Federal Energy Regulatory Commission

Office of Energy Projects

June 2018

National Grid LNG, LLC **Docket No. CP16-121-000**

FIELDS POINT LIQUEFACTION PROJECT

Environmental Assessment

Cooperating Agencies:

CRMC
Coastal Resources Management Council

Department of Transportation, United States of America

D·E·M
Rhode Island Department of Environmental Management

Washington, DC 20426

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas 4
National Grid LNG, LLC
Fields Point Liquefaction Project
Docket No. CP16-121-000

TO THE PARTY ADDRESSED:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared an environmental assessment (EA) for the Fields Point Liquefaction Project, proposed by National Grid LNG, LLC (National Grid) in the above-referenced docket. National Grid requests authorization to construct natural gas liquefaction facilities at its existing Fields Point liquefied natural gas (LNG) storage facility in Providence, Rhode Island.

The EA assesses the potential environmental effects of the construction and operation of the Fields Point Liquefaction 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, Rhode Island Department of Environmental Management, and the Rhode Island Coastal Resources Management Council participated as cooperating agencies in the preparation of the EA. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and participate in the NEPA analysis.

For its Fields Point Liquefaction Project, National Grid would construct a natural gas liquefier, including the following facilities:

- electric-powered booster compressor;
- pretreatment system;
- gas regeneration heater; and
- liquefaction train including heat exchangers cooled by a closed-loop nitrogen refrigeration cycle.

The FERC staff mailed copies of the EA 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. In addition, the EA is available for public viewing on the FERC's website (www.ferc.gov) using the eLibrary link. A limited number of copies of the EA are available for distribution and public inspection at:

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

Any person wishing to comment on the 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 in Washington, DC on or before 5:00pm Eastern Time on **July 25, 2018.**

For your convenience, there are three methods you can use to file your comments to the Commission. In all instances please reference the applicable project docket number (CP16-121-000) with your submission. The Commission encourages electronic filing of comments and has staff available to assist you at (866) 208-3676 or FercOnlineSupport@ferc.gov.

(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. Using eComment is an easy method for submitting brief, text-only comments on a project;

(2) You can also file your comments electronically using the eFiling feature located 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." You must select the type of filing you are making. A comment on a particular project is considered a "Comment on a Filing"; or

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

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

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). Only intervenors have the right to seek rehearing or judicial review of the Commission's decision. The Commission grants affected landowners and others with environmental concerns intervenor status upon showing good cause by stating that they have a clear and direct interest in this 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.**

Additional information about the project is available from the Commission's Office of External Affairs, at **(866) 208-FERC**, or on the FERC website (www.ferc.gov) using the eLibrary link. Click on the eLibrary link, click on "General Search," and enter the docket number in the "Docket Number" field excluding the last three digits (i.e., CP16-121). 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. 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 which 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.

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TECHNICAL ABBREVIATIONS AND ACRONYMS

AEGL	Acute Exposure Guideline Method
AIM	Algonquin Incremental Market
AQCR	Air Quality Control Region
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
BLEVE	Boiling Liquid Expanding Vapor Explosion
BPVC	Boiler and Pressure Vessel Code
Btu/ft^2-hr	British thermal units per cubic foot per hour
CAA	Clean Air Act
Certificate	FERC Certificate of Public Convenience and Necessity
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CRMC	Rhode Island Coastal Resources Management Council
CRMP	Rhode Island Coastal Resources Management Program
CZMA	Coastal Zone Management Act
dBA	decibels on the A-weighted scale
DE	design earthquake
DHS	U.S. Department of Homeland Security
DOE	Department of Energy
DOT	U.S. Department of Transportation
EA	environmental assessment
EFH	essential fish habitat
EI	environmental inspector
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guidelines
FAA	Federal Aviation Administration
FEED	Front End Engineering Design
FEMA	Federal Emergency Management Agency
FERC Plan	FERC *Upland Erosion Control, Revegetation, and Maintenance Plan*
FERC	Federal Energy Regulatory Commission
FLAG	Federal Land Managers' Air Quality Related Values Work Group
GHG	greenhouse gas
GWP	global warming potential
H_2S	hydrogen sulfide
HAP	hazardous air pollutant
HAZOP	Hazard and Operability Review
IBC	International Building Code
ISA	International Society for Automation
kV	kilovolt
L_{90}	sound pressure level exceeded 90 percent of the time
L_{dn}	day-night sound level
L_{eq}	equivalent sound level

LFL	lower flammable limit
LNG	liquefied natural gas
m/s	meters per second
MCE	maximum considered earthquake
MMbtu/hr	million British thermal units per hour
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NAVD 88	North American Vertical Datum 1988
NEHRP	National Earthquake Hazards Reduction Program
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NGA	Natural Gas Act
NNSR	Nonattainment New Source Review
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	*Notice of Intent to Prepare an Environmental Assessment for the Planned Fields Point Liquefaction Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting*
NO_X	nitrogen oxides
NRHP	National Register of Historic Places
NSA	noise-sensitive area
NSPS	New Source Performance Standards
NSR	New Source Review
OBE	operating basis earthquake
OEP	Office of Energy Projects
OSHA	Occupational Safety and Health Administration
P&IDs	Piping and Instrumentation Diagrams
PGA	peak ground acceleration
PHMSA	DOT's Pipeline and Hazardous Materials Safety Administration
PIP	Public Involvement Plan
PM_{10}	particulate matter less than 10 microns in aerodynamic diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in aerodynamic diameter
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
psig	pounds per square inch gauge
RIDEM	Rhode Island Department of Environmental Management
RMP	Risk Management Program
RPT	rapid phase transition
Secretary	Secretary of the Commission
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SMP	Southeast Market Pipelines Project
SPCC Plan	National Grid's *Spill Prevention, Control, and Countermeasures Plan & Preparedness, Prevention, and Contingency Plan*
SSE	safe shutdown earthquake

STRAP	Short Term Response Action Plan
SWEL	still water elevation level
TNEC	The Narragansett Electric Company
tpy	tons per year
UFL	upper flammable unit
USGS	U.S. Geological Survey
VOC	volatile organic compound

1.0 PROPOSED ACTION

1.1 INTRODUCTION

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared this environmental assessment (EA) to assess the potential environmental impacts of the construction and operation of a liquefaction facility proposed by National Grid LNG, LLC (National Grid) at its existing Fields Point liquefied natural gas (LNG) storage and peak shaving facility (Fields Point LNG Facility) in the City of Providence, Rhode Island. The project is referred to as the Fields Point Liquefaction Project (Project). The proposed Project site is within the footprint of the Fields Point LNG Facility. The location and a general overview of the Project facilities are provided on figure 1.1-1.

On April 1, 2016, National Grid filed an application with FERC in Docket Number CP16-121-000 for authorization under section 7(c) of the Natural Gas Act (NGA) and Part 157 of the Commission's regulations. The application requested authorization to construct and operate a new liquefaction facility adjacent to National Grid's existing LNG storage tank within National Grid's Fields Point LNG Facility. The Project includes a new connection to the existing Algonquin Gas Transmission, LLC (Algonquin) pipeline that passes adjacent to the Project site and would supply natural gas to the liquefaction facility. Liquefaction would supplement the existing source of LNG that is currently trucked to the storage tank from an import terminal in Everett, Massachusetts. The Fields Point LNG Facility is used for peak-shaving to guarantee reliable gas availability during the winter heating months. LNG deliveries made by truck are vaporized for redelivery to customers by existing pipelines; however, the facility also currently has the capability to redeliver LNG to customer trucks. Prior to filing the formal application, the Project underwent initial environmental review by Commission staff as part of the pre-filing process, which was initiated on July 2, 2015, under Docket Number PF15-28-000. The main purposes of pre-filing is to encourage early involvement of interested stakeholders, facilitate interagency cooperation, and identify and resolve environmental issues before an application is filed with FERC.

The FERC is the lead federal agency for authorizing interstate natural gas transmission facilities under the NGA, and is the lead federal agency for preparation of the EA. We[1] prepared this EA in compliance with the requirements of the National Environmental Policy Act (NEPA) (Title 40 of the Code of Federal Regulations, Parts 1500-1508) [40 CFR 1500-1508]), and the Commission's implementing regulations under 18 CFR 380. The U.S. Department of Transportation (DOT), Rhode Island Department of Environmental Management (RIDEM), and Rhode Island Coastal Resources Management Council (CRMC) were cooperating agencies in the preparation of this EA. The major federal, state, and local permits and consultations associated with the Project are discussed further in section 1.10, below.

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

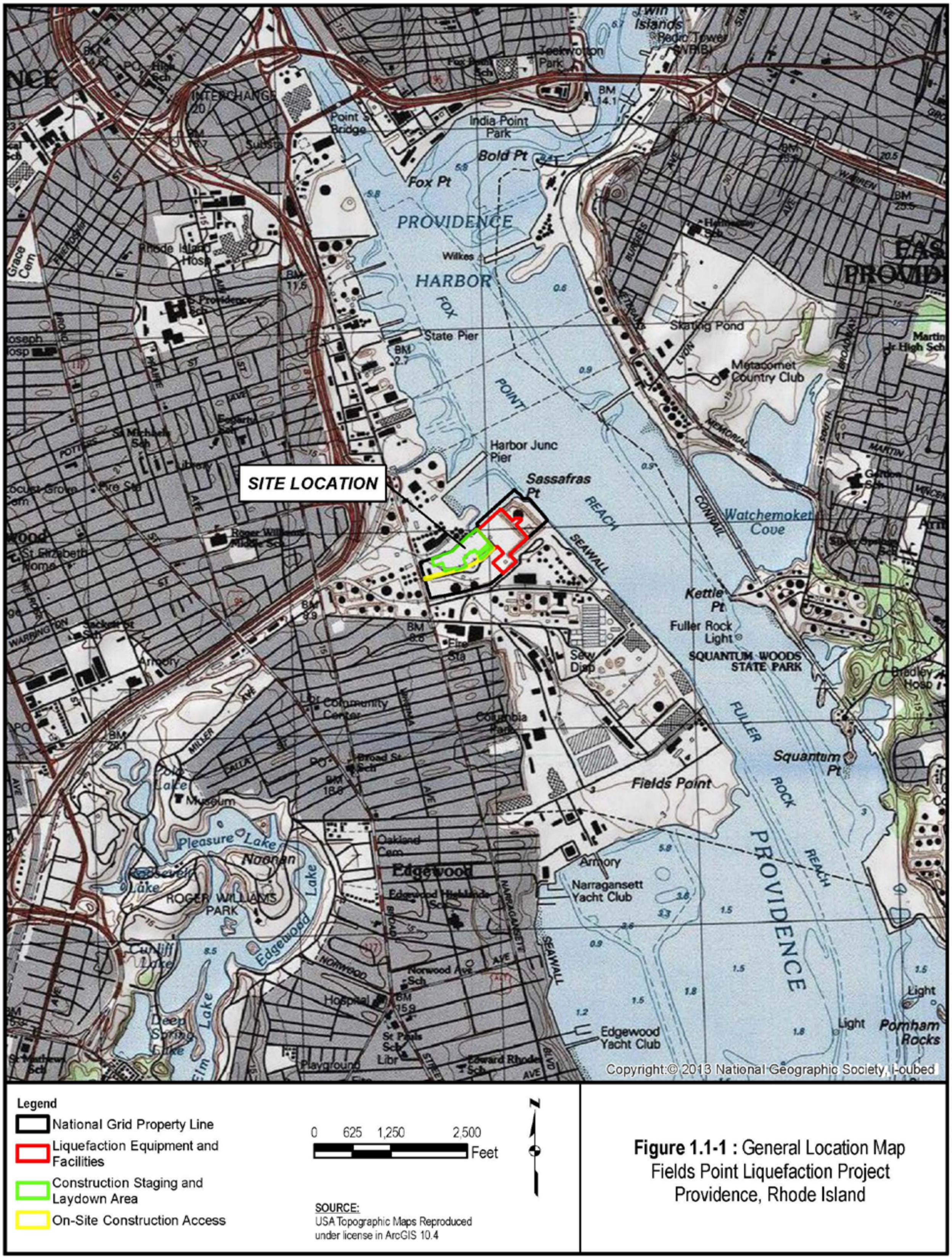


Figure 1.1-1 : General Location Map
Fields Point Liquefaction Project
Providence, Rhode Island

The assessment of environmental impacts is an integral part of the FERC's decision on whether to issue National Grid a Certificate of Public Convenience and Necessity (Certificate) to construct and operate the proposed facilities. Our principal purposes in preparing this EA are to:

- identify and assess potential impacts on the natural and human environment that would result from the proposed action;
- identify and recommend reasonable alternatives and specific mitigation measures, as necessary, to avoid or minimize Project-related environmental impacts; and
- facilitate public involvement in the environmental review process.

The EA will be used by the Commission in its decision-making process to determine whether to authorize National Grid's proposal. Approval would be granted if, after consideration of both environmental and non-environmental issues, the Commission finds that the Project is in the public convenience and necessity.

1.2 PROPOSED FACILITIES

The Fields Point LNG Facility is on a property that has been used for the production, generation, and transmission of natural gas or manufactured gas for more than 100 years. From about 1910 to 1954, a manufactured gas plant operated within the Project site, and between 1952 and 1990, liquefied petroleum gas storage and peak-shaving activities associated with natural gas distribution took place to the southwest of the Project site. The LNG storage facility at National Grid's Fields Point site has been in operation since completion of the LNG storage tank in 1974. Within the existing storage facility site, the land to the southwest of the Project site is occupied by a compressed natural gas fueling area owned and operated by National Grid and a natural gas regulation facility owned and operated by The Narragansett Electric Company (TNEC).

New liquefaction facilities proposed at the Project site include a gas pretreatment and liquefaction system capable of converting and storing 20 million standard cubic feet per day. Natural gas would be delivered to the facility via a connection to an existing pipeline immediately adjacent to the Project site and then cooled to its liquid form at –260 °F. The truck delivery facilities would remain in place. The Project does not propose to increase the storage capacity of the existing LNG storage tank and does not propose to relocate any of the existing cryogenic piping or vaporization equipment. In addition to the new liquefaction facilities, National Grid would construct a new LNG pump loading skid containment sump, which would serve a new LNG truck loading pump area, within the existing LNG tank containment sump in the LNG storage containment area. Vapor barriers would also be installed at various locations.

1.2.1 Pretreatment System

The pre-treatment system would be designed to improve the quality of the feed gas to meet the quality standards necessary for the liquefaction process equipment. Feed gas obtained from the existing Algonquin pipeline would be provided via an existing 12-inch-diameter connecting pipeline owned by TNEC. The pretreatment system has been designed to incorporate a molecular sieve adsorber which would remove impurities in the input feed gas.

The pretreatment system would consist of a semi-continuous, three bed system, single train which would transport treated natural gas to the liquefier. Gas would enter the system and pass through the coalescing vessel and filter, which would remove any water and solids. From there, gas would then be compressed and fed into the pre-treatment system, which would remove carbon dioxide (CO_2) and other contaminants.

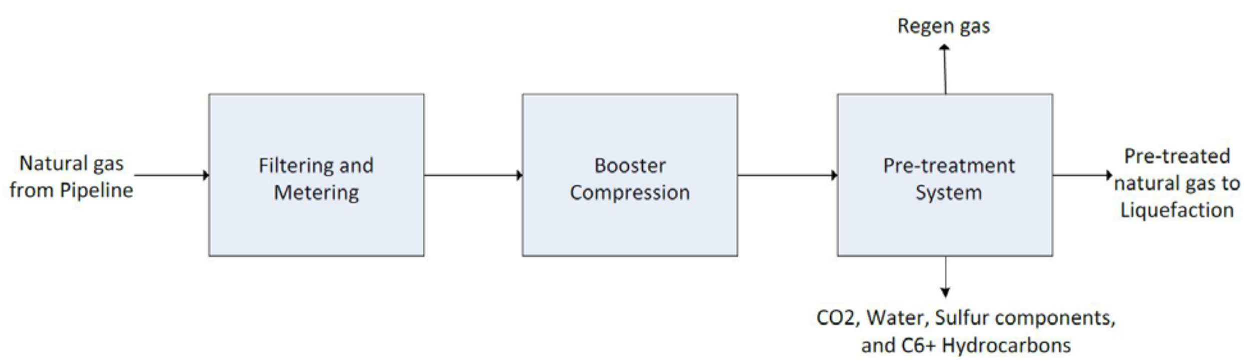
1.2.2 Regeneration Heater

The regeneration heater would be fueled by a portion of the treated feed gas and used to treat the molecular sieve vessels once they have been burdened by contaminants from the raw feed gas. A water heater would heat-treat gas to about 550 °F by a heat transfer mechanism. The regeneration gas exiting the heater would then pass through a mole sieve, where the contaminants would be expelled. The regeneration gas would then be combined with flow-by gas in the pressurized distribution system. The heater for the regeneration component would be fueled by natural gas from the existing TNEC gas pipeline on the Project site.

1.2.3 Liquefaction System

The major components of the liquefaction system consist of a brazed aluminum heat exchanger (i.e., cold box) and nitrogen refrigeration system. The process of liquefaction involves cooling natural gas vapor to a temperature cold enough so that it condenses and changes its physical state from a gas to a liquid. To accomplish this, methane is cooled to –263 °F in the cold box, which utilizes a liquid nitrogen refrigeration cycle. After pretreatment, which removes contaminants in the feed gas that would otherwise clog the heat exchanger, treated gas is then sent to a feed liquefier exchanger and cooled to –95 °F. After exiting the exchanger, the cooled gas is transferred to the heavy hydrocarbon knockout drum where contaminants heavier than methane are condensed and are removed from the stream before being transferred to the feed liquefier exchanger for additional cooling, condensing, and subcooling. Following this step, the condensed LNG is discharged into the LNG storage tank.

Figure 1.2.3-1 illustrates the proposed Project pretreatment system, regeneration heater, and liquefaction system in a simple flow diagram.[2]



2 C6+ hydrocarbons have six or more carbon atoms. Sulfur components may include a variety of sulfur-containing molecular compounds. National Grid's feed gas would be largely free of C6+ hydrocarbons.

Figure 1.2.3-1 Project Pretreatment System

1.3 PROJECT PURPOSE AND NEED

National Grid's stated purpose of the Project is to add liquefaction capability to its existing Fields Point LNG Facility to enable customers to deliver gas for storage in vapor form as an alternative to delivering LNG for storage wholly by tanker trucks. National Grid is proposing this Project at the request of its two affiliated storage customers, TNEC and Boston Gas Company,[3] and the firm capability of the new liquefaction facility is fully subscribed under precedent agreements with these customers. These customers requested the addition of new liquefaction service to diversify their gas storage supply sources. Currently, these customers rely primarily on a single source of LNG: the Everett, Massachusetts import terminal. To reduce supply risk, enhance the reliability of the downstream gas service it provides its customers, and provide an additional means by which to fill its contracted storage capacity, National Grid proposes the Project in order to liquefy natural gas obtained from the existing TNEC pipeline traversing the Project. National Grid states it would financially support the Project without relying on subsidization from existing customers.

Under section 7(c) of the NGA, the Commission determines whether interstate natural gas transportation facilities are in the public convenience and necessity and, if so, grants a Certificate to construct and operate them. The Commission is an independent regulatory agency and therefore conducts a complete independent review of project proposals, including an environmental review of proposed facilities. The Commission bases its decisions on technical competence, financing, rates, market demand, gas supply, environmental impact, long-term feasibility, and other issues concerning a proposed project.

We received several comments stating that the Project was not needed and that the customers would incur the cost of the Project through increased rates. Commenters also noted that the affiliated storage customers, TNEC and Boston Gas Company, are subsidiaries of National Grid. As stated above, the Commission will independently determine if the Project is in the public convenience and necessity when it decides whether to authorize the Project after the EA is issued.

1.4 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

The resource topics addressed in this EA include: 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 and 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 Energy Policy Act of 2005 provides that FERC shall act as the lead agency for coordinating all applicable authorizations related to jurisdictional natural gas facilities and for purposes of complying with NEPA. The FERC, as the "lead federal agency," is responsible for

[3] Both The Narragansett Electric Company and Boston Gas Company are affiliates of National Grid LNG, LLC.

preparation of this EA. This effort was undertaken with the participation and assistance of the DOT, RIDEM, and CRMC as “cooperating agencies” under NEPA. Cooperating agencies have jurisdiction by law or special expertise with respect to environmental impacts involved with a proposal. The roles of the FERC, DOT, RIDEM, and CRMC in the Project review process are described below. The EA provides a basis for coordinated federal decision making in a single document, avoiding duplication among federal agencies (or state agencies with federal delegation authority) in the NEPA environmental review process. In addition to the lead and cooperating agencies, other federal, state, and local agencies may use this EA in approving or issuing permits for all or part of the Project. Federal, state, and local permits, approvals, and consultations for the Project are discussed in section 1.10.

1.4.1 Federal Energy Regulatory Commission

Based on its authority under the NGA, FERC is the lead agency for preparation of this EA in compliance with the requirements of NEPA, the Council on Environmental Quality’s regulations for implementing NEPA (40 CFR 1500-1508), and FERC regulations implementing NEPA (18 CFR 380).

As the lead federal agency for the Project, FERC is required to comply with section 7 of the Endangered Species Act of 1973, as amended, the Magnuson-Stevens Fishery Conservation and Management Act, section 106 of the National Historic Preservation Act, and section 307 of the Coastal Zone Management Act (CZMA). Each of these statutes has been taken into account in the preparation of this EA. The FERC will use this document to consider the environmental impacts that could result if it authorizes the Project.

1.4.2 U.S. Department of Transportation

Under Title 49 U.S. Code section 60101, the DOT has prescribed the minimum federal safety standards for LNG facilities. Those standards are codified in 49 CFR 193 and apply to the siting, design, construction, operation, maintenance, and security of LNG facilities. The National Fire Protection Association Standard 59A, “*Standard for the Production, Storage, and Handling of Liquefied Natural Gas*,” is incorporated into these requirements by reference, with regulatory preemption in the event of a conflict. In accordance with the 1985 Memorandum of Understanding on LNG Facilities and the 2004 Interagency Agreement on the safety and security review of waterfront LNG import/export facilities, the DOT participates as a cooperating agency and assists in assessing any mitigation measures that may become conditions of approval for an LNG project.

1.4.3 Rhode Island Department of Environmental Management

RIDEM’s Office of Waste Management Site Remediation Program is overseeing National Grid’s cleanup of 642 Allens Avenue. As part of the cleanup, National Grid submitted a *Short Term Response Action Plan* (STRAP) for the remediation of impacted soil and groundwater on the portion of its property where it has proposed a natural gas liquefaction facility. In response to National Grid’s proposed Fields Point Liquefaction Project, the local community requested a Public Involvement Plan (PIP) for this site. As part of the PIP process, National Grid held two public meetings (July 13 and August 9, 2017) to collect and respond to community concerns about the investigation and cleanup of the site.

The scope of the public meetings and entire public participation process, which was initiated through the PIP, was specifically limited to the items under the jurisdiction of RIDEM's Office of Waste Management Remediation Regulations. The Office of Waste Management's jurisdiction in this matter is specific to the cleanup of the polluted soil and groundwater at the site. The FERC is responsible for approval of the proposed liquefaction facility. However, in an effort to be responsive to public concerns, RIDEM expanded the public participation process by granting an extension of its PIP public comment period to the maximum amount of time allowable by regulation, and allowing National Grid to hold the second public meeting on August 9, 2017 (only one is required by regulation), and by requesting that National Grid provide meeting notices and fact sheets in multiple languages for both meetings, as well as establish an information repository at the Knight Memorial Library for all documents associated with the Project.

RIDEM responded to all technical STRAP comments from the community in its October 6, 2017 Letter Response to STRAP Comments, as well as addressing questions regarding the Department's jurisdiction, explanation of the regulatory process, and clarification of the public's ongoing opportunities for public participation and comment through the federal FERC review process for the proposed liquefaction facility. RIDEM also provided comments on the draft STRAP to National Grid. National Grid responded with a STRAP Addendum, and on October 27, 2017, RIDEM issued a Short Term Response Action Approval Letter to National Grid. RIDEM's STRAP is further discussed in sections 2.1.2.2 and 2.2.1.2.

National Grid submitted an application for a Water Quality Certification to RIDEM on September 14, 2016. A State of Rhode Island Water Quality Certificate is required in accordance with Rule 13 A. (3) (a.) of RIDEM's water quality regulations:

> *(a). In accordance with Section 401 of the [Clean Water Act], applicants for any project which may result in a discharge to waters of the State and which requires a federal permit must directly apply for and receive a Water Quality Certification from RIDEM, Water Resources, except as described in footnotes (1)(3) & (4) below.*

A 30-day Public Notice was issued by RIDEM on October 18, 2017, which ended on November 20, 2017. RIDEM extended the public comment period and held a public meeting on January 31, 2018, at 6:00 p.m. at the Veterans Memorial Auditorium in Providence. Notice of the public meeting was posted on RIDEM's website in several languages, including English, Spanish, Kmer/Cambodian, Cape Verdean Creole, and Portuguese. At the time of publication of this EA, RIDEM continues to work with National Grid regarding the Water Quality Certification process.

See section 2.7.1.2 for discussion of RIDEM's air quality permitting requirements.

1.4.4 Rhode Island Coastal Resources Management Council

The CRMC has jurisdiction pursuant to the CZMA Section 307(c)(3)(A) (Title 16 U.S. Code Section 1456(c)(3)(A)) and the implementing regulations at 15 CFR 930, Subpart D – Consistency for Activities Requiring a Federal License or Permit. The CRMC reviews federal actions, including the issuance of federal licenses, permits, or authorizations that would have a reasonably foreseeable effect on any land or water use or natural resources of a coastal zone, and issues a determination as to whether they are consistent with the enforceable policies and standards of the federally approved state coastal management plan, which in this case is the Rhode Island Coastal Resources Management Program (CRMP), in accordance with the applicable federal regulations of 15 CFR 930, Subpart D.

The Project site is within the first tier of Rhode Island's coastal zone, which extends 200 feet inland from a coastal feature, and is within a coastal community (Providence). FERC has exclusive jurisdiction in this matter relative to the siting, construction, and operation of this proposed Project in accordance with U.S. Code 15 Section 717. While FERC's jurisdiction preempts state permitting of the siting of the Project, federal preemption does not remove the CRMC's federal consistency review authority for the Project pursuant to the federal CZMA, 16 U.S. Code Sections 1451-1464, and the CZMA's implementing regulations at 15 CFR 930, Subpart D. Accordingly, the CRMC review is specific to the reasonably foreseeable coastal effects of the Project.

On October 31, 2016, National Grid filed with the CRMC a federal consistency certification along with Project information and data. In its filing, National Grid certified that "the proposed activity will be consistent with Rhode Island's federally approved Coastal Resources Management Program." Construction of the proposed liquefaction facility necessitates a variance from the CRMC setback requirements of CRMP Section 140. To meet the burden of proof for the granting of the variance, the CRMC must find that National Grid has met the six variance criteria of CRMP Section 120:

1. The proposed alteration conforms with applicable goals and policies of the CRMP;

2. The proposed alteration will not result in significant adverse environmental impacts or use conflicts, including but not limited to, taking into account cumulative impacts;

3. Due to conditions at the site in question, the applicable standard(s) cannot be met:

4. The modification requested by the Applicant (i.e., National Grid) is the minimum variance to the applicable standard(s) necessary to allow a reasonable alteration or use of the site;

5. The requested variance to the applicable standard(s) is not due to any prior action of the Applicant or the Applicant's predecessors in title. With respect to subdivisions, the Council will consider the factors as set forth in (B) below in determining the prior action of the Applicant; and

6. Due to the conditions of the site in question, the standard(s) will cause the Applicant an undue hardship. In order to receive relief from an undue hardship an Applicant must demonstrate inter alia the nature of the hardship and that the hardship is shown to be unique or particular to the site. Mere economic diminution, economic advantage, or inconvenience does not constitute a showing of undue hardship that will support the granting of a variance.

Based on the October 31, 2016 filing date, the 6-month state agency review period specified in 15 CFR 930.60 was to end on April 30, 2017. However, the CRMC and National Grid mutually agreed to stay the CRMC 6-month review period until June 15, 2017. Subsequently, the

CRMC and National Grid agreed to further stay the review period until February 28, 2018 to allow sufficient time for National Grid to obtain other needed authorizations or permits to incorporate into the CRMC record. The CRMC continued to provide guidance and assistance to National Grid during this review period in accordance with 15 CFR 930.56.

The CRMC issued a public notice for the Project on November 16, 2016, and public comments were accepted until January 23, 2017. After reviewing Project information filed by National Grid as well as public comments, the CRMC staff issued a report on October 25, 2017. The CRMC held three public hearings on November 14 and 28, and December 12, 2017 where the Council considered the findings of the CRMC staff report, the public comments and testimony on the Project, and the materials, representations, and testimony submitted by National Grid. The Council concurred with the recommendation of the CRMC Executive Director based upon his review of the record that the Project is consistent with the applicable enforceable policies of the CRMP. The CRMC issued its consistency determination on December 20, 2017; which officially ended the review period discussed above.

1.5 PUBLIC REVIEW AND COMMENT (FERC NEPA PROCESS)

On June 22, 2015, National Grid filed a request to utilize our pre-filing process; we approved and initiated the pre-filing process on July 2, 2015, in Docket No. PF15-28-000. We participated in one public open house sponsored by National Grid near the Project site on August 13, 2015, to explain our environmental review process to interested stakeholders. FERC staff also participated in a site visit on that same day to examine the existing facilities and the proposed site for the new liquefaction facilities.

On September 25, 2015, we issued a *Notice of Intent to Prepare an Environmental Assessment for the Planned Fields Point Liquefaction Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting* (NOI). The NOI was published in the Federal Register[4] and was sent to over 560 parties, including: federal, state, and local officials; agency representatives; Native American tribes; local newspapers and libraries; and landowners, residents, and businesses potentially affected by the Project, as defined by the FERC regulations in 18 CFR 157.6. The NOI was produced in English and Spanish to aid the stakeholders whose primary language is Spanish.

On October 8, 2015, we conducted a public scoping meeting in Providence to provide an opportunity for agencies and the general public to learn more about the Project and to participate in the environmental analysis by identifying issues to be addressed in the EA. About 70 individuals attended the scoping meeting and 33 speakers presented comments. Also on October 8th, FERC staff met with staff from RIDEM, the CRMC, and the City of Providence to discuss the Project. The transcripts of the public scoping meeting and all written scoping comments are part of the public record for the Project and are available for viewing on the FERC Internet website (http://www.ferc.gov).[5] Table 1.5-1 summarizes the environmental issues identified during the

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4 The NOI was published in 80 Federal Register 59769 on October 2, 2015.

5 Using the "eLibrary" link, select "General Search" from the eLibrary menu and enter the docket number excluding the last three digits in the "Docket Number" field (i.e., PF15-28 and/or CP16-121). Select an appropriate date range.

scoping process. Substantive environmental issues raised by commenters are addressed in the applicable sections of the EA.

TABLE 1.5-1 **Key Environmental Concerns Identified During the Scoping Process**	
Issue/Specific Comment	**EA Section Addressing Comment**
General	
Project purpose and need	1.3
General environmental impacts	2.0
Alternatives	
Renewable energy alternatives	3.0
Energy conservation	3.0
Geology/Soils	
Risks from earthquakes	2.1.1
Land Use	
Impacts on neighboring residential properties	2.4
Socioeconomics	
Environmental Justice	2.5.7
Impacts on public facilities	2.5.3
Property values	2.5.5
Lack of local employment opportunities/short-term employment opportunities	2.5.1
Air Quality	
Greenhouse gases	2.7.1
Impacts on air quality/existing air quality in Project area	2.7.1
Reliability and Safety	
General safety of Project	2.8
Safety of nearby residents	2.8
Risks due to extreme weather events	2.8
Cumulative Impacts	
Additional impact of Project considering existing industrial area impacts	2.9
Climate change	2.9.2.4

1.6 LAND REQUIREMENTS

The Project's construction would temporarily disturb a total of 16.3 acres, of which 12.0 acres would be required for operation of the Project facilities. A summary of land requirements for the Project is provided in table 1.6-1 and shown on figure 1.6-1.

The Project would be entirely within the existing 16.3-acre Project site currently owned by TNEC and operated by National Grid. About 14.1 acres of this site are already developed as part of the existing LNG storage facilities, access, and other impacted areas.

TABLE 1.6-1 **Land Requirements for the Project**		
Facility	Land Required for Construction (acres)	Land Required for Operation (acres)
Liquefaction Equipment and Facilities	9.2	9.2
Construction Staging and Laydown	6.2	2.7
On-Site Construction Access	0.9	0.1
TOTAL	**16.3**	**12.0**

1.7 CONSTRUCTION, OPERATION, AND MAINTENANCE

The Project would be designed, constructed, operated, and maintained in accordance with the DOT regulations at 49 CFR 193, Federal Safety Standards for LNG Facilities and the National Fire Protection Association Standard 59A, Standards for Protection, Storage, and Handling of LNG. National Grid would also comply with the applicable measures outlined in the FERC *Upland Erosion Control, Revegetation, and Maintenance Plan* (FERC Plan)[6] to minimize impacts during construction activities. The FERC *Wetland and Waterbody Construction and Mitigation Procedures* would not apply as no wetland resources are within or directly adjacent to the Project site, and no construction in or across waterbodies is proposed.

Construction of the Project would require the placement of fill, grading, and ground preparation for the proposed gas pretreatment and liquefaction systems. Beyond this work, the Project site would require additional preparation through the installation of piles and engineered backfill to provide adequate geotechnical stabilization. The Project site is currently at an elevation lower than the maximum flood levels; therefore, the area of the proposed liquefaction system would need to be raised, and earthen berms or other floodwater barriers would need to be constructed. In order to accommodate National Grid's 500-year design basis, the elevation of the Project site would be raised about 9 feet in concert with constructed floodwater protections and equipment elevations, which should account for anticipated flood water levels as well as sea level rise and maximum predicted wave heights.

If the Commission approves the Project, National Grid anticipates construction of the Project facilities to begin as soon as 2 months after Commission approval, based on its original schedule included in its application. Construction is expected to take about 24 months; the construction workforce would be about 155 workers.

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[6] The FERC Plan and Procedures are a set of construction and mitigation measures that were developed to minimize the potential environmental impacts of the construction of natural gas facilities in general. Copies of our Plan and Procedures may be accessed on our web site (http://www.ferc.gov/industries/gas/enviro/guidelines.asp), or copies may be obtained through our Office of External Affairs at 1-866-208-3372.

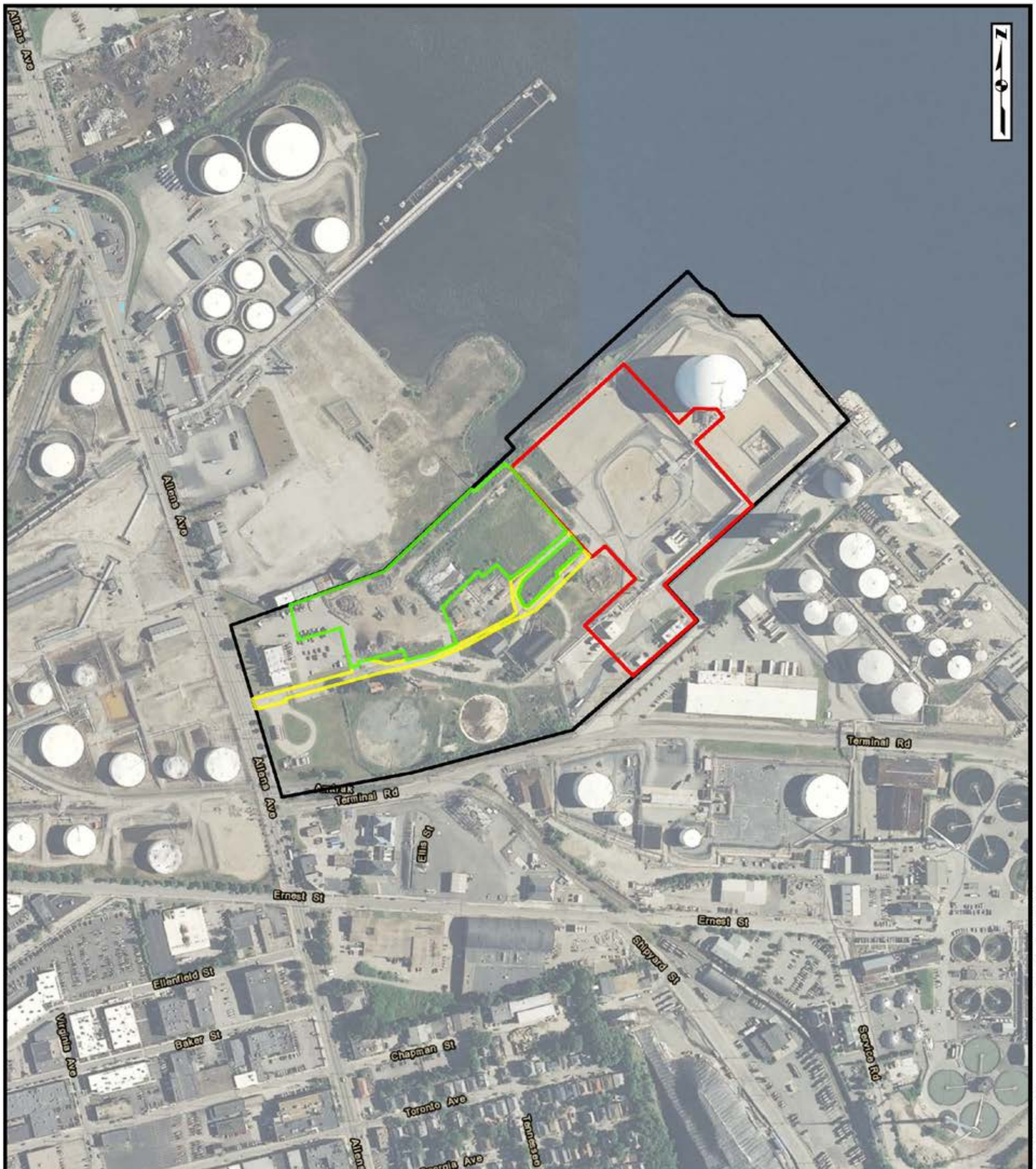

Figure 1.6-1 : Land Requirements
Fields Point Liquefaction Project
Providence, Rhode Island

Pilings would be installed following the installation of the subsurface utilities. Pilings would be delivered to the Project site via truck and would be installed to facilitate the construction of the other components of the Project. Following the installation of the piles, pile caps would be installed on top of each piling to support the equipment foundations.

The main components of the Project would be constructed following the completion of the foundation installation. The majority of the facilities would be constructed on the Project site; however, some components may arrive preassembled. Equipment would be leveled and shimmed prior to being anchored to a foundation. Rotating equipment would require the additional step of pre-commissioning, which includes filling lubricants and the initial energizing of motors to ensure proper rotation.

Subsurface utilities such as fire suppression lines, electrical lines, and similar utilities would be installed throughout the Project site. All of the underground utilities would have between 3 and 5 feet of surficial cover dependent on each utility's expected surface load.

National Grid would test the newly installed systems to ensure their integrity and safety; such tests include hydrostatic testing and pneumatic testing of piping; testing of electrical cables; and equipment calibrations.

1.7.1 Operation and Maintenance

National Grid would operate and maintain the Project facilities to meet or exceed all applicable regulations and would implement applicable environmental compliance and monitoring requirements. Prior to the start of Project construction and operation, National Grid would prepare supplemental operation and maintenance plans, which include regular leak inspections. The modified Fields Point LNG storage facilities, including the Project facilities, would be staffed 24 hours per day with all systems monitored and controlled in a central control building. All personnel would be sufficiently trained in the operation and monitoring of the proposed Project liquefaction facilities.

1.7.2 Future Plans and Abandonment

In its initial application filing with the FERC for the proposed Project, National Grid expressed an intent to construct an LNG storage tank containment enhancement project, also known as the "bund wall project." The containment enhancement project would be independent from the proposed liquefaction Project and would entail National Grid constructing a reinforced concrete wall around its existing LNG storage tank to enhance the existing impoundment capacity.

However, in a filing dated March 16, 2017, National Grid stated that it intends to file a separate application with FERC for the containment enhancement project at some point in the future, as yet undetermined. National Grid stated that the new liquefaction facility is being proposed regardless of the bund wall project. As discussed in section 2.8, the proposed Project facilities would be sited consistently with federal regulations promulgated by the DOT in 49 CFR 193, as well as other relevant regulations, and other industry codes, engineering standards, and guidelines. The potential cumulative impacts of the containment enhancement project are further discussed in section 2.9 of this EA.

Apart from the aforementioned containment enhancement project, National Grid states that it has no future plans for development or abandonment of any other facilities at the Project site.

1.8 ENVIRONMENTAL COMPLIANCE, INSPECTION, AND MONITORING

National Grid would obtain all the necessary environmental permits and approvals as summarized in EA section 1.10; and would construct, operate, and maintain the Project facilities in compliance with permit conditions and other applicable federal and state regulations and guidelines. Prior to Project construction, National Grid would be required to submit an Implementation Plan to FERC for review and approval. The Implementation Plan would describe how National Grid would maintain environmental compliance with the Commission's Order, and other applicable regulations and permit requirements.

National Grid would conduct training for its construction personnel, contractors, and its employees regarding proper field implementation of the FERC Plan, erosion and sediment control measures, and other Project-specific plans and mitigation measures. National Grid would employ one environmental inspector (EI) for Project construction. The responsibilities of the EI would include ensuring compliance with the requirements of the FERC Plan, environmental conditions of the FERC approval, applicable mitigation measures, other environmental permits and approvals; documenting compliance with environmental requirements; and identifying and overseeing corrective actions where necessary. The EI would have the authority to stop activities that violate the Project's environmental conditions and to order appropriate corrective action. We would conduct inspections during construction of the Project facilities to ensure environmental compliance. In addition, FERC LNG Engineering staff would conduct site inspections on at least a biennial basis or more frequently as circumstances indicate of the Project site during the operating life of the facilities.

1.9 NON-JURISDICTIONAL FACILITIES

Under section 7(c) of the NGA, the Commission is required to consider, as part of its decision to approve facilities under Commission jurisdiction, all factors bearing on the public convenience and necessity. Occasionally, proposed projects have associated facilities that do not come under the jurisdiction of FERC. These "non-jurisdictional" facilities may be integral to the needs of a project (e.g., a new or expanded power plant at the end of a pipeline that is not under the jurisdiction of FERC) or may be merely associated as minor, non-integral components of the jurisdictional facilities that would be constructed and operated as part of a project.

Natural gas would be delivered to the Project site through existing non-jurisdictional facilities, and no construction of new non-jurisdictional gas infrastructure is planned related to the Project. However, additional electric power would be required to supply the liquefaction facilities. Electric service would be provided by TNEC by installing dedicated 13 megawatt (MW), 34.5-kilovolt (kV) electric service. This service would require an upgrade to a nearby substation and a new underground electric cable that would be added to an existing electrical conduit that connects to the Project site. Specifically, TNEC's electric service project consists of installing an 11/34.5-kV step-up transformer at the existing Franklin Square, Providence Substation and extending 1.4 miles of 34.5-kV underground cable to a primary metered overhead service point at the Project site. Cumulative impacts associated with these non-jurisdictional facilities, the Project facilities, and other planned or proposed projects in the Project vicinity are addressed in section 2.9 of this EA.

1.10 PERMITS, APPROVALS, AND REGULATORY CONSULTATIONS

Table 1.10-1 identifies the major federal, state, and local environmental permits, approvals, and regulatory clearances for the Project.

TABLE 1.10-1

Major Permits, Approvals, and Consultations for the Project

Agency	Permit/Approval/Consultation	Status
Federal Energy Regulatory Commission	Certificate of Public Convenience and Necessity under Section 7 of the NGA	Pending
U.S. Fish and Wildlife Service	Section 7 of the Endangered Species Act Consultation	Consultation not required, as no federally listed species would be affected
National Marine Fisheries Service	Magnuson-Stevens Fishery Conservation and Management Act consultation on Essential Fish Habitat (EFH)	Consultation not required, as no federally listed species or EFH would be affected
Rhode Island Coastal Resources Management Council	Coastal Zone Management consistency review	Determination received December 2017
Rhode Island Department of Environmental Management	Section 401 Water Quality Certificate	Application submitted September 2016
	General Permit for Stormwater Discharges from Construction Activity	Application submitted September 2016
	Emergency Generator Permit	General Permit received October 31, 2016
	Short Term Remedial Action Plan	Approval letter issued October 27, 2017
Rhode Island State Historic Preservation Office	Section 106, National Historic Preservation Act Consultation	Consultation completed March 23, 2016
City of Providence	Soil Erosion and Sediment Control Ordinance	Application submitted February 2017

2.0 ENVIRONMENTAL ANALYSIS

2.1 GEOLOGY AND SOILS

2.1.1 Geologic Setting, Mineral Resources, and Natural Hazards

2.1.1.1 Geologic Setting

The Project site is in the Seaboard Lowland section of the New England Physiographic Province. This section is lower in elevation and typically less hilly than the New England Upland section and has many small rivers and streams flowing along land surfaces that slope towards the ocean. The area was inundated by the ocean and large proglacial lakes during the last glacial retreat about 10,000 years ago. Local relief is typically less than 200 feet in most places within this section (U.S. Geological Survey [USGS], 1999). At the Project site, the topography is generally level and is the result of historic filling and grading associated with construction of industrial operations within the Fields Point area.

2.1.1.2 Mineral Resources

Based on a review of USGS topographic maps, recent aerial photography, and available USGS databases, no active mining or oil and gas extractive operations are within 0.25 mile of the Project facilities (USGS, 2008; 2016).

2.1.1.3 Geologic and Other Natural Hazards

Geologic hazards are natural, physical conditions that can result in damage to land and structures or injury to people. Potential geologic hazards associated with the Project include earthquake ground motions (and associated soil liquefaction) and surface faulting, landslides, subsidence, and tsunamis. Other natural hazards include wind, flooding/storm surge, and sea level rise. Conditions necessary for the development of other geologic hazards, including regional subsidence, avalanches, karst terrain, and volcanism, are not present in the region.

In general, the potential for geologic hazards to significantly affect construction or operation of the Project facilities is low.

Seismicity and Surface Faulting

The east coast of the United States is a passive tectonic plate boundary on the “trailing edge” of the North American continental plate, which is relatively seismically quiet. The nearest large seismic event was in 1755 off Cape Ann, Massachusetts, about 90 miles northeast of the Project.

The shaking during an earthquake can be expressed in terms of the acceleration due to gravity. For reference, peak ground acceleration (PGA) of 4 percent of gravity or less would result in light to no perceived shaking and no potential damage, and PGAs between 4 and 9 percent would result in moderate perceived shaking and very light damage. PGA of 10 percent of gravity is generally considered the minimum threshold for damage to older structures or structures not made to resist earthquakes (USGS, 2006a). Based on USGS seismic hazard mapping for rock sites, the Project site is an area where PGAs, with a 2 percent probability of exceedance in 50 years (2,500-year return time), are 10 percent of gravity and PGAs with a 10 percent probability of exceedance in 50 years (475-year return time) are 2 percent of gravity (USGS, 2014). On soft soil sites such as that found at the Project site, earthquake ground motions can be amplified by a factor of two or more. Therefore, while the seismic risk in Rhode Island is generally low, it is more significant on soft soil sites where the risk is considered moderate.

Coastal Flooding, Storms, Hurricanes, Tsunamis, and Sea Level Rise

Flood hazard areas on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map are identified as a Special Flood Hazard Area. Special Flood Hazard Areas are defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also referred to as the base flood or 100-year flood. Moderate flood hazard areas are also shown on the Flood Insurance Rate Map and are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood. According to the FEMA National Flood Hazard Layer, portions of the Project site are within the 100-year and 500-year floodplain (FEMA, 2016). FEMA flood hazard maps include the effects of hurricane storm surge. According to FEMA, the 100-year flood elevation at the Site is 12 feet (North American Vertical Datum, 1988 [NAVD 88]) and the 500-year flood elevation is 19 feet (NAVD 88). Adding the anticipated sea level rise of 0.9 feet to the 500-year flood elevation of 19 feet equals a total elevation of 19.9 feet (NAVD 88) of potential flood depth.

2.1.1.4 Project Design and Construction

The Project facilities would be designed and built in accordance with DOT Federal Safety Standards for Liquefied Natural Gas Facilities (49 CFR 193 and National Fire Protection Association Standard 59A) and all other applicable state and federal safety building codes.

National Grid conducted geotechnical investigations and has prepared a *Geotechnical Engineering Report* to investigate subsurface conditions at the Project site and provide foundation design recommendations. Based on the test borings conducted, the Project site is composed of about 10 to 20 feet of sand and gravel fill, with various amounts of concrete, brick, and other debris. The fill is underlain by silty organic deposits from 12 to 83 feet below the ground surface. Groundwater was intersected at about 10 feet below the surface. Based on the results of the *Geotechnical Engineering Report*, the existing soil materials at the Project site are not suitable for the support of structures. In addition, it is anticipated that settlement of up to 18 inches would occur during site filling. Therefore, National Grid is proposing to drive displacement-type concrete piles and use micro-piles to support the Project facilities. A relieving platform supported by embedded piles would be installed under the proposed northern embankment to minimize slope instability along the embankment.

National Grid conducted a seismic hazard analysis in accordance with the FERC (2007) *Seismic Design Guidelines for LNG Facilities* and the requirements of American Society of Civil Engineers/Structural Engineering Institute Standard 7-05. Site-specific ground motion analyses were conducted for two soil conditions: Site Class B (weak rock) and Site Class E (soil). The seismic hazard analysis determined that the calculated PGA and spectral acceleration values indicate a low level of seismic hazard for the 2,475-year return period at the Project site. Seismic design parameters for the Project site have been developed in accordance with the FERC Guidelines. Other seismic-related hazards such as soil liquefaction, lateral spreading, surface fault ruptures, and tsunamis are considered insignificant to incorporate additional engineering analysis and design. However, as noted above due to soil issues, structures would be on appropriately designed piles.

National Grid conducted a coastal and hydraulic modeling analysis to model 100- and 500-year storm wave action. As a result of the analysis, National Grid has proposed to raise the elevation of the liquefaction equipment from about 12 feet to 21 feet (NAVD 88) to accommodate a 500-year design basis. According to FEMA (2016), the 100-year flood elevation at the Project site is 12 feet (NAVD 88), and the 500-year flood elevation is 19 feet (NAVD 88). Adding the anticipated sea level rise of 0.9 feet to the 500-year flood elevation of 19 feet equals a total elevation of 19.9 feet (NAVD 88) of potential flood depth. National Grid anticipates placing 22,000 cubic yards of fill within the Project site in order to meet the 500-year design requirement.

Based on National Grid's proposed mitigation measures, we conclude that the Project would not have significant impacts on geological resources or be susceptible to significant geologic hazards. Geologic and other natural hazards are further addressed in section 2.8.4 of this EA.

2.1.2 Soils

Soil information for the Project site was obtained from the Natural Resources Conservation Service's Soil Survey Geographic database (Soil Survey Staff, 2016). The Soil Survey Geographic database is a digital version of the original county soil surveys developed by the Natural Resources Conservation Service for use with geographic information systems. This database provides a detailed level of soils information for natural resource planning and management.

2.1.2.1 Existing Soil Resources

The entirety of the Project site is on soils mapped as Udorthents-Urban land complex (map unit symbol UD) (Soil Survey Staff, 2016). This complex consists of moderately well drained to excessively well drained soils that have formed from the deposition of cut and fill human transported materials, as well as soils covered in pavement or structures. Udorthents generally consist of moderately coarse textured material; however, soil permeability and stability can be highly variable within a map unit depending on the properties of the materials deposited. The Project location UD map unit is not designated prime farmland, and is not considered to be prone to erosion, compaction, or have concerns for successful revegetation.

The Project site has historically been used for industrial operations, and contaminated soils and groundwater are present in some areas of the site. A former manufactured gas plant that operated at the site from 1910 until 1954 released by-products including coke, coal tar, ammonia, toluene, and benzene (FERC, 2005). Investigations have been conducted at the Project site under RIDEM approval since 1994. The extent of soil contamination varies across the site, ranging vertically from the surface to the water table and extending over large portions of the property. A soil cap[7] has been installed within the liquefaction area of the Project site; however, there is no soil cap within the proposed construction staging and laydown area.

In 1998, RIDEM approved a *Remedial Action Work Plan* that defined remediation objectives for National Grid's existing Fields Point property, including objectives for surface soils (0 to 2 feet below ground surface), subsurface soils (greater than 2 feet below ground surface) within 100 feet from the Providence River shoreline, and subsurface soils more than 100 feet from the Providence River shoreline. Two major soil remediation projects have been conducted at the Project site since 1998 by the former site tenant (Algonquin LNG, Inc.), including excavating and removing contaminated soil from an area southeast and adjacent to the truck offloading facility and from an area within the containment dike, adjacent to the LNG tank sub-impoundment; and excavating and removing contaminated soil from between the north waterfront and the truck offloading facility. Other areas of contaminated soil within the Project site have been covered with various materials including clean sand, crushed stone, and rip-rap, consistent with the *Remedial Action Work Plan*.

Soils along the northern and eastern access roads that surround the LNG containment berm, within the truck offloading area, and within the southwestern-most portion of the Project site are still contaminated by metals, semi-volatile organic compounds, and petroleum (FERC, 2005). Explorations performed in the liquefaction work area of the Project site identified coal tar-like and fuel oil-like contamination in the fill layer, as evidenced by elevated levels of volatile organic compounds (VOC), polycyclic aromatic hydrocarbons, total petroleum hydrocarbon, metals, and cyanide. In addition, light non-aqueous phase liquids were observed in some monitoring wells screened within the fill layer. The horizontal extent of contamination includes the entire proposed Project work area. Vertically, contamination within the proposed Project work area extends through the fill layer to less than 10 feet into the organic silt layer. The thickness of the organic silt in this area of the Project site ranges from about 15 to 20 feet below ground surface, and appears to limit vertical migration of contaminants. Evidence of soil contamination in the bearing sand (which is below the organic silt layer) has not been observed in geotechnical borings performed in the proposed Project work area.

2.1.2.2 Impacts and Mitigation

Due to the historic disturbance at the Project site, construction and operation of the Project are not anticipated to result in additional impacts on soils resources. National Grid would implement the FERC Plan to minimize soil erosion and sedimentation during construction. Temporary erosion controls, including slope breakers and sediment barriers (e.g., hay bales and silt fences), would be installed following initial ground disturbance to control runoff and prevent sediment transport off the construction workspace. Revegetation measures are not proposed for the Project because the disturbed areas would be stabilized and covered with concrete, newly installed facilities, asphalt, and gravel.

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[7] Soil Cap: Placement of defined thickness of clean fill over an area of contaminated soil (typically 2-3 feet of soil for non-residential uses, 10 feet for residential uses) to prevent contact with contaminated soil (EPA, 2010).

In accordance with Section 6.00 of the RIDEM Office of Waste Management's Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Remediation Regulations), National Grid submitted a STRAP and a STRAP Addendum to RIDEM on May 12 and October 11, 2017, respectively. National Grid would implement mitigation measures from the STRAP and STRAP Addendum for handling, storing, and the reuse or disposal of contaminated soils and the handling and management of contaminated groundwater that would be encountered during construction. Some measures include:

- segregate and stockpile suspect contaminated soils on polyethylene sheeting or other appropriate sealed containers;
- cover all stockpiled materials at the end of each work day with polyethylene sheeting;
- surround stockpiled materials with erosion controls to prevent spreading materials;
- surround proximate catch basins, storm drains, or receiving waters with erosion controls to prevent sedimentation;
- implement dust and/or nuisance odor control (e.g., spraying, mulching, foaming);
- if dewatering is necessary, adequately treat all water prior to discharge or transfer to sealed containers for off-site disposal at a licensed facility;
- return soils to their same locations to the maximum extent possible, or sample and ship soils off-site for disposal;
- restore the existing soil cap at the end of construction; and
- decontaminate heavy equipment and hand tools at the conclusion of construction.

National Grid would install foundation piles in contaminated soils; however, the installation of these piles is not anticipated to affect contamination migration. Displacement-type concrete pilings equipped with a piling point and pile driving shoe act to move soil and rock aside of the pile while driving and compact the soil around the piling, reducing the potential for vertical migration of contamination by creating an impermeable layer. Depth of the piles would range from 50 to 90 feet below ground surface. The contaminated soils are within the surficial fill materials and upper portion of the organic silt layer. As the piles are driven through the deeper organic silt materials, a smeared, compacted interface would likely occur at the pile contact. Because the organic silt is of low permeability, and there are no known downward seepage gradients based on available site investigations, downward migration of contamination more than a few feet is not anticipated.

Dust suppression to prevent contaminated soil from moving off-site and to also minimize dust generated by moving vehicles and wind is further discussed in section 2.7.1.3.

National Grid's use of the FERC Plan would minimize impacts on soils and reduce sedimentation. In a letter dated October 27, 2017, RIDEM offered its concurrence with the proposed remedial actions for the Project area, provided that National Grid strictly adheres to all activities and procedures detailed in the STRAP and STRAP Addendum. Based on the mitigation measures National Grid has committed to in its STRAP and STRAP Addendum approved by RIDEM, we conclude that the existing contamination encountered at the Project site would be managed effectively to minimize impacts on soils during construction and operation of the Project.

2.2 WATER RESOURCES, FISHERIES, AND WETLANDS

2.2.1 Groundwater

2.2.1.1 Existing Groundwater Resources

Groundwater exists beneath the Project site in both a shallow unconsolidated aquifer and a fractured bedrock aquifer. The shallow aquifer consists of glacially derived sedimentary material (stratified drift) and fill material historically used to raise the land elevation. Beneath the unconsolidated sediments groundwater exists within a fractured sedimentary bedrock aquifer (USGS, 1991). Groundwater is largely influenced by the tidal ebb and flow of the Providence River and is naturally brackish. The depth to the water table varies due to disturbance and filling of the natural contours (Natural Resources Conservation Service, 1981). Based on the results of soil borings conducted at the Project site in 2015, the water table is about 10 feet below the existing ground surface (about 20 feet below the proposed ground surface of the liquefaction area) (Weidlinger, 2016). Groundwater beneath the Project site is classified by RIDEM as "GB" which means that groundwater may not be suitable for drinking water use without treatment due to known or presumed degradation. Areas in the state where groundwater is classified as GB are served by public water supply systems. Drinking water in the City of Providence is supplied by the Providence Water Supply Board, which utilizes only surface water supplied from less urbanized portions of the state. As further discussed below, no sole source aquifers underlie the Project site and no potable public or private wells exist within 4 miles of the Project site based on information available from the Rhode Island Geographic Information System.

Soil and groundwater beneath the Project site have been contaminated by historical manufactured gas plant operations and other historical industrial activities in the vicinity of the Project site. Existing groundwater contaminants include dissolved phase impacts (benzene, ethylbenzene, and naphthalene) and light non-aqueous phase liquids. Additional information related to contamination at the Project site is discussed in section 2.1.2.

<u>Sole Source Aquifers</u>

Sole or principal source aquifers are defined by the U.S. Environmental Protection Agency (EPA) as those aquifers that supply at least 50 percent of the drinking water consumed in the area overlying the aquifer. The Project site is not above a state or EPA sole source aquifer. The EPA lists the Block Island Aquifer, Pawcatuck River Basin Aquifer System, Conanicut Island Aquifer, and Hunt-Annaquatucket Pettaquamscutt Aquifer as sole source aquifers within the State of Rhode Island (EPA, 2016a). These aquifers are more than 8 miles from the Project site.

Water Supply Wells and Springs

The City of Providence obtains water from the Scituate Reservoir in central Rhode Island. The Scituate Reservoir is the largest body of freshwater in Rhode Island and has a total watershed area of about 93 square miles (Providence Water, 2015). The Project site is more than 9 miles from the Scituate Reservoir and more than 7 miles from the Scituate Reservoir watershed.

The Rhode Island Department of Health (2015) indicated that no public or private water wells are known to exist at the Project site. In addition, the Project would not affect any state-designated wellhead protection areas based on a review of data available through the Rhode Island Geographic Information System. No springs were identified in the vicinity of the Project site.

2.2.1.2 Impacts and Mitigation

Construction and operation of the Project would not require the use of groundwater. Project water needs would be met by utilizing City of Providence water. There are no groundwater withdrawal areas or springs within 150 feet of the Project, and the closest groundwater withdrawal area used for potable water is about 4 miles from the Project site. The Project would not involve blasting or deep trenching, although pile driving would intersect groundwater below the Project site (discussed further below). There would be no process wastewater discharges to groundwater, and the Project facilities are expected to be constructed without excavation into the shallow groundwater zone that would necessitate the need for dewatering. The placement of fill and addition of impervious surfaces at the Project site would impact groundwater recharge from the surface. However, these impacts would be minor due to the small increase in impervious surfaces that is proposed as part of the Project and would likely not affect local groundwater flow patterns.

Surficial aquifers have the potential to be affected by spills and excavated soils that were contaminated by previous site operations. To minimize potential impacts on shallow groundwater from construction activities, National Grid would implement mitigation measures from its STRAP and STRAP Addendum. Additionally, construction equipment would be refueled in areas with impervious surfaces to the extent practicable to prevent accidental discharges of fuels to surface soils or groundwater. All construction activities would adhere to National Grid's Project-specific *Spill Prevention, Control, and Countermeasure Plan & Preparedness, Prevention, and Contingency Plan* (SPCC Plan) that identifies and addresses:

- the type and quantity of material handled, stored, or used on site during construction;
- the measures to be taken for spill preparedness and prevention;
- emergency response procedures;
- spill incident reporting/notification procedures; and
- local emergency response team arrangements.

As noted above, the aquifer at the Project site is brackish and has been contaminated by historical manufactured gas plant and other industrial operations at and in the vicinity of the site. Construction of the Project facilities would require the installation of deep foundation pilings into groundwater to a depth of about 50 to 90 feet below the ground surface; however, the installation of piles is not expected to significantly impact groundwater flow conditions. Two types of piles would be installed as part of the Project, including displacement-type concrete piles and micro-piles, as further discussed below.

During installation of the displacement-type piles, there is tight pile-to-soil contact that results in increased lateral pressures. This increase in soil pressure around the pile would provide protection against vertical migration of groundwater. The micro-piles would be installed using temporary casings and would be drilled to depth. The auger bit and displaced soils would be removed once the required depth is obtained, and grout would then be placed into the void and the temporary casing would be removed. Additional grout would be injected under pressure to seal the bore hole and provide protection against migration of groundwater. In addition to limited vertical migration, pile driving would not be expected to significantly affect the lateral migration of groundwater due to the even spacing of the piles throughout the Project work area. In the event that unforeseen issues arise during pile driving (e.g., obstructions, pile head damage), the pile would be cut off to elevation and left in place. If it is determined that removal of a damaged or obstructed pile is required, the hole would be backfilled with a material impervious to groundwater migration such as bentonite slurry. National Grid would evaluate and treat any unanticipated hazardous materials uncovered during construction in accordance with its STRAP, STRAP Addendum, and applicable federal requirements.

The Project would adhere to all federal and state water quality standards to ensure that no adverse effects on the quality of groundwater resources would occur. Based on the mitigation measures National Grid has committed to in its STRAP and STRAP Addendum approved by RIDEM, we conclude that the existing contamination encountered at the Project site would be managed effectively to minimize impacts on groundwater resources during construction and operation of the Project.

2.2.2 Surface Water

2.2.2.1 Existing Surface Water Resources

The Project site is adjacent to the Providence River, a large perennial river which flows south into Narragansett Bay. The Providence River is listed as an impaired water on the 2014 303(d) List of Impaired Waters (RIDEM, 2015a), and receives substantial pollutant loadings from wastewater treatment facilities that are not tied into the Narragansett Bay Commission's Combined Sewer Overflow project, as well as runoff from industrial areas. In addition, the August 2001 *Providence River and Harbor Maintenance Dredging Project Final Environmental Impact Statement*, prepared by the U.S. Army Corps of Engineers (2001), indicated that Providence River sediments in the vicinity of the Project site are considered contaminated.

There are no sensitive waterbodies that would be affected by the Project, and there are no rivers in the vicinity of the Project that are listed, or proposed for listing, as National or State Wild and Scenic Rivers (National Park Service, 2016).

Surface Water Use

No potable water intake sources are within 3 miles downstream of the Project site, and the Providence River is not part of the public water supply system for the City of Providence. As stated above, the City of Providence obtains water from the Scituate Reservoir Complex.

The primary use of the Providence River in the vicinity of the Project site is for shipping transportation. A maintained federal navigation channel in the Providence River extends from the Upper Narragansett Bay to Fox Point. The navigation channel has an authorized depth of 40 feet at Mean Lower Low Water and is about 1,500 feet wide in the vicinity of the Project site. The CRMC classified the Providence River in the vicinity of the Project site as Type 6 Waters: Industrial Waterfronts and Commercial Navigation Channels area. Within Type 6 Waters, the maintenance of adequate water depths is essential, and water-dependent industrial and commercial activities take precedence over other activities. The CRMC acknowledges that high water quality is seldom achievable in Type 6 Waters.

In the vicinity of the Project site, RIDEM has classified the Providence River as a Class SB1 surface water. Designated uses for SB1 waters include primary and secondary recreational contact, shellfish harvesting for controlled relay and depuration, fish and wildlife habitat, aquacultural uses, navigation, and industrial cooling. However, the Providence River adjacent to the Project site is subject to a RIDEM partial use designation, indicating that surface water is affected by various activities, such as combined sewer outfalls or a concentration of vessels, which partially restricts some designated uses. For example, primary recreational contact activities may be restricted due to pathogens from approved wastewater discharges in the area from other facilities. In addition, the existing industrial character of the waterfront in the vicinity of the Project site is not conducive to recreational uses.

Floodplains

The Project site is within a FEMA-mapped 100-year floodplain, Zone AE (elevation 12, NAVD 88) and predominantly lies at a lower elevation than maximum flood water levels that have been recorded over the past 100 years. Based on coastal and hydraulic modeling analyses conducted by National Grid, additional site work would be required to accommodate its 500- year design basis, including raising the elevation of the liquefaction area and installing earthen berms or other barriers. Preliminary Project designs propose raising the elevation of the Project site in the proposed liquefaction area by about 9 feet (to elevation 21; NAVD 88) to account for expected still water levels plus sea level rise. A combination of barriers and equipment design elevations would account for maximum predicted wave heights. About 22,000 cubic yards of fill would be required over a 1.85-acre portion of the Project site where the liquefaction equipment would be installed in order to meet 500-year flood design criteria. Compensatory flood storage is not proposed as part of this Project because the area is associated with tidal waters and, in a January 7, 2016 meeting with the CRMC and RIDEM, National Grid confirmed that compensatory flood storage would not be required (CRMC, 2016).

Hydrostatic Testing

Hydrostatic testing of non-cryogenic systems, such as fire water, water service piping, natural gas and fuel gas piping, gaseous nitrogen, and hot oil would be performed prior to operation of the Project facilities. Water for hydrostatic testing would be obtained from the City of Providence water distribution system. The estimated volume of potable water required is about 6,500 gallons. Other piping systems, including but not limited to the cryogenic pipes for nitrogen refrigerant, cold natural gas vapor, liquefaction, and LNG transfer, would be pneumatically tested.

Hydrostatic test water would be reused for additional hydrostatic testing and dust suppression to the extent possible. Hydrostatic test water would be removed from the Project site for disposal following construction, where no on-site reuse is possible. Water would not be discharged to the Providence River. If hydrostatic test water is used for dust suppression or discharged to the ground surface, it would be tested prior to being placed on the ground surface. National Grid would comply with all the conditions included in the General Permit for Storm Water Discharges that would be obtained from RIDEM.

2.2.2.2 Impacts and Mitigation

The Project would not have significant water requirements associated with construction and operation of the Project facilities. Potable water for operational needs (personnel), temporary facilities, hydrostatic pressure testing, and construction water would be obtained from the Providence Water Supply Board distribution system. In addition, all Project work activities would be land-based; therefore, no Project work would take place within waterbodies (including the Providence River). Direct impacts on water resources are not expected.

During construction, potential indirect impacts on surface water resources would primarily be associated with stormwater runoff from disturbed areas into the Providence River. These impacts could include increased turbidity and sediment deposition in the waters adjacent to the Project Site; however, these impacts would be short-term and would not represent a significant impact on the river. National Grid would minimize or avoid these impacts through implementation of best management practices such as installation and maintenance of silt fence and hay bales, implementation of measures outlined in the FERC Plan and National Grid's Soil Management Plan, and adherence to the *Rhode Island Soil Erosion and Sediment Control Handbook, 2016 Update* and all other applicable federal, state, and local regulatory requirements.

During Project operation, a stormwater management system would be installed to manage stormwater that does not infiltrate as a result of new impervious surfaces installed on the Project site. This stormwater management system would be designed in accordance with the Rhode Island Stormwater Design and Installation Standards Manual (as amended March 2015) (RIDEM, 2015c) to ensure that any direct stormwater runoff discharge is treated prior to entering the Providence River. The stormwater system would include a new outfall for stormwater discharge to the Providence River. Prior to discharge into the river, stormwater would be treated to remove phosphorus, nitrogen, pathogens, metals and solids. As discussed above, National Grid would be required to obtain and adhere to a Water Quality Certification from RIDEM. In addition, all construction activities would adhere to the Project-specific SPCC Plan (see section 2.2.1).

Based on National Grid's proposed mitigation measures, including the stormwater management system, we conclude that the Project would not have significant impacts on surface water resources.

2.2.3 Wetlands

2.2.3.1 Existing Wetland Resources

In 2013, National Grid conducted wetland and waterbody surveys in the vicinity of the Project. No wetlands were identified within or directly adjacent to the Project site with the exception of the Providence River, which is classified as an estuarine open water wetland. In addition, the National Wetlands Inventory and Rhode Island Geographic Information System did not identify any other wetlands on or adjacent to the Project site.

2.2.3.2 Impacts and Mitigation

No impacts on wetland resources would occur as a result of the Project because no wetland resources are within or directly adjacent to the Project site, with the exception of the Providence River. Potential impacts on the Providence River are discussed in section 2.2.2.

2.3 VEGETATION AND WILDLIFE

2.3.1 Vegetation

2.3.1.1 Existing Vegetation Resources

As stated above, the Project is in a highly developed industrial location. The majority of the Project construction work area consists of impervious surfaces, graveled areas, crushed stone, and bare soil. The remainder of the area is sparsely vegetated with herbaceous forbs and grasses typical of disturbed areas. Common species found on the Project site include ragweed, pepperweed, goldenrod, little bluestem, and English plantain. One individual sassafras tree is near the site adjacent to the access road.

2.3.1.2 Sensitive Vegetation Communities

No rare vegetation communities of concern are present within the Project site. The limited vegetation habitat present provides minimal habitat value due to its close proximity to heavy industrial use, isolation from other contiguous suitable habitats, and previous development impacts.

2.3.1.3 Impacts and Mitigation

The construction and operation of the Project would impact about 3.22 acres of herbaceous vegetation (table 2.3.1-1). Existing vegetation within the Project site is shown on figure 2.3.1-1. No trees are proposed to be cut as part of the Project. Vegetation on the Project site would be cleared and the area permanently covered with either gravel or asphalt.

TABLE 2.3.1-1 **Estimated Vegetation Impacts**		
Facility/ Vegetation Cover Area	Construction Impacts (acres)	Operation Impacts (acres)
Liquefaction Area	0.44	0.44
Laydown Area	2.67	2.67
Access Road	0.11	0.11
TOTAL	**3.22**	**3.22**

Based on the Rhode Island Natural History Survey and Rhode Island Invasive Species Council's *Invasive Species List for Plants Present in the State*, two invasive species (Japanese knotweed and oriental bittersweet) are present at the Project site (Rhode Island Invasive Species Council, 2013). Currently, National Grid controls invasive species at the Project site using spot treatment applications of glyphosate. During construction and operation, National Grid would continue spot treatments of invasive plant species with glyphosate and/or use mechanical means to remove the invasive vegetation.

Due to the low quality habitat provided by the limited herbaceous vegetation on the Project site, we conclude that construction and operation of the Project would not significantly impact vegetation communities in the area.

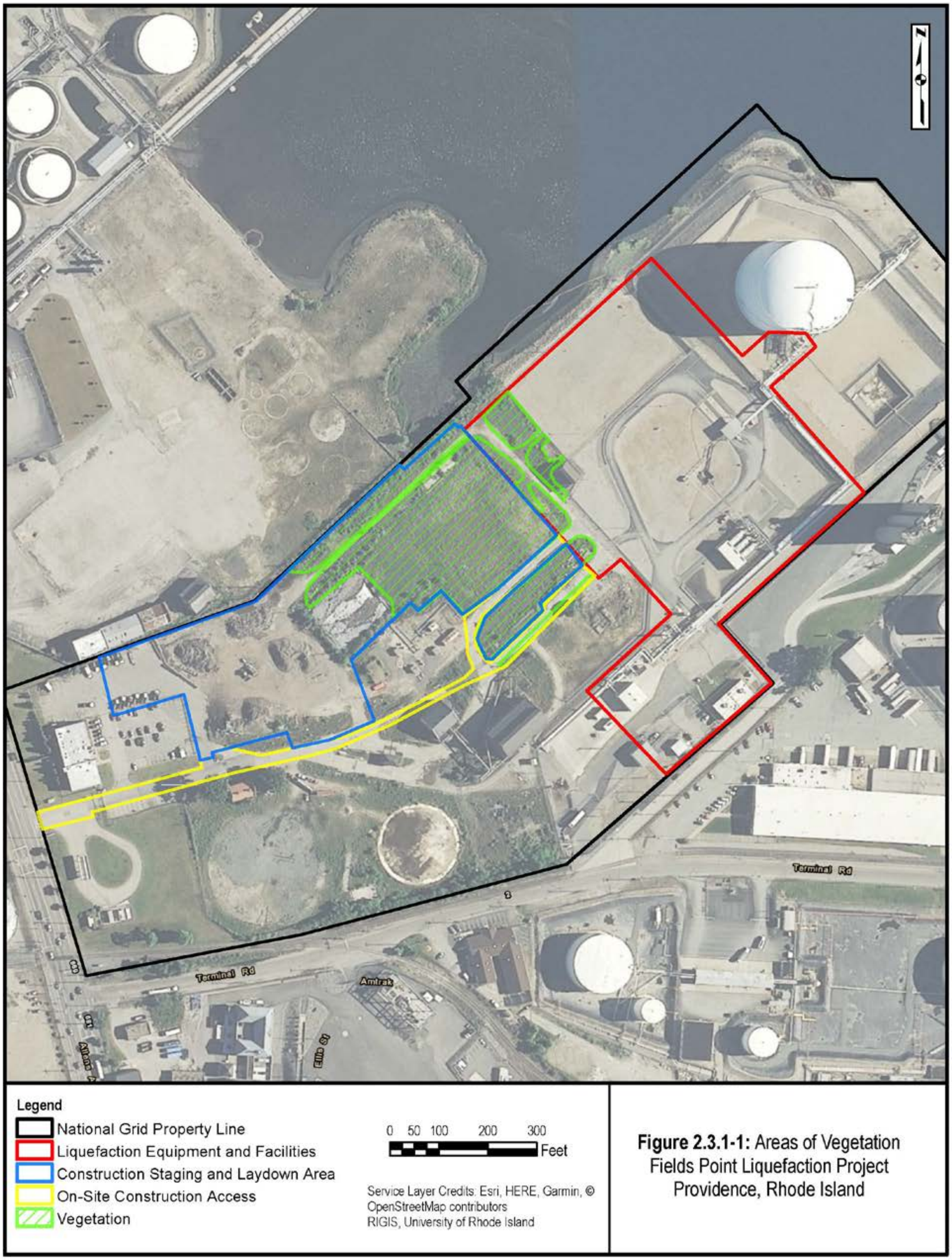

Figure 2.3.1-1: Areas of Vegetation
Fields Point Liquefaction Project
Providence, Rhode Island

2.3.2 Wildlife

2.3.2.1 Existing Wildlife Resources

As a result of the limited vegetation and industrial nature of the area, wildlife inhabiting the Project site is characterized by species highly tolerant of anthropogenic influences. These wildlife species commonly occur throughout the northeast and are typically associated with human habitation. Representative species that could occur in the Project site are summarized in table 2.3.2-1.

TABLE 2.3.2-1

Wildlife Typically Found in the Project Site

Species	Common Name	Species	Common Name
BIRDS		**AMPHIBIANS**	
Charadrius vociferus	Killdeer	*Bufo americanus*	Eastern American toad
Sayornis phoebe	Eastern phoebe	**REPTILES**	
Columba livia	Rock dove	*Thamnophis sirtalis*	Eastern garter snake
Zenaide macroura	Mourning dove	**MAMMALS**	
Chaetura pelagica	Chimney swift	*Sylvilagus floridanus*	Eastern cottontail
Cyanocitta cristata	Blue jay	*Mus musculus*	House mouse
Parus antricapillus	Black-capped chickadee	*Peromyscus leucopus*	White-footed mouse
Sita carolinensis	White-breasted nuthatch	*Rattus norvegiucs*	Norway rat
Troglodytes aedon	House wren	*Sciurus carolinensis*	Gray squirrel
Turdus migratorius	American robin	*Procyon lotor*	Raccoon
Dumetella carolinensis	Gray catbird	*Mephitis*	Striped skunk
Mimus polyglottos	Northern mockingbird		
Sturnus vulgaris	European starling		
Quiscalus quiscula	Common grackle		
Molothrus ater	Brown-headed cowbird		
Carpodacus mexicanus	House finch		
Passer domestricus	House sparrow		

Source: DeGraaf and Rudis,1986

National Grid conducted field surveys in August 2015 and January 2016 to identify wildlife species and evaluate potential habitat within the Project site. Wildlife identified during the surveys consisted of several species of birds including American robin, house sparrow, and European starling; no amphibians, reptiles, or mammals were observed.

2.3.2.2 Impacts and Mitigation

The Project site is characterized by habitats that have been heavily affected by anthropogenic changes. Urban fill soils, industrial development, impervious surfaces, and sparse vegetation all contribute to the minimal utilization of the Project site by wildlife. Wildlife that do use the Project site include common species that are highly adaptable and thrive in urban environments. Project construction and operation would generate noise that could have effects on an individual's fitness by disrupting its physiology or behavioral patterns. However, most species in the area are habituated to current activities at the Fields Point LNG Facility and are highly mobile and may opt to avoid the area and relocate to similar nearby habitats. Therefore, we conclude that construction and operation of the Project would not have a significant impact on wildlife.

2.3.3 Fisheries Resources

2.3.3.1 Existing Fisheries Resources

As discussed in section 2.2.2, the Project is situated directly adjacent to the Providence River; however, no in-water work is proposed as part of the Project. Representative recreational or commercial marine fish species found in the Providence River include black sea bass, bluefish, scup, and summer and winter flounder. Several anadromous fish also occur in the River including alewife, striped bass, blueback herring, and American eel (Paulus, Sokoloski, and Sartor Engineering, PC, 2004). Currently, shellfishing is prohibited in the entire Providence River south to Nayatt Point (about 6 miles south of the Project site). Shellfishing in this area has been historically closed due to the proximity of urbanized areas and outflow from two major wastewater treatment facilities.

Essential Fish 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." Regional fishery management councils (established by 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act), with assistance from the National Marine Fisheries Service, are required to delineate EFH for all managed species. According to the Draft Environmental Assessment for the Maintenance Dredging of the Providence River (U.S. Army Corps of Engineers, 2004), and the National Marine Fisheries Service Guide to EFH (National Marine Fisheries Service, 2016) the water areas adjacent to the Project have been designated as EFH for 15 species.

2.3.3.2 Impacts and Mitigation

Because the Project work activities would all occur on land, impacts on fisheries resources, including EFH, are not anticipated as a result of the Project. Sediment deposition and increased turbidity from stormwater runoff and accidental spills near the Providence River could have impacts on fish and/or habitat adjacent to the Project site. This sediment deposition could bury benthic organisms and habitat, increase the rates of stress, injury, and mortality experienced by fish, and cause fish to avoid the area. However, National Grid would implement measures outlined in the FERC Plan, its Soil Management Plan, and its SPCC Plan, and adhere to all applicable federal, state, and local regulatory requirements to prevent or mimimize the potential for impacts on the Providence River. Thus, any impacts on fisheries would be minor, temporary, and localized. In the event Project activity does result in some minor impact, other areas within the Providence River would provide similar and ample habitats for any fishery resources that would be temporarily displaced.

Based on National Grid's proposed mitigation measures and the lack of anticipated impacts on the Providence River, we conclude that the Project would not have significant impacts on fisheries resources.

2.3.4 Threatened, Endangered, and Special Status Species

The Commission is required by section 7 of the Endangered Species Act to ensure that the construction and operation of any authorized project would not jeopardize the continued existence of a federally listed threatened or endangered species or result in the destruction or adverse modification of the designated critical habitat of a federally listed species.

According to the U.S. Fish and Wildlife Service's list of federally listed species in Providence County (U.S. Fish and Wildlife Service, 2015), the federally threatened northern long-eared bat (*Myotis septentrionalis*) is the only protected species that may occur within the Project site. Existing conditions on the Project site do not support sufficient habitat for this species. The Project site is within an existing industrialized area which lacks suitable areas of preferred forested habitat. One sassafras tree is adjacent to the on-site construction access road; however, no trees are proposed to be cut as part of the Project. Therefore, we conclude that the Project would have no effect on the northern long-eared bat.

A review of the available Rhode Island Geographical Information System Natural Heritage Areas database did not identify any records of state-protected species or natural communities within 0.25 mile of the Project site. Correspondence received from the Rhode Island Natural History Survey and RIDEM confirmed that there were no known occurrences of state-protected rare species or habitats within 0.25 mile of the Project (Rhode Island Natural History Survey, 2015; RIDEM, 2015b).

2.3.4.1 Impacts and Mitigation

Based on the lack of suitable habitat and absence of any known species occurrences proximate to the Project site, we conclude that the construction and operation of the Project would have *no effect* on any threatened, endangered, or special status species.

2.4 LAND USE, RECREATION, AND VISUAL RESOURCES

2.4.1 Existing Land Use

The Project is in an industrial waterfront area known as Fields Point on the western bank of the Providence River in Providence. The Project site is in the City's Port/Maritime Industrial Waterfront (W-3) zoning district (City of Providence, 2016). Existing land use on the Project site is limited to Commercial/Industrial/Disturbed Land, which includes the existing developed portions of the Fields Point LNG Facility. Land uses outside of the immediate Project site, but within 0.25 mile, include port facilities, petroleum and fuel oil storage tank facilities, warehouses, storage yards, and access roads, as well as some businesses and residences.

Table 2.4.1-1 summarizes the land use requirements associated with construction and operation of the Project.

TABLE 2.4.1-1 **Land Use Affected by Construction and Operation of the Project**		
	Commercial/Industrial/Disturbed	
State/County/Facility	Construction (acres)	Operation (acres)
Liquefaction Equipment and Facilities	9.2	9.2
Construction Staging and Laydown	6.2	2.7
On-Site Construction Access	0.9	0.1
TOTAL	**16.3**	**12.0**

About 12.0 acres of land on the Project site would be permanently affected by Project operations. The construction footprint includes about 3.2 acres of herbaceous vegetation that would be permanently converted to either asphalt or gravel. This vegetation provides minimal habitat value due to its close proximity to heavy industrial use, isolation from contiguous suitable habitats, and previous development impacts (see section 2.3). The construction footprint also includes about 3.5 acres of unvegetated soil that was recently used for soil stockpiles, access roads, and former structures. The remainder of the construction footprint would be existing industrial land.

Construction of the on-site access road between the Project site and Allens Avenue would affect about 0.9 acre of commercial/industrial/disturbed land. National Grid states that it would minimize impact associated with the construction of this access road by re-using the footprint of an existing access road to the extent feasible. About 0.1 acre of non-tree vegetation along the sides of the existing road would be cleared for the on-site construction access road improvements to widen the existing road.

No temporary or permanent pipeline right-of-way would be required for Project pipeline facilities. The land required for Project construction equipment laydown/staging and the liquefaction equipment is owned by TNEC. National Grid would execute a temporary access agreement with TNEC for use of the laydown area during Project construction. The existing lease allows National Grid to use these adjacent parcels for access and egress.

2.4.2 Recreation and Special Interest Areas

No state forest lands, national or state parks or trails, Indian reservations, or registered national landmarks are in the vicinity of the Project. No rivers in the vicinity of the Project are listed or designated to be added as National or State Wild and Scenic Rivers. No areas designated for inclusion in the National Trails System or wilderness areas designated under the Wilderness Act are within or adjacent to the Project area. As such, the Project would not affect federal or state recreation and special use areas.

No designated public or privately owned natural, recreational, or scenic areas are within 0.25 mile of the Project site. In addition, no in-water work is proposed. As a result, the Project would have no impacts on recreational activities.

The nearest recreational area is a recreational field (Drummond Field) about 0.4 mile south of the Project site. The nearest parks include Columbia Park in the Washington Park neighborhood, about 0.5 mile south of the Project site, and Richardson Park in the Lower South

Providence neighborhood, about 0.5 mile west of the Project site. The East Bay Bike Path is on the east side of the Providence River in East Providence, Rhode Island, about 0.6 mile from the Project site.

Users of these recreational facilities could notice construction-related traffic, noise (see section 2.7.2), and visual effects; however, such effects would be limited to the time of construction and would minimally impact these facilities considering the distance from the Project site. The Project would be visually consistent with the industrial appearance of existing facilities, and none of the Project facilities would exceed the height of other nearby industrial structures.

2.4.3 Existing Residences and Planned Future Developments

We received comments expressing concern that the Project is close to residential areas and public facilities. The Project is within an existing industrial site that has been in operation since 1974, and on property currently owned by TNEC. As an industrial/utility use, the Project is generally consistent with the underlying W-3 zoning. Existing residential homes and commercial stores in the Washington Park neighborhood are approximately 0.25 mile southwest of the Project site. The nearest residences to the Project site (including the construction laydown area and on-site construction access road) are about 1,000 feet (0.2 mile) to the southwest, in the Washington Park neighborhood. The Project site would be about 1,900 feet (0.4 mile) from these residences.

The Project site is less than 1 mile from two planned residential areas on the eastern shore of the Providence River in East Providence. The Village on the Waterfront, a mixed use (commercial/residential) development, is about 0.5 mile from the Project; and Kettle Point, a residential development, is about 0.75 mile from the Project. Both developments have been approved for construction, with site preparation work getting underway in 2016, and estimated completion in 2018.

Potential effects on existing residences and ongoing residential development could include fugitive dust and noise resulting from construction activities (see section 2.7); however, these impacts would be temporary during the Project's construction period. In addition, National Grid's hazard modeling for the Project (see section 2.8) concludes that dispersion hazards from thermal radiation, vapor dispersion, and explosion overpressure would not extend beyond the boundaries of the Project site. We conclude that the Project site is a sufficient distance away from existing and planned future residences and public services, and that no significant adverse impacts would occur during Project construction or operation.

2.4.4 Coastal Zone Management

A portion of the Project site is within a coastal zone management area. As discussed in section 1.4.4, in Rhode Island, federal coastal zone consistency requirements are overseen by the CRMC. National Grid attended several meetings with CRMC staff to discuss its filing for a coastal zone consistency determination, which National Grid submitted to the CRMC in October 2016. CRMC held three public hearings in November and December 2017. The waters of the Providence

River in the vicinity of the Project are classified by the CRMC as "Industrial Waterfronts and Navigational Channels." The CRMC issued its consistency determination on December 20, 2017.[8]

2.4.5 Visual Resources

Visual resources refer to the composite of basic terrain features, geologic features, hydrologic features, vegetation patterns, and anthropogenic features that influence the visual appeal of an area for residents or visitors. We received several comments regarding potential impacts to visual resources. Many commenters noted that the facility would be too close to residential areas and public facilities, in a community with other chemical facilities.

The Project is in an existing industrial area characterized by large human-made structures, including vertical features such as fuel storage tanks. Project construction activities, such as the presence of construction equipment and partially completed structures, would be visible to anyone with a view of the Project site itself. Potential visual effects from Project operations would include the presence of new industrial facilities and lighting within the site.

Visually sensitive areas near the Project include several locations across the Providence River in East Providence with views of the Project site, including the East Bay Bike Path, the Village on the Waterfront, and the Kettle Point development (see section 2.4).

While views from much of the bike path and waterfront development are screened by dense vegetation, some gaps in vegetation exist. The Project site is already visible from waterfront areas East of Providence, at least 2,300 feet away. The Project site would also be visible from the condominiums and townhouses at the forthcoming Village on the Waterfront and Kettle Point developments, referenced above. The primary visible element at the Project site is the existing LNG storage tank, which would not be altered by the Project. The liquefaction facilities would have a height of about 10 feet above the ground surface and would be directly behind (west of) the storage tank (see section 2.2.1). To the degree that the new liquefaction facilities are visible, their appearance would be generally consistent with the industrial character of the existing site and surrounding properties.

Vapor fencing at the Project site would consist of an 8- to 12-foot-high metal slatted fence along the eastern and southern portions of the property (including along the southern section of the existing earthen berm dike) and also along portions of the northern and eastern property boundaries along the waterfront. An additional approximately 32-foot-high section of vapor fencing would be within the containment area in close proximity to the existing LNG storage tank. Views of the vapor fence from the eastern shore of the Providence River would generally be screened by the existing LNG storage tank. The vapor fence is discussed in more detail in section 2.8.6.

Additional nighttime lighting would be installed at the Project site; however, the existing lighting on the LNG storage tank would continue to be the main source of nighttime lighting at the

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8 CRMC's consistency determination and associated documents may be accessed at: http://www.crmc.ri.gov/news/2017_1220_lngfedcon.html.

site. In addition, the other surrounding industrial properties in the area also contribute to nighttime lighting near the Project site.

Based on the discussion above, we conclude that construction and operation of the Project would not result in significant adverse visual impacts.

2.5 SOCIOECONOMICS

The potential socioeconomic effects of Project construction and operation include: temporary changes in population levels or local demographics; increased opportunities for employment; increased demand for housing and public services; changes in traffic patterns; an increase in government revenue associated with sales, payroll, and property taxes; and effects on populations covered under federal Environmental Justice guidance and statutes.

2.5.1 Population, Economy, and Employment

Table 2.5.1-1 summarizes selected demographic and socioeconomic information for affected communities near the Project site.

TABLE 2.5.1-1

Existing Population and Economic Conditions in the Project Area

Location	Population [a]	Population Density (persons per square mile)	Per Capita Income [a]	Civilian Labor Force [b]	Unemployment Rate (percent) [b]	Top Three Industries [b, c]
City of Providence	178,562	9,677 [a]	$21,924	91,946	8.8	E, A, M
Washington Park Neighborhood (Census Tract 1.01)	4,706	5,773 [d]	$12,761	2,484	11.6	E, A, M
Lower South Providence Neighborhood (Census Tract 6)	2,063	2,189 [d]	$11,756	798	10.0	E, A, T

a Source: U.S. Census Bureau, 2015b
b Source: U.S. Census Bureau, 2015a
c A = Arts, entertainment, recreation, accommodation, and food
E = Educational services, and health care and social assistance
M = Manufacturing
T = Transportation, warehousing, and utilities
d Calculated based on U.S. Census Bureau, 2015a

Construction of the Project, if approved, would likely take place between 2018 and 2019. National Grid estimates that the construction workforce would be about 155 workers, of whom about 65 percent (about 100 workers) would come from the local workforce, including local union halls. Operation of the liquefaction facility would require about five new employees (in addition to existing employees at the Project site). The total population change during construction and operation would equal the total number of non-local workers plus any family members accompanying them. If all 55 non-local construction workers and family members temporarily move to Providence, this would represent considerably less than a 0.1 percent increase in the total population of the city (which is currently about 180,000). If the five new permanent employees at the Project site all moved to Providence (i.e., were not already residents of the local area), this would represent less than a 0.01 percent increase in the city's total population. Therefore, the temporary and permanent workers associated with Project construction and operations would not result in a significant change in the population.

A short-term decrease in the unemployment rate could occur as a result of hiring local workers for construction and increased demands on the local economy in Providence. Because operation of the liquefaction facility would require five new employees, Project operations would not meaningfully affect population or employment in Providence.

Construction of the Project facilities would increase economic activity through direct, indirect, and induced effects. Direct effects would include hiring of local construction workers (and possibly full-time operations staff) and purchases of goods and services from local businesses. Indirect effects would include additional demands for goods and services resulting from direct effects, such as when local firms replace inventory sold directly to the Project. Induced effects include economic activity not captured as direct or indirect effects, but that would not otherwise occur "but for" the Project, such as Project construction workers spending disposable income at local businesses. The magnitude of economic impacts from Project construction has not been calculated or estimated, but would be positive for the local economy.

2.5.2 Housing

Table 2.5.2-1 provides a summary of housing statistics for the communities proximate to the Project site.

TABLE 2.5.2-1

Housing Characteristics in the Project Area

Location	Total Housing Units	Owner Occupied	Renter Occupied	Vacancy Rate, Owner-occupied (percent)	Vacancy Rate, Rental (percent)
City of Providence	71,147	21,345	39,622	3.1	8.7
Washington Park Neighborhood (Census Tract 1.01)	1,346	638	481	1.1	15.2
Lower South Providence neighborhood (Census Tract 6)	609	122	405	7.6	6.5

Source: U.S. Census Bureau, 2015a

Project construction would temporarily affect the Providence housing market as construction personnel move into the area. Locally hired workers would commute from their homes, while non-local workers would likely choose to stay in apartments, hotels, or motels, depending on the anticipated duration of their work at the Project site. As described in section 1.7, Project construction would involve a variety of discrete phases and activities, and few construction workers would need to be on-site for the full two-year construction period. As a result, construction workers are unlikely to purchase homes in Providence.

In 2015, there were more than 3,800 housing units available for rent in Providence, including about 115 in the Washington Park and Lower South Providence neighborhoods (U.S. Census Bureau, 2015a), and there were 164 hotels/motels within 15 miles of the Project site (Yellowbook, 2016). As mentioned previously, construction of the Project would require up to

155 workers, about 55 of whom would not already live within commuting distance of the Project site. Based on the ample rental housing, hotel, and motel options in Providence, we conclude that the Project workforce would not meaningfully impact local housing markets. Short-term home rentals and hotel stays by Project construction workers would positively affect the local economy. The five operational staff that would be hired permanently for operation of the new liquefaction facility would have a negligible long-term effect on housing demand, particularly if those individuals already live in the Providence area.

2.5.3 Public Services

We received several comments regarding potential impacts on public services. These comments generally expressed the belief that the Project would present health and safety concerns to individuals at these public facilities. Some commenters expressed concern that the proposed Project would be close to schools, day care facilities, and hospitals.

Providence and surrounding communities provide a wide range of public services and facilities, including public safety (police, fire, and emergency medical services), hospitals, and schools. Public safety services include two Providence police department substations and two fire stations within 1.5 miles of the Project site (City of Providence, 2016). There are several large medical facilities in the City of Providence, including Rhode Island Hospital about 1 mile from the Project site (Rhode Island Department of Health, 2016). The Providence public school system includes 42 schools serving about 24,000 students (Providence Public School District, 2016). Project construction could increase demand for public services through increased police enforcement associated with construction vehicle movement to and from the Project site, as well as emergency medical services to treat construction injuries. The increased operational workforce would not be large enough to meaningfully affect the cost or availability of public services.

National Grid states that the Project would require additional security measures, but that additional Providence Police Department activity is not anticipated. The fire risk after Project completion would be similar to the fire risk of the existing Fields Point LNG Facility, and National Grid states that current resources at the Providence Fire Department would be sufficient to provide fire protection services for the Project. Therefore, the demand for police, fire, and medical services would not exceed existing capabilities.

During Project operation, National Grid would continue to work with state and local agencies to ensure that fire protection and other applicable life safety systems meet these agencies' requirements including all applicable codes and standards. National Grid would update its Emergency Response Plan to account for changes in emergency needs at the liquefaction facility, and would provide the revised Emergency Response Plan to emergency service providers. National Grid would also conduct additional training and facility drills with the participation of emergency service providers. Therefore, we conclude that the Project's operation would not have a significant impact on public services.

2.5.4 Transportation and Traffic

We received four comments regarding potential impacts on transportation and traffic. These comments expressed the belief that the proposed action would worsen truck, train, and ship traffic in the vicinity of the Project site. Commenters noted that there is already a high volume of vehicular traffic in the area.

The local road and highway systems in the vicinity of the Project facilities include Interstate highways, U.S. highways, state highways, secondary roads, county roads, and private roads. Construction of the Project could result in minor, short-term impacts on the transportation network due to the movement of Project-related equipment, materials, and workers. The principal roadways that provide access to the Project site are Interstate 95, U.S. Route 1A (Allens Avenue and Narragansett Boulevard), Ernest Street, Eddy Street, and Thurbers Avenue. Table 2.5.4-1 lists the annual average daily traffic for these roads.

TABLE 2.5.4-1

Daily Traffic on Roadways Providing Access to the Project Site

Road	Annual Average Daily Traffic Count [a]
Interstate 95	176,700
U.S. Route 1A (Allens Avenue/Narragansett Boulevard)	12,000
Ernest Street	2,700
Eddy Street	11,200
Thurbers Avenue	11,554

a Source: Rhode Island Department of Transportation, 2009, 2016

2.5.4.1 Traffic during Construction

Table 2.5.4-2 summarizes National Grid's anticipated average, peak, and off-peak traffic generated by Project construction.

TABLE 2.5.4-2

Anticipated Construction Traffic Generated by the Project

Vehicle Trips	Average	Peak	Off-Peak
Truck round-trips per week	72	186	4 [a]
Personal vehicle round-trips per week (construction workers)	450	775	100

a National Grid estimates that off-peak construction activity would generate about 15 truck round trips per month.

During Project construction, National Grid does not intend to provide employee bus transportation to the Project site. While some workers who live near the Project site may choose to travel to work via existing public transit, we anticipate that most workers are likely to drive to the Project site. Construction workers would park at National Grid's existing parking area, or at the on-site construction laydown and staging area if necessary. National Grid does not anticipate the need for off-site parking.

Construction vehicle use would temporarily increase traffic on surrounding streets; however, the average traffic volumes represent a small percentage of existing average daily traffic for most nearby roads (although Ernest Street carries much less traffic, it has the same number of lanes—and thus a similar traffic-carrying capacity—as Eddy Street). The roads used during construction are predominately in industrial and commercial areas. To minimize construction traffic impacts, National Grid proposes to schedule construction deliveries to avoid the road network's peak hours, and to maintain access to businesses and residences in the area at all times. National Grid and its contractors would also work with local law enforcement and other regulatory agencies to comply with road and bridge weight restrictions, and to keep roads free of construction debris. Due to the proximity of the Project site to major roadways and the characteristics of the greater Fields Point industrial area, Project construction traffic would not significantly impact traffic volume or road capacity.

2.5.4.2 Traffic during Operation

Traffic during operation of the liquefaction facility would include employee commuter vehicle trips and truck deliveries. Regionally, the Project would essentially reverse the flow of LNG trucks; instead of delivering LNG to the storage tank at the Project site, trucks would distribute stored LNG from the Project location to smaller LNG storage sites in New England. National Grid states that completion of the Project would not meaningfully change the number of LNG truck trips to and from its Fields Point LNG Facility.

The Project would employ up to five new permanent employees, which would result in an increase of about 25 trips (roundtrips) per week from the current level of 75 weekly trips, for a total of about 100 trips per week during operation of the modified Fields Point LNG Facility. These additional trips would not meaningfully affect traffic volume or road capacity. As a result, Project impacts on traffic are expected to be insignificant.

Section 2.7.1.3 describes the Project's impacts on environmental justice due to increased air emissions, including those associated with increased vehicular traffic. Because the Project would not meaningfully change vehicular traffic volumes in the Project area or Providence region, Project-related traffic would not meaningfully contribute to impacts on environmental justice communities.

2.5.5 Property Values

We received comments expressing concern about the devaluation of properties as a result of Project construction. The Project's effects on nearby property values, including resale ability, are not wholly quantifiable. Potential impacts on property values of adjacent or nearby properties would likely be attributable to operational noise, visual impacts, and/or negative public perception if certain homebuyers were to find the existing Fields Point LNG facility to be acceptable, but the proposed Project infrastructure to be a detractor.

The Project site is currently used as an LNG storage facility, is within a Port/Maritime Industrial zoning district, and is not immediately adjacent to residential areas. While the Project would add some additional light and noise sources, these changes would generally be consistent with existing and nearby industrial activities, as well as the existing Fields Point LNG Facility itself (see section 2.7.2). Furthermore, Project activities would be limited to the existing site and no change in volume would occur to the existing LNG storage tank. The addition of the liquefaction facilities to National Grid's existing Fields Point LNG Facility would not change the existing industrial land use classification of the facility, nor alter the inherent characteristics of this facility that may influence the value of adjacent properties. Therefore, we conclude that operation of the Project would not meaningfully affect property values.

2.5.6 Tax Revenues

Project construction and operation would result in increased revenues from property taxes, payroll taxes, and sales taxes from local material purchases. National Grid is negotiating a long-term property tax agreement with the City of Providence to provide cost stability for the Project and its customers, while making the City's fiscal plans more reliable. National Grid states that the Project would contribute a total of about $3,500,000 in property taxes over the life of the Project, an increase over its current property tax payments.

National Grid further states that the total Project payroll would be about $10,500,000 during the construction period, and that non-local workers temporarily relocating to the Project vicinity would spend in excess of $50,000 on local goods and services, excluding housing (assuming on average that the 55-person non-local Project workforce would spend about $500 per week for two years at restaurants, gas stations/convenience stores, grocery stores, coffee and sandwich shops, etc.). Actual spending may be higher. National Grid states that it anticipates additional local spending on equipment and common supply purchases from vendors in areas near the Project site, such as stone, lumber, and concrete, landscaping supplies, tires, and automotive supplies, etc.

Project construction would also result in increased indirect state and local sales tax revenues associated with the purchase of some construction materials, as well as goods and services, by the construction workforce. National Grid estimates the total cost of Project materials purchased locally within Rhode Island would be about $2,500,000, resulting in $175,000 of estimated state sales tax revenue.

2.5.7 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, recognizes the importance of using the NEPA process to identify and address, as appropriate, any disproportionately high and adverse health or environmental effects of federal programs, policies, or activities on minority populations and low-income groups. Consistent with Executive Order 12898 and subsequent guidance (i.e., Council on Environmental Quality, 1997b and EPA, 2016b), federal agencies must actively scrutinize the following issues:

- the racial and economic composition of affected communities;
- health-related issues that may amplify project effects to minority or low-income individuals;
- "interrelated cultural, social, occupational, historical, or economic factors that may amplify…environmental effects of the proposed agency action"; and
- public participation strategies, including meaningful community and tribal participation in the NEPA process.

Table 2.5.7-1 summarizes the minority and low income components of the populations in the Project area, along with comparable state and federal data. For this analysis, the Project area includes all census block groups within about 1 mile of the Project site on the west side of the Providence River.[9] The EPA's EJSCREEN tool defines low-income populations as individuals whose income is less than 200 percent of the poverty level. EJSCREEN further defines minority residents as individuals who identify themselves as a race other than white or Caucasian, or who identify their ethnicity as Hispanic, regardless of race (EPA, 2016c).

EPA guidance further states that environmental justice concerns have the potential to occur where a project affects an area whose population is over 50 percent minority, or where the minority population or low-income population is "meaningfully greater" than the minority percentage in a "reference area." In this case, the reference area is the State of Rhode Island. National data are provided for comparison.

As shown in table 2.5.7-1, the City of Providence and most of the block groups within 1 mile of the Project have minority populations that comprise more than 50 percent of the total population. The city and most Project area block groups also have low-income populations that are substantially greater than the state average. EJSCREEN shows that the area within 1 mile of the Project (a circular radius that does not necessarily include all portions of the block groups described above) ranks in the 95th percentile or above (compared to the state) for the following variables related to environmental justice:

- traffic proximity and volume (primarily reflecting proximity to Interstate 95);
- proximity to sites requiring risk management plans;
- proximity to hazardous waste management facilities; and
- proximity to wastewater dischargers (EPA, 2016c).

To aid stakeholders whose primary language is Spanish, we issued the NOI for the Project in English and Spanish. The public notice issued by RIDEM was posted on its website in several languages, including English, Spanish, Kmer/Cambodian, Cape Verdean Creole, and Portuguese.

We received numerous comments regarding potential impacts on environmental justice communities. These comments generally expressed the belief that the proposed action would worsen existing environmental justice concerns in the neighborhoods near the Project site. Many commenters used the term "environmental racism" (defined by one commenter as "the concentration of environmentally hazardous conditions in communities of color"), noting that the facility was not being proposed for a more affluent or non-minority (i.e., white) part of the Providence area.

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9 Block groups that have minimal area or minimal residential development within the 1 mile radius are not included in this analysis.

TABLE 2.5.7-1 **Demographics and Low Income Populations in the Project Area**		
Location	Low Income Population Percentage	Minority Population Percentage [a]
United States	15	23
Rhode Island	14	24
City of Providence	29	63
Census Tract 1.01, Block group 1	39	33
Census Tract 1.01, Block group 2	44	72
Census Tract 1.01, Block group 3	46	73
Census Tract 1.01, Block group 4	49	79
Census Tract 1.02, Block group 1	61	93
Census Tract 1.02, Block group 2	49	65
Census Tract 1.02, Block group 3	48	82
Census Tract 1.35, Block group 1	35	21
Census Tract 1.35, Block group 2	54	75
Census Tract 1.35, Block group 4	35	32
Census Tract 4, Block group 3	75	95
Census Tract 5, Block group 1	74	98
Census Tract 5, Block group 3	82	99
Census Tract 6, Block group 1	51	34
Census Tract 6, Block group 2	60	96

Source: EPA, 2016d
a Includes individuals who identify themselves as nonwhite or Hispanic (regardless of race).

To evaluate the presence and/or severity of environmental justice impacts, the demographic data in table 2.5.7-1 should be balanced against the environmental impacts described in this EA. From a socioeconomic perspective, the Project would be in an existing industrial area, within a zoning district that accommodates industrial uses such as the Project, and on a site that is already used for LNG storage with the LNG currently being transported by truck to the site. Therefore, the Project would not represent a "new" type of use in proximity to low-income, minority neighborhoods. There are no residences immediately adjacent to the Project (as discussed in section 2.4.3, the closest residences are about 1,000 feet from the Project site) and, as further discussed in sections 2.5.2 and 2.5.5, Project operations would not meaningfully decrease property values or affect housing availability. The Project also would not significantly increase noise, air emissions, visual impacts, traffic congestion, or demands on public services during operation. Further discussion of the Project's impacts on these resource areas is found in sections 2.7.2, 2.7.1, 2.4.5, 2.5.4, and 2.5.3, respectively. Cumulative impacts on environmental justice are discussed in section 2.9. Section 3 of this EA discusses the alternatives considered as part of this Project, and describes why other sites were not selected.

Commenters stated that, due to proximity, the adverse health and economic impacts of pollution or catastrophic events at the Project site would be disproportionately borne by low-income communities, communities of color, and women, but that these communities would not reap a sufficient portion of the Project's economic benefits. The Project is also near many schools and major healthcare facilities centered around the Rhode Island Hospital (the state's only Level 1 trauma center and host to Hasbro Children's Hospital and Women and Infants Hospital, along with other specialized medical facilities). Section 2.8 discusses topics related to reliability and safety, and concludes that National Grid's 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, regardless of demographic make-up. Section 4.0 provides our recommendations related to safety. Sections 2.5.1, 2.5.4, and 2.7.1 evaluate the Project's impacts on employment and the economy, traffic, and air pollution, respectively.

Commenters noted that these communities already experience disproportionately high rates of asthma and other illnesses related to pollution, are already near numerous documented contaminated sites and the traffic (and associated pollution) of Interstate 95, and that communities near the Project site therefore rank high on many of EPA's EJSCREEN indices. Finally, some commenters stated that data from the U.S. Census Bureau and EJSCREEN were not properly used (or not used at all), resulting in an analysis that underestimates environmental justice impacts. These comments primarily reflected the analysis conducted by National Grid, and presented during Project scoping and in National Grid's FERC Application. The analysis in this EA addresses these concerns by using the State of Rhode Island as the "reference geography" for analysis, and by citing EJSCREEN indices.

Based on the reasons discussed above, we conclude that the Project would not have disproportionately high and adverse impacts on environmental justice populations.

2.6 CULTURAL RESOURCES

Section 106 of the National Historic Preservation Act, as amended, requires FERC to take into account the effects of its undertakings on properties listed or eligible for listing on the National Register of Historic Places (NRHP), and to afford the Advisory Council on Historic Preservation an opportunity to comment. National Grid, as a non-federal party, is assisting us in meeting our obligations under section 106 and its implementing regulations at 36 CFR 800.

2.6.1 Cultural Resources Investigations

The Project site was previously surveyed under Docket Nos. CP96-517-000 and CP04-223-000/CP04-293-000. No archaeological sites were identified as a result of those surveys. However, the surveys documented 10 aboveground structures associated with the Sassafras Point Station, on and in the vicinity of the current Project site. The Sassafras Point Station was an early to mid-twentieth century gas storage facility and was determined eligible for the NRHP in 1996. Four of the structures have since been demolished. One of the historic structures (known as the Tar Extractor and Washer House) is within the Project site, and is proposed to be demolished as part of the Project. For the current Project site, National Grid completed an assessment of the integrity of the Sassafras Point Station to determine if it was still eligible for the NRHP. The assessment recommended that the historic building complex is no longer eligible for the NRHP as a district due to loss of integrity, and that none of the six surviving historic buildings are eligible individually due to loss of integrity and alterations. National Grid provided the assessment (Public Archaeology Laboratory, 2016) to FERC and the Rhode Island

State Historic Preservation Office (SHPO). In a letter dated March 23, 2016, the SHPO concurred that due to a lack of integrity, the Sassafras Point Station was not eligible for listing in the NRHP, and no historic properties would be affected by the Project. We agree with the SHPO.

2.6.2 Native American Consultation

On June 29, 2015, National Grid sent a notification letter for the Project to the Narragansett Indian Tribe. On September 25, 2015, National Grid sent a follow- up letter to the tribe. The letter was sent to inform the tribe about the Project and to request that it communicate any potential concerns it might have with respect to potential impacts on cultural resources, including archaeological sites, burials, and traditional cultural properties. No responses have been received. We sent our NOI to the tribe. No response to our NOI has been received.

2.6.3 Unanticipated Discovery Plan

National Grid developed an Unanticipated Discovery Plan to address the unexpected discovery of archaeological resources and human remains during construction. We find the plan acceptable. The plan was submitted to the SHPO on February 1, 2016, and the SHPO concurred with the plan in a letter dated February 10, 2016.

2.7 AIR QUALITY AND NOISE

2.7.1 Air Quality

Air quality in Providence County would be affected by construction and operation of the Project. During construction of the Project, short-term emissions would be generated by operation of construction equipment, land disturbance, and increased traffic from worker and delivery vehicles. Operation of the proposed equipment would also result in small amounts of long-term air emissions. This section of the EA addresses the construction and operating emissions from the Project, as well as projected impacts and compliance with regulatory requirements.

2.7.1.1 Existing Environment

Regional Climate

The existing Fields Point LNG Facility is in the City of Providence, which has a temperate climate. The area experiences an average annual precipitation of about 47 inches with minimal fluctuation in precipitation month to month. Monthly average daily temperatures range from 29.2 °F in January to 73.5 °F in July. The areas surrounding the Project site have an infrequent history of severe thunderstorms during the summer months, but experience periodic heavy snowfalls and blizzards during the winter season. Also, though very infrequent due to the Fields Point LNG Facility’s location along the Providence River, the area is vulnerable to storm surge associated with Atlantic hurricanes.

National Ambient Air Quality Standards

Ambient air quality is protected by federal and state regulations. Under the Clean Air Act (CAA) and its amendments, the EPA is required to establish National Ambient Air Quality Standards (NAAQS) that are protective of human health and welfare, especially including infants and children, the elderly, and infirm (EPA, 2016e). These NAAQS (which are periodically updated based on the latest science) have been established for carbon monoxide (CO), lead, nitrogen dioxide (NO_2), ozone, particulate matter less than 10 microns in aerodynamic diameter (PM_{10}) and less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$), and sulfur dioxide (SO_2). Of these, different standards have been adopted for different averaging times to reflect both long-term and short-term impacts where appropriate. The NAAQS include primary standards, which are designed to protect human health including the health of sensitive subpopulations such as children and those with chronic respiratory problems, as well as secondary standards designed to protect public welfare, including economic interests, visibility, vegetation, animal species, and other concerns not related to human health.

Individual states may set individual air quality standards, which must be at least as stringent as the NAAQS. RIDEM has adopted all of the NAAQS as promulgated by the EPA. The NAAQS are summarized in table 2.7.1-1.

On December 7, 2009, the EPA expanded its definition of air pollution to include six well-mixed greenhouse gases (GHG), finding that the presence of the following GHGs in the atmosphere endangers public health and public welfare currently and in the future: CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. GHGs occur in the atmosphere both naturally and as a result of human activities, such as the burning of fossil fuels. These gases are the integral components of the atmosphere's greenhouse effect that warms the earth's surface and moderates day/night temperature variation. In general, the most abundant GHGs are water vapor, CO_2, methane, nitrous oxide, and ozone.

Operation of the new liquefaction equipment would emit minor amounts of GHGs (as carbon dioxide equivalent emissions [CO_2e]). The principal GHGs that would be produced by the Project are CO_2, methane, and nitrous oxide. Emissions of GHGs are quantified and regulated in units of CO_2e. The CO_2e unit of measure takes into account the global warming potential (GWP) of each GHG. The GWP is a ratio relative to CO_2 that is based on the GHG's ability to absorb solar radiation as well as its residence time within the atmosphere. Thus CO_2 has a GWP of 1, methane has a GWP of 34, and nitrous oxide has a GWP of 298. To obtain the CO_2e quantity, the mass of the particular chemical is multiplied by the corresponding GWP, the product of which is the CO_2e for that chemical. The CO_2e values for the GHGs are summed to obtain the total GHG emissions as CO_2e. In compliance with the EPA's definition of air pollution to include GHGs, we have provided estimates of GHG emissions for construction and operation, as discussed throughout this section. Cumulative impacts from GHG emissions (climate change) are discussed in more detail in section 2.9.

TABLE 2.7.1-1

National Ambient Air Quality Standards

Criteria Pollutant	Primary/ Secondary	Averaging Time	Level	Form
CO	Primary	8-hour	9 ppm (10,000 µg/m^3)	Not to be exceeded more than once per year
	Primary	1-hour	35 ppm (40,000 µg/m^3)	Not to be exceeded more than once per year
Lead	Primary	Rolling 3-month average	0.15 µg/m^3 [a]	Not to be exceeded
NO_2	Primary	1-hour	100 ppb (189 µg/m^3)	98th percentile, averaged over 3 years
	Primary and Secondary	Annual	53 ppb[b] (100 µg/m^3)	Annual Mean
Ozone	Primary and Secondary	8-hour (2008)	0.070 ppm[c] (150 µg/m^3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
$PM_{2.5}$	Primary	Annual	12 µg/m^3	Annual Mean, averaged over 3 years
	Secondary	Annual	15 µg/m^3	Annual Mean, averaged over 3 years
	Primary and Secondary	24-hour	35 µg/m^3	98th percentile, averaged over 3 years
PM_{10}	Primary and Secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
SO_2	Primary	1-hour	75 ppb[d] (195 µg/m^3)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3-hour	53 ppb (1,300 µg/m^3)	Not to be exceeded more than once per year

Source: EPA. The EPA continually updates the NAAQS on its website https://www.epa.gov/criteria-air-pollutants/naaqs-table (EPA, 2016d).

a Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m^3 as a quarterly average) remains in effect until 1 year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

b The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

c Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) ozone standards additionally remain in effect in some areas. Revocation of the previous (2008) ozone standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

d Final rule signed June 2, 2010. The 1971 annual and 24-hour SO_2 standards were revoked in that same rulemaking. However, these standards remain in effect until 1 year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans attain or maintain the 2010 standard are approved.

Notes: ppm = parts per million; µg/m^3 = micrograms per cubic meter; ppb = parts per billion

Air Quality Control Regions and Attainment Status

Air Quality Control Regions (AQCR) were established in accordance with section 107 of the CAA as a means to implement the CAA and to comply with the NAAQS through State Implementation Plans. The AQCRs are intra- and interstate regions such as large metropolitan areas where the improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR. Each AQCR, or portion thereof, is designated in one of four categories: attainment (i.e., "attaining the standard"), unclassifiable, maintenance, or nonattainment. Areas where an ambient air pollutant concentration is determined to be less than the applicable ambient air quality standard are designated attainment. Areas where insufficient data are available are designated "unclassifiable." Unclassifiable areas are treated as attainment areas for the purpose of permitting a new stationary emission source. Areas where the ambient air concentration is even occasionally greater than the applicable ambient air quality standard are designated "nonattainment." Areas that were once designated nonattainment but have since come into compliance with the ambient air quality standard(s) are designated "maintenance" for that pollutant.

The Fields Point LNG Facility is within Providence County, which is presently designated as in attainment or unclassifiable for all NAAQS pollutants.[10] However, as of 2015 the 8-hour ozone standard has been tightened, and county-wide monitoring indicates ambient levels just slightly above the new standard.

Rhode Island is part of the Northeast Ozone Transport Region (essentially due to transported emissions within the Interstate 95 corridor from New Jersey to Massachusetts). Air quality in Providence is directly influenced by the transport of pollutants from upwind states (released several hundred kilometers away). For new emission sources that could contribute to ozone formation downwind, RIDEM implements stringent permitting requirements for ozone precursors, including nitrogen oxides (NO_X) and VOCs, designed to protect air quality in the state and reduce ozone levels from many sources (including automobile traffic) in the Transport Region.

Air Quality Monitoring and Existing Air Quality

The EPA as well as state and local agencies have established a network of ambient air quality monitoring stations to measure and track background concentrations of criteria pollutants in Rhode Island (and across the United States). These data sets are then used by regulatory agencies to compare the air quality of an area to the various NAAQS. To characterize the existing (background) air quality in the region surrounding the Project, data were obtained from representative RIDEM and EPA air quality monitoring stations. Monitoring stations near the Fields Point LNG Facility provide continuous information on regional ambient air quality. A summary of the regional ambient air quality monitoring data from the most recent 3-year period for which data were available (2012 to 2014) for the Project site is presented in table 2.7.1-2.

TABLE 2.7.1-2

Ambient Air Quality Concentrations in the Project Area

Pollutant	Monitors [a]	Site ID [b]	Distance from Fields Point LNG Facility	Averaging Period	Value (µg/m^3)[c]	NAAQS (µg/m^3)
CO	A	44-007-1010	3.4 miles northeast	1-hour	2,346	40,000
	A	44-007-1010	3.4 miles northeast	8-hour	1,495	10,000
NO_2	B	44-007-0012	1.9 miles north	1-hour	80	188
	B	44-007-0012	1.9 miles north	Annual	19.7	100
Ozone	A	44-007-1010	3.4 miles northeast	8-hour	73	2008–75 ppb
	A	44-007-1010	3.4 miles northeast	8-hour	73	2015–70 ppb
$PM_{2.5}$	C	-	-	24-hour	20.9	35
	C	-	-	Annual	8.79	12
PM_{10}	C	-	-	24-hour	31	150
SO_2	A	44-007-1010	3.4 miles northeast	1-hour	36	196
	A	44-007-1010	3.4 miles northeast	3-hour	45	1,300

a Monitoring Stations Designations: A = Francis School East Providence; B = Brown University; C = Providence Monitors
b Ambient concentration for $PM_{2.5}$ and PM_{10} based on Pawtucket, Providence, and East Providence Monitors.
c Source: RIDEM, 2016 and EPA Aerometric Information Retrieval System Database
Notes: µg/m^3 = micrograms per cubic meter; ppb = parts per billion

10 The EPA has not made a determination of attainment status regarding the 2015 8-hour ozone standard. We note that the entire state of Rhode Island is part of the Northeast Ozone Transport Region, and monitored data appear to be just over the new 8-hour standard; therefore, our impact analysis treats Providence County as being in nonattainment for the 2008 8-hour ozone standard.

2.7.1.2 Permitting and Regulatory Requirements

The CAA, as amended in 1977 and 1990, is the basic federal statute governing air pollution. The provisions of the CAA that are potentially relevant to the Project include the following, which are discussed further below:

- New Source Review (NSR);
- Prevention of Significant Deterioration (PSD);
- Nonattainment New Source Review (NNSR);
- Title V Operating Permits;
- New Source Performance Standards (NSPS);
- National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Source Categories;
- Chemical Accident Prevention Provisions;
- General Conformity;
- GHG Reporting Rule; and
- State Regulations.

For the purposes of air permitting, the proposed liquefaction facilities and existing Fields Point LNG Facility are considered a single stationary source for determining regulatory applicability.

New Source Review

Sources subject to NSR must undergo a NSR permitting process prior to construction or operation. Through the NSR permitting process, local, state, and federal regulatory agencies review and approve project construction plans, regulated pollutant increases or changes, emissions controls, and other details. The agencies then issue construction permits that include specific requirements for emissions control equipment and operating limits. The three basic categories of NSR permitting are PSD, NNSR, and minor source NSR. Federal preconstruction review for affected sources in attainment areas is called PSD. Federal preconstruction review for affected sources in nonattainment areas is called NNSR and contains stricter thresholds and requirements. Minor source (non-major source) permitting is not a federal requirement but is left to the states to define and implement.

The Project site is within an area designated as attainment or unclassifiable for all criteria pollutants; however, the Project site is within the Northeast Ozone Transport Region where sources of NO_X or VOCs classified as “major sources or major modifications” are subject to NNSR. The

Project would not be classified as major for any air pollutant; therefore, NSR permitting does not apply.

Prevention of Significant Deterioration

The PSD regulations, codified in 40 CFR 52.21, apply to new major sources or major modifications at existing sources in attainment areas or in areas that are unclassifiable. PSD is intended to keep new air emission sources from causing the existing air quality to deteriorate beyond acceptable levels. Under PSD regulations, a major source is any source type belonging to a list of 28 named source categories that emit or have the potential to emit 100 tons per year (tpy) or more of any regulated pollutant. Additionally, source categories not named on this list are considered major if a facility emits or has the potential to emit 250 tpy or more of any criteria pollutants. Liquefaction facilities are not among the 28 listed source categories; therefore, the 250 tpy major source threshold would apply to the Project.

A major modification is a physical change or a change in the method of operation at an existing major source facility that causes emissions of criteria pollutants to increase in excess of any of the following Significant Emission Rates:

- 100 tpy for CO;
- 40 tpy for NO_X;
- 40 tpy for VOCs;
- 40 tpy for SO_2;
- 15 tpy for PM_{10}; or
- 10 tpy for $PM_{2.5}$.

At an existing minor source facility, PSD review is triggered if the Significant Emission Rate is exceeded by the Project-related emissions increase. The proposed emissions increase from the Project would be well under the major source thresholds and would not exceed the Significant Emission Rate; therefore PSD review does not apply.

Class I Areas

The potential impact on protected Class I areas must be considered in the PSD review process. Areas of the country are categorized as Class I, Class II, or Class III. Class I areas are designated specifically as pristine natural areas or areas of natural significance, including wilderness areas and national parks, and are afforded special protection under the CAA. Class III designations, intended for heavily industrialized zones, can be made only on request, and must meet all requirements outlined in 40 CFR 51.166. The remainder of the United States is designated as Class II. The Federal Land Managers' Air Quality Related Values Work Group (FLAG) 2010 (FLAG, 2010) guidance states that a ratio of visibility-affecting emissions to distance value of 10 or less indicates that Air Quality Related Values analyses should not be required. Visibility-affecting pollutants are defined by the Federal Land Managers as: SO_2, NO_2, PM_{10}, and sulfuric acid mist. The nearest Class I area to the Project is Lye Brook Wilderness, which is about 196 kilometers away. Based on the negligible visibility-affecting emissions increase from the Project and the distance to the nearest Class I area, the visibility-affecting emissions to distance value would be near zero. Therefore, under FLAG guidance a PSD Class I analysis is not applicable.

Nonattainment New Source Review

In nonattainment areas, a separate procedure has been established for federal pre-construction air permit review of certain large proposed projects; known as NNSR. NNSR applicability is determined separately and independently from PSD review. In general, the applicability of the NNSR permitting program is based on the major source status of a facility and the emissions increase from a facility modification. A physical modification or a change in the method of operation of an existing major source is subject to NNSR if the alteration would result in a significant emission increase of affected pollutants. Each NNSR pollutant and its precursor(s) are reviewed individually and compared to the applicable major source threshold to determine major source status on a pollutant-by-pollutant basis. For each pollutant that is subject to NNSR permitting, the applicant must assess the following items in the NNSR permit application to the extent each is applicable:

- Lowest Achievable Emission Rate;
- alternatives analysis; and
- purchasing of emission offsets.

Because the Project would be a non-major (minor) emission source, NNSR does not apply to the Project.

Title V Operating Permit

The Title V Operating Permit program, as described in 40 CFR 70, requires major stationary sources of air emissions to obtain an operating permit within 1 year of initial facility startup. To determine if a facility is required to obtain a Title V permit, the potential emissions of criteria pollutants, hazardous air pollutants (HAP), or GHGs from the entire facility are compared to the Title V major source thresholds of each pollutant. If emissions of any pollutant exceed the applicable major source threshold, the facility must obtain a Title V permit. The major source thresholds for determining the need for a Title V permit are a potential to emit 100 tpy or more of any criteria pollutant, 10 tpy of any individual HAP, or 25 tpy of total HAPs (in aggregate).

The EPA also promulgated the Title V GHG Tailoring Rule, which established permitting thresholds for GHG emissions under the Title V program. Sources with an existing Title V permit or new sources obtaining a Title V permit for non-GHG pollutants are required to address GHGs. New sources and existing sources not previously subject to Title V that have a potential to emit equal to or greater than 100,000 tpy CO_2e are subject to Title V permitting requirements.

The existing Project site, including the existing storage tank, does not currently require or operate under a Title V permit. Maximum potential emissions of all pollutants from the modified Fields Point LNG Facility following the completion of the Project would remain well below any applicable major source threshold; therefore, the facility would not require a Title V permit.

New Source Performance Standards

The NSPS, codified in 40 CFR 60, govern emission rates and provide other requirements for new or significantly modified sources. NSPS requirements include emission limits, monitoring, reporting, and record keeping. The following NSPS requirements are potentially applicable to the Project.

NSPS Subpart Dc, *Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units*, applies to all steam generating units with a heat capacity of 29 MW (100 million MMBtu/hr) or less and greater than 2.9 MW (10 MMBtu/hr). The regeneration heater is not technically a steam generating unit, but for this purpose is assumed to be covered under the requirements of NSPS Subpart Dc.

NSPS Subpart Kb, *Standards of Performance for Volatile Organic Liquid Storage Vessels, (Including Petroleum Liquid Storage Vessels),* applies to storage vessels that are constructed, reconstructed, or modified after July 23, 1984, with a capacity greater than 75 cubic meters (19,800 gallons) that would store volatile organic liquids. Stored LNG (methane) is not a VOC. Therefore, Subpart Kb is not applicable to the Project.

NSPS Subpart KKK, *Standards of Performance for Equipment Leaks of VOC from Onshore Natural Gas Processing Plants for Which Construction, Reconstruction, or Modification Commenced After January 20, 1984, and on or before August 23, 2011*, sets VOC limits as well as recordkeeping and reporting requirements for onshore natural gas processing plants and compressors in VOC service. The Project is scheduled to commence after August 23, 2011; therefore, the Project is not subject to Subpart KKK.

NSPS Subpart IIII, *Standards of Performance for Stationary Compression Ignition Internal Combustion Engines*, applies to the proposed emergency generator. The generator would be subject to NSPS Subpart IIII because it would be a stationary compression ignition internal combustion engine manufactured after April 1, 2006 and ordered after July 11, 2005. Any affected engines installed as a part of the Project would be required to comply with the emission standards and work practice requirements of this regulation.

NSPS Subpart JJJJ, *Standards of Performance for Stationary Spark Ignition Internal Combustion Engines,* applies to stationary spark-ignition engine manufacturers and owners/operators. For natural gas-fired emergency engines manufactured after January 1, 2009, the applicable emission limits for engines with a rated capacity equal to or greater than 130 grams per brake horsepower are:

- for NO_X: 2.0 grams per brake horsepower-hour, or 160 parts per million by volume, dry at 15 percent oxygen;

- for CO: 4.0 grams per brake horsepower-hour, or 540 parts per million by volume, dry at 15 percent oxygen; and

- for VOCs (not including formaldehyde): 1.0 grams per brake horsepower-hour or 86 parts per million by volume, dry at 15 percent oxygen.

National Grid would comply with Subpart JJJJ and other requirements outlined in the General Permit for Emergency Generator that was received for the Project on October 31, 2016.

NSPS Subpart OOOO, *Crude Oil and Natural Gas Production, Transmission and Distribution*, is not applicable to the Project. Storage tanks are subject to the regulation if they are new or modified and have potential VOC emissions greater than 6 tpy. The LNG storage tank would not be modified as part of the Project and would not have a VOC emission rate greater than 6 tpy. Therefore, Subpart OOOO is not applicable to the Project.

<u>National Emission Standards for Hazardous Air Pollutants</u>

The NESHAPs, codified in 40 CFR 61 and 63, regulate the emissions of HAPs from existing and new sources. Part 61 NESHAP regulations apply to the following eight compounds listed as HAPs prior to the CAA Amendments of 1990: asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chlorides. The regulations list emission limits and operating parameters that must be followed for specified sources that emit these compounds. The emission sources included in the Project would not emit these pollutants; therefore, the Project has no requirements under the 40 CFR 61 NESHAP regulations.

The NESHAP standards in 40 CFR 63, also known as the Maximum Achievable Control Technology standards, regulate HAP emissions for specific source types at major or area sources of HAPs. The existing LNG storage tank and appurtenances are not a major source for HAPs, because HAP emissions are below the major source threshold of 10 tpy of any single HAP or 25 tpy of all HAPs in aggregate. The Project site (including the proposed liquefaction facilities) would remain minor sources of HAPs after the Project. NESHAPs apply to sources in specifically regulated industrial source categories (CAA section 112(d)) or on a case-by-case basis (section 112(g)) for major sources not regulated as a specific industrial source type. Below is a detailed discussion of the NESHAP regulations that are potentially applicable to the proposed liquefaction facilities. In addition to the source type-specific regulations, any source which is subject to a subpart of 40 CFR 63 is also subject to the general provision of NESHAP Subpart A, unless otherwise noted in the applicable subpart.

The following NESHAP subparts were identified as potentially applicable to the Project based on source type: Subpart HHH, Subpart EEEE, Subpart YYYY, and Subpart DDDDD. As explained below, these subparts are not applicable because neither the existing Fields Point LNG Facility nor the proposed modified Fields Point LNG Facility is a major source of HAP emissions.

NESHAP Subpart Y, *National Emission Standards for Marine Tank Vessel Loading Operations*, applies to new sources with an initial startup date after September 20, 1999 having a potential to emit less than 10 tons individual HAP and 25 tons combined HAPs. Per 40 CFR 63.560(d)(5), this rule does not apply to marine tank vessel loading operations that exclusively transfer liquids containing organic HAPs as impurities, as defined in 40 CFR 63.561. The liquefaction facilities would meet this exemption; therefore, this rule is not applicable to the Project.

NESHAP Subpart ZZZZ, *National Emission Standards of Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines* applies to stationary reciprocating internal combustion engines at major and area sources of HAPs. Although the overall modified Fields Point LNG Facility would be a minor source of HAPs, the generator included in the Project would be constructed after June 12, 2006 at an area source of HAPs and would therefore be subject to Subpart ZZZZ. Compliance with Subpart ZZZZ for these engines is attained by meeting the requirements of NSPS Subpart JJJJ (section 63.6590(c)(1)). No applicable emission limits or other requirements would apply under Subpart ZZZZ.

Chemical Accident Prevention Provisions

The Chemical Accident Prevention Provisions codified in 40 CFR 68 are federal regulations designed to prevent the release of hazardous materials in the event of an accident and minimize potential impacts if a release does occur. The regulations contain a list of substances and threshold quantities for determining applicability to stationary sources, including methane, propane, and ethylene in amounts greater than 10,000 pounds. If a stationary source stores, handles, or processes one or more substances on this list in a quantity equal to or greater than that specified in the regulation, the facility must prepare and submit a risk management plan. A risk management plan is not required to be submitted to the EPA until the chemicals are stored on-site at a particular facility.

If a facility does not have a listed substance on-site, or the quantity of a listed substance is below the applicability threshold, the facility does not have to prepare a risk management plan. In the latter case, the facility still must comply with the requirements of the general duty provisions in section 112(r)(1) of the 1990 CAA Amendments if there is any regulated substance or other extremely hazardous substance on-site. The general duty provision states: *"The owners and operators of stationary sources producing, processing, handling and storing such substances have a general duty to identify hazards which may result from such releases using appropriate hazard assessment techniques, to design and maintain a safe facility, taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur."*

Stationary sources are defined in 40 CFR 68 as any buildings, structures, equipment, installations, or substance-emitting stationary activities that belong to the same industrial group, that are located on one or more contiguous properties, are under control of the same person (or persons under common control), and from which an accidental release may occur.

The definition of a stationary source does not apply to transportation of any regulated substance or any other extremely hazardous substance. When the EPA issued the final rule for the Chemical Accident Prevention Provisions (Federal Register, January 6, 1998 [Volume 63, Page 639-645]), it clarified that the transportation exemption applies to LNG facilities subject to oversight or regulation under 49 CFR 193. These exempt facilities include those used to liquefy natural gas or those used to transfer, store, or vaporize LNG in conjunction with pipeline transportation. Therefore, the Project is exempt from 40 CFR 68.

General Conformity

The General Conformity Rule is codified in 40 CFR Part 51, Subpart W and Part 93, Subpart B, Determining Conformity of General Federal Actions to State or Federal Implementation Plans.

A conformity determination must be conducted by the lead federal agency if a federal action's construction and operation are likely to generate direct and indirect emissions that would exceed the conformity threshold for the minimum levels of the pollutant(s) for which an air basin is classified nonattainment or maintenance. According to the conformity regulations, emissions from sources that are major for any criteria pollutant with respect to the NNSR or PSD permitting/licensing are exempt and are deemed to have conformed.

Section 176(c)(1) of the CAA (40 CFR 51.853) states that a federal agency cannot approve or support any activity that does not conform to an approved State Implementation Plan. Conforming activities or actions should not, through additional air pollutant emissions:

- cause or contribute to new violations of the NAAQS in any area;
- increase the frequency or severity of any existing violation of any NAAQS; or
- delay timely attainment of any NAAQS or interim emission reductions.

Although Rhode Island is part of the Northeast Ozone Transport Region, Providence is classified as being in attainment or unclassifiable for all criteria pollutants. Therefore, Project activities are not subject to General Conformity.

Greenhouse Gas Reporting Rule

On September 22, 2009, the EPA issued the final Mandatory Reporting of Greenhouse Gases rule, establishing the Greenhouse Gas Reporting Program codified in 40 CFR 98. Since 2011, the Greenhouse Gas Reporting Program has required large direct emitters of GHGs, and certain suppliers (e.g., of fossil fuels, petroleum products, industrial gases, and CO_2) to report GHGs. Subpart C of 40 CFR 98 applies to combustion units, and Subpart W applies to petroleum and natural gas systems, including: both onshore and offshore petroleum and natural gas production; onshore natural gas processing; natural gas transmission compression; underground natural gas storage; LNG storage, and import and export facilities that emit greater than or equal to 25,000 metric tons of GHGs, as CO_2e, per year.

Emissions of GHG pollutants associated with the construction and operation of the Project were calculated. In addition, GHG emissions were converted to total CO_2e emissions based on the GWP of each pollutant. GHG emissions associated with operation of the Project, as discussed earlier, are shown in tables 2.7.1-4 and 2.7.1-5 (see section 2.7.1.3 below).

The Greenhouse Gas Reporting Program does not apply to construction emissions; however, we have included the construction emissions in table 2.7.1-3 (see section 2.7.1.3 below) for accounting and disclosure purposes. Based on the emission estimates for operation of the proposed modified Fields Point LNG Facility listed in table 2.7.1-4, the GHG emissions would not exceed 25,000 metric tpy; therefore, the modified facility is not subject to the requirements of 40 CFR 98.

State Regulations

RIDEM is the lead air permitting authority for the Project site. Rhode Island air permitting requirements are codified in RIDEM's Air Pollution Control Regulations 1-49. The process of obtaining an air permit involve the review and implementation of state regulations, inclusive of requirements for PSD and NNSR, as applicable.

The state regulations summarized below are those that would establish emission limits or other restrictions that may be in addition to those required under federal regulations. State regulations that are not applicable to the Project are not discussed in the following summary.

In general, projects trigger review by other states if within 50 miles of an adjacent state's border. The Project site is within 3 miles of the Massachusetts state line and 21 miles from the Connecticut border; therefore, the Massachusetts Department of Environmental Protection and Connecticut Department of Energy & Environmental Protection would have the opportunity to review and comment on the air permit application and subsequent permits.

Applicable air quality regulations within the state of Rhode Island include the following:

- Air Pollution Control Regulation No. 1, Visible Emissions, which states that no person shall emit into the atmosphere from any source any air contaminant for a period or periods aggregating more than three minutes in any one hour, which is greater than or equal to 20 percent opacity.

- Air Pollution Control Regulation No. 3, Particulate Emissions from Industrial Processes, which limits the amount of particulate matter emissions being emitted into the atmosphere from industrial sources (not including products of combustion). The amount of particulate emissions allowed is based on the process weight rate and the hours of operation.

- Air Pollution Control Regulation No. 5, Fugitive Dust, which regulates the amount of fugitive dust being emitted. A facility cannot permit any materials to be handled, transported, or otherwise utilized so as to cause airborne particulate matter to travel beyond the property line without taking adequate precautions in accordance with good industrial practice.

- Air Pollution Control Regulation No. 7, Emissions of Air Contaminants Detrimental to Person or Property, which states that no person shall emit any contaminant which either alone or in connection with other emissions, by reason of their concentration or duration, may be injurious to human, plant or animal life, or cause damage to property or which unreasonably interferes with the enjoyment of life and property.

- Air Pollution Control Regulation No. 8, Sulfur Content of Fuels, which limits the amount of sulfur in fuel oils. The amount of sulfur allowed changes as new requirements become active. Current requirements limit the sulfur content of no more than 0.05 percent (500 parts per million) in distillate oil, biodiesel, and alternative fuel. As of July 1, 2018, this limit reduces to 0.0015 percent (15 parts per million).

- Air Pollution Control Regulation No. 9, Air Pollution Control Permits, which details air permitting requirements. A Minor Source Permit or Major Source Permit is required to be obtained before the construction, installation, or modification of any applicable sources. Once construction is complete, Operating Permits are required for major sources. The regeneration heater would have a heat input less than the RIDEM permitting threshold of 10 MMBtu/hr and would not require a Minor Source Air Permit. The emergency generator is subject to permitting because it would have a capacity greater than the threshold of 50 horsepower. The emergency generator may be permitted under the General Permitting program specific to emergency generators in lieu of obtaining a Minor Source Permit if it meets the eligibility requirements of the General Permit.

- Air Pollution Control Regulation No. 13, Record Keeping and Reporting, which states that the owner or operator of any facility that emits air contaminants shall, at the request of the Director, provide data on operational processes, fuel usage, raw materials, stack dimensions, exhaust gas flow rates and temperatures, emissions of air contaminants, steam or hot water generator capacities, types of equipment producing air contaminants and air pollution control systems or other data that may be necessary to determine if the facility is in compliance with air pollution control regulations. These records shall be maintained at the facility for a period of five years.

- Air Pollution Control Regulation No. 17, Odors, which prohibits the emissions of any air contaminant which creates an objectionable odor beyond the property line of the applicable facility.

According to the RIDEM "Rhode Island Air Dispersion Modeling – Guidelines for Stationary Sources," modeling is automatically required for new major stationary sources, modifications to existing major stationary sources which would exceed specified Significant Emissions Rate Thresholds, and new or modified minor sources that exceed the Significant Emissions Rate Thresholds. Since the potential emissions from the proposed Project, detailed in table 2.7.1-5, are below the Significant Emissions Rate Thresholds, modeling in accordance with the RIDEM Guidelines is not required.[11]

On October 31, 2016, the RIDEM's Office of Air Resources issued a Permit for the proposed emergency generator. The RIDEM Office of Air Resources concurred with National Grid's assessment that the proposed regeneration heater to be installed at the Providence site does not require an air pollution control permit. This determination was based on the information provided by National Grid on October 19, 2017, which stated that the nitrogen compressor would be driven by an electric motor and one regeneration heater less than 10 British thermal units per hour (MMbtu/hr) heat input. Natural gas-fired heaters having a heat input of less than 10 MMBtu/hr are not required to obtain a permit under RIDEM's Air Pollution Control Regulation No. 9 section 9.3.1(a)(3) "Air Pollution Control Permits." Natural gas-fired fuel burning

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[11] Air dispersion modeling analyses were filed on June 30, 2016 (FERC Accession Number 20160630-5311) and September 16, 2016 (FERC Accession Number 20160916-5190).

equipment is also exempt from RIDEM's Air Pollution Control Regulation No. 22 section 22.2.2(c) "Air Toxics."

2.7.1.3 Impacts and Mitigation

We received several comments regarding potential impacts on air quality. These comments generally expressed the belief that the Project would worsen the air quality near the Project site, particularly on low-income communities and communities of color and women. Commenters noted that these communities already experience disproportionately high rates of asthma and other illnesses related to pollution, are already near numerous documented contaminated sites and the traffic (and associated pollution) of Interstate 95.

The Project would produce air emissions from both construction and operation. Construction of the Project would occur over a period of about two years, and during this time fugitive dust emissions and combustion emissions from trucks and other typically utilized fossil fuel-fired mobile construction equipment would result. The following discussion of the proposed construction and operational emissions, and the associated air quality impacts from the Project addresses the concern raised regarding local air impacts.

Project Construction Emissions Impacts and Mitigation

Construction of the Project facilities would result in intermittent and short-term increases in emissions of certain air pollutants. These emissions would include combustion emissions from the use of fossil fuel-fired construction equipment and fugitive dust from construction vehicle movement and soil disruption activities such as trenching and backfilling. These estimated emissions also include indirect emissions attributable to construction workers commuting to and from construction sites, trucks transporting construction materials, and on-road and off-road construction vehicle traffic. Emissions generated from construction of the Project are summarized in table 2.7.1-3.

TABLE 2.7.1-3

Estimated Construction Emissions for the Project (tpy) [a]

Construction Activity	CO	NO_X	VOC [b]	SO_2	PM_{10}	$PM_{2.5}$	GHG [c]	HAPs [d]
Non-road equipment	5.46	12.27	1.15	0.02	0.86	0.84	1,649.03	0.06
On-road vehicles	59.58	6.49	3.49	0.15	1.54	0.40	7,711.6	0.68
Land disturbance	-	-	-	-	9.36	1.4	-	-
TOTAL	**65.04**	**18.77**	**4.63**	**0.17**	**11.76**	**2.64**	**9,360.63**	**0.75**

a Exhaust emissions from proposed Project construction equipment and vehicle engines were estimated based on the anticipated types of non-road and on-road equipment and their respective levels of use. Emission factors for diesel and gasoline on-road vehicles were obtained using EPA's Motor Vehicle Emission Simulator model (EPA, 2014). Emission factors for diesel and gasoline non-road equipment engines were obtained using EPA's NONROAD model documentation methodology (EPA, 2008). Emission factors applied to the Project that use Tier 2 diesel engine standards are conservative (estimate higher emissions) and do not reflect the anticipated phasing-in of more stringent emissions standards.

b VOC – non-methane/ethane volatile organic compounds

c GHG – as CO_2e. Approximately 99 percent of the total CO_2e is attributable to CO_2 emissions; the remainder is due to N_2O and methane emissions.

d HAPs – as aggregated total HAPs

For all Project construction, National Grid has committed to use ultra-low sulfur diesel fuel for the non-road diesel-fired equipment.

Fugitive dust would result from land clearing, grading, excavation, and vehicle traffic on paved and unpaved roads. The amount of dust generated would be a function of construction activities, soil type, moisture content, wind speed, frequency of precipitation, vehicle traffic, vehicle types, and roadway characteristics. Emissions would be greater during dry periods and in areas of fine-textured soils subject to surface activity. Fugitive dust emissions would be controlled during periods when wind erosion and dust generation are occurring or probable. Measures that National Grid would implement to control dust, if necessary, include the following:

- applying water one or more times per day (or as needed during periods of natural precipitation) to affected unpaved roads and unpaved haul and access driveways if actively used; and

- reducing vehicle speeds on unpaved roads and unpaved haul and access driveways.

Non-jurisdictional Facility Construction

Emissions from construction of the electric service project described in section 1.9 are summarized in table 2.7.1-4.

TABLE 2.7.1-4

Construction Emissions for the Electric Service Project [a]

Construction Activity	Total Site Emissions (tons per year) [b]							
	CO	NO_x	VOC [a]	SO_2	PM_{10}	$PM_{2.5}$	GHG [c]	HAPs [d]
Non-Road Equipment	0.07	0.20	0.01	<0.01	0.01	0.01	26.16	<0.01
On-Road Vehicles	0.36	0.10	0.03	<0.01	0.01	0.01	52.78	<0.01
Land Disturbance	-	-	-	-	0.15	0.02	-	-
Total	0.43	0.30	0.04	<0.01	0.17	0.04	78.94	<0.01

a VOC – non-methane/ethane volatile organic compounds
b Exhaust emissions from electric service project construction equipment and vehicle engines were estimated based on the anticipated types of non-road and on-road equipment and their respective levels of use. Emission factors for diesel and gasoline on-road vehicles were obtained using EPA's Motor Vehicle Emission Simulator model (EPA, 2014). Emission factors for diesel and gasoline non-road equipment engines were obtained using EPA's NONROAD model documentation methodology (EPA, 2008). Emission factors applied to the Project that use Tier 2 diesel engine standards are conservative (estimate higher emissions) and do not reflect the anticipated phasing-in of more stringent emissions.
c GHG – as CO_2e
d HAPs – as aggregated total HAPs

Operational Impacts and Mitigation

The Project would include the installation and operation of the following stationary point sources of air pollutants at the Project site:

- a regeneration heater with a heat input of 9.76 MMBtu/hr; and
- an emergency generator with a heat input of 6.12 MMBtu/hr.

In addition, the following activities that potentially result in the emissions of air contaminants would continue at the Fields Point LNG Facility after all proposed Project modifications are complete:

- truck loading and unloading of liquids;
- emergency venting;
- fugitive emissions sources (valves, flanges, connectors, and pump seals);
- maintenance activities;
- intermittent equipment operated on an as-needed basis; and
- laboratory equipment use.

Operation of the modified Fields Point LNG Facility would result in minor air emissions increases over the existing facility. The potential emissions for operation of the existing and proposed modified facility are summarized in table 2.7.1-5.

TABLE 2.7.1-5

Summary of Potential Emissions for the Proposed Modified Fields Point LNG Facility (tpy) [a]

	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$	VOC	GHG [c]	HAPs
Existing Fields Point LNG Facility[b]	13.09	11.16	0.2835	0.767	0.767	0.792	13,348.97	0.247
Project emission sources	5.05	5.13	0.0267	0.354	0.354	0.65	8,446.53	0.12
Total for proposed modified Fields Point LNG Facility	**18.1**	**16.3**	**0.31**	**1.12**	**1.12**	**1.44**	**21,796**	**0.37**

a Operational emissions for Project equipment were calculated using equipment information from manufacturer specifications, manufacturer/regulatory/EPA emission factors, and equipment level of use. The proposed heater has the potential to operate 8,760 hours per year, and the proposed emergency generator is limited to 500 hours of operation per year.

b Values were provided by National Grid for existing sources used as needed for facility.

c GHG – as CO_2e. The Project's operation would emit approximately 5,227 tpy CO_2, 92.4 tpy methane (as fugitive releases), and 0.009 tpy N_2O, each contributing to the total CO_2e.

The proposed emergency generator is equivalent to other generators currently in use in and around the Providence area, which may be found in hospitals, universities, condominium complexes, and other commercial facilities. The generator would operate only for periodic testing and in the infrequent event of power interruption. The regeneration heater would emit minor amounts of air pollutants due to its small size and intermittent operation.

Although not required by state or federal regulations due to the small nature of the proposed sources, in response to public comments, FERC requested that National Grid perform an air dispersion modeling analysis to evaluate potential impacts on off-site air quality from operation of the proposed modified Fields Point LNG Facility. The results of the air dispersion modeling analysis predict air quality impacts that are generally well below the applicable NAAQS thresholds.[12] Air dispersion modeling results are shown in table 2.7.1-6.

[12] An air dispersion modeling analysis was filed on June 30, 2016 (FERC Accession Number 20160630-5311).

TABLE 2.7.1-6

Air Dispersion Modeling Results for the Modified LNG Storage Facility

Pollutant	Averaging Period	Form of Standard	Modeled Concentration [a] ($\mu g/m^3$)	Ambient Background [b] ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2 [c]	1-hour [d]	High-8th-high	104.2	80.0	184.2	188
	Annual	Annual Mean	5.3	19.7	25.0	100
CO	1-hour	2nd Max	318.79	2,346.0	2,664.79	40,000
	8-hour	2nd Max	162.85	1,495.0	1,657.85	10,000
PM_{10}	24-hour	High-6th-high	1.48	44.0	45.48	150
$PM_{2.5}$	24-hour	High-8th-high	1.07	20.9	21.97	35
	Annual	Annual Mean	0.26	8.79	9.05	12
SO_2	1-hour	High-4th-high	0.46	36.0	36.46	196
	3-hour	2nd Max	0.42	45.0	45.42	1,300

a Design concentrations for NAAQS are based on the standards listed in table 2.7.1-1.
b Values taken from RIDEM document "Background Criteria Pollutant Air Monitoring Data for Modeling Rhode Island Sources" (RIDEM, 2016).
c The EPA default NO_X to NO_2 conversion rates of 0.8 (1-hour NO_2) and 0.75 (annual NO_2) are applied to the modeled NO_2 concentrations.
d The 1-hour NO_2 analysis includes existing facility sources in addition to proposed Project sources.
Note: $\mu g/m^3$ = micrograms per cubic meter

We note that the total maximum modeled concentration of hourly NO_2 (184.2 micrograms per cubic meter) is close to the 1-hour NAAQS of 188 micrograms per cubic meter; however, air dispersion modeling is generally understood to provide a conservative (and protective) prediction. Further, as shown in figure 2.7.1-1, the small area of maximum impact lies along the ProvPort marine terminal dock for ocean-going vessels. While technically defined as ambient air (not under direct control of National Grid), this area is not accessible to the public as a practical matter.

As summarized in table 2.7.1-5, the proposed Project sources would emit minor amounts of NO_X and VOCs, much less than the threshold levels for which a major source permit is required.

Potential impacts on air quality associated with construction and operation of the Project would be minimized by strict adherence to all applicable federal and state regulations. Based on the analysis presented above, operation of the modified Fields Point LNG Facility would minimally impact local and regional air quality.

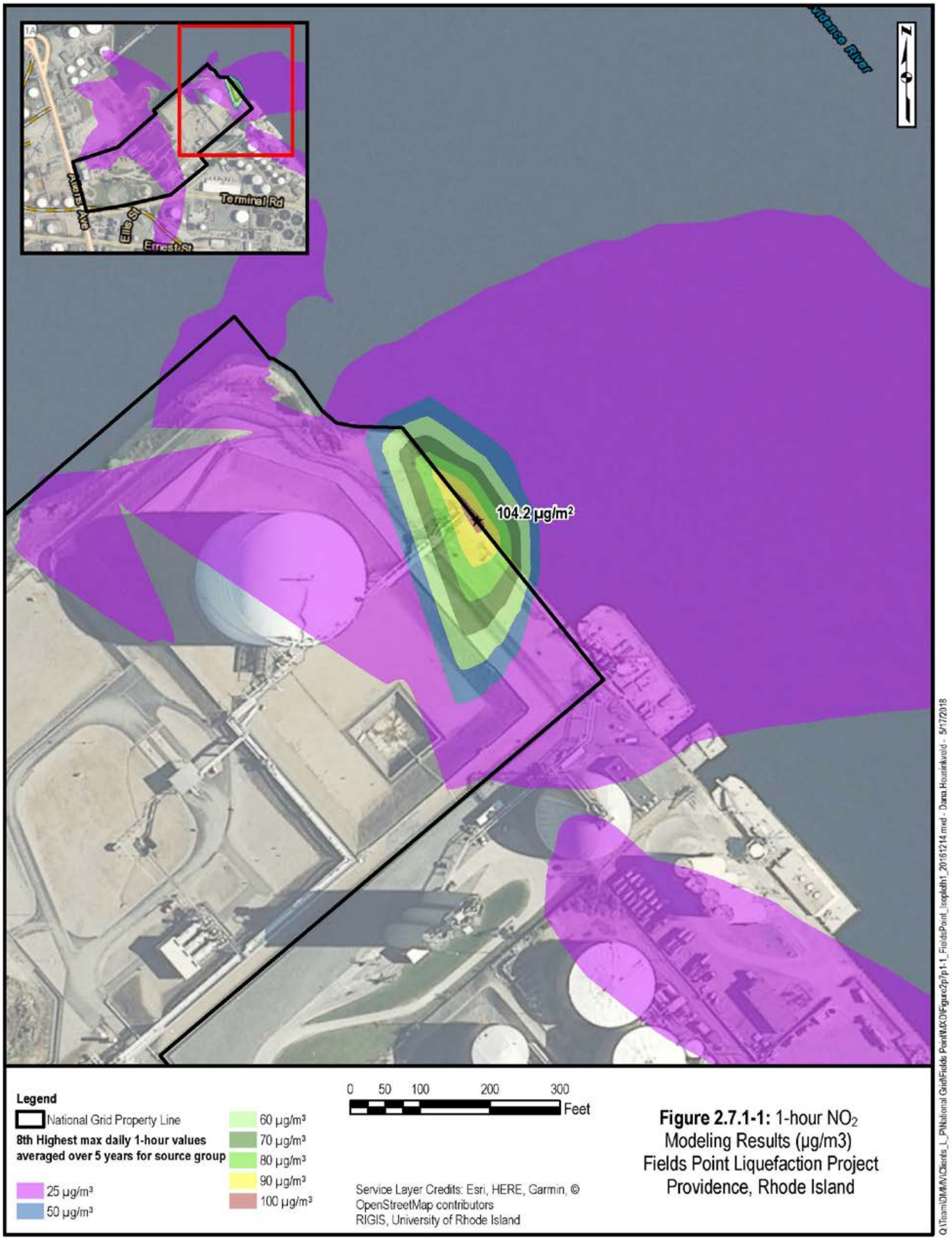

Figure 2.7.1-1: 1-hour NO_2 Modeling Results (µg/m3)
Fields Point Liquefaction Project
Providence, Rhode Island

Impacts on Environmental Justice Populations

To the degree that degradation of air quality disproportionately and negatively impacts minority or low income populations, such degradation may have environmental justice impacts. Poor or degraded air quality can contribute respiratory illness, cancer risks, and other adverse health outcomes. Children, as well as minority and low-income populations often experience substantially higher incidences of and are more susceptible to these adverse health outcomes (EPA, 2016f). Section 2.5.7 evaluates the Project's overall impacts on environmental justice communities. As described in section 2.7.1.3, overall air quality impacts would be minimal, and would not exceed applicable air quality standards (either alone or in combination with existing ambient air pollution). As a result, we conclude that impacts on environmental justice communities would be comparably minimal.

2.7.2 Noise

Two measurements used by some federal agencies to relate the time-varying quality of environmental noise to its known effects on people are the equivalent sound level (L_{eq}) and the day-night sound level (L_{dn}). The L_{eq} is an A-weighted sound level in decibels containing the same sound energy as the instantaneous sound levels measured over a specific time period. Noise levels are perceived differently, depending on length of exposure and time of day. The L_{dn} takes into account the duration and time the noise is encountered. Late night and early morning (10:00 p.m. to 7:00 a.m.) noise exposures are penalized +10 decibels to account for people's greater sensitivity to sound during the late evening and early morning hours. The A-weighted scale is used to assess noise impacts because human hearing is less sensitive to low and high frequencies than mid-range frequencies. The human ear's threshold of perception for noise change is considered to be 3 dBA; 6 dBA is clearly noticeable to the human ear, and 10 dBA is perceived as a doubling of noise (Bies and Hansen 1988).

In 1974, the EPA published its Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. This document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has indicated that an L_{dn} of 55 decibels on the A-weighted scale (dBA) protects the public from indoor and outdoor activity interference. We have adopted this criterion and use it to evaluate the potential noise impact from the operation of facilities.

The City of Providence's Code of Ordinances, Section 1, Chapter 16, Article III ("noise code") was amended in 2014. Section 16-93 of the amended noise code states that no property can produce a sound level that when measured at or within the real property boundary of a receiving land use exceeds limits specified in the section. The most restrictive of these limits is 55 dBA during nighttime hours when measured at any receiving property line within residential, commercial, or industrial land use districts. For typical urban areas including residences and commercial buildings, most of the available footprint is occupied by each residential and commercial structure falling within each respective property line; therefore, the noise measured at the property line is nearly the same as the noise measured at the structure. The FERC L_{dn} noise criterion of 55 dBA, equivalent to an L_{eq} noise level of 48.6 dBA, applies to noise levels averaged over a 24-hour time period and only to applicable noise-sensitive areas (NSA), per 18 CFR 380.12(k)(4). Therefore, the City of Providence noise code that limits noise (including intermittent construction noise) at any residential, commercial, or industrial property line to an L_{eq} of 55 dBA may be more (or less) restrictive than the FERC 55 dBA L_{dn} noise criterion depending on: (1) the identity of the noise receptor, and (2) the degree to which the noise source is continuous or intermittent in nature.

Although the City of Providence, through its Code of Ordinances, has promulgated regulations for noise control, Part II, Section 16-91(b)(1) of the Code of Ordinances states that City noise regulations are not applicable for projects authorized by a state or federal agency, as is the case for this Project. The City of Providence noise ordinance is therefore not applicable to the Project.

The City of East Providence's Code, Chapter 10 - Nuisances, Article III – Noise contains limits of the octave band sound pressure levels and overall A-weighted sound level when measured at a residential receiving property line. However, similar to the City of Providence Ordinance, the City of East Providence regulation is not applicable for projects authorized by a state or federal agency.

2.7.2.1 Existing Noise Conditions

The existing Project site is within an industrial waterfront area known as Fields Point, which is bordered to the east by the Providence River. This area is generally characterized by industrial land uses such as port facilities, petroleum and fuel oil storage tank facilities, warehouses, and storage yards; all of which immediately surround the Project location. The Fields Point area is occupied by a variety of industrial facilities, including National Grid's existing Fields Point LNG Facility; a cement import terminal, storage, and distribution center (Holcim, Inc.); a chemical distribution company (Univar); a petroleum import terminal, storage, and distributor (Motiva); a marine terminal operator known as Port of Providence (ProvPort); and a wastewater treatment plant operated by the Narragansett Bay Commission. The nearest residential area is about 1,940 feet to the south of the Project site with residential areas about 2,500 feet from the north and west, of the Project site.

In July 2015, National Grid performed baseline sound pressure level measurements at points along the Project site perimeter and in the surrounding community (Lewis S. Goodfriend & Associates, 2016). Four of these measurements were taken at an approximately 60 feet from the proposed liquefaction location. One measurement was taken at the nearest NSA, a residential area approximately 1,940 feet to the south. Two additional measurements within the surrounding industrial complexes were taken at distances of 1,880 feet and 2,180 feet west and northwest of the Project. All of the measurements were performed for 10-minute periods at each location using a portable octave band sound pressure level analyzer. The measurements performed at the Project site were taken during daytime hours, and measurements at the three off-site locations were taken during daytime and nighttime hours. The measured 10-minute A-weighted L_{eq} and sound pressure level exceeded 90 percent of the time during the Measurement (L_{90})[13] sound levels are summarized in table 2.7.2-1.

TABLE 2.7.2-1

Measured Ambient Sound Levels Near the Project Site [a]

Location and Distance/Direction	Measurement Start Time	L_{eq} Sound Level (dBA)	L_{90} Sound Level (dBA)	Equivalent L_{dn} Sound Level based on L_{90} (dBA)
LNG site – 60 feet north	10:31 a.m.	59	54	60.4
LNG site – 60 feet east	10:42 a.m.	64	61	67.4
LNG site – 60 feet south	10:53 a.m.	64	62	68.4
LNG site – 60 feet west	11:05 a.m.	60	55	61.4
Residences – 1,940 feet south	11:37 a.m.	66	57	63.4
	10:07 p.m.	52	49	55.4
Industrial location – 2,180 feet northwest	12:18 p.m.	69	59	65.4
	10:50 p.m.	62	55	61.4
Industrial location – 1,880 feet west	12:02 p.m.	68	61	67.4
	10:20 p.m.	65	54	60.4

a Measurements were taken on July 23, 2015, and averaged over 10-minute periods.

Project construction would not be subject to the City of Providence or City of East Providence noise ordinances as all construction would occur between the hours of 7:00 am and 10:00 pm.

2.7.2.2 Impacts and Mitigation

Construction Noise Impacts and Mitigation

Construction of the Project would involve operation of general construction equipment. Noise would be generated during operation of this equipment required for the installation of the various Project components and other related ground-disturbing activities. Measures to mitigate construction noise would include compliance with federal regulations limiting noise from trucks, proper maintenance of equipment, and maintaining sound muffling devices provided by the manufacturer in good working condition. Noise levels would increase in the immediate vicinity of the construction activities; however, the noise would be localized and temporary. Nighttime noise levels are not expected to increase during construction because most construction activities would be limited to daylight hours. Nighttime activities would consist of clean-up and staging of materials, which generate less noise than other construction activities.

Construction of the Project would take about 2 years. Construction noise would be highly variable because of the types of equipment in use would change with the construction phase and the types of activities. Noise from construction activities may be noticeable at nearby NSAs. National Grid calculated the expected A-weighted sound level for each of the pieces of proposed Project construction equipment at various receiver locations ranging from 1,900 to 4,400 feet from the Project site. The sound levels from proposed Project construction activities were calculated

13 The L_{90} is the sound pressure level exceeded 90 percent of the time during the measurement, and represents the background sound level during the measurement, excluding other intermittent and louder noise sources typical of urban areas.

using the distances from the Project site to the receivers, the source A-weighted sound levels in the Federal Highway Administration's Roadway Construction Noise Model noise emissions database, and National Grid's methodology. The total sound levels calculated at the NSAs in the community predicted by the construction noise model ranged from a minimum of 50.7 dBA at 4,400 feet to a maximum of 58 dBA at 1,900 feet. The maximum L_{eq} noise level due to construction at the nearest NSA, 58 dBA, is near or below typical daytime ambient levels for urban residential areas (60 dBA). Therefore, we do not expect the proposed Project construction activities to result in significant noise impacts on adjacent communities.

Operational Noise Impacts and Mitigation

We received several comments concerning the operational noise impacts from the proposed Project liquefaction facilities. The Project facilities would generate noise from operation of equipment, further described in section 2.8, including but not limited to a nitrogen recycle compressor, feed gas booster compressor, compressor/expanders, various intercooler/aftercoolers, compressor suction and discharge lines, transformers, pumps, motors, and skids.

Sound power levels for all major Project liquefaction equipment (nitrogen recycle compressor, feed gas booster compressor, compressor/expanders, various intercooler/aftercoolers, compressor suction and discharge lines, transformers, pumps, motors, and skids) were estimated using octave band data from manufacturers; field-obtained data; and data from industry-standard prediction algorithms. National Grid calculated potential operation noise associated with the Project, detailed in its noise level evaluation for the Project (Michael Theriault Acoustics, Inc., 2016). National Grid developed a three-dimensional, computer-generated acoustical model of the Project using specialized software (SoundPLAN® 7.3)[14] and International Organization for Standardization 9613 to estimate the Project's noise contribution at off-site receivers and identify any need for mitigation measures.

Based on the noise level evaluation, operation of the Project would meet the FERC criterion of an L_{dn} of 55 dBA, as well as the Rhode Island noise ordinances. Table 2.7.2-3 details the estimated noise contribution of the proposed modified Fields Point LNG Facility at nearby NSAs, and the predicted increase in noise over the lowest measured ambient L_{dn} noise level summarized in table 2.7.2-1 (55.4 dBA L_{dn}).

[14] SoundPLAN® 7.3 is a computer-based acoustical analysis package specially designed for predicting environmental noise levels from industrial operations and activities. Equipment sound power levels were adjusted for the reduction of sound by distance; the molecular absorption of sound by air; absorption and reflection of sound by the ground; and by the effects of shielding (i.e., via buildings, tanks, equipment, topography, etc.) and by changes in noise from Project operation with direction to estimate the Project's noise contribution at nearby NSAs.

TABLE 2.7.2-2

Modeled Results of Operational Noise Levels for the modified Fields Point LNG Facility

NSA	Description	Distance from proposed modified LNG facility site center (feet)	Modeled Noise Level dBA (L_{dn}) [a]	Lowest measured ambient noise level (L_{dn})	Combined noise level (L_{dn})	Increase above ambient (dB)
1	Toronto Ave Residences	1,900	52.4	55.4	57.0	+1.6
2	Porter Street Residences	3,100	43.4	55.4	55.7	+0.3
3	Roger Williams Middle School	3,800	39.4	55.4	55.5	+0.1
4	Pavilion Street Residences	2,500	41.4	55.4	55.6	+0.2
5	Meeting Street School	2,600	42.4	55.4	55.6	+0.2
6	Mary E. Fogarty Elementary School	4,400	37.4	55.4	55.5	+0.1
7	Village on the Water Front	2,900	48.4	55.4	56.2	+0.8

a Project equipment is assumed to operate continuously over a 24-hour period. Conversion from L_{eq} to L_{dn} is achieved by adding 6.4 dB.

As indicated in table 2.7.2-3, the noise contribution of the modified Fields Point LNG Facility at nearby NSAs is predicted to be below FERC's L_{dn} noise criterion of 55 dBA. In addition, the predicted increase in noise over existing ambient noise levels would be no more than +1.6 dB at the nearest NSAs (Toronto Avenue residences) over the quietest measured ambient noise level summarized in table 2.7.2-1, which was measured during the evening hours. As shown in table 2.7.2-1, daytime noise levels at or near these NSAs are likely higher. Therefore, during operation, the modified Fields Point LNG Facility's noise contribution at nearby NSAs would likely not be perceptible.

However, to ensure that the actual noise contributions at nearby NSAs resulting from operation of the modified facility are at or below an L_{dn} of 55 dBA and therefore not significant, **we recommend that:**

- **National Grid should file a full load noise survey with the Secretary of the Commission (Secretary) no later than 60 days after placing the modified Fields Point LNG Facility in service. If a full load condition noise survey is not possible, National Grid should provide an interim survey at the maximum possible operation and file the full load operational survey within 6 months. If the noise attributable to the operation of all of the equipment at the modified Fields Point LNG Facility, under interim or full load conditions, exceeds an L_{dn} of 55 dBA at any nearby NSAs, National Grid 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. National Grid should confirm compliance with the above requirement by filing a second noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

2.8 RELIABILITY AND SAFETY

2.8.1 Regulatory Oversight

Multiple federal agencies share regulatory authority over the siting, design, construction, and operation of LNG facilities. The safety, security, and reliability of the Project would be regulated by the FERC and the DOT. The existing facilities would continue to be regulated by FERC, DOT, and the U.S. Department of Homeland Security (DHS).

The FERC authorizes the siting and construction of LNG facilities under the NGA and delegated authority from the Department of Energy (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 DOT's safety-related 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 changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs that we considered during our review process. As part of the review required for a FERC authorization, we use this information from the applicant to assess whether the proposed facilities would have a public safety impact.

The DOT establishes and has the authority to enforce the federal safety standards for the siting, 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 U.S. Code 1671 *et seq*.). The DOT'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 U.S. Code 60101 *et seq*.), and 49 CFR 192. In 1985, the FERC and the DOT entered into a memorandum of understanding regarding the execution of each agency's respective statutory responsibilities to ensure the safe siting, design, construction, operation, and maintenance of LNG facilities. In addition to the FERC's existing ability to impose requirements to ensure or enhance the operational reliability of LNG facilities, the memorandum specified that the FERC may, with appropriate consultation with the DOT, impose more stringent safety requirements than those in Part 193. As a cooperating agency, the DOT assists the FERC staff in evaluating whether an applicant's proposed project siting meets the DOT requirements. If the project is constructed and becomes operational, the facilities would be subject to the DOT's inspection program. Final determination of whether the facilities are in compliance with the requirements of 49 CFR 193 would be made by the DOT staff.

Under Section 550 of the Homeland Security Appropriations Act of 2007, the DHS was provided with the authority to regulate the security of certain chemical plants in the United States. Accordingly on April 9, 2007, DHS created the "Chemical Facility Anti-Terrorism Standards" under 6 CFR 27 to establish risk-based performance standards related to plant security. On November 20, 2007, DHS issued the list of threshold quantities of chemicals of interest which trigger Part 27 review. The Project does not include any chemicals of interests that would be stored on site as specified in Appendix A to Part 27. However, the existing LNG facility is required to comply with the security regulations under 6 CFR 27.

Federal regulations issued by the Occupational Safety and Health Administration (OSHA) under 29 CFR 1910.119 (Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents), and the EPA under 40 CFR 68 (Chemical Accident Prevention Provisions) cover hazardous substances, such as methane, propane, and ethylene at many industrial plants in the United States. However, on October 30, 1992, shortly after the promulgation of the OSHA Process Safety Management regulations, OSHA issued a letter of interpretation that precluded the enforcement of Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents regulations over gas transmission and distribution facilities. In a subsequent letter on December 9, 1998, OSHA further clarified that this letter of interpretation applies to LNG distribution and transmission facilities.

In addition, the EPA's preamble to its final rule in the Federal Register, Volume 63, Number 3, 639 645, clarified that exemption from the requirements in 40 CFR 68 for regulated substances in transportation, including storage incident to transportation, is not limited to pipelines. The preamble further clarified that the transportation exemption applies to LNG facilities subject to oversight or regulation under 49 CFR 193, including facilities used to liquefy natural gas or used to transfer, store, or vaporize LNG in conjunction with pipeline transportation. Therefore, the above OSHA and EPA regulations are not applicable to facilities regulated under 49 CFR 193.

2.8.2 Hazards

Before liquefaction, National Grid would pre-treat the natural gas feed stream to remove impurities and components that would be incompatible with the liquefaction process or equipment, including hydrogen sulfide (H_2S), CO_2, water, and heavy hydrocarbons. In general, H_2S gas can be flammable and is also toxic upon inhalation, while CO_2 gas can cause respiratory irritation or asphyxiation. In this specific Project, the "heavy hydrocarbons" would primarily be composed of methane and ethane with minimal toxic components.[15] Most other designs would also propose a means to remove mercury to safeguard their equipment and reduce the likelihood of potential losses of containment because mercury can react with damaging effects with downstream aluminum heat exchangers. Mercury induced embrittlement and corrosion resulted in a catastrophic failure of a heat exchanger at a LNG liquefaction plant at Skikda (Kinney, 1975; Kehnat, 1977; Leeper, 2007). While the National Grid Project is not expecting mercury in the feed gas, and mercury concentrations have been generally low in natural gas found in the United States, mercury concentrations can still exceed typical specified mercury concentration limits. We note that no specific tests for mercury have been carried out by National Grid to support that mercury does not currently exist in the proposed feed gas sources. In addition, there are no other assurances (e.g., tariffs) that would prohibit mercury from being present in the proposed feed gas sources in the future. Therefore, we have included a recommendation in section 2.8.4 for National Grid to provide a means to remove mercury to limit concentrations to less than 0.01 micrograms per normal cubic meter or alternatively provide monitoring for mercury by means of an analyzer or

[15] Typically heavy hydrocarbons refer to streams with significant amounts of heavier hydrocarbons, such as propane, butane, pentane, hexane, heptane, or even heavier hydrocarbons with noticeable concentration of benzene, toluene, ethylbenzene, and xylenes. However, National Grid's feed gas would be largely free of these heavier hydrocarbons.

preventative maintenance inspections of the heat exchangers and provisions for a mercury removal package. In general, mercury can result in toxic effects if contacted, ingested, or inhaled.

The CO_2, H_2S, and water would be removed from the feed gas by contact with a molecular sieve adsorption system. The proposed pre-treatment system would be capable of handling a natural gas feed stream with up to 3 parts per million by volume of H_2S, and 0.33 mole percent CO_2[16]. The adsorbers would be regenerated to remove accumulated CO_2 and H_2S using pretreated dry gas, cooled, and then sent to the 99 pounds per square inch gauge (psig) natural gas distribution system[17] as spent regeneration gas. The concentrations of H_2S and CO_2 in the spent regeneration gas stream could reach 8 parts per million by volume and 0.91 mole percent, respectively, during this process. The spent catalyst in the pretreatment beds would be properly disposed of and replaced after a certain number of regenerating cycles using maintenance and safety procedures. The hazards associated with a release from spent regeneration gas stream containing H_2S, before it reaches the 99 psig natural gas distribution system, are described further in sections 2.8.6 and 2.8.7.

In the case of rich feed gas, heavy hydrocarbons would be removed by cooling in a brazed-aluminum heat exchanger which would be located within a cold box and then flashing in a vessel. The separated heavy hydrocarbon liquids would be re-vaporized in a feed liquefier exchanger and sent into the 99 psig natural gas distribution system. No heavy hydrocarbon liquids would be stored onsite. However, a loss of containment from the heavy hydrocarbon stream would result in a release of both toxic components and flammable components, with the ability to produce damaging overpressures. The primary toxic components in the heavy hydrocarbon stream would typically include benzene, butanes, ethylbenzene, hexanes, H_2S, methyl mercaptan, propane, toluene, and xylenes. The associated hazards are further described in sections 2.8.6 and 2.8.7.

After removal of the heavy hydrocarbons and the other components from the natural gas feed stream, National Grid would liquefy the natural gas. In this process, the gas would be cooled and liquefied using a nitrogen cycle refrigeration system. After cooling the natural gas into its liquid form, this LNG would be stored in the existing single-containment LNG storage tank. The principal hazards associated with a release of LNG would be the potential for flammable vapor dispersion, radiant heat from a fire, and the ability to produce damaging overpressures. The principal hazards associated with a release of nitrogen would be its cryogenic temperatures and potential for asphyxiation. All of these hazards are further described in the following subsections and analyzed for the Project in sections 2.8.6 and 2.8.7.

In addition, National Grid proposes to use hot oil as the heat transfer fluid in the pre-treatment system. The primary hazards associated with a release of hot oil would be the potential for flammable vapor dispersion, radiant heat from a fire, and the ability to produce damaging overpressures. The potential hazard from a hot oil release is addressed in sections 2.8.6 and 2.8.7.

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[16] The proposed feed gas impurities are much lower compared to other sites. However, National Grid feed gas would be largely free of these impurities. We routinely request feed gas compositions as part of our inspection process in part to ensure design limits are not being exceeded.

[17] Existing distribution pipeline that is operated at a nominal pressure of 99 psig. TNEC is the Owner/Operator of the 99 psig distribution pipeline and any spent regeneration gas that is sent to the 99 psig distribution system from the Project would be monitored to ensure that TNEC customers receive tariff compliant gas.

2.8.2.1 Hazardous Releases

A release of hazardous fluid from piping or equipment is the initial event that could result in all other potential hazards. This initial loss of containment can produce a liquid and/or gaseous release with the formation of vapor at the release location as well as at the location of any liquid that may have pooled. The released fluid may present low or high temperature hazards and may result in the formation of toxic and/or flammable vapors. The extent of the hazards depends on the material released, the storage and process conditions, and the volumes released.

LNG is typically stored near its boiling point at approximately -260 °F and liquid nitrogen is typically stored at or above its boiling point from -320 °F to -250 °F. Loss of containment of these liquids could lead to the release of both liquid and vapor into the immediate area. Exposure to either cold liquid or vapor could cause freeze burns and, depending on the length of exposure, more serious injury or death. However, spills would be contained to onsite areas, and the extent of the cold vapor state from these releases would be greatly limited due to the continuous mixing with the warmer air. The cold temperatures from the release would not present a hazard to the public, which would not have access to onsite areas.

These releases may also quickly cool any materials contacted by the liquid, causing extreme thermal stress in materials not specifically designed for such conditions. These thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These temperatures, however, would be accounted for in the design of equipment and structural supports, and would not be substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296 ºF) or several other cryogenic liquids that have been routinely produced and transported in the United States.

A rapid phase transition (RPT) can occur when a cryogenic liquid is spilled onto water and changes from liquid to gas, virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction, an RPT is the result of heat transferred to the liquid, inducing a change to the vapor state. RPTs have been observed during LNG test spills onto water. In some test cases, the overpressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. The sizes of the overpressure events have been generally small and did not cause significant damage. The average overpressures recorded at the source of the RPTs during the Coyote tests have ranged from 0.2 to 11 pounds per square inch (psi).[18] These events are typically limited to the area within the spill and are not expected to cause damage outside of the area engulfed by the LNG pool. However, an RPT may affect the rate of pool spreading and the rate of vaporization for a spill on water. Regardless, the Project facilities would not be expected to release LNG into the Providence River, and the impoundment areas are required by 49 CFR 193.2173 to be constructed so that all areas drain completely to prevent water collection.

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[18] The Lawrence Livermore National Laboratory conducted seven tests (the Coyote series) on vapor cloud dispersion, vapor cloud ignition, and RPTs at the Naval Weapons Center in China Lake, California in 1981.

2.8.2.2 Vapor Dispersion

In the event of a release, the LNG, nitrogen, or heavy hydrocarbon would produce vapor. Depending on the size and pressure of the release, these liquids may also form a liquid pool that would continue to vaporize because of exposure to ambient heat sources, such as water or soil. The vapor may form a toxic, flammable, or asphyxiant cloud, depending on the material released. The dispersion of the vapor cloud will depend on the physical properties of the cloud, the ambient conditions, and the surrounding terrain and structures. Generally, a denser-than-air vapor cloud would sink to the ground due to the relative density of the vapor to the air and would travel with the prevailing wind, while a lighter-than-air vapor cloud would rise and travel with the prevailing wind. The density depends on the material released and the temperature of the material. For example, an LNG release would initially form a denser-than-air vapor cloud and transition to a lighter-than-air vapor cloud as the vapor disperses downwind and mixes with the warm surrounding air. However, experimental observations and vapor dispersion modeling indicate that an LNG vapor cloud would not typically be warm, or buoyant, enough to lift off from the ground before the LNG vapor cloud disperses below its lower flammable limit (LFL). A liquid nitrogen release would form a denser-than-air vapor cloud and transition to a neutrally buoyant vapor cloud as it mixes with the warm surrounding air; and a heavy hydrocarbon release would form a denser-than-air vapor cloud that would remain denser than the surrounding air, even after warming to ambient temperatures.

The vapor cloud would continue to be hazardous until it dispersed below toxic and asphyxiant levels and/or flammable limits. Toxicity is primarily dependent on the concentration of the vapor cloud in the air and the exposure duration, while flammability of the vapor cloud primarily depends only on the concentration of the vapor when mixed with the surrounding air. In general, higher concentrations within the vapor cloud would exist near the spill, and lower concentrations would exist near the edge of the cloud as it disperses downwind.

Toxicity is defined by a number of different agencies for different purposes. Acute Exposure Guideline Levels (AEGL) and Emergency Response Planning Guidelines (ERPG) are recommended for use by federal, state, and local agencies as well as the private sector for emergency planning, prevention, and response activities related to the accidental release of hazardous substances (EPA, 2014). Other federal agencies, such as the DOE, EPA, and the National Oceanic and Atmospheric Administration (NOAA), use AEGLs and ERPGs as the primary measure of toxicity (DOE, 2008; EPA, 1996; NOAA, 2013).

There are three AEGLs and three ERPGs that are distinguished by varying degrees of severity of toxic effects, with AEGL-1 and ERPG-1 (Level 1) being the least severe to AEGL-3 and ERPG-3 (Level 3) being the most severe.

- AEGL-1 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, these effects are not disabling and are transient and reversible upon cessation of the exposure.

- AEGL-2 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

- AEGL-3 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

The EPA directs the development of AEGLs in a collaborative effort consisting of committee members from public and private sectors across the world. We use AEGLs preferentially as they are more inclusive and provide toxicity levels at various exposure times (10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours). The use of AEGLs is also preferred by the DOE and NOAA and DOT Federal Aviation Administration (FAA).

ERPG levels have similar definitions but are based on the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing similar effects defined in each of the AEGLs. The EPA provides ERPGs (1 hour) for a list of chemicals. EPA currently requires the determination of distances to toxic concentrations based on ERPG-2 levels.[19] The AEGL and ERPG toxic concentrations for the primary toxic components that would be processed onsite are presented in table 2.8.2-1.

[19] RMP toxic endpoints are based on ERPG-2 levels where these levels are available. For substances that do not have established ERPG-2 levels, the toxic endpoint is the level of concern from the EPA's 1987 Technical Guidance for Hazards Analysis.

TABLE 2.8.2 -1

Toxicity Levels (in ppm) for Various Exposure Times [a, b]

		10 min	30 min	60 min	4 hr	8 hr
Benzene	AEGL 1	130	73	52	18	9
	ERPG 1	-	-	50	-	-
	AEGL 2	2,000	1,100	800	400	200
	ERPG 2	-	-	150	-	-
	AEGL 3	9,700	5,600	4,000	2,000	990
	ERPG 3	-	-	1,000	-	-
Butane	AEGL 1	10,000	6,900	5,500	5,500	5,500
	ERPG 1	-	-	None	-	-
	AEGL 2	24,000c	17,000	17,000	17,000	17,000
	ERPG 2	-	-	None	-	-
	AEGL 3	77,000[c]	53,000[c]	53,000[c]	53,000[c]	53,000[c]
	ERPG 3	-	-	None	-	-
Ethylbenzene	AEGL 1	33	33	33	33	33
	ERPG 1	-	-	None	-	-
	AEGL 2	2,900	1,600	1,100	660	580
	ERPG 2	-	-	None	-	-
	AEGL 3	4,700	2,600	1,800	1,000	910
	ERPG 3	-	-	None	-	-
Hexanes	AEGL 1	NR	NR	NR	NR	NR
	ERPG 1	-	-	None	-	-
	AEGL 2	4,000	2,900	2,900	2,900	2,900
	ERPG 2	-	-	None	-	-
	AEGL 3	12,000[c]	8,600	8,600	8,600	8,600
	ERPG 3	-	-	None	-	-
Hydrogen sulfide	AEGL 1	0.75	0.60	0.51	0.36	0.33
	ERPG 1	-	-	0.1	-	-
	AEGL 2	41	32	27	20	17
	ERPG 2	-	-	30	-	-
	AEGL 3	76	59	50	37	31
	ERPG 3	-	-	100	-	-
Methyl mercaptan	AEGL 1	NR	NR	NR	NR	NR
	ERPG 1	-	-	0.005	-	-
	AEGL 2	40	29	23	14	7.3
	ERPG 2	-	-	25	-	-
	AEGL 3	120	86	68	43	22
	ERPG 3	-	-	100	-	-
Propane	AEGL 1	10,000	6,900	5,500	5,500	5,500
	ERPG 1	-	-	None	-	-
	AEGL 2	17,000	17,000	17,000	17,000	17,000
	ERPG 2	-	-	None	-	-
	AEGL 3	33,000[c]	33,000[c]	33,000[c]	33,000[c]	33,000[c]

TABLE 2.8.2 -1

Toxicity Levels (in ppm) for Various Exposure Times [a, b]

		10 min	30 min	60 min	4 hr	8 hr
	ERPG 3	-	-	None	-	-
Toluene	AEGL 1	67	67	67	67	67
	ERPG 1	-	-	50	-	-
	AEGL 2	1,400	760	560	310	250
	ERPG 2	-	-	300	-	-
	AEGL 3	10,000	5,200	3,700	1,800	1,400
	ERPG 3	-	-	1,000	-	-
Xylenes	AEGL 1	130	130	130	130	130
	ERPG 1	-	-	None	-	-
	AEGL 2	2,500	1,300	920	500	400
	ERPG 2	-	-	None	-	-
	AEGL 3	7,200	3,600	2,500	1,300	1,000
	ERPG 3	-	-	None	-	-

a EPA, 2013d
b American Industrial Hygiene Association, 2013
c ≥100% LFL
NR Not Recommended due to insufficient data

In addition, methane (the primary component of LNG) and nitrogen and other non-toxic fluids that displace air are classified as simple asphyxiants and may pose extreme health hazards, including death, if inhaled in significant quantities within a limited time. As discussed under "Hazardous Releases," very cold LNG and nitrogen vapors may also cause freeze burns. However, the locations where high vapor concentrations could cause these cold temperatures and oxygen-deprivation effects would be greatly limited due to the vapor continuously mixing with the warmer air surrounding the spill site. For that reason, exposure and asphyxiation injuries from releases of LNG and nitrogen normally represent negligible risks to the public. The potential hazard for an aphyxiant release is addressed in section 2.8.7.

Flammable vapor can develop when the temperature of a flammable substance is above its flash point. This vapor can be ignited wherever its concentration in air is between the LFL and upper flammable limit (UFL). Vapor concentrations above the UFL or below the LFL would not ignite. The flammable properties for the various materials stored and processed onsite are tabulated in table 2.8.2-2.

TABLE 2.8.2-2

Flammable Properties [a]

Materials	Flash Point	LFL (% vol)	UFL (% vol)
Methane	-283°F	5.0	15.0
Ethane	-211°F	3.0	12.5
Propane	-155°F	2.1	9.5
n-Butane	-76°F	1.8	8.5
i-Butane	-105°F	1.8	8.4
n-Pentane	-56°F	1.4	7.8
i-Pentane	-60°F	1.4	7.6
n-Hexane	-7.6°F	1.2	7.5
Methyl mercaptan[b]	0.0°F	3.9	21.8
Benzene	11°F	1.4	7.1
Toluene	45°F	1.2	7.1
Ethylbenzene[b]	55°F	0.8	6.7
m-Xylene	77°F	1.1	7.0
o-Xylene	75°F	1.1	6.0
p-Xylene	77°F	1.1	7.0
Hydrogen sulfide	-116°F	4.0	44
Hot oil	338°F[c]	0.8[d]	5.0[d]

a Society of Fire Protection Engineers (2008) unless otherwise noted.
b The National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards (2016).
c Therminol Heat Transfer Fluids by Eastman (https://www.therminol.com/).
d Niesson, Walter. *Combustion and Incineration Processes*. Boca Raton: CRC Press, 2010.

For flammable vapors, the extent of the affected area and the severity of the impacts on objects within a vapor cloud primarily depend on the material, quantity, and duration of the initial release; the surrounding terrain; and the environmental conditions present during the dispersion of the cloud. Although H_2S and methyl mercaptans are flammable materials, they would be present at this plant only in small quantities and in mixtures with other materials, and always at concentrations less than the LFL. Therefore, toxicity would be the governing hazard for an H_2S release. Toxic and flammable vapor dispersion distances for the Project are evaluated in sections 2.8.6 and 2.8.7.

2.8.2.3 Flammable Vapor Ignition

If the flammable portion of a vapor cloud encounters an ignition source, the vapor cloud will ignite. Once a vapor cloud is ignited, the flame front may propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. In most circumstances, the flame would be driven by the heat it generates. This process is known as a "deflagration," or a flash fire, because of its relatively short duration. However, exposure to a deflagration can cause severe burns and death, and can ignite combustible materials within the cloud. Flammable vapor dispersion distances for the proposed Project are evaluated in section 2.8.6.

If the deflagration in a flammable vapor cloud accelerates to a sufficiently high rate of speed, pressure waves that can cause damage would be generated. If a deflagration accelerates to super-sonic speeds, the large shock waves produced, rather than the heat, would begin to drive the flame, resulting in a detonation. High-speed deflagrations or detonations are generally characterized as explosions, as the rapid movement of the flame and pressure waves associated with them cause additional damage beyond that from the heat. The amount of damage an explosion causes depends on the amount that the produced pressure wave is above atmospheric pressure (i.e., an overpressure) and its duration (i.e., pulse). For example, a 1 psi overpressure, often cited as a safety limit in U.S. regulations, is associated with glass shattering and the glass pieces traveling with velocities high enough to lacerate skin and sufficient to collapse wooden framed structures. The flame speeds primarily depend on the reactivity of the fuel, the ignition strength and location, the degree of congestion and confinement of the area occupied by the vapor cloud, and the flame travel distance. Overpressure hazards for the proposed Project are addressed in section 2.8.7.

When the flame reaches vapor concentrations above the UFL, the deflagration could transition to a fireball and result in a pool or jet fire back at the source. A fireball would occur near the source of the release and would be of a relatively short duration compared to an ensuing jet or pool fire. The extent of the affected area and the severity of the impacts on objects in the vicinity of a fire would primarily depend on the material, quantity, and duration of the fire; the surrounding terrain; and the environmental conditions present during the fire. Radiant heat hazards for the proposed Project are addressed in section 2.8.7.

The heat from a fire may also cause failures of nearby storage vessels, piping, and equipment, and structures if not properly mitigated. The failure of a pressurized vessel could cause fragments of material to fly through the air at high velocities, posing damage to surrounding structures and a hazard for operating staff, emergency personnel, or other individuals in proximity to the event. In addition, failure of a pressurized vessel when the liquid is at a temperature significantly above its normal boiling point could result in a boiling-liquid-expanding-vapor explosion (BLEVE). BLEVEs can produce overpressures when the superheated liquid rapidly changes from a liquid to a vapor upon the release from the vessel. BLEVEs of flammable fluids may also ignite upon its release and cause a subsequent fireball. The potential for these hazards are further discussed in section 2.8.7.

2.8.3 Past Incidents at LNG Plants

With the exception of the October 20, 1944 failure at an LNG plant in Cleveland, Ohio, the operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200 to 400 more people.[20] The failure of the LNG storage tank was due to the use of materials inadequately suited for cryogenic temperatures. LNG migrating through streets and into underground sewers due to the lack of adequate spill impoundments at the site was also a contributing factor. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used and that spill impoundments are designed and constructed properly to contain a spill at the site. To ensure that this potential hazard would be addressed for the National Grid, we evaluated the preliminary specifications for suitable materials of construction and made a recommendation in section 2.8.4 for National Grid to provide for our

[20] 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.

approval the final design details. In addition, we evaluated their preliminary impoundment sizing calculations and made a recommendation in section 2.8.4 for National Grid to provide for our approval the final design details of the spill impoundment 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 seal failure resulted in gas vapors entering an electrical conduit and settling in a confined space. When a worker switched off a circuit breaker, the gas ignited, causing heavy damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident resulted in changing the national fire codes to better ensure that the situation would not occur again. To ensure that this potential hazard would be addressed for the National Grid Project, we evaluated the preliminary pump seal design to prevent migration of flammable vapors and made recommendations in section 2.8.4 for National Grid to provide for our approval the final design details of the seal design at the interface between flammable fluids and the electrical conduit or wiring system and the details of a physical 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. Findings of the accident investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced to the high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train 40 had been operating with its original equipment since start-up in 1981. To ensure that this potential hazard would be addressed for the Project, we evaluated the preliminary design for mitigation of flammable vapor dispersion and ignition in buildings and combustion equipment to ensure they were 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 made a recommendation in section 2.8.4 for National Grid to provide for our approval of the final design details.

On March 31, 2014, an internal detonation occurred within a gas heater at Northwest Pipeline Corporation's LNG peak-shaving plant in Plymouth, Washington[21]. 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 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

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[21] 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.

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 the Project, we included a recommendation in section 2.8.4 for National Grid to provide a plan for purging that 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. We also included a recommendation in section 2.8.4 for National Grid to provide, for review and approval, its operating and maintenance plans, including safety procedures. In order to prevent other sources of projectiles from affecting occupied buildings and storage tanks, we also included a recommendation in section 2.8.4 for an analysis of thermal mitigation to prevent a BLEVE from occurring.

2.8.4 Technical Review of the Preliminary Engineering Design

Operation of the proposed facilities poses a potential hazard that could affect the public safety if strict design and operational measures to control potential accidents are not applied. The primary concerns are those events that could lead to a hazardous release of sufficient magnitude to create an offsite hazard, as discussed in section 2.8.2. However, it is important to recognize the stringent requirements in place for the design, construction, operation, and maintenance of the facilities, as well as the extensive safety systems proposed to detect and control potential hazards.

In general, we consider 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 commonly independent of one another so that any one layer would perform its function regardless of the initiating event or action, or failure of any other protection layer. Such design features and safeguards typically include:

- a facility design that prevents hazardous events through the use of inherently safer designs; suitable materials of construction; operating and design limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;
- 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 emergency shutdown 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 and control equipment, firewater systems, and coordination with local first responders, to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

We believe 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. In addition, siting of the proposed facilities with regard to potential offsite consequences can further minimize impacts on public safety. The DOT's regulations in 49 CFR 193, Subpart B also requires an additional mitigative safeguard by excluding the public from certain hazards as determined by a siting analysis performed by National Grid as discussed in section 2.8.5.

As part of its application, National Grid provided a front-end-engineering-design (FEED) for the Project. We used this information to assess the safety of the Project. The objectives of our FEED review focused on the engineering design and safety concepts of the various protection layers, as well as the projected operational reliability of the proposed facilities.

Process Design Review

Per previous discussion, National Grid would have various pretreatment, liquefaction, and associated facilities with this Project. The failure of that equipment could pose potential harm if not properly safeguarded through the use of appropriate controls and operation. National Grid selected the use of nitrogen as the refrigerant for the liquefaction process, which is an inherently safer design than the use of flammable refrigerants such as ethylene, propane, butane, etc.

In developing the FEED, National Grid conducted a hazard identification study of the preliminary process design to identify potential risk scenarios. This study identified potential hazards for the process area, operating area, and adjacent spaces and considered the consequences of these hazards. The study also identified the safeguards that would be in place to prevent or mitigate the hazard and proposed recommendations as needed to eliminate, prevent, control, or mitigate the hazards. A more detailed and thorough hazard and operability review (HAZOP) analysis would be performed by National Grid during the final design phase to identify the major hazards that may be encountered during the operation of facilities. The HAZOP study would be intended to address hazards of the process, engineering and administrative controls and would provide a qualitative evaluation of a range of possible safety, health, and environmental effects that may result from the design or operation of the facilities. Recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review. We have included a recommendation that National Grid should file the HAZOP study on the completed final design. We would monitor resolutions of the recommendations generated by the HAZOP review. Once the design has been subjected to a HAZOP review, the design development team tracks changes in the facility design, operations, documentation, and personnel. National Grid would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled based on the company's change management procedures. We have included a recommendation for National Grid to file all changes to its FEED, regardless of origination, for our review and approval. However, major modifications could require an amended filing or new FERC proceeding.

National Grid 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. National Grid would develop facility operation procedures after completion of the final design; this timing is fully consistent with accepted industry practice. National Grid would design its 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 have made recommendations for National Grid to provide more information on the operating and maintenance procedures as they are developed, including safety procedures, hot work procedures and permits, abnormal operating conditions procedures, and personnel training. In addition, we have recommended measures such as labeling of instrumentation and valves, piping, and equipment and car-seals/locks to address human factor considerations and improve facility safety. An alarm management program in accordance with ISA Standard 18.2 would also be in place to ensure the effectiveness of the alarms.

In the event of a process deviation, emergency shutdown valves and instrumentation would be installed to monitor, alarm, shut down, and isolate equipment and piping during process upsets or other emergency conditions. The plant would have plant-wide emergency shutdown and individual process unit shutdown capabilities. Safety-instrumented systems would comply with ISA Standard 84.01 and other recommended and generally accepted good engineering practices. We also made recommendations on the final design, installation, and commissioning of instrumentation and emergency shutdown equipment to ensure appropriate cause-and-effect alarm or shutdown logic and enhanced representation of the emergency shutdown valves in the facility control system.

Mechanical Design Review

The design specifies materials of construction and ratings suited to the pressure and temperature conditions of the process design. Piping would be designed, fabricated, assembled, erected, inspected, examined, and tested in accordance with the American Society of Mechanical Engineers (ASME) Standards B31.3, B31.5, B36.10, and B36.19. Pressure vessels would be designed and fabricated in accordance with the 2013 edition of the ASME Boiler and Pressure Vessel Code (BPVC) Section VIII and testing (i.e., use of pressure test factors) would be in accordance with the 1992 edition of the ASME BPVC. Based on consultation between National Grid and DOT Pipeline and Hazardous Materials Safety Administration (PHMSA), PHSMA determined that National Grid's proposed use of ASME BPVC Section VIII would be acceptable based on preliminary findings of a research study comparing the 1992 version of ASME to newer versions[22]. However, in very limited cases, using a combination of the 2013 and 1992 editions can result in overstressing of a vessel. Therefore, we have included a recommendation for National Grid to provide the procedures for pressure/leak tests which address the requirements of ASME BPVC Section VIII to assure this does not occur and to ensure that their procedures are done safely and meet code and recommended and generally accepted good engineering practices. Low-pressure storage tanks would be designed in accordance with the API Standard 650. Heat

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[22] For a description of the preliminary findings, see "ASME BPVC Devlopments," dated November 16 and 17, 2016 at https://primis.phmsa.dot.gov/rd/mtg_111616.htm.

exchangers would be designed to ASME BPVC Section VIII standards; API Standard 661; and the Tubular Exchanger Manufacturers Association standards. Rotating equipment would be designed to standards and recommended practices, such as API Standards 610, 613, 614, 617, 618, 619, 670, 671, 672, 675, 682, and 686; and ASME Standards B73.1 and B73.2. Valves would be designed to standards and recommended practices such as API Standards 589, 594, 598, 600, 602, 607, and 609; ASME Standards B16.5, B16.10, B16.20, B16.25, and B16.34; and ISA Standards 75.01.01, 75.08.01, and 75.08.05.

Pressure and vacuum safety relief valves and vents would be installed to protect the storage containers, process equipment, and piping. The safety relief valves would be designed to handle process upsets and thermal expansion within piping, per National Fire Protection Association (NFPA) 59A (2001 edition) and ASME Section VIII; and would be designed in accordance with API Standards 520, 521, 526 and 527 (2000 requirements); ASME Standards B31.3 and B31.5; and other recommended and generally accepted good engineering practices. In addition, we made recommendations to ensure that the design and installation of pressure and vacuum relief devices are adequate.

Hazard Mitigation Design Review

If operational control of the facilities were lost and operational controls and emergency shutdown system failed to maintain the Project within the design limits of the piping, containers, and safety relief valves, a release could potentially occur. However, as required by 49 CFR 193 through NFPA 59A (2001 edition) section 9.1.2, fire protection must be provided for all LNG 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.

To satisfy these requirements, National Grid performed a preliminary fire protection evaluation that serves as a basis to ensure adequate mitigation would be in place, including spill containment and spacing, hazard detection, emergency shutdown and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response. We have made recommendations for National Grid to provide a final fire protection evaluation and more information on the final design, installation, and commissioning of spill containment, hazard detection, hazard control, and firewater systems as National Grid would further develop this information during the final design phase.

Spill Containment, Spacing and Ignition Controls

In the event of a release, the sloped areas at the base of storage and 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. The spacing of vessels and equipment between each other, from ignition sources, and to the property line would meet the requirements of NFPA Standards 30 and 59A (2001 edition) as referenced in 49 CFR 193.2401. We evaluated the adequacy of the spill containment conveyance system flows and total volume to handle a full spectrum of releases based on the FEED. In addition, we have recommended additional information on final design of these systems where details are yet to be determined and final design could change as a result of these details or other changes in the final design of the Project.

Project areas would be designated with a hazardous electrical classification and process seals in accordance with NFPA 59A, 70, 497, and API 500. Depending on the risk level, these areas would either be classified as non-classified, Class 1 Division 1, or Class 1 Division 2. In addition, equipment 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. We have included a recommendation for National Grid to provide for our approval the final design of the electrical area classification for the Project facilities.

Hazard Detection, Emergency Shutdown and Depressurization Systems

National Grid would also install hazard detection systems to detect cryogenic spills, flammable and toxic vapors, and fires. The hazard detection systems would alarm and notify personnel in the area and control room to initiate an emergency shutdown, depressurization, or initiate other appropriate procedures, and would meet NFPA Standard 72, ISA Standard 12.13, and other recommended and generally accepted good engineering practices. We evaluated the adequacy of the general hazard detection type and coverage to detect cryogenic spills, flammable and toxic vapors, and fires as well as the related cause and effect matrices that would initiate an alarm, shutdown, depressurization, or other action based on the FEED. In addition, we have recommended additional information on final design of these systems where details are yet to be determined (e.g., manufacturer and model, elevations, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project.

Hazard Control

If ignition of flammable vapors occurred, hazard control devices would be installed to extinguish or control incipient releases and fires, and would meet NFPA 59A; NFPA 10, 11, 12, 13, 15, 17, and 2001; API 2510A; as well as other recommended and generally accepted good engineering practices. We verified the adequacy of the number and availability of handheld, wheeled, and fixed fire extinguishing devices throughout the site based on the FEED. In addition, we have recommended additional information on final design of these systems where details are yet to be determined (e.g., travel distances, 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.

Structural Fire Protection

If a fire could not be separated, controlled, or extinguished to limit fire exposures to insignificant levels, structural fire protection would be provided to prevent failure of structural supports of equipment and pipe racks. The structural fire protection would comply with NFPA 59A (2001 edition) and other recommended and generally accepted good engineering practices. Based on the FEED, we verified all pressure vessels and structural supports to facilities within 3,000 British thermal units per hour per square foot radiant heat zone from pool fires with durations that could result in failures[23] and that they would be specified in accordance with recommended and generally accepted good engineering practices with a fire protection rating of a commensurate fire exposure and duration or higher. In addition, we have recommended additional information on final design of these systems 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.

Firewater Systems

National Grid would also provide firewater systems, including monitors for use during an emergency to better disperse or control flammable or toxic vapors and to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire, and would meet NFPA 59A, 13, 14, 15, 20, 22, 24, 25, 30, 37, 750, and 1961 requirements. Based on the FEED, we evaluated the adequacy of the general firewater system coverage from hydrants, hose wheels, fixed and automatic monitors, fixed deluge systems, and sprinklers, and verified the appropriateness of the associated demands of those devices and worst case fire scenarios to size the firewater pumps and judge whether the firewater source or onsite storage volume was appropriate. In addition, we have recommended additional information on final design of these systems 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.

Onsite and Offsite Emergency Response Plans

National Grid would also update its existing emergency procedures to include the Project, as required by 49 CFR 193. The emergency procedures would provide for protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the facility. We evaluated a draft of the emergency response procedures to assure that it would be incorporated to cover the new hazards associated with the Project appropriately. In addition, we have recommended additional information on development and final updated emergency response plans.

Geotechnical and Structural Design Review

FERC staf evaluated National Grid's geotechnical and structural design information to ensure the site preparation and foundation designs are appropriate for the underlying 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 to be resilient 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.

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[23] Pool fires from impoundments are generally mitigated through use of emergency shutdowns, depressuzation 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.

Geotechnical Evaluation

As required by NFPA 59A (2001 edition) section 2.1.4, National Grid provided a geotechnical report that evaluated the existing soil site conditions and proposed foundation design for the Project. Weidlinger Associates, Inc. (Weidlinger) performed four soil borings and four seismic cone penetrometers tests, in addition to subsurface explorations for previous construction and environmental investigations, ranging from 51 feet to 101 feet below existing grade. Weidlinger performed classification tests (water content, Atterberg limit tests, sieve tets), compression tests, triaxial tests, and corrosion potential tests (pH, electrical resistivity). We reviewed the adequacy in the number, coverage, and results of the geotechnical borings, seismic cone penetrometers tests, laboratory tests, in addition to previous studies, and found them to adequately cover all major facilities.

The existing site has an elevation that ranges between 10 to 12 feet (NAVD 88). The top 6 inches of the existing site are gravel. The ground water table is located approximately 2 to 3 feet above sea level or approximately 10 feet below the existing ground surface. The design of the Project facilities indicates the site would be raised from an elevation of 10 to 12 feet (NAVD 88) to an elevation of 21 feet (NAVD 88) to accommodate potential storm surge as discussed in more detail later. National Grid anticipates placing 22,000 cubic yards of fill within the site in order to achieve this elevation. The fill would be placed in lifts specified in the Geotechnical Engineering Report and compacted to the values specified (92 to 95 percent modified proctor [ASTM D698] depending on location).

Based on the test borings conducted, the site is composed of approximately 10 to 20 feet of sand and gravel fill, with various amounts of concrete, brick, and other debris. The fill is underlain by silty organic deposits from 12 to 83 feet below the ground surface. Some borings indicate the presence of traces of peat within this layer. The thickness of the organics increases from south to north across the site. The organic silt transitions to a stiff clay organic clay in some locations near the bottom of the stratum. Medium dense to very dense sands and silts underlie the organic soils.

Because of the subsurface conditions and expected settlements, the existing and added fill soil materials at the Project site are not suitable for the support of a majority of the structures. It is anticipated that significant settlement of up to 18 inches would occur during site filling. Therefore, National Grid is proposing to drive either displacement-type concrete piles or closed-ended steel pile piles to support the majority of foundations and micro-piles through buried foundations of pre-existing structures where driving piles is not feasible. The piles are to be embedded between 15 and 40 feet into the widely graded sand layer, depend on the type of pile selected. Downdrag forces on the piles will be significant due the settlement of the organic layers. Pile capacities and embedment lengths will consider the working capacity to be allowable capacity (factor of safety of 2) less the downdrag forces and thus represent the capacity available for the support of the foundations and structures.

The foundation for one pre-existing structure in the fill zone, the gas holder, would be left in place to support foundations for the electrical switchgear building, the outdoor substation building and transformers. These structures are not considered sensitive to settlement and are not LNG process equipment. Based on historical information from the site, the static load that was imposed by the gas holder is estimated at 2,000 pound per square foot, which is approximately equal to the load from the fill and the static (i.e., dead and live loads) of the structures to be founded over portions of the historical structure.

In areas not in the fill zone (i.e., within the containment berm for the existing storage tank, south of the process area in the vicinity of the plant's trucking facilities, and west of the liquefaction plant in the area of an existing propane building), only lightly loaded structures and utilities are proposed. An existing industrial building would be demolished and the existing foundation would be used for the liquid nitrogen storage vessels and skid. Usage of the existing foundation is considered acceptable by National Grid because the pre-existing propane building is not located in the fill zone and the loads from the new equipment are less than those imposed by the demolished existing building. Other structures to be located in this area are lightly loaded and therefore expected to add little to the existing overburden and settlement is expected to be minimal (less than one inch) National Grid proposes that these structures be founded on shallow foundations. Even though only minimal settlement is anticipated, National Grid would include provisions in the design to allow for shimming of supports for utility runs. We evaluated this information and agree with National Grid's conclusion.

The proposed Project area is bounded by slopes down to the existing grade on the north, west and south sides and to the east by a slope to an access roadway which tie into the existing LNG storage tank containment berm. National Grid proposes to construct a 7 feet high by 150 feet long mechanically stabilized earthen wall along the southern edge of the site to provide room for process equipment. The slope of fill along the northern and southern edges is planned to be 1.5 feet horizontal to 1 foot vertical. This steep slope would likely require slope reinforcement based on recommendations by the geotechnical evaluation. For the northern edge, National Grid currently proposes to use a combination of existing below grade pile foundations and an addition of a driven piled area under the toe of the slope to minimize slope instability along the embankment.

Structural Evaluation

The Project facilities would be constructed to satisfy the design requirements of 49 CFR 193, NFPA 59A-2001, 2009 International Building Code and ASCE 7-05. For seismic design, the facility would be designed to satisfy the requirements of NFPA 59A-2006 and ASCE 7-05. These regulations and 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 from extreme events, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism. We evaluated the design basis for the environmental loads as described more fully for various hazards below. In addition, we recommend that the final design information and associated quality assurance and control procedures are completed as follows:

- **<u>Prior to construction of the final design</u>, National Grid should file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Rhode Island:**

  a. quality assurance and quality control procedures to be used for civil/structural design and construction;

b. site preparation drawing and specifications;

c. pile installation drawings and specifications;

d. seismic specifications for procured equipment prior to the issuing of requests for quotations;

e. LNG facility structures and foundation design drawings and calculations (including prefabricated and field-constructed structures); and

f. condition assessment evaluation of representative existing piles supporting pre-existing structure foundations.

- **<u>Prior to construction of the final design</u>, National Grid should specify fire protection systems, uninterruptable power supply, emergency power generators, emergency lighting, radio communications system, control valves, instrumentation, and shutdown systems associated with the LNG storage tanks and their isolation as Seismic Category I.**

Earthquakes, Tsunamis, and Seiche

Earthquakes and tsunamis have the potential to cause damage from the 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 as a result of ground motions are 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, National Grid 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). There are no Quaternary-aged faults identified in the database in near proximity to the Project (USGS, 2006b). While there are no faults identified near the site that would potentially be the epicenter of large ground motions, this does not mean that there is no risk of earthquakes causing ground motions that can impact the site as ground motions can be felt large distances away from an earthquake depending on number of factors.

The current seismic requirements for LNG facilities in DOT regulations under 49 CFR 193 incorporate, by reference, NFPA 59A-2001 and NFPA 59A-2006 for LNG storage tanks (which are not proposed and the existing LNG storage tank is not significantly altered as a result of this Project). NFPA 59A-2001 requires piping and equipment with cold contents (−20 °F or lower) to be designed dynamically for the operating basis earthquake (OBE) or statically 0.60 S_{DS} (maximum spectral acceleration of the design earthquake which equals 2/3 of the Maximum Considered Earthquake [MCE]) as specified in the National Earthquake Hazards Reduction

Program (NEHRP) Recommended Provisions. The OBE is defined as a seismic event with ground motion that has a 10 percent probability of exceedance within a 50-year period (a 475-year return period event) or as two-thirds of the maximum considered earthquake, MCE. The MCE ground motions are defined as having a 2 percent probability of exceedance within a 50-year period, or a 2,475 year mean return period. NFPA 59A-2001, Appendix B.5.2, refers seismic design for the remainder of the LNG facilities to NEHRP Recommended Provisions, but these are in non-mandatory Appendix B. We also recognize the current FERC regulations under 18 CFR 380.12(h)(5) continues 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, we recommend that other LNG project structures classified as Seismic Category II or Category III be seismically designed to satisfy the seismic requirement of the American Society of Civil Engineers (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 adopted into NFPA 59A-2006 and is a complete American National Standards Institute consensus design standard, its seismic requirements are based directly on the NEHRP Recommended Provisions, and it is referenced directly by the International Building Code (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 NEHRP Recommended Provisions are not. National Grid proposes to satisfy the seismic design requirements provided in 2009 IBC and ASCE 7-05 including the design earthquake (DE) ground motions specified in ASCE 7-05. In ASCE 7, the DE ground motions are defined as two-thirds of the MCE ground motions. The facility would also be designed to withstand aftershock level earthquakes, which is assumed as one-half Safe Shutdown Earthquake (SSE) in accordance with NFPA 59A (2013 and 2016 edition).

Golder Associates performed a site-specific seismic hazard study for the site. The study concluded that the site would have an OBE peak ground acceleration of 0.079 g, a SSE peak ground acceleration of 0.187 g, a 0.2-second spectral acceleration value of 0.468 g, and a 1.0-second spectral acceleration at the site of 0.171 g. Based on ASCE 7-05, the DE ground motion parameters are calculated as two-thirds the ground motion parameters of the SSE, resulting in S_{DS}=0.312 g and S_{D1}=0.114. Based on the DE ground motions for the site and the importance of the facility, the facility seismic design is assigned Seismic Design Category C in accordance with the 2009 IBC and ASCE 7-05.

The geotechnical investigations of the existing site performed by Weidlinger Associates indicated the presence of more than a 10 foot layer of organic material, which is characterized as Site Class F[24] in accordance ASCE 7-05 and IBC (2012), which are incorporated into 49 CFR 193 and the Rhode Island Building Code. However, downhole shear wave velocity tests performed by Golder Associates at the site measured average shear velocities of 692 and 806 feet per second

[24] 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).

which are indicative of Site Class D. For purposes of determining seismic design ground motions, National Grid has elected to conservatively classify the site as Site Class F which satisfies the Rhode Island Building Code. This conservative assumption is important as soft soil can amplify surface ground motions by a factor of two or more. Therefore, while the seismic risk in Rhode Island is generally low, it is more significant on soft soil sites where the risk is considered moderate. As a result of the moderate risk, we recommend a special inspector be provided to inspect construction of the Project facilities and that reports on the construction and inspection of the Project are provided to us for review as follows:

- **National Grid should employ a special inspector during construction, and a copy of the special inspector's reports should be included in the <u>monthly</u> status reports filed with the Secretary. The special inspector should be responsible for:**

  a. observing the construction of the liquefaction facility to be certain it conforms to the design drawings and specifications;

  b. furnishing inspection reports to the engineer- or architect-of record and other designated persons. All discrepancies should be brought to the immediate attention of the contractor for correction, then if uncorrected, to the engineer- or architect-of-record; and

  c. submitting a final signed report stating whether the work requiring special inspection was, to the best of his/her knowledge, in conformance with the approved plans and specifications and the applicable workmanship provisions.

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) 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. In their Geotechnical Engineering Report, Weidlinger Associates concludes that the soil at the site is not considered to be liquefaction susceptible based on grain size and density of the soil. Since the soil conditions necessary for liquefaction to occur would not be present at the at the Project area and the potential for a seismic event that would cause strong and prolonged ground shaking is low, the potential for soil liquefaction to occur at the site is considered very low.

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. Due to the low probability and historical record of seismic events in the Project area and lack of volcanic activity or conditions for landslides (discussed in more detail later), tsunamis and seiches are not anticipated to have an effect on the Project.

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, National Grid 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.

In accordance with DOT regulations under 49 CFR 193.2067, all LNG facilities, including vapor barriers, must withstand a sustained wind speed of 150 mph or winds that have 0.5 percent probability of being exceeded in 50 years (10,000-year mean return interval) unless they are shop fabricated containers of LNG or other hazardous fluids less than 70,000 gal. National Grid indicated that they would design the Project facilities to withstand the sustained wind speed of 150 mph. We evaluated this proposed wind speed against historical events and the 1 in 10,000 year event alternative requirement as well as the 1,700 year event required by ASCE 7-10 and ASCE 7-16 for Risk Category IV requirements for shop fabricated containers less than 70,000 gal using various wind gust conversion factors for use in structural codes that use a 3-second gust value. Specifically, we estimated a 150-mph sustained wind speed would correspond to a 183-mph 3-second gust using the Durst Curve in ASCE 7-05 and a 185-mph 3-second gust using a 1.23 gust factor for onshore winds at a coast line recommended in World Meteorological Organization, *Guidelines for Converting between Various Wind Averaging Periods in Tropical Cyclone Conditions*. These wind speeds are equivalent to approximately a 53,000-year mean return interval or 0.09 percent probability of exceedance in a 50-year period for the site, based on ASCE 7-05 wind speed return period conversions. Therefore, this would meet regulations and provide a resilient design.

In addition, Rhode Island has been subjected to three hurricanes greater than Category 2[25] since 1851, including the 1938 Hurricane (Category 3), Hurricane Carol in 1954 (Category 3), and Hurricane Bob in 1991 (Category 2) (NOAA, 2016). Providence suffered extensive damage during the 1938 Hurricane and Hurricane Carol when, in each instance, where sustained wind speeds would have been between 111 mph and 129 mph, and water depths of up to 8 feet were reported in the city's commercial area (U.S. Army Corps of Engineers, 2016). The proposed design would have been able to withstand these historical event wind speeds and flood levels as described more fully below.

Potential flood levels may also be informed from the FEMA Flood Insurance Rate Maps, which identifies 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 moderate flood hazard areas that have a 0.2 percent probability of exceedance in 1 year to flood (or a 500 year mean return interval). According to the FEMA National Flood Hazard Layer, portions of the Project site would be located in the 100-year and 500-year floodplain (FEMA, 2016). In addition, according to FEMA flood hazard maps (2016), the 100-year flood elevation at the site is 12 feet (NAVD 88) and the 500-year flood elevation is 19 feet (NAVD 88).

National Grid conducted a Coastal and Hydraulic Modeling Analysis to determine the height increase associated with wind driven wave effects and from sea level rise at the Project site

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[25] Hurricane Saffir-Simpson Category 5 >156 mph sustained, >195 mph 3-second gust, Category 4 130-156 mph sustained, 166-195 mph 3-second gust, Category 3 111-129 mph sustained, 141-165 mph 3-second gust, Category 2 96-110 mph sustained, 117-140 mph 3-second gust, Category 1 74-95 mph sustained, 91-116 mph 3-second gust.

during the expected life of the liquefaction facility. The study concluded wave heights would be approximately 2.9 feet for the 100-year storm and 3.9 feet for the 500-year storm and sea level rise would be approximately 11 inches (0.9 feet) over the 30 year design life of the facility. Adding the Project anticipated 500-year still water elevation level (SWEL) of 19 feet and sea level rise of 0.9 feet would equal an elevation of 19.9 feet (NAVD 88) of potential flood depth and adding 3.9 feet caused by 500-year wave effects results in a total elevation of 23.8 feet (NAVD 88) in areas exposed to waves. In addition to a minimum elevation of 21ft NAVD88 for the equipment on site, National Grid would have armored revetment along the northern portion of the site and anchored jersey barrier walls located on top of the revetwment adjacent to a road that would sit atop the berm. The top of the jersey barriers would be at 22.75 feet in elevation NAVD88. This would be above the SWEL and projected seal level rise, but below the elevation when also considering wave crest heights. To analyze the site from wave overtopping, National Grid conducted a wave analysis that demonstrated the north side of the site to be most prone to be exposed to high wave elevations, but that the use of armored revetment and anchored jersey barriers would dissipate the waves to within 30 feet from the top edge of the revetment. National Grid would not have any equipment within this 30 feet and provided the foundation and setbacks for critical equipment that demonstrated they would not be affected by the waves.

Code requirements provided by DOT regulations and its primary reference document NFPA 59A-2001 require that LNG facilities be designed to withstand a 100-year flood event. In hearings with CRMC in late 2016, National Grid agreed to design the facility to withstand a 100-year flood event in conjunction with a 30 year design life sea level rise of 1.57 feet sea level rise (anticipated to occur in the year 2050) and wind driven wave effects. This means that the facility is required to be designed to with a 100 year flood elevation of 13.57 feet plus wind driven wave effects. We recognize that a 500 year flood event has been recommended as the basis of design for critical infrastructure in publications, including ASCE 24. Therefore, we believe it is good practice to design critical energy infrastructure to withstand 500 year event from a safety and reliability standpoint. National Grid, on a voluntary basis, has elected to design the Project to withstand a 500-year flood event, which would exceed the DOT federal regulations and CRMC requirements. Furthermore, we believe the use of intermediate values for sea level rise 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.

The Rhode Island CRMC filed a comment stating that using CRMC's methodology based on NOAA's 2012 high curve for Newport, Rhode Island, the sea level rise would be approximately 1.57 feet, which would equal a total elevation of 20.57 feet (NAVD 88) if using a 500-year SWEL and a total elevation of 24.47 feet (NAVD 88) if also using a 500-year wave crest elevation. While the CRMC's estimate for sea level rise is more conservative, the value of Providence would seem more appropriate for the Project site in lieu of Newport, and the CRMC also only requires a 100-

[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.

year storm surge elevation, which is less conservative than the 500-year SWEL and 11 inches (0.9 ft) of sea level rise. The 11 inches (0.9 feet) proposed by National Grid is within the range of NOAA's 2012 intermediate low and intermediate high projected sea level rise for Providence from 2020 to 2050 of 0.786 feet and 1.294 feet, respectively, and close to NOAA's 2017 intermediate curve value rise of 1.01 feet.[27] Therefore, we agree with National Grid's proposal based on the revetment and jersey barriers along with the proposed site and equipment elevations and locations that protect it from the 500-year SWEL and waves and projected sea level rise of 11 inches. However, in recognition of the uncertainties in respect to water levels, wave conditions, and future settlement, sea level, and subsidence changes, and the potential for the Project to operate more than a 30-year period, **we recommend that:**

- **Prior to commencement of service, National Grid should file with the Secretary a surface maintenance plan for perimeter berm, stamped and sealed by the professional engineer-of-record, registered in Rhode Island. The surface maintenance plan should include procedures to ensure the crest elevation relative to mean sea level would be maintained for the life of the facility considering berm settlement, subsidence, and sea level rise.**

Landslides and other Natural Hazards

Landslides involve the down slope movement of earth materials under a force of gravity due to natural or man-made causes. The Project is located in a gently sloping, developed area considered to have a low incidence of, and low susceptibility to, landslides (Godt, 1997) from adjacent areas. The proposed liquefaction facilities would be located primarily on a new fill zone of between 9 and 11 feet thick. The edges of this fill zone may have lateral slope stability issues unless reinforced. As previously discussed, the edges of this fill zone would be sloped with reinforcement at the toe of the slope to minimize lateral slope instability.

External Impact Evaluation

Transportation and other land uses and activities within, adjacent, and nearby the site may have the potential to cause damage or failure of facilities through external impacts with the Project facilities. To assess the potential impact from these external events, National Grid evaluated transportation routes and land use and activities within and surrounding the Project site and the safeguards in place to mitigate such events as described below.

Air

The closest airport to the National Grid project site is the T.F. Green Airport, which is approximately 5.6 miles away. Since the proposed facilities do not include equipment taller than 200 feet, the regulations in 14 CFR 77 do not require National Grid to provide notice to the FAA of its proposed construction as the distance of the facilities being greater than 20,000 feet and less than 200 feet in height are presumed to not be a hazard to aircraft by the FAA.

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[27] Sea-Level Change Curve Calculator (2017.55), United States Army Corps of Engineers, http://corpsclimate.us/ccaceslcurves.cfm.

Adjacent Land Use

The existing National Grid site is located in an industrial area adjacent to several chemical and petroleum storage facilities. We received comments that this Project would increase the risk to and from these facilities. These facilities are existing and regulated under EPA Risk Management Program (RMP) regulations. The EPA RMP regulations require certain hazard distances to be calculated and a risk management plan to be developed commensurate with those consequences. We evaluated the consequences from these adjacent land uses based on EPA RMP hazard distances and found that the existing adjacent facilities would not significantly increase the risk to the National Grid site or public beyond those that currently exist. In addition, the new National Grid Project facilities would be located within National Grid existing site and based on the hazard analyses discussed below in section 2.8.5, the new facilities would not significantly increase the risk to adjacent facilities from the National Grid site. The existing National Grid emergency response plans also addresses the need to coordinate with the local emergency response office in charge on the decision to evacuate areas around and outside of the plant.

Security Design Review

In order to minimize the risk of an intentional event, National Grid would update its existing security fencing, gates, lighting, camera systems, and instruction detection to deter, monitor, and detect intruders into the facility. We evaluated drawings reflecting these updates to determine if the facilities would be fully enclosed by a protective barriers with controlled access and that there was adequate number of lights and coverage of cameras and intrusion detection. In addition, we have recommended National Grid provide any revisions to their existing facility security plans for review and approval.

Final Design Review

As a result of the technical review of the FEED information provided by National Grid in the submittal documents, we issued a number of clarifications and justifications in information request letters issued on August 29, 2016; March 10, April 4, and October 13, 2017; February 12 and 27, 2018; March 27, 2018; and April 30, 2018, relating to the civil/structural aspects, reliability, operability, and safety of the proposed design. National Grid provided written responses to the August 29, 2016 information request on September 16, 23, 26, and 30; October 21, 24, and 26; and November 2, 3, 8, 23, 28, and 29, 2016. In addition, National Grid provided written responses to the March 10, 2017 information request on March 16, 2017, and written responses to the April 4, 2017 information request on May 12 and June 9, 2017. Written responses to the October 13, 2017 information request were provided on October 30, November 13 and 30, and December 7, 2017; and January 11, 18, and 23, 2018. Written responses to the February 12, 2018 information request was provided on February 15, 2018; written responses to the February 27, 2018 information request were filed on March 9, 2018; written responses to the March 27, 2018 information request were filed on April 16, 2018; and written response to the April 30, 2018 information request was filed on May 4, 2018. Some of these responses indicated that National Grid would correct or modify its design in order to address issues raised in the information request. As a result, we included a recommendation in this section for the company to file final design information on those items.

The FEED and specifications submitted for the proposed facilities to date are preliminary but would serve as the basis for any detailed design to follow. If authorization is granted by the Commission, the next phase of the Project would include development of the final design, including final selection of equipment manufacturers, process conditions, and resolution of some safety-related issues. We do not expect that the more detailed final design information would result in changes to the basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs that were presented as part of the FEED. However, we have made a number of recommendations to ensure the final design details are captured and any changes of these are reviewed prior to implementation. Information regarding the development of the final design, as detailed below, would need to be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, before equipment construction at the site would be authorized. To ensure that the concerns we've identified relating to the reliability, operability, and safety of the proposed design are addressed by National Grid, and to ensure that the Project facilities are subject to the Commission's construction and operational inspection program, **we are recommending that the following measures should apply to this Project. 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 (Dec. 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>, National Grid should file an overall project schedule, which includes the proposed stages of the commissioning plan.**

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

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

- **<u>Prior to construction of the final design</u>, National Grid should file change logs that list and explain any changes made from the FEED provided in National Grid's application and filings. A list of all changes with an explanation for the design alteration should be filed and all changes should be clearly indicated on all diagrams and drawings.**

- **<u>Prior to construction of the final design</u>, National Grid should file information/revisions pertaining to National Grid's response numbers 8, 22, 33, 50, 54, 55, 64, and 67 of its September 16, 2017 filing; response numbers 9 and 114 of its September 23, 2016 filing; response number 71 of its September**

26, 2016 filing; response numbers 1 and 13 of its May 12, 2017 filing; response number 2 of its June 23, 2017 filing; response numbers 11, 12, 15, and 17 of its October 30, 2017 filing; response numbers 1, 3, 6, 10, and 11 of its March 9, 2018 filing; response number 2, 4, 6, 8, and 10 of its April 16, 2018 filing; and response number 1 of its May 4, 2018 filing, which indicated features to be included or considered in the final design.

- **Prior to construction of the final design, National Grid should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.**

- **Prior to construction of the final design, National Grid should file an up-to-date complete equipment list, process and mechanical data sheets, and specifications.**

- **Prior to construction of the final design, National Grid should file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.**

- **Prior to construction of the final design, National Grid should file up-to-date Process Flow Diagrams with heat and material balances and one complete set of Piping and Instrumentation Diagrams (P&IDs), which include the following information:**

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

  b. equipment insulation type and thickness;

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

  d. piping with line number, piping class specification, size, and insulation type and thickness;

  e. piping specification breaks and insulation limits;

  f. all control and manual valves numbered;

  g. relief valves with size and set points; and

  h. drawing revision number and date.

- **Prior to construction of the final design, National Grid should file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect the Project to the existing LNG facility.**

- **Prior to construction of the final design, National Grid should file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs.**

- **Prior to construction of the final design, National Grid should file a hazard and operability review of the completed design prior to issuing the P&IDs for**

construction. A list of recommendations resulting from its review and actions taken on the recommendations should also be included.

- **<u>Prior to construction of the final design</u>, National Grid should file the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. 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 the final design</u>, National Grid 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 the final design</u>, National Grid should specify that piping specifications for stainless steel piping capable of operating at cryogenic temperatures should require the inner and outer ring of spiral wound gaskets to be stainless steel.**

- **<u>Prior to construction of the final design</u>, National Grid should file the sizing basis and capacity for the final design of the vent stack as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.**

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

- **<u>Prior to construction of the final design</u>, National Grid 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 (2001 edition).**

- **<u>Prior to construction of the final design</u>, National Grid 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 the final design</u>, National Grid should provide a means to remove mercury as part of the design to limit concentrations to less than 0.01 micrograms per normal cubic meter or alternatively provide monitoring for mercury by means of an analyzer or preventative maintenance inspections of the heat exchangers and connections for a mercury removal package.**

- **<u>Prior to construction of the final design</u>, National Grid should include provisions in the facility plot plan for the possible future installment of a mercury removal system.**

- **<u>Prior to construction of the final design</u>, National Grid should file procedures and a method to monitor the LNG density from the liquefaction process facilities to the existing LNG storage tank to aide in the selection of top or bottom fill of the tank and to prevent tank rollover.**

- **<u>Prior to construction of the final design</u>, National Grid should file the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3, as required by 49 CFR 193.**

- **<u>Prior to construction of the final design</u>, National Grid 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 required by 49 CFR 193, 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 construction of the final design</u>, National Grid should file an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A (2001 edition), Chapter 9.1.2 as required by 49 CFR 193. A list of recommendations resulting from its review and actions taken on the recommendations should also be included.**

- **<u>Prior to construction of the final design</u>, National Grid should specify that all emergency shutdown valves are to be equipped with open and closed position switches connected to the Distributed Control System /Safety Instrumented System.**

- **<u>Prior to construction of the final design</u>, National Grid 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 the final design</u>, National Grid should file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments.**

- **<u>Prior to construction of the final design</u>, National Grid should file a revised spill conveyance and sump box design that would prevent spills from reaching the cold box and compander foundation.**

- **<u>Prior to construction of the final design</u>, National Grid should demonstrate how an LNG spill from the LNG liquefaction rundown line would be safely**

transferred from the elevated diversion tray to the grade-level liquefaction area trench system and also into the trench system to the existing LNG storage tank containment sump.

- **Prior to construction of the final design, National Grid should provide an evaluation of how its impoundment rainwater removal systems complies with 49 CFR 193.2173 with concurrence from PHMSA or how it provides an equivalent level of safety with concurrence from PHMSA.**

- **Prior to construction of the final design, National Grid 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. In addition, National Grid should include in the final design oxygen sensors to be installed in the liquid nitrogen storage area.**

- **Prior to construction of the final design, National Grid should file a technical review of its proposed facility design that:**

  a. **identifies all combustion/ventilation air intake for equipment and buildings and the distances to any possible hazardous fluid release (LNG, flammable refrigerants, flammable liquids, and flammable gases); 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 ventilation equipment whose continued operation could add to or sustain an emergency.**

- **Prior to construction of the final design, National Grid should file complete plan drawings and a list of the fixed and wheeled, dry-chemical, and hand-held fire extinguishers, and other hazard control equipment. Drawings should clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list should include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units.**

- **Prior to construction of the final design, National Grid should file facility plans and drawings that show the location of the firewater and foam systems. Plan drawings should clearly show the planned 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 system.**

- **Prior to construction of the final design, National Grid 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 Distributed Control System and recorded. The firewater main header pressure transmitter should also be connected to the Distributed Control System and recorded.

- **<u>Prior to construction of the final design</u>, National Grid should specify that it will install a minimum of two firewater jockey pumps.**

- **<u>Prior to construction of the final design</u>, National Grid should certify that the final design is consistent with the information provided to the DOT as described in the design spill determination letter dated June 28, 2017 (Accession Number 20170628-4002). In the event that any modification to the design alters the candidate design spills on which the 49 CFR 193 siting analysis was based, National Grid should consult with the DOT on any actions necessary to comply with Part 193.**

- **<u>Prior to construction of the final design</u>, National Grid should file the final design details of the pipe shrouding that demonstrates how the shroud design accounts the mechanical forces from a release at maximum pressures and thermal stresses and shock from sudden cryogenic temperatures of a LNG release. In addition, the final design should consider the installation of the pipe shrouding to ensure that operation and maintenance of equipment and valves is not impacted.**

- **<u>Prior to construction of the final design</u>, National Grid should file procedures to maintain and inspect the vapor barriers provided to meet the siting provisions of 49 CFR 193.2059.**

- **<u>Prior to commissioning</u>, National Grid should file an updated emergency procedures to include the Project facilities as well as instructions to handle onsite emergencies related to the hazardous project fluids.**

- **<u>Prior to commissioning</u>, National Grid 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. National Grid 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.**

- **<u>Prior to commissioning</u>, National Grid should file plans and detailed procedures for testing the integrity of onsite mechanical installation, functional tests, introduction of hazardous fluids, operational tests, and placing the equipment into service.**

- **<u>Prior to commissioning</u>, National Grid 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>, National Grid should file a tabulated list and drawings of the proposed hand-held fire extinguishers. The list should include the equipment tag number, extinguishing agent type, capacity, number, and location. The drawings should show the extinguishing agent type, capacity, and tag number of all hand-held fire extinguishers.**

- **<u>Prior to commissioning</u>, National Grid should file updates, addressing the Project facilities, in the existing operation and maintenance procedures and manuals, as well as safety procedures.**

- **<u>Prior to commissioning</u>, National Grid should provide a detailed training log that demonstrates all operating staff has completed required training.**

- **<u>Prior to introduction of hazardous fluids</u>, National Grid should file an evaluation on the snow volume allowance criteria for impoundments that demonstrates National Grid's assertion that a potential LNG spill would sink beneath the snow or provide snow removal procedures that include the new LNG Pump Loading Skid Sub-Containment Sump or include an adequate snow volume allowance with quantitative justification.**

- **<u>Prior to introduction of hazardous fluids</u>, National Grid should complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system.**

- **<u>Prior to introduction of hazardous fluids</u>, National Grid should complete 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 LNG production</u>, National Grid should receive written authorization from the Director of OEP. After producing LNG, National Grid 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 liquefaction train, LNG storage inventories in the storage tank, and anticipated and actual sendout volumes. 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 <u>within 24 hours</u>.

- **<u>Prior to commencement of service</u>, National Grid should update procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by National Grid staff.**

- **<u>Prior to commencement of service</u>, National Grid should label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001 edition).**

- **<u>Prior to commencement of service,</u> National Grid should notify the FERC staff of any proposed revisions to the security plan and physical security of the plant.**

In addition, **we are recommending that the following measures should apply <u>throughout the life</u> of the Project facilities:**

- **The facilities should be subject to regular FERC staff technical reviews and site inspections on at least a <u>biennial</u> basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, National Grid 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 piping and instrumentation diagrams 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;**

- **National Grid should report any design modifications and operating problems for the Project facilities in the <u>semi-annual</u> operational reports filed with the Secretary for the facility.**

- **<u>Semi-annual</u> operational reports should be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., liquefied and vaporized quantities, boil off/flash gas, number and volume of trucking, etc.); and plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to, 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 <u>within 45 days after each period ending June 30 and December 31</u>. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" 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 reporting 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 FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made <u>immediately</u>, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to FERC staff <u>within 24 hours</u>. This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids related incidents include:**

  a. **fire;**

  b. **explosion;**

  c. **estimated property damage of $50,000 or more;**

  d. **death or personal injury necessitating in-patient hospitalization;**

  e. **release of hazardous fluids for five minutes or more;**

  f. **unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;**

  g. **any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;**

  h. **any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;**

  i. **a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;**

  j. **inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;**

  k. **any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator),**

for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents to hazardous fluids 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 LNG facility to cease operations. Following the initial company notification, FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.**

In addition to the final design review, we would conduct inspections during construction and would review additional materials, including quality assurance and quality control plans, non-conformance reports, and cool down and commissioning plans, to ensure that the installed design would be consistent with the safety and operability characteristics of the FEED. We would also conduct inspections during operation to ensure that the Project facilities would be operated and maintained in accordance with the filed design throughout the life of the facilities. Based on our analysis and recommendations presented above, we conclude that the Project FEED would include acceptable layers of protection or safeguards which would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

2.8.5 Siting Requirements

The principal hazards associated with the Project result from cryogenic and flashing liquid releases; flammable and toxic vapor dispersion; vapor cloud ignition; pool fires; jet fires; BLEVEs; and overpressures. As discussed in section 2.8.4, our FEED review indicates that sufficient layers of protection would be incorporated into the facility design to mitigate the potential for an initiating event to develop into an incident that could impact the safety of the offsite public. Siting the facilities to ensure that the public impact would be minimized is also required by DOT's regulations in 49 CFR 193, Subpart B. The Commission's regulations under 18 CFR 380.12(o)(14) require National Grid to identify how the proposed design complies with the siting requirements of 49 CFR 193, Subpart B. As part of our review, we used National Grid's information, provided to show compliance with DOT's regulations, to assess whether or not the proposed facilities would have a public safety impact.

The requirements in 49 CFR 193 state that an operator or government agency must exercise control over the activities that can occur within an "exclusion zone," defined as the area around an LNG facility that could be exposed to specified levels of thermal radiation or flammable vapor in the event of a release of LNG or ignition of LNG vapors. Approved mathematical models must be used to calculate the dimensions of these exclusion zones. The siting requirements of the 2001 edition of NFPA 59A, a 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 Part 193 specifically address siting requirements for each LNG container and LNG transfer system:

- Section 193.2001, Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the marine vessel and the last manifold or valve immediately before a storage tank.

- 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).

The above LNG siting requirements would be applicable to the following Project facilities:

- all LNG facility piping, including the 4-inch-diameter LNG liquefaction rundown line;

- two 300-gpm truck loading LNG transfer pumps; and

- various LNG process vessels, exchangers, and other facilities.

National Grid indicated that the flow rates in the existing tank fill lines would not increase due to the proposed Project. Although it is not anticipated that tank filling would occur by way of simultaneous truck unloading plus liquefaction, the system is designed to allow for that, with a reduction of the two truck unloading rate equal to the liquefaction rate. National Grid would include a mechanism that would have a reliability equivalent to a safety integrity level of 2 that would limit the flow of LNG from truck unloading piping in order to not exceed the current maximum sustained flow rate in the LNG tank fill piping during periods of liquefaction. In addition, the existing truck transfer lines and hoses for the existing truck station are also not proposed to transfer at higher rates. For these reasons, these existing lines and hoses were not evaluated with regard to the above requirements. Also, the existing LNG tank has a bottom withdrawal line, for which a design spill would not change due to this Project.

We received comments from the public indicating that this Project should be denied for the same reasons the 2005 KeySpan import terminal project was denied by the Commission. However, the 2005 *KeySpan* decision involved a major modification to the historic operation of the existing LNG storage tank and represented "a significant modification to the historical mode of operation."[28] Here, by contrast, the proposed liquefaction Project would not modify the existing mode of operation of the storage tank. Furthermore, the proposed equipment has been designed to meet current federal safety regulations.

Previous FERC environmental assessments and impact statements for past projects have identified inconsistencies and areas of potential conflict between the requirements in Part 193 and NFPA 59A (2001). Sections 193.2057 and 193.2059 require exclusion zones for each LNG container and LNG transfer system. An LNG transfer system is defined in 193.2007 to include cargo transfer systems and transfer piping, and does not distinguish between permanent or temporary. However, NFPA 59A (2001) requires exclusion zones only for "transfer areas," which is defined as the part of the plant where the facility introduces or removes the liquids, such as truck loading or ship unloading areas. The NFPA 59A (2001) definition does not include permanent plant piping, such as cargo transfer lines.

The DOT has addressed some of these issues in a March 2010 letter of interpretation[29] (PHMSA Interpretation #PI-10-0020, Mar. 25, 2010). In that letter, DOT concluded that: (1) the requirements in the NFPA 59A (2001) for transfer areas for LNG apply to the marine cargo transfer system at a proposed waterfront LNG facility, except where preempted by the regulations in Part 193; (2) the regulations in Part 193 for LNG transfer systems conflict with NFPA 59A (2001) on whether an exclusion zone analysis is required for transfer piping or permanent plant piping; and (3) the regulations in Part 193 prevailed as a result of that conflict.

In FERC environmental assessments and impact statements for past projects, we have also noted that when the DOT incorporated NFPA 59A into its regulations, it removed the regulation that required impounding systems around transfer piping. As a result of that change, it is unclear whether Part 193 or the adopted sections of NFPA 59A (2001) require impoundments for LNG transfer systems. We note that Part 193 requires exclusion zones for LNG transfer systems and that those zones were historically calculated based on impoundment systems. We also believe that the omission of containment for transfer piping is not a sound engineering practice. For these reasons, we generally recommend containment for all LNG transfer piping within the plant's property lines.

As stated in section193.2051, LNG facilities must be provided with the siting requirements of NFPA 59A (2001). The siting requirements for flammable liquids within an LNG facility are contained in NFPA 59A, Chapter 2:

- NFPA 59A (2001) section 2.1.1 requires consideration of clearances between flammable refrigerant storage tanks, flammable liquid storage tanks, structures and plant equipment, both with respect to plant property lines and each other. This section also requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered,

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[28] *See* May 20, 2005 Environmental Impact Statement, Docket Nos. CP04-223-000, CP04-293-000, and Docket No. CP04-358-000, Executive Summary at ES-11 (KeySpan EIS) and FERC's July 5, 2005 *Order Denying Authorization Under Section 3 and Dismissing Certificate Application*.

[29] https://www.phmsa.dot.gov/regulations/title49/interp/PI-10-0020.

including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility.

- NFPA 59A (2001) section 2.2.2.2 requires impoundments serving flammable refrigerants or flammable liquids to contain a 10-minute spill of a single accidental leakage source or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the DOT. In addition, NFPA Section 2.2.2.5 requires impoundments and drainage channels for flammable liquid containment to conform to NFPA 30, *Flammable and Combustible Liquids Code*.

- NFPA 59A (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 cubic 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 are acceptable to DOT.

- NFPA 59A (2001) 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. Alternative models must have been validated by experimental test data appropriate for the hazard to be evaluated and must be acceptable to the DOT. NFPA 59A (2001) section 2.2.3.5 requires the design spill for impounding areas serving vaporization, process, and LNG transfer areas to be based on the flow from any single accidental leakage source.

The above siting requirements from 49 CFR 193 and NFPA 59A (2001) would be applicable to the following Project facilities:

- two 10,000-gallon liquid nitrogen storage tanks and associated piping and equipment;

- piping and equipment associated with the liquefaction train; and

- piping and equipment associated with the feed gas pre-treatment.

2.8.6 LNG Facility Siting Analysis

2.8.6.1 Impoundment Sizing

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 DOT.

We recommend that impoundments be sized based on the largest flow capacity from a single pipe for 10 minutes or the capacity of the largest vessel served, whichever is greater, while recognizing that different spill scenarios may be used for the single accidental leakage sources for the hazard calculations required by 49 CFR 193.

National Grid proposes to use both existing and new spill impoundments to contain potential process fluid spills from the proposed facilities. This new spill impoundment system, the existing spill impoundments, and their sizing spills are discussed below and shown in Figure 2.8.6-1.

Figure 2.8.6-1 Spill Impoundment Systems

A new LNG Pump Loading Skid Sub-Containment Sump would serve the new LNG truck loading pump area and would be located within the existing LNG Tank Containment Sump in the LNG storage containment area. Curbing and troughing, as well as shrouding on the suction and discharge piping of the LNG truck loading pumps, would be installed to direct a spill from the LNG truck loading pump skid area into this new sub-containment sump. This sub-containment sump would be 15 feet long by 15 feet wide and 11.5 feet deep below the bottom of the trench that directs liquid into it. These dimensions result in a volumetric capacity of approximately 19,356 gallons. National Grid would use an existing spare 10-inch tank withdrawal nozzle as the tie-in point for the new LNG truck loading pumps. National Grid would install a 4-inch orifice plate directly on the existing 10-inch withdrawal nozzle to ensure that a potential spill from this new piping would be limited to the release rate from a full rupture of the 4-inch-diameter LNG truck loading pump suction line which would equal approximately 18,255 gallons including associated piping inventory. Furthermore, National Grid also stated that the existing spare 10-inch tank nozzle currently has an existing internal tank shutoff valve that is part of the emergency shutdown system and, as part of the final design, an additional emergency shutdown valve would be installed at the interface between the 10-inch withdrawal nozzle and the new 4-inch-diameter suction line for the new LNG truck loading pumps. Based on the proposed design, the new LNG Pump Loading Skid Sub-Containment Sump would contain a 10-minute release from the 4-inch-diameter LNG truck loading pump suction line.

Potential spills from the liquefaction areas would be directed by sloped curbing and troughs to the existing Truck Loading Sump, which is 21.5 feet long by 21 feet wide and 7 feet deep, having a volumetric capacity of approximately 23,500 gallons. This existing sump would contain a 10-minute release from the 4-inch-diameter LNG liquefaction rundown line, which is the line that would provide the greatest liquid flow rate that could drain to this sump. National Grid indicates that this scenario flow rate would release 1,680 gallons of LNG during maximum liquefaction production, plus up to approximately 450 gallons of LNG piping de-inventory, which totals 2,130 gallons.

Spills occurring from the LNG liquefaction rundown line located within the liquefaction process area would flow to the existing Truck Loading Sump. These spills would first be directed to the sloped and curbed Cold Box and Compander Foundation Collection Basin by concrete troughs that are a minimum of 1.5 feet wide and 4 inches tall, which would be capable of conveying a guillotine failure of the largest piping served. The spill would then be directed through a 1-foot wide outlet from the foundation basin sump box into a trough leading to the south trench, which would direct the spill to the existing Truck Loading Sump. The south trench is a minimum of 2 feet wide and 4 inches tall and would also be capable of conveying a guillotine failure of the largest piping served. National Grid stated that the detailed design of the foundation basin sump box would be determined during the detailed engineering design phase. Therefore, we made a recommendation in section 2.8.4 for National Grid to provide final design details of the sump box.

Potential spills occurring from the portion of the LNG liquefaction rundown line that would travel above a plant roadway, over the existing LNG storage tank containment berm, and into the existing LNG storage tank containment area would be directed with a sloped diversion tray, that would be installed beneath the pipe rack, and would allow the collected LNG spills to fall into the liquefaction area trench at grade or into the containment system within the LNG storage tank containment berm. This diversion tray would be a minimum of 2.7 feet-wide and 1.6 feet-tall which would be capable of conveying a guillotine failure of the LNG liquefaction rundown line. National Grid stated that the detailed design of the diversion tray including material selection would be determined during detailed engineering design. Therefore, we made a recommendation in section 2.8.4 for National Grid to provide final design details of the diversion tray including an evaluation that the construction material of the diversion tray would be capable of handling temperatures and pressures of a sudden cryogenic liquid spill. In addition, due to the heights that LNG may fall to collection at grade from the elevated diversion tray and along the elevated rundown line, we have made a recommendation in section 2.8.4 for National Grid to provide an evaluation of the effectiveness of this collection method and details of the cryogenic protection for the nearby supports and other components.

Inside the existing LNG storage tank containment area, potential spills from the LNG liquefaction rundown line and the new LNG truck loading pumps would be directed to a new sloped concrete trough that is a minimum of 2 feet-wide and 10 inches-tall, which would be capable of conveying a guillotine failure of the largest piping served. This trough would connect to an existing concrete trough that would deliver the spill to the new LNG Pump Loading Skid Sub-Containment Sump.

Each of the vessels in the pretreatment/liquefaction areas, which contain fluids such as hot oil and lube oil would be installed in a curbed area to contain at least 100 percent of the vessel or system capacity.

Table 2.8.6-1 summarizes the impoundments and their sizing spills.

TABLE 2.8.6-1

Impoundment Sizing Spills

Spill Source	Sizing Spill (gallons)	Impoundment System	Impoundment Size (gallons)
4-inch diameter LNG Liquefaction Rundown Line	2,130	Existing Truck Loading Sump	23,500
LNG Truck Loading Pumps (Pump-out Rate)	8,000	LNG Pump Loading Skid Sub-Containment Sump	11,950
4-inch diameter LNG Truck Loading Pumps Suction Line	18,255	Existing LNG Tank Containment Sump	19,356
Hot Oil Skid	1,100	Hot Oil Curbed Area	3,848
Liquid Nitrogen Storage Tank	10,000	Liquid Nitrogen Curbed Area	22,820

Storm water sump pumps would be included in the new sub-containment sump. These new pumps would have the capacity to remove water at minimum of 25 percent of the rate from a storm of a 10-year frequency and one-hour duration, as required by 49 CFR 193.2173. The storm water sump pumps would be automatically operated with level switches to ensure the impounding space would be as dry as practical. Low temperature detectors would be provided in the sub-containment sump to prevent pumps from operating if LNG is present, which may be used to address the redundant automatic shutdown controls required by the same regulation for automatic LNG impoundment water removal pumps.

The existing Truck Loading Sump is currently drained by means of a sump pump. National Grid indicated that it would evaluate the storm water flow characteristics in and out of this containment sump to verify that the removal system capacity conforms to 49 CFR 193.2173. In addition, National Grid indicated that other hazardous fluid impoundments, such as for the hot oil, would be sloped to drain points at manual valves. The use of manual drain valves instead of pumps may not meet the requirements of 193.2173. For the above reasons, we have included a recommendation in section 2.8.4 for National Grid to provide an evaluation of how its impoundment rainwater removal systems comply with 49 CFR 193.2173 with concurrence from PHMSA or how the system provides an equivalent level of safety with concurrence from PHMSA.

National Grid indicates that the plant operators currently remove the snow from the trench between the existing vaporizers and the existing Truck Loading Sump in order to maintain functionality of the spill trough as a normal course of operations. National Grid noted that it would be unlikely that the liquefier would be operated in cold weather conditions due to the peak shaving service role of the LNG plant, but the plant operators can easily maintain snow removal of the additional spill way trench similar to current operations. When LNG is not running through the liquefier, National Grid indicates that curbed areas may be kept clear for operator safety reasons with manual snow removal as needed. National Grid would also keep the curbing and trenches serving the new truck loading pumps which are located inside the existing LNG storage containment area clear of snow. However, for the LNG Pump Loading Skid Sub-Containment Sump that would serve the new LNG truck loading pump area, National Grid stated that based on a conservative snow density value, in the event of an LNG spill, the LNG would sink beneath the snow. Therefore, we have included a recommendation in section 2.8.4 for National Grid to demonstrate that LNG would sink beneath the snow and that snow would not reduce the capacity of the LNG Pump Loading Skid Sub-Containment Sump or, as an alternative, National Grid should provide snow removal procedures or include an adequate snow volume allowance for the LNG Pump Loading Skid Sub-Containment Sump.

2.8.6.2 Design Spills

Design spills are used in the determination of the hazard calculations required by 49 CFR 193. Prior to the incorporation of NFPA 59A in 2000, the design spill in Part 193 assumed the full rupture of "a single transfer pipe which has the greatest overall flow capacity" for not less than 10 minutes (old Section 193.2059[d]). With the adoption of NFPA 59A (2001), the basis for the design spill for impounding areas serving only vaporization, process, or LNG transfer areas became the flow from any single accidental leakage source. Neither Part 193 nor NFPA 59A (2001) define "single accidental leakage source."

In a letter to us, dated August 6, 2013, the DOT requested that LNG facility applicants contact the DOT's Office of Pipeline Safety's Engineering and Research Division regarding the Part 193 siting requirements.[30] Specifically, the letter stated that the DOT required a technical review of the applicant's design spill criteria for single accidental leakage sources on a case-by-case basis to determine compliance with Part 193.

National Grid provided the DOT with its design spill criteria and identified leakage scenarios for the proposed equipment. The DOT reviewed the data and methodology National Grid used to determine the single accidental leakage sources for the design spills, which were based on the flow from various leakage sources including piping, containers, and equipment containing LNG, nitrogen, and other hazardous fluids. On June 28, 2017, the DOT provided a letter to us stating that the DOT had no objection to National Grid's methodology for determining the single accidental leakage sources for candidate design spills to be used in establishing the Part 193 siting requirements for the proposed facilities.[31] The design spills produced by this method were identified in the documents reviewed by the DOT and have been filed in the FERC docket for the proposed Project. These are the same design spills described in the following sections.

The DOT's conclusions on the candidate design spills used in the siting calculations required by Part 193 were based on preliminary design information which may be revised as the engineering design progresses. If National Grid's design or operation of the proposed facilities

30 August 6, 2013 letter from Kenneth Lee, Director of Engineering and Research Division, DOT's Office of Pipeline Safety to Terry Turpin, FERC LNG Engineering and Compliance Branch, Office of Energy Projects. Filed in Docket No. PF13-14 on August 13, 2013. Accession Number 20130813-4015.

31 June 28, 2017 letter "Re: National Grid Fields Point Liquefaction Project, FERC Docket No. CP16-121-000" from Kenneth Lee to Rich McGuire. Filed in Docket Number CP16-121-000 on June 28, 2017. Accession Number 20170628-4002.

differs from the details provided in the documents on which the DOT based its review, the facilities may not comply with the siting requirements of Part 193. As a result, we included a recommendation in section 2.8.4 for the company to provide certification that the final design is consistent with the information provided to DOT.

A different subset of design spills would be applicable to each type of hazard. Therefore, the specific design spills used for each part of the Project siting analysis are listed in the applicable hazard analysis section below.

2.8.6.3 Flammable Vapor Dispersion Analysis

As discussed in section 2.8.2, a large quantity of flammable material released without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limit or encountered an ignition source. To address this hazard, 49 CFR sections 193.2051 and 193.2059 require the evaluation of flammable vapor dispersion in accordance with applicable sections of NFPA 59A (2001). Taken together, Part 193 and NFPA 59A (2001) require that flammable vapors either from an LNG tank withdrawal impoundment or a single accidental LNG leakage source do not extend beyond areas in which the operator or a government agency legally controls all activities. NFPA 59A Section 2.2.3.4 also requires provisions to minimize the possibility of any flammable mixture of vapors from any design spill reaching a property line that can be built upon and that would result in a distinct hazard. In addition, NFPA 59A Section 2.1.1 requires that factors applicable to the specific site with a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated into the design or operation of the facility.

49 CFR 193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration (one-half the LFL) of LNG vapor under meteorological conditions which result in the longest downwind distances at least 90 percent of the time. Alternatively, where the models give longer distances at lower wind speeds, section 193.2059 indicates that maximum downwind distances may be estimated for Pasquill-Gifford Atmospheric Stability Class F, a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature. However, based on the DOT PHMSA's Final Decisions that we assisted in developing, the intention of these alternative conditions were to reduce the climate data and dispersion modeling processing needs. Moreover, at the time these alternative conditions were specified, the only approved pool source dispersion model that was being used generated maximum dispersion distances at those wind conditions. Since that time, computational time and capability has greatly improved for dispersion models and, as discussed in PHMSA's Final Decisions for those models, the leakage source scenarios currently being analyzed, using the models discussed below, can produce maximum dispersion distances over a wider array of wind conditions. For other flammable fluids, similar parameters have been specified, and the calculation of the dispersion distances to the one-half LFL level has been recommended to account for uncertainty in the computer models currently approved by DOT.

The regulations in Part 193 specifically approve the use of two models for performing these dispersion calculations, DEGADIS and FEM3A, but also allow the use of alternative models approved by the DOT. Although Part 193 does not require the use of a particular source term model, modeling of the spill and resulting vapor production is necessary prior to the use of vapor dispersion models. In August 2010, the DOT issued Advisory Bulletin ADB-10-07 to provide guidance on obtaining approval of alternative vapor-gas dispersion models under Subpart B of 49 CFR 193. In October 2011, two dispersion models were approved by DOT for use in vapor dispersion exclusion zone calculations: PHAST-UDM Version 6.6 and Version 6.7 (submitted by Det Norske Veritas) and FLACS Version 9.1 Release 2 (submitted by GexCon). National Grid used PHAST 6.7 and FLACS 9.1, with their built-in source term models, to calculate vapor dispersion distances.

As discussed under "Design Spills," failure scenarios must be selected as the basis for the Part 193 dispersion analyses. Process conditions at the failure location would affect the resulting vapor dispersion distances. In determining the spill conditions for these leakage sources, process flow diagrams for the proposed design, used in conjunction with the heat and material balance information (i.e., flow, temperature, and pressure), can be used to estimate the flow rates and process conditions at the location of the spill. In general, higher flow rates would result in larger spills and longer dispersion distances, higher temperatures would result in higher rates of flashing, and higher pressures would result in higher rates of jetting and aerosol formation. The release may drain into a spill containment system with an impoundment located relatively far from the release, therefore, two different pressure scenarios may be considered for each design spill:

1. The pressure in the line is assumed to be maintained by pumps and/or hydrostatic head to produce the highest rate of flashing and jetting (i.e., flashing and jetting scenario).

2. The pressure in the line is assumed to be depressurized by the breach and/or emergency shutdowns to produce the highest rate of liquid flow within a curbed, trenched, or impounded area (i.e., liquid scenario).

Alternatively, a single scenario for each design spill could be selected if adequately supported with an assessment of the depressurization calculations and/or an analysis of process instrumentation and shutdown logic acceptable to the DOT.

In addition, the location and orientation of the leakage source must be considered. The closer a leakage source is to the property line, the higher the likelihood that the vapor cloud would extend offsite. As most flashing and jetting scenarios would not have appreciable liquid rainout and accumulation, the siting of impoundment systems would be driven by liquid scenarios, while siting of piping and other remaining portions of the plant would be driven by flashing and jetting scenarios.

The design spill selection methodology discussed under "Design Spills" was applied to the facilities to determine the flashing and jetting design spill cases that would produce the greatest vapor flow rate from each process fluid in each area of the plant. All of the design spills were modeled as horizontal releases, and those for spent regeneration gas (TX01), heavier hydrocarbons (TX03) and natural gas (NG12), were also modeled as downward releases. The design spills producing the most significant flammable vapor dispersion, including the depressurized liquid scenarios, are presented in table 2.8.6-2.

TABLE 2.8.6-2 **Flammable Dispersion Design Spills**					
Scenario	Description	Line Diameter (inches)	Hole Diameter (inches)	Total Flow Rate (lb/hr)	Liquid Rainout (%)
LNG02	LNG rundown line (liquefaction area at the cold box)	4	4	39,683	100%
LNG03	LNG rundown line (liquefaction area outside the tank berm area)	4	4	39,683	<1%
LNG06	LNG pump discharge line (existing LNG storage tank area)	4	4	39,683	5%
LNG10	LNG pump discharge line (existing LNG storage tank area)	6	4	168,257	100%
LNG12	LNG pump suction line (existing LNG storage tank area)	4	4	390, 500	100%
TX01	Regeneration Gas Knockout Drum (liquefaction area)	-	2	585,800	0%
TX03	Heavy Hydrocarbon stream (liquefaction area)	3	3	5,140	0%
NG12	Natural gas (metering area)	8	2	61,179	0%

Scenarios LNG10 and LNG12 would have a 100 percent liquid rainout case, because National Grid proposes to use pipe shrouding to immediately cause impingement of the jetting release and redirect liquid LNG from flashing and jetting releases. The pipe shrouding would be installed on both the suction and discharge piping of the new LNG trucking loading pumps and would fully encompass piping, appurtenances, piping connections, and tie-in points to the existing piping as well as allow for air flow. National Grid stated that the pipe shroud would be composed of steel sheeting that would be designed to withstand maximum pressure generated by a jetting release. To ensure that an evaluation of the detailed design of the pipe shrouding is provided, we included a recommendation in section 2.8.4 for the Company to provide the final design of the pipe shrouding and details of how the shroud design accounts for maximum pressures and cryogenic temperatures of an LNG release. In addition, the final design should consider the installation of the pipe shrouding to ensure that operation and maintenance of equipment and valves is not impacted.

For the Project dispersion scenarios, National Grid used the following conditions: average regional temperature of 53 °F, relative humidity of 50 percent, wind speeds of 1 and 2 meters per second (m/s), and Pasquill-Gifford Atmospheric Stability Class F. These selections considered hourly-collected weather data from the National Weather Service station located at Theodore Francis Green Memorial State Airport from a period beginning January 1, 2010 and ending December 31, 2014. We agree with National Grid's selection of atmospheric conditions. A ground surface roughness of 0.03 meter was used for all scenarios. In addition, we performed a sensitivity analysis for wind speed to demonstrate the longest predicted downwind dispersion distances and the results did not change the conclusion. Therefore, we agree with the selected wind speeds.

National Grid used PHAST 6.7 to analyze various vapor dispersion impacts based on hole diameter, release orientation, wind direction, wind speed, and other parameters. National Grid also used FLACS to model the vapor dispersion from scenarios where consideration of 3D geometry or vapor mitigation measures was required, because FLACS can account for mitigation features and facility geometry within the dispersion cloud, including the impoundments, trenches, tanks, and equipment geometry details. The model also included vapor barriers that are proposed to be installed as shown in figure 2.8.6-2. The vapor barriers would be 8, 12, and 32.8 feet tall and 10 percent porous. National Grid also intends to include a vapor barrier wall that would run north and south along the eastern edge of the air cooler area, which is located in the center of the liquefaction process area, to mitigate vapor dispersion from a potential cold box piping release. Details regarding the design of this vapor barrier wall would be included in the final design.

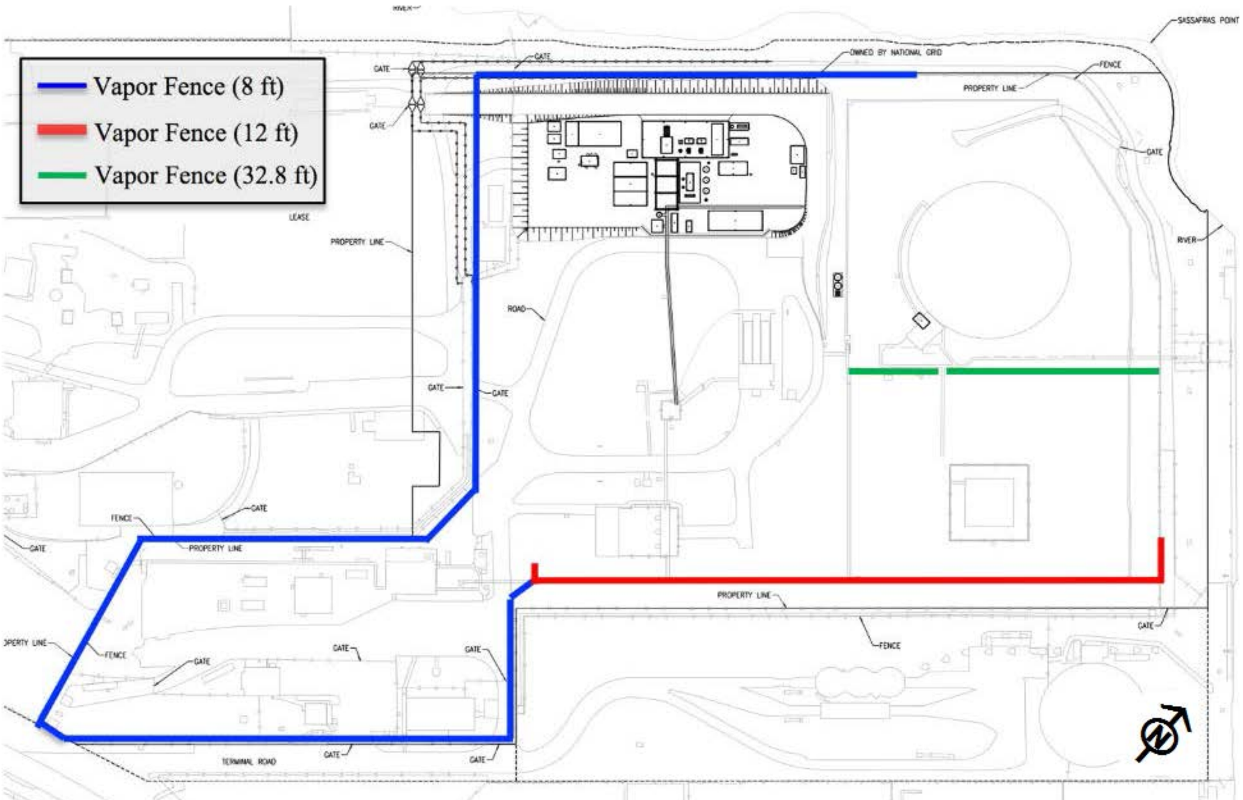

Figure 2.8.6-2: Vapor Barrier Placement

The release was initiated in the FLACS model simulations after sufficient time had passed to allow the wind profile to stabilize from effects due to the presence of on-site obstructions.

Figures 2.8.6-3 through 2.8.6-7 below shows the maximum potential extent of the LFL vapor dispersion, modeled to the one-half LFL to account for the uncertainty in the models, for the design spill scenarios.

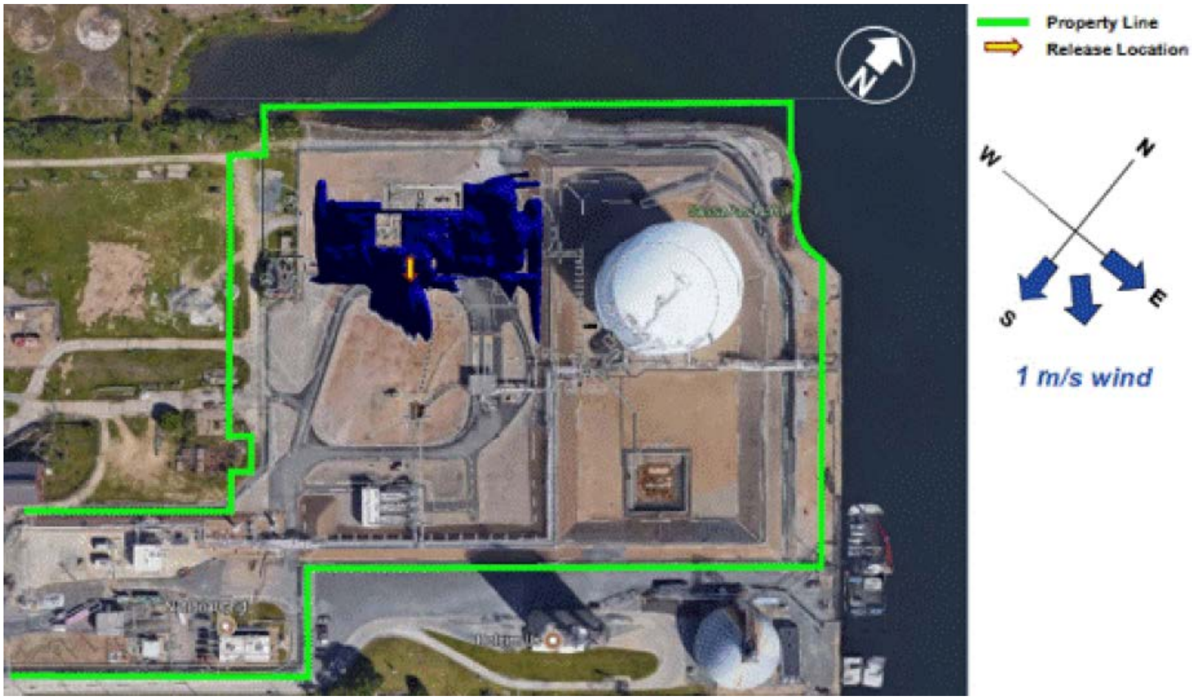

Figure 2.8.6-3 Maximum Flammable Vapor Dispersion from Scenarios LNG02 and LNG03 in the Liquefaction Area (*using a model uncertainty factor of 2)*

Figure 2.8.6-4 Maximum Flammable Vapor Dispersion from Scenarios LNG06 and LNG10 in the Existing LNG Storage Tank Area (*using a model uncertainty factor of 2)*

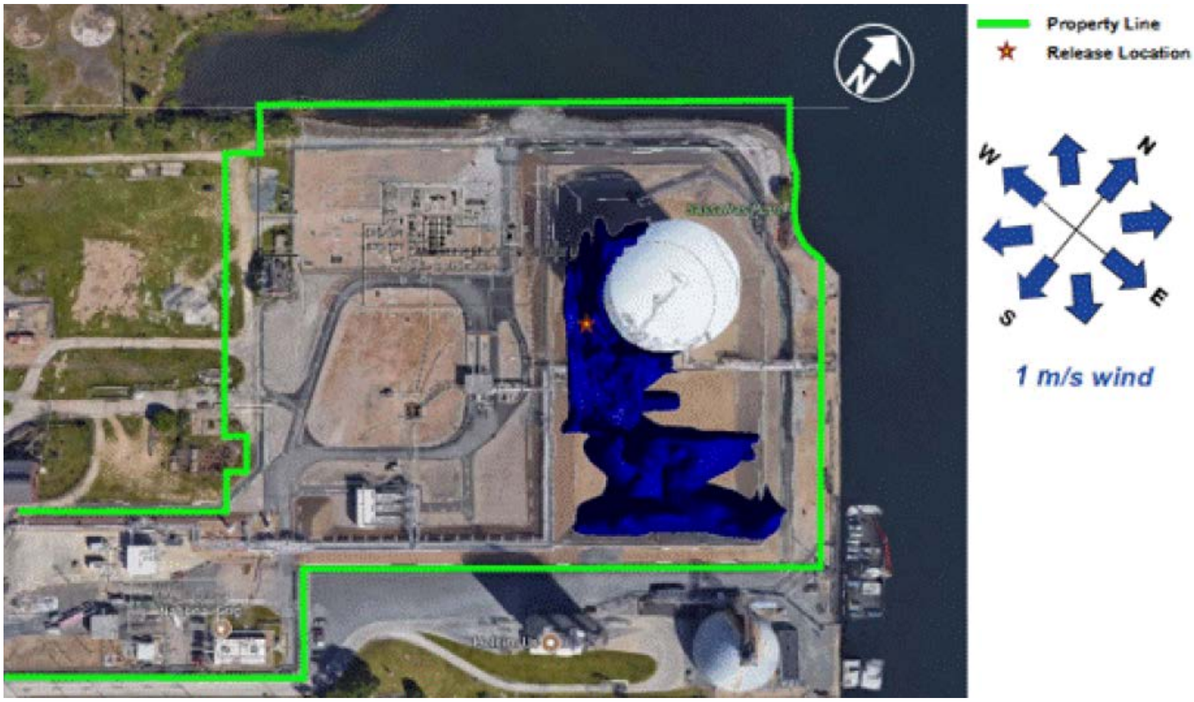

Figure 2.8.6-5 Maximum Flammable Vapor Dispersion from Scenario LNG12 in the Existing LNG Storage Tank Area (using a model uncertainty factor of 2)

Figure 2.8.6-6 Maximum Flammable Vapor Dispersion from Regeneration Gas Knockout Drum Scenario TX01 in the Liquefaction Area (*using a model uncertainty factor of 2)*

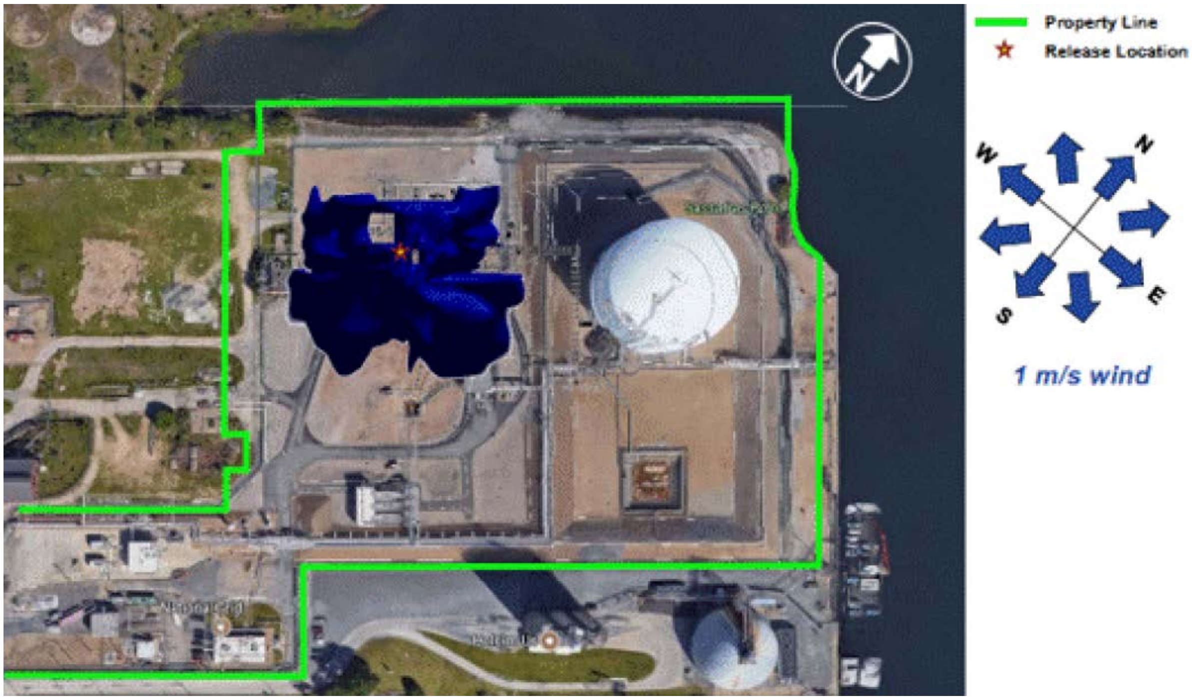

Figure 2.8.6-7 Maximum Flammable Vapor Dispersion from Heavy Hydrocarbon Scenario TX03 in the Liquefaction Area (*using a model uncertainty factor of 2)*

Figure 2.8.6-8 Maximum Flammable Vapor Dispersion from Natural Gas Scenario NG12 in the Liquefaction Area *(using a model uncertainty factor of 2 and up to 6 m/s wind)*

The proposed vapor barriers would be necessary for compliance with the flammable vapor dispersion requirements in 49 CFR 193.2059 and would need to be maintained. To ensure the integrity of the vapor barriers is maintained throughout the life of the facility, we included a recommendation in section 2.8.4 for the company to provide procedures to maintain and inspect the vapor barriers provided to meet the siting provisions of 49 CFR 193.2059.

We also requested National Grid evaluate flammable vapor dispersion from a hot oil release. National Grid stated that based on hot oil vendor information, hot oil has no flammability limits and modeling an accurate representation of hot oil in PHAST would not be possible. However, National Grid also stated that hot oil has the potential to ignite at very high temperatures (flash point temperature of 338 °F). Therefore, since the proposed hot oil system would be designed to operate above its flash point, we believe that a hot oil release at a temperature above its flash point could generate flammable vapors. We conducted an analysis in PHAST utilizing a combination of data from the Design Institute for Physical Properties database and vendor property data for hot oil. The PHAST results showed that a guillotine of a 2-inch-diameter line from the hot oil expansion tank with a flow rate of 401,800 pounds per hour, based on the conservative conditions noted for this vessel on the vendor P&IDs, would generate approximately 99.9 percent rainout and a one-half-LFL dispersion distance of approximately 233 feet during 6 m/s winds and without consideration of any containment. This one-half-LFL distance, shown below in Figure 2.8.6-8, would not reach a property that could be built upon.

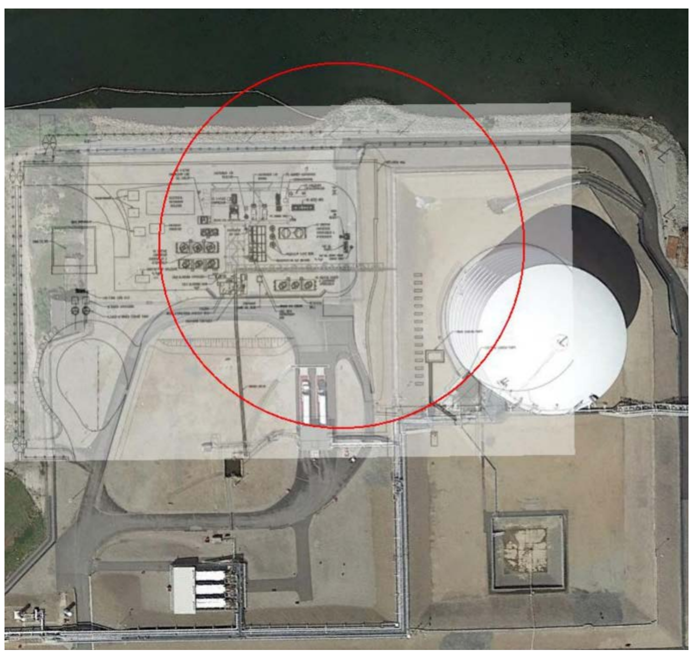

Figure 2.8.6-9 Estimated Maximum Flammable Vapor Dispersion from the Hot Oil Scenario
(using a model uncertainty factor of 2 and 6 m/s wind speed)

Based on the analysis presented in this section and our recommendations, we conclude that the siting of the proposed Project, with respect to flammable vapor dispersion, would not cause a significant impact on public safety or reliability. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of the DOT's inspection and enforcement program.

2.8.7 Toxic and Asphyxiant Dispersion Analysis

As discussed in section 2.8.2, a release of heavy hydrocarbons or spent regeneration gas may form a toxic cloud. To address these hazards, 49 CFR 193.2051 requires siting provisions in accordance with applicable sections of NFPA 59A (2001 edition). NFPA 59A, Section 2.1.1 requires that factors applicable to the specific site with a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated into the design or operation of the facility. Taken together, Part 193 and NFPA 59A (2001 edition) require that potential incidents (e.g., toxic releases) must be considered.

The "heavy hydrocarbon" stream for this Project consists of primarily methane and ethane with an insignificant amount of toxic components.[32] The design spills, as discussed in the "Design Spills" section, with toxic and asphyxiant properties that were analyzed by National Grid are listed in table 2.8.7-1.

TABLE 2.8.7-1

Toxic and Asphyxiant Release Design Spills

Scenario	Location	Line Diameter (inches)	Hole Diameter (inches)	Total Flow Rate (lb/hr)	Liquid Rainout (%)
TX01	Regeneration Gas Knockout Drum	--	2	585,800	0%
N201a	Liquid Nitrogen Storage Area	2	2	423,000	0%

For the LNG vapor dispersion analysis, 49 CFR 193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration (one-half the LFL) under meteorological conditions that result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for Pasquill-Gifford Atmospheric Stability Class F, a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature. Similar uncertainty factors (e.g., one-half the AEGL of toxic materials) and similar parameters (i.e., Pasquill-Gifford Atmospheric Stability Class F, 1–2 m/s wind speed, 50 percent relative humidity, average regional temperature, and 0.03 m surface roughness) were used to model the dispersion from toxic fluid releases.

The toxic dispersion analysis considered a method to account for the potential additive toxicity of components in the spent regeneration gas stream, including propane, butane, ethylbenzene, hexane, hydrogen sulfide, methyl mercaptan, benzene, toluene, and xylene. This method is found in the Compressed Gas Association P-20 Standard for Classification of Toxic Mixtures (2009 edition).[33]

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[32] Typically heavy hydrocarbon streams refer to streams with significant amounts of heavier hydrocarbons, such as propane, butane, pentane, hexane, heptane, or even heavier hydrocarbons with noticeable concentration of benzene, toluene, ethylbenzene, and xylenes.

[33] Compressed Gas Association P-20 Standard for Classification of Toxic Mixtures is based on Le Chatelier's Rule which is a common methodology for calculating concentrations of interest for various hazards. A generalization of Le Chatelier's Rule can be found here: H.F. Coward, C.W. Carpenter, and W. Paymen, J. Chem. Soc., 115, 27 (1919).

For each of the three AEGL levels discussed in section 2.8.2, National Grid evaluated gaseous releases using a 10-minute exposure time because the gaseous toxic cloud would disperse after that duration.

As discussed in section 2.8.2, the AEGL-2 would be the expected limit of potential irreversible impacts to the general public, including susceptible individuals, for the exposure time. National Grid calculated distances to all three AEGLs using the half-AEGL values as the endpoints in order to account for uncertainty in the model. The increased distance to the half-AEGL provides better confidence that the actual maximum distance to the AEGL during a release event would be within the calculated distance. The dispersion distance calculated for the half-AEGL-1 for toxic design spill scenario TX01 in the horizontal direction resulted in 257 feet and would not reach beyond a property line that can be built upon. The half-AEGL-2 and half-AEGL-3 would not generate a dispersion distance due to low toxicity of the toxic stream. As a result, we conclude that the siting of the proposed Project would not cause a significant impact on public safety with respect to the presence of the toxic components. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of the DOT's inspection and enforcement program.

In addition to considering toxic effects, National Grid evaluated the need for oxygen sensors near the liquid nitrogen storage area to protect operators from a localized asphyxiation hazard. Figure 2.8.7-1 presents the results of PHAST modeling, using an uncertainty factor of two, to show the extent of 19.5 percent-vol, 16 percent-vol, and 12.5 percent-vol oxygen concentrations due to a 2-inch-diameter nitrogen leakage source release, having a total flow rate of 423,000 pounds per hour in the liquid nitrogen storage area. The concentration levels modeled are from OSHA's *Respiratory Protection Standard,*[34] which states that any atmosphere with a concentration below 19.5 percent oxygen by volume, air is considered oxygen-deficient and would cause impaired thinking or coordination. Concentrations of 12.5 to 16 percent oxygen by volume causes tachypnea (increased breathing rates), tachycardia (accelerated heartbeat), impaired attention, thinking, and coordination, even in people who are resting. Oxygen levels of less than 12.5 percent could result in death.

As shown in figure 2.8.7-1, the 19.5 percent-vol would extend offsite, and the 16 percent-vol and 12.5 percent-vol would remain within the plant site boundary. The 19.5 percent-vol extends offsite, but is the point where temporary and unnoticeable adverse physiological effects begin, and these oxygen levels (at sea level[35]) would not cause any impairment or permanent irreversible harm. The 16 percent-vol would be a point where some effects would become noticeable, but these oxygen levels (at sea level) would also not result in permanent or irreversible effects and do not extend offsite or onto any onsite occupied buildings. The 12.5 percent-vol or less (at sea level) could result in permanent effects or even death; however, these oxygen levels

[34] U.S. Department of Labor, Occupational Safety and Health Administration, *Respiratory Protection Standard*, 63 Fed. Reg. 1152 – 1300, Jan. 1998, (https://www.osha.gov/laws-regs/federalregister/1998-01-08).
American National Standards Institute Z88.2, *American National Standard for Respiratory Protection,* 1992.

[35] Oxygen deprivation effects are dependent on the partial pressure of oxygen in the lungs, which depends on both altitude and reduced percentage of oxygen. Combined effects of altitude and reduced percentage of oxygen can be found in American National Standards Institute Z88.2 (1992 edition), but altitude would have minimal effect for this site given that its location/altitude is near sea level.

(at sea level) would not extend offsite or onto any building which may impair response to an incident. As a result, we conclude that the siting of the proposed Project would not cause a significant impact on public safety with respect to the presence of the asphyxiant components. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of the DOT's inspection and enforcement program.

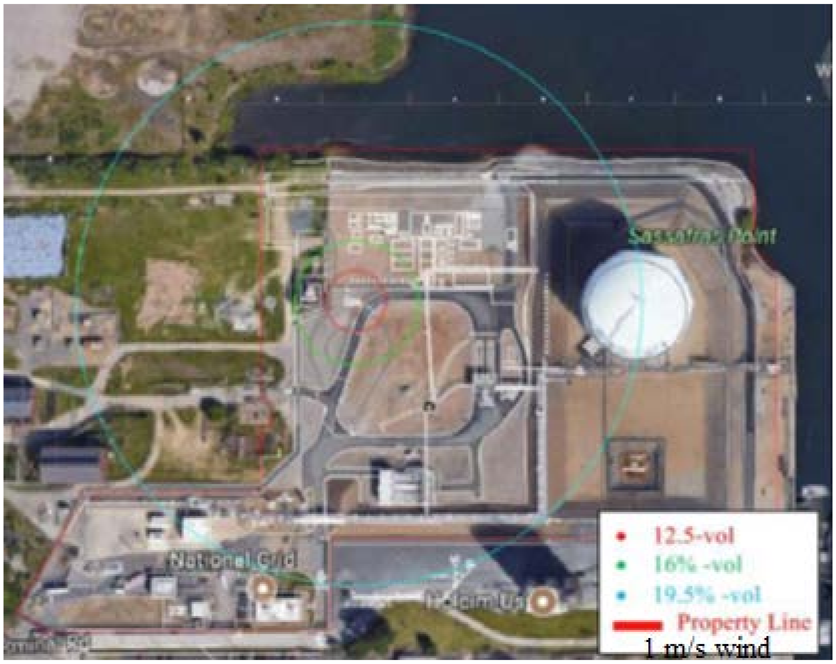

Figure 2.8.7-1 Asphyxiant Results from Liquid Nitrogen Scenario N201a *(using a model uncertainty factor of 2)*

2.8.7.1 Vapor Cloud Overpressure Considerations

As discussed in section 2.8.2, the propensity of a vapor cloud to detonate or produce damaging overpressures is influenced by the reactivity of the material, the level of confinement and congestion surrounding and within the vapor cloud, and the flame travel distance. It is possible that the prevailing wind direction may cause the vapor cloud to travel into a partially confined or congested area. Section 2.1.1 of NFPA 59A (2001 edition), as adopted by 49 CFR 193, requires consideration of factors applicable to the specific site with a bearing on the safety of plant personnel and the surrounding public.

<u>LNG Vapor Clouds</u>

The potential for unconfined LNG vapor cloud detonations was investigated by the Coast Guard in the late 1970s at the Naval Weapons Center in China Lake, California. Using methane, the primary component of natural gas, several experiments were conducted to determine whether unconfined LNG vapor clouds would detonate. Unconfined methane vapor clouds ignited with low-energy ignition sources (13.5 joules) and produced flame speeds ranging from 12 to 20 mph. These flame speeds are much lower than the flame speeds associated with a deflagration with damaging overpressures or a detonation.

Additional tests were conducted to study the influence of confinement and congestion on the propensity of a vapor cloud to detonate or produce damaging overpressures. The tests used obstacles to create a partially confined and turbulent scenario but found that flame speeds developed for methane were not significantly higher than the unconfined case and were not in the range associated with detonations.

To examine the potential for detonation of an unconfined natural gas cloud containing heavier hydrocarbons that are more reactive, such as ethane and propane, the Coast Guard conducted further tests on ambient-temperature fuel mixtures of methane-ethane and methane-propane. Explosive charges were used as ignition sources for these tests. For the vapor clouds containing from 86 to 96 percent methane in near stoichiometric proportions, the Coast Guard indicated that the overpressures produced during those tests were the same overpressures produced by the ignition source alone. However, the Coast Guard found that less processed natural gas with greater amounts of heavier hydrocarbons and less methane would be more sensitive to detonation.

Although it has been possible to produce damaging overpressures and detonations of unconfined LNG vapor clouds, the Project would be designed to receive feed gas with methane concentrations as low as 88 percent, which are not in the range shown to exhibit overpressures and flame speeds associated with high-order explosions and detonations in excess of the initiating charge. The substantial amount of initiating explosives needed to create the shock initiation during the limited range of ignitable vapor-air concentrations also renders the possibility of detonation of these vapors at an LNG plant as unrealistic.

Ignition of a confined LNG vapor cloud could result in higher overpressures. In order to prevent such an occurrence, National Grid would take measures to mitigate flammable vapor dispersion and ignition in confined areas, such as buildings and fired equipment. In addition, we have made a recommendation in section 2.8.4 for National Grid to ensure the final design would include the installation of gas detection devices at the air intakes of all buildings and combustion equipment to enable isolation and deactivation of equipment whose continued operation could add to, or sustain, an emergency.

<u>Vapor Clouds from Other Hazardous Fluids</u>

In comparison with LNG vapor clouds, there is a higher potential for unconfined propane clouds to produce damaging overpressures, and an even higher potential for unconfined ethylene vapor clouds to produce damaging overpressures. Unconfined ethylene vapor clouds also have the potential to transition to a detonation much more readily than propane. This has been shown by multiple experiments conducted by the Explosion Research Cooperative to develop predictive blast wave models for low-, medium-, and high-reactivity fuels and varying degrees of congestion and confinement (Pierorazio et al., 2005). The experiments used methane, propane, and ethylene, as the respective low-, medium-, and high-reactivity fuels. In addition, the tests showed that if methane, propane, or ethylene is ignited within a confined space they all have the potential to produce damaging overpressures. The heavy hydrocarbon and hot oil streams would not contain a mixture of components such as the ones discussed above (i.e., ethylene and propane), however, a potential exists for these process streams to produce unconfined vapor clouds that could produce damaging overpressures in the event of a release.

National Grid used the Baker-Strehlow-Tang Explosion Model in PHAST (v6.7) to estimate the distances to the 1 psi overpressure threshold resulting from the heavy hydrocarbon design spill dispersion scenario (TX03). The flammable vapor cloud was ignited at the maximum extent of the predicted LFL dispersion. National Grid indicated that a low obstacle density was assumed. For additional conservatism, the obstructed volume was assumed to include the entire vapor cloud. Figure 2.8.7-2 shows the results of the overpressure analyses using PHAST, which demonstrate that the 1 psi overpressure threshold would not extend beyond a plant property line.

Figure 2.8.7-2 Maximum Extent of 1 psi from the Heavy Hydrocarbon TX03 Overpressure Scenario

Initially, National Grid indicated that it was unable to perform an overpressure analysis of hot oil based on the same justifications that were discussed in the flammable vapor dispersion analysis section. However, in order to evaluate the potential overpressure hazard of a hot oil release, National Grid used FLACS to estimate the distance to 1 psi overpressure threshold resulting from the ignition of vapors similar to those from hot oil. National Grid selected dodecane as the component most similar to hot oil with a high molecular weight and appropriate material data. This flammable vapor cloud was ignited in the most congested region of the liquefaction process area. Figure 2.8.7-3 shows the result of these FLACS vapor cloud overpressure analyses, which demonstrates that the 1 psi overpressure (represented as the dark blue 0.5 psi to account for the uncertainty of model) threshold would not reach a property line that can be built upon. In addition, critical emergency equipment, such as the emergency generator and the fire water booster pumps, would not be expected to experience significant overpressures from this scenario.

Based on the analysis presented in this section, we conclude that the siting of the proposed facility, with respect to vapor cloud overpressures, would not cause a significant impact on public safety. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of the DOT's inspection and enforcement program.

The overpressure analyses were based on the preliminary information contained in the FEED submitted by National Grid and our review. Piping and equipment arrangements may differ in final design, potentially resulting in increased congestion or confinement and an increase in the overpressure distance. Therefore, we included a recommendation in section 2.8.4 for the company to provide verification of the congestion or confinement represented in the FEED or provide revised overpressure calculations indicating that a 1 psi overpressure would not impact the public.

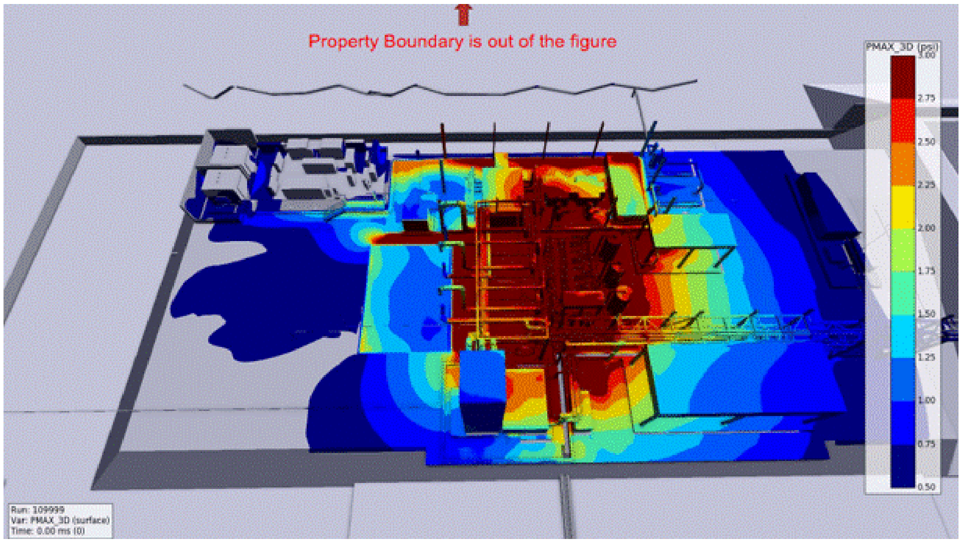

Figure 2.8.7-3 Estimated Maximum Extent of 1 psi from Hot Oil Overpressure Scenario, using dodecane as a representative fluid ***(The 1 psi result is located at the outer edge of the dark blue band, considering a model uncertainty factor of 2.)***

Thermal Radiation Analysis

As discussed in section 2.8.2, if flammable vapors are ignited, the deflagration could propagate back to the spill source and result in a pool fire causing high levels of thermal radiation (i.e., heat from a fire). In order to address this, 49 CFR 193.2051 and 193.2057 require evaluation of thermal radiation hazards of potential incidents and exclusion zones in accordance with applicable sections of NFPA 59A (2001). Together, Part 193 and NFPA 59A (2001) specify that, for spills from process or 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. The 1,600 Btu/ft^2-hr flux level is associated with producing second degree burns in approximately 30-40 seconds, assuming no shielding from the pool fire. For distances farther away from the pool fire, the flux levels would be lower. Other potential incidents that could have a bearing on the safety of plant personnel or surrounding public are also required to be evaluated under NFPA 59A, section 2.1.1.

Part 193 requires the use of the LNGFIRE3 computer program model developed by the Gas Research Institute or other approved model to determine the thermal radiation distances. Part 193 also stipulates that the wind speed, ambient temperature, and relative humidity that produce the maximum exclusion distances must be used for LNG fires, except for conditions that occur less than 5 percent of the time based on recorded data for the area. National Grid selected the following ambient conditions to produce the maximum exclusion or hazard distances for all impoundment fires: wind speeds up to 18 mph, an ambient temperature of 24 °F; and a relative humidity of 35 percent. These selections considered hourly-collected weather data from the National Weather Service station located at Theodore Francis Green Memorial State Airport from a period beginning January 1, 2010, and ending December 31, 2015. We agree with National Grid's selection of atmospheric conditions.

National Grid used LNGFIRE3 to predict the maximum distance to a thermal radiation level of 1,600 Btu/ft^2-hr for fires from all impoundments. Although LNGFIRE3 is specifically designed to calculate distances to thermal radiation flux levels for LNG pool fires, LNGFIRE3 provides conservative distances to thermal radiation flux levels for other flammable or combustible hydrocarbons such as hot oil.

LNGFIRE3 calculates thermal radiation flux using parameters that include the mass burning rate of LNG and the surface emissive power of the flame, which is an average value of the thermal radiation flux emitted by the fire. Both the mass burning rate and surface emissive power of hot oil fire would be less than that of an equally sized LNG fire. Since the thermal radiation from a pool fire is dependent on the mass burning rate and the surface emissive power, the distances to specific thermal flux levels for hot oil fires would not extend as far as the distances calculated for an LNG fire in the same sump.

The maximum distance calculated from a fire over the full surface area of each spill impoundment to the 1,600 Btu/ft^2-hr level is shown in Figure 2.8.7-4 below.

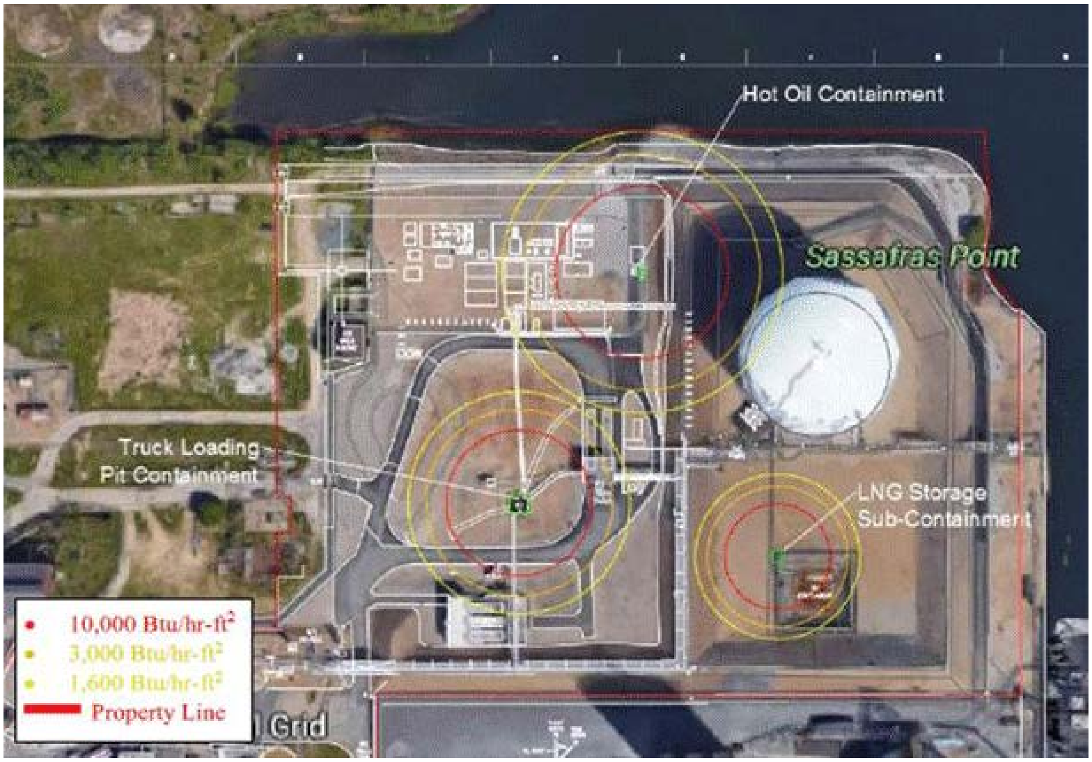

Figure 2.8.7-4 Thermal Radiation Isopleths from an Impoundment Pool Fire

As shown, none of the thermal radiation zones would extend onto offsite property that could be built upon.

National Grid also evaluated jet fires from the design spills using PHAST and FLACS. The same ambient weather conditions used for the flammable vapor dispersion analysis were also used to evaluate jet fires: average regional temperature of 53 °F, relative humidity of 50 percent, wind speeds of 1 and 2 m/s, and Pasquill-Gifford Atmospheric Stability Class F. We verified that the selected weather conditions were appropriate for evaluating jet fires from the design spills by remodeling the Phast scenarios with the temperature and humidity used for radiant heat modeling from impoundment fires and considering the wind speed range at the site, which did not change the conclusion for the jet fire scenarios. The FLACS jet fire analysis for scenario TX01, shown in figure 2.8.7-7 below, did not account for any uncertainty factor in the model. Based on staff review of available validation data, it appears that an uncertainty factor of potentially up to 3 may be appropriate for this model. The distance to one third of the thermal flux level at 1,600 Btu/ft^2-hr would extend farther over water but would not impact any offsite land areas, based on staff's analysis. The Phast modeling results for the other jet fires, including the jet fire from the hot oil release evaluated by staff, also indicated that the radiant heat to the 1,600 Btu/ft^2-hr for the design spills would not impact offsite property. National Grid's jet fire radiant heat results are shown below in Figures 2.8.7-5 through 2.8.7-6.

Figure 2.8.7-5 Jet Fire Distances from LNG-02 Design Spill

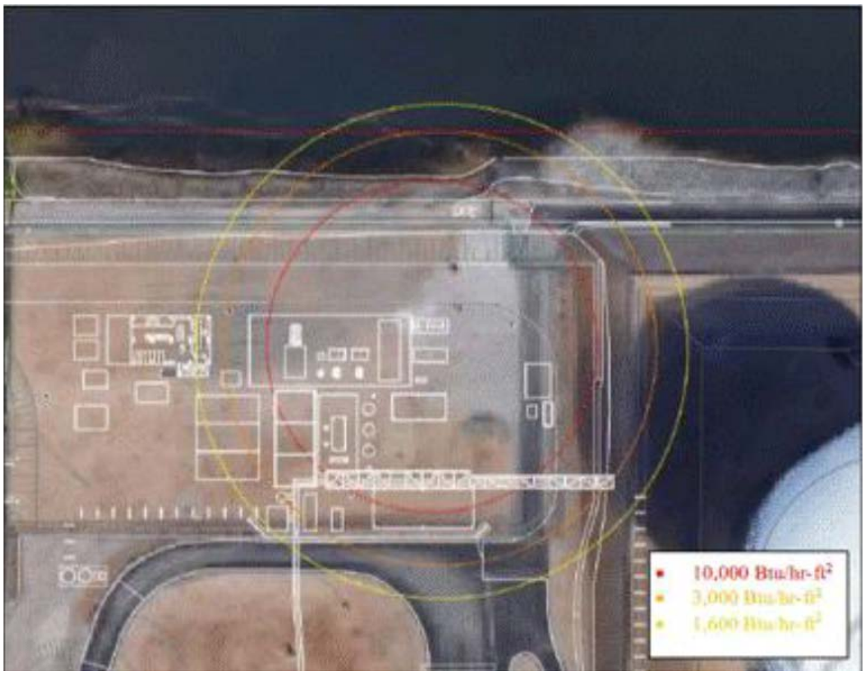

Figure 2.8.7-6 Jet Fire Distances from Natural Gas NG12 Design Spill

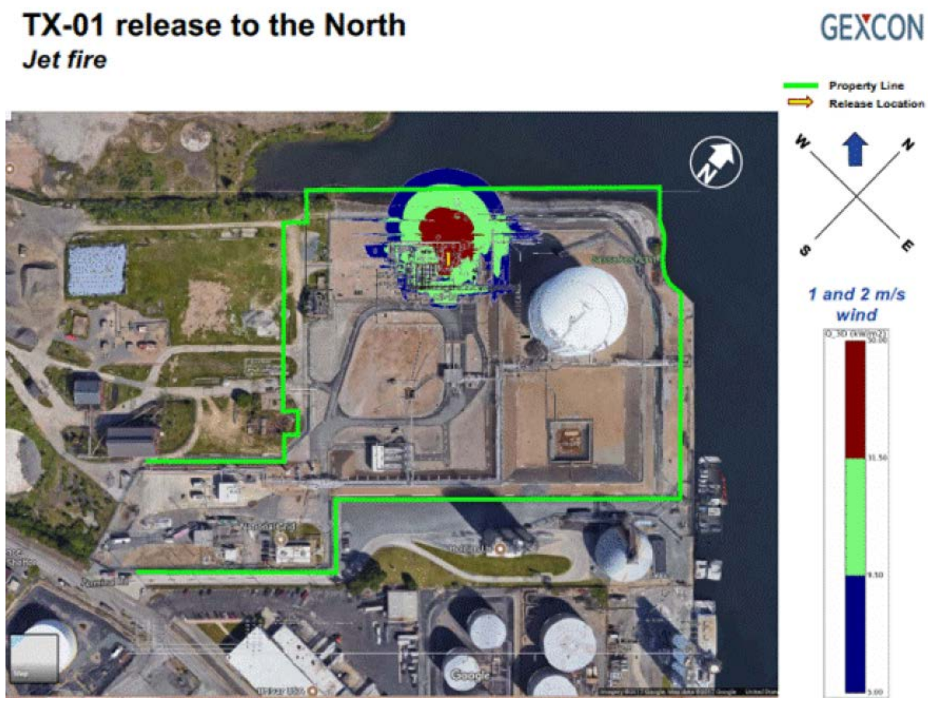

Figure 2.8.7-7 Jet Fire Distances from the Regeneration Gas Knockout Drum TX01 Design Spill (The 5 kW/m^2 level corresponds to approximately 1,600 Btu/ft^2-hr at the outer edge of the dark blue band. Applying an uncertainty factor up to 3 would increase the distance but would not reach any offsite land areas based on staff's analysis.)

Fires may also cause failures of nearby storage vessels, piping, and equipment. The failure of a pressurized vessel could cause fragments of material to fly through the air at high velocities, posing damage to surrounding structures and a hazard for operating staff, emergency personnel, or other individuals in proximity to the event. In addition, failure of a pressurized vessel when the liquid is at a temperature significantly above its normal boiling point could result in a BLEVE. BLEVEs can produce overpressures when the superheated liquid rapidly changes from a liquid to a vapor upon the release from the vessel. BLEVEs of flammable liquids can produce a subsequent fireball if they are ignited upon their release.

Radiant heat from pool fires in the hot oil containment area, existing LNG Tank Containment Sump, and existing Truck Loading Sump may extend over the existing LNG Storage Tank, Truck Loading Skid, and proposed liquefaction process area including the molecular sieve beds, regeneration gas knockout drum, and other various process vessels. However, National Grid has existing and proposed various layers of protection that would include trained operations personnel, emergency shutdown systems capable of isolating inventory and decreasing pressure, fire and gas detection equipment that would alarm and/or shutdown process equipment, fixed, wheeled, and portable dry chemical systems to extinguish a fire, a concrete barrier and pipe shrouding to shield the LNG storage tank, firewater monitors and hydrants to cool equipment, high expansion foam system, and an emergency response plan. Generally, high expansion foam systems have been shown to reduce radiant heat fires up to 50 percent;[36] therefore, this would reduce the radiant at the truck loading skid to levels that would not result in a pressure vessel burst or BLEVE scenario. We also note that the hot oil containment pool fire was modeled using LNGFIREIII which is overly predictive in modeling radiant heat, therefore, we have included a recommendation in section 2.8.4 for National Grid to provide refined modeling or demonstrate thermal protection measures for the process vessels would be applied in a way that adequately protects all significant components from the impacts of a potential hot oil containment fire.

Jet fires modeled from design spills may have thermal radiant heat levels that would reach the existing LNG storage tank and proposed liquefaction process vessels, piping, and equipment. However, National Grid would incorporate layers of protection to mitigate the potential for an initiating event to develop into a BLEVE incident. These layers of protection would include trained operations personnel, emergency shutdown valves including an ESD system capable of isolating inventory and decreasing pressure, fire and gas detection equipment that would alarm and/or shutdown process equipment, fixed, wheeled, and portable dry chemical systems to extinguish a fire, a concrete barrier and pipe shrouding to shield the LNG storage tank, firewater monitors and hydrants to cool equipment, and an emergency response plan which would reduce the duration of a jet fire. Therefore, we believe that these layers of protection would reduce the duration of a jet fire and radiant heat such that it would not result in a pressure vessel burst or BLEVE.

Based on the thermal radiation analysis presented in this section and our recommendations, we conclude that the siting of the proposed Project, with respect to thermal radiation, would not cause a significant impact on public safety. If the facilities are constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of the DOT's inspection and enforcement program.

2.8.8 Emergency Response and Evacuation

As required by 49 CFR 193.2509, LNG plant operators need to prepare emergency procedures manuals that provide for: a) responding to controllable emergencies and recognizing an uncontrollable emergency; b) taking action to minimize harm to the public including the possible need to evacuate the public; and c) coordination and cooperation with appropriate local officials. Specifically, section 193.2509(b)(3) requires "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…," which sets forth the steps required to protect the public in the event of an emergency.

National Grid currently has an existing Facility Response Plan in place which covers procedures to respond to a plant emergency. The existing response plan would need to be updated to include the proposed facilities and emergencies related to Project operations. Therefore, we have recommended in section 2.8.4 that National Grid to provide an updated Facility Response Plan for approval prior to initial site preparation.

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[36] Zhang, Bin (2015). *Liquefied Natural Gas Hazards Mitigation with High Expansion Foam*. Doctoral dissertation, Texas A & M University. Available electronically from http://oaktrust.library.tamu.edu/handle/1969.1/156368.

2.8.9 Conclusions on Facility Reliability and Safety

As part of the NEPA review, Commission staff must assess whether the proposed facilities would be able to operate safely and securely. As a result of our technical review of the preliminary engineering design, we have made a number of recommendations to 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. Based on our analysis and recommended mitigation, we believe that National Grid's Field Point Liquefaction 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.

In addition, we analyzed whether Fields Point Liquefaction Project would be sited consistently with federal regulations promulgated by the DOT in 49 CFR 193, as well as other relevant regulations, and other industry codes, engineering standards, and guidelines. As a cooperating agency, the DOT assisted us in evaluating whether National Grid's proposed design would meet the DOT siting requirements. The DOT reviewed the criteria and methodology National Grid used to identify design spill scenarios, which included determining single accidental leakage sources for various components, including piping, containers, and equipment. National Grid used those scenarios to model hazardous releases. On June 28, 2017, the DOT provided a letter to us stating that the DOT had no objection to National Grid's methodology for determining the single accidental leakage sources for candidate design spills to be used in establishing the Part 193 siting requirements for the proposed LNG liquefaction facilities. Based on the hazardous area calculations we reviewed and upon satisfactory resolution of our recommendations, we would conclude that potential hazards from the siting of the facility at this location would not cause a significant impact on public safety. The areas impacted by these design spills also appear to meet the DOT's exclusion zone requirements by either being within the facility property boundary or over a navigable body of water. If the facility is constructed and becomes operational, the facility would be subject to the DOT's inspection and enforcement program. Final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the DOT staff.

2.9 CUMULATIVE IMPACTS

In accordance with NEPA, we identified other actions in the vicinity of the Project facilities and evaluated the potential for a cumulative impact on the environment. As defined by the Council on Environmental Quality, a cumulative effect is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. The Council on Environmental Quality guidance (Council on Environmental Quality, 1997a) states that an adequate cumulative effects analysis may be conducted by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions. In this analysis, we consider the impacts of past projects within defined geographic scopes as part of the affected environment (environmental baseline) which were described and evaluated in the preceding environmental analysis. However, present effects of past actions that are relevant and useful are also considered. Table 2.9-1 summarizes the resource-specific geographic scopes that were considered in this analysis, and indicates whether the Project may have the potential to result in cumulative impacts when combined with other identified projects, as further discussed in this section.

As described throughout section 2.0 of this EA, construction of the Project would temporarily affect the environment, and the Project would result in very limited and minor environmental impacts during operation. National Grid's proposed mitigation measures and our recommendations, as applicable, would limit Project impacts to less than significant levels. Most resources (i.e., geology, wetlands, surface waters, fisheries, vegetation, wildlife, cultural resources, and land use/recreation) would not be affected or would be only minimally affected and contained within or immediately adjacent to the areas directly affected by construction. As such, we conclude that the Project would not contribute to cumulative impacts on these resources, and they are not discussed further in this section.

We have thus focused our impacts analysis on those resources (soil and groundwater contamination, socioeconomics [including environmental justice and traffic impacts], air quality, and noise) which may experience cumulative impacts when Project-related impacts are added to impacts from other projects or activities in the vicinity. In addition, we received comments regarding climate change impacts and have included a discussion of climate change in this analysis. These are discussed below.

TABLE 2.9-1 **Cumulative Impact Resource-Specific Geographic Scope**		
Resource	Cumulative Impact Geographic Scope	Finding
Geology	Project construction workspaces	All impacts would be confined to the existing facility; no potential for cumulative impacts
Soils and Groundwater (contamination)	Surface and substrate below the Project site boundaries and in the nearby industrial area	Potential cumulative impacts
Surface Water, Fisheries, and Wetlands	Hydrologic Unit Code-12 watershed boundaries	Project not anticipated to affect; no potential for cumulative impacts
Vegetation and Wildlife	Hydrologic Unit Code-12 watershed boundaries	Minimal impacts and confined to the Project site; no potential for cumulative impacts
Land Use and Recreation	1-mile radius from Project site center	Project would not result in a change in land use and would not impact surrounding land uses or area recreation; no potential for cumulative impacts
Visual Landscape	The distance that the tallest Project feature would be visible from neighboring communities	Proposed facilities would not appreciatively alter the visual landscape; no potential for cumulative impacts
Socioeconomics and Environmental Justice	Providence County	Potential cumulative impacts
Traffic	The state of Rhode Island and parts of Massachusetts and Connecticut	Potential cumulative impacts
Cultural Resources	Overlapping impacts within the Area of Potential Effects	Project not anticipated to affect; no potential for cumulative impacts
Air Quality (construction)	within 0.25 mile of construction workspaces	Potential cumulative impacts
Air Quality (operation)	10-kilometer radius from Project site center	Potential cumulative impacts
Noise (construction and operation)	1-mile radius from Project site center	Potential cumulative impacts
Climate Change	see section 2.9.2.4	Potential cumulative impacts

2.9.1 Identified Actions

The ongoing, planned, or past projects in proximity to the proposed Project and that have the potential to result in cumulative impacts include three FERC-jurisdictional projects (including National Grid's potential containment enhancement project, also known as the bund wall project); nine power generation projects; one non-jurisdictional pipeline project (the Mid-Cape Main Replacement); thirteen projects related to electric transmission (including the non-jurisdictional Fields Point LNG-35 kV Electric Service Project); one utility (sewer) project; three transportation-related projects; and eleven other projects. These projects are briefly summarized below; more detailed descriptions are provided in appendix A.

The actions considered in our cumulative impact analysis may vary from the proposed Project in nature, magnitude, and duration. These actions are included based on the likelihood of completion near the proposed construction time span, and only projects with either ongoing impacts or that are "reasonably foreseeable" future actions were evaluated. Existing or reasonably foreseeable future actions that would be expected to affect similar resources during similar periods as the Project were considered further.

2.9.1.1 Other FERC-Regulated Section 7(c) Projects

National Grid states it has plans at some point to construct a storage tank containment enhancement project east of the Project site. The containment enhancement project would involve the addition of a reinforced concrete wall around the existing storage tank within the existing containment area. Based on preliminary designs, the wall would be approximately 85 feet tall measured from the floor of the existing tank containment system, which is slightly lower than the elevation of the property outside the existing containment berm. These preliminary designs also showed that the wall would be 240 feet in diameter and have a circular foundation that is concentric with the existing LNG tank, which is 172 feet tall and 190 feet in diameter. National Grid indicates that the containment enhancement project construction would not overlap with proposed Project construction.

On October 22, 2015, Algonquin and Maritimes & Northeast Pipeline, LLC filed an application with FERC under Docket No. CP16-9-000 for the Atlantic Bridge Project. FERC issued its EA for this project in May 2016, and issued a Certificate authorizing the project in January 2017. The Atlantic Bridge Project involves expansion of an existing natural gas transmission pipeline system in New York, Connecticut, Massachusetts, and Maine, including construction and operation of about 6.3 miles of 42-inch-diameter pipeline to replace existing 26-inch-diameter pipeline; construction of a new compressor station and modifications to three existing compressor stations to install an additional total of 26,500 horsepower for the project; modifications to five existing metering and regulating stations and one existing regulator station; and construction of one new meter station. The Atlantic Bridge project is currently under construction and is scheduled to be competed in 2018 or 2019.

On February 28, 2014, Algonquin filed an application with FERC under Docket No. CP14-96-000 for the Algonquin Incremental Market (AIM) Project. This project involved expansion of an existing natural gas transmission pipeline system in New York, Connecticut, Rhode Island, and Massachusetts, including construction and operation of about 37.4 miles of replacement, loop, and lateral pipeline facilities; modifications to 6 existing compressor stations; modifications to 24 existing meter stations; the removal of an existing meter station; and the construction of 3 new meter stations. The project also involved the abandonment of two segments of existing mainline and four compressor units at one existing compressor station. On March 3, 2015, FERC issued a Certificate for the AIM Project. Construction of this project began in May 2015 and was completed in January 2017.

Several commenters stated that the Fields Point Liquefaction Project should be considered a connected action to the AIM and Atlantic Bridge projects, as the Project would receive its gas from Spectra Energy's pipeline system. We do not consider these projects connected actions due to the fact that each project would be constructed regardless of the status of the other projects, thereby establishing independent utility of the three separate projects.

2.9.1.2 Power Generation Projects

Invenergy, LLC is proposing to build the Clean River Energy Center, a two-unit 900-MW natural gas-fired combined-cycle power plant, in Burrillville, Rhode Island. The site is adjacent to an Algonquin natural gas pipeline and compressor station, and the electrical power generated by the power plant would be transmitted through a new 345-kV transmission line to be installed from the plant through an existing National Grid right-of-way. Construction of this power plant is scheduled to begin in 2018 and be completed in Fall 2020.

NRG Energy, Inc. is proposing the Cape Cod Canal Power Plant Expansion project to modernize the existing Canal Generating Station in Sandwich, Massachusetts. This project would serve as a peaking plant and would involve the addition of a 333-MW natural gas turbine, alongside a planned 1.5-MW solar field. Construction of this project is scheduled to begin in 2018 and be completed in Spring 2019.

Exelon West Medway II, LLC is proposing to add two natural gas turbines fueled by natural gas and ultra-low sulfur diesel at the existing West Medway Generating Station in Medway, Massachusetts. The project would add 200 MW of electricity to this station. This project is currently under construction and is anticipated to be completed in Fall 2018.

Additional projects related to power generation include the Brayton Point Power Plant retirement and the construction of one solar project and four wind farms.

2.9.1.3 Non-jurisdictional Pipeline Project

One pipeline project not under FERC jurisdiction, the Mid-Cape Main Replacement project, is being performed by National Grid and involves the replacement of approximately 16.4 miles of existing natural gas distribution mains in Yarmouth, Dennis, Harwich, and Brewster, Massachusetts. Work on the project was anticipated to commence in mid-2017, and is reported by National Grid to have an expected completion date in 2019.

2.9.1.4 Electric Transmission Projects

TNEC is proposing, is currently constructing, or has completed twelve projects in proximity to the proposed Project, as summarized below:

- 35-kV Electric Service project – This project involves upgrading the Franklin Square substation and installing new underground electric lines to the proposed Project Site. This project will provide 35 kV of primary metered electric service to the proposed Project Site. This project is identified in section 1.9 as a non-jurisdictional facility that would provide electricity to the proposed Project liquefaction facilities. This project is anticipated to be completed in 2018.

- Burrillville Interconnection Project – This project involves construction of 6.8 miles of 345-kV electrical transmission line from an existing switching station (Sherman Road SS) to an existing 345-kV transmission line to the proposed Clear River Energy Center in Burrillville, Rhode Island. This project is anticipated to commence in late 2018 at the earliest.

- Franklin Square Project – This project involves the relocation and burying of 1,300 linear feet of three existing 115-kV overhead electric transmission lines that connect the Franklin Square Substation and the South Street Substation in Providence. This project is anticipated to be completed in Summer 2019.

- E183 115-kV Transmission Line Relocation Project – This project involves construction of approximately 6,000 feet of underground 115-kV electric transmission line and relocation of approximately 1,500 feet of overhead 115-kV electric transmission line, and removal of existing overhead transmission line in the area of Providence and East Providence, Rhode Island. This project is anticipated to commence in Summer 2019.

- L190 and G185S Transmission Line Project – This project involves refurbishment of 3.1 miles of an existing 115-kV electric transmission line in North Kingstown and East Greenwich, Rhode Island. As of August 2017, construction was anticipated to commence in Spring 2018.

- J16 115-kV Transmission Line Reconductoring Project – This project involves reconductoring 2.2 miles of an existing 115-kV electric transmission line between Riverside substation in Woonsocket, Rhode Island and the Highland Park substation in Cumberland, Rhode Island. This project was competed in Spring 2017.

- V148N 115-kV Transmission Line Reconductoring Project – This project involves reconductoring 4.2 miles of existing 115-kV electric transmission line between Woonsocket substation in North Smithfield, Rhode Island and Washington substation in Lincoln, Rhode Island. This project was completed in 2016.

- G-185S 115-kV Transmission Line Reconductoring Project – This project includes reconductoring of 5.3 miles of existing 115-kV electric transmission line between the Kent County substation in Warwick, Rhode Island and the Old Baptist Road Tap Point in East Greenwich, Rhode Island. This project was completed in 2015.

- Q143S & R144 LPFF Underground Transmission Cable Replacement Project – This project includes replacement of 2.3 miles of 115-kV underground electric transmission lines between the Admiral Street substation and the Franklin Square substation, including a 700-foot-long direct buried crossing of the Providence River, in Providence. This project is estimated to be completed in July 2021.

- Q143S & R144 Refurbishment Project – This project includes reconductoring of 11.4 miles of 115-kV transmission line between the Woonsocket Substation in North Smithfield, Rhode Island and the Admiral Street Substation in Providence. This project was completed in 2014.

- South Street Substation Rebuild Project – This project involves demolition of an existing substation and control building, construction of a new substation, and placing existing overhead electric transmission lines underground, in Providence. Project construction commenced in early 2016 and is expected to be complete in 2019.

- Aquidneck Island Reliability Project - This project involves conversion of 4.4 miles of existing 69-kV electric transmission line to 115 kV in Newport, Middletown, and Portsmouth, Rhode Island. This project is currently under construction and is estimated to be completed in Spring 2020.

In addition to the projects summarized above, Northeast Utilities (Connecticut Light & Power) and New England Power Company completed the Interstate Reliability project in 2015. This project involved construction of 75 miles of new and reconstructed electric transmission lines in Connecticut, Rhode Island, and Massachusetts to improve efficiency and address weaknesses in power transmission.

2.9.1.5 Other Utility (Sewer) Project

The Narragansett Bay Commission is undertaking a three-phased combined sewer overflow project in Providence. Phase I consists of the construction of a 3-mile-long, 26-foot-wide combined sewer overflow storage tunnel connecting to the Fields Point wastewater treatment facility. Phase II consists of construction of interceptors to connect additional outfalls to the tunnel. Phase III facilities originally consisted of a combined sewer overflow tunnel and stub tunnel connecting to the Bucklin Point Wastewater Treatment Facility; however, in response to the EPA's guidance on affordability and integrated planning, the Narragansett Bay Commission reevaluated Phase III in 2013. Phase I was completed in 2008 and Phase II was completed in 2015. Phase III construction is planned for years 2019 through 2038.

2.9.1.6 Transportation-Related Projects

The Rhode Island Department of Transportation is proposing two projects within 3 miles of the proposed Project, as summarized below:

- The Providence Viaduct project is a multi-phase project that involves construction of new Interstate 95 South and North bridges, demolition of an old bridge, and construction of new and modified exit ramps, in Providence, approximately 2.3 miles from the Fields Point Project site. The southbound construction began in June 2013, and the northbound construction is scheduled to begin in Summer 2018 with a target completion date of 2021.

- The Interstate 95 Corridor Bridge Preservation and Resurfacing project includes bridge preservation efforts, as well as resurfacing and minor safety improvements for mainline highway segments and ramps, throughout the Providence, metropolitan area. Portions of this project were completed in 2016 and 2017, and it has continued into 2018.

In addition to the Rhode Island Department of Transportation projects summarized above, the Rhode Island Airport Corporation is currently implementing the Green Airport Improvement Program which includes runway lengthening and safety projects, as well as street and recreational park relocation at the T.F. Green Airport in Warwick, Rhode Island. Work began in July 2013 and concluded in December 2017.

2.9.1.7 Other Projects

Eleven other past, current, and future projects were identified in proximity of the proposed Project. These projects include a range of industrial, commercial, and residential development projects. Details for these projects are provided in appendix A.

2.9.2 Potential Cumulative Impacts of the Proposed Action

2.9.2.1 Soils and Groundwater

Properties surrounding the Project site along the Providence River are currently zoned Maritime Industrial Waterfront District, and properties west of the Project are currently zoned General Industrial, Mixed Use Industrial and Light Industrial (City of Providence, 2017). Industrial use of properties surrounding the Project dates back to at least 1901, when the Fields Point Waste Water Treatment Facility was constructed (Narragansett Bay Commission, 2017). The Fields Point Waste Water Treatment Facility is still in operation today, and occupies approximately 25 acres of land southeast of the Project site. A review of historical aerial photos shows that industrial land use was evident on properties to the north, south, and west of the Project site in the late 1930s, and industrial land use has continued uninterrupted until the present (Rhode Island Geographic System, 2017).

The Project site has been used for the production, generation, and transmission of natural gas or manufactured gas for more than 100 years, and a manufactured gas plant operated within the Project site from about 1910 to 1954. We have not found that any of the other projects listed in appendix A and discussed above are currently contributing or would likely contribute to groundwater or soil contamination on the National Grid property. Thus, these types of cumulative impacts are not expected. However, our cumulative effects analysis considers that historical activities have contributed to the current condition of contaminated soils and groundwater below the Project site. Our Project impacts analysis for contaminated soils and groundwater in sections 2.1.2 and 2.2.1, respectively, also considers this historical context. Thus, much of our cumulative impacts analysis here reiterates what was discussed above.

Although two soil remediation efforts have been performed since 1998, impacted soil and groundwater associated with the manufactured gas plant operations still exist in the fill layer, as evidenced by elevated levels of VOCs, polycyclic aromatic hydrocarbons, total petroleum hydrocarbon, metals, and cyanide. In addition, light non-aqueous phase liquids were observed in some monitoring wells screened within the fill layer. The horizontal extent of impacts includes the entire proposed Project work area. Vertically, impacts within the proposed Project work area extend through the fill layer to less than 10 feet into the organic silt layer. The thickness of the organic silt in this area of the Project site ranges from about 15 to 20 feet below ground surface, and appears to limit vertical migration of contaminants. Evidence of soil or groundwater impacts in the sand unit below the organic silt layer has not been observed in geotechnical borings performed in the proposed Project work area.

Regarding potential Project impacts on soil and groundwater, National Grid would implement mitigation measures from its 2017 STRAP and STRAP Addendum for handling, storing, and the reuse or disposal of contaminated soils and the handling and management of contaminated groundwater that would be encountered during construction. For example, suspect contaminated soils would be placed on and covered with polyethylene sheeting, and surrounded by erosion controls. In addition, if dewatering is necessary during construction, the STRAP requires all water to be containerized in fractionation tanks and disposed/recycled off-site at a licensed facility. See section 2.1.2.2 for further information on the STRAP. In addition, the types and installation methods for the foundation pilings were chosen to minimize the potential for creating vertical groundwater migration pathways. National Grid proposes to install displacement piles and micro-piles to a depth of about 50 to 90 feet below the ground surface. The installation of displacement piles causes increased lateral soil pressures around the pile, and the resulting tight pile-to-soil contact would protect against vertical migration of groundwater. Micro-piles would be installed using an auger bit and temporary casing. The auger bit and displaced soils would be removed once the required depth is obtained, and grout would then be placed into the void and the temporary casing would be removed. Additional grout would be injected under pressure to seal the bore hole and provide protection against vertical migration of groundwater. National Grid would also adhere to its Project-specific SPCC Plan, which includes spill avoidance and response procedures to minimize potential impacts of spills. See section 2.2.1.2 for further information on the SPCC Plan.

Based on these proposed mitigation measures and existing plans, the location of the Project in an area with a long history of industrial activity, and the highly localized nature of potential impacts to soil and groundwater, the Project would not significantly add to cumulative impacts on soil or groundwater resources in the Project area.

2.9.2.2 Socioeconomics

The majority of the present and reasonably foreseeable future projects and activities listed above (referred to here as "the cumulative projects") could cumulatively impact socioeconomic conditions in the Project area due to their presence in or adjacent to Providence County. Employment, tax revenue, housing, public services, and infrastructure could experience both beneficial and detrimental impacts.

The Project's socioeconomic impacts are described in section 2.5, and include temporary changes in population levels or local demographics, increased opportunities for employment, increased demand for housing and public services, changes in traffic patterns, and an increase in government revenue associated with sales, payroll, and property taxes.

The cumulative projects would generate additional temporary employment from construction jobs, as well as provide an influx of associated spending on local goods and services, including temporary housing. This spending influx would provide a temporary economic benefit to the individuals and communities in the Project area. During operation of the Project, along with operation of the other projects listed above, annual tax revenue income would increase and permanent employment would slightly increase. While the magnitude of these changes cannot be calculated, we conclude that these cumulative positive impacts would be minor, compared to the overall employment and economic activity in the Providence metropolitan area.

Based on the geographic location of the cumulative projects—up to 41 miles from the Project site—the potential commuting distance for local workers likely includes much of Rhode

Island, as well as portions of Massachusetts and eastern Connecticut. The size of the workforce in the City of Providence (as cited in table 2.5.1-1), as well as the larger workforce within this commuting area reduces the magnitude of an influx of non-local construction workers for the cumulative projects. To the degree that such an influx occurs, these additional workers would temporarily impact housing availability and demand for public services in the Providence metropolitan area during construction of the cumulative projects. The vacancy rates and the number of rental housing units and hotel/motel rooms in the Project area are sufficient to absorb this influx, and increased service demands would not exceed existing capacity. Based on these findings, and the share of construction workers who would already be local residents, we conclude that negative impacts on housing and public services would be minor (if not negligible) and temporary.

Operation of the cumulative pipeline and electrical transmission projects, along with the containment enhancement project, and combined sewer overflow project will generate a negligible number of vehicle trips, limited to occasional monitoring and maintenance. Industrial and residential developments, along with improvements at T.F. Green Airport are likely to generate larger traffic volumes, while the Providence Viaduct and Interstate 95 Corridor Bridge Preservation and Resurfacing projects will improve traffic congestion and flow. Construction of the Project could occur within the same timeframe as cumulative projects, and could potentially result in cumulative traffic impacts, particularly along Interstate 95 and U.S. Highway 1, although, as described in section 2.5.4, the number of Project-related construction trips would be negligible compared to existing traffic on these major roads. Operation of the Project would also result in a negligible increase (less than 100 trips per week) in daily vehicle traffic entering and exiting the Project site. Due to the limited traffic impacts expected from the Project and other cumulative impacts projects identified in appendix A, we conclude that construction and operation of the Project would have temporary and minor cumulative effects on traffic.

The majority of the City of Providence (including much of the area surrounding the Project site) meets EPA criteria related to both race and income status for the potential presence of environmental justice concerns. These potential concerns notwithstanding, construction-phase impacts such as traffic and worker influx would be temporary. Operation of the Project would not meaningfully change the number of truck trips to and from the Project area. Further, as discussed in section 2.9.2.2, the Project would create only minor sources of air emissions. Due to the limited impacts environmenetal justice populations expected from the Project and other cumulative impacts projects identified in appendix A, we conclude that the Project would not result in adverse cumulative impacts on environmental justice populations (see section 2.5.7).

2.9.2.3 Air Quality

Cumulative construction projects within 0.25 mile of the Project include the containment enhancement project and a 35-kV electric service upgrade project. However, the construction timelines for these projects and other identified projects would not overlap with the proposed Project timeline; therefore, no cumulative impacts on air quality are expected as a result of Project construction.

As discussed and illustrated by the refined modeling results summarized in section 2.7.1, operation of the Project's liquefaction equipment would contribute minor additions of pollutant emissions to the general environment, and would negligibly increase the ambient pollutant concentrations in the Providence County metropolitan area over existing levels. Project pollutant concentrations would quickly blend into existing ambient concentrations within a short distance from the Fields Point LNG Facility property boundaries, and the Project site. In addition, the actual emissions from the modified Fields Point LNG Facility as a whole (i.e., after the Project facilities go into operation), would likely be less than the potential emissions summarized in table 2.7.1-5; therefore, the refined modeling results for the Project and the potential emissions from the modified Fields Point LNG Facility represent an unlikely worst-case scenario. We find that a 10-kilometer radius geographic scope fully encompasses the area within which cumulative air emission impacts from the Project, and the modified Fields Point LNG Facility, could potentially occur. [37]

The nearest existing major point sources of emissions to the Project site identified in appendix A are the Algonquin Incremental Market Project, the Clear River Energy Center, the West Medway Generating Station, and the Cape Cod Power Plant Expansion (all well outside the defined geographic scope). As with the emissions from the proposed Project's emission sources, the pollutant concentrations of the emissions from the these nearest point source facilities would drop sharply with distance, and blend into existing background concentrations within a few kilometers from each source.[38] The containment enhancement project and non-jurisdictional facilities would not generate emissions during operation. Thus, we conclude that the Project would result in minimal cumulative air quality impacts when considered with the past, present, and reasonably foreseeable projects in the Project area. Further, as concluded in section 2.7.1, the Project's operational emissions included in the refined modeling analysis for the proposed modified Fields Point LNG Facility, when combined with existing ambient concentrations, would remain below the NAAQS, and therefore the Project's cumulative impact on local Providence area air quality, as well as regional air quality, would not be significant.[39]

All GHG emissions from the Project and cumulative projects contribute to the global budget in terms of their potential for climate change impacts but do not influence local air quality. Climate change impacts are discussed below.

2.9.2.4 Noise

Cumulative construction projects within 1 mile of the Project include the containment enhancement project and 35-kV electric service upgrade project. However, construction of these projects and other identified projects would not overlap with the proposed Project timeline; therefore, no cumulative impacts on noise are expected as a result of Project construction.

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37 We have found that Significant Impact Level analyses for considerably larger sources of air emissions than what the Project proposes, carried out to determine the need to perform refined air modeling with nearby emission sources to assess potential cumulative air impacts, determine that pollutant concentrations drop below Significant Impact Levels for which a refined analysis would be required to determine cumulative air impacts at distances of a few kilometers or less from the source.

38 The AIM Project was placed into service in January 2017, and therefore is already contributing to existing ambient background concentrations of air pollutants in the airsheds within which its respective emission sources operate.

39 We note that the retirement of the 1,500 MW coal-fired Brayton Point Power Plant identified in appendix A, recently decommissioned in 2017 and less than 12 miles from the Project site, resulted in positive impacts on regional air quality.

As discussed in section 2.7.2, the Project facilities would generate noise during operation. The containment enhancement project and electric service upgrade facility would not produce noise during operation. As summarized in appendix A, no existing or reasonably foreseeable facility having the potential to produce noise during operation falls within the geographic scope defined by a 1-mile radius.

Based on our analysis above, we do not anticipate significant cumulative noise impacts from construction or operation of the Project when considered with other nearby past, present, or reasonably foreseeable projects.

2.9.2.5 Climate Change

Commenters noted that there would be impacts on air quality from VOCs and that the proposed action would contribute to climate change due to the potential of various Project components to emit GHGs. In addition, commenters asserted that the Project would result in an increase in fracking activity within the Marcellus Shale region, including emissions contributing to 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 (U.S. Global Change Research Program, 2017).

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 GHGs 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 20^{th}, and into the 21^{st} century. Climate change is a global concern; however, for this analysis, we will focus on the potential cumulative climate change impacts on the Project area.

The following observations of environmental impacts with a high or very high level of confidence are attributed to climate change in the Northeast region (Melillo, Richmond, Yohe, 2014; NOAA, 2017; U.S. Global Change Research Program, 2017):

- average temperatures have risen about 2 °F between 1895 and 2011 and are projected to increase another 1 to 8 °F over the next several decades with more frequent days above 90 °F;
- areas that currently experience ozone pollution problems are projected to experience an increase in the number of days that fail to meet the federal air quality standards;

- an increase in health risks and costs for vulnerable populations due to projected additional heat stress and poor air quality;

- winter precipitation is projected to increase 5 to 20 percent by the end of the century;

- extreme/heavy precipitation events have increased more than 70 percent between 1958 and 2010 and are projected to continue to increase;

- sea levels have risen about 1 foot since 1900 and are projected to continue increasing 1 to 4 feet by year 2100 stressing infrastructure (e.g. communications, energy, transportation, water and wastewater);

- severe flooding due to sea-level rise and heavy downpours is likely to occur more frequently;[40]

- crop damage from intense precipitation events, delays in crop plantings and harvest, and heat stress negatively affect crop yields;

- invasive weeds are projected to become more aggressive due to their benefit of higher CO_2 levels;

- a change in range, elevation, and intra-annual life cycle events of vegetation and wildlife species; and

- an increase in carrier habitat and human exposure to vector-borne diseases (e.g. Lyme disease, Zika, Chikamunya, or West Nile).

The rate and magnitude of expected changes will exceed those experienced in the last century. Rhode Island's municipalities are in the preliminary stages of integrating planning for sea level rise and climate change into their comprehensive planning process (State of Rhode Island Division of Statewide Planning, 2015a; 2015b).

We have presented the GHG emissions associated with construction and operation of the Project in section 2.7.1. These emissions would increase the atmospheric concentration of GHGs, in combination with past and future emissions from all other sources, and would contribute incrementally to climate change that produces the impacts previously described. But there is no widely accepted standard established by international or federal policy or by a recognized scientific body to ascribe significance to a given rate or volume of GHG emissions.

Commentors assert that the Project would result in an increase in fracking activity within the Marcellus Shale region. Natural gas production is not causally related to the proposed action, and no production activites fall within the geographic scope for our cumulative impacts analysis;

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[40] See the January 2017 NOAA Technical Report NOS CO-OPS 083, *Global and Regional Sea Level Rise Scenarios for the United States*, available at: https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf.

therefore, natural gas production emissions are not considered as part of this NEPA review. We will analyze upstream environmental effects when those effects are sufficiently causally connected to a proposed project and are reasonably foreseeable, as contemplated by CEQ's regulations.

We received comments that the Commission should employ the Social Cost of Carbon (SCC) tool to inform its environmental review for the Project. We recognize the availability of the SCC tool; however, the Commission has previously indicated[41] that it is not appropriate for use in our project-specific analyses for the following reasons: (1) the incorporation of the SCC tool into our review under NEPA cannot meaningfully inform the Commission's decision whether and how to authorize a proposed project under the NGA; (2) the Commission does not use monetized cost-benefit analyses as part of the review under NEPA or the decision under the NGA; and (3) the SCC tool has methodological limitations (e.g., different discount rates introduce substantial variation in results and no basis exists to designate a particular monetized value as significant) that limit the tool's usefulness in the review under NEPA and the decision under the NGA. As such, FERC staff did not use the SCC tool in this NEPA analysis.

In December 2013, the governors of the six New England states agreed to an energy initiative designed to bring affordable, cleaner, and more reliable power to homes and businesses across the northeast. This would be accomplished through cooperative investments in energy efficiency, renewable generation, natural gas pipelines, and electric transmission (New England Governors, 2013). National Grid's proposed Project would provide an additional means to supply the New England region with natural gas for use during the peak heating season, and would therefore be consistent with this initiative.

2.9.2.6 Conclusion

Based on our analysis, we conclude that the potential exists for cumulative impacts on soils, groundwater, socioeconomics (including environmental justice and traffic), air quality, and noise. However, our analysis concludes that the Project effects on these resources, when combined with impacts from other projects in the geographic scope, including construction and operation of the containment enhancement project, the non-jurisdictional facilities, and projects identified in appendix A, would not result in significant cumulative impacts. Additionally, potential impacts on sensitive resources resulting from these projects would be mitigated, as appropriate, and mitigation generally leads to the minimization of cumulative impacts. Therefore, we conclude that the construction and operation of the Project, when combined with other past, present, and foreseeable future projects, would not result in significant cumulative impacts on these resources. Furthermore, for the reasons stated in section 2.9.2.6 above, we cannot determine whether the Project's contribution to climate change would be discretely or cumulatively significant.

[41] Order on Remand Reinstating Certificate and Abandonment Authorization, Southeast Market Pipelines Project (SMP Project) CP14-554-002, CP15-16-003, CP15-17-002, March 14, 2018.

3.0 ALTERNATIVES

In accordance with NEPA and Commission policy, we evaluated alternatives to National Grid's proposed action including the no-action alternative, system alternatives, energy alternatives, and site alternatives. These alternatives were evaluated using a specific set of criteria to determine whether they would be preferable to constructing the Project as proposed. Our evaluation criteria for selecting potentially preferable alternatives are:

- ability to meet the objectives of the proposed Project summarized in section 1.3 (i.e., add liquefaction capability to National Grid's existing Fields Point LNG Facility to enable customers to deliver natural gas in vapor form for liquefaction and storage to supplement existing LNG deliveries by tanker truck);
- technical and economic feasibility and practicality; and
- significant environmental advantage over the proposed Project.

Our evaluation of alternatives is based on: Project-specific information provided by the applicant; stakeholder comments; publicly available information; our consultations with federal and state resource agencies; and our expertise and experience regarding the siting, construction, and operation of natural gas facilities and their potential impact on the environment.

3.1 NO-ACTION ALTERNATIVE

Under the no-action alternative, the Project would not be constructed; thus, the impacts described in section 2 that would result from the construction and operation of the Project would not occur. However, National Grid customers would continue to deliver imported LNG for storage via tanker truck from the Boston area, which incurs certain impacts which would be continued if the no-action alternative is selected. Further, the purpose of the Project would not be met and the benefits of the Project would not be realized. According to National Grid, without the Project, its LNG storage customers would continue to encounter supply constraint issues and the LNG price volatility of overseas markets, and in general, continue to be wholly dependent on LNG derived from imported sources. The Project would allow customers the opportunity to fully utilize an existing interstate pipeline to utilize a reliable domestic natural gas supply at National Grid's existing Fields Point LNG Facility.

Although the no-action alternative would not result in any new or adverse impacts, failure to construct the Project would not meet the Project's purpose and need described in section 1.3. We have concluded that construction and operation of the proposed Project would entail minor alteration of the existing LNG storage systems, and that impacts associated with the proposed new facilities would be minimal. Therefore, we do not recommend the no-action alternative.

3.2 SYSTEM ALTERNATIVES

System alternatives would make use of other existing, modified, or proposed systems to meet the stated objectives of the Project. Because National Grid's stated purpose for the Project is to add liquefaction capability to its existing Fields Point LNG Facility (and, as further explained in section 3.4, identified site alternatives would require the construction of similar liquefaction facilities in order to serve National Grid's stated purpose and need) we did not identify any system alternatives that would meet the stated objectives of the Project or provide any significant environmental advantage over the proposed Project.

3.3 ENERGY ALTERNATIVES

We received several comments suggesting that renewable energy alternatives including but not limited to wind power, solar power, and hydropower be used in lieu of natural gas. While these alternatives may have the potential to provide part or all of the energy required in specific applications, as described in section 1.3, the purpose and need for the Project is to add liquefaction capability to National Grid's existing Fields Point LNG Facility to provide its customers with an alternative means to fill their contracted LNG storage capacity using pipeline-sourced natural gas as an alternative to LNG delivered by truck. Because the purpose of the Project is to liquefy natural gas for storage and revaporization during the peak heating season on an as-needed, on-demand basis, the development or use of currently feasible renewable energy technologies cannot function in a peak shaving capacity similar to the proposed Project or provide energy in the form and quantities demanded by the Project's customers and therefore cannot be considered a feasible Project alternative.

Comments were also received regarding energy conservation. The objective of energy conservation is to reduce total energy consumption, as opposed to energy consumption that occurs during times of peak demand. The Project would supplement National Grid's existing Fields Point LNG Facility peak shaving operations and would only be used when the pipeline infrastructure in the region cannot accommodate the overall natural gas demand (typically, during the coldest days of the heating season). Although energy conservation initiatives within areas served by National Grid's facility could help to alleviate the facility's overall peak shaving demands, energy conservation is not an alternative to the proposed Project because energy saved by any such conservation measures does not eliminate the need for peak shaving services, such as those provided by National Grid's existing and proposed modified Fields Point LNG Facility.

3.4 SITE ALTERNATIVES

National Grid considered a total of five alternative locations for the siting of the Project. Four of these alternative sites are National Grid affiliate-owned and include existing storage tanks, peak shaving facilities, and access to natural gas pipelines. These sites include the Cumberland LNG facility in Cumberland, Rhode Island; the Commercial Point LNG facility in Dorchester, Massachusetts; the Lynn LNG facility in Lynn, Massachusetts; and the Tewksbury LNG facility in Tewksbury, Massachusetts. National Grid also identified a greenfield site in Burrillville, Rhode Island.

We considered the four sites with existing LNG facilities. These locations contain storage tanks that range in size from 23,900 to 331,000 barrels, which is 4 to 55 percent of the volume of the existing tank at the Fields Point site, and would not meet the capacity required for the Project. In addition, the current LNG truck traffic to these sites is much less than the traffic to the

Project site and would need to increase considerably to meet the objectives of the Project,[42] resulting in air quality and noise impacts in the vicinity of each site and the Fields Point LNG Facility, and further adding to the traffic congestion of the area. Due to the land disturbance required for construction of additional LNG storage capacity (i.e., a new or larger LNG tank) and increased truck traffic that would be required to transport LNG produced at these sites to the Fields Point LNG Facility, constructing equivalent liquefaction facilities at any of these sites capable of serving National Grid's stated purpose and need for the Project would not present a significant environmental advantage over the proposed Project, and would likely result in substantially greater environmental impacts.

The greenfield site in Burrillville is mostly forested and would require substantial tree clearing and grading to construct a new LNG storage tank as well as associated utilities required to operate in a peak shaving capacity similar to National Grid's existing Fields Point LNG Facility. As with the four sites with existing facilities, the Burrillville site would also require that LNG produced be transported by truck to the Fields Point LNG Facility. The required land disturbance, tree clearing, and truck traffic would result in considerably greater environmental impacts relative to the proposed Project.

Use of any of the above alternate sites to construct the Project facilities would result in greater environmental impacts when compared to the limited environmental impacts associated with the proposed modification of the existing Fields Point LNG Facility. Based on these reasons, we conclude that the proposed Project is the preferred alternative that meets the Project's stated objectives.

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[42] The four sites considered here would only be capable of serving as liquefaction facilities, and cannot provide peak shaving services to the Project area currently served by the existing Fields Point LNG Facility. In order to meet the Project objectives, LNG produced at these sites would need to be transported by truck to the existing Fields Point LNG Facility to serve its peak shaving needs.

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4.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon the analysis in this EA, we have determined that if National Grid constructs and operates the proposed facilities in accordance with its application, supplements, Project-specific plans, and the staff's recommended mitigation measures below, approval of the Project would not constitute a major federal action significantly affecting the quality of the human environment.

The staff recommends that the Commission Order contain a finding of no significant impact and the following mitigation measures be included as conditions of any Certificate of Public Convenience and Necessity the Commission may issue.

1. National Grid shall follow the construction procedures and mitigation measures described in its application, supplemental filings (including responses to staff data requests), and as identified in the EA, unless modified by the Order. National Grid 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 the OEP **before using that modification**.

2. 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. **Prior to any construction**, National Grid 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.

4. The authorized facility locations shall be as shown in the EA, as supplemented by filed maps and diagrams. **As soon as they are available, and before the start of construction**, National Grid shall file with the Secretary any revised maps or diagrams 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 maps/diagrams.

5. National Grid shall file with the Secretary detailed maps/diagrams and aerial photographs at a scale not smaller than 1:6,000 identifying any facility relocations, and staging areas, storage yards, 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/diagrams/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

6. **Within 60 days of the acceptance of the Certificate and before construction begins**, National Grid shall file an Implementation Plan for the Project for review and written approval by the Director of OEP. National Grid must file revisions to the plan as schedules change. The plan shall identify:

    a. how National Grid 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 National Grid 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 on-site construction and inspection personnel;

    c. 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 National Grid will give to all personnel involved with construction and restoration (initial and refresher training as the project progresses and personnel change);

    f. the company personnel (if known) and specific portion of National Grid 's organization having responsibility for compliance;

g. the procedures (including use of contract penalties) National Grid 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 on-site personnel;

(3) the start of construction; and

(4) the start and completion of restoration.

7. National Grid shall employ at least one EI. The EI shall be:

a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or other authorizing documents;

b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 6 above) and any other authorizing document;

c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;

d. a full-time position, separate from all other activity inspectors;

e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and

f. responsible for maintaining status reports.

8. Beginning with the filing of its Implementation Plan, National Grid shall file updated status reports with the Secretary on a **monthly** basis 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 National Grid'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 National Grid from other federal, state, or local permitting agencies concerning instances of noncompliance, and National Grid's response.

9. National Grid shall employ a special inspector during construction, and a copy of the special inspector's reports shall be included in the **monthly** status reports filed with the Secretary (see condition 8 above). The special inspector shall be responsible for:

a. observing the construction of the liquefaction facility to be certain it conforms to the design drawings and specifications;

b. furnishing inspection reports to the engineer- or architect- of-record and other designated persons. All discrepancies shall be brought to the immediate attention of the contractor for correction, and then if uncorrected, to the engineer- or architect- of-record; and

c. submitting a final signed report stating whether the work requiring special inspection was, to the best of his/her knowledge, in conformance with the approved plans and specifications and the applicable workmanship provisions.

10. National Grid must receive written authorization from the Director of OEP **before commencing construction of any Project facilities**. To obtain such authorization, National Grid must file with the Secretary documentation that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).

11. **Prior to construction of final design**, National Grid shall file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Rhode Island:

a. quality assurance and quality control procedures to be used for civil/structural design and construction;

b. site preparation drawing and specifications;

c. pile installation drawings and specifications;

d. seismic specifications for procured equipment prior to the issuing of requests for quotations;

e. LNG facility structures and foundation design drawings and calculations (including prefabricated and field-constructed structures); and

f. condition assessment evaluation of representative existing piles supporting pre-existing structural foundations.

12. National Grid 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.

13. **Prior to commencement of service**, National Grid shall file with the Secretary a surface maintenance plan for perimeter berm, stamped and sealed by the professional engineer-of-record, registered in Rhode Island. The surface maintenance plan shall include procedures to ensure 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.

14. National Grid must receive written authorization from the Director of OEP **before placing into service the liquefaction facility and other components of the Project**. 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 areas affected by the Project are proceeding satisfactorily.

15. **Within 30 days of placing the authorized facilities in service,** National Grid 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 National Grid 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.

16. National Grid shall file a full load noise survey with the Secretary **no later than 60 days** after placing the modified Fields Point LNG Facility in service. If a full load condition noise survey is not possible, National Grid shall provide an interim survey at the maximum possible operation and file the full load operational survey **within 6 months**. If the noise attributable to the operation of all of the equipment at the modified Fields Point LNG Facility, under interim or full load conditions, exceeds an L_{dn} of 55 dBA at any nearby NSAs, National Grid 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. National Grid shall confirm compliance with the above requirement by filing a second

noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls.

The following conditions shall apply to this Project. 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 (Dec. 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 will be subject to public disclosure. All information shall be filed a minimum of 30 days before approval to proceed is requested.

17. **Prior to initial site preparation**, National Grid shall file an overall Project schedule, which includes the proposed stages of the commissioning plan.

18. **Prior to initial site preparation**, National Grid shall file quality assurance and quality control procedures for construction activities.

19. **Prior to initial site preparation**, National Grid shall file procedures for controlling access during construction.

20. **Prior to construction of the final design,** National Grid shall specify fire protection systems, uninterruptable power supply, emergency power generators, emergency lighting, radio communications system, control valves, instrumentation, and shutdown systems associated with the LNG storage tanks and their isolation as Seismic Category I.

21. **Prior to construction of the final design**, National Grid shall file change logs that list and explain any changes made from the FEED provided in National Grid's application and filings. A list of all changes with an explanation for the design alteration shall be filed and all changes shall be clearly indicated on all diagrams and drawings.

22. **Prior to construction of the final design**, National Grid shall file information/revisions pertaining to National Grid's response numbers 8, 22, 33, 50, 54, 55, 64, and 67 of its September 16, 2017 filing; response numbers 9 and 114 of its September 23, 2016 filing; response number 71 of its September 26, 2016 filing; response numbers 1 and 13 of its May 12, 2017 filing; response number 2 of its June 23, 2017 filing; response numbers 11, 12, 15, and 17 of its October 30, 2017 filing; response numbers 1, 3, 6, 10, and 11 of its March 9, 2018 filing; response numbers 2, 4, 6, 8, and 10 of its April 16, 2018 filing; and response number 1 of its May 4, 2018 filing, which indicated features to be included or considered in the final design.

23. **Prior to construction of the final design**, National Grid shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.

24. **Prior to construction of the final design**, National Grid shall file an up-to-date complete equipment list, process and mechanical data sheets, and specifications.

25. **Prior to construction of the final design**, National Grid shall file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.

26. **Prior to construction of the final design**, National Grid shall file up-to-date Process Flow Diagrams with heat and material balances and one complete set of P&IDs, which include the following information:

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

    b. equipment insulation type and thickness;

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

    d. piping with line number, piping class specification, size, and insulation type and thickness;

    e. piping specification breaks and insulation limits;

    f. all control and manual valves numbered;

    g. relief valves with size and set points; and

    h. drawing revision number and date.

27. **Prior to construction of the final design**, National Grid shall file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect the Project to the existing LNG facility.

28. **Prior to construction of the final design**, National Grid shall file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs.

29. **Prior to construction of the final design**, National Grid shall file a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A list of recommendations resulting from its review and actions taken on the recommendations shall also be included.

30. **Prior to construction of the final design**, National Grid shall file the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and set points.

31. **Prior to construction of the final design**, National Grid 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.

32. **Prior to construction of the final design**, National Grid shall specify that piping specifications for stainless steel piping capable of operating at cryogenic temperatures shall require the inner and outer ring of spiral wound gaskets to be stainless steel.

33. **Prior to construction of the final design**, National Grid shall file the sizing basis and capacity for the final design of the vent stack as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.

34. **Prior to construction of the final design**, National Grid shall file electrical area classification drawings.

35. **Prior to construction of the final design**, National Grid 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 (2001 edition).

36. **Prior to construction of the final design**, National Grid 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.

37. **Prior to construction of the final design**, National Grid shall provide a means to remove mercury as part of the design to limit concentrations to less than 0.01 micrograms per normal cubic meter or alternatively provide monitoring for mercury by means of an analyzer or preventative maintenance inspections of the heat exchangers and connections for a mercury removal package.

38. **Prior to construction of the final design**, National Grid shall include provisions in the facility plot plan for the possible future installment of a mercury removal system.

39. **Prior to construction of the final design**, National Grid shall file procedures and a method to monitor the LNG density from the liquefaction process facilities to the existing LNG storage tank to aide in the selection of top or bottom fill of the tank and to prevent tank rollover.

40. **Prior to construction of the final design**, National Grid shall file the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3, as required by 49 CFR 193.

41. **Prior to construction of the final design**, National Grid 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 required by 49 CFR 193,

and shall provide justification if National Grid is not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.

42. **Prior to construction of the final design**, National Grid shall file an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A (2001 edition), Chapter 9.1.2 as required by 49 CFR 193. A list of recommendations resulting from its evaluation, supporting justifications, and actions taken on the recommendations shall also be included.

43. **Prior to construction of the final design**, National Grid shall specify that all emergency shutdown valves are to be equipped with open and closed position switches connected to the Distributed Control System/Safety Instrumented System.

44. **Prior to construction of the final design**, National Grid 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 will be accessible during an emergency.

45. **Prior to construction of the final design**, National Grid shall file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments.

46. **Prior to construction of the final design**, National Grid shall file a revised spill conveyance and sump box design that will prevent spills from reaching the cold box and compander foundation.

47. **Prior to construction of the final design**, National Grid shall demonstrate how an LNG spill from the LNG liquefaction rundown line will be safely transferred from the elevated diversion tray to the grade-level liquefaction area trench system and also into the trench system to the existing LNG storage tank containment sump.

48. **Prior to construction of the final design**, National Grid shall file an evaluation of how its impoundment rainwater removal systems complies with 49 CFR 193.2173 with concurrence from PHMSA or how it provides an equivalent level of safety with concurrence from PHMSA.

49. **Prior to construction of the final design**, National Grid 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. In addition, National Grid shall include in the final design oxygen sensors to be installed in the liquid nitrogen storage area.

50. **Prior to construction of the final design**, National Grid shall file a technical review of its proposed facility design that:

   a. identifies all combustion/ventilation air intake for equipment and buildings and the distances to any possible hazardous fluid release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and

   b. demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices will isolate or shut down any combustion or ventilation equipment whose continued operation could add to or sustain an emergency.

51. **Prior to construction of the final design**, National Grid shall file complete plan drawings and a list of the fixed and wheeled, dry-chemical, and hand-held fire extinguishers, and other hazard control equipment. Drawings shall clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list shall include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units.

52. **Prior to construction of the final design**, National Grid shall file facility plans and drawings that show the location of the firewater and foam systems. Plan drawings shall clearly show the planned 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 system.

53. **Prior to construction of the final design**, National Grid 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 Distributed Control System and recorded. The firewater main header pressure transmitter shall also be connected to the Distributed Control System and recorded.

54. **Prior to construction of the final design**, National Grid shall specify that it will install a minimum of two firewater jockey pumps.

55. **Prior to construction of the final design**, National Grid shall certify that the final design is consistent with the information provided to the DOT as described in the design spill determination letter dated June 28, 2017 (Accession Number 20170628-4002). In the event that any modification to the design alters the candidate design spills on which the 49 CFR 193 siting analysis was based, National Grid shall consult with the DOT on any actions necessary to comply with Part 193.

56. **Prior to construction of the final design**, National Grid shall file the final design details of the pipe shrouding that demonstrates how the shroud design accounts the mechanical

forces from a release at maximum pressures and thermal stresses and shock from sudden cryogenic temperatures of a LNG release. In addition, the final design shall consider the installation of the pipe shrouding to ensure that operation and maintenance of equipment and valves is not impacted.

57. **Prior to construction of the final design**, National Grid shall file procedures to maintain and inspect the vapor barriers provided to meet the siting provisions of 49 CFR 193.2059.

58. **Prior to commissioning**, National Grid shall file an updated emergency procedures to include the Project facilities as well as instructions to handle onsite emergencies related to the hazardous project fluids.

59. **Prior to commissioning**, National Grid 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. National Grid shall file documentation certifying that each of these milestones has been completed before issuance of any authorization by the Director of OEP to commence the next phase of commissioning and startup.

60. **Prior to commissioning**, National Grid shall file plans and detailed procedures for testing the integrity of onsite mechanical installation, functional tests, introduction of hazardous fluids, operational tests, and placing the equipment into service.

61. **Prior to commissioning**, National Grid shall tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.

62. **Prior to commissioning**, National Grid shall file a tabulated list and drawings of the proposed hand-held fire extinguishers. The list shall include the equipment tag number, extinguishing agent type, capacity, number, and location. The drawings shall show the extinguishing agent type, capacity, and tag number of all hand-held fire extinguishers.

63. **Prior to commissioning**, National Grid shall file updates, addressing the Project facilities, in the existing operation and maintenance procedures and manuals, as well as safety procedures.

64. **Prior to commissioning**, National Grid shall provide a detailed training log that demonstrates all operating staff has completed required training.

65. **Prior to introduction of hazardous fluids**, National Grid shall file an evaluation on the snow volume allowance criteria for impoundments that demonstrates National Grid's assertion that a potential LNG spill would sink beneath the snow or provide snow removal procedures that include the new LNG Pump Loading Skid Sub-Containment Sump or include an adequate snow volume allowance with quantitative justification.

66. **Prior to introduction of hazardous fluids**, National Grid shall complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated

with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system.

67. **Prior to introduction of hazardous fluids**, National Grid shall complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s).

68. **Prior to LNG production**, National Grid shall receive written authorization from the Director of OEP. After producing LNG, National Grid 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 liquefaction train, LNG storage inventories in the storage tank, and anticipated and actual sendout volumes. 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**.

69. **Prior to commencement of service**, National Grid shall update procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by National Grid staff.

70. **Prior to commencement of service**, National Grid shall label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001 edition).

71. **Prior to commencement of service**, National Grid shall notify the FERC staff of any proposed revisions to the security plan and physical security of the plant.

The following measures shall apply **throughout the life** of the Project facilities:

72. The facilities shall be subject to regular FERC staff technical reviews and site inspections on at least a **biennial** basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, National Grid 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 piping and instrumentation diagrams 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.

73. National Grid shall report any design modifications and operating problems for the Project facilities in the **semi-annual** operational reports filed with the Secretary for the facility.

74. **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., liquefied and vaporized quantities, boil off/flash gas, number and volume of trucking, etc.); and plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to, 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 will provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities.

75. The plant's incident reporting 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 FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to FERC staff **within 24 hours**. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids related incidents include:

a. fire;

b. explosion;

c. estimated property damage of $50,000 or more;

d. death or personal injury necessitating in-patient hospitalization;

e. release of hazardous fluids for five minutes or more;

f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents to hazardous fluids 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 LNG facility to cease operations. Following the initial company notification, FERC staff will 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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Environmental Resources Management 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.

APPENDIX A

Existing or proposed projects evaluated for potential cumulative impacts associated with the proposed Project liquefaction facilities

Existing or Proposed Projects Evaluated for Potential Cumulative Impacts Associated with the Liquefaction Facilities				
Project description	Approximate distance from project (miles)	Status	Resources affected	
			Construction	Operation
Containment Enhancement Project (also known as the "Bund Wall Project"): Storage tank containment enhancement currently being contemplated by National Grid. The Containment Enhancement Project would include the construction of a concrete wall located around an existing LNG tank. The work would be performed completely within the existing tank containment area on the plot to the east of the Fields Point Liquefaction Project. Source: National Grid LNG, LLC, 2017	0.0	no schedule available	socioeconomics (employment, tax revenue, transportation); air quality; noise; climate change	none
Atlantic Bridge Project (FERC Docket No.: CP16-9-000): Expansion of the Algonquin and Maritimes pipeline systems. The project will provide additional capacity to move natural gas into New England and Canada. The additional natural gas supply will increase energy reliability in the region. Additions and modifications include 6.3 miles of pipeline replacement, modifications at two compressor stations, and one new compressor station. Source: https://elibrary.ferc.gov/idmws/file_list.asp?document_id=14390611; National Grid LNG, LLC, 2017	41	estimated construction period: 2017-2018; estimated in-service 2018-2019	socioeconomics (employment, tax revenue, transportation); air quality; climate change	socioeconomics (tax revenue, transportation); air quality; climate change
Algonquin Incremental Market (FERC Docket No.: CP14-96-000): Expansion of the capacity of the existing Algonquin Gas Transmission Line. Approximately 37 miles of replaced or modified pipeline; construction of compressor stations and meter stations. Source: https://www.ferc.gov/industries/gas/enviro/eis/2015/01-23-15-eis.asp; http://www.naturalgasintel.com/articles/109045-remaining-aim-facilities-up-and-running-algonquin-gas-transmission-says	16.6	in-service January 2017	not applicable	socioeconomics (tax revenue, transportation); air quality; climate change
Clear River Energy Center: Proposed 900 MW natural gas-fired power plant to be constructed in Burrillville, RI. The proposed plant will help combat the forecast 10,000 MW shortfall forecast for the region and replace coal fired and oil burning plants currently relied upon to keep up with the region's energy demand. Sources: http://clearriverenergycenter.com; National Grid LNG, LLC, 2017	22.3	estimated construction to start 2018; estimated in-service Summer 2021	socioeconomics (employment, tax revenue, transportation); air quality; climate change	socioeconomics (tax revenue, transportation, public services); air quality; climate change

Existing or Proposed Projects Evaluated for Potential Cumulative Impacts Associated with the Liquefaction Facilities

Project description	Approximate distance from project (miles)	Status	Resources affected	
			Construction	Operation
Cape Cod Canal Power Plant Expansion: The Expansion would include the installation of a 1.5-MW solar field and the construction of a 330-MW natural gas-fired turbine. Source: http://www.capecodtimes.com/article/20150716/NEWS/150719565; National Grid LNG, LLC, 2017	46	estimated completion June 2019	air quality; climate change	air quality; climate change
West Medway Generating Station: Proposed addition of two 100-MW dual-fuel (natural gas and ultra-low sulfur diesel oil) combustion turbine generators on an adjacent site to Exelon's existing Medway, MA Generating Station. Source: http://www.businesswire.com/news/home/20150805006729/en/Gemma-Power-Systems-Wins-Contract-Build-Exelon; National Grid LNG, LLC, 2017	24	estimated completion June 2018	air quality; climate change	air quality; climate change
Brayton Point Power Plant Retirement: Retirement of a 1,500-MW coal-fired power plant in Somerset, MA. Source: https://www.bostonglobe.com/business/2014/01/27/must-run-coal-plant-shut-down/O7YN3tbgFvxVEdxBgM8siM/story.html; National Grid LNG, LLC, 2017	11.8	decommissioned in 2017	air quality; climate change	air quality; climate change
Forbes Street Landfill Solar Project: Completed 3.7-MW, direct current solar power project at the closed Forbes Street Landfill. The project is expected to produce 5000 MW-hours of electricity annually. Source: National Grid LNG, LLC	3.3	completed in 2014	not applicable	visual resources; socioeconomics (tax revenue, public services); air quality; climate change
Block Island Wind Farm Project: Completed 30-MW offshore wind farm approximately 3 miles southeast of Block Island, RI, as well as submarine cables connecting the wind turbine generators to each other, to Block Island, and to mainland Rhode Island. Sources: http://dwwind.com/press/americas-first-offshore-wind-farm-powers/; National Grid LNG, LLC	44	operational in December 2016	air quality; climate change	air quality; climate change
South Fork Wind: Proposed 90-MW wind farm approximately 30 miles south of mainland Massachusetts, which will deliver energy to East Hampton, NY. Source: National Grid LNG, LLC	50	estimated completion 2022	air quality; climate change	air quality; climate change

Existing or Proposed Projects Evaluated for Potential Cumulative Impacts Associated with the Liquefaction Facilities				
Project description	Approximate distance from project (miles)	Status	Resources affected	
			Construction	Operation
Revolution Wind: Proposed 144-MW offshore wind farm approximately 12 miles south of Martha's Vineyard, MA, paired with a 40 MW-hour battery storage system in New Bedford, MA.	50	estimated completion 2023	air quality; climate change	air quality; climate change
Bay State Wind: Proposed 2,000-MW offshore wind farm, to be developed in phases, approximately 15-25 miles south of Martha's Vineyard, MA.	50	no schedule available	air quality; climate change	air quality; climate change
Mid-Cape Main Replacement: Proposed replacement of about 16.4 miles of existing natural gas distribution mains in Yarmouth, Denis, Harwich, and Brewster, MA.	47.9	estimated completion early 2019	air quality; climate change	none
Fields Point LNG 35-kV Electric Service: Upgrade to the Franklin Square Substation in Providence. New underground electric lines will also be installed along Allens Ave to provide 35 kV of electric service to the proposed Fields Point Liquefaction Project site. The scope of the substation and distribution work is to install an 11/34.5-kV step-up transformer at the existing Franklin Square Substation and extend 1.4 miles of 34.5 kV underground cable. See section 1.9 for additional details.	0.0	construction start 2017; estimated completion 2018	socioeconomics (employment, tax revenue, transportation); air quality; noise; climate change	socioeconomics (public services)
Burrillville Interconnection Project: Proposed 6.8-mile-long, 345-kV electrical transmission line connection from an existing switching station (Sherman Road) and an existing 345-kV transmission line to the proposed Clear River Energy Center in Burrillville, RI.	20.4	estimated construction start Spring 2018; estimated in-service Summer 2019	socioeconomics (employment, tax revenue, transportation); air quality; climate change	visual resources; Socioeconomics (public services)
Franklin Square Project: Relocation and burying of approximately 1,300 feet of three existing 115-kV overhead electric transmission lines connecting the Franklin Square Substation and the South Street Substation in Providence.	1.3	construction start Summer 2016; estimated in-service Summer 2019	water resources, wetlands and fisheries; vegetation and wildlife; visual resources; socioeconomics (employment, tax revenue, transportation); air quality; climate change	visual resources; socioeconomics (public services)
E183 115-kV Transmission Line Relocation Project: Proposed installation of about 6,000 feet of underground 115-kV transmission line and the relocation of 1,500 feet of overhead transmission line. Several existing transmission lines would also be removed including those between the Franklin Square Substation in Providence and across the Providence and Seekonk River, and in the Bold Point area of East Providence, RI.	1.5	estimated construction start Summer 2019	water resources, wetlands and fisheries; vegetation and Wildlife; visual resources; socioeconomics (employment, tax revenue, transportation); air quality; climate change	visual resources; socioeconomics (public services)

Existing or Proposed Projects Evaluated for Potential Cumulative Impacts Associated with the Liquefaction Facilities				
Project description	Approximate distance from project (miles)	Status	Resources affected	
			Construction	Operation
L190 and G185S Transmission Line Project: Proposed refurbishment of about 3.1 miles of existing 115-kV transmission line in North Kingstown and East Greenwich, RI.	14	estimated construction start Spring 2018	air quality; climate change	socioeconomics (public services)
J16 115-kV Transmission Line Reconductoring Project: Reconductor 2.2 miles of 115-kV transmission line between the Riverside Substation in Woonsocket, RI and the Highland Park Substation in Cumberland Park, RI.	14	completed in Spring 2017	socioeconomics (employment, tax revenue, transportation); air quality; climate change	socioeconomics (public services)
V148N 115-kV Transmission Line Reconductoring Project: Reconductor 4.2 miles of 115-kV transmission line between the Woonsocket Substation in North Smithfield, RI and the Washington Substation in Lincoln, RI.	10.3	completed in 2016	not applicable	socioeconomics (public services)
G-185S 115-kV Transmission Line Reconductoring Project: Reconductor 5.3 miles of 115-kV transmission line between the Kent County Substation in Warwick, RI and the Old Baptist Road Tap Point in East Greenwich, RI.	9.2	completed in 2015	not applicable	socioeconomics (public services)
Q143S & R144 LPFF Underground Transmission Cable Replacement: Proposed replacement of 2.3 miles of low-pressure fluid-filled 115-kV transmission lines between the Admiral Street Substation and the Franklin Square Substation. Also includes the direct burial of a 700-foot-long cable crossing the Providence River in Providence.	1.3	still in conceptual phase as of 2016; estimated in-service July 2021	socioeconomics (employment, tax revenue, transportation); air quality; climate change	socioeconomics (public services)
Q143S & R144 Refurbishment Project: Reconductor 11.4 miles of 115-kV transmission line between the Woonsocket Substation in North Smithfield, RI and the Admiral Street Substation in Providence.	3.3	completed April 2014	not applicable	socioeconomics (public services)
South Street Substation Rebuild Project: Demolition of an existing substation and control building followed by the construction of a new substation. Existing transmission lines will also be moved underground.	1.6	construction start February 2016; estimated completion August 2019	water resources, wetlands and fisheries; vegetation and wildlife; visual resources; socioeconomics (employment, tax revenue, transportation); air quality; climate change	visual resources; socioeconomics (public services)
Aquidneck Island Reliability Project (On Island): Convert about 4.4 miles of existing 69-kV line to 115-kV line in Newport, Middletown, and Portsmouth, RI.	4.4	construction start Summer 2016; estimated completion Spring 2020	water resources, wetlands and fisheries; vegetation and wildlife; air quality; climate change	socioeconomics (public services)

Existing or Proposed Projects Evaluated for Potential Cumulative Impacts Associated with the Liquefaction Facilities

Project description	Approximate distance from project (miles)	Status	Resources affected	
			Construction	Operation
Interstate Reliability Project: Installation of a 345-kV transmission line to be constructed within an existing right-of-way. The project begins in MA travels into RI and CT for a total distance of 75 miles.	23	in-service December 2015	not applicable	socioeconomics (public services)
Combined Sewer Overflow: Consists of three phases in Providence. Phase I includes a 26-foot-wide combined sewer overflow storage tunnel that will connect to the Fields Point Waste Water Treatment Facility. Phase II includes the installation of interceptors to connect additional outfalls to the tunnel. Phase III consists of a combined sewer overflow tunnel and stub tunnel connecting to the Bucklin Point Waste Water Treatment Facility.	0.3	Phase I completed in 2008; Phase II completed in 2015; Phase III to be constructed 2019-2038	socioeconomics (employment, tax revenue, transportation); air quality; noise; climate change	socioeconomics (public services)
Providence Viaduct: Replacement of the Interstate 95 bridge through Providence. Travel lanes and shoulders will be made wider to increase bridge safety and alleviate congestion. Additional lanes will be built for traffic entering and exiting the highway.	2.2	southbound construction began June 2013; northbound construction to begin Summer 2018; estimated completion late 2021	socioeconomics (employment, tax revenue, transportation); air quality; climate change	socioeconomics (transportation)
Interstate 95 Corridor Bridge Preservation and Resurfacing: Bridge maintenance and repair for bridges along the Interstate 95 corridor between Route 4 in Warwick, RI and Interstate 195 in Providence. Resurfacing will be conducted for portions of the Interstate 95 mainline northbound and for designated ramps.	to be determined	estimated completion 2018	socioeconomics (employment, tax revenue, transportation); air quality; noise; climate change	socioeconomics (transportation)
Green Airport Improvement Program: Improvements to increase safety and efficiency at the airport. Safety upgrades include improvements to the runway to maintain compliance with FAA regulations.	5.3	work began in July 2013; completed December 2017	socioeconomics (employment, tax revenue, transportation); air quality; noise; climate change	socioeconomics (transportation)
Port of Providence Infrastructure: Acquisition of up to 25 acres of land in Providence between Allens Ave and the Providence River and any infrastructure improvements associated with the acquisition. Further details are yet to be determined.	0.1	no schedule available	water resources, wetlands and fisheries; vegetation and wildlife; socioeconomics (employment, tax revenue, transportation); land use; visual resources; air quality; noise; climate change	water resources, wetlands and fisheries; vegetation and wildlife; socioeconomics (employment, tax revenue, transportation); land use; visual resources; air quality; noise; climate change

Existing or Proposed Projects Evaluated for Potential Cumulative Impacts Associated with the Liquefaction Facilities

Project description	Approximate distance from project (miles)	Status	Resources affected	
			Construction	Operation
McInnis Cement Distribution Center: Construction of a cement distribution center in Providence (Fields Point).	0.4	construction began August 2016; construction status unknown	socioeconomics (employment, tax revenue, transportation); land use; visual resources; air quality; noise; climate change	socioeconomics (employment, tax revenue, transportation); land use; visual resources; air quality; noise; climate change
Maintenance Dredging: Maintenance dredging of approximately 5,500 cubic yards of sediment within existing north and south berths at existing Motiva piers at 520 Allens Avenue, Providence.	0.2	construction status unknown (CRMC File No. 2017-06-022)	water resources, wetlands and fisheries; vegetation and wildlife; socioeconomics (employment, tax revenue); air quality; noise; climate change	water resources, wetlands and fisheries; vegetation and wildlife; socioeconomics (tax revenue); air quality; noise; climate change
East Providence Waterfront Remediation: Shoreline and intertidal site remediation activities to remediate petroleum impacted shoreline area to accommodate future development.	0.5	CRMC Public Notice issued July 2016; construction status unknown	water resources, wetlands and fisheries; vegetation and wildlife; land use; visual resources; socioeconomics (employment, tax revenue); air quality; noise; climate change	water resources, wetlands and fisheries; vegetation and wildlife; land use; visual resources; air quality; noise; climate change
Marina Expansion: Expansion and reconfiguration of portions of an existing marina on the Seekonk River.	1.3	CRMC Public Notice issued October 2016; construction status unknown	water resources, wetlands and fisheries; vegetation and wildlife; socioeconomics (employment, tax revenue); air quality; climate change	water resources, wetlands and fisheries; vegetation and wildlife; socioeconomics (tax revenue); air quality; climate change
Maintenance Dredging: Proposed maintenance dredging of approximately 900 cubic yards of material from a marina on the Pawtuxet River in Cranston, RI. The material would be placed within confined aquatic disposal cells.	2.4	CRMC Public Notice issued October 2016; construction status unknown	socioeconomics (employment, tax revenue); air quality; climate change	none
Storm Water Master Plan: Applies to development projects in the Interstate 95 Redevelopment District in Providence. No construction is currently proposed as part of the development of the Master Plan as the goals of the Master Plan will be met through individual parcel review.	1.8	varies	None	socioeconomics (public services)

Existing or Proposed Projects Evaluated for Potential Cumulative Impacts Associated with the Liquefaction Facilities				
Project description	Approximate distance from project (miles)	Status	Resources affected	
			Construction	Operation
Facility Redevelopment: Proposed commercial redevelopment project that includes the razing of the current structure and the construction of an office building, diesel dispenser, parking lot, trailer parking area, snow storage area, and storm water management in Pawtucket, RI.	4.4	public notice issued April 2015; construction start unknown	socioeconomics (employment, tax revenue, transportation); air quality; climate change	visual resources; socioeconomics (employment, tax revenue, transportation); air quality; climate change
Kettle Point Redevelopment: Residential development consisting of 400+ residential units, residential roadway system, parking areas, utilities, stormwater management, and sewer pump station in Providence. Also includes site remediation and development of a waterfront greenway with public access and parking.	0.8	construction began in 2015; estimated completion 2018	water resources, wetlands and fisheries; vegetation and wildlife; socioeconomics (employment, tax revenue, transportation); land use; air quality; noise; climate change	socioeconomics (employment, tax revenue, transportation); land use; visual resources; air quality; noise; climate change
Village on The Waterfront Development: Construction of 600 homes, a restaurant, commercial space, and a fitness center. The project is scheduled to be constructed in four phases.	0.7	site remediation began in 2013; estimated completion 2018	water resources, wetlands and fisheries; vegetation and wildlife; land use; visual resources; socioeconomics (employment, tax revenue, transportation); air quality; noise; climate change	land use; visual resources
Maintenance Dredging: Proposed maintenance dredging of the Edgewood Yacht Club marina on the Providence River in Cranston, RI. Up to 25,000 cubic yards of material is scheduled to be removed. The material will be placed in confined aquatic disposal cells.	1.5	public notice filed July 2014; status unknown	water resources, wetlands and fisheries; vegetation and wildlife; socioeconomics (employment, tax revenue, transportation); air quality; climate change	none

Note: Data regarding status of the projects identified in this table were submitted by National Grid on August 16, 2017 in response to FERC's August 7, 2017 Environmental Information Request and/or were updated based on publicly available data sources.

CRMC = Coastal Resources Management Council

MW = megawatt

kV = kilovolt

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