132 million British thermal units per hour (MMBtu/hr) and be required to meet a NO_x emission rate of 0.10 pound per million British thermal (lb/MMBtu) on a 30-day rolling average basis.

- 40 CFR 60 Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines. The Project's diesel engines (emergency and non-emergency generators and backup compressors) would be required to meet NO_x, unburned hydrocarbon, and particulate matter emission rates which are determined by the size, use, and manufacture date of each engine.

- 40 CFR 60 Subpart OOOOa - Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification, or Reconstruction Commenced after September 18, 2015. Subpart OOOOa applies to emissions from wet seals of centrifugal compressors, reciprocating compressors, pneumatic controllers, storage vessels, equipment leaks, and sweetening units at natural-gas processing plants. The Pretreatment Facility is a natural-gas processing plant while the Liquefaction plant would not be subject to this provision. Subpart OOOOa would require monitoring of the fugitive emissions from equipment leaks and the use of a thermal oxidizers to control SO_2 emissions from the Pretreatment Facility's amine units.

National Emissions Standards for Hazardous Air Pollutants. National Emissions Standards Hazardous Air Pollutants (NESHAP) standards, at 40 CFR 61, apply to emissions of particular HAPs from specified source categories. Natural gas processing facilities are not a specified category under 40 CFR 61 and would not apply to the Project.

Maximum Achievable Control Technology 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 HAP source is a stationary source with potential HAP emissions less than the thresholds. Table 30 summarizes the potential HAP emissions. The proposed Project would be an area HAP source.

The following NESHAP would apply:

- 40 CFR 63 Subpart ZZZZ – Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. Because the emergency generators and firewater pump engines are subject to 40 CFR 60 Subpart IIII, they would comply with Subpart ZZZZ by complying with 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 EPA to the TCEQ. Title V Operating Permit No. O2878 was issued by TCEQ to cover operations at the Terminal from January 9, 2014 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 a 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 submitted to TCEQ an application for renewal of Permit No. O2878 on August 2, 2016, and the permit was renewed on an August 31, 2017.[39]

Greenhouse Gas Reporting Rule. The EPA's Mandatory Reporting of GHG Rule requires reporting of GHG emissions from suppliers of fossil fuels and facilities that emit greater than or equal to 25,000 metric tons of GHG CO_2e per year. Based on the existing GHG emission estimates, the Terminal and Pretreatment Facility would be subject to the GHG Mandatory Reporting rule and would each be required to report the GHG emissions to EPA if its actual emissions exceed metric 25,000 metric tons of GHG CO_2e per year.

State Air Quality Requirements

Air emission sources in Texas must meet state air emission standards codified in TAC 30 Chapters 100-122. Emission related standards that would apply to the proposed Project are listed below.

- TAC 30 Chapter 101, Subchapter H, Division 3 (Mass Emissions Cap and Trade)
- TAC 30 Section 111.111

[39] http://www2.tceq.texas.gov/airperm/index.cfm?fuseaction=tv.start, Accessed 05/08/18.

- TAC 30 Section 111.145
- TAC 30 Section 111.151
- TAC 30 Section 112.3
- TAC 30 Section 112.9
- TAC 30 Section 112.31
- TAC 30 Section 112.41
- TAC 30 Section 115 Subchapter D, Division 3
- TAC 30 Section 116.111(a)(2)(C)
- TAC 30 Section 117 Subchapter B Division 3

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. Construction emissions are summarized in table 29.

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 combust 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 vegetative cover, mulch, windbreaks, crushed stone, tarps, water sprays, and dust suppressants, to mitigate fugitive dust emissions during construction. Additionally, all areas disturbed by construction would be stabilized in accordance with the Project-specific Plan.

Emissions would occur over the duration of construction activity and would vary along the length of the Pipeline. Construction emissions, including dust emissions, would affect residents near to the Terminal and Pretreatment Facility. As stated, impacts from construction equipment would occur over the 4 years of construction. While these would not result in a significant effect on regional air quality or result in any violation of applicable AAQS, it may result in elevated pollutant levels near the construction sites.

As is discussed above, measures to mitigate the air emissions during Project construction include the following:

- use of construction equipment engines that incorporate modern pollution control technology;
- properly maintaining construction equipment engines;
- use of clean fuels in construction equipment engines;
- use of dust-control measures; and
- stabilizing areas disturbed by construction.

The USEPA has recommended that Freeport LNG adopt a Construction Emission Mitigation Plan. However, construction emissions for the Train 4 Project are relatively low, and we conclude a mitigation plan is unnecessary.

Emissions over the construction period would increase pollutant concentrations in the vicinity of the Project site. However, their effect on ambient air quality would vary with time due to the construction schedule, the mobility of the sources, and the variety of emission sources. Fugitive dust and other emissions due to construction activities generally do not pose a significant increase in regional pollutant levels; however, local pollutant levels would increase. Considering these factors, we determine that construction of the Project would impact local air quality. However, due to the magnitude of emissions and the limited time frame, air quality impacts from construction would not be significant.

TABLE 29

Summary of Estimated Emissions for Project Construction

Year	Estimated Emissions (tons)							
	VOC	PM_{10} a/	$PM_{2.5}$ a/	CO	NO_x	SO_2	CO_2e	Total HAPs
Train 4 Project								
Year 1								
Commuter Transit	0.20	0.06	0.03	1.70	0.70	3.00E-3	8,841	0.02
On-Road Vehicles	1.00E-3			1.50E-2	2.00E-3		2	
Off-Road Vehicles	0.70	0.40	0.40	3.00	6.30	8.00E-3	1,293	2.70
Barges								
Fugitive Dust		52.98	5.75					
Total	0.90	53.44	6.18	4.72	7.00	0.01	10,135	2.72
Year 2								
Commuter Transit	4.40	0.90	0.40	41.80	9.80	0.05	169,764	0.20
On-Road Vehicles	0.02	0.01	3.00E-3	0.23	0.09		42	1.00E-3
Off-Road Vehicles	3.70	1.20	1.10	46.50	21.10	0.02	4,308	7.20
Barges	0.18	0.18	0.17	1.80	7.30	0.02	523	0.06
Fugitive Dust		165.12	18.10					
Total	8.30	167.40	19.77	90.33	38.29	0.09	174,637	7.46
Year 3								
Commuter Transit	8.90	1.90	0.90	83.80	19.70	0.10	342,258	0.50
On-Road Vehicles	0.04	0.01	7.00E-3	0.52	0.24	1.00E-3	85	3.00E-3
Off-Road Vehicles	6.80	0.69	0.68	126.60	20.10	0.03	3,749	4.50
Barges	0.29	0.29	0.29	2.80	11.70	0.03	833	0.10
Fugitive Dust		151.92	16.66					
Total	16.03	154.82	18.54	213.72	51.74	0.16	346,925	5.10
Year 4								
Commuter Transit	4.34	0.91	0.30	41.60	8.33	0.05	157,753	0.19
On-Road Vehicles	0.01	3.00E-3	1.00E-3	0.11	0.05		19	1.00E-3
Off-Road Vehicles	1.80	0.24	0.24	32.80	5.80	6.00E-3	1,132	1.60
Barges	0.15	0.15	0.15	1.60	6.40	0.02	460	0.06
Fugitive Dust		136.91	15.04					
Total	6.30	138.21	15.73	76.11	20.58	0.07	159,365	1.85
General Conformity Applicability **Threshold b/**	100	---	---	---	100	---	---	---

HAPs = Hazardous Air Pollutants

a. Includes fugitive dust emission estimates which were submitted by Freeport LNG and corrected by FERC.

b. General Conformity applicability thresholds for O_3 moderate non-attainment area

Air Pollutant Emissions from Operations

Anticipated emissions for the proposed Project facilities are shown in tables 28 and 30. 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 30

Air Emission Estimates for the Existing and Proposed Stationary Facilities

Source	Potential Emissions (tpy)									
	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	H_2S	CO_2e	Total HAPs
Quintana Island Terminal										
Phase I - Vaporization Plant	25.1	80.9	6.7	6.4	6.4	2.3	0.22	---	250,255	
Liquefaction Facility										
Trains 1-3 (Authorized)	13.93	25.90	6.96	0.06	0.06	0.002	<0.001	---	12,852	0.06
Trains 1-3 (Proposed changes)[a]	-8.16	-15.65	2.25	0.05	0.05	0.019	<0.001	---	-7,274	-0.055
Liquefaction Train 4 (Train 4 Project)	0.28	0.49	2.26	0.03	0.03	0.0006	<0.001	---	303	<0.001
Liquefaction Total	**6.05**	**10.74**	**11.47**	**0.14**	**0.14**	**0.02**	**0.22**	**---**	**5,881**	**0.005**
Pretreatment Facility										
Units 1-3 (Authorized)	51.85	68.30	18.02	87.06	87.06	24.67	1.89	1.86	1,549,999	6.07
Units 1-3 (Proposed changes)[a]	-11.16	-9.78	-2.39	-20.92	-20.92	-3.29	-0.44	-1.14	39,675	5.52
Unit 4 (Train 4 Project)	5.13	7.31	4.67	13.81	13.81	3.68	0.28	0.24	448,222	3.92
Facility Total	**45.82**	**65.83**	**20.30**	**79.95**	**79.95**	**25.06**	**1.73**	**0.97**	**2,037,896**	**15.51**

Freeport LNG performed refined air dispersion modeling using the AERMOD program of the existing sources at the Terminal (Trains 1-3) and Pretreatment Facility (Units 1-3) plus proposed Project sources (Train 4, Unit 4). Preprocessed meteorological data for 2012 from the Angleton Brazoria Airport (surface air) and Lake Charles, Louisiana, (upper air) was used for this modeling analysis. The USEPA's Tier 2 Ambient Ratio Method (ARM) was used to account for conversion from NO_x to NO_2 in the atmosphere. Consistent with USEPA guidance, NO_2 to NO_x ratios of 0.8 and 0.75, respectively, were used for the 1-hour and annual NO_2 standards.

Tables 32 and 33, respectively, summarize modeling results for the existing facility sources and existing facility plus proposed Project sources for CO, NO_x, $PM_{2.5}$, PM_{10}, and SO_2. For each pollutant and averaging period combination, the tables show the model concentration (predicted maximum highest-first-high concentration), the ambient concentration, and the total concentration (the sum of the model concentration and ambient background. For each pollutant and averaging period combination, the total concentration is less than the relevant NAAQS.

TABLE 31

Air Dispersion Modeling Summary – Existing Facility Sources

Pollutant and Averaging Period	Pollutant Concentration ($\mu g/m^3$) Model Concentration a/	Ambient Background	Total Concentration b/	NAAQS
Quintana Island Terminal				
CO				
1-hour	98.94	1,829	1,928	40,000
8-hour	14.42	1,181	1,195	10,300
NO_2				
1-hour	3.45	30.7	34.15	188
Annual	0.16	2.76	2.92	100
$PM_{2.5}$				
24-hour	0.40	22.5	22.9	35
Annual	0.02	8.9	8.92	12
PM_{10}				
24-hour	0.40	67	67.4	150
SO_2				
1-hour	0.01	31.8	31.81	196
3-hour	0.36	23.1	23.46	1,300
Pretreatment Facility				
CO				
1-hour	171.43	1,829	2,000	40,000
8-hour	37.09	1,181	1,218	10,300
NO_2				
1-hour	3.39	30.7	34.09	188
Annual	0.30	2.76	3.06	100
$PM_{2.5}$				
24-hour	3.30	22.5	25.8	35
Annual	0.67	8.9	9.57	12
PM_{10}				
24-hour	3.30	67	70.3	150
SO_2				
1-hour	2.50	31.8	34.3	196
3-hour	2.25	23.1	25.35	1,300

a. High first high

b. Modeling result + Ambient background

$\mu g/m^3$ = micrograms per cubic meter.

TABLE 32

Air Dispersion Modeling Summary – Existing Facility Sources Plus Proposed Project Sources

Pollutant and Averaging Period	Pollutant Concentration ($\mu g/m^3$) Modeling Result a/	Ambient Background	Total Concentration b/	NAAQS
Quintana Island Terminal				

TABLE 32

Air Dispersion Modeling Summary – Existing Facility Sources Plus Proposed Project Sources

Pollutant and Averaging Period	Pollutant Concentration (μg/m³)			
	Modeling Result a/	Ambient Background	Total Concentration b/	NAAQS
CO				
1-hour	148.98	1,829	1,978	40,000
8-hour	23.77	1,181	1,205	10,300
NO_2				
1-hour	5.2	30.7	35.9	188
Annual	0.26	2.76	3.02	100
$PM_{2.5}$				
24-hour	0.66	22.5	23.16	35
Annual	0.02	8.9	8.92	12
PM_{10}				
24-hour	0.66	67	67.66	150
SO_2				
1-hour	0.01	31.8	31.81	196
3-hour	0.55	23.1	23.65	1,300
Pretreatment Facility				
CO				
1-hour	232.11	1,829	2,061	40,000
8-hour	37.25	1,181	1,218	10,300
NO_2				
1-hour	3.39	30.7	34.09	188
Annual	0.32	2.76	3.08	100
$PM_{2.5}$				
24-hour	4.03	22.5	26.53	35
Annual	0.89	8.9	9.79	12
PM_{10}				
24-hour	4.03	67	71.03	150
SO_2				
1-hour	2.63	31.8	34.43	196
3-hour	2.43	23.1	25.53	1,300

a. High first high
b. Modeling result + Ambient background
μg/m³ = micrograms per cubic meter.

Table 34 presents the predicted maximum ambient concentration for the existing sources and existing-plus-Project sources, and the incremental concentration increase due the Project's sources. For each pollutant and averaging period combination, the maximum predicted concentration plus background concentration is less than the NAAQS.

TABLE 33			
Air Dispersion Modeling Summary – Incremental Impact of Proposed Project Facilities			
Pollutant and Averaging Period	**Pollutant Concentration (µg/m³)**		
	Modeling Results - Existing Plus Proposed Project Facilities a/	**Modeling Results - Existing Facilities a/**	**Incremental Ambient Concentration Increase**
Quintana Island Terminal			
CO			
1-hour	148.98	98.94	50.04
8-hour	23.77	14.42	9.35
NO_2			
1-hour	5.2	3.45	1.75
Annual	0.26	0.16	0.1
$PM_{2.5}$			
24-hour	0.66	0.40	0.26
Annual	0.02	0.02	0.00
PM_{10}			
24-hour	0.66	0.40	0.26
SO_2			
1-hour	0.01	0.01	0.00
3-hour	0.55	0.36	0.19
Pretreatment Facility			
CO			
1-hour	232.11	171.43	60.68
8-hour	37.25	37.09	0.16
NO_2			
1-hour	3.39	3.39	0.00
Annual	0.32	0.30	0.02
$PM_{2.5}$			
24-hour	4.03	3.30	0.73
Annual	0.89	0.67	0.22
PM_{10}			
24-hour	4.03	3.30	0.73
SO_2			
1-hour	2.63	2.50	0.13
3-hour	2.43	2.25	0.18

a. High first high
b. Existing Plus Proposed Project Facilities Existing Facilities
µg/m³ = micrograms per cubic meter.

Freeport LNG performed air dispersion modeling of the existing and proposed stationary sources at the Terminal and the Pretreatment Facility, and the marine sources (anticipated LNG carriers and support vessels) within the moored safety zone. Three scenarios were modeled (table 35):

(1) Terminal and the Pretreatment Facility stationary sources in operation and an LNG carrier hoteling/unloading at each of the two docks.
(2) Terminal and the Pretreatment Facility stationary sources in operation, an LNG carrier transiting/maneuvering in the moored safety zone, a second LNG carrier hoteling/unloading at one of the dock, the other dock vacant.
(3) The same configuration as scenario 2, but the status of the two docks is reversed.

Modeling was performed using the AERMOD modeling system and a pre-processed meteorological data set obtained from the TCEQ (surface data from the Angleton Brazoria Airport; upper air data from Lake Charles, Louisiana) for the year 2012. Anticipated LNG carrier calls per year were modeled to represent the expected LNG carrier traffic for the Liquefaction Project and Train 4 Project.

The model runs accounted for the conversion of NO_x to NO_2 using methods approved by EPA. The Tier 2 ambient ratio method (ARM2) was used for the annual NO_2 NAAQS. When ARM2 is applied, the predicted NO_2/NO_x ambient ratio is a specified value. For the annual average NO_2 analysis, the default ambient NO_2/NO_x ratio of 0.75 was used. The Tier 3 plume volume molar ratio method (PVMRM) was used for the 1-hour NO_2 NAAQS. The PVMRM algorithm calculates the NO_2/NO_x ratio at a downwind receptor location based on the NO_2/NO_x in-stack ratio (ISR), the ambient O_3 concentration, NO_2/NO_x ambient equilibrium ratio, and the distance from the source to the receptor. The default NO_2/NO_x ambient equilibrium ratio of 0.9 was applied. For all sources except the LNG carriers, the default (0.5) NO_2/NO_x ISR was used. For the LNG carriers, a NO_2/NO_x ISR of 0.25 was justified and used (Alföldy, et. al., 2013).

TABLE 34

Air Dispersion Modeling Summary – Terminal, Pretreatment Facility, and Marine Sources

Pollutant and Averaging Period	Pollutant Concentration (μg/m³)			
	Modeling Result a/	Ambient Background	Total Concentration c/	NAAQS
CO				
1-hour	149.26	1,829	1,978	40,000
8-hour	116.86	1,181	1,298	10,300
NO_2				
1-hour	143.07	30.7	173.77	188
Annual	9.59	2.76	12.35	100
$PM_{2.5}$				
24-hour	4.72	22.5	27.22	35
Annual	0.17	8.9	9.07	12
PM_{10}				
24-hour	5.13	67	72.13	150
SO_2				
1-hour	32.18	31.8	63.98	196
3-hour	21.66	23.1	44.76	1,300

a. Terminal + Pretreatment Facility + marine sources
b. Terminal + Pretreatment Facility + marine sources + ambient background
μg/m³ = micrograms per cubic meter.

Table 35 summarizes the results. The modeling results for 1-hour and 8-hour CO, 1-hour NO_2, 24-hour $PM_{2.5}$, 24-hour PM_{10}, and 1-hour and 3-hour SO_2 are the high-first high values for the three marine vessel scenarios described above. The annual NO_2 and $PM_{2.5}$ values are the average values for the year modeled. The predicted impacts for the 1-hour NO_2, annual NO_2, 24-hour $PM_{2.5}$, 24-hour PM_{10}, and 1-hour SO_2 exceed their respective SILs. Nevertheless, the predicted impact of the Terminal, Pretreatment Facility, and marine vessels plus background concentration for each pollutant / averaging period is less than its respective NAAQS.

The Train 4 Project would construct while the Liquefaction Project would continue construction and while it would begin operation. The Liquefaction Project final EIS indicated that construction would continue through December 2019. The Liquefaction Facility and Pretreatment Facility operation would begin in December 2018 and complete operation is estimated for December 2019. Due to delays, Freeport LNG has accelerated its schedule, however it is possible that construction of the Liquefaction Project could continue through 2020. Thus in 2019 and 2020 simultaneous construction, commissioning, and operational emissions from the Liquefaction Project would occur with the Train 4 Project construction. In years 2021 and 2022 simultaneous operation of Trains 1-3 and construction for Train 4 would occur at both the Quintana Island Terminal and the Pretreatment Facility. Table 36 show the overlapping emissions by year. These overlapping emissions would be in excess of the modeled operational emissions in the Liquefaction Project. During the years of simultaneous commissioning, construction and operation, a higher level of emissions may occur and result in exceedances of the NAAQS. Due to its variability, it is our opinion that these rare occurrences would not result in a significant air quality impact to the local residents or the regional air quality.

TABLE 35

Combined Construction, Commissioning, and Operational Emissions of the Liquefaction Project and the Train 4 Project

	Emissions (tpy)							
Year	**NOx**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**CO_2e [a]**	**Total HAPs**
2019 [1]	221.8	2746.52	21.71	775.84	116.28	88.9	590,542	13.79
2020 [2]	156.0	1266.83	18.34	896.8	314.9	53.6	984,161	12.66
2021 [3]	58.24	307.7	25.16	241.82	105.54	40.03	505832	9.0
2022 [4]	85.58	170.11	25.07	225.21	102.73	30.3	318272	5.75

1 2017 construction emissions from Table 4.11.1-3 from the Liquefaction Facility final EIS (FERC, 2014) plus operation Train 1/Unit 1 Emissions plus construction emissions from Train 4 Project for 2019.

2 2018 construction emissions from Table 4.11.1-3 from the Liquefaction Facility final EIS (FERC, 2014) plus operation Train 1/Unit 1 plus half year emissions from Train 2/Unit 2 plus construction emissions from Train 4 Project for 2020.

3 No construction emissions for the Liquefaction Project. Operation emissions from Table 4.11-5 from the Liquefaction Facility final EIS (FERC, 2014) that included full operations of the Liquefaction Project plus construction emissions from Train 4 Project for 2021

4 No construction emissions for the Liquefaction Project. Operation emissions from Table 4.11-5 from the Liquefaction Facility final EIS (FERC, 2014) that included full operations of the Liquefaction Project plus construction emissions from Train 4 Project for 2022

a CO_2e is expressed in English tons (not metric tons)

Based upon the magnitude of emissions, and air quality modeling results, we have determined that the operation of the Project, while having moderate impacts to the local and regional air quality, would not result in significant impacts.

12. Noise

The noise environment can be affected both during construction and operation of pipeline and LNG terminal projects. The magnitude and frequency of environmental noise may vary considerably over the course of the day, throughout the week, and across seasons, in part due to changing weather conditions. This section will identify the potential sources of noise, the magnitude of noise, and discuss the change in noise attributable to construction and operation of the Project.

Sound is a sequence of waves of pressure that propagates through compressible media such as air or water. When sound becomes excessive, annoying, or unwanted, it is referred to as noise. Construction and operation of the proposed projects would affect overall noise levels in the vicinity of Project components. The ambient sound level of a region is defined by the total noise generated within the specific environment and usually comprises natural and man-made sounds.

Two measures used by some federal agencies to relate the time-varying quality of environmental noise with its known effect on people are the equivalent continuous sound level (L_{eq}) and the day-night average sound level (L_{dn}). The preferred single value figure to describe sound levels that vary over time is L_{eq}, which is defined as the sound pressure level of a noise fluctuating over a period of time, expressed as the amount of average energy. L_{dn} is defined as the 24-hour average of the equivalent average of the sound levels during the daytime (L_d – from 7:00 a.m. to 10:00 p.m.) and the equivalent average of the sound levels during the nighttime (L_n – 10:00 p.m. to 7:00 a.m.). Specifically, in the calculation of the L_{dn}, late night and early morning (10:00 p.m. to 7:00 a.m.) noise exposures are increased by 10 decibels (dB) to account for people's greater sensitivity to sound during nighttime hours. In general, if the sound energy does not vary over the given time period, the L_{dn} level will be equal to the L_{eq} level plus 6.4 dB. The 6.4 dB difference between the L_{dn} and the L_{eq} is a result of the 10 dB nighttime addition for the L_{dn} calculation.

Decibels are the units of measurement used to quantify the intensity of noise. To account for the human ear's sensitivity to low level noises the decibel values are corrected to weighted values known as decibels on the A-weighted scale (dBA). The A-weighted scale is used because human hearing is less sensitive to low and high frequencies than mid-range frequencies.

Noise is typically measured on the A-weighted scale (dBA). The A-weighting scale was developed and has been shown to provide a good correlation with the human response to sound and is the most widely used descriptor for community noise assessments. The faintest sound that can be heard by a healthy ear is about 0 dBA, while an uncomfortably loud sound is about 120 dBA. A 3 dB change of sound level is considered to be barely perceivable by the human ear, a 5 or 6 dB change of sound level is considered noticeable, and a 10 dB increase is perceived as if the sound intensity has doubled.

12.1. Applicable Noise Standards and Ordinances

The day-night sound level (L_{dn}) is a 24-hour average L_{eq} of the measured daytime (L_d) and measured nighttime (L_n) sound levels, with 10 dB added to the sound levels occurring during the nighttime hours of 10 p.m. to 7 a.m. to compensate for enhanced receptor sensitivity during the nighttime. Rather than being a true measure of the sound level, the L_{dn} represents a skewed average that correlates generally with the results of studies relating environmental sound levels to physiological reaction and effects. For a source that operates at a continuous sound level over a 24-hour period, such as an LNG terminal, the L_{dn} is about 6.4 dBA above the measured L_{eq}. Consequently, an L_{dn} of 55 dBA corresponds to a steady state A-weighted Leq of 48.6 dBA.

FERC guidelines require that the sound attributable to new or modified compressor equipment, or LNG equipment not exceed an L_{dn} of 55 dBA at any nearby noise sensitive area (NSA), unless such NSAs are established after facility construction.

Also, a sound level of 55 dBA (L_{dn}) can be used as a benchmark sound criterion or guideline for assessing the noise impact of other sources of noise, such as meter stations or HDD activity.

There are no Texas, Brazoria County, or local numerical noise standards applicable to the Project.

12.2. Existing Conditions

12.2.1. Quintana Island Terminal

The Bryan Beach subdivision, located west of the Terminal, contains residences. The nearest NSA to the Project's liquefaction train within the Terminal is a residence located 2,857 feet southwest of the center of Train 4 (NSA 1). No other potential NSAs were identified within 0.5 mile of the Terminal. Any residence/home not owned by Freeport LNG, or a subsidiary/affiliate would be considered an NSA.

Freeport LNG conducted ambient noise surveys at NSA 1 in March 2016 and again in April 2017. The existing BOG compressors were operating at about 95-percent load during the surveys. Contributing sources of noise at the measurement location included vehicular traffic, vessel traffic, an industrial facility not associated with the Terminal, and natural sounds (insects, ocean waves, birds). Noise from the Terminal was not detected by the acoustical technician during any of the measurements. Provided in table 37 is the NSA location, its distance and direction from the site, and the measured ambient noise levels. NSA 2, the campground located within the Quintana Beach County Park, is located more than 0.5 mile from the Terminal and not subject to noise-impact evaluation.

TABLE 36 **Quintana Island Terminal Train 4** **Identified NSA Location and Measured Ambient Noise Levels**			
Station	**NSA**	**Distance and Direction**	**Calculated Ambient dBA L_{dn} a/**
Quintana Island Terminal Train 4	NSA 1	2,857 feet / Southwest	67.1
Quintana Island Terminal Train 4	NSA 2 b	8,450 feet / East	

a. Daytime ambient measured in March 2016. Nighttime ambient measured in April 2017. L_{dn} calculated from measured daytime and nighttime ambient levels.
b. FERC requires evaluation of impacts to NSAs located within 0.5 mile of proposed facilities.

12.2.2. Pretreatment Facility

Freeport LNG identified five NSAs within one mile of the proposed Unit 4 within the Pretreatment Facility (NSAs 4, 5, 6, 9, and 14). Freeport LNG conducted ambient-noise measurement programs in March 2016 and April 2017 at three locations that were selected to represent conditions at these five NSAs. Existing sources of noise during the measurement programs included occasional vehicular traffic, natural sounds, and an industrial facility not associated with the Pretreatment Facility. Provided in table 38 are the identified NSA areas, their distance and direction from the site, and the ambient noise levels, based on the nearest measurement locations.

TABLE 37 **Pretreatment Facility Unit 4** **Identified NSA Location and Calculated Ambient Noise Levels**			
Station	**NSA**	**Distance and Direction**	**Calculated Ambient dBA L_{dn} a/**
Pretreatment Facility Unit 4	NSA 4	2,900 feet / West	51.0
	NSA 5	3,500 feet / Northwest	51.0
	NSA 6	4,200 Feet / Northwest	49.4
	NSA 9	3,900 feet / North	49.4
	NSA 14	4,000 feet / Southwest	64.8

a. Daytime ambient measured in March 2016. Nighttime ambient measured in April 2017. L_{dn} calculated from measured daytime and nighttime ambient levels.

12.2.3. Pipeline Corridor

Freeport LNG identified NSAs within 0.5 mile of each HDD and Direct-Pipe-installation site. The measured ambient noise levels for the nearest NSA for each HDD or Direct Pipe site are shown in table 39. The primary audible noise sources contributing to the ambient daytime sound levels included wind, birds, occasional traffic, and construction in the distance. The primary audible noise sources contributing to the ambient nighttime sound levels included birds, crickets, wind, an unrelated facility located approximately 2 miles west of the Pretreatment Facility, distant traffic, distant barking dogs, and frogs.

Along the pipeline route, HDD and Direct Pipe installation would occur and may continue into nighttime hours, potentially operating 24 hours per day for up to three months. Freeport LNG conducted a noise assessment for HDD and Direct Pipe activities that included ambient noise level measurements. Although Direct Pipe installation usually generates lower noise levels than HDD, Freeport LNG conservatively assumed that Direct Pipe installation would generate the same sound levels as HDD. Freeport LNG would be conducting these activities at five locations along the Pipeline route. NSAs within 0.5 mile of each HDD and Direct-Pipe-installation site were identified and potential impacts were assessed.

12.3. Construction Noise Impacts

Construction activity and associated noise levels would vary depending on the phase of construction in progress at any time. The highest level of construction noise typically occurs during earth-moving work. Because drilled soil displacement concrete piles (also known as DeWaal piles or cast-in-place piles) would be used, no impact pile driving is proposed for either facility. Construction noise is highly variable. Construction equipment operates intermittently, and the type of equipment in use at a given location at any time changes with the phase of construction. The sound level impacts on NSAs along the pipeline right-of-way due to construction activities would depend on the type of equipment used, the duration of use for each piece of equipment, the number of construction vehicles and machines used simultaneously, and the distance between the sound source and receptor.

12.3.1. Quintana Island Terminal and Pretreatment Facility

Nighttime construction activity would occur at the Terminal and Pretreatment Facility, but heavy equipment such as bulldozers are not expected to be used regularly during nighttime hours. Construction noise is expected to be consistent with noise associated with the currently ongoing construction of the previously authorized Phase II Modification and Liquefaction Projects. As discussed in section B.8.6.2, Freeport LNG has used heavy equipment during nighttime construction of the Phase II Modification and Liquefaction Projects; however, Freeport LNG has indicated that increased workforces and evening work will not be required for the Train 4 Project based on the currently proposed schedule.

Freeport LNG calculated estimated construction related noise levels for both Train 4 and Unit 4. Calculated construction noise levels would be at or below 55 dBA as an L_{dn} at nearby NSAs, and increases over ambient conditions would be less than 10 dBA. We conclude that there would be no significant or long-term noise impacts due to construction at the Terminal and the Pretreatment Facility.

12.3.2. Pipeline Corridor

FERC's recommended criteria for HDD and Direct Pipe installation noise are a limit of no greater than 55 dBA as an L_{dn}, or, if the existing ambient sound level is already greater than 55 dBA L_{dn}, then HDD and Direct Pipe noise should not increase the ambient sound level by more than 10 dBA.

Table 39 shows the HDD and Direct Pipe installation locations, the distance and direction to the NSA with the highest potential construction noise levels to each, and the results of Freeport LNG's noise assessment.

TABLE 38

HDD and Direct Pipe Installation Noise Analysis

Location (Method)	HDD or Direct Pipe Entry and Exit MP	NSA Distance/ direction	Measured Ambient Noise Level (dBA L_{dn})	Estimated HDD Noise Level Without Mitigation (dBA L_{dn})	Combined Ambient Plus HDD/Direct Pipe (dBA L_{dn})	Increase Over Existing Ambient (dBA L_{dn})
FHC (Direct Pipe)	0.0, 1.0	NSA 11 263 ft/SE	55.8	63.0	63.7	7.9
ICW (HDD)	1.3, 1.7	NSA 13 2,267 ft / NE	61.8	56.3	62.8	1.1
Wetland Complex (HDD)	2.4, 3.6	NSA 13 810 ft / SE	61.8	65.2	66.8	5.0
CR 690 East Levee Road Crossing 1 (Direct Pipe)	4.4, 4.8	None within 0.5 mile	NA	NA	NA	NA
CR 690 East Levee Road Crossing 2 (Direct Pipe)	5.1, 5.5	None within 0.5 mile	NA	NA	NA	NA
Oyster Creek (Direct Pipe)	6.4, 6.8	NSA 8 540 ft / SSE	49.6	68.7	68.8	19.2

Of the six sites, the Oyster Creek HDD site shows noise levels and increases over ambient conditions that exceed our criteria and would require mitigation. Calculated noise levels of up to 68.7 dBA, and increases over ambient conditions of up to 19.2 dBA, are shown. Freeport LNG is proposing to use one or more of the following noise mitigation measures at the Oyster Creek location to reduce HDD noise to 55 dBA L_{dn} or less.

- temporary noise barriers;
- acoustical "tent" over the HDD entry work space;
- high performance exhaust silencers on engines;
- partial engine enclosures;
- strategic placement of HDD equipment; and
- low noise generators.

To insure that potential noise impacts on nearby NSAs are minimized to the extent practical, **we recommend that:**

<u>Prior to construction of the Oyster Creek crossing</u>, Freeport LNG should file with the Secretary, for review and written approval by the Director of OEP, an HDD noise mitigation plan for the Oyster Creek crossing to reduce the projected noise level attributable to the proposed drilling operations at the nearby NSA. During drilling operations, Freeport LNG should implement the approved plan, monitor noise levels, and make all reasonable efforts to restrict the noise attributable to the drilling operations to no more than a L_{dn} of 55 dBA at the NSA.

Based on the noise analyses above and our recommendations, we conclude that construction of the Project, while audible during construction, would not have a significant impact on the noise environment near the pipeline, Terminal or the Pretreatment Facility.

12.4. Operational Noise Impacts

12.4.1. Quintana Island Terminal

Train 4 at the Terminal would contain noise-generating sources that include air coolers, propane condensers, compressor aftercoolers, and aboveground piping. Operational noise and impacts on nearby NSAs are discussed below.

Freeport LNG used a noise model to calculate noise levels that would be attributable to operation of Train 4 (proposed) and Trains 1-3 (authorized and currently under construction). Table 40 presents the calculated noise levels for all four trains operating under full-load conditions, as well as the existing ambient noise levels and predicted future noise levels at the nearest NSA. The noise analysis for the facility incorporated specific noise-mitigation measures to reduce impacts. Freeport LNG indicated that these measures were included in its noise analysis to achieve the noise level presented. These mitigation measures include installation of the following:

- acoustical lagging for aboveground compressor piping;
- acoustical enclosures for air compressors, refrigerant and propane compressors, motors and pumps;
- acoustical pipe-rack louvers;
- in-line compressor discharge silencers; and
- super-low-noise air cooler fans for Train 4.

TABLE 39

Calculated Operational Quintana Island Terminal Noise Levels Summary

Station	NSA	Distance and Direction to Center of Train 4	Existing Measured Ambient L_{dn} (dBA)	Calculated Project L_{dn} a/ (dBA)	Cumulative Future (Existing Plus Project) (dBA)	Increase Over Existing Ambient L_{dn} (dBA)
Quintana Island Terminal Trains 1-4	NSA 1	2,857 / SW	67.1	54.7	67.3	0.2

a. Calculated sound level is for all four trains in full-load operation at the Terminal.

As shown in table 40, the calculated sound level attributable to the Train 4 Project and the entire Terminal under full load is below our 55 dBA L_{dn} criterion. Increases over existing ambient levels should not be perceptible over existing noise levels.

12.4.2. Pretreatment Facility

Unit 4 at the Pretreatment Facility would contain noise-generating sources that include compressors, aboveground piping, and air coolers. Operational noise and impacts on nearby NSAs are discussed below.

A noise model was used to estimate noise levels that would be attributable to operation of Unit 4 (proposed) and Units 1-3 (authorized and currently under construction). Table 40 presents the calculated noise levels for Units 1-4 operating under full-load conditions, as well as the existing ambient noise levels and predicted future noise levels at the nearest NSAs. The noise analysis for the facility incorporated specific noise-mitigation measures to reduce impacts. Freeport LNG indicated that these measures were included in its noise analysis to achieve the noise levels presented. These mitigation measures include the following:

- low-noise design air coolers; and
- acoustical insulation on compressor suction and discharge piping.

TABLE 40

Calculated Operational Pretreatment Facility Noise Levels Summary

Station	NSA	Distance and Direction to Center of Train 4	Existing Measured Ambient L_{dn} (dBA)	Calculated Project L_{dn} a/ (dBA)	Cumulative Future (Existing Plus Project) (dBA)	Increase Over Existing Ambient L_{dn} (dBA)
Pretreatment Facility	NSA 4	2,900 feet / West	51.0	54.1	55.8	4.8
	NSA 5	3,500 feet / Northwest	51.0	53.3	55.3	4.3
	NSA 6	4,200 Feet / Northwest	49.4	51.6	53.7	4.3
	NSA 9	3,900 feet / North	49.4	52.9	54.5	5.1
	NSA 14	4,000 feet / Southwest	64.8	51.4	65.0	0.2

a. Calculated sound level is for all four units in operation at the Pretreatment Facility.

As shown in table 40, the calculated sound level attributable to the full Pretreatment Facility is below our 55 dBA L_{dn} criterion at all NSAs. As part of their analysis, Freeport LNG has concluded that no perceptible increase in vibration would occur from operation of the Pretreatment Facility at any NSAs.

Based on the noise analyses above, noise levels attributable to full-load cumulative operation of the four-train Terminal and the four-unit Pretreatment Facility would be greater than

55 dBA L_{dn} at three of the NSAs, including ambient noise. To ensure that the noise from these facilities does not exceed an L_{dn} of 55 dBA at the nearest NSAs, **we recommend that**:

> **Freeport LNG should file noise surveys with the Secretary no later than 60 days after placing the entire Train 4 facilities at the Quintana Island Terminal into service and no later than 60 days after placing the entire Unit 4 facilities at the Pretreatment Facility into service. If full-load condition noise surveys are not possible, Freeport LNG should provide an interim survey at the maximum possible load within 60 days of placing that Project facility into service and provide the full-load surveys within 6 months. If the noise attributable to operation of the equipment at the Terminal or the Pretreatment Facility exceeds an L_{dn} of 55 dBA at the nearest NSA under interim or full load conditions, Freeport LNG should file a report on what changes are needed and should install the additional noise controls to meet the level within 1 year of the in-service date. Freeport LNG should confirm compliance with the above requirement by filing an additional noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

Based on the noise analyses above and our recommendations, we conclude that operation of the Project, while audible during operation, would not have a significant impact on the noise environment near either the pipeline, Terminal or the Pretreatment Facility.

13. Cumulative Impacts Analysis

NEPA requires the lead federal agency to consider the potential cumulative impacts of proposals under its review. Cumulative impacts may result when the environmental effects associated with the proposed action (Project) are superimposed on or added to impacts associated with past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

The Project-specific impacts of the Train 4 Project are discussed in detail in other sections of this EA. The purpose of this section is to identify and describe cumulative impacts that would potentially result from implementation of the proposed Project along with other projects that could affect the same resources in the same approximate timeframe. To ensure that this analysis focuses on relevant projects and potentially significant impacts, the actions included in the cumulative impact analysis include projects that:

- impact a resource potentially affected by the proposed Project;
- impact that resource within all or part of the timespan encompassed by the proposed or reasonably expected construction and operation schedule of the proposed Project; and
- impact that resource within all or part of the same geographic area affected by the proposed Project. The geographic area considered varies depending on the resource being discussed, which is the general area (geographic scope) in which the projects could contribute to cumulative impacts on that particular resource.

The resources that would be affected as a result of the Train 4 Project include soils; surface water; wetlands; vegetation; wildlife and aquatic resources; threatened, endangered, and other special status species; land use; socioeconomics; air quality; and noise.

The Train 4 Project would be an expansion of the Liquefaction Project currently under construction, along with the Phase II Modification Project. The Liquefaction Project and Phase II Modification Project impact analysis and associated cumulative effects were analyzed in the 2014 EIS (FERC 2014). The majority of the area used for construction of the Train 4 Project (87 percent) would be within the areas disturbed during construction of the Liquefaction Project, and the operation of the Train 4 Project would result in the addition of one liquefaction train to the three liquefaction trains analyzed in the 2014 EIS.

The regional landscape in the Project area has been radically altered by human occupation over the last 150 years or so, first by agriculture, and later by the development of extensive industrial and port facilities. As a result, the region includes a substantial amount of commercial developments, residential areas, and attendant public infrastructure (e.g., schools, hospitals, roads).

13.1. Temporal and Geographic Distribution (Geographic Scope)

For the purpose of this analysis, the temporal extent of other projects would start in the recent past and extend out for the expected duration of the impacts caused by the Project. Some Project impacts from construction could occur as soon as site preparation begins and occur over about 42 months, while operational impacts are assumed to exist throughout the life of the facility. Freeport LNG proposes to begin operations in 2022 and anticipates at least a 20-year life span for the Project, but the facilities would be designed and capable of operating for longer with proper maintenance.

The geographic distribution of the area considered in the cumulative effects analysis varies by project and by resource. The cumulative impact analysis area, or geographic scope, for a resource may be substantially greater than the corresponding project-specific area of impact in order to consider an area large enough to encompass likely effects from other projects on the same resource. The CEQ (1997) recommends setting the geographic scope based on the natural boundaries of the resource affected, rather than jurisdictional boundaries. Resource-specific geographic scopes are provided in table 41 and used to assess cumulative impacts for each resource.

Based on our analysis in the previous sections, we conclude that the Project has little or no impacts on the following resources: geology, groundwater, recreation, and cultural resources. Because the Project does not contribute to impacts on these resources, we do not consider them further in this analysis,

TABLE 41 **Resource-specific Geographic Scopes**	
Environmental Resource	**Geographic Scope**
Soils	Construction workspace/right-of-way
Water Resources	Surface Water: USGS 10-digit HUC 1204020540 (Lower Oyster Creek watershed) Wetlands: USGS 10-digit HUC 1204020540 (Lower Oyster Creek watershed)
Vegetation	USGS 10-digit HUC 1204020540 (Lower Oyster Creek watershed)
Wildlife and Aquatic Resources	USGS 10-digit HUC 1204020540 (Lower Oyster Creek watershed)
Threatened, Endangered, and other Special Status Species	USGS 10-digit HUC 1204020540 (Lower Oyster Creek watershed)
Land Use and Visual Resources	Right-of-way and a 0.5-mile radius around the Project facilities
Socioeconomics	Brazoria County
Air Quality	Construction: right-of-way and 0.25-mile radius around Project facilities Operation: right-of-way and 50-km radius around Project facilities
Noise	1-mile radius around aboveground facilities and HDDs

13.2. Projects and Activities Considered

With respect to past actions, CEQ guidance (2005) allows agencies to adopt a broad, aggregated approach without "delving into the historical details of individual past actions". Past projects that are no longer contributing to changes in the environment are included as part of the environmental baseline. Past, present, and reasonably foreseeable projects within the geographic scope for the Project, that might cause cumulative impacts when considered with the proposed Project, are discussed in this section. For FERC-regulated projects, proposed projects are those for which the proponent has submitted a formal application to the FERC, and planned projects are projects that are either in pre-filing or have been announced, but have not been proposed. Planned projects also include projects not under the FERC's jurisdiction that have been identified through publicly available information such as press releases, internet searches, and the applicant's communications with local agencies.

Other projects considered for cumulative impacts are defined within 40 CFR § 1508.7 as, "those projects within the geographic scope and timeframe of the Project that are not considered speculative". Projects are not considered speculative if there are existing proposals, a commitment of resources or funding, or those for which the permitting process has commenced. Present effects of past actions with the potential to cumulatively interact with the Project were considered for the cumulative analysis.

The majority of impacts from the Project would be contained within or adjacent to the boundaries of the Project construction right-of-way, ATWS, and site boundaries. For example, the use of the Project-specific Plan, Procedures, and ESCP and the Liquefaction Project's SWPPP would help ensure that ground disturbance and site-stabilization activities would remain within work areas. The implementation of these plans would also limit the cumulative impacts on other resources by restoring vegetation and wetland communities once construction is complete. As described in the impact analysis in section B, the impacts for the Train 4 Project are generally temporary, localized, and not significant. As the impacts of the Project would be localized, they would not be expected to contribute significantly to the cumulative impact in the region. As a result, we have related the scope of our analysis to the magnitude of the aforementioned environmental impacts described in the impact analysis.

Because of the isolation of the Quintana Island with respect to the mainland, the majority of the socioeconomic impacts from construction of the project would apply primarily to the residents of the town of Quintana. Because the Train 4 Project is an extension of the Liquefaction Project currently under construction, Project impacts would be generally perceived as an extension in duration of the current impacts, rather than as a standalone impact. Similarly, socioeconomic impacts of operation of the Project would be perceived as an incremental increase in the current impacts, rather than as a standalone impact.

Projects within the geographic scope of analysis are shown on figure F-1 in appendix F, and listed in tables in appendix F. These include: FERC-jurisdictional projects, other industrial facilities, federal and state agency projects, non-FERC-jurisdictional pipelines, road projects, commercial developments, and residential developments. These projects were identified through an independent review of publicly available information, aerial and satellite imagery, consultations with federal agencies, information provided by the Applicant and potentially affected landowners, and comments submitted into the Commission's administrative record.

In appendix F, the tables address the following subjects:

- Table F-1 lists the other projects considered in the cumulative impacts analysis for land-disturbing and other nearby impacts that could contribute to cumulative impacts on the following resources: surface water, wetlands, vegetation, wildlife (aquatic and terrestrial), land use, visual resources, and noise. This table identifies the type of project, the distance from the Train 4 Project, a short description, the construction and operation timeline, the number of workers required, and the approximate size of the action. Finally, the table identifies the relevant geographic scope for the resources listed above potentially affected by each project.
- Table F-2 summarizes the other projects considered in the cumulative impacts analysis for land-disturbing and other nearby impacts, according to the HUC-10 watershed in which they occur and identifies their impacts on wetlands and waterbodies.
- Table F-3 focuses on the projects considered in the cumulative impacts analysis for socioeconomics.
- Table F-4 focuses on the projects considered in the cumulative impacts analysis for air quality.

13.3. Present and Reasonably Foreseeable Future Actions

Industrial developments in the geographic scopes include Freeport LNG's Liquefaction Project and Phase II Modification Project. Both projects involve construction at and adjacent to the existing Terminal (and at additional locations in the case of the Liquefaction Project).

13.4. Analysis of Cumulative Impacts

To analyze the cumulative impact of the Freeport LNG work, impacts associated with the Train 4 Project for the factors listed above were evaluated with respect to other proposed development projects within the development categories noted in table F-1 and then overall cumulative impacts were described.

13.4.1. Soils

The geographic scope for cumulative impacts on soil resources is considered to be the construction workspace right-of-way. The other projects found in this geographic scope include the following:

- Freeport LNG Liquefaction's Liquefaction and Phase II Modification Projects;
- CenterPoint Energy's (CenterPoint) Electric Transmission Line to the Terminal.

The Liquefaction Project previously disturbed the soils within the Terminal; the Pretreatment Facility; offsite workspaces A, C, D, E, F, G, H; and the Heavy Haul Road. The Train 4 activities would be within the existing footprint and would not affect additional soils. The CenterPoint Energy electric transmission line would have insignificant effects on soils near the Terminal but not adjacent to the Project's construction workspace. Soils along the pipeline, the temporary workspaces, and offsite workspace Area B would be affected by the Train 4 Project; however these areas would be restored following construction in accordance with the Project-specific Plan and Procedures and returned to preconstruction condition. Impacts would be minimized by following the Project-specific Plan, Procedures, and ESCP and the SWPPP. Therefore, we conclude that the Project would contribute minimally to cumulative impacts on soil within the geographic scope for soil resources.

13.4.2. Water Resources

The geographic scope established for cumulative impacts on water resources includes the USGS 10-digit HUC 1204020540 (Lower Oyster Creek watershed), which underlies the Train 4 Project area. The other projects identified within the Lower Oyster Creek watershed that might have impacts on water resources include the following:

- Freeport LNG Liquefaction's Liquefaction and Phase II Modification Projects;
- CenterPoint's Electric Transmission Line to the Terminal;
- BASF's Ammonia Production Facility and Storage Tank;
- MEGlobal EQUATE Petrochemicals Co.;
- Port Freeport and COE's FHC Improvement Project;
- Port Freeport Velasco Terminal Development;
- Gulf South Pipeline Company Coastal Bend Header Project;
- Kinder Morgan Lateral Development Project;
- Texas Eastern's Stratton Ridge Expansion Project, Brazoria;
- Interconnector Gas Pipeline (BIG Pipeline);
- South Texas Eastern Pipeline Project (STEP Project) Modifications;
- Texas General Land Office Dune Restoration;
- Various Transportation Projects;
- Texas Gulf Regional Airport;
- Brazosport ISD;
- Various Residential Developments.

Surface Water

Effects on waterbodies at the Terminal and the Pretreatment Facility include direct impacts on a stormwater pond and indirect effects on a stormwater retention pond, a drainage channel, and a water detention pond. Indirect impacts could result from stormwater discharges during construction and operation and potential spills and leaks. The Pipeline would cross major waterbodies using the HDD or Direct Pipe method and would restore intermediate and minor waterbodies in accordance with the Project-specific Plan and Procedures following construction.

The waterbodies affected by other projects are summarized in table F-2. Before construction affecting surface waters can occur, project proponents are required to obtain authorization under section 404 of the CWA and section 10 of the RHA from the COE, and corresponding WQC under Section 401 of the CWA from the TCEQ. These authorizations would be contingent on each projects' use of best management practices to minimize effects on water quality and to ensure that state water quality standards are not violated. These measures would ensure that long-term cumulative impacts on water quality are minimized. Impacts on surface water from construction and operation of the Train 4 Project are anticipated to be temporary, localized, and insignificant, as such we conclude that the Project when considered with the other projects in the HUC-10 watershed would not contribute to significant cumulative impacts on surface water resources.

Wetlands

There are no wetlands within the Terminal or the Pretreatment Facility. Freeport LNG would follow permit conditions; the Project-specific Plan, Procedures, and ESCP; and the SWPPP for the Liquefaction Project to avoid indirect impacts (e.g., from stormwater runoff) on the wetlands that lie beyond the construction workspace.

Wetlands would be affected during construction activities within the Pipeline Corridor. Following construction activities, disturbed areas would be restored and allowed to revegetate. A 10-foot-wide corridor centered along the pipeline would be maintained in an herbaceous state to allow periodic corrosion/leak surveys, which would result in the conversion of 0.1 acre of scrub-shrub wetlands to emergent wetlands.

The wetlands affected by other projects within the HUC-10 watershed are listed in table F-2. As noted previously, the proponents of each of the projects would need to obtain applicable permits from the COE and TCEQ. As discussed in section B.3.7, effects on wetlands from construction and operation of the Train 4 Project are anticipated to be insignificant, as such we conclude when considered with the other projects in the HUC-10 watershed would not contribute to significant cumulative impacts on wetland resources.

13.4.3. Vegetation

The geographic scope established for cumulative impacts on vegetation resources is the same as that for water resources. See section B.13.4.2 for a list of the projects considered.

No vegetation is present within the Terminal; Pretreatment Facility; Stratton Ridge Meter Station; Heavy Haul Road; and offsite workspaces Areas A, C, D, E, F, G, and H. Therefore, there would be no direct effects on vegetation from construction and operation in these areas. Construction of the Pipeline and Area B would temporarily affect vegetation, and areas not required for operation would be revegetated following the Project-specific Plan and Procedures. As discussed in section B.4.0 we conclude that the Project would cause temporary, insignificant impacts on vegetation.

The acreage affected by other projects in the Lower Oyster Creek HUC-10 Watershed (the only watershed for which this information was publicly available) is listed in table F-1. These projects, if constructed in the same general location and timeframe, could have a cumulative impact on local vegetation communities but would not have a significant impact on regional vegetation. These effects would be greatest during any overlap in the construction timing of these projects. Construction and operation of the other projects would also result in temporary impacts on vegetation communities and would likely result in the permanent conversion of vegetated habitats to developed, industrial land. Based on a desktop review, many of the projects are located within developed or open areas and appear to require minimal vegetation clearing. Vegetation near the Project and other projects has been affected by ongoing industrial development and construction and maintenance of existing roads, railroads, natural gas and oil pipelines, utility lines, and electrical transmission line rights-of-way. As cumulative impacts on regional vegetation would not be significant and vegetation impacts from construction and operation of the Train 4 Project are anticipated to be insignificant, we conclude that the Project when considered with the impacts of the other projects would not contribute to significant cumulative impacts on vegetation.

13.4.4. Wildlife and Aquatic Resources

The geographic scope established for cumulative impacts on wildlife and aquatic resources is the same as that for water resources. See section B.13.4.2 for a list of the projects considered.

If the other projects are constructed concurrently, cumulative impacts (e.g., displacement, stress, and direct mortality of some individuals) on terrestrial wildlife could occur. The timeframes for each project, where publicly available, are summarized in table F-1. Based on current published schedules, limited schedule overlap would occur between the Train 4 Project and the other projects listed above. Operation of the other projects would also result in habitat destruction, increased noise, lighting, and human activity that could disturb wildlife in the area. Wildlife generally relocate from habitat that has become unsuitable either through impacts on vegetation (as discussed in section B.5.2) or through disturbance. Because the acreage of affected habitat is relatively small compared to the total available habitat in the geological scope, we conclude that cumulative impacts on wildlife are not significant and that the Project when considered with the other projects in the HUC-10 watershed would not contribute to significant cumulative impacts on wildlife resources.

Cumulative impacts on aquatic resources could occur if construction and operation of other projects have similar construction timeframes or result in permanent or long-term impacts on the same or similar habitat types. Each of the other projects would require federal and/or state permits, and each of the projects would be required to follow CWA permitting requirements if surface waters or wetlands are affected. These authorizations would be contingent on each projects’ use of best management practices to minimize effects on water quality and aquatic resources, ensuring that long-term cumulative impacts on these resources are minimized. Because the cumulative effects of other projects are reduced by adherence to the CWA permitting process and because the impacts on aquatic resources from construction and operation of the Train 4 Project are temporary, localized, and insignificant, we conclude that the Project when considered with the other projects in the HUC-10 watershed would not contribute to significant cumulative impacts on aquatic resources.

13.4.5. Threatened, Endangered, and Other Special Status Species

The geographic scope established for cumulative impacts on threatened, endangered, and other special status species is the same as that for water resources. See section B.13.4.2 for a list of the projects considered.

Each of the projects listed above has federal permit requirements, and each of the other projects has or would be required to comply with section 7 of the ESA. As part of the section 7 consultation process, the FWS and NMFS would review each project’s potential impacts on federally listed species. Because the Train 4 Project would not have significant impact on threatened, endangered, and other special status species and because the other projects would also be required to comply with section 7 of the ESA, we conclude that the Project when considered with the other projects in the HUC-10 watershed would not contribute to significant cumulative impacts on threatened, endangered, and other special status species.

13.4.6. Land Use and Visual Resources

The geographic scope for land use and visual resources includes the Project right-of-way, as well as a 0.5-mile-radius around the Project facilities. The other projects encompassed by this geographic scope with the potential to affect land use, recreation, and visual resources include the following:

- Freeport LNG Liquefaction's Liquefaction and Phase II Modification Projects;
- CenterPoint's Electric Transmission Line to the Terminal;
- Port Freeport and COE's FHC Improvement Project;
- Gulf South Pipeline Company's Coastal Bend Header Project;
- Kinder Morgan's Lateral Development Project;
- Various Residential Developments.

Land Use

Impacts on land use associated with the Train 4 Project would be insignificant, as they would be unchanged from the existing land use classification. For the Pipeline Corridor, once construction and restoration are complete, current land use would continue over the easement and land use classifications within the permanent easement would not change because of the Project.

The acreage of industrial development in southern Brazoria County is summarized in table F-1. Based on the insignificant impacts on land use from the Train 4 Project, we conclude that the impacts on land use from the Project and the other projects considered would not result in significant cumulative impacts on land use within its geographic scope.

Visual Resources

The visually prominent features of the proposed Project facilities would be consistent with the general character of the existing landscape and as such, visual impacts during construction and operation of the Train 4 Project would be minimal. Visual Simulation Studies found that the visual impacts at the Pretreatment Facility would be negligible because of the limited number of persons in the area, the fact that the facilities are only partially visible above the levee, and that the facilities would be entirely within the fence line of the authorized facility. Lighting impacts would be mitigated through the implementation of the Facility Lighting Design Plan. Based on this, additional lighting impacts would be expected to be insignificant.

Depending on the timing of construction, it is possible that activities associated with construction of more than one project could be visible from a single vantage point; however, it is likely that any cumulative visual impacts would be limited in duration. In addition, the construction activities and facilities would be consistent with the ongoing construction and existing industrial infrastructure in the Project vicinity. The other projects within a 0.5-mile radius of the Project facilities are primarily pipeline projects with minimal visual effect on the emergent vegetation in the area, and we conclude that these projects, considered together, would not result in significant cumulative visual impacts within its geographic scope.

13.4.7. Socioeconomics

The geographic scope established for socioeconomics for the Train 4 Project includes Brazoria County, Texas. The projects listed in table F-3 are included in the cumulative impact analysis for socioeconomics. However, a number of the projects listed may have entered operation by the time construction of the Train 4 Project begins. For the purposes of this analysis, the review of cumulative impacts focused on projects that are anticipated to be under construction concurrently with the Train 4 Project and/or operating concurrently with the Train 4 Project.

The Train 4 Project construction is planned to occur within and sequential to the proposed construction of the Phase II Modification and Liquefaction Projects. As discussed in section B.8.0, it is assumed that many of the same workers working on the Phase II Modification and Liquefaction Projects would extend their contracts to work on the Train 4 Project. As such, impacts would be seen as a continuation of the impacts from the Liquefaction and Phase II Modification Projects, rather than a separate impact. Any additional impacts would be temporary, insignificant, and offset by employment and economic benefits.

The construction and operation workforces required for major industrial projects in southern Brazoria County could result in increased demand for housing and public services such as schools, health care facilities, social services, utilities, and emergency services. The cumulative impact of Freeport LNG's Train 4 Project and the others listed in table F-3 on public services during construction would depend on the number of projects underway at any one time, but the Train 4 Project's contribution to the impact would be small because many of the workers for the Train 4 Project would be continuing workers from the Liquefaction Project.

In Freeport, where most of the new projects are concentrated, local schools could see student enrollment numbers increase significantly, depending on how many temporary workers are accompanied by their families. However, public schools near the Project area have yet to see increased enrollment, despite the development currently under way in the Freeport area. The Brazosport ISD has 20 schools (10 elementary, three middle, three intermediate, three high, and one alternative) and 12,342 students for the 2015–2016 school year, which is down slightly from 12,542 students in the 2013-3013 academic year (Brazosport ISD 2017; Texas Education Agency, 2016).

Brazoria County has a well-developed infrastructure to provide health, police, fire, emergency, and social services. In addition, the new industrial projects are at or adjacent to existing facilities with well-established emergency response plans, whereby site-security and day-to-day events would be handled by site personnel. The Brazosport Industrial CAER program serves to provide information to the local community if an emergency should occur at one of the area's industrial plants (Brazosport Industrial CAER, 2016). Brazosport Industrial 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 Brazosport Industrial CAER program greatly reduces the probability of a major chemical emergency because both the community and industry are prepared.

The Train 4 Project along with the other projects would contribute to the local, regional, and state economy in terms of direct payroll expenditures, purchase of supplies and materials, indirect employment in the service sector, and taxes. With the increase in local taxes and government revenue associated with the Train 4 Project as well as the other projects, the overall cumulative impact on public services during construction and operation of the Project is anticipated to be generally positive.

Construction of the Train 4 Project would overlap with construction of the Liquefaction and Phase II Modification Projects and extend construction activities at the Terminal. Therefore, increased traffic levels would also be extended because of construction of the Train 4 Project. However, because the workforce and related construction worker traffic associated with the Train 4 Project is expected to be less than that associated with the Liquefaction and Phase II Modification Projects, an increase over current traffic levels is not anticipated.

Where other projects or project phases are constructed at the same time, the potential for additional consequent traffic congestion exists, particularly where the projects share routes for workers and/or site deliveries. Due to staggered project schedules and the distance between the various projects listed in table F-3 that are located outside of the Freeport area, cumulative impacts on traffic are anticipated to be localized and minor. The major improvements to State Highway 288 in Lake Jackson and Clute have improved traffic flows and access to the other project sites further north in Freeport, allowing quicker and safer access for traffic destined for the Train 4 Project area. Although the projects listed in table F-3 that are in the Freeport area would also have staggered project schedules, the cumulative impact on traffic from these projects is anticipated to be moderate due to their proximity to the Project area, but temporary, lasting only for the duration of construction.

13.4.8. Air Quality and Noise

Air Quality

The geographic scope for construction air emissions was considered to be the right-of-way and 0.25-mile radius around Project facilities for construction and a 50-km radius around Project facilities for operations. The geographic scope for operational air emissions was considered to be the Project footprint, as well as a 50-kilometer-radius around the Project facilities. All projects listed in table F-4, except one (Mitsubishi Heavy Industries Manufacturing Site) are included in the cumulative impact analysis for Air Quality.

During construction, a temporary reduction in ambient air quality would result from emissions and fugitive dust generated by construction equipment. 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 the construction sites. Freeport LNG performed air dispersion modeling using the AERMOD for the existing sources and the proposed Project sources as described in section B.11. The Project emissions during operations constitute small fractions (less than 1 percent) of the emissions in the region, which indicates that the Project's emissions would have negligible impacts on regional air quality.

Temporary cumulative impacts on local air quality would result from overlapping construction schedules and geographies for other projects with the Train 4 Project. Temporary cumulative impacts on local air quality would be due to emissions from the combustion engines used to power construction equipment, vehicle emissions traveling to and from the site, deliveries of construction materials, and from fugitive dust emissions resulting from earth-disturbing activities and equipment movement on dirt roads. The potential for cumulative construction emissions impacts would be greatest during site preparation of the various construction projects when fugitive dust production would be at its peak. Emissions from equipment engines and vehicles operating concurrently for the different projects would also result in cumulative air quality impacts in the local area. The only projects that would overlap with the Train 4 Project geographic scope for cumulative construction emissions are associated with the Liquefaction and Phase II Modification Projects, and the CenterPoint Energy's Electric Transmission Line. CenterPoint Energy's 300-foot-long electric transmission line would be sited from an existing transmission tower to a substation within the Terminal and would not require significant facilities to be constructed; therefore, construction of the electric transmission line would not generate a significant amount of air emissions. Mitigation measures would be employed to minimize air emissions during Project construction for the Train 4 Project as well as the Liquefaction and Phase II Modification Projects. Therefore, we conclude that the Train 4 Project when considered with the other projects would not result in significant cumulative impacts on air quality.

Climate Change

Climate change is the change in climate over time, and cannot be represented by single annual events or individual weather anomalies. While a single large flood event; a particularly cold summer; or warm winter are not necessarily strong indications of climate change; a series of floods or warm years that statistically change the average precipitation or temperature over years or decades may indicate climate change. However, recent research has begun to attribute certain extreme weather events to climate change.[40]

Climate Change has already resulted in a wide range of impacts across every region of the United States and those impacts extend beyond atmospheric climate change alone and include changes to water resources, agriculture, ecosystems, and human health. As climate change is currently happening, the United States and the world are warming; global sea level is rising and acidifying; and certain extreme weather events are becoming more frequent and more severe. These changes are driven by accumulation of GHG in the atmosphere primarily through combustion of fossil fuels (coal, petroleum, and natural gas), combined with agricultural emissions and clearing of forests. These impacts have accelerated throughout the end of the 20th, and into the 21st century.

[40] U.S. Global Change Research Program, 2017: Climate Science Special Report: Fourth National Climate Assessment, Volume I, Chapter 3 Detection and Attribution of Climate Change [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 470 pp., doi: 10.7930/J0J964J6.

Although climate change is a global phenomenon, this GHG emissions/climate change cumulative impact analysis focuses on the impacts of climate change in the Southeast region of the United States. The following observations and predictions of environmental impacts with a high or very high level of confidence are attributed to climate change in the Gulf Cost and Southeast regions:[41,42,43]

- Average temperatures have risen about 2° F since 1970 and are projected to increase another 4.5 to 9°F during this century. Higher average temperatures are occurring in the summer months. There have been increasing number of days above 95°F and decreasing number of extremely cold days since the 1970s;

- Increases in illness and death due to greater summer heat stress;

- Higher temperatures will likely increase heat stress, respiratory illnesses, and heat-related deaths in the Southeast. High temperatures also correlate with poor air quality and pose a risk to people with respiratory problems. While the number of cold-related deaths is projected to decrease, net climate-related mortality will likely increase.

- 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;

[41] 2013 Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

[42] Global and Regional Sea Level Rise Scenarios for the United States, NOAA January 2017

[43] USGCRP, 2017: Climate Science Special Report: Fourth National Climate Assessment, Volume I

- 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;

- 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

- Increasing risk from sea-level rise and storm surge. Many coastal areas in Texas and Louisiana are subsiding; local land elevation is sinking relative to sea level. Combined with global sea level rise, local subsidence will lead to a higher "relative" change in sea level at the local scale. Observed subsidence rates in the southeast are significant. The highest rise in relative sea level in the United States is found in Louisiana (0.3 to 0.4 inch per year) and Texas (0.2 to 0.3 inch per year).

- Projected changes in surface water runoff to the coast and groundwater recharge will likely allow saltwater to intrude and mix with shallow aquifers in some coastal areas of the Southeast, particularly in Florida and Louisiana.

- Increased flooding and hurricanes could present extreme public-health and emergency-management challenges.

- The spread of some types of bacteria has been linked to warmer temperatures. For example, food poisoning from eating shellfish infected with Vibrio spp. bacteria is reported both a month earlier and a month later than historically observed, increasing the infection report period by two months. As temperatures increase, the frequency of these types of shellfish-borne disease outbreaks in coastal waters is likely to increase.

- The rate and magnitude of expected changes will exceed those experienced in the last century. Existing adaptation and planning efforts are inadequate to respond to these projected impacts.

Currently, the state of Texas has no GHG-reduction goals or any statewide plans to mitigate the impact of climate change on the environment, citizens or infrastructure.

The GHG emissions associated with construction and operation of the Train 4 Project are identified in section B.4.11. Freeport LNG would implement BACT (or the more stringent LAER) controls for emission sources for Project air emission sources. There are no generally accepted significance criteria for GHG emissions. In addition, we cannot determine the Train 4 Project's incremental physical impacts on the environment caused by GHG emissions. Therefore we cannot determine whether the Projects contribution to climate change would be significant.

Noise

The geographic scope for noise was conservatively estimated to be the area within a 1-mile radius around aboveground facilities and HDDs. The other projects encompassed by this geographic scope with the potential to affect noise levels include the following:

- Freeport LNG Liquefaction's Liquefaction and Phase II Modification Projects;
- CenterPoint's Electric Transmission Line to the Terminal;
- MEGlobal EQUATE Petrochemicals Co.;
- Port Freeport and COE's FHC Improvement Project;
- Kinder Morgan Lateral Development Project;
- Various Residential Developments.

Construction activity and associated noise levels associated with the Project or with other projects within the geographic scope for cumulative impacts would vary depending on the construction activities occurring. The highest level of construction noise typically occurs during earth-moving work. The sound level impacts on NSAs along the pipeline right-of-way due to construction activities would depend on the type of equipment used, the duration of use for each piece of equipment, the number of construction vehicles and machines used simultaneously, and the distance between the sound source and receptor. For the Terminal and the Pretreatment Facility, calculated construction noise levels (L_{dn}) would be at or below 55 dBA at nearby NSAs, and increases over ambient conditions would be less than 10 dBA. During pipeline construction, mitigation would be employed at the Oyster Creek HDD to reduce HDD noise to 55dBA L_{dn} or less. The noise impacts associated with the construction of the pipeline would be intermittent and temporary.

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.

The only projects in close enough proximity to potentially add to or compound noise levels are the Liquefaction and Phase II Modification Projects, the CenterPoint Energy's Electric Transmission Line, and the Kinder Morgan Lateral Development Project. Construction of the Train 4 Project would overlap with construction of the Liquefaction and Phase II Modification Projects and extend construction activities at the Terminal. There could be cumulative noise impacts if construction for the Kinder Morgan Lateral Development Project or the CenterPoint Energy Electric Transmission Line overlaps with Pipeline construction. However, due to the relatively brief nature of pipeline and transmission line construction and the typically staggered schedule, it is unlikely these projects would overlap. 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.

Operation of the Train 4 Project would generate noise throughout the life of the Project; however, attributable sounds from the Terminal under full load would be under the 55 dBA L_{dn} criterion. Buried pipelines are not anticipated to generate operational noise.

13.5. Conclusion

Construction of the Project, in addition to other projects within the same watershed, would have cumulative impacts on a range of environmental resources, as discussed above. We provided information about project-related impacts and mitigation measures for specific environmental resources where available. Given the project BMPs and design features, mitigation measures that would be implemented, federal and state laws and regulations protecting resources, and permitting requirements, we conclude that when added to other past, present, and reasonably foreseeable future actions, the Train 4 Project would not have significant adverse cumulative impacts on environmental resources within the geographic scope affected by the projects.

C. ALTERNATIVES

In accordance with NEPA and FERC policy and EPA recommendations, we evaluated a range of alternatives to determine whether an alternative would be preferable to the proposed action. The range of alternatives evaluated include the No-Action Alternative, system alternatives, and route alternatives. Our criteria for determining if an alternative is "preferable" are discussed in the following section.

1. Evaluation Process

The purpose of this evaluation is to determine whether an alternative would be preferable to the proposed action. We generally consider an alternative to be preferable to a proposed action using three evaluation criteria, as discussed in greater detail below. These criteria include:

- the alternative meets the stated purpose of the project;
- is technically and economically feasible and practical; and
- offers a significant environmental advantage over a proposed action.

The alternatives were reviewed against the evaluation criteria in the sequence presented above. The first consideration for including an alternative in our analysis is whether or not it could satisfy the stated purpose of the project. An alternative that cannot achieve the purpose for the project cannot be considered as an acceptable replacement for the project.

For further consideration, an alternative has to be technically and economically feasible. Technically practical alternatives, with exceptions, would generally require the use of common construction methods. An alternative that would require the use of a new, unique, or experimental construction method may not be technically practical because the required technology is not available or is unproven. Economically practical alternatives would result in an action that generally maintains the price competitive nature of the proposed action. Generally, we do not consider the cost of an alternative as a critical factor unless the added cost to design, permit, and construct the alternative would render the project economically impractical.

Determining if an alternative provides a significant environmental advantage requires a comparison of the impacts on each resource as well as an analysis of impacts on resources that are not common to the alternatives being considered. The determination must then balance the overall impacts and all other relevant considerations. In comparing the impact between resources (factors), we also considered the degree of impact anticipated on each resource. Ultimately, an alternative that results in equal or minor advantages in terms of environmental impact would not compel us to shift the impacts from the current set of landowners to a new set of landowners.

We considered a range of alternatives in light of the Project's objectives, feasibility, and environmental consequences. Through environmental comparison and application of our professional judgment, each alternative is considered to a point where it becomes clear whether the alternative could or could not meet the three evaluation criteria. To ensure a consistent environmental comparison and to normalize the comparison factors, we generally used desktop sources of information (e.g., publicly available data, aerial imagery) and assumed the same right-of-way widths and general workspace requirements. We evaluated data collected in the field if surveys were completed for both the proposed site or route and its corresponding alternative site or route. Where appropriate, we also used site-specific information (e.g., detailed designs). Our environmental analysis and this evaluation considers quantitative data (e.g., counts, acreage, or mileage) and uses common comparative factors such as total length, amount of collocation, and land requirements.

Our evaluation also considers impacts on both the natural and human environments. The natural environment includes water resources and wetlands, vegetation, wildlife and fisheries habitat, farmland soils, and geology. The human environment includes nearby landowners, residences, land uses and recreation, utilities, and industrial and commercial development near construction workspaces. In recognition of the competing interests and the different nature of impacts resulting from an alternative that sometimes exists (i.e., impacts on the natural environment versus impacts on the human environment), we also consider other factors that are relevant to a particular alternative or discount or eliminate factors that are not relevant or may have less weight or significance. In our alternatives analyses, we often have to weigh impacts on one kind of resource (i.e., habitat for a species) against another resource (i.e., residential construction).

It is intended that each of the cooperating agencies, as discussed in section A.4, will review this alternatives analysis for consistency with their own administrative procedures, and those agencies with NEPA obligations may choose to adopt this analysis as part of their decision-making process.

2. No-Action Alternative

Under the no-action alternative Freeport LNG would not construct the Project. If the Project is not constructed, then neither the adverse environmental nor beneficial potential economic impacts described in this EA would occur. Implementing the no-action alternative would not allow Freeport LNG to meet the purpose and need as described in section A.2.

It is reasonable to expect that if the Project is not constructed (the no-action alternative), export of LNG from one or more new or expanded LNG export facilities located near a natural gas production and distribution hub could eventually be constructed in response to the established demand. Thus, although the environmental impacts associated with constructing and operating the Project would not occur under the no-action alternative, equal or greater impacts could occur at other location(s) in the region as a result of another LNG export project seeking to meet the demand identified by Freeport.

We conclude that the no-action alternative does not meet the Project objective and an alternative project to meet the market demand would not likely provide a significant environmental advantage over the proposed action. Therefore, we do not consider it further.

3. 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 facilities, 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 Gulf Coast, there is currently one operating LNG export terminal (Sabine Pass LNG in Cameron Parish, Louisiana) and five approved LNG export terminals in addition to Freeport LNG (Cameron LNG in Cameron Parish, Louisiana; Corpus Christi LNG in Corpus Christi, Texas; Lake Charles LNG in Calcasieu Parish, Louisiana; Magnolia LNG in Calcasieu Parish, Louisiana; and Golden Pass LNG in Sabine Pass, Texas). Additional LNG export terminals are at various stages of regulatory review. Each of these existing, approved, or proposed projects would need to add facilities similar to those proposed for the Train 4 Project and may need to expand docking facilities. New LNG terminals or expansion of existing LNG terminals would either have similar environmental impacts (if expansion were possible within previously disturbed areas) or significantly larger impacts (if a greenfield site was required). Additional air emissions would occur regardless of which project the facilities were expanded. Because the Train 4 Project does not have significant environmental impacts, none of these system alternatives could offer a significant environmental advantage over the proposed action. Therefore, we do not find any of the system alternatives to be preferable to the proposed action.

4. Site Alternatives

Site Alternatives include different locations for Freeport LNG's facilities that could reduce environmental impacts and still allow the Project to meet its objectives. We evaluated site alternatives for the components of the Project's liquefaction train, pretreatment unit, and Pipeline.

4.1. Quintana Island Terminal

The site for the Train 4 Project facilities at the Terminal was selected on the basis of compatibility with the existing and authorized Terminal layout, ease of functional integration, compliance with the siting and design requirements in Title 49 CFR Part 193 and NFPA-59A, and availability of open space. The Train 4 Project facilities within the Terminal would be located entirely within previously disturbed areas.

Because of the clear advantages of using existing infrastructure and constructing within previously disturbed areas, we focused our analysis of site alternatives for Train 4 at the Terminal. For these reasons, we were not able to identify an alternative to the proposed action that was both feasible and would offer a significant environmental advantage. Further, no stakeholder requested that we consider an alternative.

4.2. Pretreatment Facility

Within the Pretreatment Facility, the site for Unit 4 was selected on the basis of compatibility with the authorized Pretreatment Facility layout, avoidance of sensitive resources, ease of functional integration, and availability of sufficient open space to accommodate Unit 4 and peripheral aboveground infrastructure. Ground alternatives for placement of Project pretreatment facilities were essentially dictated by technological and safety considerations, including compliance with regulatory siting and design requirements. For these reasons, we were not able to identify an alternative to the proposed action that was both feasible and would offer a significant environmental advantage. Further, no stakeholder requested that we consider an alternative.

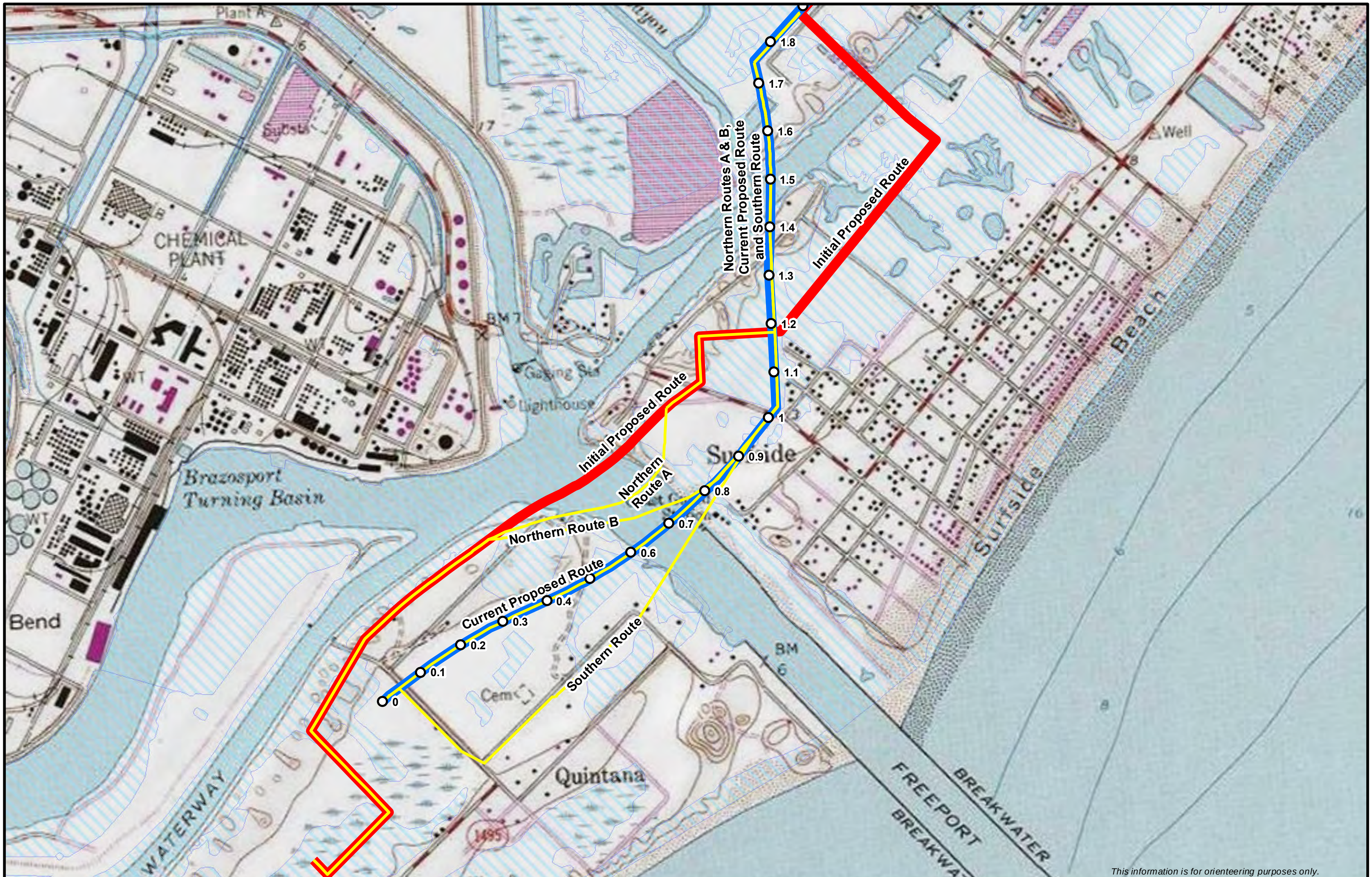
4.3. Pipeline Corridor

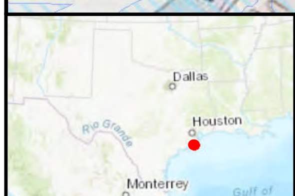
We evaluated route alternatives as compared to Freeport's filed proposed route to determine whether their implementation would be preferable to the proposed corresponding action. The siting of the proposed Pipeline Corridor was primarily influenced by the location of the Terminal, the Pretreatment Facility, and the Stratton Ridge Meter Station. The route is largely collocated with the existing 42-inch-diameter natural gas pipeline and the authorized Liquefaction Project pipeline/utility corridor.

Freeport LNG's initial proposed route was distributed for public comment during the scoping process. Comments were received requesting route alternatives that would avoid the USCG facility and several existing or planned residential properties in Surfside Beach (see Public Comments, section A.5.2). To address these comments, four alternate routes were considered for the southern segment of the route between the Terminal and MP 1.9 of the current proposed route: Original Route, Northern Route A, Northern Route B, Southern Route, and the Proposed Route (figures C 4-1 and C 4-2).

Figure C 4-1
Alternative Pipeline Routes - Aerial
Freeport LNG
Brazoria County, Texas

1:18,000 | REVISED: 10/11/2017 | DRAWN BY: 0239





- Milepost
- Current Proposed Route
- Considered Route Variation
- Initial Proposed Route
- NWI Wetland

0 750 1,500 Feet

N

Figure C 4-2
Alternative Pipeline Routes - Topographic
Freeport LNG
Brazoria County, Texas

1:18,000 | REVISED: 10/11/2017 | DRAWN BY: 0239

Our review of these routes finds that the differences in impacts between the alternatives is minor. However, the proposed route avoids the USCG facility and the residential properties, is the shortest of the five route options, has the smallest footprint for both construction and operation, and (like the Southern Route) has the lowest impacts on wetlands (table 42). Therefore, none of the alternative routes offered a significant environmental advantage, and thus are not recommended.

TABLE 42

Environmental Factors Considered for Route Variations for the "Southern Segment"
(i.e., between the Terminal and MP 1.9 of the current proposed route)

Environmental Factor a/	Unit	Original Route	Northern Route A	Northern Route B	Southern Route	Proposed Route
Length of Southern Segment	Miles	2.7	2.6	2.6	2.1	1.9
Installation Method						
HDD	Miles	1.5	1.3	1.4	0.4	0.4
Direct Pipe	Miles	0.0	0.0	0.0	0.7	1.0
Open Cut	Miles	1.2	1.3	1.2	1.0	0.5
Rights-of-way						
Within Terminal	Miles	1.0	1.0	1.0	0.3	0.2
Adjacent to existing rights-of-way	Miles	0.9	0.5	0.9	1.7	0.9
Right-of-way Requirement b/						
Construction	Acres	23.6	23.5	22.5	18.6	14.9
Operation	Acres	16.5	15.6	15.5	12.8	11.5
Residences						
Within 50 feet of workspace	Number	2	0	0	0	0
Between 50 and 100 feet of workspace	Number	1	1	2	2	1
Planned Residences within 50 feet of workspace	Number	4	3	0	0	0
Wetlands c/						
EEM/ESS	Acres	7.7	7.9	7.4	5.1	5.5
PEM	Acres	2.6	2.6	2.7	0.1	0.1
Total Wetlands	Acres	10.3	10.5	10.1	5.2	5.6
Cultural Resources within 500 feet						
Cemetery	Number	0	0	0	1	0
Land Use						
Open Land	Acres	8.9	7.6	6.7	9.6	7.1
Residential	Acres	0.6	0.6	0.0	0.3	0.0
Commercial/Industrial	Acres	11.0	11.5	11.6	5.9	2.5
Water	Acres	3.2	7.6	4.2	2.8	5.3

a. The following resources were not considered in this analysis:
   i. Waterbodies, because all five alternative routes crossed the same two major waterbodies (FHC, ICW) using trenchless methods (HDD or Direct Pipe), and no in-water impacts were anticipated;
   ii. Protected-species habitat and critical habitat (i.e., major waterbodies), because no impacts were anticipated; and
   iii. Recreational areas, because all were in similar proximity to nearby recreational areas.

b. Acreages reflect a nominal 100-foot construction workspace, including a 50-foot permanent easement, in areas crossed using an open-cut method. In areas crossed using the HDD or Direct Pipe method, a 50-foot easement is reserved, although impacts are not anticipated in those areas.

c. Wetland acreages for all routes are based on National Wetlands Inventory Data. Acreages were calculated based on a standard 100-foot-wide construction workspace in areas where the Underground Facilities would be installed using the open-cut crossing method. Areas between entry/exit points for HDD and Direct Pipe installations assumed that wetlands would be avoided.

5. Alternatives Considered

Based on the results of the alternatives analysis discussed in the preceding sections, we find that the Train 4 Project, as currently proposed and modified by our recommended mitigation measures, is the preferred alternative that can meet the Project's objectives.

D. CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis contained in this EA, we have determined that if Freeport LNG constructs and operates the proposed facilities in accordance with its application and supplements and our recommended mitigation measures, approval of this proposal would not constitute a major federal action significantly affecting the quality of the human environment. We recommend that the Order contain a finding of no significant impact and include the following mitigation measures listed below as conditions to any authorization the Commission may issue.

1. Freeport LNG shall follow the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests) and as identified in the EA, unless modified by the Order. Freeport LNG must:

    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary;
    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. For the Terminal and Pretreatment facilities, the Director of OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of life, health, property, and the environment during construction and operation of the Project. This authority shall allow:

    a. the modification of conditions of the Order;
    b. stop-work authority and authority to cease operation; and
    c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from Project construction and operation.

3. For the Pipeline facilities, the Director of OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of environmental resources during construction and operation of the Project. This authority shall allow:
    a. the modification of conditions of the Order;
    b. stop-work authority; and
    c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from Project construction and operation

4. **Prior to any construction**, Freeport LNG shall file an affirmative statement with the Secretary, 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.

5. The authorized facility locations shall be as shown in the EA, as supplemented by filed alignment sheets. **As soon as they are available, and before the start of construction**, Freeport LNG shall file with the Secretary any revised detailed survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all 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.

6. Freeport LNG shall file with the Secretary 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 with the Secretary. 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 Commission's *Upland Erosion Control, Revegetation, and Maintenance Plan* 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.

7. **Within 60 days of the acceptance of the authorization and before construction** begins, Freeport LNG shall file an Implementation Plan with the Secretary for review and written approval by the Director of OEP. 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 application and supplements (including responses to staff data requests), identified in the EA, 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, 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 material;
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 Project progresses 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.

8. Freeport LNG shall employ at least one EI for the Project. The EI(s) 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.

9. Beginning with the filing of its Implementation Plan, Freeport LNG shall file updated status reports with the Secretary on a **biweekly** basis for the Pipeline facilities and a

monthly basis for the Terminal and Pretreatment facilities until all construction and restoration activities are complete. Problems of a significant magnitude shall be reported to the FERC **within 24 hours.** 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. project schedule, including current construction status of the Project and work planned for the following reporting period;
c. a listing of all problems encountered, contractor nonconformance/deficiency logs, and each instance of noncompliance observed by the 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 and remedial actions implemented in response to all instances of noncompliance, nonconformance, or deficiency;
e. the effectiveness of all corrective and remedial 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.

10. Freeport LNG must receive written authorization from the Director of OEP **before commencing construction of any Project facilities.** To obtain such authorization, Freeport LNG must file with the Secretary documentation that it 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 Project facilities**. 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 Pipeline facilities into service**. Such authorization will only be granted following a determination that rehabilitation and restoration of the right-of-way and other areas affected by the Project are proceeding satisfactorily.

13. Freeport LNG must receive written authorization from the Director of OEP **before placing the Terminal and Pretreatment facilities into service**. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with FERC approval, can be expected to operate safely as designed, and the rehabilitation and restoration of the areas affected by the Terminal and Pretreatment facilities are proceeding satisfactorily.

14. **Within 30 days of placing the authorized facilities in service**, Freeport LNG shall file an affirmative statement with the Secretary, certified by a senior company official:

    a. 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 conditions in the Order Freeport LNG has complied with or will comply with. This statement shall also identify any areas affected by the Project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

15. **Before construction,** Freeport LNG shall file with the Secretary the location by milepost of all private wells within 150 feet of pipeline construction activities. Freeport LNG shall conduct, with the well owner's permission, pre- and post-construction monitoring of well yield and water quality for these wells. **Within 30 days of placing the facilities in service**, Freeport LNG shall file a report with the Secretary discussing whether any complaints were received concerning well yield or water quality and how each was resolved. *(section B.3.1.2)*

16. **Prior to construction of the Pipeline facilities**, Freeport LNG shall file with the Secretary, for review and written approval by the Director of OEP, site-specific justification for each location where topographic conditions or soil limitations require that the construction right-of-way width within the boundaries of a federally delineated wetland be expanded beyond 75 feet. *(section B.3.3.2)*

17. **Prior to construction of the Pipeline facilities,** Freeport LNG shall file with the Secretary written documentation of consultation with the TPWD expressly permitting the requested construction time windows for waterbody crossings on a site-specific basis or confirmation that it will adhere to the warmwater fishery crossing time windows in the FERC Procedures. *(section B.5.1.2)*

18. Freeport LNG shall **not begin** Project construction activities **until:**

    a. FERC staff receives comments from the FWS and NMFS regarding the proposed action;
    b. FERC staff completes any necessary Section 7 ESA consultation with the FWS and NMFS; and
    c. Freeport LNG has received written notification from the Director of OEP that construction or use of mitigation may begin. *(section B.6.4)*

19. **Prior to construction of the Project**, Freeport LNG shall file with the Secretary a copy of concurrence from the Coastal Coordination Council that the Project is consistent with the Texas Coastal Management Program. *(section B.7.6)*

20. **Prior to construction of the Project,** Freeport LNG shall provide an updated Transportation Management Plan for the Train 4 Project, for review and written approval by the Director of OEP. The plan shall include provisions for accommodating and mitigating impacts related to evening delivery of 120-foot-long piping segments, and the locations of offsite parking areas for busing of workers to the construction sites. *(section B.8.5.2)*

21. **Prior to construction of the Oyster Creek crossing,** Freeport LNG shall file with the Secretary, for review and written approval by the Director of OEP, an HDD noise mitigation plan for the Oyster Creek crossing to reduce the projected noise level attributable to the proposed drilling operations at the nearby NSA. During drilling operations, Freeport LNG shall implement the approved plan, monitor noise levels, and make all reasonable efforts to restrict the noise attributable to the drilling operations to no more than a L_{dn} of 55 dBA at the NSA. *(section B.12.3.2)*

22. Freeport LNG shall file noise surveys with the Secretary **no later than 60 days** after placing the entire Train 4 facilities at the Quintana Island Terminal into service and **no later than 60 days** after placing the entire Unit 4 facilities at the Pretreatment Facility into service. If full-load condition noise surveys are not possible, Freeport LNG shall provide an interim survey at the maximum possible load **within 60 days** of placing that Project facility into service and provide the full-load surveys **within 6 months.** If the noise attributable to operation of the equipment at the Terminal or the Pretreatment Facility exceeds an Ldn of 55 dBA at the nearest NSA under interim or full load conditions, Freeport LNG shall file a report on what changes are needed and shall install the additional noise controls to meet the level **within 1 year** of the in-service date. Freeport LNG shall confirm compliance with the above requirement by filing an additional noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. *(section B.12.4.2)*

23. **Prior to construction of final design**, Freeport LNG shall file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Texas:

    a. site preparation drawing and specifications;
    b. LNG Terminal and Liquefaction Facility structures and foundation design drawings and calculations (including prefabricated and field-constructed structures);
    c. seismic specifications for procured equipment; and
    d. quality control procedures to be used for civil/structural design and construction.

    In addition, Freeport LNG shall file, in its Implementation Plan, the schedule for producing this information.

24. **Prior to initial site preparation,** Freeport LNG shall file with the Secretary documentation demonstrating it has received a determination of no hazard (with or without

conditions) by USDOT FAA for all permanent structures and temporary construction equipment that exceed the height requirements in 14 CFR 77.9. *(section B.10.6)*

25. **Prior to construction of final design,** Freeport LNG shall file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Texas:

    a. site preparation drawings and specifications;
    b. Pretreatment Facility and Liquefaction Facility structures and foundation design drawings and calculations (including prefabricated and field constructed structures);
    c. seismic specifications for procured equipment; and
    d. quality control procedures to be used for civil/structural design and construction.

    In addition, Freeport LNG shall file, in its Implementation Plan, the schedule for producing this information. *(section B.10.6)*

26. **Prior to commencement of service,** Freeport LNG shall file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Texas, for the perimeter levee which ensures the crest elevation relative to mean sea level will be maintained for the life of the facility considering berm settlement, subsidence, and sea level rise. *(section B.10.6)*

Conditions 27 through 92 shall apply to the Train 4 Project facilities at the Freeport Liquefaction Facility and Pretreatment Facility. For Pretreatment and Liquefaction Facilities, information pertaining to these specific conditions shall be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, shall be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information, Order No. 833, 81 Fed. Reg. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). 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 shall be filed a minimum of **30 days before approval** to proceed is requested.

27. **Prior to initial site preparation,** Freeport LNG shall file an overall project schedule, which includes the proposed stages of the commissioning plan. *(section B.10.6)*

28. **Prior to initial site preparation,** Freeport LNG shall update and file quality assurance and quality control procedures for construction activities. *(section B.10.6)*

29. **Prior to initial site preparation,** Freeport LNG shall file procedures for controlling access during construction. *(section B.10.6)*

30. **Prior to initial site preparation,** Freeport LNG shall file an updated Emergency Response Plan for the additional facilities of the Project. *(section B.10.6)*

31. **Prior to initial site preparation,** Freeport LNG shall file an updated Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. This comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. *(section B.10.6)*

32. **Prior to construction of final design,** Freeport LNG shall file change logs that list and explain any changes made from the front end engineering design provided in Freeport LNG's application 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. *(section B.10.6)*

33. **Prior to construction of final design,** Freeport LNG shall file scaled plot plans of the final design showing all major equipment, structures, buildings, and impoundment systems. *(section B.10.6)*

34. **Prior to construction of final design,** Freeport LNG shall file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion. *(section B.10.6)*

35. **Prior to construction of final design,** Freeport LNG shall file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications shall include:
    a. Building Specifications (e.g., electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);
    b. Mechanical Specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage vessels, and other specialized equipment);
    c. Electrical and Instrumentation Specifications (e.g., power system specifications, control system specifications, safety instrument system [SIS] specifications, cable specifications, other electrical and instrumentation specifications);
    d. Security and Fire Safety Specifications (e.g., security, passive protection, hazard detection, hazard control, firewater). *(section B.10.6)*

36. **Prior to construction of final design,** Freeport LNG shall clarify the use, applicability, and priority of design codes used in piping specification R30A for natural gas pipelines. *(section B.10.6)*

37. **Prior to construction of final design,** Freeport LNG shall file up-to-date process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) including vendor P&IDs.

The PFDs shall include heat and material balances. The P&IDs shall include the following information:

a. equipment tag number, name, size, duty, capacity, and design conditions;
b. equipment insulation type and thickness;
c. valve high pressure side and internal and external vent locations;
d. isolation valves necessary for startup, operation, shutdown, restart, and maintenance procedures;
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 size and set points; and
i. drawing revision number and date. *(section B.10.6)*

38. **Prior to construction of final design**, Freeport LNG shall file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect Project facilities with the previously installed systems. *(section B.10.6)*

39. **Prior to construction of final design,** Freeport LNG shall file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs. *(section B.10.6)*

40. **Prior to construction of final design,** the engineering, procurement, and construction contractor shall verify that the recommendations from the Front End Engineering Design Hazard Identification are complete and consistent with the requirements of the final design as determined by the engineering, procurement, and construction contractor. *(section B.10.6)*

41. **Prior to construction of final design**, Freeport LNG shall file a hazard and operability review prior to issuing the P&IDs for construction. A copy of the review, a list of the recommendations, and actions taken on the recommendations shall be filed. *(section B.10.6)*

42. **Prior to construction of final design**, Freeport LNG shall provide information/revisions pertaining to the response numbers 2, 7, 14, 19, 24, 25, 26, 28, 30, 31, 32, and 35 of their October 4, 2018, filing, and the response numbers 4, 5c, 6, 7b, 13a, 13c, 18, 19, 21, 25, 26, 27, 28, 30, 31, 33, 39, 46, 47a, 47b, 48, and 49 of their October 11, 2018, filling which indicated features to be included or considered in the detailed design. *(section B.10.6)*

43. **Prior to construction of final design**, Freeport LNG shall file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (e.g., temperature, pressures, flows, and compositions). *(section B.10.6)*

44. **Prior to construction of final design**, Freeport LNG shall file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system for review and approval. The cause-and-effect matrices shall include alarms and

shutdown functions, details of the voting and shutdown logic, and set points. *(section B.10.6)*

45. **Prior to construction of final design**, Freeport LNG shall file an evaluation of emergency shutdown valve closure times. The evaluation shall account for the time to detect an upset or hazardous condition, notify plant personnel, and close the emergency shutdown valve. *(section B.10.1)*

46. **Prior to construction of final design**, Freeport LNG shall file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump operations. *(section B.10.6)*

47. **Prior to construction of final design**, Freeport LNG shall demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators. *(section B.10.6)*

48. **Prior to construction of final design**, Freeport LNG shall specify that all drains from high pressure hazardous fluid systems are to be equipped with double isolation and bleed valves. *(section B.10.6)*

49. **Prior to construction of final design**, Freeport LNG shall file electrical area classification drawings. *(section B.10.6)*

50. **Prior to construction of final design**, Freeport LNG shall file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A. *(section B.10.6)*

51. **Prior to construction of final design**, Freeport LNG shall file details of 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, alarm the hazardous condition, and shut down the appropriate systems. *(section B.10.6)*

52. **Prior to construction of final design**, Freeport LNG shall include layout and design specifications of the pig trap, inlet separation and liquid disposal, inlet/send-out meter station, and pressure control. *(section B.10.6)*

53. **Prior to construction of final design**, Freeport LNG shall specify that piping and equipment that may be cooled with liquid nitrogen is to be designed for liquid nitrogen temperatures, with regard to allowable movement and stresses. *(section B.10.6)*

54. **Prior to construction of final design**, Freeport LNG shall include the sizing basis and capacity for the pressure and vacuum relief valves for major process equipment and vessels. *(section B.10.6)*

55. **Prior to construction of final design**, Freeport LNG shall include pressure relieving protection for flammable liquid piping segments (i.e., refrigerants, liquid hydrocarbon products) that can be isolated by valves. *(section B.10.6)*

56. **Prior to construction of final design**, Freeport LNG shall specify that all emergency shutdown (ESD) valves are to be equipped with open and closed position switches connected to the Distributed Control System (DCS)/SIS. *(section B.10.6)*

57. **Prior to construction of final design**, Freeport LNG shall file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons shall be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency. *(section B.10.6)*

58. **Prior to construction of final design**, Freeport LNG shall install internal road vehicle protections, such as guard rails, barriers, and bollards to protect transfer piping, pumps, and compressors, etc. to ensure that they are protected from inadvertent damage from vehicles. *(section B.10.6)*

59. **Prior to construction of final design**, Freeport LNG shall file security camera, intrusion detection, and lighting drawings. The security camera drawings shall show the location, areas covered, and features of the camera (fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify camera coverage of the entire perimeter with redundancies for cameras interior to the facility to enable rapid monitoring of the LNG plant. The intrusion detection drawings shall show or note the location of the intrusion detection to verify it covers the entire perimeter of the LNG plant. The lighting drawings shall show the location, elevation, type of light fixture, and lux levels of the lighting system. *(section B.10.6)*

60. **Prior to construction of final design**, Freeport LNG shall file an updated fire protection evaluation of the proposed liquefaction and pretreatment facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. *(section B.10.6)*

61. **Prior to construction of final design**, Freeport LNG shall file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments. The spill containment drawings shall show containment for all hazardous liquids, including all liquids handled above their flashpoint, from the largest flow from a single line for 10 minutes, including de-inventory, or the maximum liquid from the largest vessel (or total of impounded vessels) or otherwise demonstrate that providing spill containment would not significantly reduce the flammable vapor dispersion or radiant heat consequences of a spill.

Where Project piping ties into previously authorized piping, the total flow capacity in the previously authorized piping shall be considered. *(section B.10.6)*

62. **Prior to construction of final design**, Freeport LNG shall file 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. *(section B.10.6)*

63. **Prior to construction of final design**, Freeport LNG shall include a technical review of facility design that:
    a. identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and
    b. demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shut down any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency. *(section B.10.6)*

64. **Prior to construction of final design**, Freeport LNG shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, ethylene, propane, butane, and natural gas liquids. *(section B.10.6)*

65. **Prior to construction of final design**, Freeport LNG shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as aqueous ammonia, natural gas liquids, and hydrogen sulfide. *(section B.10.6)*

66. **Prior to construction of final design**, Freeport LNG shall file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan 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. *(section B.10.6)*

67. **Prior to construction of final design**, Freeport LNG shall file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings shall clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. The drawings shall also include piping and instrumentation diagrams of the firewater and foam systems. *(section B.10.6)*

68. **Prior to construction of final design**, Freeport LNG shall specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream

of the flow transmitter. The flow transmitter and pressure transmitter shall be connected to the DCS and recorded. *(section B.10.6)*

69. **Prior to construction of final design**, Freeport LNG shall specify that each Intracoastal Waterway Firewater Pump relief valve discharge piping is run independently back to the supply source. *(section B.10.6)*

70. **Prior to construction of final design**, Freeport LNG shall file detailed calculations to confirm that the final fire water volumes would be accounted for when evaluating the capacity of the impoundment system during a spill and fire scenario. *(section B.10.6)*

71. **Prior to construction of final design**, Freeport LNG shall provide the fire water required for foam generation in calculating the total fire water required for 2 hours of supply. *(section B.10.6)*

72. **Prior to construction of final design**, Freeport LNG shall specify that the firewater pump building/shelter is designed to be able to remove the largest firewater pump or other component for maintenance with an overhead or external crane. *(section B.10.6)*

73. **Prior to construction of final design**, Freeport LNG shall include or demonstrate the firewater storage volume for its pretreatment facilities has minimum reserved capacity for its most demanding firewater scenario plus 1,000 gpm for no less than 2 hours. The firewater storage shall also demonstrate compliance with NFPA 22 or demonstrate how API 650 provides an equivalent or better level of safety. *(section B.10.6)*

74. **Prior to construction of final design**, Freeport LNG shall file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases and fires with a minimum of 2-hour fire duration. *(section B.10.6)*

75. **Prior to construction of final design**, Freeport LNG shall file a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each significant component within the 4,000 BTU/ft2-hr zone from an impoundment, including from the three previously authorized impoundments that could collect spills from this project and from proposed spill collection areas for all liquids handled above their flash point. Passive mitigation shall be supported by calculations for the thickness limiting temperature rise and active mitigation shall be justified with calculations demonstrating flow rates and durations of any cooling water will mitigate the heat absorbed by the vessel. *(section B.10.6)*

76. **Prior to construction of final design**, Freeport LNG shall file an evaluation of the voting logic and voting degradation for hazard detectors. *(section B.10.6)*

77. **Prior to commissioning**, Freeport LNG shall file 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. *(section B.10.6)*

78. **Prior to commissioning**, Freeport LNG shall file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service. *(section B.10.6)*

79. **Prior to commissioning**, Freeport LNG shall file 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, and shall provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing. *(section B.10.6)*

80. **Prior to commissioning**, Freeport LNG shall file the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3. The procedures shall include a line list of pneumatic and hydrostatic test pressures. *(section B.10.6)*

81. **Prior to commissioning**, Freeport LNG shall file the updated operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms. *(section B.10.6)*

82. **Prior to commissioning**, Freeport LNG shall tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves. *(section B.10.6)*

83. **Prior to commissioning**, Freeport LNG shall maintain a detailed training log to demonstrate that operating staff has completed the required training. *(section B.10.6)*

84. **Prior to introduction of hazardous fluids**, Freeport LNG shall develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms. *(section B.10.6)*

85. **Prior to introduction of hazardous fluids**, Freeport LNG shall complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS and SIS that demonstrates full functionality and operability of the system. *(section B.10.6)*

86. **Prior to introduction of hazardous fluids**, Freeport LNG shall complete and document 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). *(section B.10.6)*

87. **Prior to introduction of hazardous fluids**, Freeport LNG shall complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review shall include any changes since the last

hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, shall be filed. *(section B.10.6)*

88. **After production of first LNG**, Freeport LNG shall file weekly reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports shall include a summary of activities, problems encountered, and remedial actions taken. The weekly reports shall also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports shall include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude shall be reported to the FERC **within 24 hours**. *(section B.10.6)*

89. **Prior to commencement of service**, Freeport LNG shall label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001). *(section B.10.6)*

90. **Prior to commencement of service**, Freeport LNG shall provide updated plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring. *(section B.10.6)*

91. **Prior to commencement of service**, Freeport LNG shall update procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Freeport LNG staff. *(section B.10.6)*

92. **Prior to commencement of service**, Freeport LNG shall notify the FERC staff of any proposed revisions to the security plan and physical security of the plant. *(section B.10.6)*

In addition, conditions 93 through 95 shall apply **throughout the life of the Pretreatment Facility and Liquefaction Facility:**

93. The facilities 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 submitted. *(section B.10.1)*

94. Semi-annual operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and

vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite 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)" shall be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities. *(section B.10.1)*

95. The plant's incident report requirements shall be updated to the following significant non-scheduled events, including safety-related incidents (e.g., LNG, heavier hydrocarbons, 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 the FERC staff. In the event that 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 the FERC staff **within 24 hours**. This notification practice shall be incorporated into the liquefaction 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 5 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 facilities 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 facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for 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 from hazardous fluids transportation 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. *(section B.10.1)*

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 liquefaction 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 shall include investigation results and recommendations to minimize a reoccurrence of the incident.

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TRC Environmental Corporation is a third-party contractor assisting the Commission staff in reviewing the environmental aspects of the project application and preparing the environmental documents required by NEPA. Third-party contractors are selected by Commission staff and funded by project applicants. Per the procedures in 40 CFR 1506.5(c), third-party contractors execute a disclosure statement specifying that they have no financial or other conflicting interest in the outcome of the project. Third-party contractors are required to self-report any changes in financial situation and to refresh their disclosure statements annually. The Commission staff solely directs the scope, content, quality, and schedule of the contractor's work. The Commission staff independently evaluates the results of the third-party contractor's work and the Commission, through its staff, bears ultimate responsibility for full compliance with the requirements of NEPA.

Federal Energy Regulatory Commission

Office of
Energy Projects

November 2018

Freeport LNG Development, L.P.
FLNG Liquefaction 4, LLC

Docket No. CP17-470-000

Freeport LNG Train 4 Project

Environmental Assessment

APPENDICES A–F

FREEPORT LNG
TRAIN 4 PROJECT

Appendix A
Wetland Impacts Within the Pipeline Corridor by Milepost

Wetland Impacts Within the Pipeline Corridor by Milepost							
Facility/Approximate Milepost							
Entry	Exit	Wetland ID [a]	Cowardin Classification [b]	Approximate Crossing Length (feet) [c]	Construction Impacts [d]	Operational Impacts [e]	Crossing Method
UNDERGROUND FACILITIES							
0.00	0.00	WE040E	PEM	N/A	0.61	0	N/A – Temporary Workspace
0.00	0.00	DWE045E	PEM	N/A	0.1	0	N/A – Temporary Workspace
0.00	0.00	DWE044E	E2EM	N/A	0.03	0	N/A – Temporary Workspace
0.91	0.96	WE042E	E2EM	210	0	0	Direct Pipe
0.91	0.92	WE042S	E2SS	36	0	0	Direct Pipe
0.92	0.93	WE042S	E2SS	28	0	0	Direct Pipe
0.96	0.97	WE042S	E2SS	N/A	0.06	0	N/A – Temporary Workspace
0.96	1.01	WE042E	E2EM	238	0.99	0	Open Cut
1.01	1.19	WE001E	E2EM	922	3.23	0	Push/Pull
1.19	1.33	DWE001E	E2EM	712	2.62	0	Push/Pull
1.33	1.35	DWE001E	E2EM	144	0	0	HDD
1.38	1.41	DWE043E	E2EM	59	0	0	HDD
1.39	1.44	DWE043E	E2EM	N/A	0.57	0	N/A – Temporary Workspace
1.57	1.57	WE005E	E2EM	N/A	0	0	HDD
1.72	1.73	WE003E	E2EM	44	0	0	HDD
1.72	1.78	WE005E	E2EM	N/A	0.16	0	N/A – Temporary Workspace
1.73	2.00	WE003E	E2EM	1399	4.3	0	Open Cut
2.00	2.02	WE003E	E2EM	126	0	0	Conventional Bore
2.03	2.08	WE004E	E2EM	275	0	0	Conventional Bore
2.09	2.12	WE004E	E2EM	165	0	0	Conventional Bore
2.12	2.40	WE004E	E2EM	1445	3.8	0	Open Cut
2.40	2.76	WE004E	E2EM	1697	0	0	HDD
2.47	2.53	WE004S	E2SS	187	0	0	HDD
2.72	2.73	WE004E	E2EM	N/A	0	0	HDD
2.75	3.26	WE004E	E2EM	2627	0	0	HDD
3.25	3.26	WE004E	E2EM	8	0	0	HDD
3.25	3.31	WE004S	E2SS	70	0	0	HDD
3.31	3.38	WE004E	E2EM	393	0	0	HDD
3.41	3.41	WL002M	E2US	8	0	0	HDD
3.41	3.41	WE034E	E2EM	15	0	0	HDD
3.42	3.55	WL002S	E2SS	281	0	0	HDD
3.42	3.57	WE008E	E2EM	233	0	0	HDD
3.57	3.61	WL002E	E2EM	N/A	0.13	0	N/A – Temporary Workspace
3.57	3.61	WL002S	E2SS	N/A	0.04	0	N/A – Temporary Workspace
3.57	3.62	WE008E	E2EM	N/A	0.03	0	N/A – Temporary Workspace
3.57	3.62	WL002S	E2SS	N/A	0.12	0	N/A – Temporary Workspace
3.57	3.63	WE008E	E2EM	61	0.12	0	Push/Pull
3.62	3.62	WL002S	E2SS	N/A	<0.01	0	Push/Pull
3.62	3.63	WE008E	E2EM	N/A	0.01	0	N/A – Temporary Workspace
3.62	3.71	WE008M	E2US	134	0.57	0	Push/Pull

Wetland Impacts Within the Pipeline Corridor by Milepost

Facility/Approximate Milepost Entry	Exit	Wetland ID [a]	Cowardin Classification [b]	Approximate Crossing Length (feet) [c]	Construction Impacts [d]	Operational Impacts [e]	Crossing Method
3.64	3.64	WL002E	E2EM	N/A	<0.01	0	N/A – Temporary Workspace
3.65	3.69	WE008S	E2SS	227	0.15	0.04	Push/Pull [f]
3.65	3.72	WL002E	E2EM	143	0.33	0	Push/Pull
3.70	3.76	WL002M	E2US	79	0.27	0	Push/Pull
3.73	3.82	WL002E	E2EM	445	0.8	0	Push/Pull
3.81	3.83	WL002M	E2US	20	0.05	0	Push/Pull
3.82	3.84	WL002E	E2EM	51	0.14	0	Push/Pull
3.84	3.85	WE008E	E2EM	20	0.03	0	Push/Pull
3.85	3.85	WE008M	E2EM	N/A	<0.01	0	N/A – Temporary Workspace
3.85	3.86	WE008E	E2EM	N/A	0.03	0	N/A – Temporary Workspace
3.84	3.86	WL001E	E2EM	N/A	0.01	0	N/A – Temporary Workspace
3.85	3.87	WE008M	E2EM	N/A	0.05	0	N/A – Temporary Workspace
3.86	3.87	WL001E	E2EM	N/A	<0.01	0	N/A – Temporary Workspace
3.85	4.04	WE008E	E2EM	481	0.35	0	Push/Pull
3.85	4.17	WE008M	E2US	1232	1.41	0	Push/Pull
3.95	4.16	WE008E	E2EM	N/A	0.5	0	N/A – Temporary Workspace
4.17	4.18	NWI002	E2EM	48	0.12	0	Push/Pull
4.39	4.40	WL001E	E2EM	N/A	5.41	0	N/A – Temporary Workspace
4.54	4.55	WL-40	PEM	31	0	0	Direct Pipe
4.56	4.57	NWI002	E2EM	106	0	0	Direct Pipe
4.72	4.80	WL-001	PEM	213	0	0	Direct Pipe
4.80	5.13	WL-001	PEM	420	0.83	0	Open Cut
5.13	5.20	WL-001	PEM	246	0	0	Direct Pipe
5.35	5.37	NWI002	E2EM	101	0	0	Direct Pipe
5.39	5.40	WL-39	E2EM	N/A	0	0	Direct Pipe
5.56	5.57	WL-38	PEM	32	0.02	0	Open Cut
5.62	5.64	WL-39	E2EM	83	0.12	0	Open Cut
5.65	5.72	WE008E	E2EM	N/A	0.3	0	N/A – Temporary Workspace
5.65	5.68	NWI002	E2EM	85	0.4	0	Open Cut
5.74	5.75	WE029E	E2EM	N/A	0.02	0	N/A – Temporary Workspace
5.95	5.99	WE030E	E2EM	N/A	0.01	0	N/A – Temporary Workspace
6.00	6.01	WE031E	E2EM	N/A	0.01	0	N/A – Temporary Workspace
6.08	6.10	WE031E	E2EM	N/A	0.05	0	Push/Pull
6.18	6.19	WE031E	E2EM	N/A	0.03	0	N/A – Temporary Workspace
6.22	6.29	WE031E	E2EM	N/A	0.15	0	N/A – Temporary Workspace
6.30	6.32	WE031E	E2EM	N/A	0.03	0	N/A – Temporary Workspace
6.37	6.41	WE036E	E2EM	N/A	0.04	0	N/A – Temporary Workspace
6.39	6.41	WE031E	E2EM	N/A	0.08	0	N/A – Temporary Workspace
6.79	6.86	WE033E	PEM	209	1.74	0	Open Cut
6.83	7.17	WE032E	PEM	1719	7.39	0	Open Cut
7.18	7.23	WE032E	PEM	280	1.08	0	Open Cut
7.23	7.24	WE032E	E2EM	20	0	0	Conventional Bore
7.23	7.23	WE032E	E2EM	N/A	<0.01	0	N/A – Temporary Workspace
7.25	7.25	WE038E	PEM	5	0	0	Conventional Bore

Wetland Impacts Within the Pipeline Corridor by Milepost

Facility/Approximate Milepost Entry	Exit	Wetland ID [a]	Cowardin Classification [b]	Approximate Crossing Length (feet) [c]	Construction Impacts [d]	Operational Impacts [e]	Crossing Method
7.25	7.29	WE038E	PEM	14	0.07	0	Open Cut
8.35	8.39	WE027E	PEM	113	0.19	0	Open Cut
8.37	8.49	WE027E	PEM	457	0.53	0	Open Cut
8.4	8.49	WE027S	PSS	N/A	0.3	0.01	Open Cut [f]
8.48	8.70	DWE026S	PSS	N/A	0.91	0.06	Open Cut [f]
8.49	8.70	DWE026E	PEM	1095	1.54	0	Open Cut
8.69	8.86	WE026E	PEM	714	1.64	0	Open Cut
8.70	8.80	WE026S	PSS	N/A	0.15	0	N/A – Temporary Workspace
8.84	8.87	WE026E	PEM	N/A	0.05	0	Open Cut
8.87	8.99	WE025E	PEM	97	0.43	0	Open Cut
8.87	8.91	WE025S	PSS	N/A	0.01	0	N/A – Temporary Workspace
9.09	9.17	WE023E	PEM	N/A	0.07	0	N/A – Temporary Workspace
9.11	9.17	WE023E	PEM	19	0.18	0	Open Cut
9.14	9.17	WE023S	PSS	N/A	0.09	0	Open Cut
9.16	9.19	WE023E	PEM	78	0.15	0	Open Cut
9.17	9.19	WE023S	PSS	N/A	0.05	0	N/A – Temporary Workspace
9.19	9.61	WE023E	PEM	636	2.42	0	Open Cut
9.2	9.29	WE023S	PSS	N/A	0.22	0	Open Cut
9.31	9.34	WE023S	PSS	N/A	0.04	0	N/A – Temporary Workspace
9.39	9.46	WE023S	PSS	N/A	0.18	0	N/A – Temporary Workspace
9.51	9.52	WE023S	PSS	N/A	<0.01	0	N/A – Temporary Workspace
9.53	9.56	WE023S	PSS	N/A	0.02	0	N/A – Temporary Workspace
9.57	9.58	WE023S	PSS	N/A	<0.01	0	N/A – Temporary Workspace
9.58	9.59	WE023S	PSS	N/A	0.02	0	N/A – Temporary Workspace
9.63	9.72	WE020E	PEM	310	0.59	0	Open Cut
9.63	9.71	WE021E	PEM	N/A	0.14	0	N/A – Temporary Workspace
9.81	9.82	WE019E	PEM	N/A	0.02	0	N/A – Temporary Workspace
9.84	9.90	WE018E	PEM	218	0.29	0	Open Cut
9.88	9.91	WE017E	PEM	N/A	0.07	0	Open Cut
9.95	9.97	WE013E	PEM	54	0.1	0	Open Cut
9.97	10.04	WE013E	PEM	79	0.32	0	Open Cut
10.02	10.07	WE015E	PEM	17	0.16	0	Open Cut
10.05	10.11	WE013E	PEM	N/A	0.08	0	N/A – Temporary Workspace
10.21	10.32	WE013E	PEM	93	0.27	0	Open Cut
10.27	10.38	WE013E	PEM	31	0.93	0	Open Cut
10.39	10.40	WE013E	PEM	21	0.1	0	Open Cut
10.43	10.57	WE013E	PEM	N/A	0.31	0	Open Cut
10.48	10.50	WE014E	PEM	42	0.12	0	Open Cut
10.52	10.53	WE013E	PEM	N/A	0.01	0	Open Cut
10.51	10.55	WE012E	PEM	127	0.23	0	Open Cut
10.52	10.54	WE013E	PEM	N/A	0.01	0	Open Cut
10.57	10.58	WE010E	PEM	19	0.05	0	Open Cut
10.59	10.60	WE009E	PEM	17	0.04	0	Open Cut
			Pipeline Subtotal [g]	**14,736**	**52.59**	**0.11**	

Wetland Impacts Within the Pipeline Corridor by Milepost							
Facility/Approximate Milepost Entry	Exit	Wetland ID [a]	Cowardin Classification [b]	Approximate Crossing Length (feet) [c]	Construction Impacts [d]	Operational Impacts [e]	Crossing Method
ACCESS ROADS							
1.33	1.35	DWE001E	E2EM	N/A	0.06	0	N/A – Temporary Access Road
1.90	1.90	WE003E	E2EM	N/A	0.03	0	N/A – Temporary Access Road
2.13	2.14	WE004E	E2EM	N/A	0.06	0	N/A – Temporary Access Road
2.29	2.30	WE004E	E2EM	N/A	0.02	0	N/A – Temporary Access Road
3.40	3.41	WL002M	E2US	N/A	0.01	0	N/A – Temporary Access Road
3.41	3.41	WE034E	E2EM	N/A	0.01	0	N/A – Temporary Access Road
3.42	3.57	WL002S	E2SS	N/A	0.31	0	N/A – Temporary Access Road
3.44	3.49	WL002E	E2EM	N/A	0.06	0	N/A – Temporary Access Road
3.55	3.57	WE008E	E2EM	N/A	0.01	0	N/A – Temporary Access Road
4.35	4.37	WL001E	E2EM	N/A	0.07	0	N/A – Temporary Access Road
4.36	4.37	WL001E	E2EM	N/A	<0.01	0	N/A – Temporary Access Road
4.36	4.38	WL001E	E2EM	N/A	0.02	0	N/A – Temporary Access Road
4.37	4.39	WL001E	E2EM	N/A	0.04	0	N/A – Temporary Access Road
6.41	6.41	WE031E	E2EM	N/A	<0.01	0	N/A – Temporary Access Road
6.41	6.47	WE031E	E2EM	N/A	0.12	0	N/A – Temporary Access Road
6.43	6.44	WE031E	E2EM	N/A	0.01	0	N/A – Temporary Access Road
6.45	6.47	WE031E	E2EM	N/A	0.02	0	N/A – Temporary Access Road
6.85	6.85	WE032E	PEM	N/A	<0.01	0	N/A – Temporary Access Road
7.37	7.37	WE038E	PEM	N/A	<0.01	0	N/A – Temporary Access Road
9.44	9.44	WE023E	PEM	N/A	0.01	0	N/A – Temporary Access Road
9.45	9.45	WE023E	PEM	N/A	<0.01	0	N/A - Temporary Access Road
9.73	9.73	WE022E	PEM	N/A	0.01	0	N/A - Temporary Access Road
			Access Road Subtotal [g]	**N/A**	**0.86**	**0**	
PIPELINE CORRIDOR TOTAL [g]				**14,736**	**53.45**	**0.11**	

Wetland Impacts Within the Pipeline Corridor by Milepost							
Facility/Approximate Milepost							
Entry	Exit	Wetland ID [a]	Cowardin Classification [b]	Approximate Crossing Length (feet) [c]	Construction Impacts [d]	Operational Impacts [e]	Crossing Method

a Project-specific Wetland IDs were assigned during the field survey efforts and are used to identify each delineated wetland. Features that begin with a "D" prefix were delineated using aerial photography and other publically available data. Features that begin with an "NWI" prefix were included strictly using NWI data.

b Wetland types according to Cowardin et al (1979): E2EM = Estuarine emergent; E2SS = Estuarine scrub-shrub; E2US = Estuarine unconsolidated shore; PEM = Palustrine emergent; PSS = Palustrine scrub-shrub. Note: For the purposes of determining impacts, E2US wetlands were considered emergent wetlands.

c N/A indicates the wetland or portion of wetland does not cross the centerline.

d Temporary wetland impacts that would not result in conversion or permanent fill.

e Following construction activities, wetlands within the permanent easement would be allowed to revegetate. Although periodic vegetation maintenance may occur within these areas in accordance with the Procedures, permanent conversion of emergent wetlands due to operation of the Project would not occur.

f In accordance with the Project-specific Procedures, a 10-foot-wide corridor centered along the pipeline would be maintained in an herbaceous state to facilitate periodic corrosion/leak surveys. Numbers presented in this table reflect the scrub-shrub wetlands that would be converted to emergent wetlands.

g The numbers in the table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends.

Appendix B

Threatened, Endangered, and Special Status Species with Potential to Occur in the Vicinity of the Project

Threatened, Endangered, and Special Status Species with Potential to Occur in the Vicinity of the Project				
Common Name ***Scientific Name***	**Federal Status**		**State Status**	**Impact and Habitat Assessment**
	FWS	**NMFS**		
		Invertebrates		
Boulder star coral *Orbicella franksi*	-	T	-	*No effect* Species inhabits reefs in shallow waters. Suitable habitat is not present in the Project area.
Elkhorn coral *Acropora palmata*	-	T	-	*No effect* Species inhabits reefs in shallow waters. Suitable habitat is not present in the Project area.
Lobed star coral *Orbicella annularis*	-	T	-	*No effect* Species inhabits reefs in shallow waters. Suitable habitat is not present in the Project area.
Mountainous star coral *Orbicella faveolata*	-	T	-	*No effect* Species inhabits reefs in shallow waters. Suitable habitat is not present in the Project area.
Smooth pimpleback *Quadrula houstenensis*	C	-		*Not likely to adversely affect* Species occurs within a total of nine locations within the Colorado and Brazos River basins. Potential presence of this species within the Project area is so low as to be discountable.
Texas fawnsfoot *Truncilla macrodon*	C	-	T	*Not likely to adversely affect* Species occurs within a total of five locations within the Colorado and Brazos River basins. Potential presence of this species within the Project area is so low as to be discountable.
		Fishes		
Sharpnose shiner *Notropis oxyrhynchus*	E **a**/	-	-	*No effect* Species is endemic to the Colorado and Brazos River drainages and prefers large, turbid rivers with a combination of sand, gravel, and clay-mud substrates. Species is not known to occur within Brazoria County.
Smalltooth sawfish *Pristis pectinata*	E **a**/	E **a**/	E	*No effect* Species found in estuaries or river mouths with muddy or sandy substrate. Species is not known to occur within Brazoria County.
		Terrestrial Reptiles		
Texas horned lizard *Phrynosoma cornutum*	-	-	T	*No effect* Found in arid and semiarid habitats in open areas with little vegetation and loose sand or loamy soils. Suitable habitat is not present in the Project area.
Timber/canebrake rattlesnake *Crotalus horridus*	-	-	T	*Not likely to adversely affect* Species found in swamps, river floodplains, hardwood and pine forests, and rural farming areas.
		Aquatic Reptiles		
Alligator snapping turtle *Macrochelys temminckii*	-	-	T	*Not likely to adversely affect* Species found in river systems, lakes, and wetlands

Threatened, Endangered, and Special Status Species with Potential to Occur in the Vicinity of the Project				
Common Name ***Scientific Name***	**Federal Status**		**State Status**	**Impact and Habitat Assessment**
	FWS	**NMFS**		
Green sea turtle *Chelonia mydas*	T **a**/	T	T	*No effect* The species inhabits coastal areas and the open ocean. Nesting occurs along sandy beaches. Suitable habitat is not present in the Project area.
Hawksbill sea turtle *Eretmochelys imbricata*	E	E	E	*No effect* The species inhabits coastal areas and the open ocean. Nesting occurs along sandy beaches. Suitable habitat is not present in the Project area.
Kemp's ridley sea turtle *Lepidochelys kempii*	E	E	E	*No effect* The species inhabits coastal areas and the open ocean. Nesting occurs along sandy beaches. Suitable habitat is not present in the Project area.
Leatherback sea turtle *Dermochelys coriacea*	E	E	E	*No effect* The species inhabits coastal areas and the open ocean. Nesting occurs along sandy beaches. Suitable habitat is not present in the Project area.
Loggerhead sea turtle *Caretta caretta*	T	T	T	*No effect* The species inhabits coastal areas and the open ocean. Nesting occurs along sandy beaches. Suitable habitat is not present in the Project area.
			Birds	
Bald eagle *Haliaeetus leucocephalus*	DL **b**/	-	T	*No effect* Nesting typically occurs in mature trees in or near cypress/tupelo swamps, fresh to intermediate marshes, or open water. Suitable habitat is not present in the Project area.
Brown pelican *Pelecanus occidentalis*	DL	-	-	*No effect* The species is largely restricted to coastal waters for foraging and nesting. No suitable nesting or foraging habitat is present in the Project area.
Eskimo curlew *Numenius borealis*	E **a**/	-	E	*No effect* Species nests in arctic tundra and winters in open grasslands, fields, and wetlands. Species is not known to occur within Brazoria County.
Peregrine falcon *Falco peregrinus*	DL	-	T **c**/	*No effect* This species breeds in open landscapes with cliffs and winters in open habitat primarily along barrier islands, mudflats, lake edges, and coastlines. Suitable habitat is not present in the Project area.
Piping plover *Charadrius melodus*	T, CH	-	T	*No effect* The species breeds in the northern United States and Canada. Wintering habitat includes sandy beaches. Suitable habitat is not present in the Project area.

Threatened, Endangered, and Special Status Species with Potential to Occur in the Vicinity of the Project				
Common Name ***Scientific Name***	**Federal Status**		**State Status**	**Impact and Habitat Assessment**
	FWS	**NMFS**		
Red knot *Calidris canutus rufa*	T	-	-	*No effect* The species breeds in Alaska and Canada. Wintering habitat includes tidal flats and beaches. Suitable habitat is not present in the Project area.
Reddish egret *Egretta rufescens*	-	-	T	*Not likely to adversely affect* Occurs within coastal tidal flats, salt marshes, shores, and lagoons. Forages within calm, shallow waters along coast, in protected bays, and estuaries.
Sooty tern *Onychoprion fuscatus*	-	-	T	*No effect* Species breed on small islands along the coast in flat, open areas with little vegetation. Suitable habitat is not present in the Project area.
White-faced ibis *Plegadis chihi*	-	-	T	*Not likely to adversely affect* Occurs within freshwater marshes, irrigated land, and tules. Foraging habitat includes very shallow water, as in marshes, flooded pastures, and irrigated fields. Occasionally occurs within damp meadows with no standing water.
White-tailed hawk *Buteo albicaudatus*	-	-	T	*Not likely to adversely affect* Occurs within open grasslands with scattered shrubs or low trees. Species primarily inhabits coastal prairie, but may also occur inland in ranch country. Generally not found where land is farmed or heavily grazed.
Whooping crane *Grus americana*	E	-	E	*Not likely to adversely affect* Species found in salt marshes, primarily within Aransas NWR in Texas.
Wood stork *Mycteria americana*	T a/ d/	-	T	*No effect* Found in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. Species is not known to occur within Brazoria County.
		Terrestrial Mammals		
Jaguarundi *Herpailurus yaguarundi*	E a/	-	E	*No effect* Species is found in dense, thorny shrublands. Species is not known to occur within Brazoria County.
Louisiana black bear *Ursus americanus luteolus*	DL	-	T	*No effect* Species found in large tracts of forested habitat. Suitable habitat is not present in the Project area.
Ocelot *Leopardus pardalis*	E a/		E	*No effect* Species is found in dense, thorny shrublands. Species is not known to occur within Brazoria County.
Red wolf *Canis rufus*	E a/	-	E	*No effect* This species has been extirpated from Texas.

Threatened, Endangered, and Special Status Species with Potential to Occur in the Vicinity of the Project				
Common Name ***Scientific Name***	**Federal Status** FWS	**Federal Status** NMFS	**State Status**	**Impact and Habitat Assessment**
		Marine Mammals		
Bryde's whale *Balaenoptera edeni*	-	P	-	*No effect* The species inhabits a small area in the northeastern Gulf near De Soto Canyon in waters along the continental shelf break. Suitable habitat is not present within the Project area.
Fin (finback) whale *Balaenoptera physalus*	-	E **e**/	-	*No effect* This species inhabits the open ocean. Suitable habitat is not present within the Project area
Humpback whale *Megaptera novaeangliae*	-	E **e**/	-	*No effect* The species inhabits the open ocean, coastal waters, and sometimes inshore areas such as bays. Suitable habitat is not present within the Project area
Sei whale *Balaenoptera boreali*	-	E **e**/	-	*No effect* This species inhabits the open ocean. Suitable habitat is not present within the Project area.
Sperm whale *Physeter microcephalus*	-	E **e**/	-	*No effect* This species inhabits the open ocean. Suitable habitat is not present within the Project area
West Indian manatee *Trichechus manatus*	E **a**/	-	E	*No effect* Species inhabits in large, slow-moving rivers, river mouths, and shallow coastal areas such as coves and bays. Suitable habitat is not present within the Project area.

C = candidate species; P = proposed species; T = threatened species;
E = endangered species; DL = delisted species; CH = critical habitat

a. Although this species is federally listed under the ESA, it does not appear on the FWS species list for Brazoria County (FWS, 2017) or the NMFS species list for Texas (NMFS, 2017). However, because it occurs on the TPWD county list, we have included it in this analysis.

b. Although the bald eagle is delisted, it is still federally protected under the Bald and Golden Eagle Protection Act (16 USC § 668-668d).

c. Threatened status applies only to American peregrine falcon, not to Arctic peregrine falcon. Due to the similarity of the two species, the TPWD applies threatened status at the species level.

d. Only the portion of the wood stork population that breeds in the U.S. is federally listed as threatened. Breeding populations of wood storks are found in Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina.

e. Also federally protected and defined as depleted by the Marine Mammal Protection Act (16 USC 31) "-" (blank)—No regulatory listing status by agency for the Project area.

Sources: 81 Federal Register 88,639; NMFS, 2017; TPWD, 2017; FWS, 2017

Appendix C
Birds of Conservation Concern Potentially Occurring Within the Project Area

Birds of Conservation Concern Potentially Occurring Within the Project Area		
Species	**Seasonal Occurrence in Project Area**	**Preferred Habitat**
American bittern *Botaurus lentiginosus*	Non-breeding	Dense reed vegetation cover and margins of shallow freshwater marshes
American oystercatcher *Haematopus palliatus*	Year round	Coastal habitats including beaches, dunes, saltmarsh, marsh islands, mudflats, and dredge spoil islands made of shells, sand, or gravel
Audubon's shearwater *Puffinus lherminieri*	Non-breeding	Open ocean over warm waters following the warm current of Gulf Stream. Very seldom comes near land in North America
Bald eagle **a**/ *Haliaeetus leucocephalus*	Non-breeding	Near lakes, reservoirs, rivers, marshes, and coasts
Band-rumped storm-petrel *Oceanodroma castro*	Non-breeding	Pacific and Atlantic oceans with tropical migration and breeding patterns
Black rail *Laterallus jamaicensis*	Non-breeding	Salt marshes, shallow freshwater marshes, wet meadows, and flooded grassy vegetation
Black skimmer *Rynchops niger*	Year round	Open sandy beaches and saltmarshes, on gravel or shell bars with sparse vegetation
Botteri's sparrow *Peucaea botterii*	Year round	Grassland and coastal prairie, with some interspersed shrubs and trees
Buff-breasted sandpiper *Calidris subruficollis*	Non-breeding	Dry grasslands (usually short grass), pastures, and plowed fields
Dickcissel *Spiza americana*	Migration	Tall grasslands, prairies, hayfields, lightly grazed pastures, and roadsides
Grasshopper sparrow *Ammodramus savannarum*	Year round	Open grasslands and prairies with patches of bare ground
Gull-billed tern *Gelochelidon nilotica*	Year round	Nests in salt marshes and sandy beaches. Winters in salt marshes, estuaries, lagoons and plowed fields
Henslow's sparrow *Ammodramus henslowii*	Non-breeding	Large, flat fields that lack woody plants. Favors tall, dense grass, a dense litter layer, and standing dead vegetation
Hudsonian godwit *Limosa haemastica*	Non-breeding	Along marshes, beaches, flooded fields and tidal mudflats
Least bittern Ixobrychus exilis	Breeding	Freshwater or brackish marshes with tall emergent vegetation
Least tern **b**/ Sternula antillarum	Breeding	Seacoasts, beaches, bays, estuaries, lagoons, lakes and rivers, breeding on sandy or gravelly beaches and banks of rivers or lakes
LeConte's sparrow Ammodramus leconteii	Non-breeding	Open marshy meadows, hayfields, open grassy fields, sedge fields, rice stubble, and prairie
Lesser yellowlegs Tringa flavipes	Non-breeding	Variety of shallow fresh and saltwater habitats
Loggerhead shrike Lanius ludovicianus	Year round	Open country with short vegetation and well-spaced shrubs or low trees
Long-billed curlew Numenius americanus	Non-breeding	Wetlands, tidal estuaries, mudflats, flooded fields, and occasionally beaches
Marbled godwit Limosa fedoa	Non-breeding	Mudflats and beaches
Mountain plover Charadrius montanus	Non-breeding	Short-grass plains and fields, plowed fields, and sandy deserts
Nelson's sharp-tailed sparrow Ammodramus nelsoni	Non-breeding	Salt and brackish marshes
Painted bunting *Passerina ciris*	Breeding	Breeds around thickets, hedgerows, woodland clearings and edges, and undergrowth of open woods

Birds of Conservation Concern Potentially Occurring Within the Project Area		
Species	**Seasonal Occurrence in Project Area**	**Preferred Habitat**
Peregrine falcon **a**/ **b**/ *Falco peregrinus*	Non-breeding	Open habitats, along barrier islands, mudflats, coastlines, lake edges, and mountain chains
Prothonotary warbler *Protonotaria citrea*	Non-breeding	Mangrove forests
Reddish egret *Egretta rufescens*	Year Round	Sandy beaches, mud flats, or in shallow, coastal lagoons and marshes
Red knot, **b**/ *Calidris canutus roselaari*	Non-breeding	Intertidal, marine habitats, near coastal inlets, estuaries, and bays
Red knot **c**/ *Calidris canutus rufa*	Non-breeding	Intertidal, marine habitats, near coastal inlets, estuaries, and mudflats
Sandwich tern *Thalasseus sandvicensis*	Year Round	Seacoasts, bays, estuaries, and mudflats, occasionally open ocean
Seaside sparrow **b**/ *Ammodramus maritimus*	Year Round	Salt marshes, especially spartina grass, rushes, and tidal reeds
Sedge wren *Cistothorus platensis*	Non-breeding	Grassy marshes and dry grass fields
Short-billed dowitcher *Limnodromus griseus*	Non-breeding	Coastal mud flats, brackish lagoons, and flooded agricultural fields
Short-eared owl *Asio flammeus*	Non-breeding	Woodlots, stubble fields, fresh and saltwater marshes, weedy fields, rock quarries, and shrub thickets
Snowy plover **b**/ *Charadrius nivosus*	Non-breeding	Barren to sparsely vegetated sand beaches, dry salt flats in lagoons , levees and flats at salt-evaporation ponds, and river bars
Solitary sandpiper *Tringa solitaria*	Non-breeding	Freshwater ponds, stream edges, temporary pools, flooded ditches and fields, and in wooded regions
Sprague's pipit *Anthus spragueii*	Non-breeding	Open grassland with good drainage that lack shrubs and trees
Swainson's warbler *Limnothlypis swainsonii*	Breeding	Thick undergrowth, canebrakes, and floodplain forests in lowlands
Swallow-tailed kite *Elanoides forficatus*	Migration	Open woods, bottomlands, and wetlands
Upland sandpiper *Bartramia longicauda*	Migration	Native prairie and other dry grasslands
Whimbrel *Numenius phaeopus*	Non-breeding	Tidal flats and shorelines, occasionally visiting inland field habitats
White-tailed hawk *Geranoaetus albicaudatus*	Year Round	Open country, savanna, prairie and arid habitats of mesquite, cacti, and bushes
Wilson's plover *Charadrius wilsonia*	Breeding	Ocean beaches, lagoons, and salt flats
Yellow rail *Coturnicops noveboracensis*	Non-breeding	Dry fresh-water and brackish marshes. Dense deep grass and rice fields

a. ESA delisted

b. Non-listed subspecies or population of federally threatened or endangered species

c. ESA listed

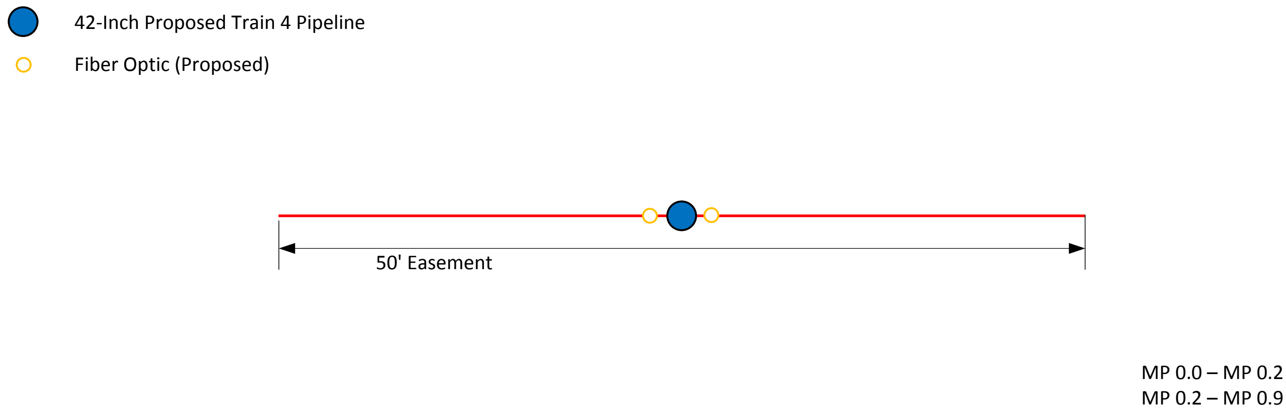
Sources: Cornell Lab of Ornithology, 2016a, 2016b; National Audubon Society, 2016; FWS, 2008

FREEPORT LNG
TRAIN 4 PROJECT

Appendix D
Typical Right-of-way Construction Configurations; Site Specific Plans for Conventional Bore, Horizontal Directional Drill, and Direct Pipe Crossing Locations

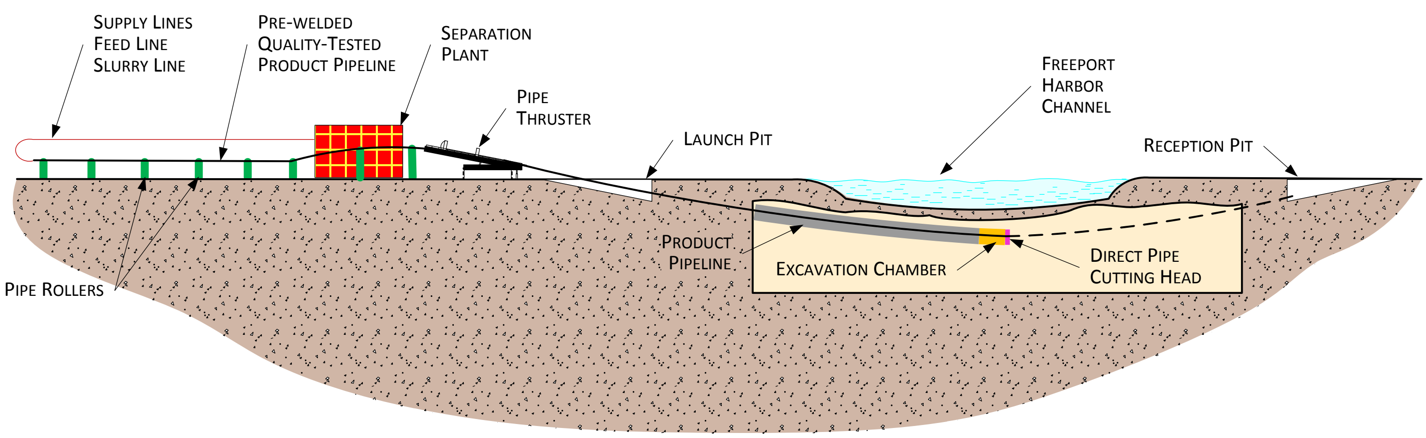
Typical Figures
Summary of Permanent Easements

MPs	Typical Figure Number	Method	Width of Existing Permanent Easement	Width of Proposed Permanent Easement	Overlap/Offset
0.0-0.9	1	DP	Not collocated	50	Partially within Terminal
0.9-1.0	2	DP	50	50	30’ overlap
1.0-1.2	3	Push-pull	50	50	10’ overlap
1.2-1.3	4	Push-pull	30	50	Abuts
1.3-1.6	5	HDD	30	50	20’ overlap
1.6-1.7	6	HDD	Not collocated	50	n/a
1.7-1.9	7	Open Cut	30	50	Abuts
1.9-2.0	8	Open cut	50	50	10’ overlap
2.0-2.1	9	Bore	50	50	10’ overlap
2.4-3.0	10	HDD	50	50	100’ offset
3.0-3.4	11	HDD	50	50	10’ overlap
3.4-3.6	12	HDD	50	50	125’ offset
3.6-4.2	13	Push-pull	50	50	100’ offset
4.2-4.4 10.6-10.6	14	Open cut	Not collocated	50	Entry/exit loop Stratton Ridge
4.4-4.8 5.1-5.5	15	DP	Not collocated	80	Entry/exit loop (30’ offset)
4.8-5.1	16	Open cut	Within Pretreatment Facility	80	Entry/exit loop (20’ offset)
5.5-5.7	17	Open cut	Not collocated	35’	Entry/exit loop
5.7-6.4	18	Push-pull	30	50	10’ overlap
6.4-6.5	19	HDD	30	50	Abuts
6.5-6.7	20	HDD	50	50	Abuts
6.7-6.8	21	HDD	30	50	20’ overlap
6.8-6.9	22	Open cut	30	50	20’ overlap
6.9-7.2	23	Open cut	Not collocated	50	n/a
7.2-7.3	24	Bore	Not collocated	50	n/a
7.3-7.7	25	Open cut	30	50	20’ overlap
7.7-7.9	26	Open cut	30	50	20’ overlap
7.9-10.0 10.4-10.6	27	Open cut	30	50	20’ overlap
10.0-10.4	28	Open cut	30	50	20’ overlap
10.4-10.4	29	Bore	30	50	20’ overlap



CROSS-SECTION

CONSTRUCTION TYPICALS



Typical Figure 1
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Direct Pipe Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

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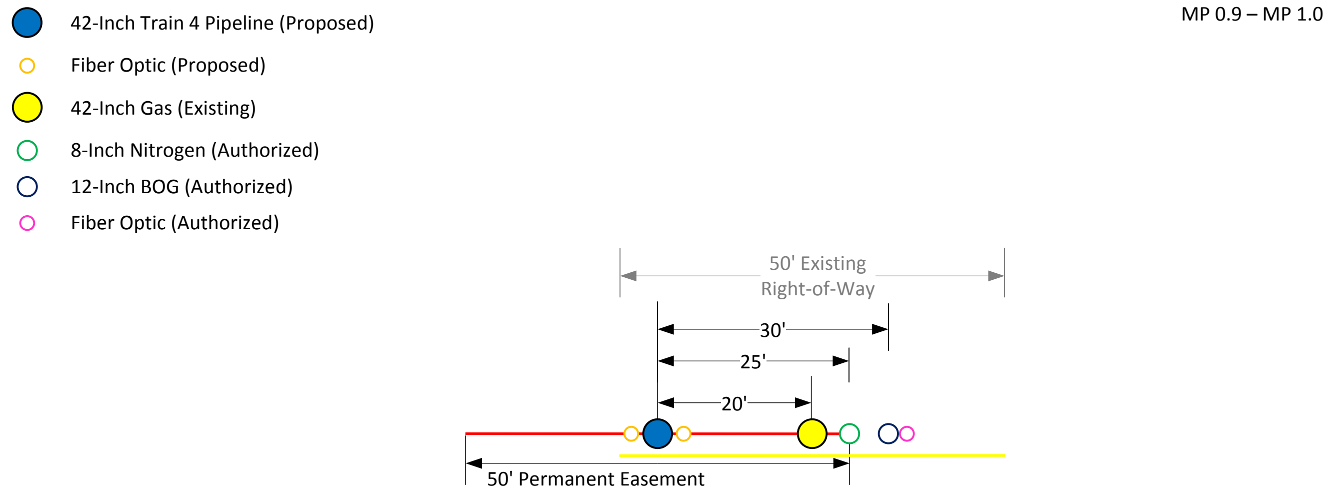
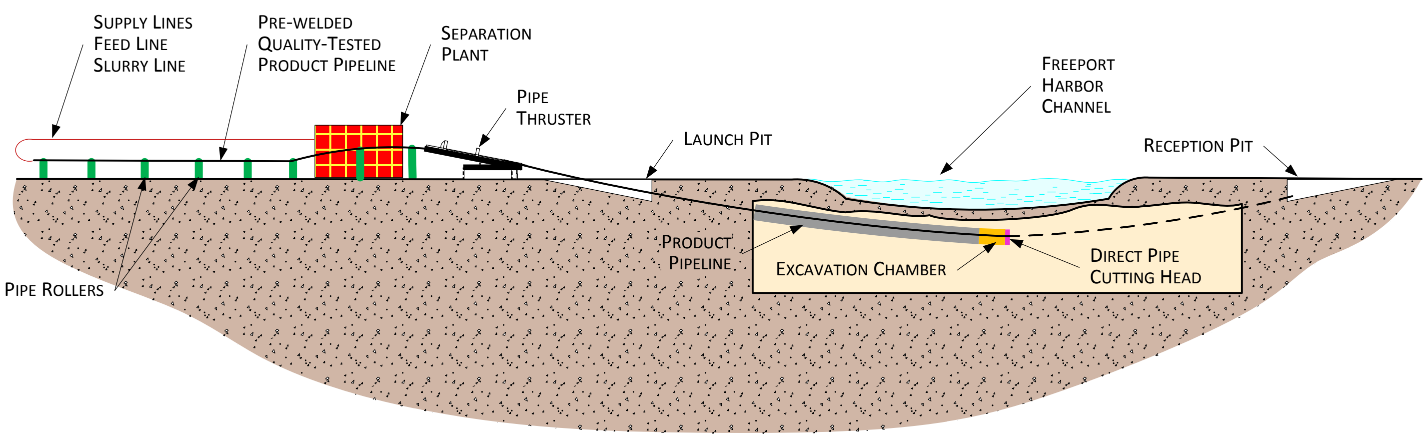


CROSS-SECTION

CONSTRUCTION TYPICALS



Typical Figure 2
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Direct Pipe Construction Typicals
Brazoria County, Texas

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FREEPORT LNG

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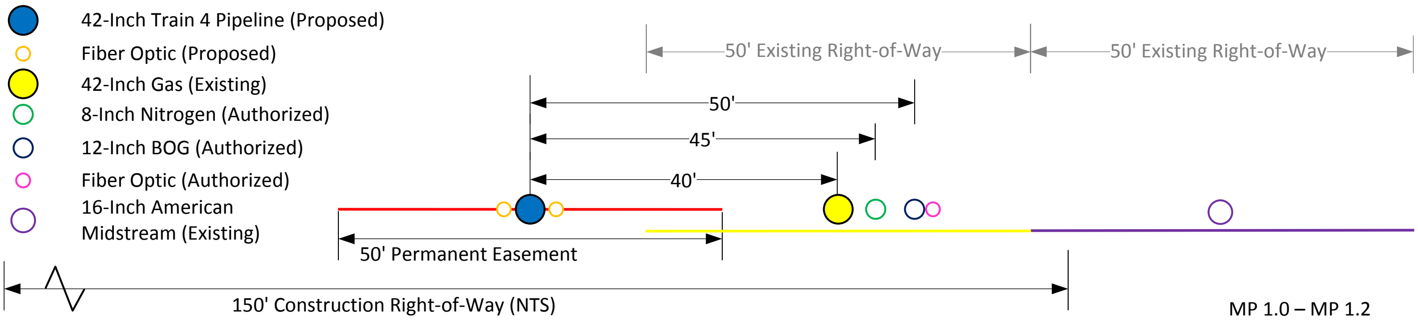

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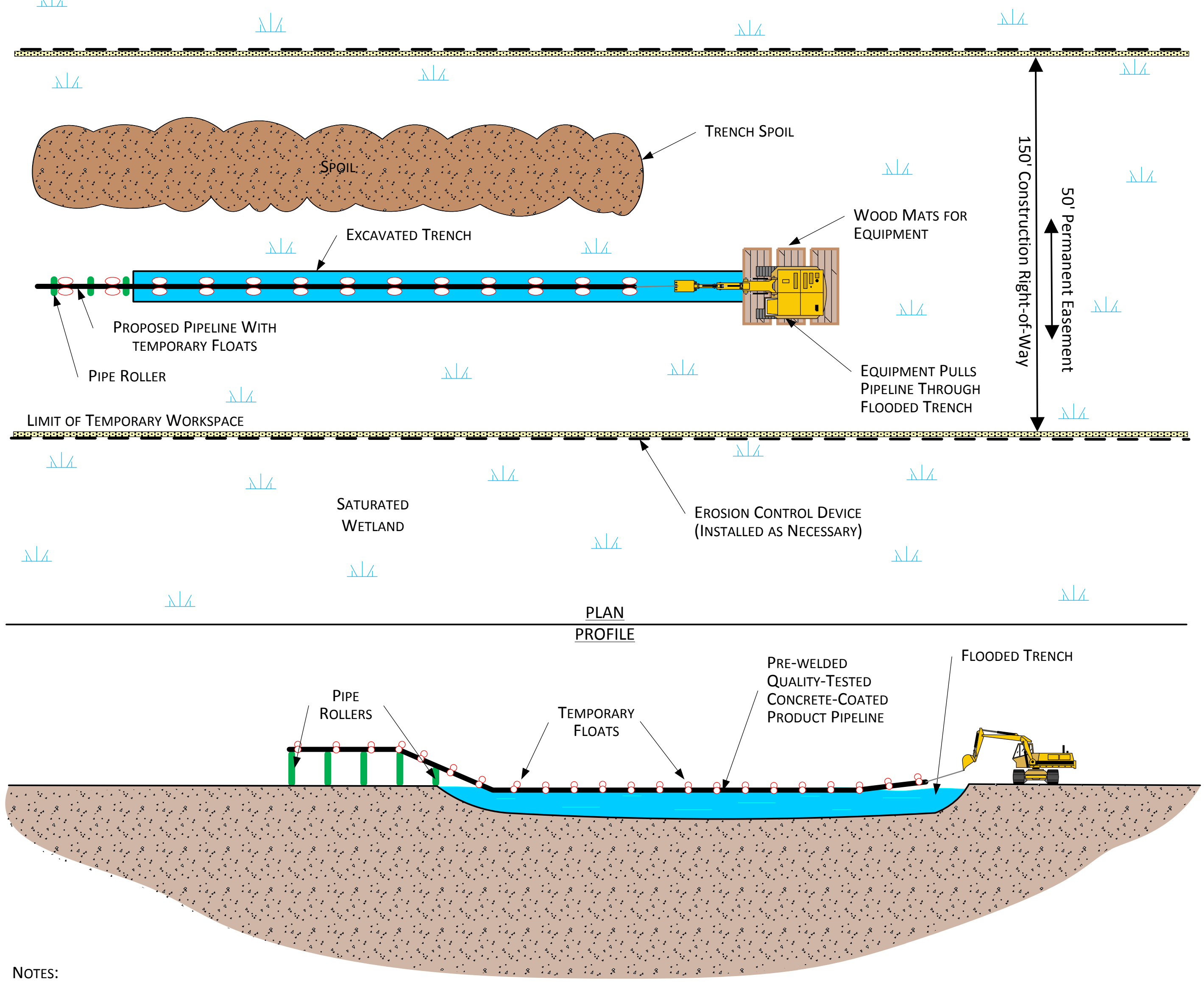
CONSTRUCTION TYPICALS



Notes:

1. Construction shall be performed in accordance with wetland and waterbody construction and mitigation procedures and upland erosion control, revegetation, and maintenance plan.
2. Construction shall be performed in accordance with all applicable federal, state, and local permits.
3. Erosion control devices to be installed as necessary.

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Typical Figure 3
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and Push-Pull Pipeline Construction Through Wetland Typicals
Brazoria County, Texas

FREEPORT LNG

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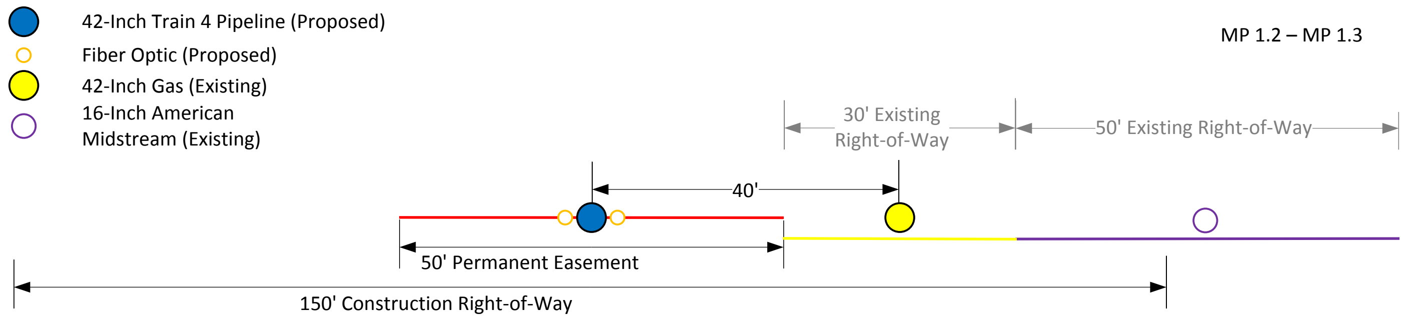
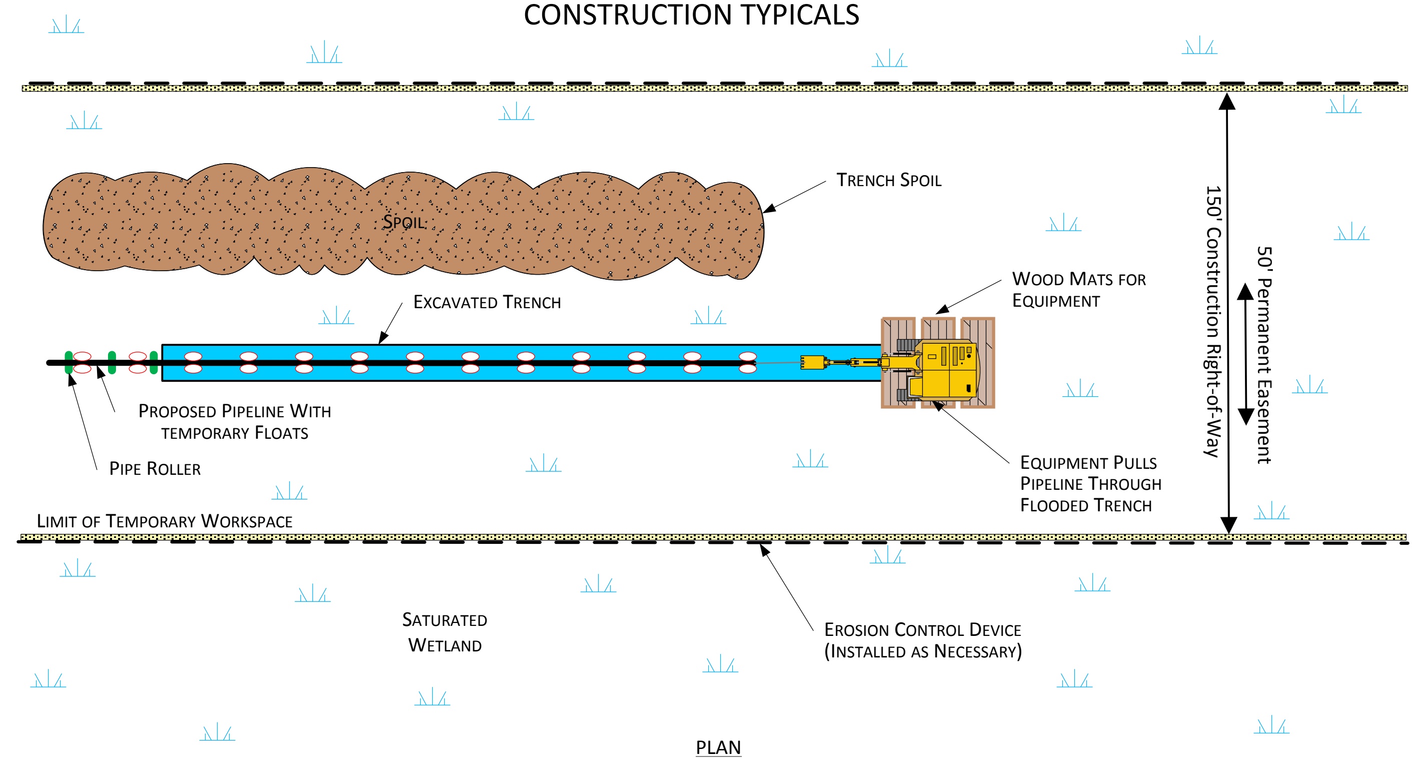


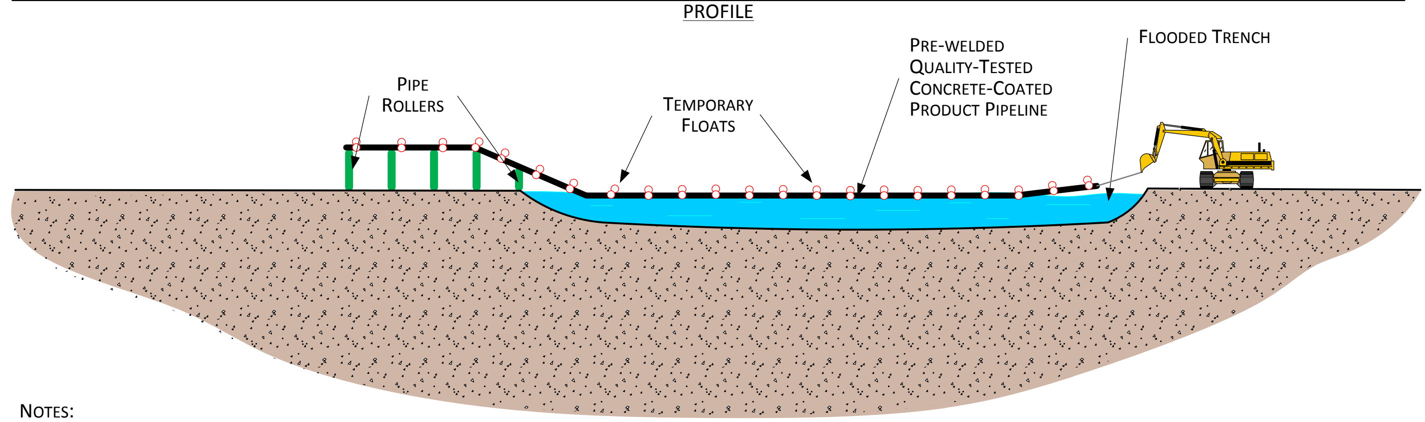
CROSS-SECTION

CONSTRUCTION TYPICALS



PLAN

PROFILE



NOTES:

1. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WETLAND AND WATERBODY CONSTRUCTION AND MITIGATION PROCEDURES AND UPLAND EROSION CONTROL, REVEGETATION, AND MAINTENANCE PLAN.
2. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL PERMITS.
3. EROSION CONTROL DEVICES TO BE INSTALLED AS NECESSARY.

For environmental review purposes only.

Typical Figure 4
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and Push-Pull Pipeline Construction Through Wetland Typicals
Brazoria County, Texas

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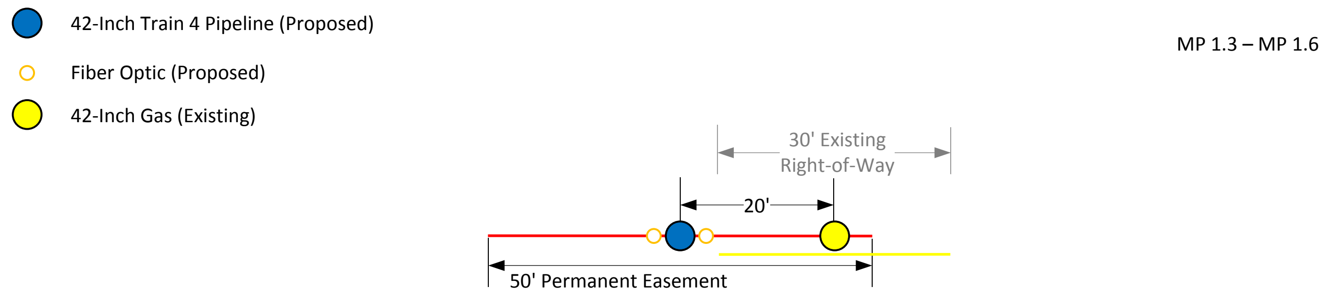
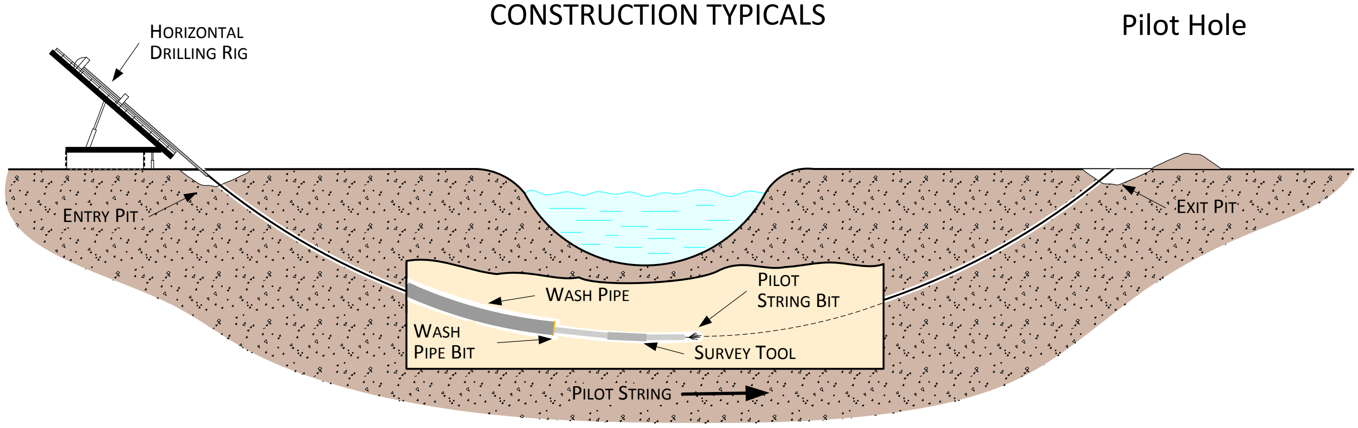


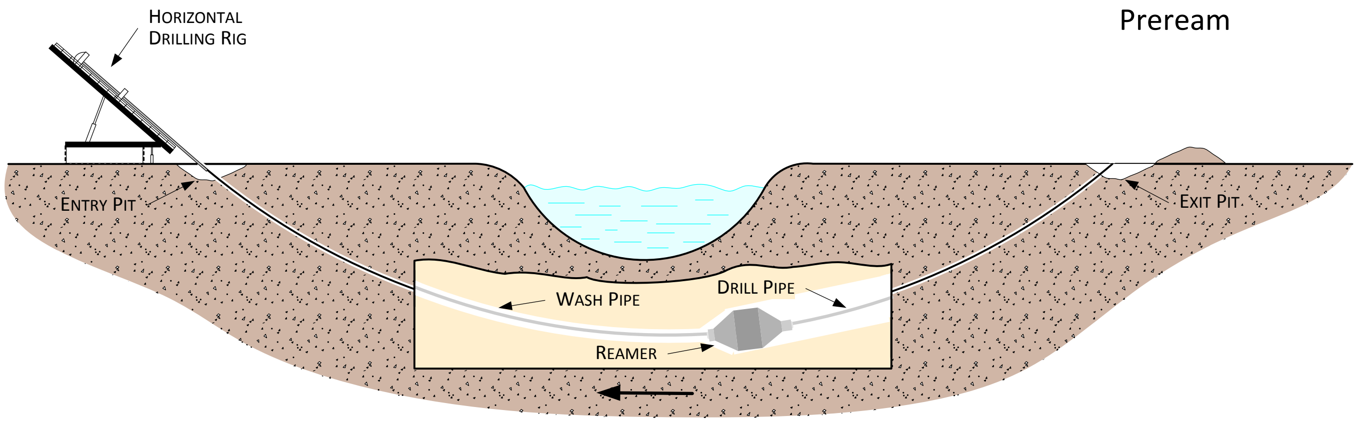
CROSS-SECTION

CONSTRUCTION TYPICALS

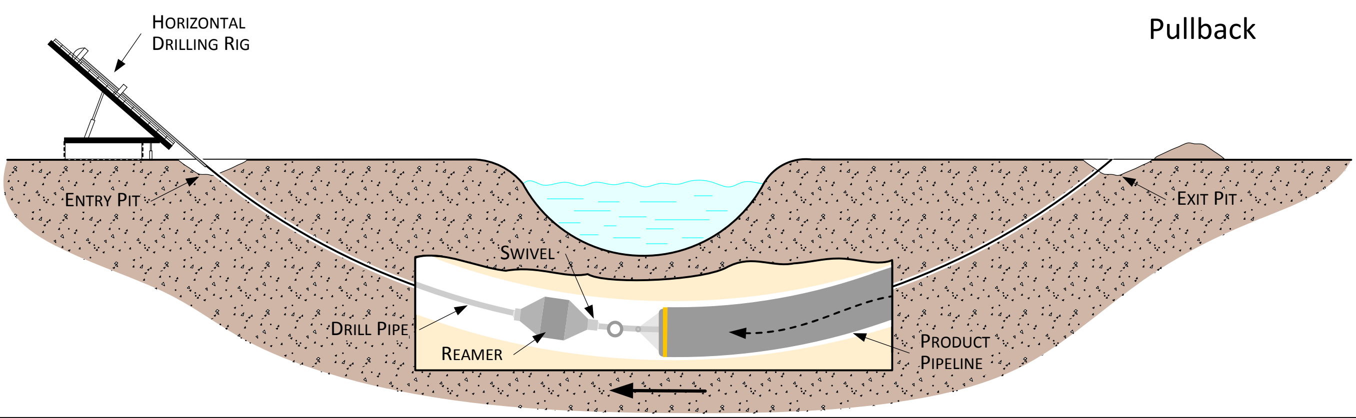
Pilot Hole



Preream



Pullback



For environmental review purposes only.

Typical Figure 5
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
HDD Pipeline Construction Typicals
Brazoria County, Texas

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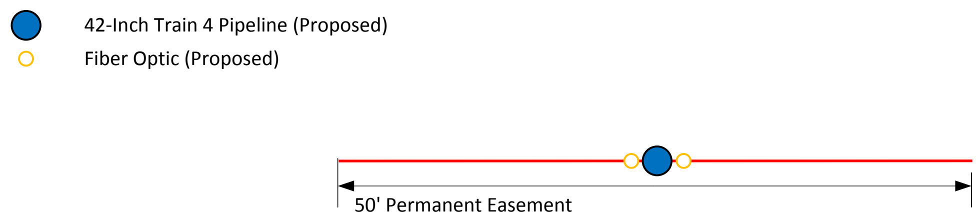
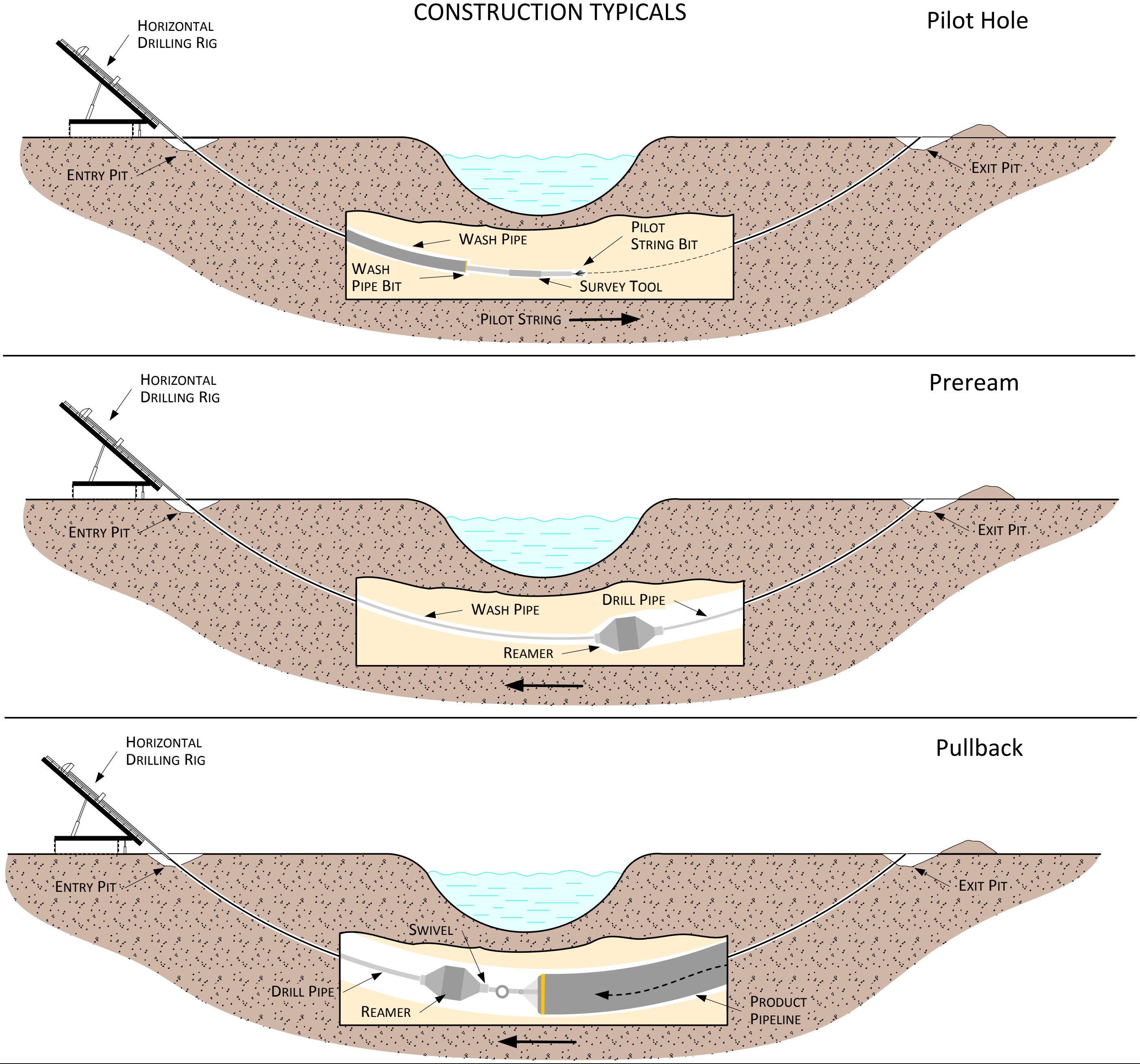


MP 1.6 – MP 1.7

CROSS-SECTION

CONSTRUCTION TYPICALS



For environmental review purposes only.

Typical Figure 6
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
HDD Pipeline Construction Typicals
Brazoria County, Texas

FREEPORT LNG

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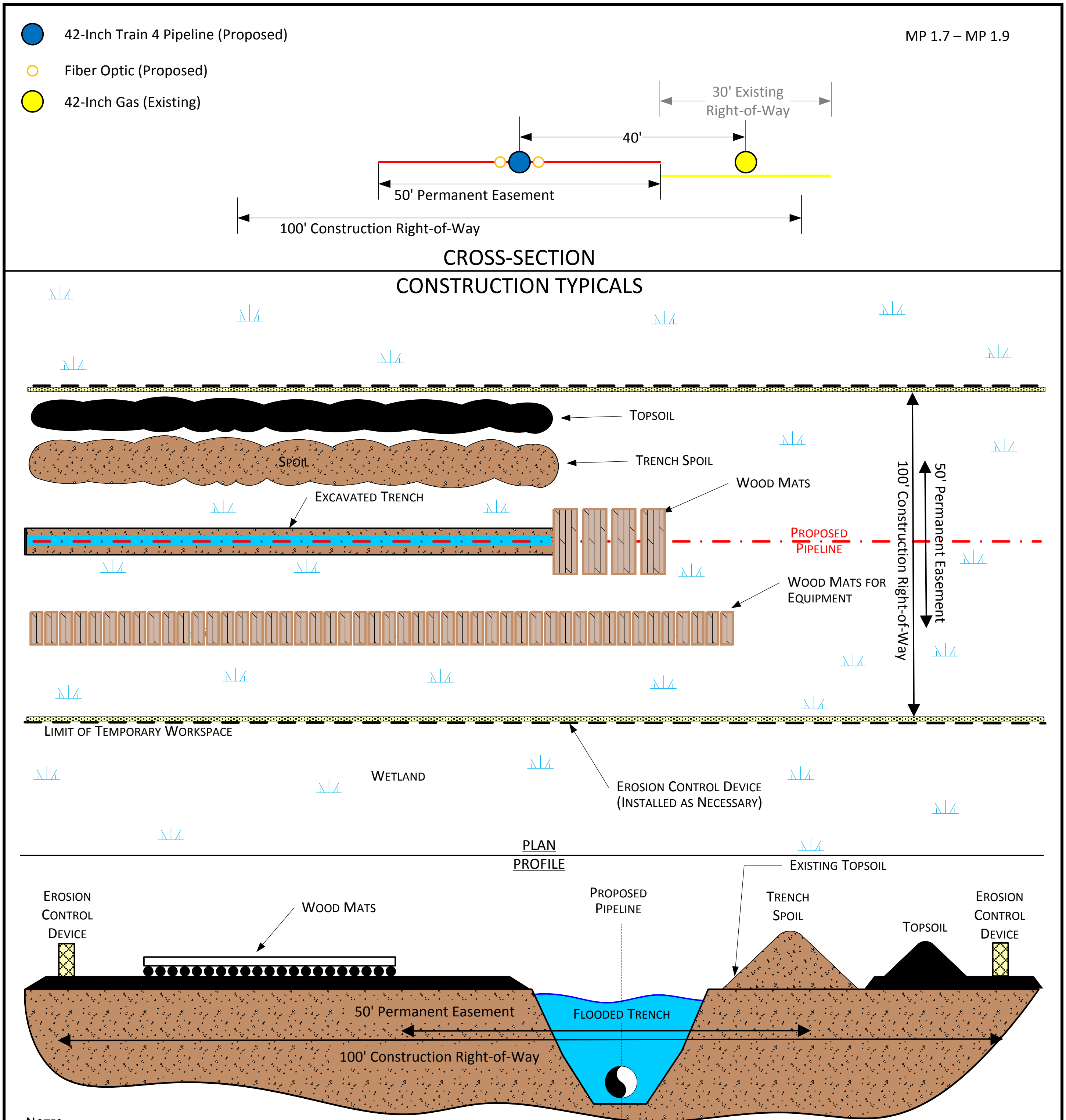

NOTES:

1. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WETLAND AND WATERBODY CONSTRUCTION AND MITIGATION PROCEDURES AND UPLAND EROSION CONTROL, REVEGETATION, AND MAINTENANCE PLAN.
2. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL PERMITS.
3. EROSION CONTROL DEVICES TO BE INSTALLED AS NECESSARY.

Typical Figure 7
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and Open Cut
Pipeline Construction Through Wetland Typicals
Brazoria County, Texas

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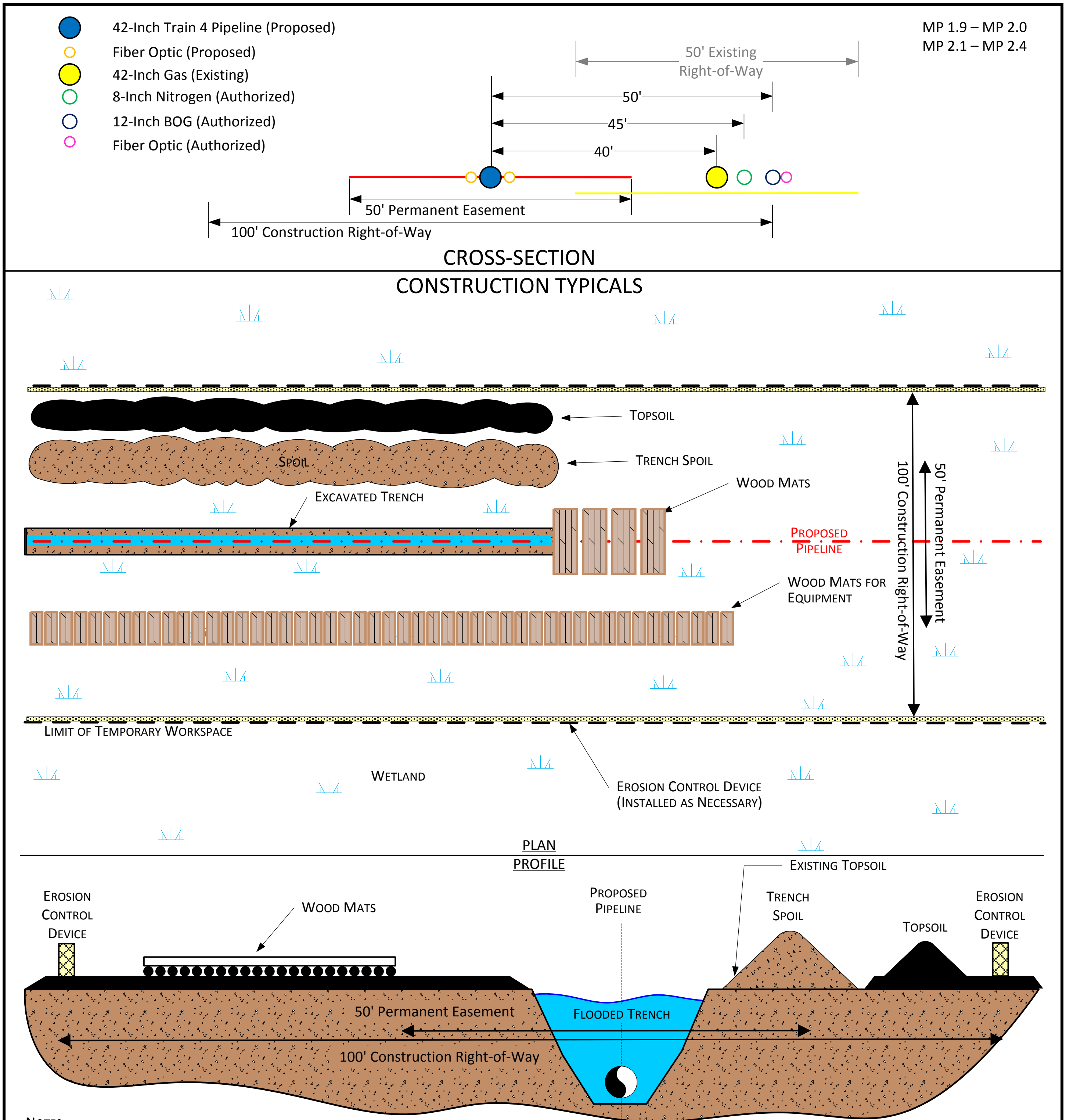

NOTES:

1. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WETLAND AND WATERBODY CONSTRUCTION AND MITIGATION PROCEDURES AND UPLAND EROSION CONTROL, REVEGETATION, AND MAINTENANCE PLAN.
2. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL PERMITS.
3. EROSION CONTROL DEVICES TO BE INSTALLED AS NECESSARY.

For environmental review purposes only.

Typical Figure 8
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and Open Cut Pipeline Construction Through Wetland Typicals
Brazoria County, Texas

FREEPORT LNG

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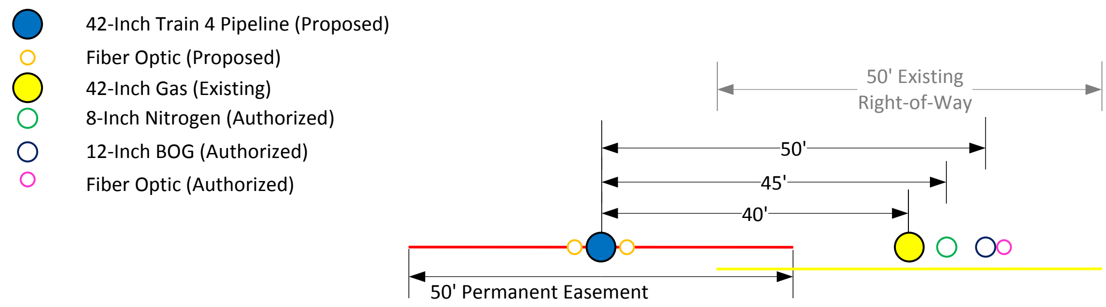
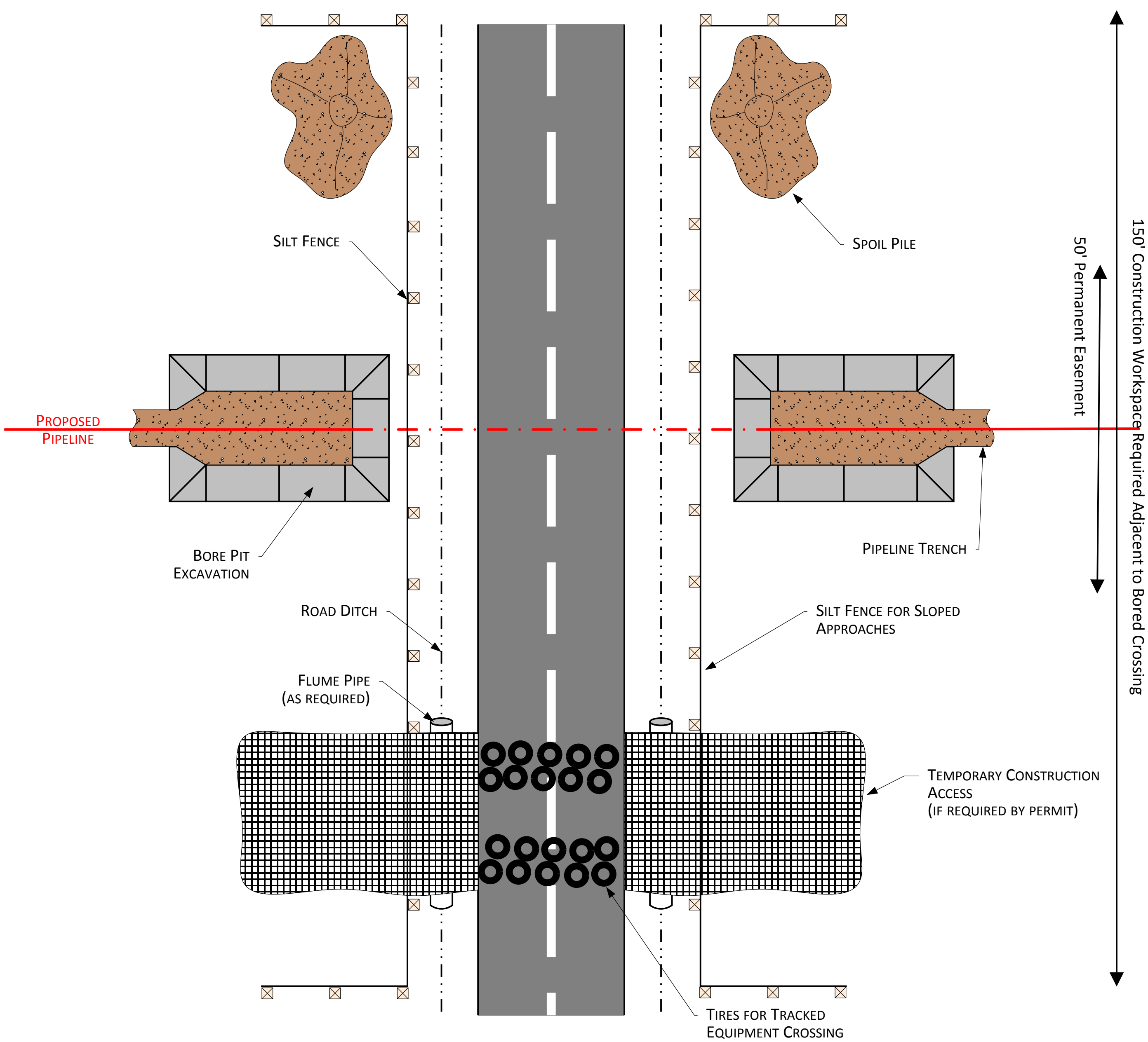
MP 2.0 – MP 2.1



CROSS-SECTION

CONSTRUCTION TYPICALS



For environmental review purposes only.

Typical Figure 9
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Bore Pipeline Construction Typicals
Brazoria County, Texas

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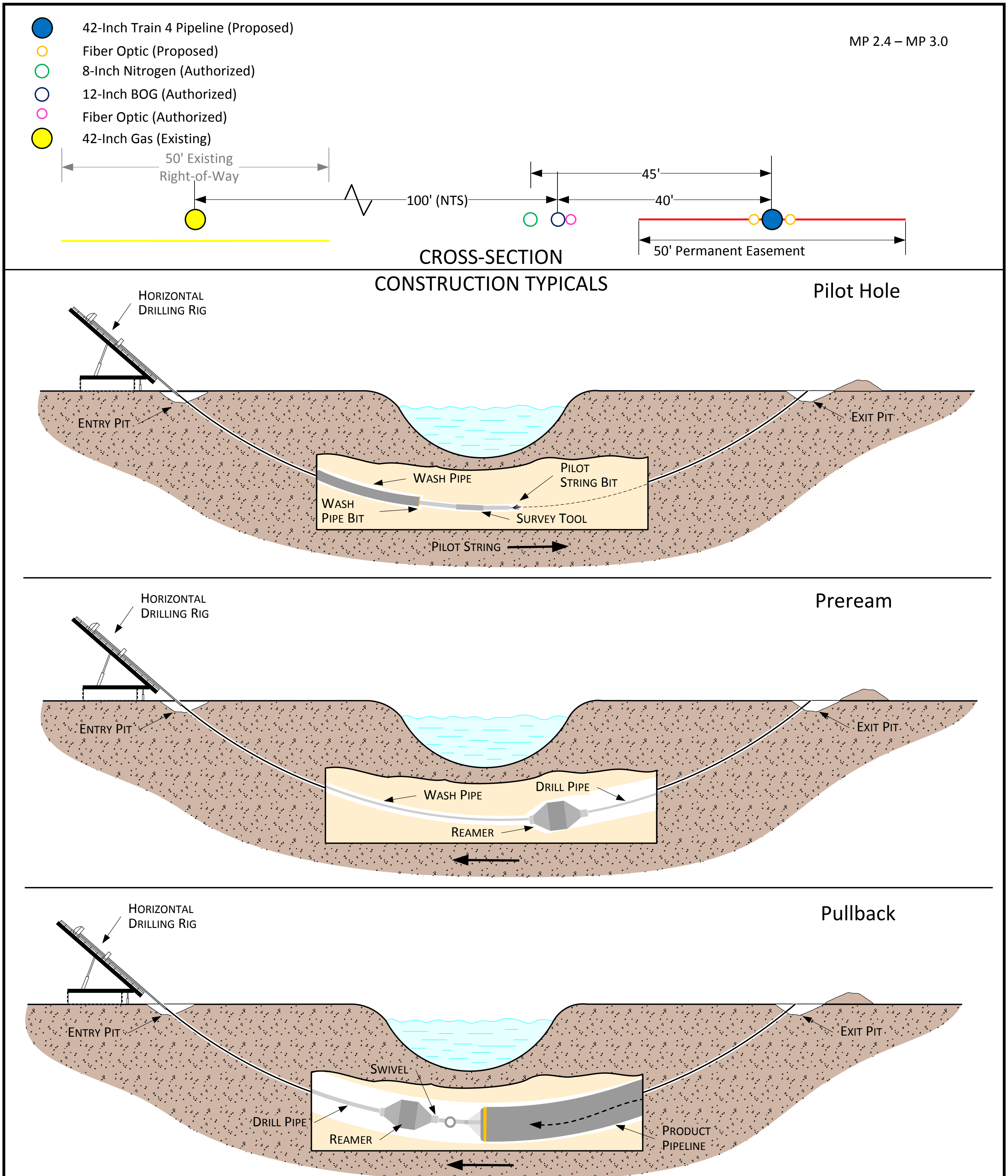

Typical Figure 10
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
HDD Pipeline Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

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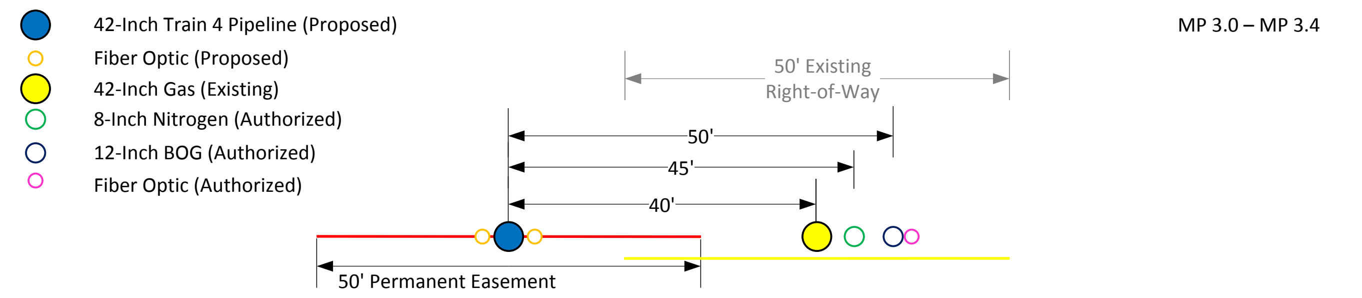
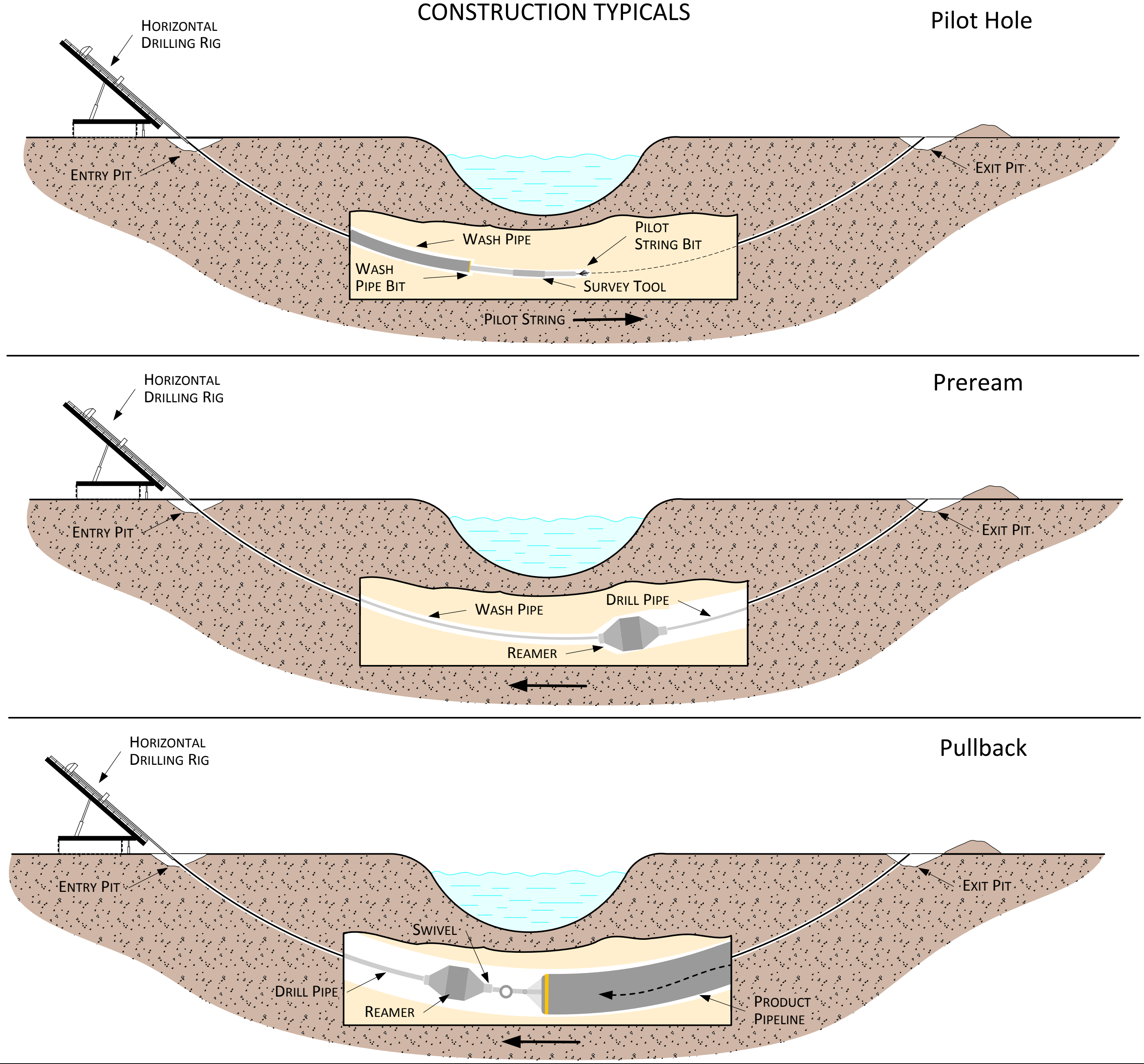


CROSS-SECTION

CONSTRUCTION TYPICALS



Typical Figure 11
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
HDD Pipeline Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

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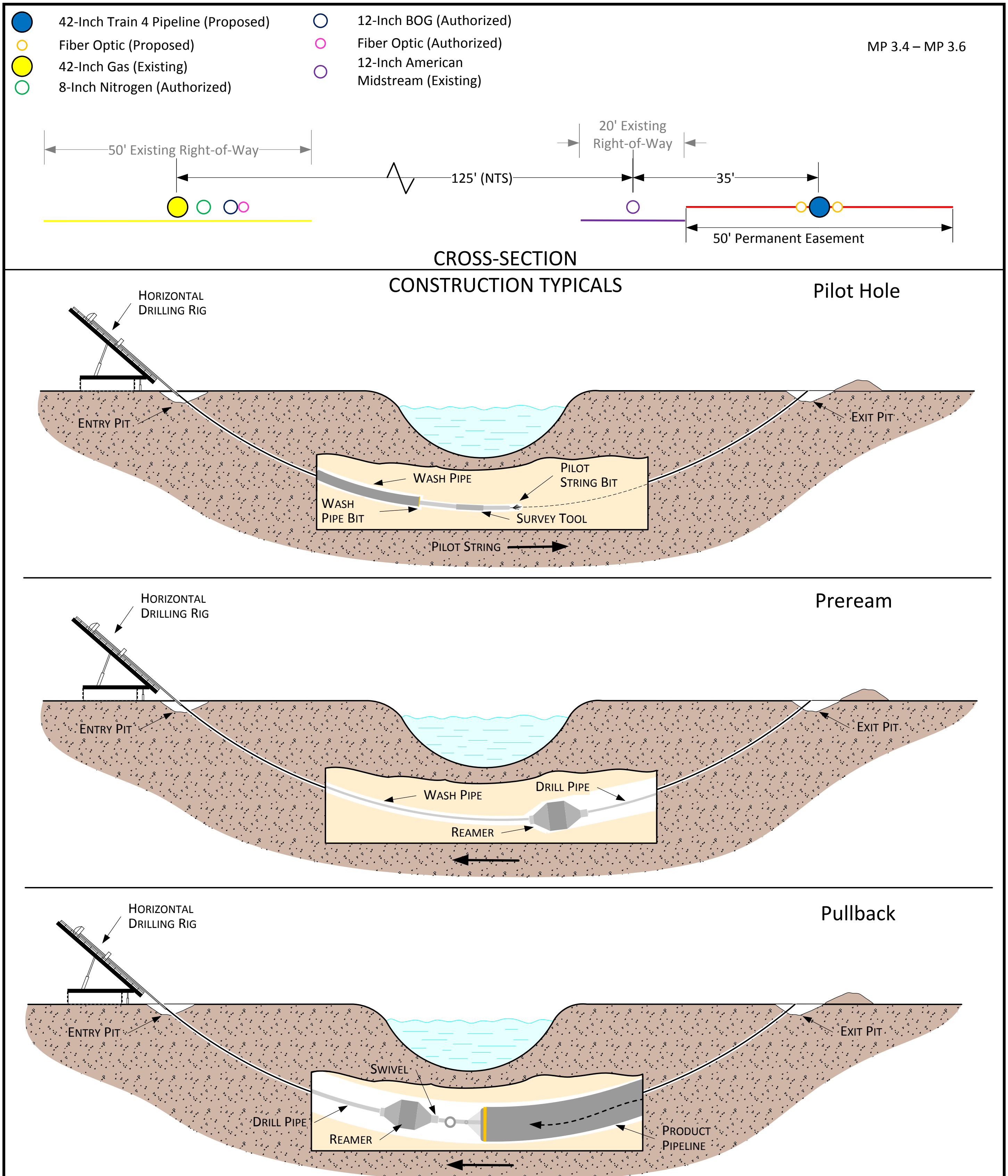

For environmental review purposes only.

Typical Figure 12
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
HDD Pipeline Construction Typicals
Brazoria County, Texas

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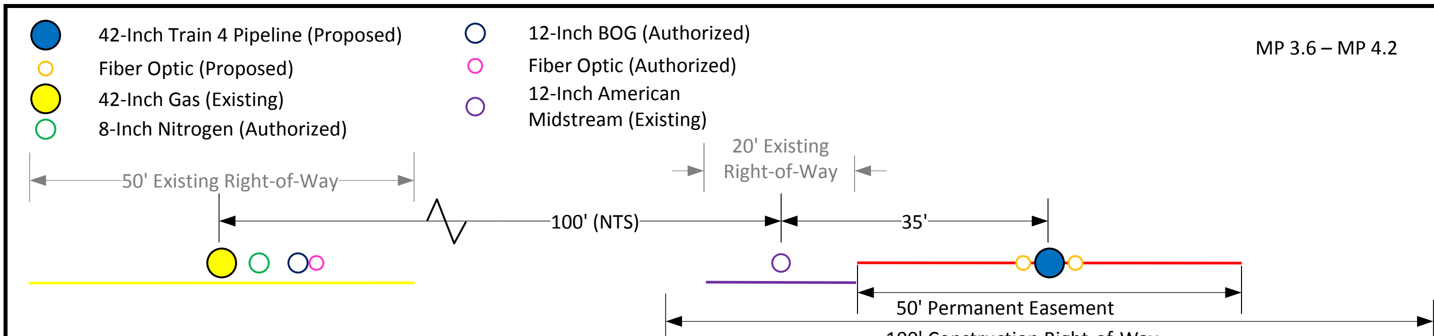
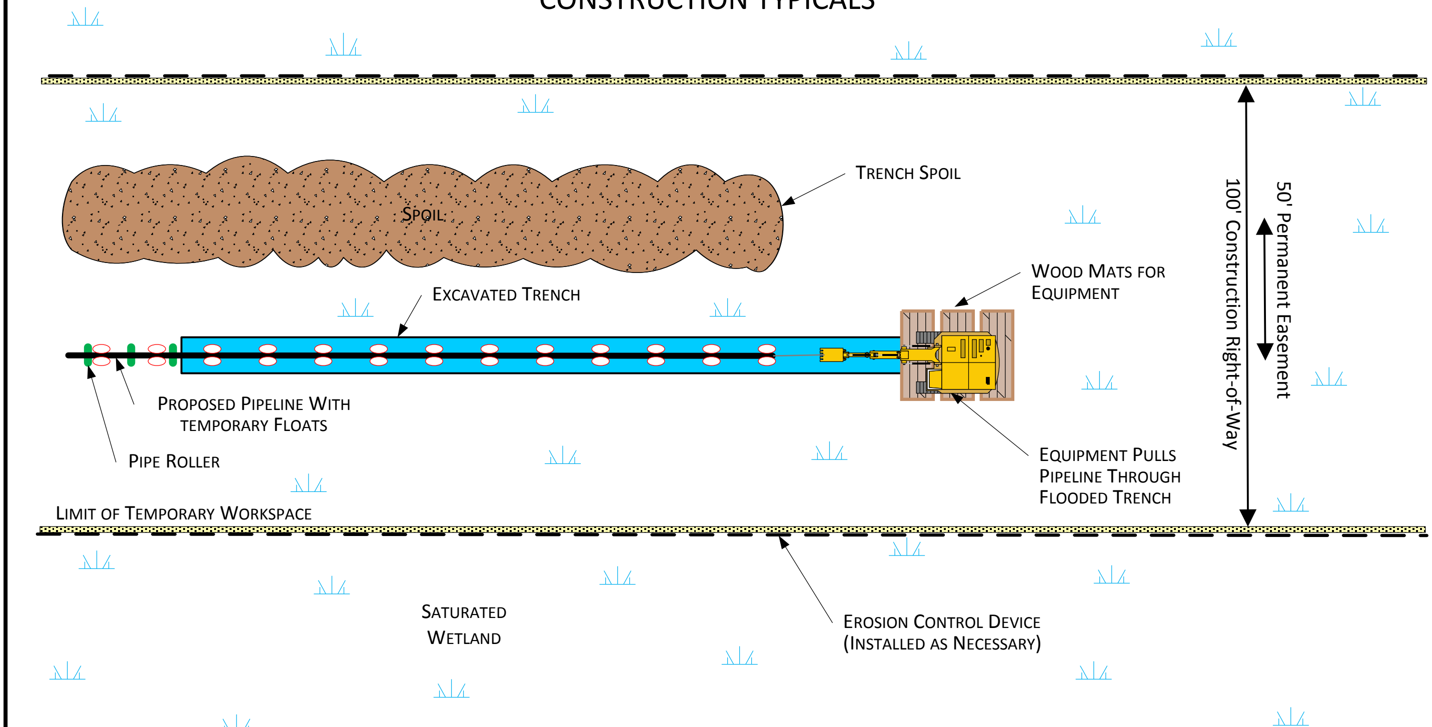


CROSS-SECTION

CONSTRUCTION TYPICALS



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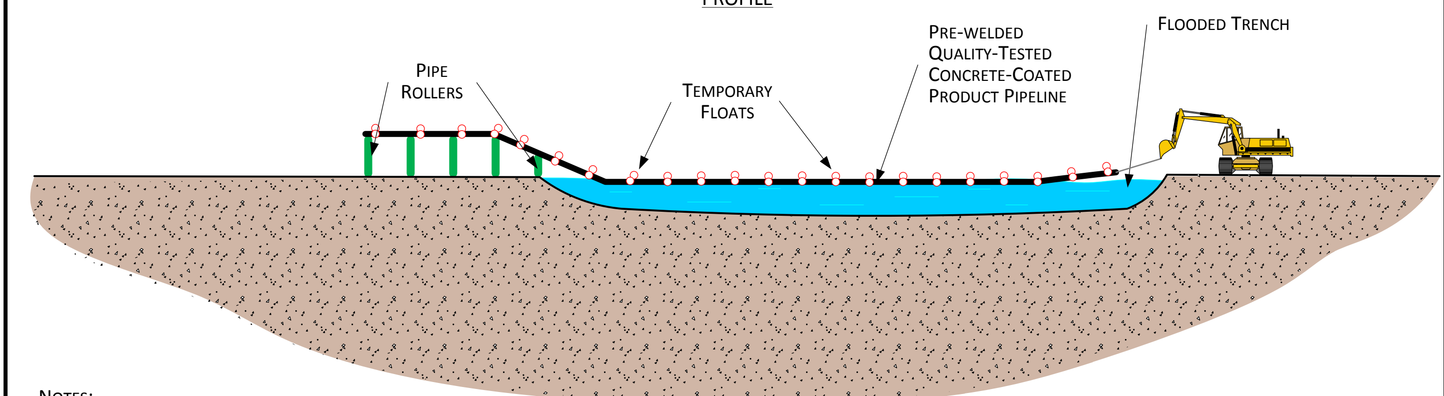

Notes:

1. Construction shall be performed in accordance with Wetland and Waterbody Construction and Mitigation Procedures and Upland Erosion Control, Revegetation, and Maintenance Plan.
2. Construction shall be performed in accordance with all applicable federal, state, and local permits.
3. Erosion control devices to be installed as necessary.

Typical Figure 13
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and Push-Pull Pipeline Construction Through Wetland Typicals

Brazoria County, Texas

For environmental review purposes only.

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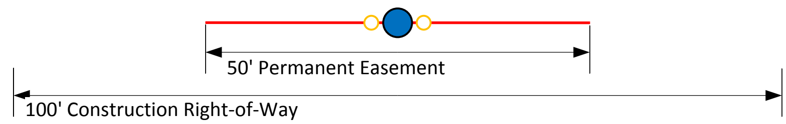
42-Inch Train 4 Pipeline (Proposed)

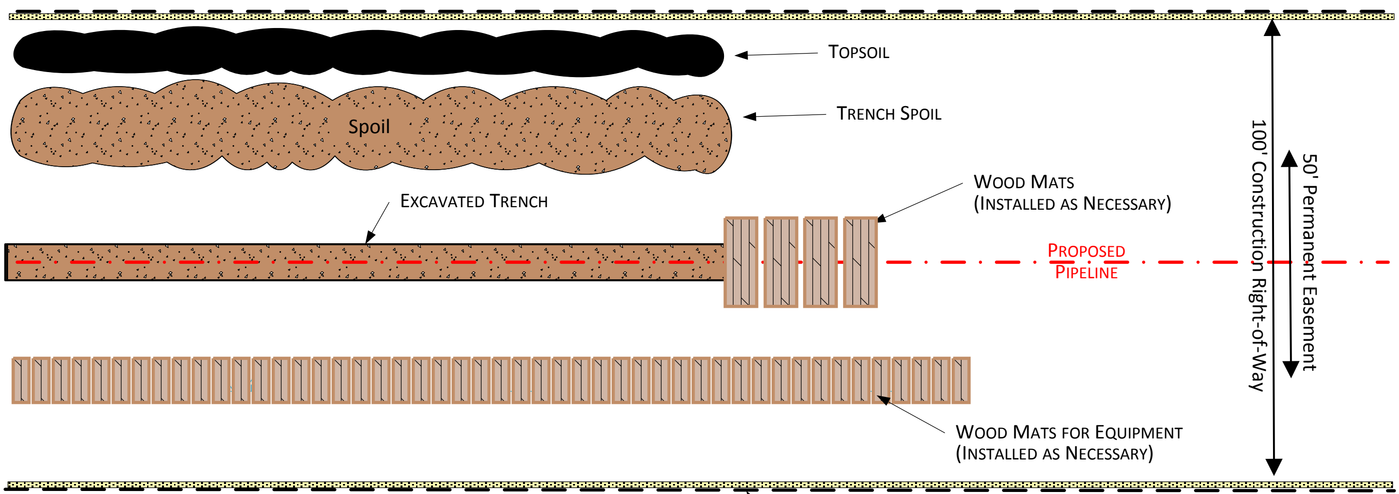
Fiber Optic (Proposed)

MP 4.2 – MP 4.4
MP 10.6 – MP 10.6



CROSS-SECTION

CONSTRUCTION TYPICALS



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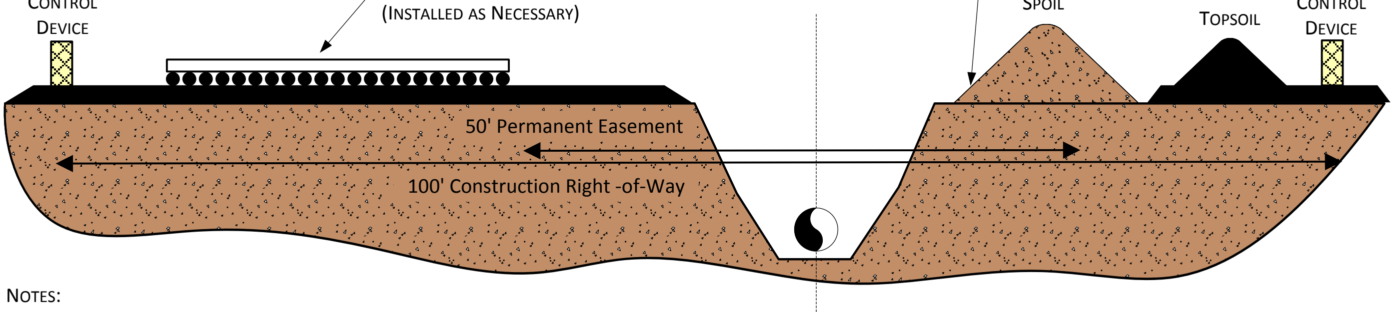


Notes:

1. Construction shall be performed in accordance with wetland and waterbody construction and mitigation procedures and upland erosion control, revegetation, and maintenance plan.
2. Construction shall be performed in accordance with all applicable federal, state, and local permits.
3. Erosion control devices to be installed as necessary.

For environmental review purposes only.

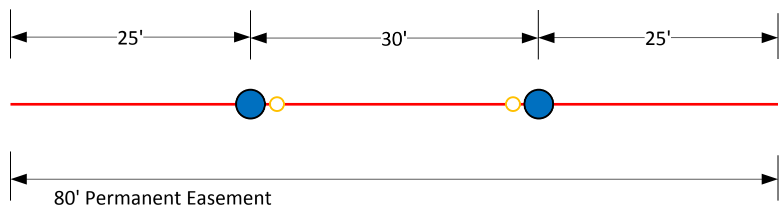
Typical Figure 14
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Open Cut Pipeline Construction Typicals
Brazoria County, Texas

M:\Clients\D-F\FRE\Liquefaction_Visio\2017\10_FRE_T4_APDX_1_C_14.VSD	SCALE: NTS		REVISED: 10/30/2017	DRAWN BY: 0239

42-Inch Train 4 Pipeline (Proposed)

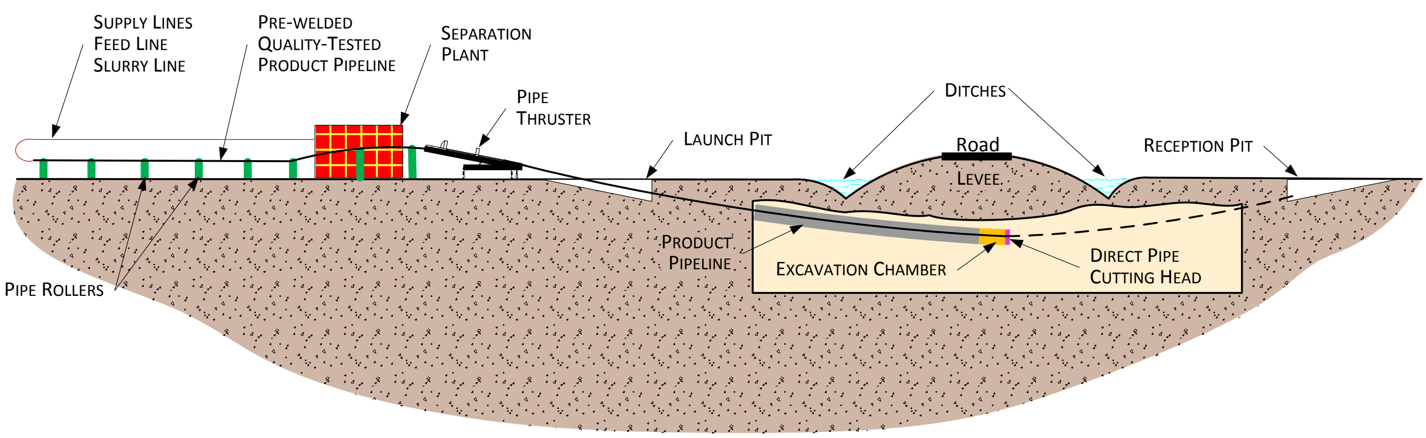
Fiber Optic (Proposed)

MP 4.4 – MP 4.7
MP 4.7 – MP 4.8
MP 5.1 – MP 5.2
MP 5.2 – MP 5.5



CROSS-SECTION

CONSTRUCTION TYPICALS



Typical Figure 15
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Direct Pipe Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

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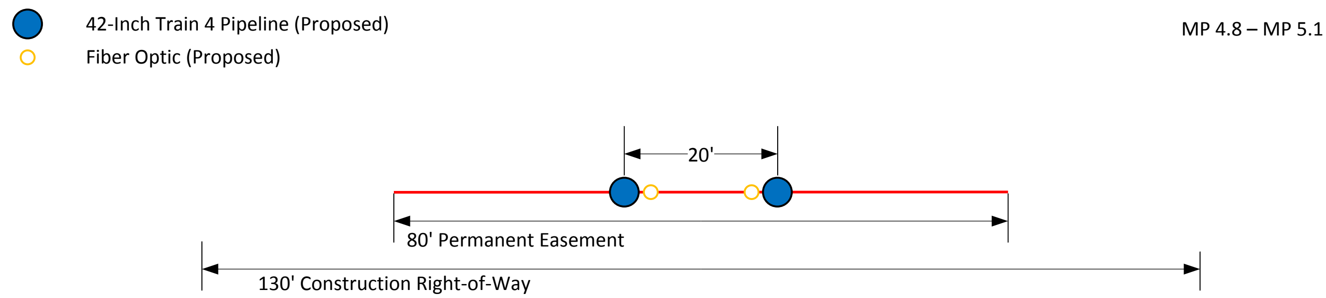
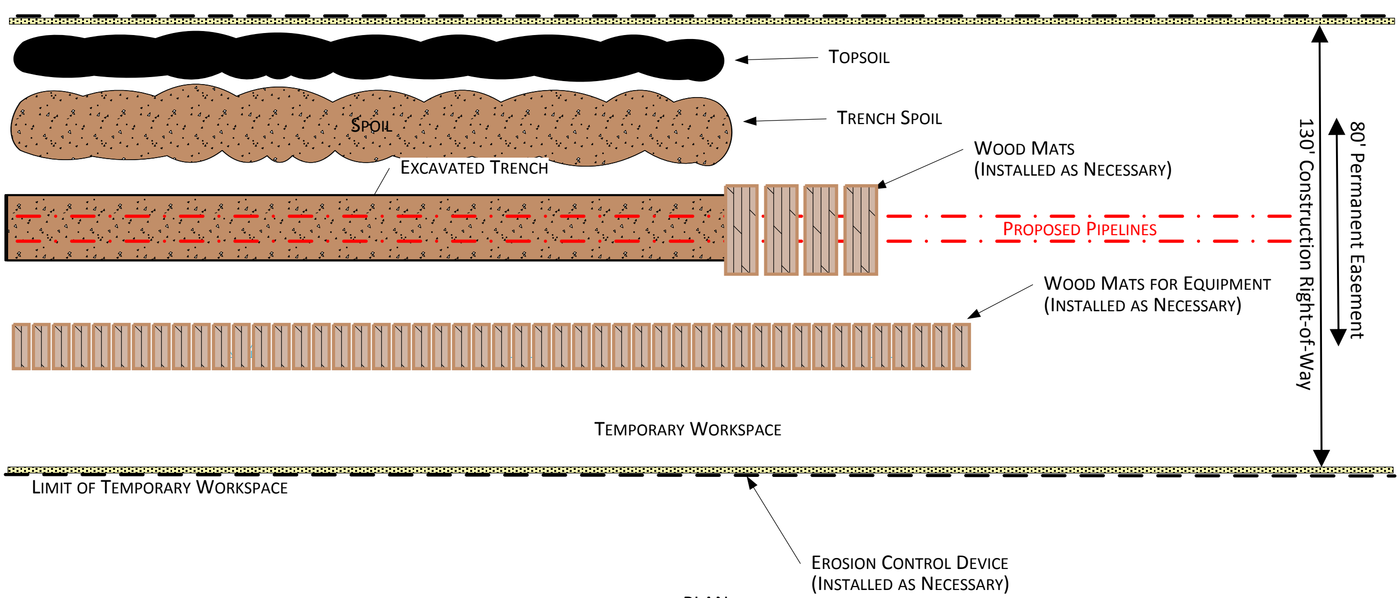


CROSS-SECTION

CONSTRUCTION TYPICALS



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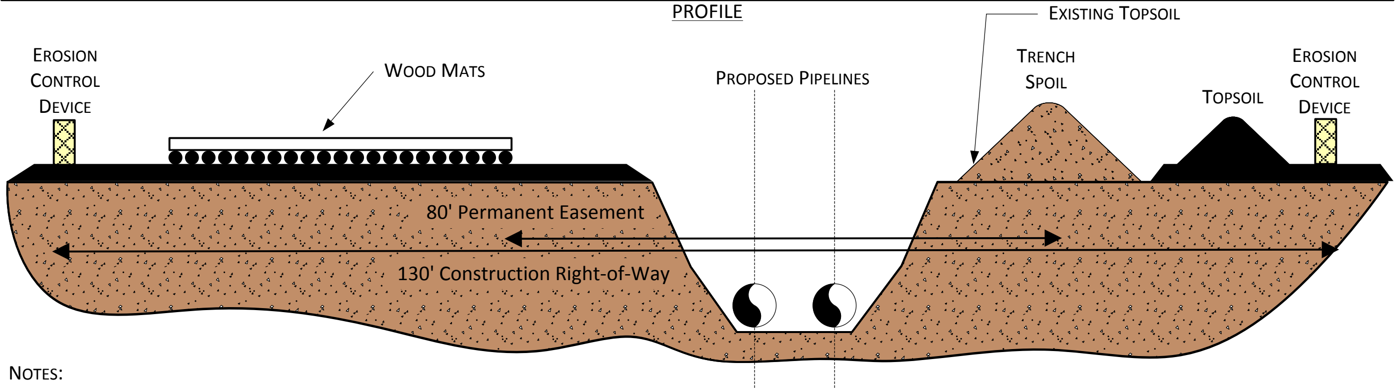

NOTES:

1. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WETLAND AND WATERBODY CONSTRUCTION AND MITIGATION PROCEDURES AND UPLAND EROSION CONTROL, REVEGETATION AND MAINTENANCE PLAN.
2. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL PERMITS.
3. EROSION CONTROL DEVICES TO BE INSTALLED AS NECESSARY.

For environmental review purposes only.

Typical Figure 16
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Open Cut Pipeline Construction Typicals
Brazoria County, Texas

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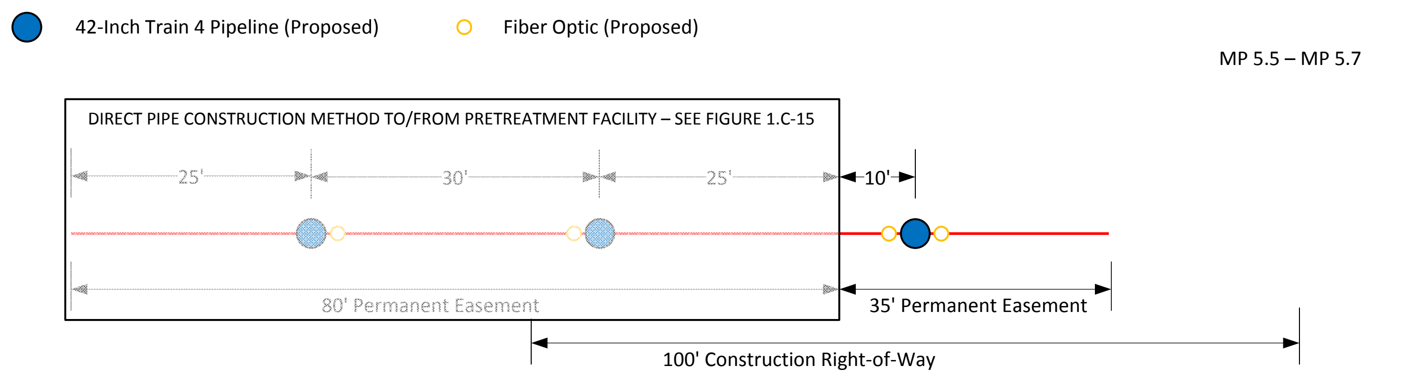
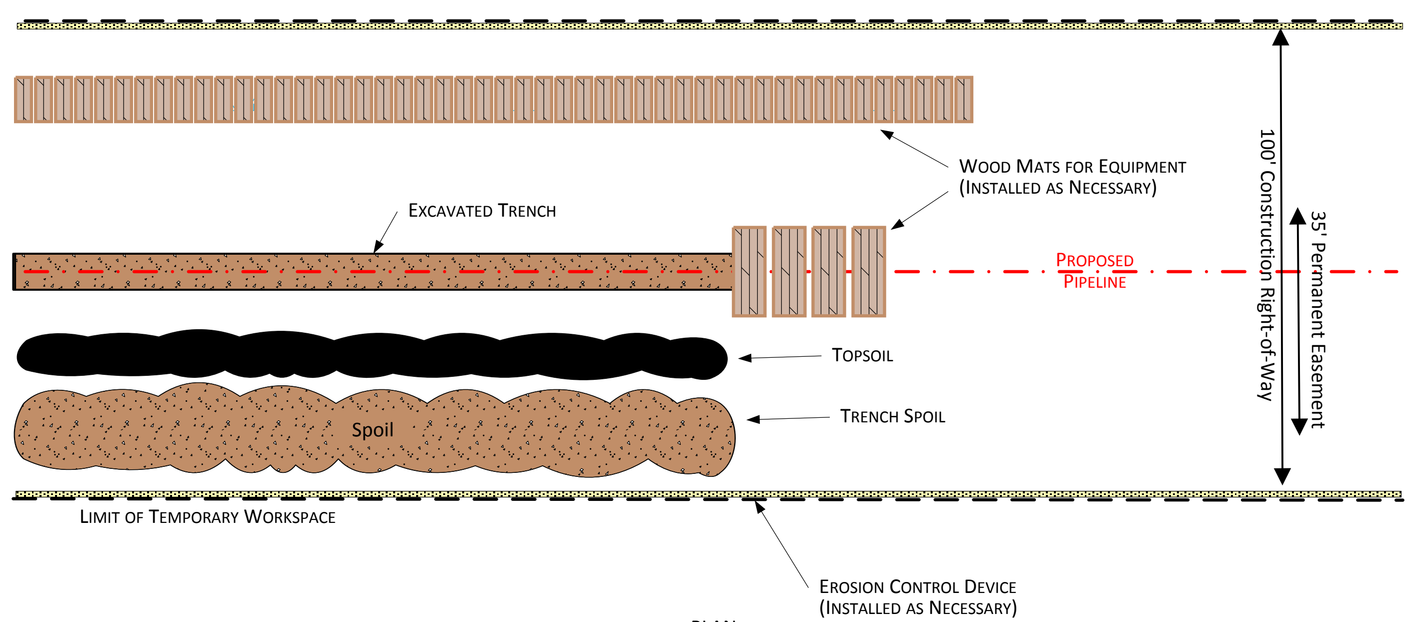


CROSS-SECTION

CONSTRUCTION TYPICALS



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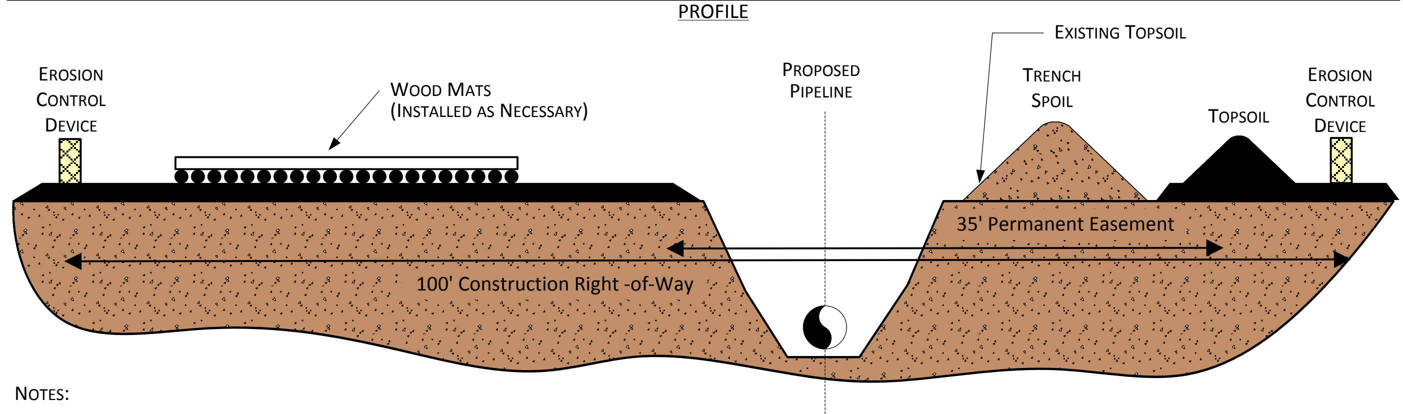

Notes:

1. Construction shall be performed in accordance with wetland and waterbody construction and mitigation procedures and upland erosion control, revegetation, and maintenance plan.
2. Construction shall be performed in accordance with all applicable federal, state, and local permits.
3. Erosion control devices to be installed as necessary.

Typical Figure 17
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Open Cut Pipeline Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

FREEPORT LNG

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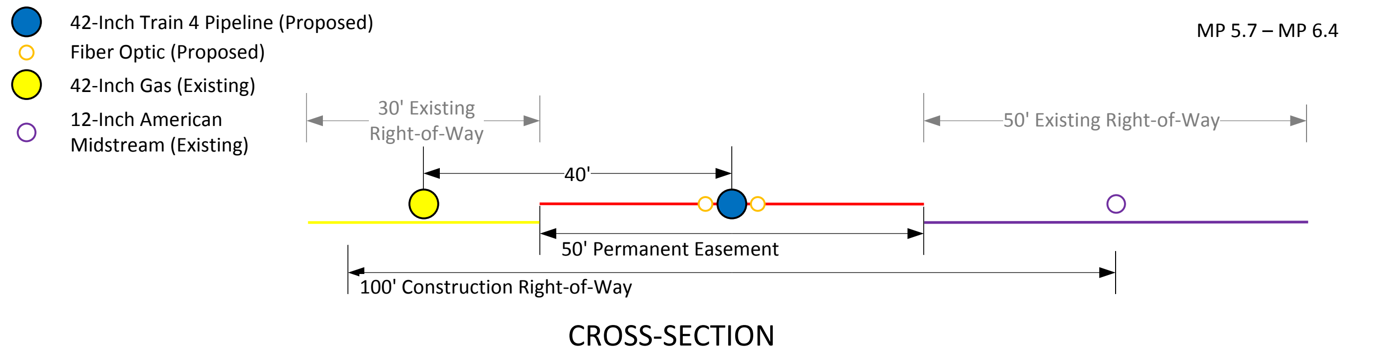

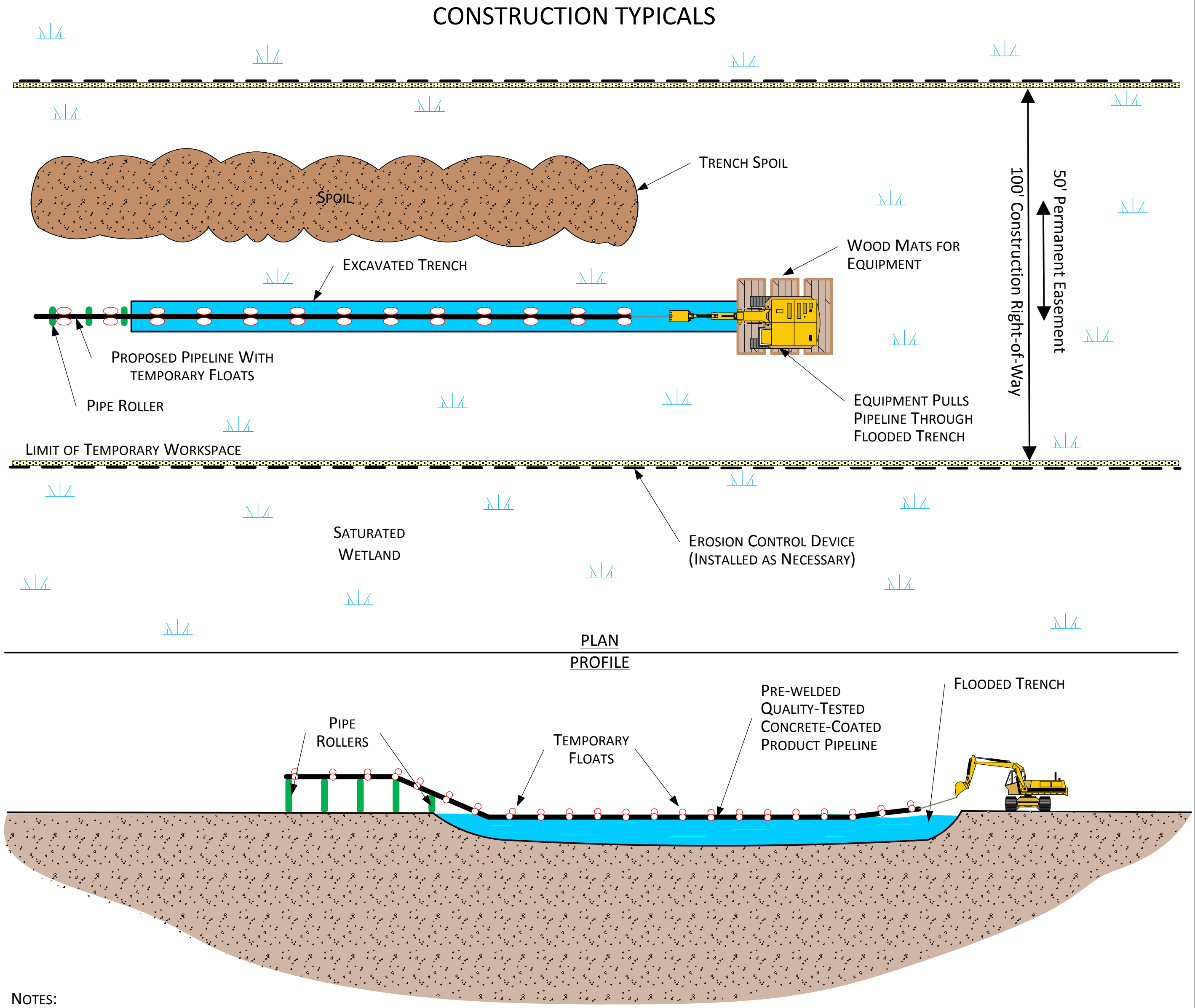

Notes:

1. Construction shall be performed in accordance with wetland and waterbody construction and mitigation procedures and upland erosion control, revegetation, and maintenance plan.
2. Construction shall be performed in accordance with all applicable federal, state, and local permits.
3. Erosion control devices to be installed as necessary.

For environmental review purposes only.

Typical Figure 18
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and Push-Pull Pipeline Construction Through Wetland Typicals
Brazoria County, Texas

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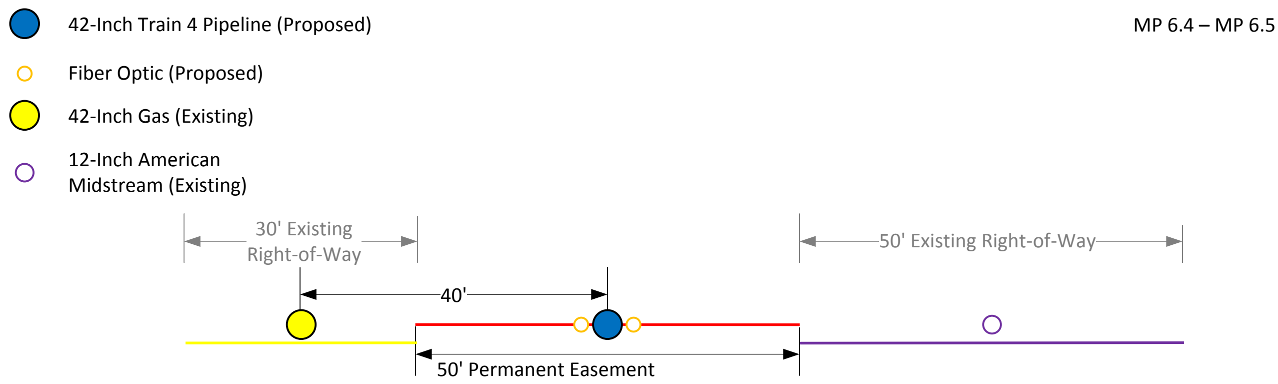
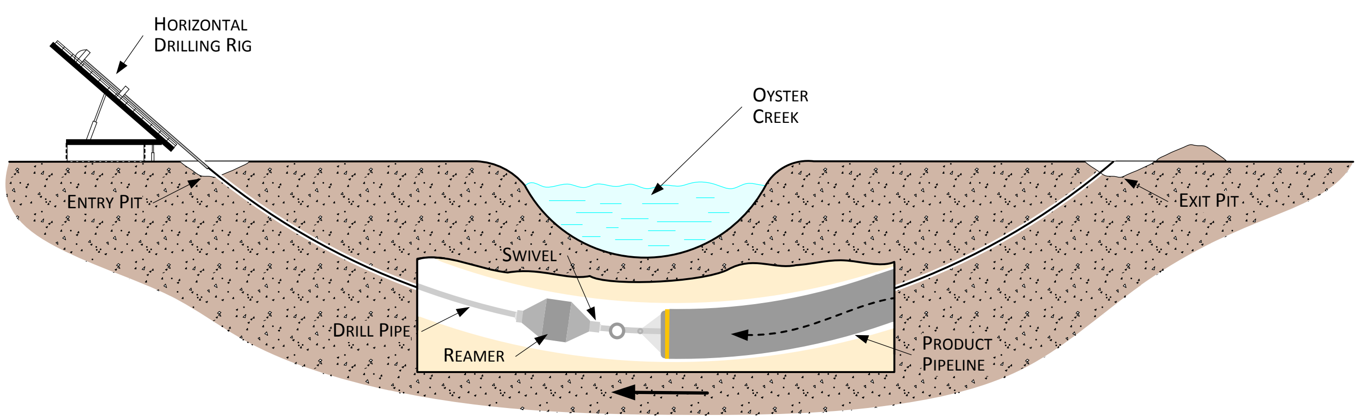
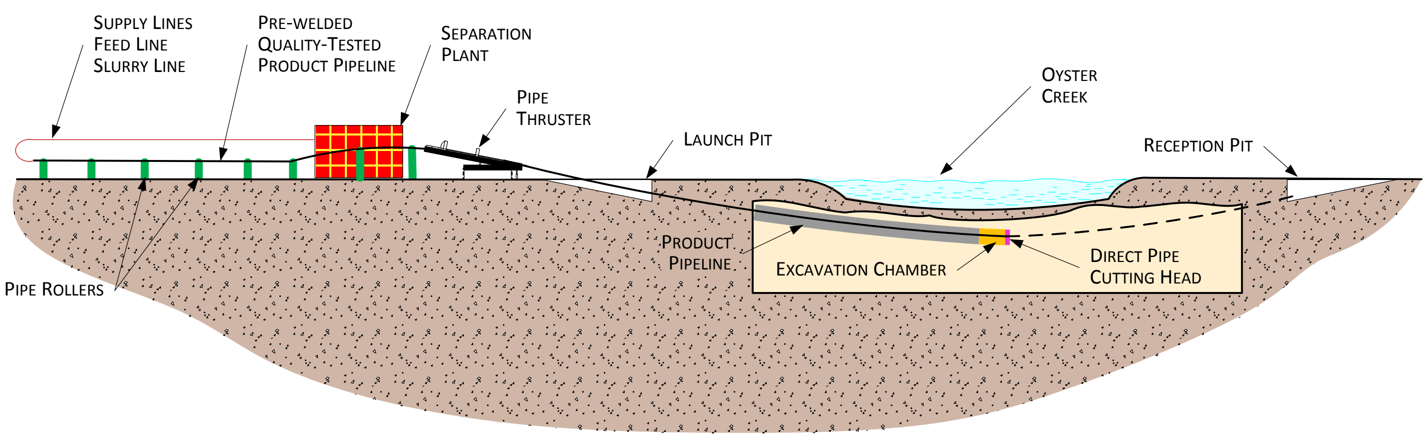


CROSS-SECTION

CONSTRUCTION TYPICAL - HDD



CONSTRUCTION TYPICAL - DIRECT PIPE



Typical Figure 19
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
HDD and Direct Pipe Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

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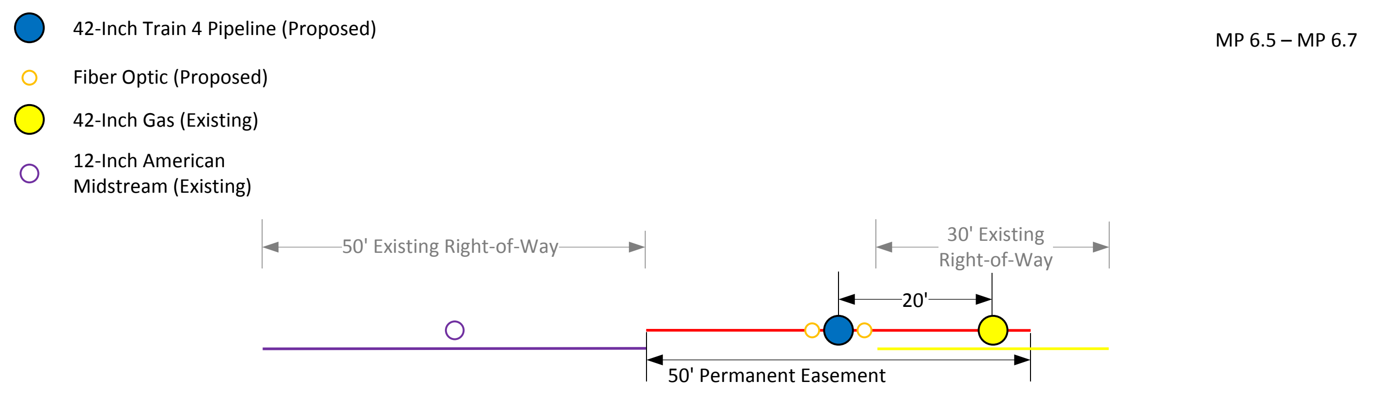
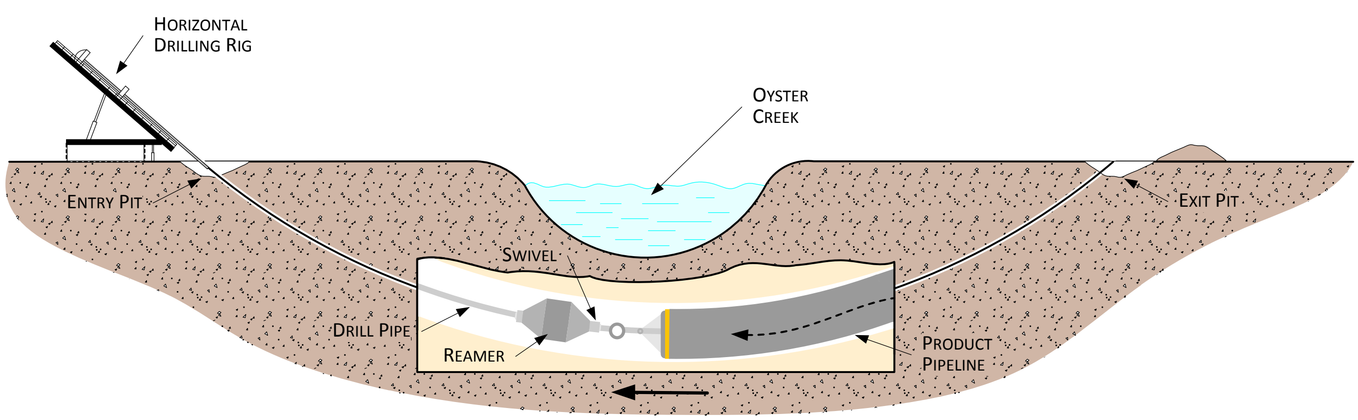
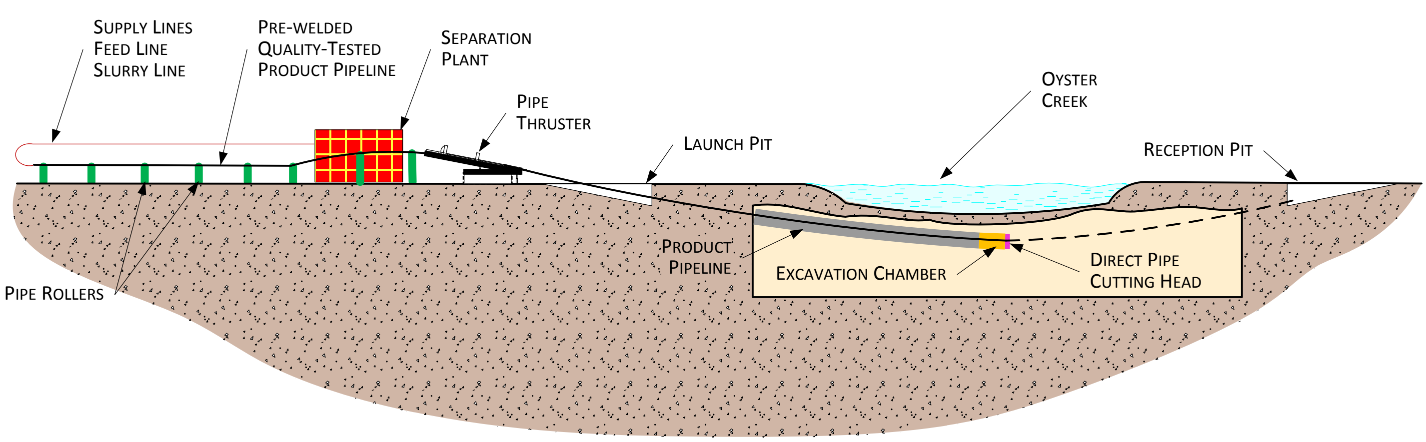


CROSS-SECTION

CONSTRUCTION TYPICAL - HDD



CONSTRUCTION TYPICAL - DIRECT PIPE



Typical Figure 20
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
HDD and Direct Pipe Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

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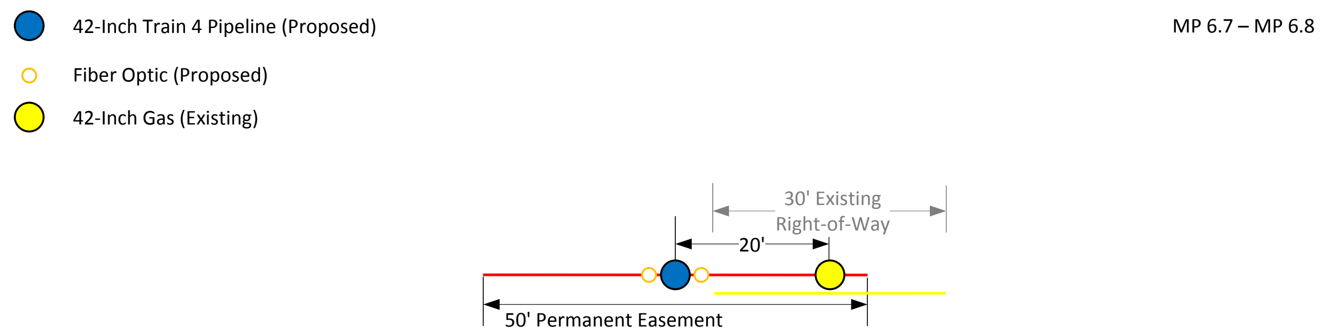
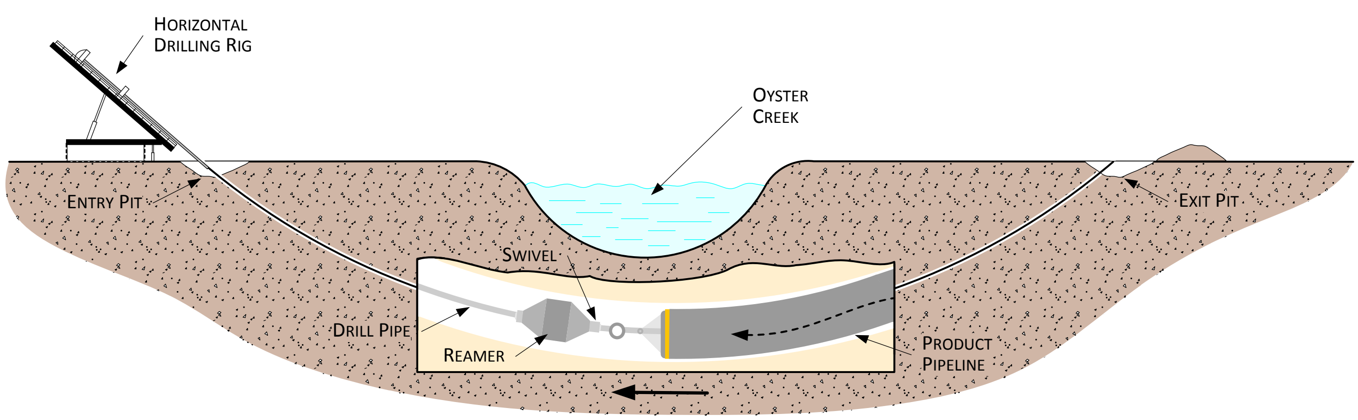
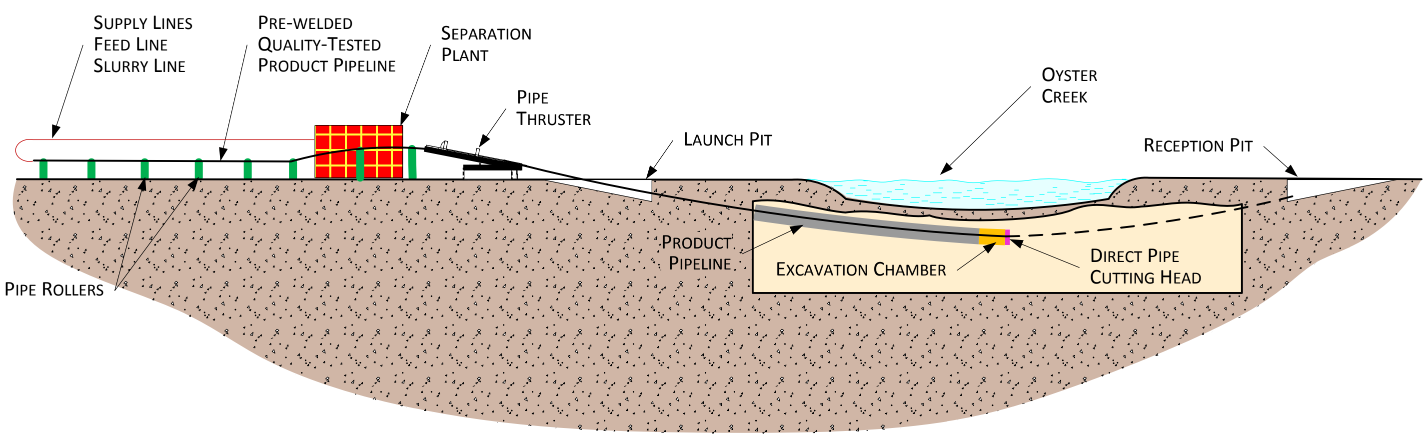


CROSS-SECTION

CONSTRUCTION TYPICAL - HDD



CONSTRUCTION TYPICAL - DIRECT PIPE



Typical Figure 21
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
HDD and Direct Pipe Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

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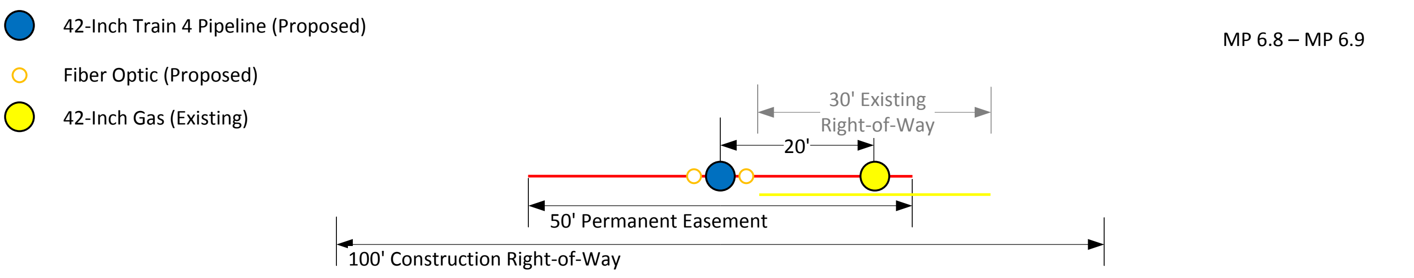
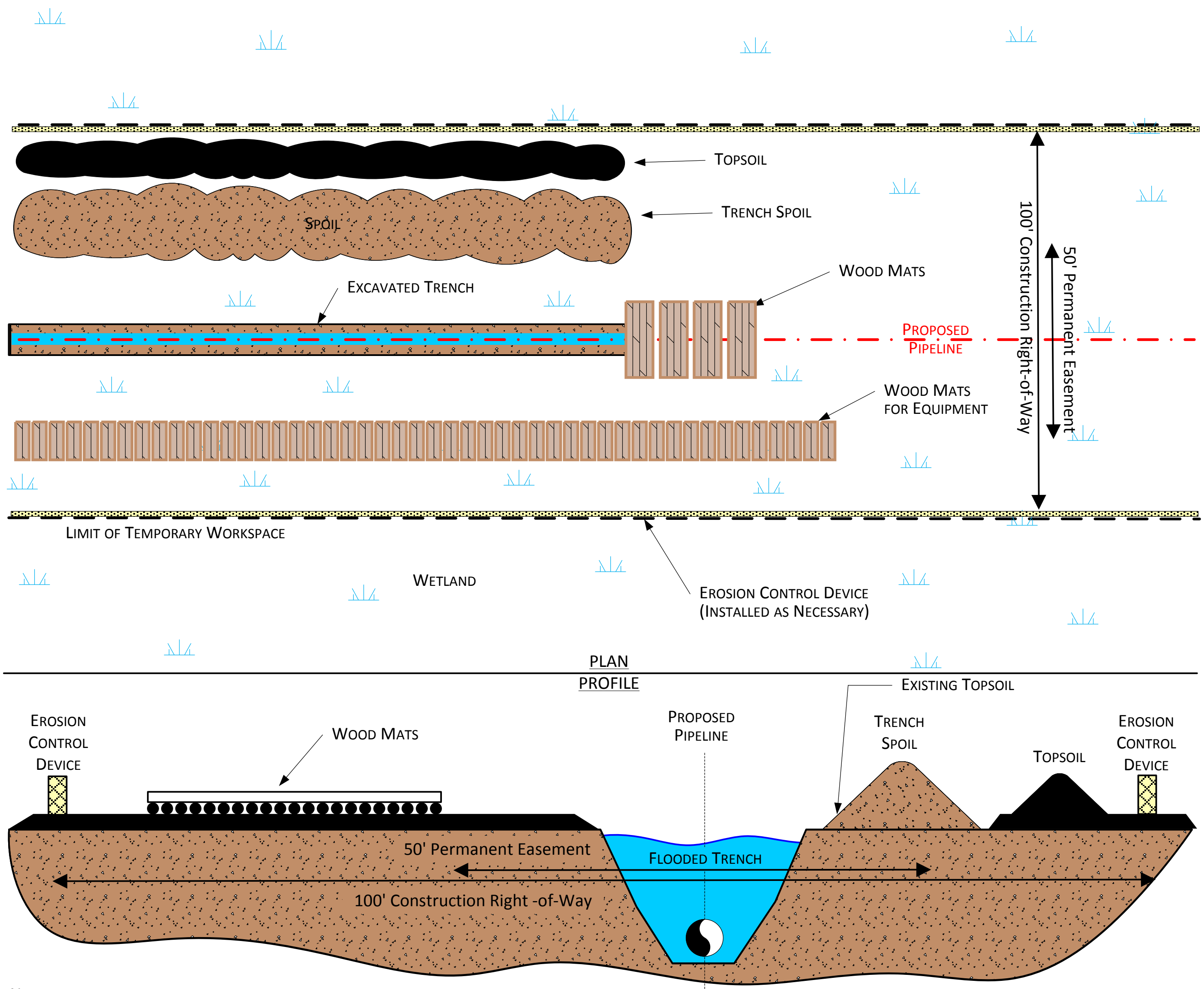


CONSTRUCTION TYPICALS



Notes:

1. Construction shall be performed in accordance with wetland and waterbody construction and mitigation procedures and upland erosion control, revegetation, and maintenance plan.
2. Construction shall be performed in accordance with all applicable federal, state, and local permits.
3. Erosion control devices to be installed as necessary.

For environmental review purposes only.

Typical Figure 22
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and Open Cut Pipeline Construction Within Wetlands Typicals
Brazoria County, Texas

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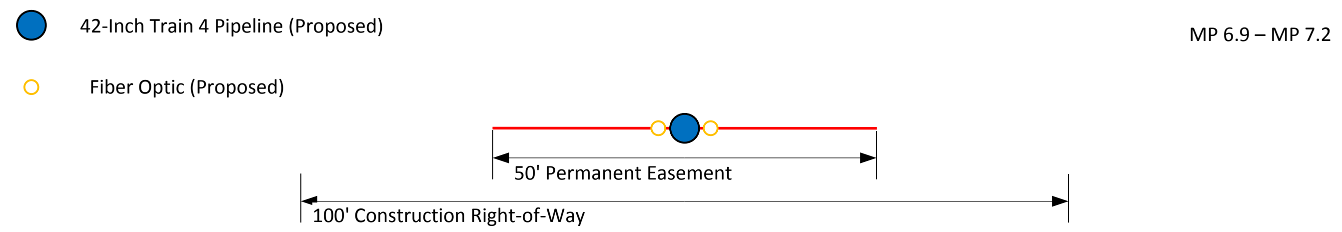
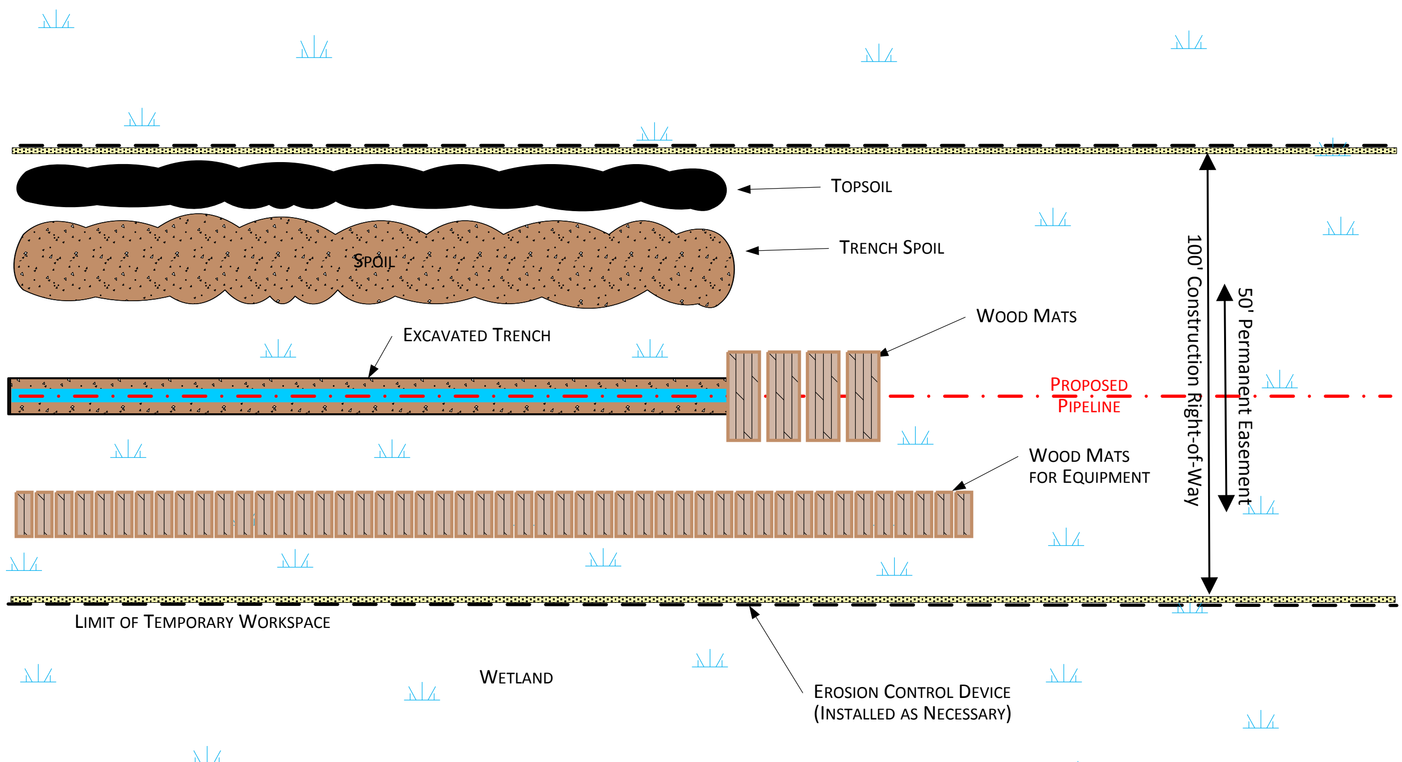


CROSS-SECTION

CONSTRUCTION TYPICALS



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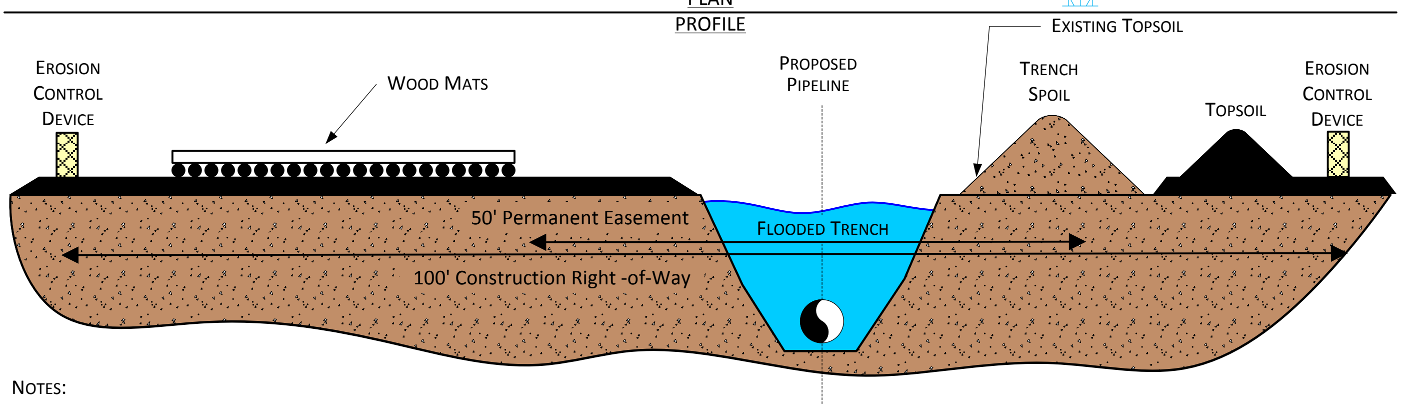

NOTES:

1. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WETLAND AND WATERBODY CONSTRUCTION AND MITIGATION PROCEDURES AND UPLAND EROSION CONTROL, REVEGETATION, AND MAINTENANCE PLAN.
2. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL PERMITS.
3. EROSION CONTROL DEVICES TO BE INSTALLED AS NECESSARY.

Typical Figure 23
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and Open Cut
Pipeline Construction Within Wetlands Typicals
Brazoria County, Texas

For environmental review purposes only.

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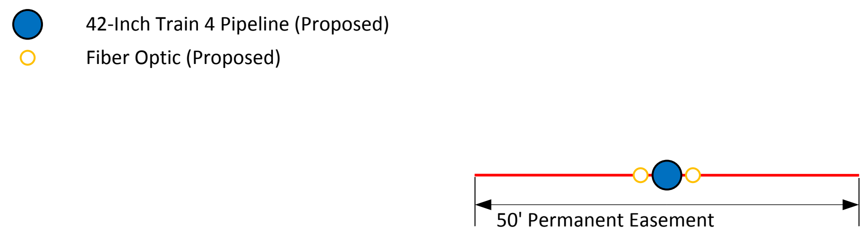
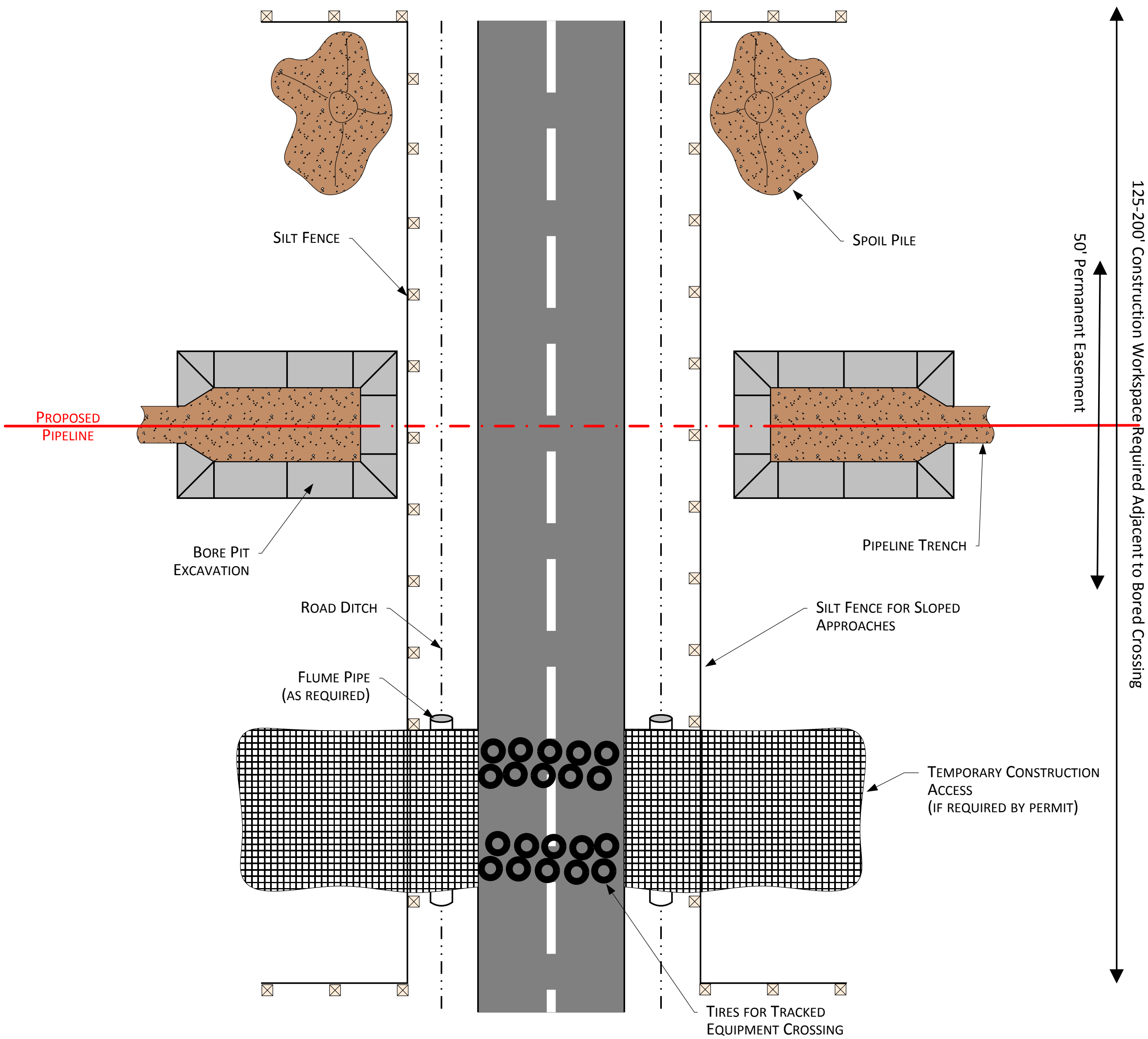


MP 7.2 – MP 7.3

CROSS-SECTION

CONSTRUCTION TYPICALS



Typical Figure 24
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Bore Pipeline Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

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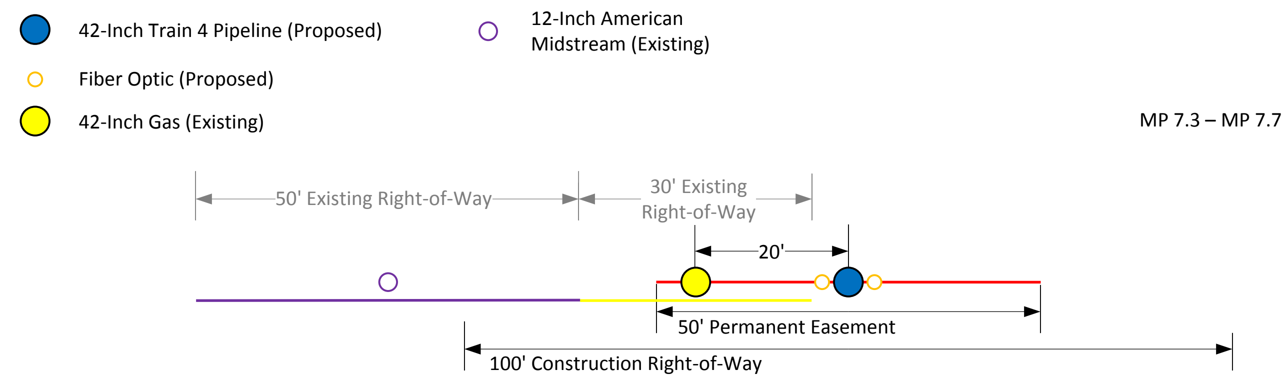
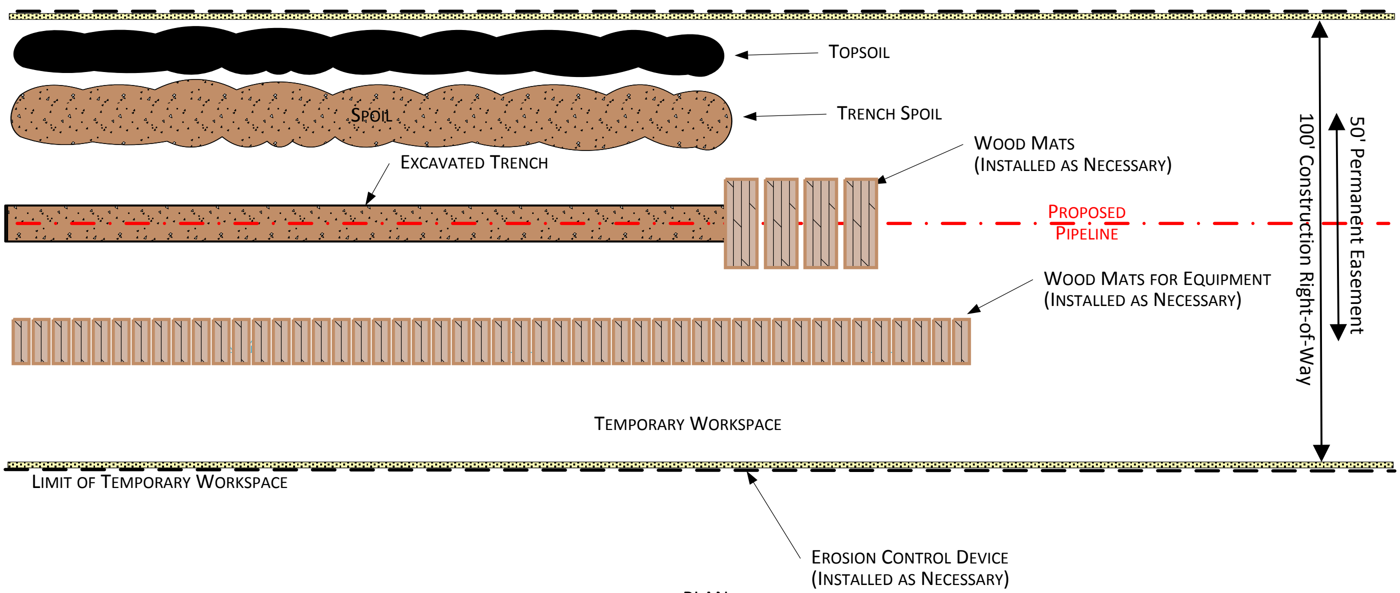


CROSS-SECTION

CONSTRUCTION TYPICALS



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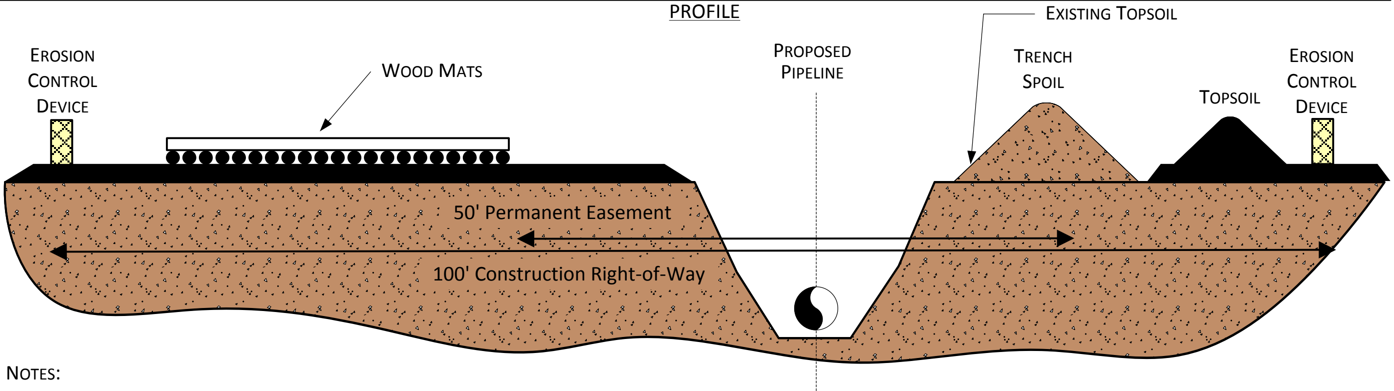


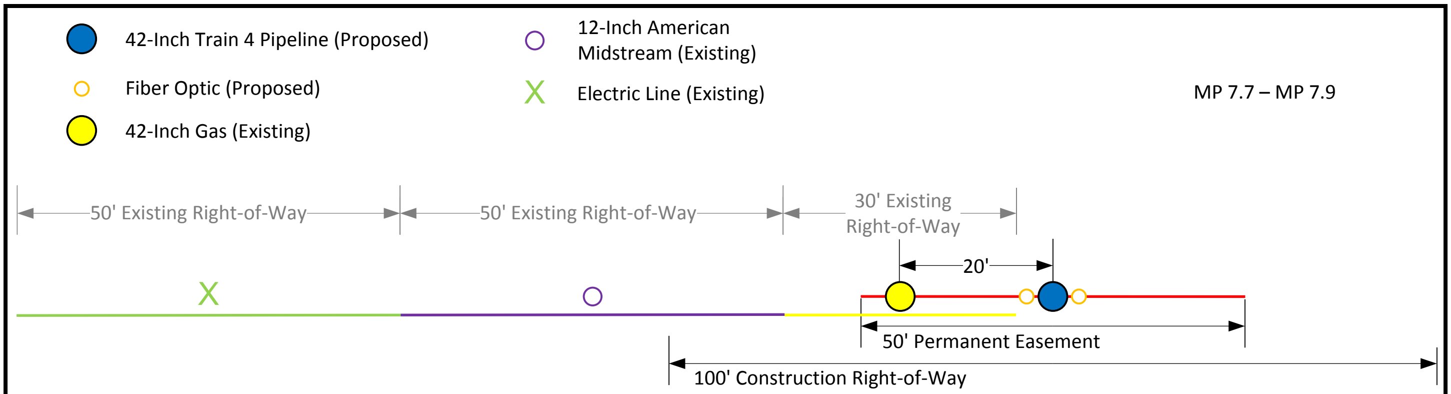
Notes:

1. Construction shall be performed in accordance with wetland and waterbody construction and mitigation procedures and upland erosion control, revegetation and maintenance plan.
2. Construction shall be performed in accordance with all applicable federal, state, and local permits.
3. Erosion control devices to be installed as necessary.

Typical Figure 25
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Open Cut Pipeline Construction Typicals
Brazoria County, Texas

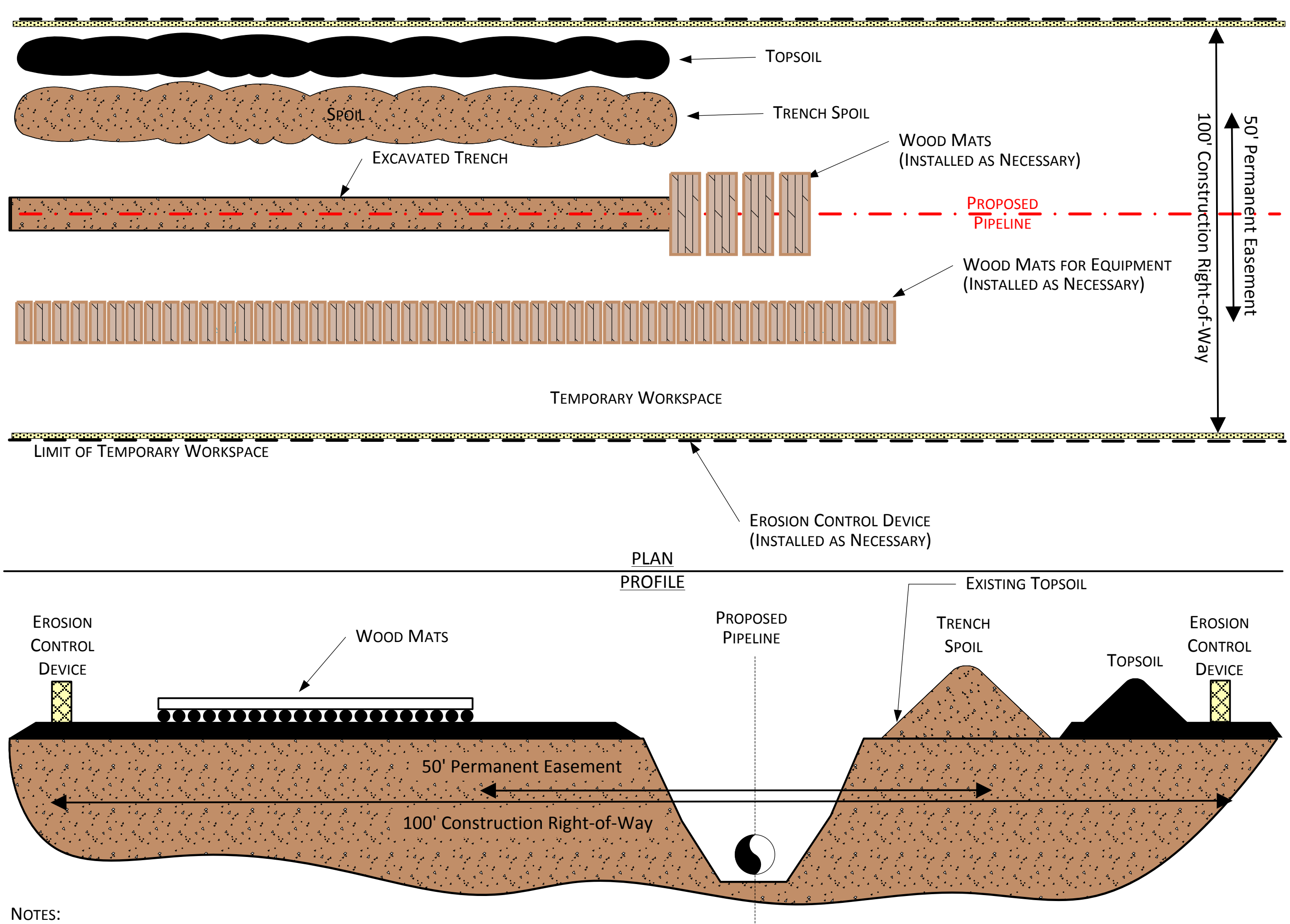
For environmental review purposes only.

M:\Clients\D-F\FRE\Liquefaction_Visio\2017\10_FRE_T4_APDX_1_C_25.VSD | SCALE: NTS | REVISED: 10/30/2017 | DRAWN BY: 0239



CROSS-SECTION

CONSTRUCTION TYPICALS



Notes:

1. Construction shall be performed in accordance with wetland and waterbody construction and mitigation procedures and upland erosion control, revegetation and maintenance plan.
2. Construction shall be performed in accordance with all applicable federal, state, and local permits.
3. Erosion control devices to be installed as necessary.

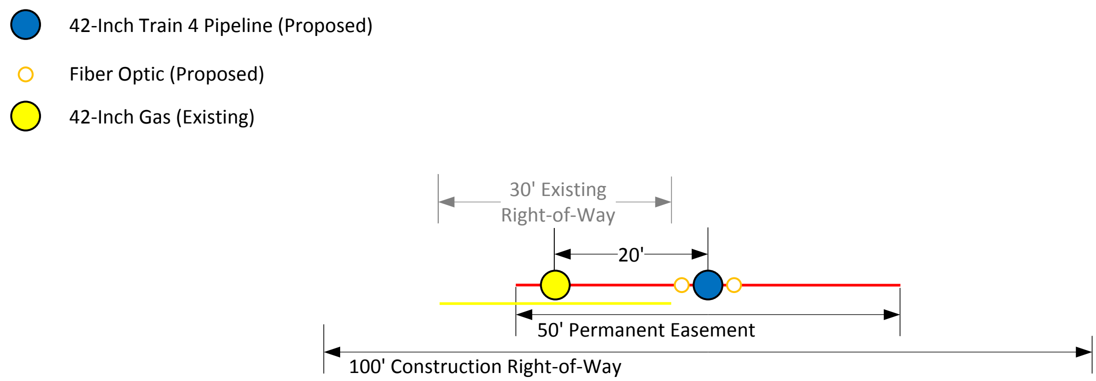
Typical Figure 26
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and Open Cut Pipeline Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

FREEPORT LNG

ERM

M:\Clients\D-F\FRE\Liquefaction_Visio\2017\10_FRE_T4_APDX_1_C_26.VSD	SCALE: NTS		REVISED: 10/30/2017	DRAWN BY: 0239

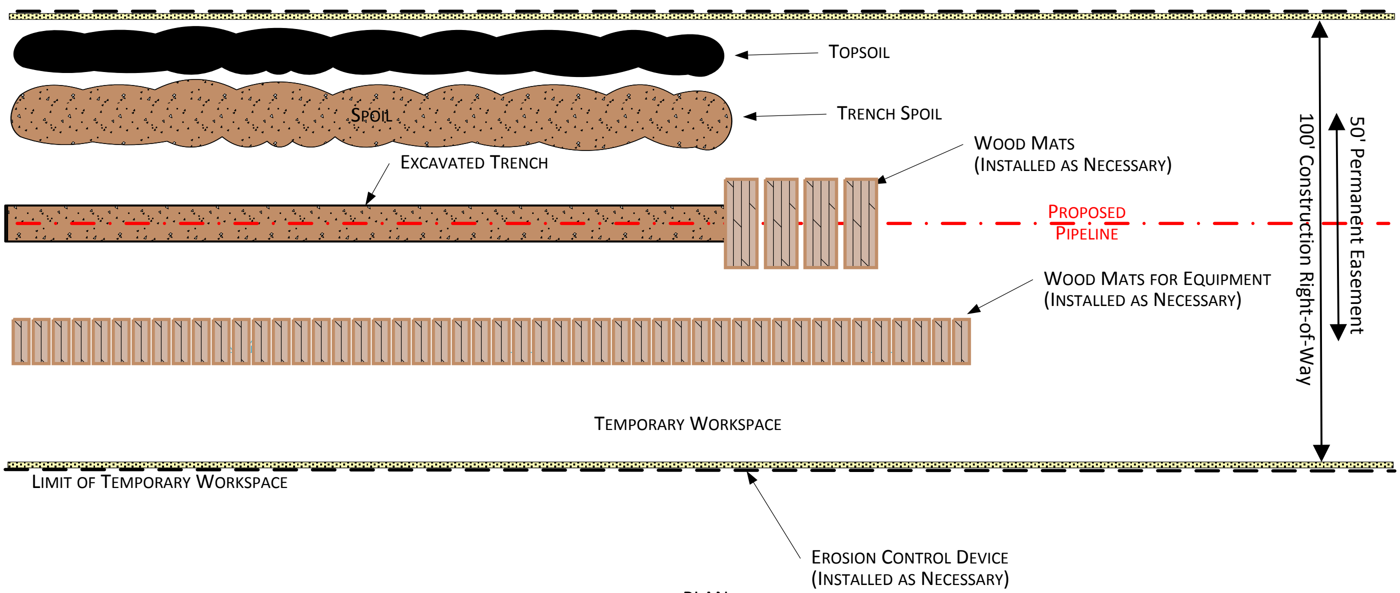


MP 7.9 – MP 8.5
MP 8.5 – MP 8.7*
MP 8.7 – MP 10.0
MP 10.4 – MP 10.6

*Permanent Easement in this segment is 10' wide.

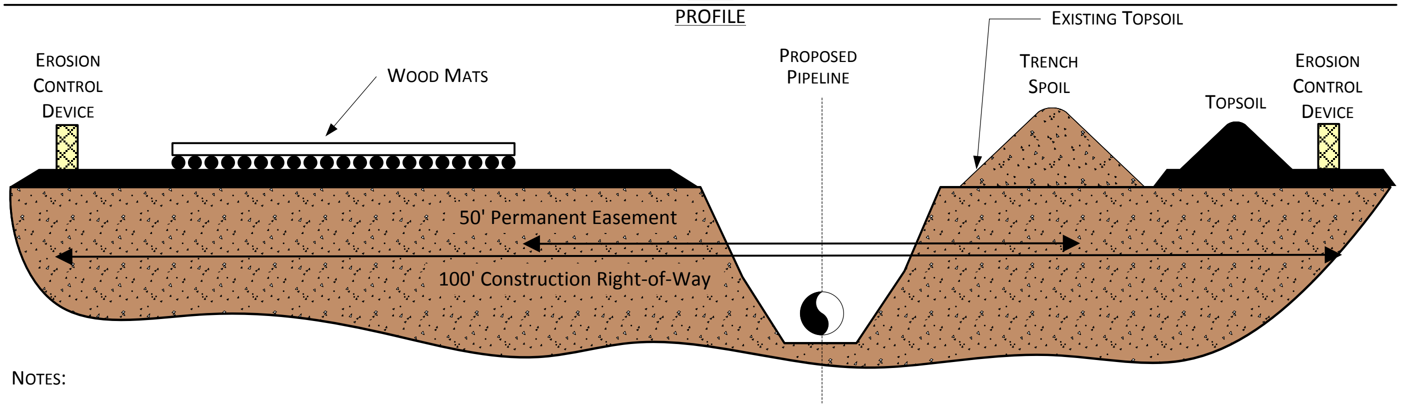
CROSS-SECTION

CONSTRUCTION TYPICALS



PLAN

PROFILE



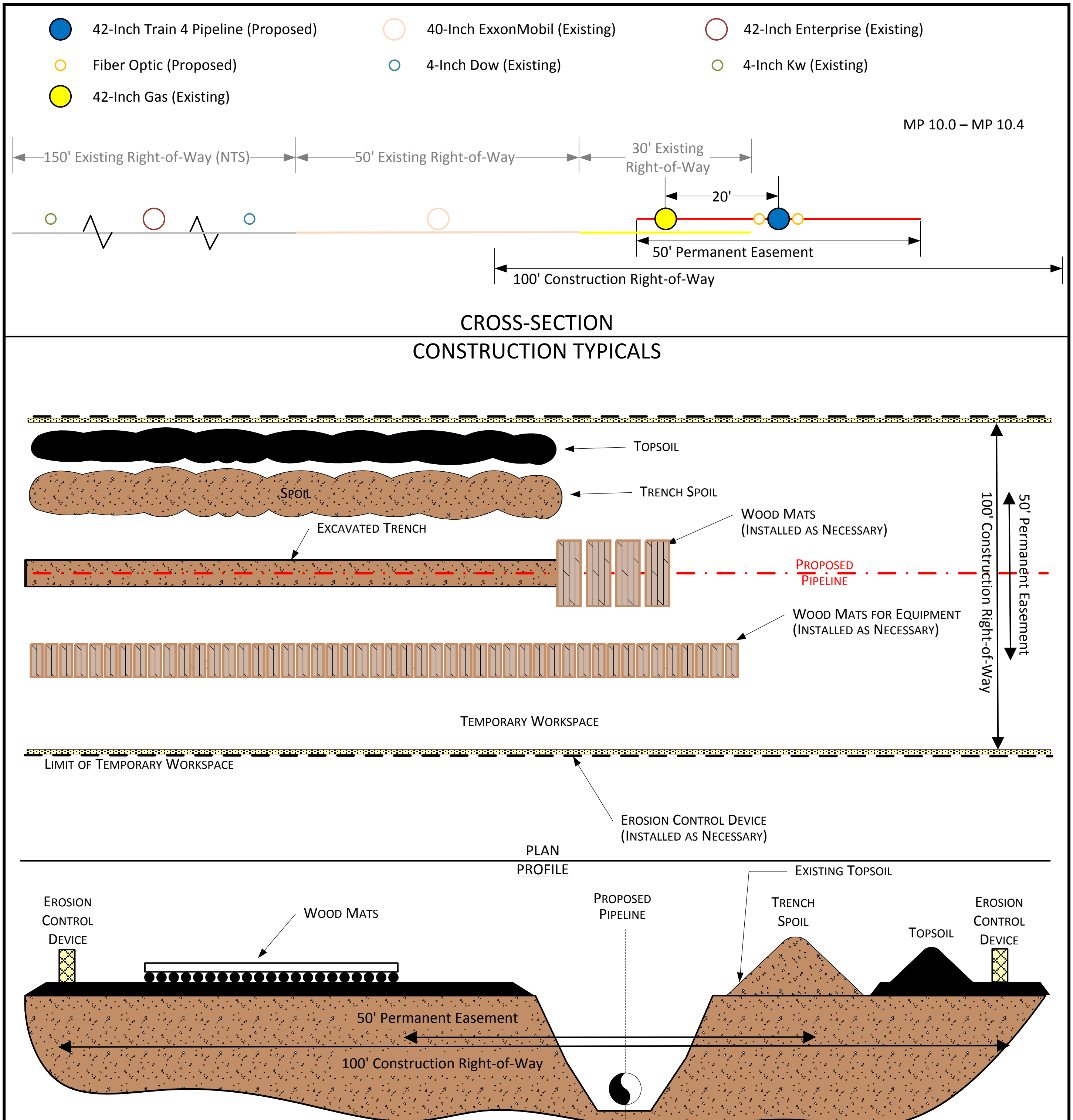
Notes:

1. Construction shall be performed in accordance with wetland and waterbody construction and mitigation procedures and upland erosion control, revegetation and maintenance plan.
2. Construction shall be performed in accordance with all applicable federal, state, and local permits.
3. Erosion control devices to be installed as necessary.

For environmental review purposes only.

Typical Figure 27
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Open Cut Pipeline Construction Typicals
Brazoria County, Texas

M:\Clients\D-F\FRE\Liquefaction_Visio\2017\10_FRE_T4_APDX_1_C_27.VSD	SCALE: NTS		REVISED: 10/31/2017	DRAWN BY: 0239



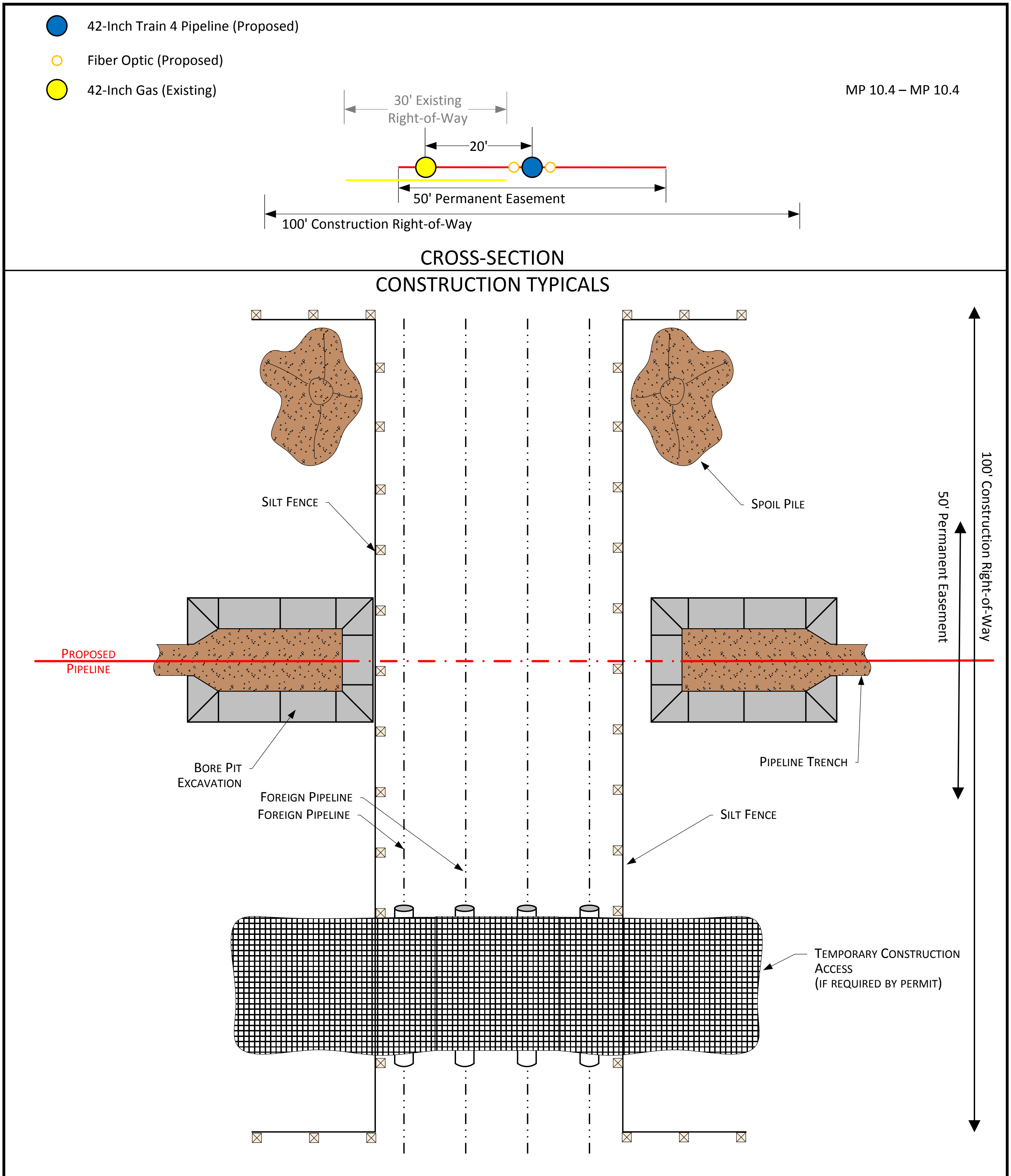
NOTES:

1. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WETLAND AND WATERBODY CONSTRUCTION AND MITIGATION PROCEDURES AND UPLAND EROSION CONTROL, REVEGETATION AND MAINTENANCE PLAN.
2. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL PERMITS.
3. EROSION CONTROL DEVICES TO BE INSTALLED AS NECESSARY.

For environmental review purposes only.

Typical Figure 28
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Open Cut Pipeline Construction Typicals
Brazoria County, Texas

M:\Clients\D-F\FRE\Liquefaction_Visio\2017\10_FRE_T4_APDX_1_C_28.VSD	SCALE: NTS	REVISED: 10/30/2017	DRAWN BY: 0239

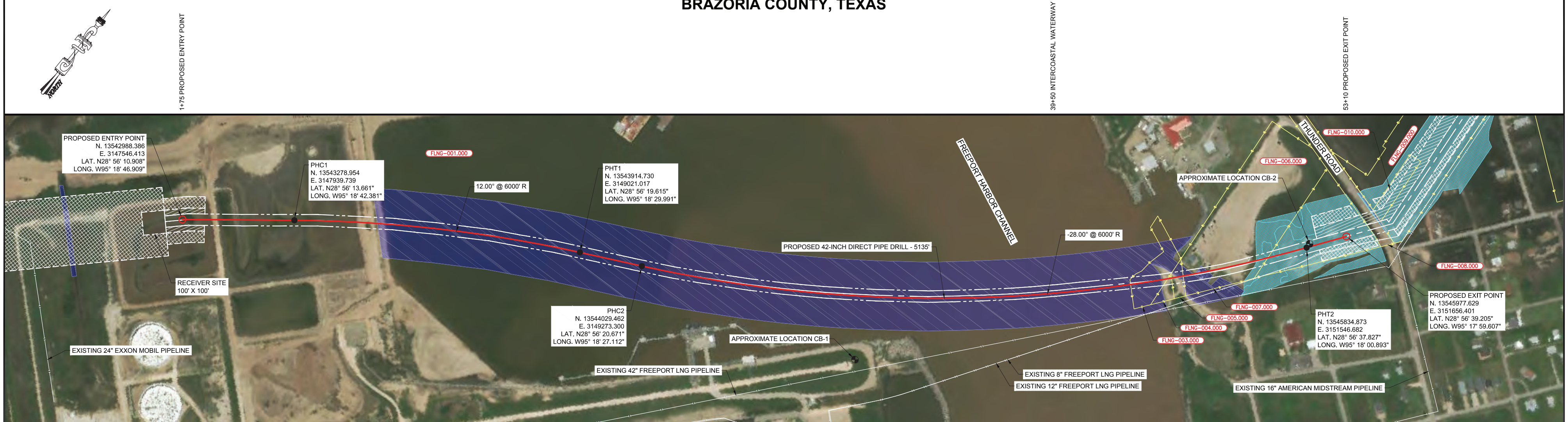


Typical Figure 29
Freeport LNG – Train 4 Project
Pipeline Facilities Cross-Section and
Bore Pipeline Construction Typicals
Brazoria County, Texas

For environmental review purposes only.

M:\Clients\D-F\FRE\Liquefaction_Visio\2017\10_FRE_T4_APDX_1_C_29.VSD	SCALE: NTS		REVISED: 10/30/2017	DRAWN BY: 0239

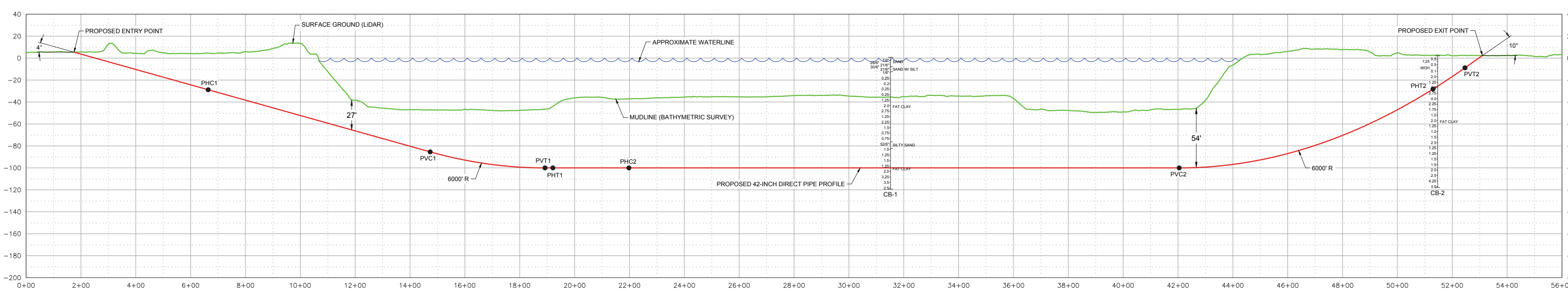
BRAZORIA COUNTY, TEXAS



PLAN VIEW

200 0 200 400

SCALE: 1" = 200



PROFILE VIEW

200 0 200 400

HORIZONTAL SCALE: 1" = 200

50 0 50 100

VERTICAL SCALE: 1" = 50

30% REVIEW
NOT FOR CONSTRUCTION

* GRID STATIONING IS BASED ON AN ARBITRARY REFERENCE POINT.

HORIZONTAL DIRECTIONAL DRILL DATA 42-IN FREEPORT HARBOR		
DESCRIPTION	* STATION (ft)	ELEVATION (ft)
ENTRY @ 4°	1+75.00	5.40
PHC1 = 12.00° 6000' RADIUS	6+64.02	-28.79
PVC1 = 6000' RADIUS	14+73.32	-85.38
PVT1 =	18+91.86	-100.00
PHT1 =	19+20.65	-100.00
PHC2 = -28.00° 6000' RADIUS	21+97.80	-100.00
PVC2 = 6000' RADIUS	42+04.45	-100.00
PHT2 =	51+29.95	-28.19
PVT2 =	52+46.33	-8.85
EXIT @ 10°	53+10.00	2.38
HORIZONTAL DISTANCE (ft) = 5135.00		
DIRECTIONAL DRILL PIPE LENGTH (ft) = 5144.80		

BORING LEGEND

SPT (N)
UCS (PSI)
SOIL DESCRIPTION
BORING NAME

DRAWING LEGEND

- PROPOSED HDD CROSSING
- PROPOSED STRINGING ALIGNMENT
- PROPOSED PIPELINE CENTERLINE
- EXISTING PIPELINES
- PERMANENT RIGHT OF WAY (ROW)
- RAILROAD TRACKS
- PROPERTY LINE
- WETLAND AREA
- WATERBODY
- TEMPORARY WORKSPACE (TW)
- ADDITIONAL TEMPORARY WORKSPACE (ATWS)
- HDD ENTRY/EXIT POINT
- GEOTECHNICAL BOREHOLE
- HDD PROFILE GEOMETRY POINT

DRAWING COORDINATE SYSTEM	
HORIZONTAL DATUM	NAD83 - SPCS, S. CENTRAL , US FOOT
VERTICAL DATUM	NAV88

PIPE SPECIFICATIONS

1. PRODUCT PIPE WILL CONSIST OF 42.000" O.D. 1.000 W.T., API-5L X-65 PIPE WITH 14-16 MILS OF FUSION BONDED EPOXY (FBE) AND 30-40 MILS ARO.
2. MAXIMUM ALLOWABLE OPERATING PRESSURE (MAOP) = 1440 psi.

REFERENCE DRAWINGS	REV.	DATE	REVISION	APPVD.
	A	10/24/17	PLAN & PROFILE	BKP

THINK SAFETY FIRST

BRAZORIA TEXAS

TITLE

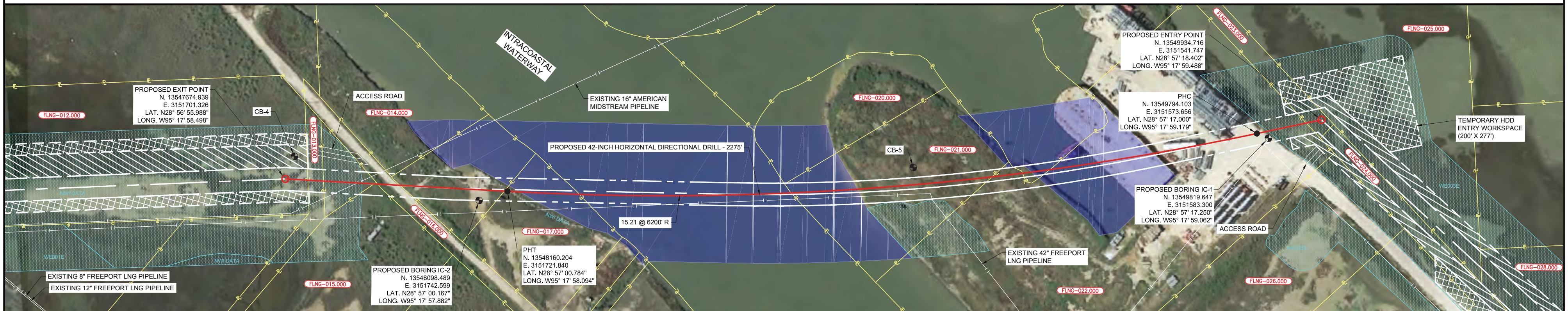
DESIGNED: BKP	DRAWN: BTL	CHECKED: BKP	PROJECT NO. 10171	REV. A
SCALE AS NOTED	DATE 09/28/2017	DWG. NO. FLNG_42-IN_DP01 SHT. 1 OF 1		

Figure D-1
Freeport LNG - Train 4 Project
Site-specific Drawing
From MP 0.0-1.0

Scale valid for 24" x 36" print

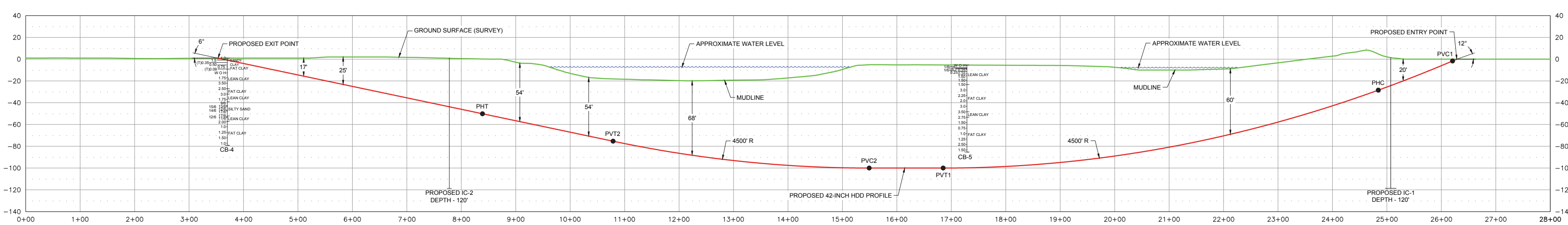
BRAZORIA COUNTY, TEXAS

3+53 PROPOSED EXIT POINT
5+10 EXISTING 16" AMERICAN MIDSTREAM PIPELINE
5+83 CANAL DRIVE
26+28 PROPOSED ENTRY POINT



PLAN VIEW

GRAPHIC SCALE IN FEET



PROFILE VIEW

HORIZONTAL SCALE: 1" = 100

VERTICAL SCALE: 1" = 50

* GRID STATIONING IS BASED ON AN ARBITRARY REFERENCE POINT.

HORIZONTAL DIRECTIONAL DRILL DATA INTRACOASTAL WATERWAY		
DESCRIPTION	* STATION (ft)	ELEVATION (ft)
ENTRY @ 12°	26+28.35	0.00
PVC1 = 4500' RADIUS	26+20.53	-1.66
PVT1 =	16+84.92	-100.00
PHC = 15.21° 6200' RADIUS	24+84.17	-28.45
PHT =	8+38.74	-50.12
PVC2 = 4500' RADIUS	15+49.06	-100.00
PVT2 =	10+78.68	-75.35
EXIT @ 6°	3+53.04	0.92
HORIZONTAL DISTANCE (ft) = 2275.32		
DIRECTIONAL DRILL PIPE LENGTH (ft) = 2287.22		

30% REVIEW
NOT FOR CONSTRUCTION

BORING LEGEND

SPT (N)
UCS (PSI)
SOIL DESCRIPTION
BORING NAME

DRAWING LEGEND

- PROPOSED HDD CROSSING
- PROPOSED STRINGING ALIGNMENT
- PROPOSED PIPELINE CENTERLINE
- EXISTING PIPELINES
- PERMANENT RIGHT OF WAY (ROW)
- RAILROAD TRACKS
- PROPERTY LINE
- WETLAND AREA
- WATERBODY
- TEMPORARY WORKSPACE (TW)
- ADDITIONAL TEMPORARY WORKSPACE (ATWS)
- HDD ENTRY/EXIT POINT
- GEOTECHNICAL BOREHOLE
- HDD PROFILE GEOMETRY POINT

DRAWING COORDINATE SYSTEM	
HORIZONTAL DATUM	NAD83 - SPCS, S. CENTRAL ZONE, US FOOT
VERTICAL DATUM	NAV88

PIPE SPECIFICATIONS

1. PRODUCT PIPE WILL CONSIST OF 42.000" O.D. 1.000 W.T., API-5L X-65 PIPE WITH 14-16 MILS OF FUSION BONDED EPOXY (FBE) AND 30-40 MILS ARO.
2. MAXIMUM ALLOWABLE OPERATING PRESSURE (MAOP) = 1440 psi.

REFERENCE DRAWINGS	REV.	DATE	REVISION	APPVD.
8J16045-01-HDD-42-2B	A	10/24/17	PLAN AND PROFILE	KBP

THINK SAFETY FIRST

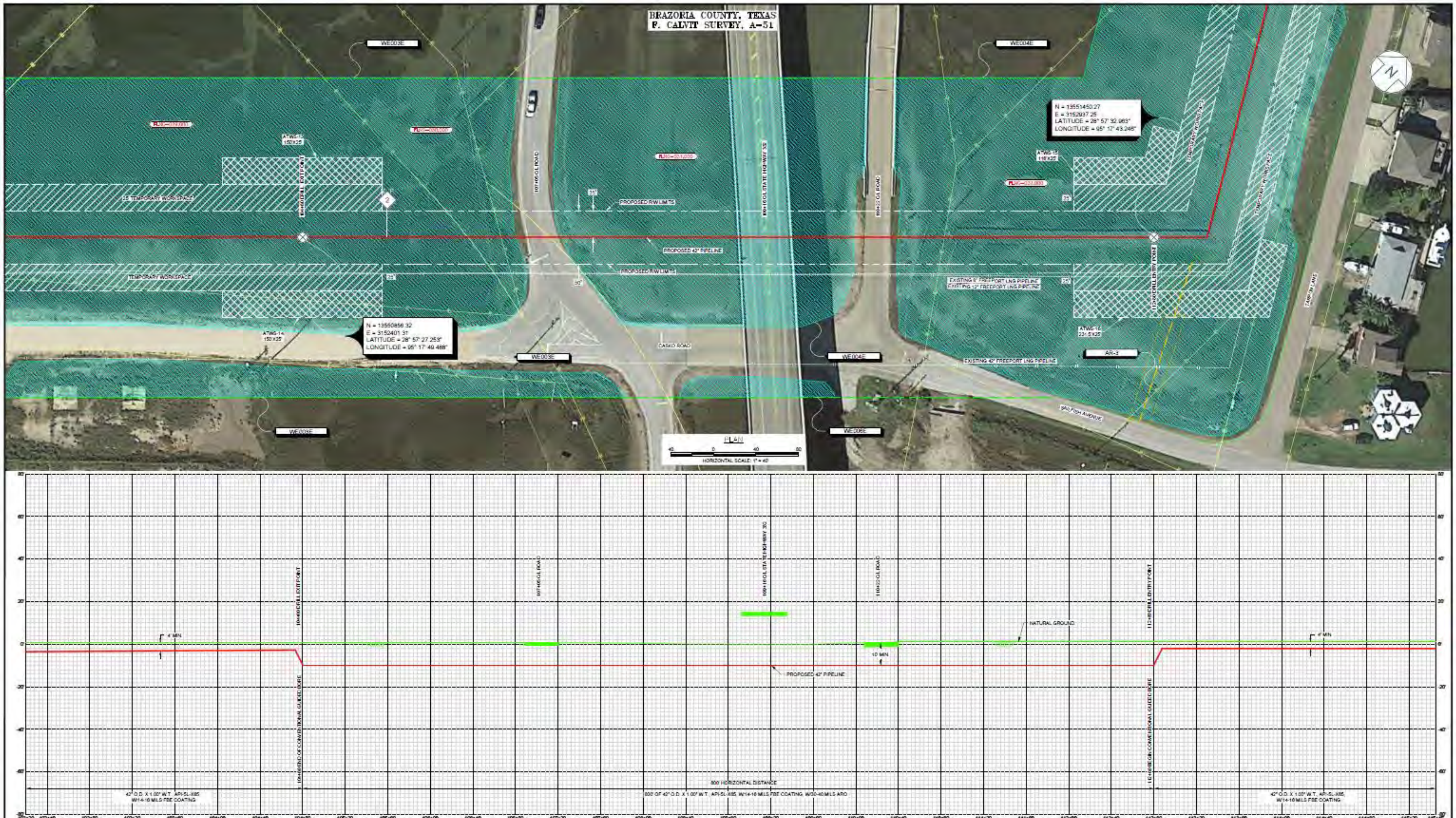
BRAZORIA TEXAS

TITLE

DESIGNED:	DRAWN:	CHECKED:	PROJECT NO.	REV.
BKP	BTL	BKP	10171	A
SCALE AS NOTED	DATE 09/28/2017		DWG. NO. FLNG_42IN_ SHT. 1 OF 1	

Figure D-2
Freeport LNG - Train 4 Project
Site-specific Drawing
From MP 1.3-1.7

Scale valid for 24" x 36" print



LEGEND

- PROPOSED 42" PIPELINE
- PROPOSED R/W
- PROPERTY LINE
- ABSTRACT LINE
- EXISTING PIPELINE
- ACCESS ROADS
- ENVIRONMENTAL SURVEY CORRIDOR
- WETLAND AREA
- WATERBODY
- TEMPORARY WORKSPACE
- ADDITIONAL TEMPORARY WORKSPACE

NOTE:
BEARINGS, DISTANCES AND COORDINATES SHOWN ARE BASED ON TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83).

PROFILE
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 20'

PRELIMINARY
DATE: 1/19/17
– NOT FOR CONSTRUCTION –

REV	DATE	BY	DESCRIPTION	CHKD	TECH	PROJ	ENG	OPS	P.M.
P2	1/19/17	HGA	PRELIMINARY	HGA					
P1	1/05/17	HGA	PRELIMINARY	HGA					
P	12/09/16	HGA	PRELIMINARY	HGA					
				CONTRACTOR		FREEPORT LNG			

REVISION

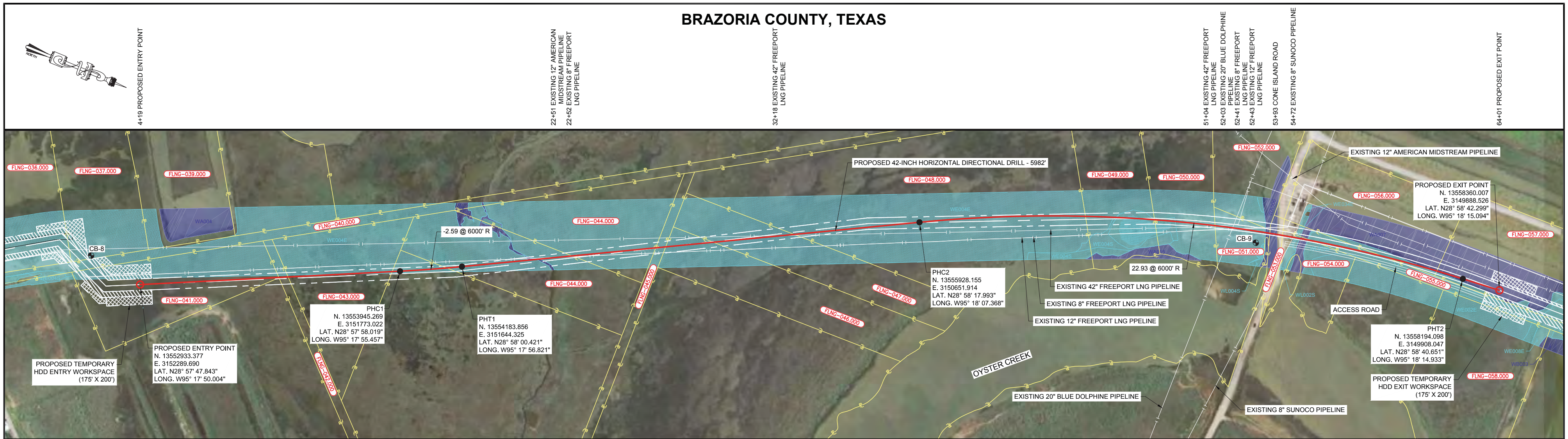
DRAWN BY	HGA	11/29/16
DESIGNED BY	HGA	11/29/16
CHECKED BY		
APPROVED BY		
HGA JOB NO.	8.J16045.01.0	
PLOT SCALE	1:1	
MODEL ID	8.J16045.01	

Project	Area	Doc Type	Eng Code	Seq No	Rev
0000	000	–	0000	000	P

Figure D-3
Freeport LNG - Train 4 Project
Site-specific Drawing
From MP 2.0 to 2.1

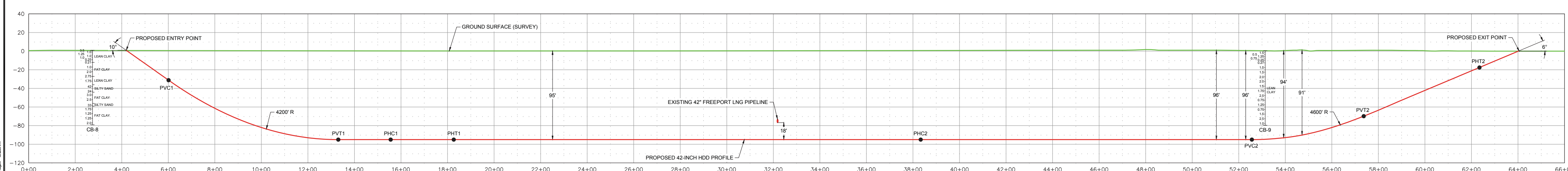
SCALE	DRAWING NUMBER	REV
AS SHOWN	8.J16045.01-HDD-42-3	P2

BRAZORIA COUNTY, TEXAS



PLAN VIEW

GRAPHIC SCALE IN FEET



PROFILE VIEW

HORIZONTAL SCALE: 1" = 200

VERTICAL SCALE: 1" = 50

* GRID STATIONING IS BASED ON AN ARBITRARY REFERENCE POINT.

HORIZONTAL DIRECTIONAL DRILL DATA MARSH AREA		
DESCRIPTION	* STATION (ft)	ELEVATION (ft)
ENTRY @ 10°	4+19.48	0.86
PVC1 = 4200' RADIUS	6+01.28	-26.19
PVT1 =	13+30.60	-95.00
PHC1 = -2.59° 6000' RADIUS	15+55.65	-95.00
PHT1 =	18+26.75	-95.00
PHC2 = 22.93° 6000' RADIUS	38+33.61	-95.00
PVC2 = 4600' RADIUS	52+60.54	-95.00
PVT2 =	57+37.37	-69.80
PHT2 =	62+34.51	-17.55
EXIT @ 6°	64+01.48	0.00
HORIZONTAL DISTANCE (ft) = 5982.00		
DIRECTIONAL DRILL PIPE LENGTH (ft) = 5996.06		

30% REVIEW
NOT FOR CONSTRUCTION

THINK SAFETY FIRST

BORING LEGEND

SPT (N)
UCS (PSI)
SOIL DESCRIPTION
BORING NAME

DRAWING LEGEND

- PROPOSED HDD CROSSING
- PROPOSED STRINGING ALIGNMENT
- PROPOSED PIPELINE CENTERLINE
- EXISTING PIPELINES
- PERMANENT RIGHT OF WAY (ROW)
- RAILROAD TRACKS
- PROPERTY LINE
- WETLAND AREA
- WATERBODY
- TEMPORARY WORKSPACE (TW)
- ADDITIONAL TEMPORARY WORKSPACE (ATWS)
- HDD ENTRY/EXIT POINT
- GEOTECHNICAL BOREHOLE
- HDD PROFILE GEOMETRY POINT

DRAWING COORDINATE SYSTEM

HORIZONTAL DATUM	NAD83 - SPCS, S. CENTRAL ZONE , US FOOT
VERTICAL DATUM	NAV88

PIPE SPECIFICATIONS

1. PRODUCT PIPE WILL CONSIST OF 42.000" O.D. 1.000 W.T., API-5L X-65 PIPE WITH 14-16 MILS OF FUSION BONDED EPOXY (FBE) AND 30-40 MILS ARO.
2. MAXIMUM ALLOWABLE OPERATING PRESSURE (MAOP) = 1440 psi.

REFERENCE DRAWINGS	REV.	DATE	REVISION	APPVD.
8J16045-01-HDD-42-4A	A	10/24/17	PLAN AND PROFILE	KBP

BRAZORIA TEXAS

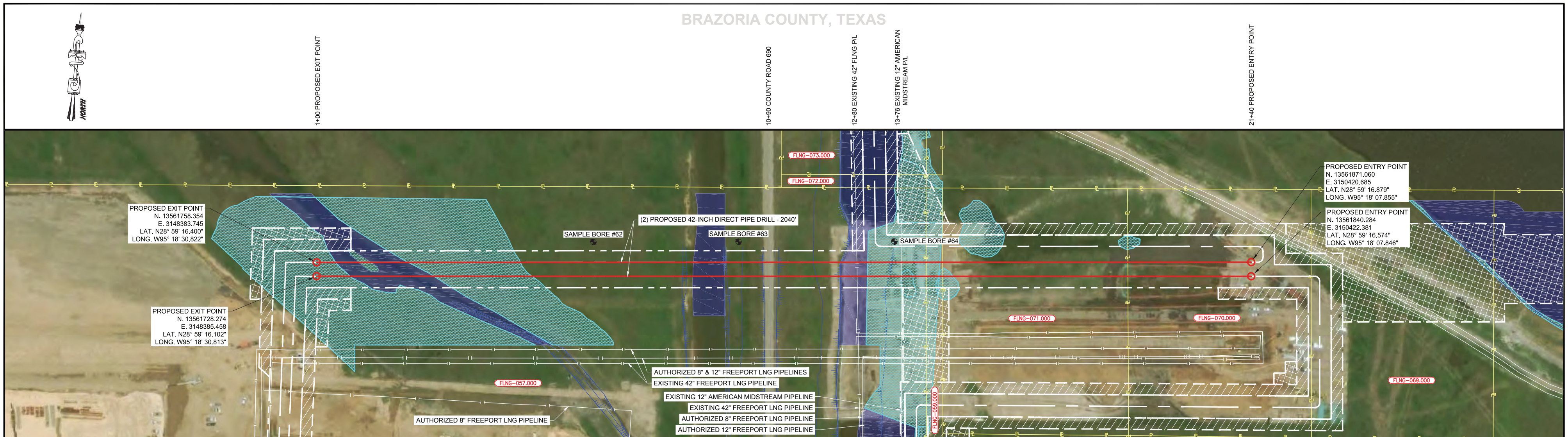
TITLE

DESIGNED: BKP DRAWN: BTL CHECKED: BKP PROJECT NO. 10171 REV. A

SCALE AS NOTED DATE 09/28/2017 DWG. NO. FLNG_42IN SHT. 1 OF 1

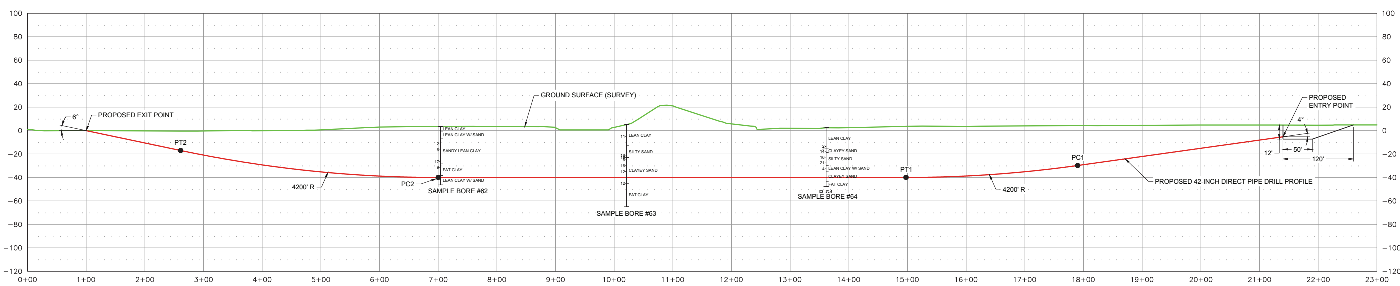
Figure D-4
Freeport LNG - Train 4 Project
Site-specific Drawing
MP 2.4 to 3.6

Scale valid for 24" x 36" print



PLAN VIEW

SCALE: 1" = 100



PROFILE VIEW

HORIZONTAL SCALE: 1" = 100

VERTICAL SCALE: 1" = 50

* GRID STATIONING IS BASED ON AN ARBITRARY REFERENCE POINT.

HORIZONTAL DIRECTIONAL DRILL DATA 42-IN CR-690 LEVEE DIRECT PIPE		
DESCRIPTION	STATION (ft)	ELEVATION (ft)
ENTRY @ 4°	21+40.00	-5.32
PC1 = 4200' RADIUS	17+90.38	-29.77
PT1 =	14+97.40	-40.00
PC2 = 4200' RADIUS	6+99.93	-40.00
PT2 =	2+60.91	-16.99
EXIT @ 6°	1+00.00	-0.08
HORIZONTAL DISTANCE (ft) =	2040.00	
DIRECTIONAL DRILL PIPE LENGTH (ft) =	2042.78	

30% REVIEW
NOT FOR CONSTRUCTION

BORING LEGEND

SPT (N)
SOIL DESCRIPTION
UCS (PSI)
BORING NAME

DRAWING LEGEND

- PROPOSED HDD CROSSING
- PROPOSED STRINGING ALIGNMENT
- PROPOSED PIPELINE CENTERLINE
- EXISTING PIPELINES
- PERMANENT RIGHT OF WAY (ROW)
- RAILROAD TRACKS
- PROPERTY LINE
- WETLAND AREA
- WATERBODY
- TEMPORARY WORKSPACE (TW)
- ADDITIONAL TEMPORARY WORKSPACE (ATWS)
- HDD ENTRY/EXIT POINT
- GEOTECHNICAL BOREHOLE
- HDD PROFILE GEOMETRY POINT

DRAWING COORDINATE SYSTEM	
HORIZONTAL DATUM	NAD83 - SPCS, SOUTH CENTRAL ZONE , US FOOT
VERTICAL DATUM	NAV88

PIPE SPECIFICATIONS

1. PRODUCT PIPE WILL CONSIST OF 42.000" O.D. X 1.000 W.T., API-5L X-85 PIPE WITH 14-16 MILS OF FUSION BONDED EPOXY (FBE) AND 30-40 MILS ARO.
2. MAXIMUM ALLOWABLE OPERATING PRESSURE (MAOP) = 1440 psi.

REFERENCE DRAWINGS	REV.	DATE	REVISION	APPVD.
WOODGROUP / FLNG DWG - 104729-9207	A	10/24/17	30% REVIEW	BKP

THINK SAFETY FIRST

BRAZORIA COUNTY TEXAS

TITLE

DESIGNED: BKP	DRAWN: JAM	CHECKED: BKP	PROJECT NO. 10171	REV. A
SCALE AS NOTED	DATE 10/16/17	DWG. NO. 10171 CR690 DP SHT. 1 OF 1		

Figure D-5
Freeport LNG - Train 4 Project
Site-specific Drawing
MP 4.4 to 4.8 and MP 5.1 to 5.5

Scale valid for 24" x 36" print

20180425-5132 FERC PDF (Unofficial) 4/25/2018 1:17:26 PM

LEGEND

MILE POST
STATE HIGHWAY
WETLAND
WATERBODIES
PROPERTY LINE
SURVEY & ABSTRACT LINE
ACCESS ROADS
FOREIGN PIPELINE
POWER LINE
CABLE
C/L WATERWAY
WATERWAY BANK
FENCE
HDD
P.I. OR AS NOTED
ADDITIONAL TEMPORARY WORK SPACE
TEMPORARY WORK SPACE

0 180 360 720 1,080 1,440 Feet

NOTE:
BEARINGS, DISTANCES AND COORDINATES SHOWN ARE BASED ON TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (NAD 83), ALL ELEVATIONS DERIVED FROM GPS OBSERVATIONS.

PRELIMINARY
4/10/18
- NOT FOR CONSTRUCTION -

NO.	DATE	BY	REVISION	CHK	APP
P	4/10/18	CST	PRELIMINARY	MB	MB

DRAWN BY	CST	4/10/18
CHECKED BY	MB	4/10/18
APPROVED BY	MB	4/10/18
HGA JOB NO.	8.J16045.00.0	
PLOT SCALE	1:1	
MODEL ID	8.J16045	
AERIAL DATE	2016	
FLNG DOCUMENT NO.	XXXX-XXX-XX-XXXX-XXX.XXXX	

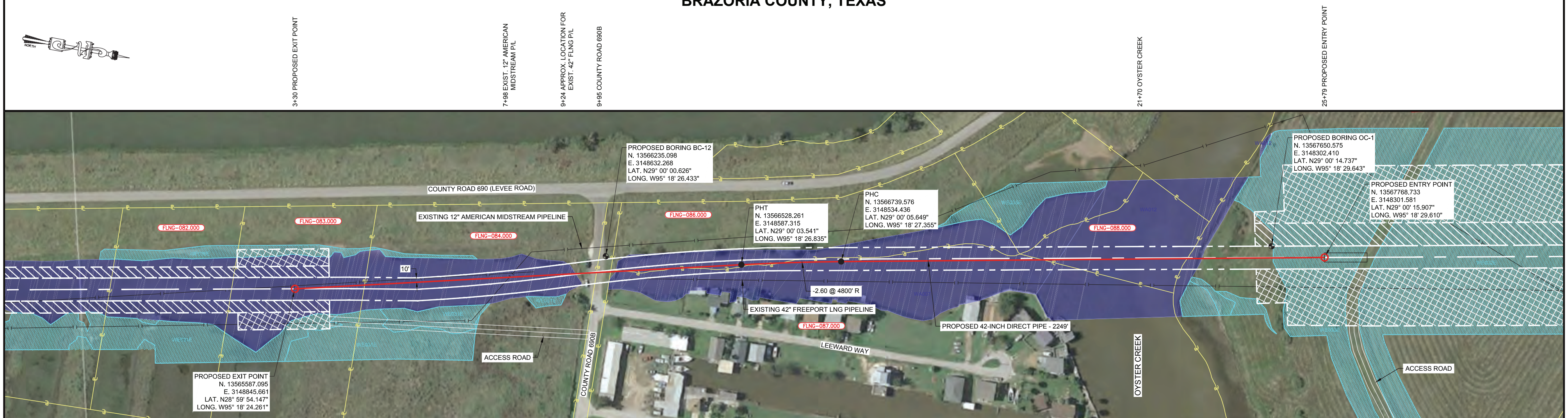
FREEPORT LNG DEVELOPMENT

HUNT, GUILLOT & ASSOCIATES, L.L.C.
603 REYNOLDS DRIVE
RUSTON, LA 71270
(318) 255-6825

Figure D-6
Freeport LNG - Train 4 Project
Proposed 42" Freeport Pipeline
Push/Pull Installation
MP 5.8 to 6.4
BRAZORIA COUNTY, TEXAS

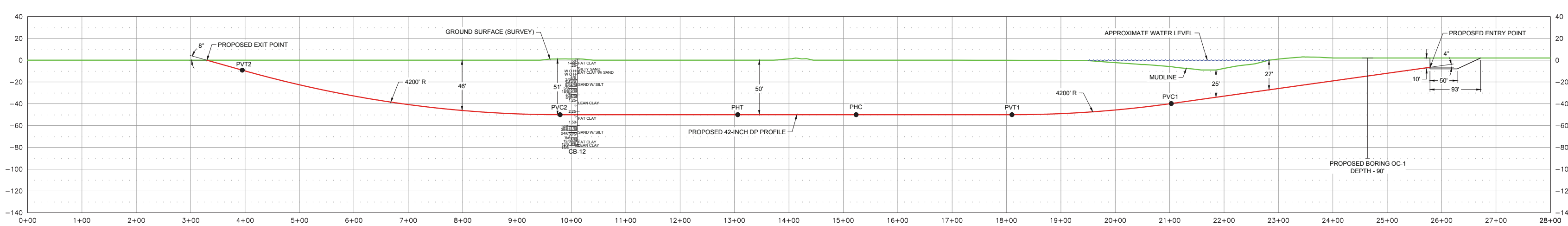
SCALE: AS SHOWN | DRAWING NUMBER: 8.J16045.01-PP-42-1 | REV: P

BRAZORIA COUNTY, TEXAS



PLAN VIEW

100 0 100 200
GRAPHIC SCALE IN FEET



PROFILE VIEW

100 0 100 200
HORIZONTAL SCALE: 1" = 100

50 0 50 100
VERTICAL SCALE: 1" = 50

* GRID STATIONING IS BASED ON AN ARBITRARY REFERENCE POINT.

HORIZONTAL DIRECTIONAL DRILL DATA 42-IN OYSTER CREEK		
DESCRIPTION	* STATION (ft)	ELEVATION (ft)
ENTRY @ 4°	25+78.79	-6.50
PVC1 = 4200' RADIUS	21+03.04	-39.77
PVT1 =	18+10.07	-50.00
PHC = -2.60° 4800' RADIUS	15+23.62	-50.00
PHT =	13+05.77	-50.00
PVC2 = 4200' RADIUS	9+79.25	-50.00
PVT2 =	3+94.73	-9.13
EXIT @ 8°	3+29.79	0.00
HORIZONTAL DISTANCE (ft) = 2249.00		
DIRECTIONAL DRILL PIPE LENGTH (ft) = 2252.94		

30% REVIEW
NOT FOR CONSTRUCTION

THINK SAFETY FIRST

BORING LEGEND

SPT (N)
SOIL DESCRIPTION
UCS (PSI)
BORING NAME

DRAWING LEGEND

- PROPOSED HDD CROSSING
- PROPOSED STRINGING ALIGNMENT
- PROPOSED PIPELINE CENTERLINE
- EXISTING PIPELINES
- PERMANENT RIGHT OF WAY (ROW)
- RAILROAD TRACKS
- PROPERTY LINE
- WETLAND AREA
- WATERBODY
- TEMPORARY WORKSPACE (TW)
- ADDITIONAL TEMPORARY WORKSPACE (ATWS)
- HDD ENTRY/EXIT POINT
- GEOTECHNICAL BOREHOLE
- HDD PROFILE GEOMETRY POINT

DRAWING COORDINATE SYSTEM	
HORIZONTAL DATUM	NAD83 - SPCS, S. CENTRAL ZONE, US FOOT
VERTICAL DATUM	NAV88

PIPE SPECIFICATIONS

1. PRODUCT PIPE WILL CONSIST OF 42.000" O.D. 1.000 W.T., API-5L X-65 PIPE WITH 14-16 MILS OF FUSION BONDED EPOXY (FBE) AND 30-40 MILS ARO.
2. MAXIMUM ALLOWABLE OPERATING PRESSURE (MAOP) = 1440 psi.

REFERENCE DRAWINGS	REV.	DATE	REVISION	APPVD.
8J16045-01-HDD-42-2B	A	10/24/17	PLAN AND PROFILE	KBP

BRAZORIA COUNTY TEXAS
TITLE

DESIGNED: BKP	DRAWN: BTL	CHECKED: BKP	PROJECT NO. 10171	REV. A
SCALE AS NOTED	DATE 10/12/2017	DWG. NO. FLNG_42IN_ SHT. 1 OF 1		

Figure D-7
Freeport LNG - Train 4 Project
Site-specific Drawing
MP 6.4 to 6.8

Scale valid for 24" x 36" print

LEGEND:

- PROPOSED 42" PIPELINE
- PROPOSED R/W
- PROPERTY LINE
- ABSTRACT LINE
- EXISTING PIPELINE
- ACCESS ROADS
- ENVIRONMENTAL SURVEY CORRIDOR
- WETLAND AREA
- WATERBODY
- TEMPORARY WORKSPACE
- ADDITIONAL TEMPORARY WORKSPACE

NOTE:
BEARINGS, DISTANCES AND COORDINATES SHOWN ARE BASED ON TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83).

PROFILE
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 10'

SHEET 1 OF 2

Project	Area	Doc Type	Eng Code	Seq No	Rev
0000	000	--	0000	000	P

PRELIMINARY
DATE: 6/15/17
– NOT FOR CONSTRUCTION –

REV	DATE	BY	DESCRIPTION	CHK'D	TECH.	PROJ.	ENG	OPS	P.M.
P3	6/15/17	HGA	RELIMINARY	HGA					
P2	1/19/17	HGA	PRELIMINARY	HGA					
P1	1/06/17	HGA	PRELIMINARY	HGA					
P	12/06/16	HGA	PRELIMINARY	HGA					

CONTRACTOR | FREEPORT LNG

REVISION

DRAWN BY	HGA	11/29/16
DESIGNED BY	HGA	11/29/16
CHECKED BY		
APPROVED BY		
HGA JOB NO.	8.J16045.01.0	
PLOT SCALE	1:1	
MODEL ID	8.J16045.01	

HUNT, GUILLOT & ASSOCIATES, L.L.C.
603 REYNOLDS DRIVE
RUSTON, LA 71270
T: 318-255-6825
FIRM #: TX 10193772

FREEPORT LNG
FLNG EXPANSION, L.P.

Figure D8
Freeport LNG - Train 4 Project
Site-specific Drawing
MP 7.2 to 7.3

SCALE	DRAWING NUMBER	REV
AS SHOWN	8.J16045.01-HDD-42-8B	P3

LEGEND:

- PROPOSED 42" PIPELINE
- PROPOSED R/W
- PROPERTY LINE
- ABSTRACT LINE
- EXISTING PIPELINE
- ACCESS ROADS
- ENVIRONMENTAL SURVEY CORRIDOR
- WETLAND AREA
- WATERBODY
- TEMPORARY WORKSPACE
- ADDITIONAL TEMPORARY WORKSPACE

NOTE:
BEARINGS, DISTANCES AND COORDINATES SHOWN ARE BASED ON TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83).

PROFILE
HORIZONTAL SCALE: 1" = 30'
VERTICAL SCALE: 1" = 10'

Project	Area	Doc Type	Eng Code	Seq No	Rev
0000	000	--	0000	000	P

PRELIMINARY
DATE: 6/15/17
– NOT FOR CONSTRUCTION –

REV	DATE	BY	DESCRIPTION	CHK'D	TECH.	PROJ.	ENG	OPS	P.M.
P4	2/03/17	HGA	PRELIMINARY	HGA					
P3	1/31/17	HGA	REVISED PER LINE CHANGE	HGA					
P2	1/19/17	HGA	PRELIMINARY	HGA					
P1	1/06/17	HGA	PRELIMINARY	HGA					
P5	6/15/17	HGA	PRELIMINARY	HGA					

CONTRACTOR | FREEPORT LNG

REVISION

DRAWN BY	HGA	11/29/16
DESIGNED BY	HGA	11/29/16
CHECKED BY		
APPROVED BY		
HGA JOB NO.	8.J16045.01.0	
PLOT SCALE	1:1	
MODEL ID	8.J16045.01	

HUNT, GUILLOT & ASSOCIATES, L.L.C.
603 REYNOLDS DRIVE
RUSTON, LA 71270
T: 318-255-6825
FIRM #: TX 10193772

FLNG EXPANSION, L.P.

Figure D9
Freeport Lng - Train 4 Project
Site-specific Drawing
MP 10.4 to 10.4

SCALE	DRAWING NUMBER	REV
AS SHOWN	8.J16045.01-HDD-42-9	P5

FREEPORT LNG
TRAIN 4 PROJECT

Appendix E
Pipeline Corridor

Index Map

Figure A 6-3 Index
Freeport LNG - Train 4 Project
Pipeline Route Map Set - Aerial
Brazoria County, Texas

| REVISED: 10/09/2017 | SCALE: 1:70,000

DRAWN BY: 0239

Page 1 of 10

Figure A 6-3 Page 1 of 10

Freeport LNG - Train 4 Project

Pipeline Route Map Set - Aerial

Brazoria County, Texas

| REVISED: 10/09/2017 | SCALE: 1:7,200

DRAWN BY: 0239

Figure A 6-3 Page 2 of 10

Freeport LNG - Train 4 Project

Pipeline Route Map Set - Aerial

Brazoria County, Texas

| REVISED: 10/09/2017 | SCALE: 1:7,200

DRAWN BY: 0239

Train 4 Centerline
Permanent Easement
Temporary Workspace
Additional Temporary Workspace
Access Road
Milepost

0 300 600 Feet

Page 3 of 10

Figure A 6-3 Page 3 of 10

Freeport LNG - Train 4 Project

Pipeline Route Map Set - Aerial

Brazoria County, Texas

REVISED: 10/09/2017 | SCALE: 1:7,200

DRAWN BY: 0239

Train 4 Centerline
Permanent Easement
Temporary Workspace
Additional Temporary Workspace
Access Road
Milepost
Pretreatment Facility Boundary

0 300 600 Feet

N

Figure A 6-3 Page 4 of 10

Freeport LNG - Train 4 Project

Pipeline Route Map Set - Aerial

Brazoria County, Texas

| REVISED: 10/09/2017 | SCALE: 1:7,200

DRAWN BY: 0239

Train 4 Centerline
Permanent Easement
Temporary Workspace
Additional Temporary Workspace
Access Road
Aboveground Facility Modification
Milepost
Pretreatment Facility Boundary
Offsite Workspace and Access

0 300 600 Feet

Figure A 6-3 Page 5 of 10

Freeport LNG - Train 4 Project

Pipeline Route Map Set - Aerial

Brazoria County, Texas

| REVISED: 10/09/2017 | SCALE: 1:7,200

DRAWN BY: 0239

Train 4 Centerline
Permanent Easement
Temporary Workspace
Additional Temporary Workspace
Access Road
Aboveground Facility Modification
Milepost
Pretreatment Facility Boundary
Offsite Workspace and Access

0 300 600 Feet

Figure A 6-3 Page 6 of 10

Freeport LNG - Train 4 Project

Pipeline Route Map Set - Aerial

Brazoria County, Texas

REVISED: 10/09/2017 | SCALE: 1:7,200

DRAWN BY: 0239

Train 4 Centerline
Permanent Easement
Temporary Workspace
Additional Temporary Workspace
Access Road
Milepost

0 300 600 Feet

Figure A 6-3 Page 7 of 10

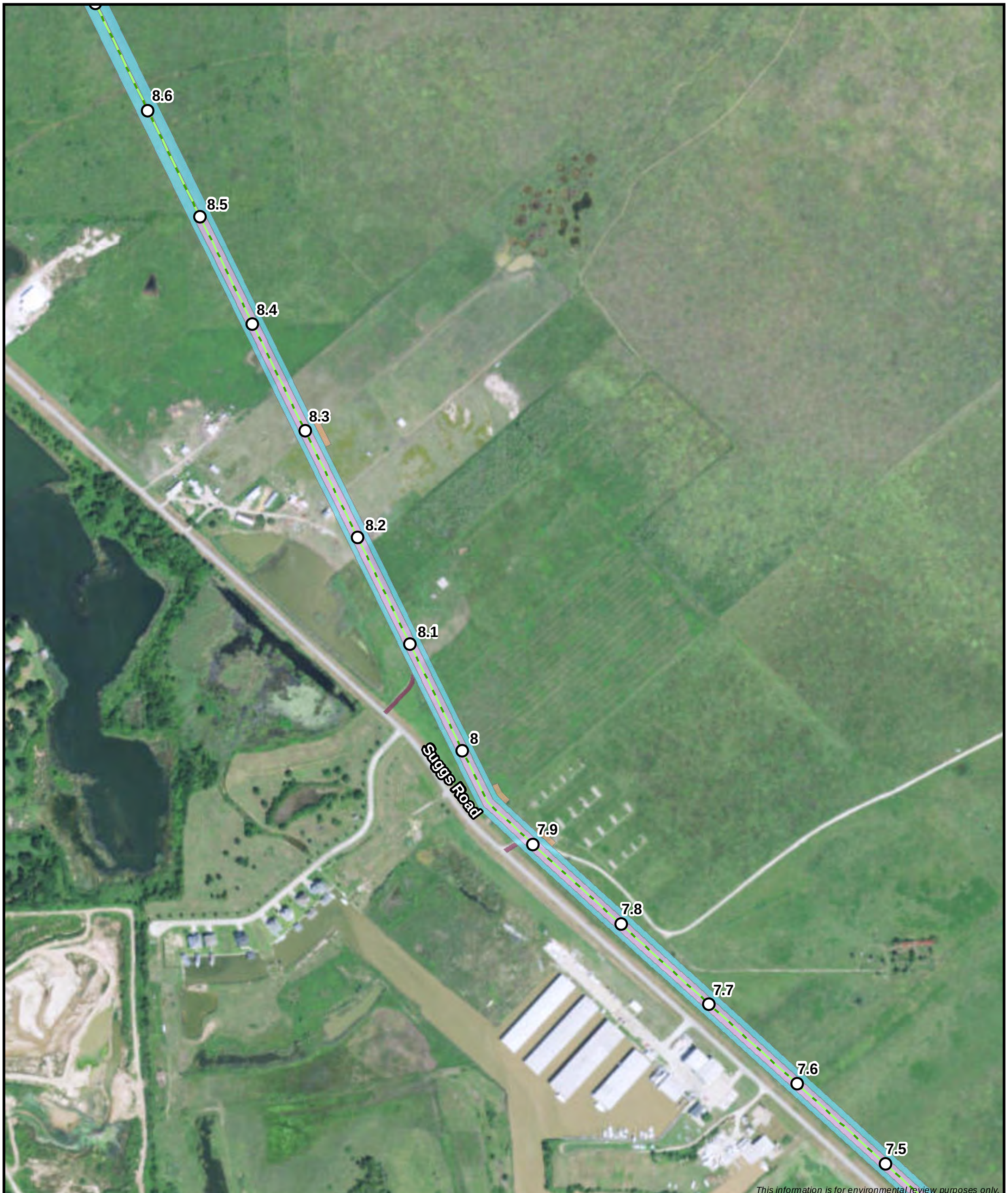
Freeport LNG - Train 4 Project

Pipeline Route Map Set - Aerial

Brazoria County, Texas

| REVISED: 10/09/2017 | SCALE: 1:7,200

DRAWN BY: 0239



Train 4 Centerline
Permanent Easement
Temporary Workspace
Additional Temporary Workspace
Access Road
Milepost

0 300 600 Feet

Figure A 6-3 Page 8 of 10

Freeport LNG - Train 4 Project

Pipeline Route Map Set - Aerial

Brazoria County, Texas

| REVISED: 10/09/2017 | SCALE: 1:7,200

DRAWN BY: 0239

Train 4 Centerline
Permanent Easement
Temporary Workspace
Additional Temporary Workspace
Access Road
Milepost

0 300 600 Feet

Figure A 6-3 Page 9 of 10

Freeport LNG - Train 4 Project

Pipeline Route Map Set - Aerial

Brazoria County, Texas

| REVISED: 10/09/2017 | SCALE: 1:7,200

DRAWN BY: 0239

Train 4 Centerline
Permanent Easement
Temporary Workspace
Additional Temporary Workspace
Access Road
Aboveground Facility Modification
Milepost
Stratton Ridge Meter Station Boundary

0 300 600 Feet

Page 10 of 10

Figure A 6-3 Page 10 of 10

Freeport LNG - Train 4 Project

Pipeline Route Map Set - Aerial

Brazoria County, Texas

| REVISED: 10/09/2017 | SCALE: 1:7,200

DRAWN BY: 0239

FREEPORT LNG
TRAIN 4 PROJECT

Appendix F
Cumulative Impacts Analysis Tables and Figure

TABLE F-1 (Appendix F)

Descriptions of Other Projects Within the Resource-specific Geographic Scopes Crossed by the Project Considered for Cumulative Impacts

Project (Project Proponent)	Type	County	Approximate Distance from nearest Train 4 Project Component [a]	Anticipated Construction Date	Description [b]	Approximate Size of Project [c] (Acres)	Cumulative Impact Association: Surface Water, Wetlands, Vegetation, Wildlife (Aquatic)	Land Use and Visual Resources	Wildlife (Terrestrial), Listed Species	Noise
Freeport LNG Liquefaction Project (Freeport LNG)	Industrial Projects	Quintana, TX	0 feet (within Terminal)	Construction 2014 Operation 2018	Liquefaction plant (three trains), Pretreatment Facility, and interconnecting pipeline/utility line system	557.8 (259.7 of which is permanent facility disturbance)	X	X	X	X
Freeport LNG Phase II Modification Project	Industrial Projects	Quintana, TX	0 feet (within Terminal)	Construction 2014 Operation 2018	Second LNG carrier berthing dock, third LNG storage tank, and plant supply systems	38.5 (14.6 of which is permanent)	X	X	X	X
CenterPoint Energy's Electric Transmission Line	Other Energy Projects	Brazoria County, TX	0 feet (within and adjacent to Terminal)	Construction 2019 Operation 2020	300-foot-long electric transmission line to the Train 4 Project area	0.6	X	X	X	X
BASF Ammonia Production Facility and Storage Tank	Industrial Projects	Freeport, TX	4 miles (west of Pretreatment Facility)	Construction 2015 Operation 2017	New ammonia tank, upgraded terminal, and pipeline assets to export ammonia	~7 (desktop measurement)	X			
MEGlobal (EQUATE Petrochemicals Co.)	Industrial Projects	Oyster Creek, TX	1 mile (west of Pretreatment Facility)	Construction underway Operation 2019	New monoethylene glycol facility	Located on DOW's Oyster Creek complex, which is 35 acres.	X			X
Port Freeport & U.S. Army Corps of Engineers Freeport Harbor Channel Improvement Project	Industrial Projects	Freeport, TX	0.2 mile (north of Terminal)	Construction 2014 Operation 2021	Channel widening from 400 feet up to 600 feet; increase depth	42.1	X	X	X	X
Port Freeport Velasco Terminal Development	Industrial Projects	Freeport, TX	1.2 miles (north of Terminal)	Operation 2021	Additional berth expansion	130	X			
Coastal Bend Header Project (Gulf South Pipeline Company, LP)	Pipeline Projects	Clute, TX	70 feet (pipeline terminates adjacent to Freeport LNG's Stratton Ridge Meter Station)	Construction 2017 Operation 2018	36- to 42-inch diameter natural gas pipeline	1,172 construction [c] 537 operation [c]	X	X	X	X
Kinder Morgan Lateral Development Project	Pipeline Projects	Brazoria County, TX	100 feet (pipeline terminates adjacent to Freeport LNG's Stratton Ridge Meter Station)	Operation 2019	Approximately 40 miles of new pipeline extending from Kinder Morgan's existing Tejas mainline to an interconnection point with Freeport LNG's existing pipeline	500	X	X	X	X
Spectra Energy Texas Eastern Stratton Ridge Expansion Project, Brazoria Interconnector Gas Pipeline (BIG Pipeline)	Pipeline Projects	Brazoria County, TX	10 miles (northwest of Pipeline Corridor)	Operation 2019	42-inch-diameter natural gas pipeline	143.3 construction 48.2 operation	X			
Spectra Energy, South Texas Eastern Pipeline (STEP) Project Modifications	Pipeline Projects	Matagorda, Nueces, Brazoria, Chambers, and Orange Counties, TX	10 miles (northwest of Pipeline Corridor)	Operation 2018	Modifications to piping and compression facilities along Texas Eastern's existing Line 16 to create a bi-directional system and increase capacity	122.2 construction 44.7 operation	X			
Texas General Land Office Dune Restoration	State Agency Projects	Follet's Island, TX	7 miles (east of Pipeline Corridor)	Completion 2017	Restoration of approximately 5 miles of dune system along the seaward side of an approximately 9-mile-long stretch of CR 257	66.8	X			

TABLE F-1 (Appendix F)

Descriptions of Other Projects Within the Resource-specific Geographic Scopes Crossed by the Project Considered for Cumulative Impacts

Project (Project Proponent)	Type	County	Approximate Distance from nearest Train 4 Project Component [a]	Anticipated Construction Date	Description [b]	Approximate Size of Project [c] (Acres)	Cumulative Impact Association: Surface Water, Wetlands, Vegetation, Wildlife (Aquatic)	Land Use and Visual Resources	Wildlife (Terrestrial), Listed Species	Noise
Business 288B, CR 288, SH 288 Tollway, SH 35, SH 36, SH 6, SH 332, SH 288, CR 58W, CR 59, CR 101, CR 290, CR 461, CR 872 Bridge, CR 190 Bridge, CR 227, CR 45, CR 59, CR 168, CR 144, CR 180, FM 1462, FM 1495, FM 2004, FM 2403, FM 2611, FM 2917, FM 517, FM 518, FM 521, FM 523, FM 524, FM 865, FM 1301, FM 2004, and various other smaller road locations within county	Transportation Projects	Brazoria County, TX	Various	Unknown	Multiple road projects	Information unavailable	X			
Texas Gulf Regional Airport	Commercial Developments	Angleton, TX	8 miles (northwest of Pipeline Corridor)	Unknown	New hanger development	270	X			
Brazosport Independent School District	Commercial Developments	Lake Jackson, TX	6 miles (west of Pipeline Corridor)	Operation 2017	New elementary school construction	Information unavailable	X			
11 housing developments with a total of about 326 residential lots, 120 apartment, units, and 72 RV campsites	Housing Developments	Angleton, TX	9 miles (northwest of Pipeline Corridor)	Various	Housing Developments	Information unavailable	X			
3 housing developments with a total of about 421 residential lots	Housing Developments	Clute, TX	4 miles (west of Pipeline Corridor)	Various	Housing Developments	Information unavailable	X			
8 housing developments with a total of about 144 residential lots and 655 RV campsites	Housing Developments	Freeport, TX	3 miles (northwest of Terminal)	Various	Housing Developments	Information unavailable	X			
1 vacation home development, 36 single family homes	Housing Developments	Follet's Island, TX	8 miles (east of Pipeline Corridor)	Various	Housing Developments	Information unavailable	X			
1 housing development with a total of 20 RV campsites	Housing Developments	Jones Creek	7 miles (west of Pretreatment Facility)	Various	Housing Developments	Information unavailable	X			
7 housing developments with a total of about 1,912 single-family homes and 888 apartment units	Housing Developments	Lake Jackson, TX	6 miles (west of Pipeline Corridor)	Various	Housing Developments	Information unavailable	X			
2 housing development with a total of 94 single-family homes and 92 RV campsites	Housing Developments	Oyster Creek, TX	1.0 mile (west of Pipeline Corridor)	Various	Housing Developments	Information unavailable	X			
3 housing developments with a total of about 131 single-family homes and 300 apartment units	Housing Developments	Richwood, TX	4 miles (west of Pipeline Corridor)	Various	Housing Developments	Information unavailable	X			
Total (for projects with available information)						**6,585.3 construction [c]** **5,455.7 permanent [c, d]**				

a Only those resources where the Project may contribute to cumulative impacts, as described in the following sections are indicated in this column. Distance is measured from the nearest portion of the Facility boundary and/or the Pipeline workspace from the identified project's location.
b Based upon readily available public information.
c Acreage not available by watershed; includes acreage outside watersheds affected by the Train 4 Project.
d Permanent size of project assumed to equal construction acreage unless otherwise noted.

TABLE F-2 (Appendix F)

Resources Affected by Other Projects in the HUC-10 Watersheds Crossed by the Project Considered for Cumulative Impacts [1,2]

Project	Impacts on Wetlands (acres)	Impacts on Waterbodies (number crossed)
Lower Oyster Creek HUC-10 Watershed		
Freeport LNG Liquefaction Project	17.3	14
Freeport LNG Phase II Modification Project	6.1	7
CenterPoint Energy's Electric Transmission Line	0.0	0
BASF Ammonia Production Facility and Storage Tank	NA	NA
MEGlobal (EQUATE Petrochemicals Co.)	NA	NA
Port Freeport & U.S. Army Corps of Engineers Freeport Harbor Channel Improvement Project	25.7	1
Port Freeport Velasco Terminal Development	NA	NA
Coastal Bend Header Project (Gulf South Pipeline Company, LP)	19.6	219
Kinder Morgan Lateral Development Project	NA	NA
Spectra Energy Texas Eastern Stratton Ridge Expansion Project, Brazoria Interconnector Gas Pipeline (BIG Pipeline)	3.2	10
Spectra Energy, South Texas Eastern Pipeline (STEP) Project Modifications	0	7 man-made, 0 natural
Texas General Land Office Dune Restoration	NA	NA
Texas Gulf Regional Airport	NA	NA
Brazosport Independent School District	NA	NA
11 housing developments with a total of about 326 residential lots, 120 apartment, units, and 72 RV campsites	NA	NA
3 housing developments with a total of about 421 residential lots	NA	NA
8 housing developments with a total of about 144 residential lots and 655 RV campsites	NA	NA
1 vacation home development, 36 single family homes	NA	NA
7 housing developments with a total of about 1,912 single-family homes and 888 apartment units	NA	NA
2 housing development with a total of 94 single-family homes and 92 RV campsites	NA	NA
3 housing developments with a total of about 131 single-family homes and 300 apartment units	NA	NA
Lower San Bernard River HUC-10 Watershed		
1 housing development with a total of 20 RV campsites	NA	NA
Dickinson Bayou, Dry Bayou-Brazos River, Lower Oyster Creek, Lower San Bernard River, and Mustang Bayou HUC-10 Watersheds		
Business 288B, CR 288, SH 288 Tollway, SH 35, SH 36, SH 6, SH 332, SH 288, CR 58W, CR 59, CR 101, CR 290, CR 461, CR 872 Bridge, CR 190 Bridge, CR 227, CR 45, CR 59, CR 168, CR 144, CR 180, FM 1462, FM 1495, FM 2004, FM 2403, FM	NA	NA

TABLE F-2 (Appendix F)		
Resources Affected by Other Projects in the HUC-10 Watersheds Crossed by the Project Considered for Cumulative Impacts [1,2]		
Project	**Impacts on Wetlands (acres)**	**Impacts on Waterbodies (number crossed)**
2611, FM 2917, FM 517, FM 518, FM 521, FM 523, FM 524, FM 865, FM 1301, FM 2004, and various other smaller road locations within county		
Total Cumulative Impact	**71.9**	**258**

[1] Only those resources where the Project may contribute to cumulative impacts, as described in the following sections, are indicated in this column. Distance is measured from the nearest portion of the Facility boundary and/or the Pipeline workspace from the identified project's location.

[2] Based upon readily available public information.

NA Information was not publicly available.

TABLE F-3 (Appendix F)

Other Projects in the Socioeconomics Geographic Scope of Analysis Considered for Cumulative Impacts

Project (Project Proponent)	Type	County	Approximate Distance from nearest Train 4 Project Component [a]	Anticipated Construction Date	Description [b]	Workforce
Freeport LNG Liquefaction Project	Industrial Projects	Quintana, TX	0 feet (within Terminal)	Construction 2014 Operation 2018	Liquefaction plant (three trains), Pretreatment Facility, and interconnecting pipeline/utility line system	8,500 construction 163 operation
Freeport LNG Phase II Modification Project	Industrial Projects	Quintana, TX	0 feet (within Terminal)	Construction 2014 Operation 2018	Second LNG carrier berthing dock, third LNG storage tank, and plant supply systems	600 construction 5 operation
CenterPoint Energy's Electric Transmission Line	Other Energy Projects	Brazoria County, TX	0 feet (within and adjacent to Terminal)	Construction 2019 Operation 2020	300-foot-long electric transmission line to the Train 4 Project area	Information Unavailable
BASF Ammonia Production Facility and Storage Tank	Industrial Projects	Freeport, TX	4 miles (west of Pretreatment Facility)	Construction 2015 Operation 2017	New ammonia tank, upgraded terminal, and pipeline assets to export ammonia	550 construction 35 operation
INEOS Oligomers	Industrial Projects	Chocolate Bayou, TX	15 miles (northeast of Pipeline Corridor)	Construction 2016 Operation 2018	Linear alpha olefin plant	3,200 construction 80 operation
Mitsubishi Heavy Industries Manufacturing Site	Industrial Projects	Pearland, TX	37 miles (north of Pipeline Corridor)	Construction 2014 Operation Phase II 2017	New 26-acre manufacturing site	200 operation
MEGlobal (EQUATE Petrochemicals Co.)	Industrial Projects	Oyster Creek, TX	1 mile (west of Pretreatment Facility)	Construction underway Operation 2019	New monoethylene glycol facility	1,400 construction 50 operation
Phillips 66 NGL Fractionator, Phase 2	Industrial Projects	Sweeny, TX	25 miles (west of Pipeline Corridor)	Construction 2016 Operation 2017	New natural gas liquids ("NGL") fractionator at existing facility	500 construction 30 operation
Port Freeport & U.S. Army Corps of Engineers Freeport Harbor Channel Improvement Project	Industrial Projects	Freeport, TX	0.2 mile (north of Terminal)	Construction 2014 Operation 2021	Channel widening from 400 feet up to 600 feet; increase depth	Information Unavailable
Port Freeport Velasco Terminal Development	Industrial Projects	Freeport, TX	1.2 miles (north of Terminal)	Operation 2021	Additional berth expansion	7,500 (direct, indirect, and induced)

TABLE F-3 (Appendix F)

Other Projects in the Socioeconomics Geographic Scope of Analysis Considered for Cumulative Impacts

Project (Project Proponent)	Type	County	Approximate Distance from nearest Train 4 Project Component [a]	Anticipated Construction Date	Description [b]	Workforce
Gulf South Pipeline Company Coastal Bend Header Project	Pipeline Projects	Clute, TX	70 feet (pipeline terminates adjacent to Freeport LNG's Stratton Ridge Meter Station)	Construction 2017 Operation 2018	36- to 42-inch diameter natural gas pipeline	1400 construction 18 operation
Kinder Morgan Lateral Development Project	Pipeline Projects	Brazoria County, TX	100 feet (pipeline terminates adjacent to Freeport LNG's Stratton Ridge Meter Station)	Operation 2019	Approximately 40 miles of new pipeline extending from Kinder Morgan's existing Tejas mainline to an interconnection point with Freeport LNG's existing pipeline	Information Unavailable
Spectra Energy Texas Eastern Stratton Ridge Expansion Project, Brazoria Interconnector Gas Pipeline (BIG Pipeline)	Pipeline Projects	Brazoria County, TX	10 miles (northwest of Pipeline Corridor)	Operation 2019	42-inch-diameter natural gas pipeline	80 construction 1 operation
Spectra Energy, South Texas Eastern Pipeline (STEP) Project Modifications	Pipeline Projects	Matagorda, Nueces, Brazoria, Chambers, and Orange Counties, TX	10 miles (northwest of Pipeline Corridor)	Operation 2018	Modifications to piping and compression facilities along Texas Eastern's existing Line 16 to create a bi-directional system and increase capacity	100 construction 0 operation
Texas General Land Office Dune Restoration	State Agency Projects	Follet's Island, TX	7 miles (east of Pipeline Corridor)	Completion 2017	Restoration of approximately 5 miles of dune system along the seaward side of an approximately 9-mile-long stretch of CR 257	Information Unavailable
Chocolate Bayou Wind Energy	Other Energy Projects	Chocolate Bayou, TX	17 miles (northeast of Pipeline Corridor)	Construction 2016 Operation 2018	130 megawatt renewable energy development	150 construction 4 operation

TABLE F-3 (Appendix F)

Other Projects in the Socioeconomics Geographic Scope of Analysis Considered for Cumulative Impacts

Project (Project Proponent)	Type	County	Approximate Distance from nearest Train 4 Project Component [a]	Anticipated Construction Date	Description [b]	Workforce
Business 288B, CR 288, SH 288 Tollway, SH 35, SH 36, SH 6, SH 332, SH 288, CR 58W, CR 59, CR 101, CR 290, CR 461, CR 872 Bridge, CR 190 Bridge, CR 227, CR 45, CR 59, CR 168, CR 144, CR 180, FM 1462, FM 1495, FM 2004, FM 2403, FM 2611, FM 2917, FM 517, FM 518, FM 521, FM 523, FM 524, FM 865, FM 1301, FM 2004, and various other smaller road locations within county	Transportation Projects	Brazoria County, TX	Various	Unknown	Multiple road projects	Information Unavailable
The Presido at Manvel	Commercial Developments	Manvel, TX	30 miles (north of Pipeline	Unknown	333-acre mixed use area	Information Unavailable
Texas Gulf Regional Airport	Commercial Developments	Angleton, TX	8 miles (northwest of Pipeline Corridor)	Unknown	New hanger development	Information Unavailable
Brazosport Independent School District	Commercial Developments	Lake Jackson, TX	6 miles (west of Pipeline Corridor)	Operation 2017	New elementary school construction	Information Unavailable
7 housing developments with a total of about 1,378 residential lots	Housing Developments	Alvin, TX	26 miles (north of Pipeline Corridor)	Various	Housing developments	Information Unavailable
11 housing developments with a total of about 326 residential lots, 120 apartment, units, and 72 RV campsites	Housing Developments	Angleton, TX	9 miles (northwest of Pipeline Corridor)	Various	Housing Developments	Information Unavailable
3 housing developments with a total of about 421 residential lots	Housing Developments	Clute, TX	4 miles (west of Pipeline Corridor)	Various	Housing Developments	Information Unavailable
8 housing developments with a total of about 144 residential lots and 655 RV campsites	Housing Developments	Freeport, TX	3 miles (northwest of Terminal)	Various	Housing Developments	Information Unavailable
1 vacation home development, 36 single family homes	Housing Developments	Follet's Island, TX	8 miles (east of Pipeline Corridor)	Various	Housing Developments	Information Unavailable
1 housing development with a total of about 1,096 single-family homes	Housing Developments	Iowa Colony, TX	30 miles (north of Pipeline Corridor)	Various	Housing Developments	Information Unavailable
1 housing development with a total of 20 RV campsites	Housing Developments	Jones Creek	7 miles (west of Pretreatment Facility)	Various	Housing Developments	Information Unavailable
7 housing developments with a total of about 1,912 single-family homes and 888 apartment units	Housing Developments	Lake Jackson, TX	6 miles (west of Pipeline Corridor)	Various	Housing Developments	Information Unavailable

TABLE F-3 (Appendix F)

Other Projects in the Socioeconomics Geographic Scope of Analysis Considered for Cumulative Impacts

Project (Project Proponent)	Type	County	Approximate Distance from nearest Train 4 Project Component [a]	Anticipated Construction Date	Description [b]	Workforce
9 housing developments with a total of about 8,800 single-family homes	Housing Developments	Manvel, TX	28 miles (north of Pipeline Corridor)	Various	Housing Developments	Information Unavailable
2 housing development with a total of 94 single-family homes and 92 RV campsites	Housing Developments	Oyster Creek, TX	1.0 mile (west of Pipeline Corridor)	Various	Housing Developments	Information Unavailable
21 housing developments with a total of about 5,500 single-family homes	Housing Developments	Pearland, TX	34 miles (north of Pipeline Corridor)	Various	Housing Developments	Information Unavailable
3 housing developments with a total of about 131 single-family homes and 300 apartment units	Housing Developments	Richwood, TX	4 miles (west of Pipeline Corridor)	Various	Housing Developments	Information Unavailable
4 residential developments with a total of about 133 RV campsites	Housing Developments	Sweeny, TX	22 miles (northwest of Pipeline Corridor)	Various	Housing Developments	Information Unavailable
Meridiana Master-Planned Community, 5,500 single-family homes	Housing Developments	Manvel, Iowa Colony, TX	28 miles (north of Pipeline Corridor)	Various	Housing Developments	Information Unavailable
5 housing developments with a total of 202 single-family hom+A3:A38es and 2 RV campsite developments including about 58 acres of land	Housing Developments	West Columbia	20 miles (northwest of Pipeline Corridor)	Various	Housing Developments	Information Unavailable

a Distance is measured from the nearest portion of the Project boundary to the identified project’s location.
b Based upon readily available public information.

TABLE F-4 (Appendix F)

Other Projects in the Air Quality Geographic Scope of Analysis Considered for Cumulative Impacts

Project (Project Proponent)	Type	County	Approximate Distance from nearest Train 4 Project Component [a]	Anticipated Construction Date	Description [b]
Freeport LNG Liquefaction Project	Industrial Projects	Quintana, TX	0 feet (within Terminal)	Construction 2014 Operation 2018	Liquefaction plant (three trains), Pretreatment Facility, and interconnecting pipeline/utility line system
Freeport LNG Phase II Modification Project	Industrial Projects	Quintana, TX	0 feet (within Terminal)	Construction 2014 Operation 2018	Second LNG carrier berthing dock, third LNG storage tank, and plant supply systems
CenterPoint Energy's Electric Transmission Line	Other Energy Projects	Brazoria County, TX	0 feet (within and adjacent to Terminal)	Construction 2019 Operation 2020	300-foot-long electric transmission line to the Train 4 Project area
BASF Ammonia Production Facility and Storage Tank	Industrial Projects	Freeport, TX	4 miles (west of Pretreatment Facility)	Construction 2015 Operation 2017	New ammonia tank, upgraded terminal, and pipeline assets to export ammonia
INEOS Oligomers	Industrial Projects	Chocolate Bayou, TX	15 miles (northeast of Pipeline Corridor)	Construction 2016 Operation 2018	Linear alpha olefin plant
MEGlobal (EQUATE Petrochemicals Co.)	Industrial Projects	Oyster Creek, TX	1 mile (west of Pretreatment Facility)	Construction underway Operation 2019	New monoethylene glycol facility
Phillips 66 NGL Fractionator, Phase 2	Industrial Projects	Sweeny, TX	25 miles (west of Pipeline Corridor)	Construction 2016 Operation 2017	New natural gas liquids ("NGL") fractionator at existing facility
Port Freeport & U.S. Army Corps of Engineers Freeport Harbor Channel Improvement Project	Industrial Projects	Freeport, TX	0.2 mile (north of Terminal)	Construction 2014 Operation 2021	Channel widening from 400 feet up to 600 feet; increase depth
Port Freeport Velasco Terminal Development	Industrial Projects	Freeport, TX	1.2 miles (north of Terminal)	Operation 2021	Additional berth expansion
Gulf South Pipeline Company Coastal Bend Header Project	Pipeline Projects	Clute, TX	70 feet (pipeline terminates adjacent to Freeport LNG's Stratton Ridge Meter Station)	Construction 2017 Operation 2018	36- to 42-inch diameter natural gas pipeline

TABLE F-4 (Appendix F)

Other Projects in the Air Quality Geographic Scope of Analysis Considered for Cumulative Impacts

Project (Project Proponent)	Type	County	Approximate Distance from nearest Train 4 Project Component [a]	Anticipated Construction Date	Description [b]
Kinder Morgan Lateral Development Project	Pipeline Projects	Brazoria County, TX	100 feet (pipeline terminates adjacent to Freeport LNG's Stratton Ridge Meter Station)	Operation 2019	Approximately 40 miles of new pipeline extending from Kinder Morgan's existing Tejas mainline to an interconnection point with Freeport LNG's existing pipeline
Spectra Energy Texas Eastern Stratton Ridge Expansion Project, Brazoria Interconnector Gas Pipeline (BIG Pipeline)	Pipeline Projects	Brazoria County, TX	10 miles (northwest of Pipeline Corridor)	Operation 2019	42-inch-diameter natural gas pipeline
Spectra Energy, South Texas Eastern Pipeline (STEP) Project Modifications	Pipeline Projects	Matagorda, Nueces, Brazoria, Chambers, and Orange Counties, TX	10 miles (northwest of Pipeline Corridor)	Operation 2018	Modifications to piping and compression facilities along Texas Eastern's existing Line 16 to create a bi-directional system and increase capacity
Texas General Land Office Dune Restoration	State Agency Projects	Follet's Island, TX	7 miles (east of Pipeline Corridor)	Completion 2017	Restoration of approximately 5 miles of dune system along the seaward side of an approximately 9-mile-long stretch of CR 257
Chocolate Bayou Wind Energy	Other Energy Projects	Chocolate Bayou, TX	17 miles (northeast of Pipeline Corridor)	Construction 2016 Operation 2018	130 megawatt renewable energy development
Business 288B, CR 288, SH 288 Tollway, SH 35, SH 36, SH 6, SH 332, SH 288, CR 58W, CR 59, CR 101, CR 290, CR 461, CR 872 Bridge, CR 190 Bridge, CR 227, CR 45, CR 59, CR 168, CR 144, CR 180, FM 1462, FM 1495, FM 2004, FM 2403, FM 2611, FM 2917, FM 517, FM 518, FM 521, FM 523, FM 524, FM 865, FM 1301, FM 2004, and various other smaller road locations within county	Transportation Projects	Brazoria County, TX	Various	Unknown	Multiple road projects
The Presido at Manvel	Commercial Developments	Manvel, TX	30 miles (north of Pipeline	Unknown	333-acre mixed use area
Texas Gulf Regional Airport	Commercial Developments	Angleton, TX	8 miles (northwest of Pipeline Corridor)	Unknown	New hanger development

TABLE F-4 (Appendix F)

Other Projects in the Air Quality Geographic Scope of Analysis Considered for Cumulative Impacts

Project (Project Proponent)	Type	County	Approximate Distance from nearest Train 4 Project Component [a]	Anticipated Construction Date	Description [b]
Brazosport Independent School District	Commercial Developments	Lake Jackson, TX	6 miles (west of Pipeline Corridor)	Operation 2017	New elementary school construction
7 housing developments with a total of about 1,378 residential lots	Housing Developments	Alvin, TX	26 miles (north of Pipeline Corridor)	Various	Housing developments
11 housing developments with a total of about 326 residential lots, 120 apartment, units, and 72 RV campsites	Housing Developments	Angleton, TX	9 miles (northwest of Pipeline Corridor)	Various	Housing developments
3 housing developments with a total of about 421 residential lots	Housing Developments	Clute, TX	4 miles (west of Pipeline Corridor)	Various	Housing developments
8 housing developments with a total of about 144 residential lots and 655 RV campsites	Housing Developments	Freeport, TX	3 miles (northwest of Terminal)	Various	Housing developments
1 vacation home development, 36 single family homes	Housing Developments	Follet's Island, TX	8 miles (east of Pipeline Corridor)	Various	Housing developments
1 housing development with a total of about 1,096 single-family homes	Housing Developments	Iowa Colony, TX	30 miles (north of Pipeline Corridor)	Various	Housing developments
1 housing development with a total of 20 RV campsites	Housing Developments	Jones Creek, TX	7 miles (west of Pretreatment Facility)	Various	Housing developments
7 housing developments with a total of about 1,912 single-family homes and 888 apartment units	Housing Developments	Lake Jackson, TX	6 miles (west of Pipeline Corridor)	Various	Housing developments
9 housing developments with a total of about 8,800 single-family homes	Housing Developments	Manvel, TX	28 miles (north of Pipeline Corridor)	Various	Housing developments
2 housing development with a total of 94 single-family homes and 92 RV campsites	Housing Developments	Oyster Creek, TX	1.0 mile (west of Pipeline Corridor)	Various	Housing developments

TABLE F-4 (Appendix F)

Other Projects in the Air Quality Geographic Scope of Analysis Considered for Cumulative Impacts

Project (Project Proponent)	Type	County	Approximate Distance from nearest Train 4 Project Component [a]	Anticipated Construction Date	Description [b]
21 housing developments with a total of about 5,500 single-family homes	Housing Developments	Pearland, TX	34 miles (north of Pipeline Corridor)	Various	Housing developments
3 housing developments with a total of about 131 single-family homes and 300 apartment units	Housing Developments	Richwood, TX	4 miles (west of Pipeline Corridor)	Various	Housing developments
4 residential developments with a total of about 133 RV campsites	Housing Developments	Sweeny, TX	22 miles (northwest of Pipeline Corridor)	Various	Housing developments
Meridiana Master-Planned Community, 5,500 single-family homes	Housing Developments	Manvel, Iowa Colony, TX	28 miles (north of Pipeline Corridor)	Various	Housing developments
5 housing developments with a total of 202 single-family homes and 2 RV campsite developments including about 58 acres of land	Housing Developments	West Columbia, TX	20 miles (northwest of Pipeline Corridor)	Various	Housing developments

a Distance is measured from the nearest portion of the Project boundary to the identified project's location.
b Based upon readily available public information.

Figure B 13-1
Freeport LNG -Train 4 Project
Cumulative Impacts
Brazoria County, Texas