USCG FINAL ENVIRONMENTAL IMPACT STATEMENT
AND MEPA FINAL ENVIRONMENTAL IMPACT REPORT

FOR

Northeast Gateway Energy Bridge, L.L.C. Liquefied Natural Gas
Deepwater Port License Application

DOT DOCKET NUMBER: USCG-2004-22219
MEPA EOEA NUMBER 13473/13474

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Northeast Gateway Energy Bridge, L.L.C. has proposed a deepwater port to import liquefied natural gas (LNG) to New England providing a base load delivery of 400 million cubic feet per day (MMcfd) and peak deliveries of approximately 800 MMcfd. The facility would be located in federal waters of Massachusetts Bay, approximately 13 miles south-southeast of Gloucester, MA. Natural gas would be delivered to shore from the port via a proposed new 24-inch-diameter-pipeline, approximately 16.4 miles in length, owned and operated by Algonquin Gas Transmission, L.L.C., to the existing offshore 30-inch-diameter Algonquin HubLine Pipeline System. The deepwater port would consist of two subsea submerged turret loading buoys, flexible risers, manifolds, and subsea flow lines to the 24-inch pipeline. Energy Bridge Regasification Vessels, each capable of transporting approximately 4.9 million cubic feet (138,000 cubic meters) of LNG, would deliver LNG to the port and vaporize to natural gas using a ship-board closed loop process.

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Date	Preparer/Environmental Project Manager	Title/Position
10-18-06		Deepwater Ports NEPA Specialist

Date	Environmental Reviewer	Title/Position
10-18-06		Chief, Deepwater Ports Standards

This document has been prepared in support of the Administrator of the Maritime Administration for purposes of issuing a Record of Decision for this deepwater port application license.

Date	Responsible Official	Title/Position
10-18-06	for	Chief, Office of Operating and Environmental Standards

Environmental Impact Statement/Environmental Impact Report
For the Northeast Gateway
Deepwater Port License Application

Location: Massachusetts Bay, approximately 13 miles south-southeast of the city of Gloucester, Massachusetts, in Block 125 of Federal waters.

USCG Docket Number: USCG-2005-22219

FERC Docket Number: CP05-383-000

Massachusetts EOEA Docket Numbers: 13473 and 13474

Prepared By: The lead agency, U.S. Coast Guard (USCG) and its contractor, Environmental Resources Management, Inc. (ERM).

Cooperating Agencies: Federal Energy Regulatory Commission; U.S. Department of Interior, Minerals Management Service; U.S. Environmental Protection Agency; U.S. Fish and Wildlife Service; U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service; U.S. Army Corps of Engineers, New England District; and the Massachusetts Executive Office of Environmental Affairs.

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Abstract: Northeast Gateway Energy Bridge, L.L.C. proposes to construct, own and operate a deepwater port in Massachusetts Bay, in the federal waters of the Continental Shelf in block 125, approximately 13 miles south-southeast of Gloucester, Massachusetts, in water depths of approximately 270 to 290 feet (82 to 88 meters).

The Port would be capable of mooring special purpose LNG carriers, referred to as Energy Bridge Regasification Vessels (EBRVs), with capacities of up to 3.2 billion cubic feet (Bcf). The Port would deliver between 150 to 175 Bcf of natural gas per year to the region. Fixed components of the Port would include two Submerged Turret Loading™ buoys (STL buoys), two flexible risers, two pipeline end manifolds (PLEMs), eight suction pile anchors and two subsea flowlines approximately 3,773 and 2,942 feet in length, that would connect to a new 16.1 mile long pipeline lateral. The pipeline lateral would connect the Port to the existing HubLine pipeline at a location approximately 3 miles east of Marblehead Neck, in Massachusetts territorial waters. Two EBRVs could be connected concurrently to the STL buoys.

The EBRVs would be equipped to store, transport and vaporize LNG and to odorize and meter natural gas. Vaporization would occur onboard the EBRVs using closed-loop shell-and-tube, re-circulating heat exchangers heated by steam from boiloff gas/vaporized LNG-fired boilers.

Onshore meter stations in Salem and Weymouth, Massachusetts would also be expanded as part of this proposed action, and existing office, dock and warehousing space would be rented for an onshore operations center for the Port.

Date of Publication: October 27, 2006

EXECUTIVE SUMMARY

The Deepwater Port Act of 1974 (DWPA)[1], as amended, establishes a licensing system for ownership, construction, and operation of manmade structures beyond state seaward boundaries. The DWPA promotes the construction and operation of deepwater ports as safe and effective means of importing oil into the United States and transporting oil from the Outer Continental Shelf (OCS), while minimizing tanker traffic and associated risks. In 2002, the Maritime Transportation Security Act[2] (MTSA) amended the definition of "deepwater port" to include natural gas facilities.

On June 13, 2005, Northeast Gateway Energy Bridge L.L.C. (hereinafter referred to as NEG or applicant), a subsidiary of Excelerate Energy Limited Partnership (Excelerate), a private company formed in 2003 in Oklahoma, submitted an application to the U.S. Coast Guard (USCG) and Maritime Administration (MARAD) seeking a federal license under the DWPA to own, construct, and operate a Deepwater Port for the import and regasification of liquefied natural gas (LNG) in Massachusetts Bay, off of the coast of Massachusetts. The project, referred to as the Northeast Gateway Deepwater Port (NEG Port), was assigned Docket Number USCG-2005-22219. Simultaneous with this filing, Algonquin Gas Transmission, LLC (Algonquin), a subsidiary of Duke Energy Gas Transmission, filed a Natural Gas Act Section 7(c) application with the Federal Energy Regulatory Commission (FERC) for a Certificate of Public Convenience and Necessity for a new 16.1-mile pipeline (NEG Pipeline Lateral) that would connect the NEG Port with the existing HubLine natural gas pipeline for transmission throughout New England (FERC Docket Number CP05-383-000).

The staff of the USCG has prepared this final Environmental Impact Statement (EIS) for the proposed NEG Port and Pipeline Lateral, which are referred to collectively in this document as the NEG Project. The NEG Port would include a deepwater port terminal off of the coast of Massachusetts in Massachusetts Bay that would receive and regasify LNG on specially designed Energy Bridge Regasification Vessels (EBRVs), and send the natural gas to the Pipeline Lateral proposed by Algonquin. Algonquin also proposes modifications to the existing Salem and Weymouth Meter Stations.

Together, the USCG and MARAD are the lead federal agencies for the review of the NEG Port. The FERC is a cooperating agency for the review of the Pipeline Lateral and onshore meter station modifications. This joint final EIS satisfies the requirements of the National Environmental Policy Act (NEPA), the DWPA, USCG Commandant Instruction M16475.ID, the Natural Gas Act, Section 10 of the Rivers and Harbors Act of 1899, and Section 404 and 511(c) of the Clean Water Act (CWA).

While the NEG Port is proposed to be located in federal waters, approximately 12.5 miles of the Pipeline Lateral would be located in Massachusetts state waters and be subject to the provisions of the Massachusetts Environmental Policy Act (MEPA). As a result, this document has been written as a joint final EIS/Environmental Impact Report (EIS/EIR) to comply with both NEPA and state MEPA requirements. The Massachusetts Executive Office of Environmental Affairs (EOEA) is a participating agency for the MEPA review. Hereafter, the EIS/EIR is referred to as the EIS. The MEPA Docket Numbers for the NEG Port and Pipeline Lateral are EOEA Number 30473 and EOEA Number 30474, respectively. The U.S. Army Corps of Engineers

[1] Public Law (P.L.) 93-627, Sec.3, January 3, 1975, 88 Stat. 2127, as amended, codified to 33 U.S. Code (U.S.C) 1501-1524.
[2] P.L. 107-295.

(ACOE) and Minerals Management Service (MMS) will also use this EIS/EIR for to fulfill their NEPA responsibilities.

PURPOSE AND NEED

The purpose of licensing deepwater ports for importing LNG in the Outer Continental Shelf (OCS) is to provide a reliable and timely supply of natural gas that will increase fuel diversity while considering impacts to the environment and mitigating safety concerns in order to serve the growing demand for residential, industrial, and electric generation within Massachusetts and New England. This requires construction of appropriate facilities for receiving the LNG, revaporizing the liquid to gaseous state, and interconnecting the facility to the transmission pipelines that can reach appropriate markets within the United States. The DWPA of 1974, as amended, was passed to promote and regulate the construction and operation of deepwater ports as a safe and effective means of importing oil or natural gas into the United States. The DWPA requires the Secretary to approve or deny a deepwater port license application. In reaching this decision, it is the purpose and need of the Secretary to carry out the Congressional intent expressed in the Deepwater Port Act, which is to:

- Authorize and regulate the location, ownership, construction, and operation of deepwater ports in waters beyond the territorial limits of the United States.
- Provide for the protection of the marine and coastal environment to prevent or minimize any adverse impact that might occur as a consequence of the development of such ports.
- Protect the interests of the United States and those of adjacent coastal States in the location, construction, and operation of deepwater ports.
- Protect the rights and responsibilities of States and communities to regulate growth, determine land use, and otherwise protect the environment in accordance with law.
- Promote the construction and operation of deepwater ports as a safe and effective means of importing oil and natural gas into the United States and transporting oil and natural gas from the OCS while minimizing tanker traffic and the risks attendant thereto.
- Promote oil or natural gas production on the OCS by affording an economic and safe means of transportation of OCS oil or natural gas to the United States mainland.

The Congressional intent is codified in nine requirements set forth in 33 U.S.C. §1503(c), which are as follows:

1. The applicant is financially responsible and will meet the requirements of the DWPA.
2. The applicant can and will comply with applicable laws, regulations, and license conditions;
3. Construction and operation of the deepwater port will be in the national interest and consistent with national security and other national policy goals and objectives, including energy sufficiency and environmental quality;
4. The deepwater port will not unreasonably interfere with international navigation or other reasonable uses of the high seas, as defined by treaty, convention, or customary international law;

5. The applicant has demonstrated that the deepwater port will be constructed and operated using best available technology, so as to prevent or minimize adverse impact on the marine environment;

6. The Secretary has not been informed, within 45 days of the last public hearing on a proposed license for a designated application area, by the Administrator of the EPA that the deepwater port will not conform with all applicable provisions of the Clean Air Act, as amended (42 U.S.C. 7401 et seq.), the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq.), or the Marine Protection, Research and Sanctuaries Act, as amended (16 U.S.C. 1431 et seq., 1447 et seq.; 33 U.S.C. 1401 et seq., 2801 et seq.);

7. The Secretary has consulted with the Secretaries of the Army, State and Defense to determine their views on the adequacy of the application, and its effect on programs within their respective jurisdictions;

8. The Governor of the adjacent coastal State approves, or is presumed to approve, issuance of the license; and

9. The adjacent coastal state to which the deepwater port is to be directly connected by pipeline has developed, or is making at the time the application is submitted, reasonable progress, toward developing and approved coastal zone management program pursuant to the Coastal Zone Management Act of 1972 (16 U.S.C. 1451 et seq.).

The DWPA application currently under consideration is one proposed by NEG to construct, own and operate the NEG Port to receive and vaporize LNG on EBRVs. The NEG Project would transport natural gas produced from the LNG through a proposed pipeline lateral that would connect with the existing HubLine pipeline for onshore markets. NEG's proposed Port and Pipeline Lateral would provide a new facility for receiving the EBRVs carrying LNG from foreign markets and for transferring natural gas into the U.S. markets via the existing natural gas transmission infrastructure.

Part of the intent for establishing the DWPA was to provide mechanisms to ensure that the Country's energy market could access worldwide natural gas supplies that the federal government recognizes would become a key supply source for the country over the next 10 years. The U.S. Department of Energy (DOE), Energy Information Administration (EIA) estimates that total energy consumption in the U.S. will increase 1.2 percent annually - over 27 quadrillion British thermal units (Btu) per year (referred to as quads) over the next 20 years, from 99.7 quads per year in 2004 to 127.0 quads per year in 2025 (EIA 2006). The EIA projects that annual demand for natural gas in the U.S. could reach 26.9 trillion cubic feet (Tcf) by 2030, compared to an annual consumption of 22.3 Tcf in 2003 (EIA 2006), due largely to projected increases in industrial demand and natural gas-fueled electrical power generation.

Recent growth in natural gas demand has been fairly consistent throughout New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont) across sector and by state. The region experienced record demand for natural gas over the past several winters and projections show retail natural gas demand continuing to grow. The number of retail gas customers in Massachusetts alone increased by nearly 300,000 new customers between 1992 and 2000.

New England's electric sector is also highly dependent on natural gas. In the late 1990s and early 2000s, more than twenty new natural gas-fired combined cycle power plants were constructed and placed into operation in New England. In 2003, approximately 40 percent of New England's electricity was generated by natural gas.

The DOE projects a 1.4 percent annual growth rate in natural gas consumption in New England, outpacing total energy consumption growth projections (1.2 percent) in the region, with projected natural gas demand increasing from 0.8 Tcf to 1.07 Tcf between 2003 and 2025. The forecast attributes 68 percent of this regional increase in consumption (0.19 Tcf) to the electric power generation sector.

With domestic production of natural gas projected to be fairly constant over the same time frame, DOE projects that the major increase in regional import supply would come from LNG (DOE, 2005). Currently, LNG meets approximately 20 percent of New England's annual gas demand while, on average, the five interstate pipelines that supply the region provide the remaining 80 percent. During winter peak demand periods, LNG supplies well over 30 percent of New England's natural gas needs (NEGC 2005).

New England has virtually no native sources of natural gas and no capacity for storing gas in large geologic repositories (such as salt caverns or depleted natural gas reservoirs). The region is essentially at the end of major natural gas pipeline transmission systems from the Gulf of Mexico region, western U.S., and western Canadian sources that serve as the primary source for natural gas in the region. Options for increasing natural gas supply in New England are limited. Supplies from traditional U.S. and Canadian sources have fallen. U.S. production of natural gas was 7 percent below its 2001 level in 2005, "with less than half of that decline reflecting the impact of hurricanes Katrina and Rita" (Bernanke 2006). Net imports from Canada have leveled off and presently represent about 35 percent of the gas supply to the region (NGA 2006). Both U.S. and Canadian gas fields have matured and are yielding smaller increases in output, despite the incentive of high prices and a substantial increase in the number of drilling rigs in operation (Bernanke 2006).

The proposed NEG Deepwater Port would add between 150 Bcf to 175 Bcf of natural gas to New England annually, or approximately 400 MMcf per day, depending on operational conditions, by the winter of 2007-2008, when several recent studies indicate that additional gas supplies will be needed. This increase would represent an approximate 8 percent increase in the region's overall delivery capacity. Operation of the Port would deliver natural gas directly to Massachusetts consumers and to other portions of New England via Algonquin's HubLine Pipeline.

PUBLIC INVOLVEMENT

On September 21, 2005, the USCG and MARAD issued a Notice of Intent (NOI) to prepare an EIS in the *Federal Register*. The NOI described the proposed project and the joint environmental review process, provided a preliminary list of issues to be addressed in the EIS, invited written comments on the environmental issues, and listed the dates and locations of two open house and public scoping meetings to be held in communities in proximity to the project area. The NOI was also published in The Boston Globe; The Boston Herald: The Gloucester Daily Times; The Salem News; and The Daily News of Newburyport. An "Interested Party" letter, the NOI, and a fact sheet describing the proposed project and announcing the location and dates of open houses and public scoping meetings were mailed to 106 parties on October 5, 2005. The USCG and MARAD sponsored open houses and public scoping meetings in Boston and Gloucester, Massachusetts, on October 18, and 19, 2005 that were also attended by FERC and EOEA staff. Public comments submitted in the public scoping meetings and by letter were considered in scoping the DEIS.

The EPA published a Notice of Availability (NOA) of the draft EIS in the *Federal Register* on May 19, 2006, that initiated a 45-day period for the public and agencies to review and comment on the draft EIS. The USCG and MARAD also announced the informational open houses and public hearings, and invited public comments on the Draft EIS in the *Federal Register* notice. On June 14, and 15, 2006, the USCG and MARAD held informational open houses and public hearings at the Gloucester High School, Gloucester, Massachusetts, and Salem State Community College, in Salem, Massachusetts. The meetings were attended by over 40 individuals, 30 of whom provided verbal or written comments on the Draft EIS at the public meetings. Transcripts of the public hearings are included in Appendix C.

Written comments were submitted to the federal docket by 16 government agencies or public officials and 21 individuals or non-government organizations, and 36 comment letters were submitted to the MEPA during the draft EIS review period. The comments submitted to MEPA are included in Appendix A along with NEG's responses to those comments. Appendix C contains copies of the comment letters submitted to the DOT docket and the USCG's responses to those comments.

SCOPE OF THE EIS

Consistent with NEPA, the DWPA, and MEPA, this EIS evaluates the potential environmental impacts associated with construction and operation of the NEG Port and Pipeline Lateral. The primary purposes of this EIS are:

- To provide an environmental analysis sufficient to support MARAD, FERC, USEPA, USACE and Massachusetts EOEA licensing and permitting decisions;
- To facilitate a determination of whether the Applicant has demonstrated that the NEG Port would be located, constructed, and operated in a manner that represents the best available technology necessary to prevent or minimize any adverse impacts on the marine environment;
- To aid in the responsible agencies' compliance with NEPA; and
- To facilitate public involvement in the decision making process.

ALTERNATIVES

If the license application is approved, the Secretary may impose enforceable conditions as part of the license. Consistent with NEPA, in determining the provisions of the license, the Secretary must also consider alternative means to construct and operate a deepwater port. Alternatives for a natural gas deepwater port can extend to matters such location, methods of construction, foundation types, and technologies for regasification. Considering alternatives helps to ensure that ultimate decisions concerning the license are well-founded and, as required by the DWPA and the nine factors mandated by the DWPA, are in the national interest and consistent with national security and other national policy goals and objectives. The following alternatives were reviewed:

Onshore vs. Offshore Alternatives: Congress has passed statutes that distribute responsibility for the development of LNG facilities in the United States across different agencies within the federal government. For offshore LNG facilities outside of state waters, the USCG and MARAD jointly share responsibility in evaluating and processing applications submitted under the DWPA. For onshore facilities and LNG terminals in state waters, that responsibility lies with the FERC under the Natural Gas Act. Nonetheless, in evaluating reasonable alternatives under NEPA for bringing LNG to the New England market, both offshore and onshore LNG facilities must be considered. Several onshore LNG facilities exist or are being proposed that target the New England market. While these facilities provide alternatives for bringing LNG into New England, they are or will be the subject of their own FERC-developed EISs and thus will not be evaluated in detail in this EIS. Further, because these are projects independent of each other (i.e., they are not mutually exclusive), they are not considered to be alternatives to each other. Onshore facilities are discussed, therefore, under the No Action alternative, since they may be developed regardless of the outcome of any proposed DWPA application. Finally, this final EIS does not address how many LNG facilities in total may be needed to meet the growing demand in New England because that decision will ultimately be based on market conditions.

Alternative Terminal Types: Alternate terminal designs considered in our analysis included Gravity Based Structures (GBS), Fixed Platform-Based terminals, Floating Storage and Regasification Units (FSRU), Special Purpose Floating Platforms and Special Purpose Vessel and Submerged Turret Loading (STL) Buoy Systems, such as that proposed by NEG. Selection criteria mandated that to be considered a reasonable alternative, the port design must satisfy the following selection criteria:

- Meet the Project purpose and need;
- Not violate state and federal standards for protecting environmental resources, as established by law and regulation;
- Be feasible from an engineering perspective; and
- Be reliable.

The Applicant proposes the STL system, using EBRVs that it currently owns and operates. Because this design would meet the project purpose and need, is a proven technology, and meets environmental, engineering feasibility, and reliability criteria, the STL system is considered to be a reasonable alternative and has been carried forward for detailed analysis in this EIS.

The GBS design was eliminated from consideration due to its requirement for siting in shallower water, its greater bottom disturbance and its potential for significant adverse impacts to nearshore fisheries and recreational boating and fishing. It would also be more visually intrusive than the other options due to its need to be located in water depths under 100 feet, which would require it to be closer to shore. Fixed platform units and FSRU's were also eliminated since they would be unreliable based on weather conditions that are common in Massachusetts Bay and would not to meet the project purpose of providing a continuous and reliable supply of natural gas (i.e. platform-based unit and FSRU).

Alternative Port Sites: The EIS analysis applied a three-phased analysis to identify reasonable alternate port sites. Phase 1 reduced the study area from waters off of New England to Massachusetts Bay using the following criteria:

- Locate in proximity to target market, and
- Locate in proximity to an existing offshore pipeline system.

Phase 2 narrowed Massachusetts Bay to a triangular area bounded by Stellwagen Bank National Marine Sanctuary (SBNMS) to the east, the North Shore and South Essex Ocean Sanctuaries on the west, and the existing and newly proposed Boston Harbor Traffic Separation Scheme (TSS) on the south first, and then reduced it further to two potential sites within that triangular area. Criteria used to reduce the area of interest in Phase 2 included:

- Locate within reasonable proximity of the HubLine
- Avoid designated shipping fairways

- Avoid state and federal marine sanctuaries
- Avoid active or retired marine disposal sites
- Locate in water depths of at least 200 feet
- Locate in an area of sufficient size for the facility footprint

Figure ES-1 shows the two alternate port locations as well as the triangular area in which they were sited.[3]

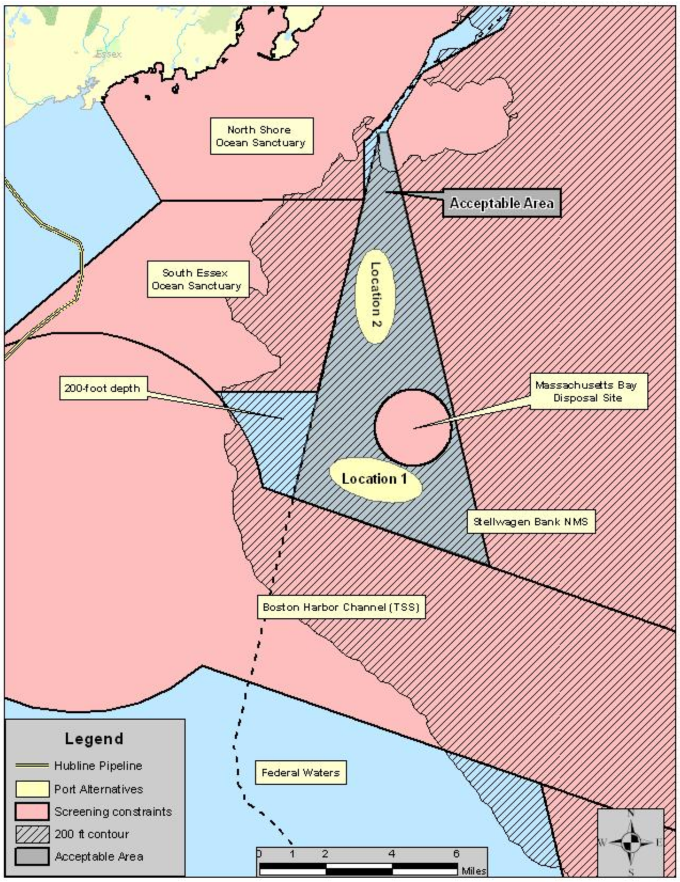

Figure ES-1 Alternate Port Locations

Phase 3 analysis compared the two port sites that were identified in Phase 2 based on:

- Potential impacts to benthic habitat and Essential Fish Habitat (EFH)
- Marine mammal occurrence
- Commercial fishing use
- Suitability of substrate
- Proximity to marine disposal sites

[3] Alternate Port Location 2 is also the proposed site for the Neptune Deepwater Port, which is being reviewed independently by the USCG.

- Sediment contamination
- Proximity to shipping lanes

Both site locations were determined to have similar characteristics. Because there are no clear environmental advantages or disadvantages, both sites are considered reasonable and discussed in this EIS.

Alternative Vaporization Technologies: Several technologies are commercially available for LNG regasification. For this EIS, Open Rack Vaporization (ORV), Submerged Combustion Vaporization (SCV), Intermediate Fluid Vaporization (IFV) and Shell-and-Tube Vaporization (STV) technologies were analyzed. The analysis considered the engineering feasibility of the technology for use on an EBRV, whether or not it was a proven and tested technology, and the potential environmental effects of each technology. Based on this review, only the STV technology was considered reasonable for use on the EBRVs. Operation of the STV system in closed- and open-loop mode was also reviewed. Although the STV closed-loop system would result in somewhat greater emissions of air pollutants than the open-loop system, it would likely have considerably less impact on marine resources. Impacts to air and water are regulated under the Clean Air Act and the Clean Water Act and are subject to EPA permits, which will be available for public review. Both systems are considered reasonable and reviewed in this EIS.

Alternative Anchoring Methods: Six different methods of anchoring the STL buoys (clump weights, drag-embedment anchors, driven pile anchors, jetted pile anchors, drilled and grouted pile anchors and suction-embedment anchors), were reviewed based on the following:

- Engineering feasibility – suitability of substrate at deepwater port locations;
- Environmental effects – extent of seafloor disturbance;
- Noise generated during construction; and
- Port decommissioning – ability to remove structures upon port decommissioning.

The final selection of an anchor type would not be made until later in the design process, however, with the exception of the suction pile and drilled and grouted pile anchor alternatives, the other anchor methods are not considered reasonable options due to the level and extent of environmental impacts and/or noise that would be caused setting them in place. Both suction pile and drilled grouted anchors are discussed in this EIS.

Alternative Pipeline Routes: Four routes, two each from the NEG and Neptune Port locations (including the applicants' proposed routes), were considered for routing the pipeline lateral between the Port and the HubLine. The evaluation of alternate routes considered the following:

- Effects on benthic habitat and EFH;
- Effects on marine protected resources;
- Effects on commercial fishing;
- Sediment contamination;
- Effects on cultural resources; and
- Geotechnical conditions and suitability of substrate.

Although all four alternate routes have positive and negative attributes, none has a fatal flaw that would preclude it from being a viable option. As a result, all four routes are considered reasonable and have been carried forward for further evaluation in this EIS. Figure ES-2 show the four alternate routes.

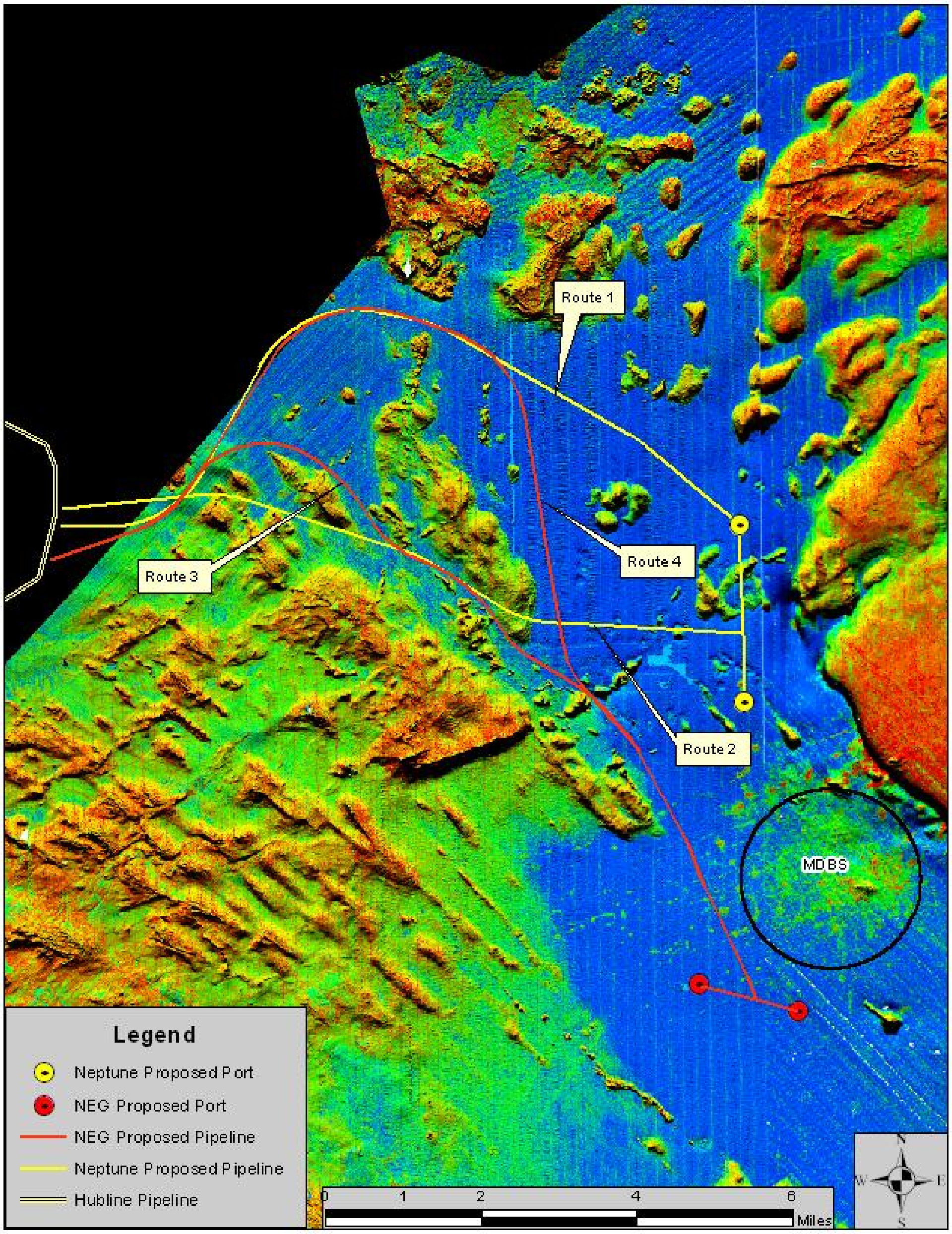

Figure ES-2 Alternate Pipeline Routes

Alternative Construction Schedules: Construction of the proposed Project would take approximately 7 months, with various activities occurring on a month-to-month basis. Depending on the activity, construction has the potential to impact listed species of marine mammals and sea turtles, as well as commercially and recreationally important finfish and shellfish. In consultation with NOAA Fisheries, the U.S. Fish and Wildlife Service (FWS), and the Massachusetts Division of Marine Fisheries (MDFW), several species of concern were identified as having the potential to be affected due to the status of their populations and/or likelihood of occurring in the Project area, listing status, or particular aspects of the their life history. Potential impacts to fisheries resources from Project construction activities would be primarily related to disturbance/loss of habitat, and entrainment of individuals in water intakes during hydrostatic testing. Potential Project-related impacts to listed species (marine mammals and sea turtles) would be primarily related to disturbance, harassment, and ship strikes. Impact magnitude was evaluated in terms of both the severity and probability of the impact.

Based on the results of the month-by-month analysis of construction related effects, and the analysis of the seasonal abundance of each species and lifestage in the Project area, it is not possible to select a single, continuous, seven-month construction window that is protective of all species and lifestages of concern. As a result, three potential construction windows were identified (May through November; January through July; and November through May). Although each of the alternatives has advantages and disadvantages to different species, each is considered reasonable and evaluated in this EIS.

DESCRIPTION OF THE PROPOSED ACTION

The proposed NEG Port would include:

- Two subsea Submerged Turret Loading Buoys (STL Buoys);
- Two flexible risers;
- Two pipeline end manifolds (PLEMS);
- Two subsea flowlines, 3,702 and 2,691 feet long; and
- One offshore 16.1-mile, 24-inch (outside diameter) pipeline lateral.

NEG proposes a fleet of specially designed EBRVs, each capable of transporting approximately 2.9 billion cubic feet (Bcf) of natural gas condensed to 4.9 million cubic feet (MMcf) of LNG to deliver the LNG and regasify it at the Port. The EBRVs would each contain:

- LNG vaporization equipment designed for an average baseload sendout of about 400 MMcfd; and
- Seawater intake and discharge systems averaging approximately 4.97 million gallons per day (mgd) of seawater.

The proposed Project also includes proposed modifications to the Salem and Weymouth Meter Stations include the following:

- Salem Meter Station:
  - A new 10-foot by 15-foot fiberglass meter building;
  - An 8-foot addition to an existing concrete building;
  - Removal and reversal of ultrasonic meter and addition of one new ultrasonic meter run; and
  - Installation of a chromatograph.
- Weymouth Meter Station:
  - A new 16-foot by 21-foot concrete meter building;
  - Installation of a gas heater;
  - Installation of a chromatograph;
  - Installation of ultrasonic meters and scrubber; and
  - Installation of a pressure control valve.

During construction, the applicants propose to use existing onshore facilities for loadout yards and construction staging. During operation, NEG proposes to rent existing office, dock and warehousing space for an onshore operations center. NEG proposes to begin construction in 2007 and place the facilities into service by the end of that year. The license term of the NEG Port and Pipeline Lateral would be 25 years. The estimated physical life of the Port and Pipeline could be in excess of 40 years. NEG estimates that the total installed cost of the Port would be $140 million.

Each STL Buoy would connect to a PLEM using the flexible riser assembly. The PLEM would connect to the subsea flow line. A fleet of EBRVs would deliver natural gas to the NEG Port. The EBRVs would vaporize the LNG on-board in a closed-loop mode of recirculating heated fresh water. Natural gas would be used to operate the regasification facilities as well as to fire turbine-generators to meet vessel electrical needs under normal operation. The proposed 24-inch diameter Pipeline Lateral would connect the proposed Port to the interstate pipeline system. The Pipeline Lateral would begin with the connection at the existing HubLine, in waters approximately three miles east of Marblehead, Massachusetts, and extend northeast for approximately 6.3 miles, crossing the outer reaches of the territorial waters of the town of Marblehead, the Cities of Salem and Beverly, and the Town of Manchester-by-the-Sea. At Milepost (MP) 6.3, the pipeline route would curve to the east and southeast, exiting the territorial waters of Manchester-by-the-Sea and entering waters regulated by the Commonwealth of Massachusetts. The proposed Pipeline Lateral route would then continue approximately 6.2 miles to the south/southeast to MP 12.5, where it would leave state waters and enter federal waters. It then would extend to the south/southeast for approximately 3.6 miles, terminating near the NEG Port. Figure 1-1 shows the general location of the proposed NEG Project.

As proposed by the applicant, the Port would be able to accommodate up to two EBRVs concurrently. Each EBRV would be capable of delivering the equivalent of 2.9 Bcf of natural gas to the system, which would contribute between 150 Bcf and 175 Bcf to the region annually, depending on operational conditions. The port has been designed to also accommodate a future generation of EBRVs that would have a capacity of 3.2 Bcf.

PROPOSED ACTION ENVIRONMENTAL CONSEQUENCES

Construction and operation of the NEG Port and Pipeline Lateral as proposed by NEG would result in a combination of adverse and beneficial impacts of varying duration and significance. The following summarizes the impacts identified in this EIS.

Water Quality. Both short- and long-term minor adverse impacts on water quality would be expected. Short-term impacts would primarily occur as the result of resuspension of sediments in the water column during installation of the Pipeline Lateral and Port anchors, flowlines and PLEM. Short-term minor impacts would also result from hydrostatic testing of the NEG Pipeline Lateral and flowlines, which could require the use of biocides to inhibit microbially-induced corrosion. During Port operation, vaporization would occur onboard the EBRVs using closed-loop shell-and-tube, recirculating heat exchangers heated by steam from boiloff gas/vaporized LNG-fired boilers. Seawater would be used for other some ship operations including ballast water. Other water for EBRV operations would be withdrawn and discharged back into Massachusetts Bay with minor changes in water quality or temperature. No water quality impacts would be expected from Pipeline operation.

Biological Resources. A number of construction and operation activities have the potential to impact biological communities in the Project area. Port construction would disturb approximately 33 acres of habitat for flowline installation, setting of the suction anchors and placement of the PLEMs. Construction of the Pipeline would temporarily disturb a 6,000-foot-wide anchor corridor along the sea floor, superimposed over an 85-foot-wide plowing corridor. Additionally, small areas along the route would be affected by jetting operations related to the pipeline burial. Hydrostatic testing of the flowlines and Pipeline Lateral could affect benthic fauna and shellfish larvae through entrainment of larval stages. Port operation would affect habitat in three ways: 1) loss of habitat; 2) alteration of the habitat conditions (conversion of soft to hard substrate by anchors, flowlines, and PLEM); and 3) increased turbidity resulting in suspended sediment in the area of anchor chain and cable sweep. Increased turbidity could result in adverse, long-term, impacts for these reasons. Specific effects on shellfish, finfish, and marine mammals and sea turtles are described below.

Shellfish: During construction, some shellfish in the Project area could be crushed or buried and some larvae would be susceptible to entrainment in the hydrostatic test water. Port operation water use and ballast water uptake would impact shellfish larvae, although the location of the intake structures 20 to 30 feet below the sea surface should help to minimize entrainment.

During construction, shellfish communities along the pipeline corridor would be smothered by the sidecasting of sediment. The primary impact to shellfish from the proposed project would occur during construction when increased water column turbidity and the release of nutrients or contaminants from sediments could impact all life stages of shellfish. However, these disturbances would be minor and short-term.

Minor impacts on planktonic lifestages of shellfish from Project construction and operation would occur as the result of withdrawal of seawater for hydrostatic testing or operation purposes or from changes in water quality (i.e. increased turbidity, thermal or wastewater discharge, or accidental spills).

Finfish: The primary direct impacts to finfish resources during construction include smothering by sidecast sediment or entrainment in water intake for hydrostatic testing. Indirect impacts to finfish would occur through habitat loss and reduction in benthic food sources for demersal species. The evaluation of impacts on fisheries resources considered the ecological, legal, commercial, recreational, and scientific importance of the resource, the proportion of the resource that would be affected relative to its occurrence in the region, its sensitivity to the proposed activities, and the duration of the impacts. During construction, finfish impacts would be minor due to the mobility of most finfish species, the limited area potentially disturbed by construction of both the Port and Pipeline Lateral, and the short duration of disturbance due to the short construction period.

During operations, impacts to finfish resources would be minor, and related primarily to the entrainment of early lifestages of finfish in ballast water intakes and discharge of small amounts of wastes into the water column from the EBRVs while berthed. NEG would follow international protocols in ballast water intake and discharges to limit impacts on finfish communities and fisheries.

Marine Mammals and Sea Turtles: Marine mammals (whales, dolphins and seals) and sea turtles could be affected by construction activities as the result of physical harassment, vessel strikes, alteration to habitat, acoustic harassment, alteration of prey species abundance and distribution, and entanglement. The overall increased risk of vessel strikes during construction of the NEG Port or Pipeline Lateral would be minor compared to the annual amount of traffic in and out of the port of Boston. NOAA (2006) indicates that ship speed is an important factor in the frequency of occurrence of ship strikes in large whale species, including right whales, and that strikes occurring at reduced speeds (below 10 knots) rarely caused serious injuries. The low speed of construction vessels would further minimize the likelihood of vessel speed-induced strikes.

Because sediments suspended as the result of construction activities are not expected to reach the water surface, and the zones of increased turbidity would be localized to the construction area and would disperse quickly upon completion of construction, it is unlikely that turbidity from construction would have a harmful effect on marine mammal and sea turtle habitat. Construction noise impacts would generally be short-term, intermittent and minor since the intensity of underwater sounds from NEG Port or Pipeline Lateral construction would be too low to mask communication signals used among the marine mammals. Operating noise produced by EBRVs while regasifying at the Port would be above normal ambient noise levels and could cause disruption in the behavior of whales within a 100-meter area around the buoys.

Project water withdrawals during construction and operation would entrain zooplankton and Atlantic herring, sources of food to whales. However, Project seawater use from the proposed closed-loop system is relatively low and the number of entrained zooplankton and Atlantic herring is correspondingly low. As a result, the impact would be minor and have a minimal impact on the whale population.

Entanglement in gear is a possible threat to marine mammals and sea turtles, however, the anchor and retrieval lines to be used during operation are large in diameter, under tension, and highly visible.[4]

Threatened and Endangered Species. Threatened and endangered species known to occur in the Project area include six species of endangered whales and five species of endangered sea turtles. Impacts to threatened and endangered species are predicted to be generally the same as for non-threatened and endangered marine mammals with the following exception. Among the species listed as threatened or endangered in the Project area, the North Atlantic right whale is the only critically endangered species for which recent population modeling exercises by NOAA indicate that the loss of a single individual could have a negative effect on the survival of the species. As a result, NOAA has set a Potential Biological Removal value of zero for North Atlantic right whales. This means that the death of even one individual is above the acceptable limit and, should it occur, would be considered a long-term major adverse impact. While it is known that an increase in vessel traffic increases the risk of collision, the probability of that risk cannot be quantified. Section 4.2.4.6 details the measures that would be taken by the applicant to reduce the potential for vessel collisions, should the proposed Project be approved.

NOAA (2006) indicates that ship speed is an important factor in the frequency of occurrence of ship strikes in large whale species, including right whales, and that strikes occurring at reduced speeds (below 10 knots) rarely caused serious injuries. The applicant proposes to slow EBRVs to a maximum speed of 12 knots while in SBNMS with further reductions in speed depending on time of year speed restrictions and proximity to the Port. The applicant has indicated a willingness to work with NOAA, MARAD and the USCG within the existing regulatory structure to ensure LNG vessels calling at the Port operate in a manner and at speeds that would reduce and avoid ship strikes to marine mammals. The USCG is working with NOAA to develop appropriate speed restrictions.

Construction and operation of the NEG Project would create underwater noise that could adversely affect marine mammals. Although certain construction activities would create loud underwater noise, it would be intermittent, of short-term duration and under acoustic harassment levels identified in the Marine Mammal Protection Act (MMPA) for construction. During

[4] For comparison purposes, typical diameters of set nets, lobster trap lines, and long lines which have been known to cause entanglement problems, are 3 inches or less. The anchor cable and retrieval lines that would be used for the NEG Project are 6 inches and 4 inches in diameter, respectively.

operation, the use of closed-loop technology for regasification would keep noise levels of the EBRVs below the regulated thresholds. The noise from thrusters that would be used to maneuver the EBRVs onto the buoys would be in the 160 to 170 dB range. However, thruster noise would be intermittent and localized. As a result, the impacts of Project noise would be long-term and minor (during regasification) to intermittent and moderate (during use of thrusters).

Essential Fish Habitat. The proposed Project affects designated essential fish habitat (EFH) for 28 species of finfish, two species of squid and three species of shellfish. The potential to impact EFH would derive primarily from disruption of substrate during construction of the Port and Pipeline. Secondary impacts on habitat, such as creation of a turbidity plume, accidental contaminant spills, and alteration of the food web could occur, but would likely be temporary and would not cause major adverse impacts on the value of habitat for managed species. Approximately 43 acres of seabed would be disturbed during operation due to scour by the mooring wire rope and chains.

Use of seawater for daily ship operations and ballast would cause entrainment of early life stages (e.g., egg and larvae) of EFH species as well as ichthyoplankton fauna in the Project area. However, seawater use is relatively low and the number of entrained ichthyoplankton is correspondingly low. As a result, long-term and adverse entrainment impacts would be minor.

Impacts to EFH would occur during construction of the NEG Pipeline Lateral. Since soft substrates, which constitute the greatest area affected by pipeline construction, are expected to recover to preconstruction conditions sooner than hard-substrate areas, recovery from pipeline construction impacts would take place relatively quickly. Entrainment of ichthyoplankton during hydrostatic testing of the Pipeline would adversely affect the ichthyoplankton community; however, the losses due to these one-time hydrostatic tests would be minor.

Regional Geology and Sediments. Project operation would have minor impacts to sediments and geological resources. During construction the pipeline route would be plowed with soil sidecast for replacement following completion of construction activities. Action of mooring chains during operation would create some sediment disturbance from anchor sweep, however, the impacts to geology would be minor.

Cultural Resources. Since no cultural resources are known to exist in the areas being considered for Port or Pipeline construction, no impacts are anticipated.

Ocean Use, Land Use, Recreation and Visual Resources. The proposed Port and Pipeline route are located in close proximity to the SBNMS, the North Shore Ocean Sanctuary, the South Essex Ocean Sanctuary, the Massachusetts Bay Disposal Area (MBDA), and grounds actively fished by commercial and recreational fishermen. Figure ES-1 shows the boundaries of these areas relative to the proposed NEG Port and Pipeline lateral. Construction of the NEG Project would temporarily limit access in the area and may cause vessels traveling through the area to have to detour around construction. In the pipeline corridor, this impact would be minor and short-term, with access restored following completion of pipeline construction. Port operation would prohibit access from 722 acres of ocean in the No-Anchoring Area (NAA) by non-port related vessels. The closure would force fishermen to move to other fishing grounds, which might require longer transits to get to similarly productive fishing areas and reduce the amount of time for actual fishing. Since landings from the Port area reflect a small percentage of multispecies and lobster landings from the larger productive fishing area, this impact would be minor.

Existing on-shore port facilities are proposed to be used as load-out yards and staging areas for construction, and NEG would rent space for its on-shore Operations Center. As a result, the Project would have no direct impact on land use.

Construction of the NEG Port and Pipeline Lateral would cause some recreational boaters and commercial whale watch cruises to alter their navigation patterns, which may result in some reduction of recreational ocean use. Over the pipeline, the impacts would be minor and short-term, with access restored following completion of construction activities. Although Port operation would prohibit access from the NAA, this restriction would have a minor impact on recreation, given the overall size of Massachusetts Bay.

Visual impacts from Project construction and operation would be limited and minor. Construction vessels would be visible for the duration of construction. From shore the vessels would appear similar to other vessels that routinely travel in Massachusetts Bay. During operation, the Pipeline lateral would not be visible and, at a distance of approximately 13 miles, the EBRVs would be slightly visible from shore during clear conditions, but would be small enough on the horizon to look similar to other commercial vessels that travel in Massachusetts Bay. During the night, lighting at the facility would be visible in clear conditions and probably more noticeable than during the day, however, the impact would be minor, given the viewing distance from shore.

Socioeconomics. In general, the NEG Project would have a moderate short-term beneficial economic impact. Port and Pipeline construction would each employ workers in two 28-day shifts on board construction barges for the duration of construction. Total combined construction employment would require 679 workers (204 for the Port and 475 for the Pipeline Lateral), of which over 200 would be hired locally. Conversely, construction impacts to the fishing industry during the 7-month construction period from restricted access to fishing grounds would result in a minor loss of about 3 jobs (see section 4.8 for a detailed discussion). Port operation would provide direct employment to 83 people, the majority of which (64) would be non-local workers living onboard the EBRVs, and a loss of an estimated 6 jobs in the fishing industry. Pipeline operation would only require 4 permanent employees. Given that a majority of workers required for operation would not be local and would be housed off-shore in the EBRVs, the economic impact is expected to be minor.

Non-local workers employed for Project construction and operation are not expected to look for local housing. While working, construction employees would be housed on the construction barges and are anticipated to return to their homes during their off-shift time. During operation, workers would be onboard the EBRVs and not require local housing.

NEG Port and Pipeline construction and operation would take place well off-shore and have minor effects on regional populations, including minority and low-income groups. Local fishermen out of Essex County communities, particularly the City of Gloucester, constitute an economic/cultural community that could experience adverse impacts from the Project. This community has expressed concern over the potential impact of the Project on their industry. In response, efforts have been made to quantify impacts to the extent possible. Data was gathered from the National Marine Fisheries Service (NMFS), the Massachusetts Department of Marine Fisheries (MDMF) and others to identify the amount of fishing that occurs within the Project area. Based on the information, which included Vessel Monitoring System (VMS) data, Project development could cause the loss of about 3 jobs during construction and approximately 6 jobs during operation. This impact is considered is minor when compared to the total number of individuals (262) employed in the fishing industry in Essex County.

Transportation. Construction of the port and pipeline would have a short-term minor impact on transportation by restricting access to Project areas during construction. There would be no restrictions to access over the Pipeline Lateral during project operation. A mandatory safety zone of approximately 2,600 feet (800 m) extending from the center of each STL Buoy would be prohibited to non-Port related vessels during Port operation. In addition, while in transit, each EBRV would be surrounded by a safety and security zone that would extend two miles ahead and one mile astern, and 500 yards on each side, while underway within the Captain of the Port Boston zone. Although this would cause some vessels to have to change their travel course, the overall impact to transportation would be minor.

Air Quality. Air emissions from construction and operation have been quantified, and the potential impacts evaluated, based on air quality modeling, permit applicability, and general conformity applicability. Based on the results of the air quality dispersion modeling that was performed using the Offshore and Coastal Dispersion (OCD) model, the impact of vessel emissions during EBRV regasification are expected to be minor and would not cause or contribute to concentrations in excess of the Significant Impact Level (SIL) or National Ambient Air Quality Standard (NAAQS) for NO_2, CO, PM_{10}, or $PM_{2.5}$ Multi-source modeling was performed for NO_2, and even accounting for other major sources, the ambient concentrations of NO_2 were still below the NAAQS. NOx emissions during construction were also modeled, and although the direct impact exceeded the SIL (4.53 $\mu g/m^3$, vs. 1 $\mu g/m^3$), the combined impact (accounting for other sources and background concentrations) was below the NAAQS.

To avoid being a “major” source, NEG would limit emissions of NOx and CO to 49 tpy and 99 tpy, respectively, by restricting the number of hours per year the boilers would operate at full load (depending on which pollutant is the limiting factor). The effectiveness and enforceability of such limits is still under review.

Approximately 263 tons of NOx would be emitted (within state boundaries and safety zone) during construction, which triggers the requirement for a General Conformity Determination. The USCG submitted a preliminary Conformity Determination to the EPA in September 2006. EPA will prepare a draft Conformity Determination, which will be issued to the public for comment. The Conformity Determination will not be final until control measures and/or offsets necessary to conform with the Massachusetts State Implementation Plan (SIP) become enforceable. The preliminary conformity document indicates that the Project has demonstrated that it would conform with the SIP for Eastern Massachusetts by complying with the control measures and regulations in the SIP and by fully offsetting its NOx construction emissions through the purchase of discrete emission reduction credits (ERCs) and/or NSR offsets (rate based ERCs) in accordance with 40 CFR 93. EPA will develop and issue all applicable CAA permits to regulate emissions from the project’s stationary operations. At this time, NEG has submitted a Clean Air Act (CAA) minor source preconstruction permit application to EPA

Noise. Underwater noise impacts are discussed above under Biological Resources. Since Port and Pipeline construction and operation would occur at a considerable distance off-shore, neither facility would impact onshore noise. Construction activities at the Salem and Weymouth Meter Stations may exceed ambient levels, however, the incidents would be of short-term duration and would have no long-term effects on the surrounding area. There would be no noise increase at the Salem Meter Station during operation, where the scope of work involves the installation of a reverse flow meter. The new heater that is proposed for installation at the Weymouth Meter Station would be much smaller than the existing heater and would require only a single burner. As a result, the combined noise level from the two heaters would be about 1 to 2 dBA higher at the property line than the current noise level. Given that the existing meter station is located in an industrial area that is bordered by a heavily trafficked highway, the slight increase in noise from the new heater is expected to be negligible and the impact minor.

NO ACTION ALTERNATIVE

Under the No Action Alternative, the Secretary would deny the License application, preventing construction and operation of this Port. If the Secretary pursues the No Action

Alternative, potential short- and long-term environmental impacts identified in this EIS/EIR would not occur. There would be no contribution to the nation's natural gas supply from this source. Because of the existing and predicted demand for natural gas, it would be necessary to find other means to facilitate the importation of natural gas from foreign markets that would equal the contribution from the Port. Strategies to meet this need could include other deepwater port applications, expansion of existing or construction of new onshore LNG ports, or increased use of other energy sources such as coal, oil, nuclear, or various forms of alternative energy.

Failing to bring LNG into the region would most likely result in short-term natural gas shortages and increased reliance on other fuel sources to make up the difference, especially for use in electricity generation. Many natural gas power plants have the option of substituting fuel oil, should natural gas become unavailable or prohibitively expensive. However, the projected national increase in petroleum product consumption between 2002 and 2025 is similar to that for natural gas. Consequently, there is unlikely to be a surplus of petroleum fuel that could readily provide a cost-effective alternative to natural gas without significant new discoveries of crude oil.

The insufficient supply of natural gas that could result under the No Action Alternative could lead to fuel substitution, most likely from other fossil fuels. Natural gas is the cleanest burning fossil fuel. Increased use of other fossil fuels with existing emissions-control technologies would lead to increased emissions of combustion by-products, including carbon dioxide (CO_2), sulfur dioxide (SO_2), and oxides of nitrogen, (NO_x). Other traditional long-term fuel source alternatives to natural gas for electric generation are nuclear power, hydropower production, and development of renewable energy sources. Because of permitting, cost considerations, nuclear waste disposal, and potential public concerns, new sources of nuclear power are unlikely to appear in the near future. It is also unlikely that significant new hydropower sources could be permitted and brought online as a reliable alternative to the LNG provided by the Project, particularly in the northeastern United States.

Although technology is improving and costs are declining for renewable energy (e.g., wind, solar, and biomass), the percentage of national electricity generated from nonhydropower renewable energy sources is projected to increase from 2.2 in 2002 to only 3.7 in 2025 (EIA 2004). Energy conservation and increased efficiency in energy production have been a component of the national energy agenda since the Arab Oil Embargo of 1973. However, while energy conservation can play a critical role in the future of the United States energy sector, growth projections continue to indicate that the demand for energy, and specifically natural gas, will outstrip cost-effective programs designed to stimulate energy conservation.

Numerous LNG import terminals are proposed for the northeastern United States and the Canadian Maritime provinces, some of which could potentially be constructed regardless of the outcome of any proposed Deepwater Port Act application. In the eastern United States, from Connecticut through northern Maine, seven new LNG terminals are currently proposed. Any LNG project would have an attendant set of environmental consequences. Each of these projects would go through a separate regulatory review and NEPA process, and are therefore not considered alternatives to the NEG Project. It is purely speculative to predict the resulting action that could be taken by the end users if natural gas is not supplied by the Project.

MITIGATION AND CONTINGENCY PLANNING

The DWPA requires that an applicant demonstrate that the proposed deepwater port be constructed and operated using the best available technology, thereby preventing or minimizing adverse impacts on the marine environment to the extent possible. Several mitigation measures have been identified that could aid in reducing impacts from the NEG Project and are described in below. Additional mitigation measures are expected to be identified during the course of the NEG Port and Pipeline engineering review, and during the analysis and approval process of the Port Operations Manual. Any license granted by MARAD and any Certificate issued by the FERC would require that the applicants comply with any mitigation measures deemed necessary to: 1) ensure that the facility would be constructed and operated using best available technology, so as to prevent or minimize adverse impact on the marine environment under DWPA §1503 (b)(5); 2) ensure that issuance of the DWPA license will comply with other applicable federal statues (e.g., the Endangered Species Act, the Magnuson-Stevens Act, the Coastal Zone Management Act, the National Marine Sanctuaries Act); and 3) ensure compliance with all permit requirements under the Clean Air Act (CAA), Clean Water Act (CWA) and any other applicable federal licensing statutes. Table ES-1 summarizes the contingency planning, mitigation and monitoring actions that would be taken to reduce potential impacts to resources during the construction and operation or mitigate unavoidable impacts of the NEG Project.

Table ES-1

Avoidance (by Project Design) and Mitigation Recommendations

Geologic Resources		
	Avoidance / Mitigation	**Monitoring**
	1. Construct the Pipeline lateral through soft bottom. Due to the soft, more easily plowed sediments, avoidance of gravel, cobble, and other hard substrates and lack of thin surficial sediment layers, construction time and potential water quality impacts caused by construction and support vessel water discharges would be reduced. 2. Although not anticipated, if blasting was determined to be required as a result of ongoing geophysical and geotechnical surveys, Algonquin would prepare a Blasting Mitigation Plan in consultation with the NOAA.	
Water Quality and Sediment Resources		
	Avoidance	**Monitoring**
	1. Summer construction would reduce construction time because it would present fewer weather delays. This would reduce water quality impacts due to construction vessel discharges and would result in a shorter time period for construction-related seabed disturbances, sediment re-suspension and elevated turbidity plumes; 2. Construct the Pipeline lateral through soft bottom. Due to the soft, more easily plowed sediments, avoidance of gravel, cobble, and other hard substrates and lack of thin surficial sediment layers, construction time and potential water quality impacts caused by construction and support vessel water discharges would be reduced. 3. Trenching and burial of the gas transmission pipeline would be performed using a pipeline plow towed by a derrick/lay barge, which would cause minimal environmental impacts from sediment re-suspension. 4. In limited areas where jetting techniques would be used, the pipeline	1. MARAD will require water quality monitoring to demonstrate impacts consistent with those analyzed in the EIS if a license is issued. Further details of this effort will be determined through coordination with EPA as part of a detailed monitoring and mitigation plan being developed by MARAD. The final monitoring and mitigation plan will be filed with FERC prior to the start of any pipeline construction activities. 2. FERC staff is recommending that water quality monitoring be incorporated into a Monitoring and Mitigation Plan for the Project, developed through consultation with the appropriate regulatory agencies.

	trench would be backfilled with sand, concrete mats, or other material. This material would be placed using a "tremie" tube or by divers to reduce turbidity. 5. The HubLine tie-in location would be excavated using a diver-assisted jetting to minimize environmental impacts from sediment re-suspension. 6. Filtered seawater and an EPA approved dye would be used for hydrostatic testing. Since the water would be in the line for less than 30 days, biocide, oxygen scavengers and corrosion inhibitor would not be added to the flooding and test water, and discharge of potentially contaminated water would be avoided. 7. Intake design improvements include optimizing the size of intake sea chests to provide the minimum possible velocity, and linking ballast water intake to the cooling water system so that cooling water could be used to provide the all non-emergency ballast requirements during LNG offloading. 8. No debris would be discharged. No sanitary wastes would be discharged from moored vessels. 9. NEG and Algonquin would require their contractors to maintain individual SPCC Plans in place for construction vessels during construction.	
Biological Resources		
Benthic Resources	**Avoidance**	**Monitoring**
	1. Plowing would be used as the primary pipeline construction technique. This would minimize the footprint adjacent to the trench where material would be sidecast; thereby minimizing overall impacts on benthic communities. 2. One-pass backfill techniques would be used to recontour bottom sediments so that benthic communities could reestablish in the shortest time possible. 3. In consultation with Secretary of EOEA, NEG is developing a compensatory mitigation program for habitats impacted by the project and is currently engaged in discussions to structure such a mitigation program.	1. Monitoring of benthic recolonization of the Pipeline and flowline routes would be done through a combination of SPI and grab sampling that would encompass a series of transects perpendicular to the pipeline or flowline. Samples along these transects would be located outside of and within the area impacted by construction. 2. In the Port area, the exposed portion of the suction anchors would be examined using video. 3. The results of the 2006 preconstruction survey would be analyzed to see if the expected conditions

		were verified and to assist in the selection of post-construction sample locations and identifying monitoring criteria. These analyses would be used to suggest specific parameters for evaluating monitoring results and to develop the criteria for determining recovery that would be confirmed during discussions with the resource and regulatory agencies.
Ichthyoplankton	**Mitigation**	**Monitoring**
	1. In consultation with Secretary of EOEA, NEG is developing a compensatory mitigation program to offset 'life cycle' impacts resulting from the Project and is currently engaged in discussions to structure such a mitigation program. 2. The applicant will implement a mitigation plan according to the specific requirements of the plan designed by MARAD to offset the base-case impacts of the facility on Species of Concern as stated in the final EIS for the DWP. These efforts should be reasonable, timely and practical and designed to specifically counter the base-case impacts associated with the operation of the Port. Based on the results of the on-going monitoring required by the license, if approved by MARAD and FERC, the mitigation plan may be modified over time to better compensate for specific impacts.	1. Regarding phytoplankton and zooplankton, the USCG and MARAD have concluded that biological monitoring would not be needed given the relatively small volumes of seawater used in the operation of the proposed closed-loop regasification system for this DWP.
Marine Mammals and Sea Turtles - Collision	**Avoidance (by design)**	**Monitoring**
	1. NEG has developed a Marine Mammal/Sea Turtle Visual Monitoring Plan (Plan) to minimize the potential for impacts to marine mammals and sea turtles from construction of the Project. This Plan would use human visual observers as the primary detection device during the construction phase of the Project. the following procedures would be followed if a marine mammal or sea turtle was spotted within 0.5 miles of the construction vessels: a. The vessel superintendent or on-deck supervisor would be notified immediately and the vessel's crew would be put on a heightened state of alert. The marine mammal would be monitored to determine if it was moving toward the construction area.	1. During construction, marine mammal and sea turtle movements in the vicinity would be monitored by trained marine mammal and sea turtle observers on-board the construction vessels who would have the authority to bring a vessel to idle if a baleen whale was seen within one km of the moving vessel. 2. Based on the analysis provided in the EIS for the NEG project and consultations with NOAA/ SBNMS, MARAD will require, as a condition of any DWPA license issued for this project, that the applicant install and operate an array of near-real-

	b. Construction vessel(s) in the vicinity of a sighting would be directed to cease any movement if a right whale came within 500 yards of any operating construction vessel. For other whales and sea turtles this distance would be established at 100 yards. Vessels transiting the construction area such as pipe haul barge tugs would also be required to maintain these separation distances. c. Construction would resume after the marine mammal/sea turtle was positively confirmed to be outside the established zones (either 500 yards or 100 yards depending upon species). 2. All construction and support vessels would report their activities to the mandatory reporting section of the USCG to remain apprised of North Atlantic right whale movements within the area. 3. While under way, all construction vessels would remain 500 yards away from right whales, and 100 yards away from all other whales to the extent physically feasible given navigational constraints. 4. All construction vessels greater than 300 gross tons would maintain a speed of 10 knots or less. Crew and supply boats, which move at up to 15 knots, when smaller than 300 gross tons would not be restricted to 10 knots; however, the crew members would be required to monitor the area for marine mammals and report any sightings to the other construction vessels operating in the area. 5. Mesh grates would be used during flooding and hydrostatic testing of the pipeline and flowlines to minimize impingement and entrainment of marine mammals and sea turtles. 6. NEG and Algonquin would require its contractors to maintain individual SPCC Plans in place for construction vessels during construction. 7. EBRVs approaching and departing the NEG Port would travel within the existing or proposed Boston TSS, once it is officially designated. The applicant will work with NOAA, MARAD and the Coast Guard within the existing regulatory structure to ensure LNG vessels calling at the NEG Port operate in a manner and at speeds that will reduce and avoid ship strikes to marine mammals. The details of the vessel operations will be developed and included as part of the vessel's operations manual	time acoustic detection buoys in the Boston TSS, the number, duration and specific location for which will be approved in advance by MARAD and NOAA as part of a detailed monitoring and mitigation plan prepared by MARAD.

	approved by the Coast Guard should a license be issued. All individuals onboard the EBRVs responsible for the navigation and lookout duties would receive training on marine mammal sighting/reporting and vessel strike avoidance measures. 8. MARAD will, to the extent practicable and consistent with applicable U.S. and international law, require the licensee to accept LNG deliveries only from LNG carriers that transit within the TSS. The details of the vessel operations will be developed and included as part of the vessel's operations manual approved by the Coast Guard should a license be issued. 9. The USCG believes that establishing mandatory speed restrictions for one small portion of a larger transportation scheme is not likely to create the desired benefit and could actually increase the likelihood of collisions and spills, and therefore increase the environmental risk. MARAD will however, address this issue on SRV speed through a combination of voluntary commitments from the applicant and licensing conditions that are developed in coordination and consultation with NOAA. 10. If a marine mammal or sea turtle was sighted by a crew member, the Person-in-Charge and the NEG Port Manager would be immediately notified and would ensure that the required reporting procedures were followed. 11. All EBRVs transiting to and from the MSRA would report their activities to the mandatory reporting section of the USCG to remain apprised of North Atlantic right whale movements within the area. 12. NEG would participate with NMFS and SBNMS in a passive acoustic monitoring program that would place auto-detection buoys within the Boston Harbor Separation Zone.	

Marine Mammals and Sea Turtles – Entanglement	Avoidance	Monitoring
	1. During Project construction and operation, NEG would use large diameter lines that would be visible to marine mammals and sea turtles. 2. During operation, lines and cables associated with the Port would be large diameter and highly visible to marine mammals and sea turtles. 3. In the unlikely event that a marine mammal became entangled, the environmental coordinator would immediately notify NMFS so that a rescue effort could be initiated.	
Marine Mammals and Sea Turtles – Underwater Noise	**Avoidance**	**Monitoring**
	1. Construction vessels in the vicinity of a sighting would be directed to cease any noise emitting activities that exceed 120 decibels (dB) if a right whale came within 500 yards of any operating construction vessel. For other whales and sea turtles this distance would be established at 100 yards. 2. By restricting construction activities to the summer months, acoustic sound disturbance to the endangered North Atlantic right whale would largely be avoided. This species may occur any time of the year, but is primarily present off the Massachusetts coast from February to May, with a peak in late March. 3. Operations involving excessively noisy equipment would "ramp-up" sound sources, allowing whales a chance to leave the area before sounds reached maximum levels. Contractors would be required to use vessel quieting technologies that minimize noise. 4. The preferred anchors for the unloading buoys would be anchored suction piles, which would avoid the sound produced by pile driving. 5. Contractors would be requested / encouraged to use equipment and procedures that minimize noise. 6. Construction operations involving excessively noisy equipment would slowly initialize sound sources. This would allow marine mammals to move farther away before full noise levels were emitted. 7. Construction equipment for installation of the proposed deepwater port	1. In order to demonstrate and document that whales are not be exposed to construction sound levels that exceed permitting thresholds, MARAD will require the applicant, as a condition of the DWPA license, to install and operate an array of near-real-time acoustic detection buoys to detect and localize vocally active marine mammals relative to construction-related sound sources. The applicant has committed to the installation and operation of an acoustic detection system that meets the requirements described by NOAA in its comments to the USCG dated July 3, 2006 (see Appendix D). Further details regarding this system, will be approved by MARAD and NOAA as part of a detailed monitoring and mitigation plan being developed by MARAD. The final monitoring and mitigation plan will be filed with FERC prior to the start of any pipeline construction activities. 2. MARAD will require the applicant, as a condition of any DWPA license granted, to install and operate an array of autonomous recording units to monitor and evaluate underwater sound output from the NEG Project. The applicant has committed to, and

	would be operated as needed and maintained to manufacturers' specifications in order to minimize noise effects, which include proper operation of any sound-muffling devices or engine covers. 8. Construction equipment would be turned off when not in operation in order to minimize the duration of noise 9. Delivery of crews and materials would follow normal vessel routes that avoid sensitive receptors, and the number of trips to bring crews to the construction site would be limited by using the full-capacity shuttles as much as possible.	MARAD will require, the installation and operation of a passive acoustic monitoring system that meets the alternative system requirements described by NOAA in their comments to the USCG date July 3, 2006 (see Appendix D). Further details regarding this system, including the duration of monitoring, will be approved by MARAD and NOAA as part of a detailed monitoring and mitigation plan being developed by MARAD. The final monitoring and mitigation plan will be filed with FERC prior to the start of any pipeline construction activities.
Marine Fish and Lobster	**Avoidance**	**Monitoring**
	1. The project has been designed to reduce impingement and entrainment through reduced velocity and intake screens to the extent practicable. Water use for the Port has been reduced by re-circulating ballast water in the regasification process.	1. MARAD agrees that mitigation and monitoring of egg and fish mortality should be required to demonstrate impacts consistent with those analyzed in the EIS. Further details of this effort, including the duration of monitoring, will be developed in coordination with NOAA, FERC and EPA as part of a detailed monitoring and mitigation plan being developed by MARAD. The final monitoring and mitigation plan will be filed with FERC prior to the start of any pipeline construction activities. 2. FERC staff is recommending that a Monitoring and Mitigation Plan for the Project is developed through consultation with the appropriate regulatory agencies and includes: a) appropriate pipeline depth of burial and cover criteria and b) measures to minimize construction impacts to migrating lobsters.

Socio-economics	Mitigation	Monitoring
	1. In consultation with the Secretary of EOEA, NEG is developing a compensatory mitigation program for commercial fishermen and lobstermen impacted by the Project and is engaged in discussions to structure the program. 2. The project would temporarily impact recreational fishermen, boaters, whale-watch vessels, and charter boats during construction of both the Port and Pipeline, and would have minor permanent impacts to these recreational interests during Port operation. To mitigate the loss of useable ocean surface area, the Project has initiated discussions with the Secretary of EOEA regarding compensatory mitigation for public benefits related to improving the quality of or access to coastal resources. To the extent possible, such compensatory mitigation would be proximate to the areas affected by the Project.	1. Available data on fishing activity in the project location has been collected and analyzed to support the conclusions in the EISs. The analyses showed minor displacement of fishing activities. Coast Guard and MARAD cannot clearly link requested fisheries research to proposed project impacts and therefore conclude that additional surveys are not justified.
Coastal Zone	**Mitigation**	**Monitoring**
	1. In consultation with the Massachusetts Secretary of EOEA, the Project is developing a compensatory mitigation program for coastal resources impacted by the Project and is currently engaged in discussions to structure such mitigation program. (See Appendix A)	
Air Quality	**Avoidance**	**Monitoring**
	1. NEG would obtain a CAA pre-construction permit prior to commencement of Port construction. 2. NEG would apply for a Title V operating permit within 1 year of commencement of operation 3. Construction of the project would result in emissions from fuel combustion from marine vessels employed during the construction phase. Emissions would be minimized through the operation and maintenance of the marine engines in accordance with recommended manufacturer operation and maintenance procedures. 4. Fuel combustion sources would result in emissions of NOx and CO, and,	1. The Project would be required to comply with all applicable permit requirements, including any monitoring that may be required under its air permits.

	to a lesser extent, emissions of VOCs, SO_2, and particulate matter. During the vaporization process, the boilers would be fired by natural gas only. The boilers would be equipped with SCR and low NOx burners (LNB) to control NOx and oxidation catalysts to control CO and VOCs. 5. Vessel emissions of NOx are above the General Conformity thresholds applicable to the Project area. NEG would obtain emission reduction credits as mitigation. 6. The power generation engines would supply electrical power for the vaporization process. Potential emissions would be based on use of natural gas (>99%) with a small amount (<1%) of diesel pilot fuel and an SCR and oxidation catalyst to control NOX and CO/VOC emissions.	
Cultural Resources	**Mitigation**	**Monitoring**
	1. The NEG Port and Pipeline Lateral were sited to avoid any identified cultural resources. 2. A plan has been developed by the applicants for management any unanticipated cultural resources that could be encountered during construction. The plan includes steps for stopping work, notifying authorities, and identification of the remains.	

FERC STAFF RECOMMENDATIONS

If the Commission authorizes the Pipeline Lateral portion of the NEG Project, the FERC staff recommends that the following measures be included as specific conditions in the Commission's Order. The FERC staff believes that these measures would further mitigate the environmental impacts associated with the construction and operation of the proposed project. Mitigation measures 1 through 9 are standard conditions recommended by the FERC staff for all pipeline projects.

1. Algonquin should follow the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests) and as identified in the environmental impact statement (EIS), unless modified by the Order. Algonquin must:

   a. request any modification to these procedures, measures, or conditions in a filing with the Secretary of the Commission (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 Office of Energy Projects (OEP) before using that modification.

2. The Director of OEP has delegated authority to take whatever steps are necessary to ensure the protection of all environmental resources during construction and operation of the project. This authority should allow:

   a. the modification of conditions of the Order; and

   b. the design and implementation of any additional measures deemed necessary (including stop work authority) to assure continued compliance with the intent of the environmental conditions as well as the avoidance or mitigation of adverse environmental impact resulting from project construction and operation.

3. **Prior to any construction**, Algonquin should file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, environmental inspectors, and contractor personnel will be informed of the environmental inspector'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 should be as shown in the EIS and as supplemented by filed alignment sheets. **As soon as they are available, and before the start of construction**, Algonquin shall file with the Secretary any revised detailed survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these alignment maps/sheets.

   Algonquin's exercise of eminent domain authority granted under Natural Gas Act (NGA) section 7(h) in any condemnation proceedings related to the Order must be consistent with these authorized facilities and locations. Algonquin's right of eminent domain granted under NGA section 7(h) does not authorize it to increase the size of its natural gas pipeline to accommodate future needs or to acquire a right-of-way for a pipeline to transport a commodity other than natural gas.

5. Algonquin should file with the Secretary detailed alignment maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage yards, 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, and documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

   This requirement does not apply to extra workspace allowed by the *Upland Erosion Control, Revegetation, and Maintenance Plan*, minor field realignments per landowner needs and requirements which do not affect other landowners or sensitive environmental areas such as wetlands.

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   a. implementation of cultural resources mitigation measures;
   b. implementation of endangered, threatened, or special concern species mitigation measures;
   c. recommendations by state regulatory authorities; and
   d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

6. **Within 60 days of the acceptance of this certificate and before construction** begins, Algonquin shall file an initial Implementation Plan with the Secretary for review and written approval by the Director of OEP describing how Algonquin will implement the mitigation measures required by the Order. Algonquin must file revisions to the plan as schedules change. The plan shall identify:

   a. how Algonquin will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;
   b. the number of environmental inspectors assigned per spread, and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;
   c. company personnel, including environmental inspectors and contractors, who will receive copies of the appropriate material;
   d. the training and instructions Algonquin will give to all personnel involved with construction and restoration (initial and refresher training as the project progresses and personnel change), with the opportunity for OEP staff to participate in the training session(s);
   e. the company personnel (if known) and specific portion of Algonquin's organization having responsibility for compliance;
   f. the procedures (including use of contract penalties) Algonquin will follow if noncompliance occurs; and

g. for each discrete facility, a Gantt or PERT chart (or similar project scheduling diagram), and dates for:

    i. the completion of all required surveys and reports;
    ii. the mitigation training of onsite personnel;
    iii. the start of construction; and
    iv. the start and completion of restoration.

7. Algonquin shall employ at least one environmental inspector per construction spread. The environmental inspector 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 5 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. Algonquin shall file updated status reports prepared by the environmental inspector with the Secretary and MMS on a **biweekl*y*** basis **until all construction and restoration activities are complete**. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

    a. the current construction status of the project, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally sensitive areas;

    b. a listing of all problems encountered and each instance of noncompliance observed by the environmental inspector(s) 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);

    c. corrective actions implemented in response to all instances of noncompliance, and their cost;

    d. the effectiveness of all corrective actions implemented;

    e. 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

    f. copies of any correspondence received by Algonquin from other federal, state or local permitting agencies concerning instances of noncompliance, and Algonquin's response.

9. Algonquin must receive written authorization from the Director of OEP **before commencing service** from the project. Such authorization will only be granted following a determination that rehabilitation and restoration of the right-of-way and other areas affected by the project are proceeding satisfactorily.

10. **Within 30 days of placing the certificated facilities in service**, Algonquin 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 certificate conditions Algonquin 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.

11. Algonquin should not begin construction activities until:

    a. FERC staff receives comments from NMFS regarding the proposed action;

    b. the Staff completes formal consultation with the NMFS, if required; and

    c. Algonquin has received written notification from the Director of the Office of Energy Projects (OEP) that construction or use of mitigation may begin.

12. **Prior to construction**, NEG should provide to the USCG staff for review and approval a full air quality analysis identifying all mitigation requirements required to demonstrate conformity and submit detailed information documenting how the project would demonstrate conformance with applicable SIP in accordance with Title 40 CFR Part 51.858. The documentation should address each regulatory criteria listed in Part 51.858; provide a detailed explanation as to whether or not the project would meet each requirement; and for each criteria being satisfied, provide all supporting information on how the project would comply.

13. **Prior to construction**, Algonquin should file documentation with the Secretary of the Commission that confirms USCG staff's review and approval of the project's air quality analysis and identifies all mitigation requirements required to demonstrate conformity with Title 40 CFR Part 51.858.

14. Algonquin should not begin construction of the project until it files with the Secretary of the Commission a copy of the determination of consistency with the Coastal Zone Management Plan issued by the Massachusetts Office Of Coastal Zone Management.

15. Algonquin should prepare as-built construction plans for the Pipeline Lateral that include the details of where the pipeline would be laid on the ocean floor and protected with concrete mats. To minimize the potential for the pipeline to become an obstacle for ground fishing gear, these plans should be made available to the USCG and other jurisdictional agencies for dissemination to the commercial fishing industry.

16. Algonquin should file with the Secretary of the Commission, **prior to construction**, a detailed Monitoring and Mitigation Plan regarding impacts associated with construction of the Pipeline Lateral, including documentation of all consultation with jurisdictional resource management agencies. The Monitoring and Mitigation Plan should include:

a. appropriate pipeline depth and cover criteria:

b. any measure to minimize impacts to migrating lobsters from pipeline trenching and backfilling;

c. mitigation and monitoring of egg and fish mortality;

d. water quality monitoring; and

e. installation and operation of an array of autonomous recording units to monitor and evaluate underwater sound output from the NEG Project.

17. Algonquin should continue consultations with the operators of the Hibernia cable to attempt to reach an agreement regarding the proposed pipeline crossing of the cable and the long term maintenance and repairs of the pipeline and the Hibernia cable.

CUMULATIVE IMPACTS

The CEQ defines cumulative impacts as the "impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions."[5] Although the impact of each individual project may be minor, the additive impacts from multiple projects could be major. The time frame for consideration in of cumulative impacts is 25 years, which corresponds with the term of the Deepwater Port Act license that may be issued.

This analysis considered both onshore and offshore facilities that could be developed and simultaneously contribute to impacts. The regional setting includes Massachusetts Bay and the Gulf of Maine, where appropriate. At the regional scale, impacts were evaluated on a broad basis and focused on historical trends that have led to the current conditions. The local setting generally focused on the vicinity around the proposed NEG Port site and considered combined effects with the proposed Neptune[6] and AES Battery Rock[7] projects, as well as the existing HubLine natural gas pipeline, Everett LNG Terminal, Massachusetts Water Resources Authority (MWRA) outfall, and Massachusetts Bay Disposal Site (MBDS). Cumulative impacts are summarized below.

Water Resources: Issues considered relative to water resources include turbidity, the effects of vessel discharges, water temperature, and contaminants.

The construction of the NEG Port would create some short-term turbidity in the lower few feet of the water column. This disturbance would be brief and would rapidly settle out or be

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[5] Title 40 CFR Section 1508.7

[6] Neptune LNG LLC, a subsidiary of Tractabel-Suez, has proposed a separate LNG port, the Neptune Project, to be located approximately 5 miles north of the NEG proposed site. That facility is also under review by the USCG (Docket No. USCG-2005-2611) and the subject of its own EIS.

[7] The AES Battery Rock LNG Project has been proposed for development on Outer Brewster Island in Boston Harbor. Since the island is part of the Boston Harbor Islands National Park, a state and national park, the project developers would require a 2/3 vote of acceptance by the Massachusetts Legislature to proceed. It would also be under the jurisdiction of the FERC and would be required to submit an application to that agency and undergo a full environmental review prior to licensing. To date, no application has been filed and the proposal is being studied by a committee in the Massachusetts Legislature.

dissipated by circulating currents. Operation of the Port would disturb an estimated 42 acres (32 under normal conditions) from anchor chain sweep, which could occasionally resuspend sediment into the lowest few feet of the water column. The Neptune Project would also cause bottom disturbance. Impacts to the water column resulting from the presence of the sediment plume would be temporary and localized for each of the proposed projects, and taken together, would not result in a considerable cumulative impact. No change in water column turbidity is anticipated during routine operation of either Port.

The addition of up to two new natural gas pipelines associated with the NEG and Neptune deepwater ports would add approximately 25.4 miles of new offshore pipeline in Massachusetts Bay in addition to the existing HubLine. Current construction schedules for the NEG and Neptune projects do not coincide. NEG construction is scheduled for 2007, while Neptune construction is scheduled for 2009. As a result, there are no expected overlapping impacts on water quality from pipeline construction.

Discharges of wastewater and cooling water from vessel operations by construction and operations vessels comprise the potential water quality impacts associated with both projects. Discharges from these vessels would be no different than those associated with normal ship and boat traffic in the area and would extend approximately 100 yards (less then 100 meters) from the vessel discharge points. As a result, these discharges would have a direct, long-term, minor adverse effect on water quality.

Both the NEG and Neptune Projects would regasify the LNG using a closed-loop system, so there would be no large-volume discharge of either heated or chilled water and water intake would be limited to amounts required for engine cooling, ballast, and hotelling uses. Cumulative, operation of the two projects would result in a water intake of roughly 7 mgd and a discharge of roughly 3 mgd. The maximum surface temperature elevation estimated for NEG's EBRVs was 1.1 °F (0.61 °C) in summer conditions, with an estimated surface temperature elevation of 0.18 °F (0.10 °C) at a distance of 1,640 feet (500 meters) downdrift from the discharge point. Modeling results indicate that the discharge would mix quickly to near ambient temperatures. Potential cooling water discharge impacts from the Neptune project would also be highly localized. Even when including the effects of the MWRA sewage outfall, which discharges approximately 350 to 400 mgd into the Bay, the cumulative impacts, while long-term, are considered minor.

Port construction and operation activities could release contaminants from the sediments, however, surveys of the area indicate that only minor levels of contaminated soils are present at the proposed NEG Port site and Pipeline corridor. Release of contaminants during the construction/operation of the proposed Neptune Project would also be minor. Since the effects of construction activities with regard to sediment redistribution would be temporary, and the offshore disposal area is outside the project area and in an area of deposition, there would be minor cumulative impacts regarding contaminated sediment redistribution.

Biological Resources: Cumulative impacts are discussed in the sections below for the following marine resources: marine fish, benthic communities, shellfish, plankton, marine mammals, and sea turtles.

<u>Marine Fish</u>: During operation, the NEG Port would have a minor impact on marine fisheries as the result of entrainment of fish eggs and larvae; and an even smaller impact from impingement of adult fish on the water intake grates covering the EBRV seachests. The Neptune DWP Project would have similar, short-term minor adverse impacts to fish from changes to the benthic community (from construction). Together, both project ports would temporarily impact roughly 1,800 acres (construction) and permanently impact 106 acres (operation) of benthic habitat. This impact would be offset by the fishing restrictions around the Projects from safety

zones. These zones would prohibit benthic disturbance from bottom-trawling activities of roughly 722 acres.

Benthic Communities: Construction of the pipeline laterals from the NEG and Neptune Ports to the HubLine would have minor impact on benthos, although it is anticipated that the impacted areas would support a viable benthic and shellfish community shortly after construction. Construction of the ports would also have a small temporary impact on benthic habitats. Although this seabed disturbance would lead to mortality of benthic organisms in this total area, NEG Project construction would precede Neptune by two years. Given the rapid regeneration time documented for soft-bottom communities, the benthic community disturbed by NEG Project construction could recover by natural population recruitment within the interval between construction of the two facilities and associated pipelines. Even when considered together, however, the impacts of construction from both projects would have a minor adverse impact on benthic communities, and not prevent their eventual recovery after construction is complete.

Cumulatively, operation of both the NEG and Neptune ports would result in the combined long-term disturbance of approximately 106 acres of soft-bottom habitat within Massachusetts Bay, due, primarily, to recurring bottom scouring caused by the sweep or motion of mooring lines of the four combined unloading/mooring buoy systems (63 acres due to Neptune and 43 acres due to NEG). Given the overall abundance of this type of habitat within the region, when considered together, the cumulative impacts from the two projects on benthic resources would be minor, long-term and direct.

Lobsters: Cumulatively, operation of both the NEG and Neptune ports would result in the combined long-term disturbance of approximately 106 acres of soft-bottom habitat within Massachusetts Bay, due, primarily, to recurring bottom scouring caused by the sweep or motion of mooring lines of the four combined unloading/mooring buoy systems (63 acres due to Neptune and 43 acres due to NEG). Impacts to shellfish from anchors and cable sweep in areas of soft sediment would be similar to those described above for benthos. Rocky areas within the anchor corridor would provide some protection for crabs and lobsters in these areas from contact with cables.

Plankton: In general, the NEG Project and any of the proposed or ongoing projects in the region produce a direct, long-term, minor adverse impact on plankton populations (including phytoplankton, zooplankton, and ichthyoplankton). Operation of the MBDS creates periodic short-term minor adverse impacts on plankton that are limited in spatial and temporal extent. When combined with the anticipated impact of turbidity changes from either construction or operation of the NEG Project, the cumulative impact to plankton populations in the Project area is minor.

Water intakes associated with both ports could adversely affect plankton. In some cases, regional onshore power plants that operate at substantially higher intake rates have not been shown to have major negative impacts on these communities, but the incremental additional impacts from future LNG terminals on these resources is difficult to predict. The USCG conducted an analysis of impingement and entrainment of ichthyoplankton communities from hydrostatic testing during construction and water intake for regasification. Losses due to one-time hydrostatic tests can be considered minor. NEG proposes to construct the project over a 7-month time frame from May through November. Assuming that construction is initiated in May and that hydrostatic testing of the pipeline and flowlines takes place in the summer, a one-time total of less than 200 fish eggs and less than 100 fish larvae might be entrained and lost. For each species these numbers would result in the loss of less than one age-1 fish. When combined with Neptune's Ichthyoplankton Assessment, which also projected losses of less than one fish for most species, these losses represent a direct, short-term, minor adverse impact on fish populations.

Adult equivalent-adult modeling showed losses of tens to hundreds of age-one individuals for most species. When taken in combination with the Neptune project, these projects would result in direct, long-term, minor adverse impact to the ichthyoplankton and finfish communities.

Marine Mammals: The proposed locations of both the NEG and Neptune Projects in Massachusetts Bay are within areas known to be visited by marine mammals. Whale species within Massachusetts Bay change with season in conjunction with the presence of forage finfish species as well as zooplankton (in the case of the right whale). The three main categories of potential impacts from the proposed projects are: vessel strikes, entanglement, and noise.

The projects most relevant to a discussion of vessel traffic and potential strikes are the proposed LNG terminals and the Massachusetts Bay Disposal Site. Collisions between marine mammals and ships, although expected to be rare, could increase with an increase in shipping. In 2003, there were 4,561 transits by large commercial vessels entering or leaving Massachusetts Bay Harbors. During routine operations at the NEG Port, approximately 130 additional LNG vessel transits would occur in Massachusetts Bay each year. Three additional LNG facilities are proposed for locations further north in the Gulf of Maine that would add approximately 350 LNG vessel trips each year to the region. Compared to the overall amount of existing commercial, recreational, fishing, and military vessel traffic in the area, this increase is moderate.

Habitat for several marine mammal species extends from the Northeastern United States and Canada to the Southeastern United States. Therefore, all of the proposed and operating LNG projects located along the East coast could impact whales or other marine mammals. There is currently uncertainty regarding vessel traffic and whale strikes. Although it is recognized that any increase in vessel traffic increases the risk for a whale strike, it is unclear how this risk translates into probability. Although the increase in vessel traffic attributed to NEG Port installation, decommissioning and routine operation would be small, the Project would contribute to an increase in the overall level of vessel traffic in Massachusetts Bay.

Since anchor lines used for both projects would be large diameter, there is a small chance that a marine mammal could become entangled in the anchor lines during construction or operation of either Project. An indirect entanglement potential could result from fishing operations being displaced to SBNMS, since increased fishing activity in an area with greater populations of marine mammals could result in a greater entanglement potential. When assessed cumulatively, the entanglement potential if such a shift did occur would be incrementally greater, but would still be expected to be minor.

Construction noise should be about the same for both projects, but would occur during different years and would therefore not be additive. Noise from Port operation, once both ports were functioning, would occur simultaneously but would be separated by 5 miles (8 kilometers). Both over-air and in-water noise levels would be attenuated sufficiently between sources that no additive noise impacts would occur, as a result there would be no additive impact on marine mammals due to noise from simultaneous operation of both projects. The noise levels associated with EBRV(s) offloading at the NEG site are below the MMPA Level B harassment thresholds of 160 dBL and 120 dBL. Acoustic impacts on marine mammals from regasification are expected to be long-term, direct, and minor. Noise levels associated with EBRVs transiting to the site, as well as positioning at the buoys, would produce intermittent, direct, minor adverse impacts on marine mammals.

MARAD will require the applicant, as a condition of any DWPA license granted, to install and operate an array of autonomous recording units to monitor and evaluate underwater sound output from the NEG Project to demonstrate and document the exposure to sound levels identified in the DWP license application, and which formed the basis for certain conclusions regarding potential impacts to whales in this EIS.

Sea Turtles: The same projects/areas/activities/features that were considered in the analysis of cumulative impacts for marine mammals were considered for analysis of cumulative impacts to sea turtles. However, given the relatively low occurrence of sea turtles in the project area, the impacts to sea turtles from the project would be expected to be minor. Therefore, the contribution to cumulative impacts would be minor.

Threatened and Endangered Species**:** In general, the impacts to Threatened and Endangered species are similar to those described above for marine mammals. NOAA has set a Potential Biological Removal value of zero for North Atlantic right whales. This means that the death of even one individual is above the acceptable limit. As noted above, although it is recognized that any increase in vessel traffic increases the risk for a whale strike, it is unclear how this risk translates into probability.

Geological Resources: The only impacts to geological resources posed by NEG would be seafloor disturbance. The Pipeline Lateral would cross the Hibernia cable between the Port and the HubLine interconnection. At that crossing, the pipeline would be laid on the surface and armored, which would alter the seafloor slightly in that immediate area by changing soft bottom to hard bottom habitat. Most of the surrounding area is soft-bottom habitat, and this change would be minor. The Neptune Project would also have a minor impact on the geology of the seafloor. The combined impact of the two projects, when considered together with the ongoing change in bottom sediments and configuration caused by ocean dumping of clean materials in the use of the MBDS, is cumulatively minor.

Cultural Resources: No cultural resources would be affected by construction of the NEG Project since none are located within the construction footprint of the Project. Consequently, the NEG Project would have no cumulative impact on these resources.

Ocean Use: Construction of the NEG and Neptune Pipelines would temporarily prohibit non-construction traffic from the areas of the corridor under active construction. This would limit access to areas within the Ocean Sanctuaries that are within the pipeline corridors. Given the limited construction period, however, and the time difference in construction schedules of the two Projects, the cumulative impacts would be short-term and minor. Operation of the ports would prohibit access from the restricted area around each port. Given the size of Massachusetts Bay, the combined impact would be minor.

Land Use: The minor scale of onshore construction within existing meter station properties, and the relatively short timeframe required for construction, make it unlikely that there would be any substantial impacts to nearby land uses. Furthermore, since space would be rented for NEG's Regional Operations Center, its operation would not cause a detectable change in land use activities. Consequently, any cumulative impacts to land use associated with the Project would be minor.

Recreational Resources: Recreational use of the deep water area in which the NEG Project is located is limited. Recreational fishing, boating, sailing, and diving are principally confined to shallower areas along the coastline. Some temporary loss of recreational fishing and boating area in the immediate vicinity of construction vessels would likely occur, and some long-distance racers may be forced to alter their navigational courses. The exception is whale watching, which occurs throughout the Project area as well as across both sanctuaries. The operation of the NEG Project would require whale watch vessels that might normally traverse the project area to maneuver around the Project area. If the Neptune project was constructed in its proposed location, that area would also have to be avoided. However, the whale watching trips can easily be rerouted and don't follow particular traffic patterns in the area. Therefore, the cumulative impact of the two projects on whale watching would be minor.

Visual Resources: Construction and operation of both NEG and Neptune projects would result in some visual impacts due to the presence of construction vessels and regasification vessels, which may be visible from the shore and to boaters in the vicinity. The size of these vessels would be similar to other commercial vessels seen in and around Massachusetts Bay, including more than 1,000 large vessels that call on the Port of Boston each year. Construction impacts from viewing construction vessels would be short-term and minor. While the EBRVs would not be visible from shore at all up to 73 percent of the time, and barely visible even on clear days, they would be highly visible from SBNMS and from other areas frequented by both commercial fishing and whale watching boats. If the Neptune project is also constructed, there would be two ships within 5 miles (8 kilometers) of one another potentially visible, and up to four ships at a time if both projects have overlapping ship visits. Taken together, the visual impact of the two projects from SBNMS would be higher than for the NEG alone. However, the impact would still be minor, given how common large commercial vessels are in Massachusetts Bay.

Socioeconomics: Historically, the marine fishery resource of Massachusetts Bay has played an important role in the development of culture and commerce to the communities encompassing the bay. The commercial fisheries and it contributions has diminished from the 20th century due to overfishing by both foreign and domestic fleets (Report of the Massachusetts Offshore Groundfish Task Force, 1990). Nonetheless, under active management of the New England Fisheries Management Council for species occurring in Massachusetts Bay, and for some species, consultation/joint management with the Mid-Atlantic Fisheries Management Council and/or Atlantic Marine Fisheries Commission, this fishing area still provides resources that support a small-vessel commercial fishery. In addition, there is a well-substantiated lobster fishery**.** Present day management efforts include regulation of minimum mesh size, fish size limit and days-at-sea restrictions. In addition, a number of annual, rolling closure periods occur in areas of Massachusetts Bay throughout the year with the intent to preserve spawning stocks of finfish within this enclosed bay.

Permanent closures near the Project area include the Western Gulf of Maine Closure Area, which is permanently closed to multispecies fishing. Seasonal closures surround the permanent closure at various times throughout the year that include portions of the Project area. The days-at-sea restrictions and Gulf of Maine Rolling Closures have substantially limited the areas and the number of days per year that fishermen can fish, which limits their ability to generate revenue and make fishing a profitable venture. The rolling closures affect areas that are several orders of magnitude larger than the combined area comprised by the Neptune and NEG projects' exclusion zones.

During the summer, assuming that the area to be avoided around the NEG Port has the effect of excluding fishing, there would be a less than one percent reduction of Block 125 available for fishing. When considered together with the existing fishing closures, the NEG project would have a cumulatively minor impact on commercial trawling fishing. Another meaningful comparison is between the NAA and a comparable trawlable area of similar habitat within the range of the inshore one-day trip for a commercial fishing vessel. There is an estimated 400 square miles of mud bottom habitat fishable by trawl that has the potential to be used by the mobile gear fishery within 30 miles of Gloucester sea buoy located near the mouth of Gloucester Harbor. The NAA around the NEG Port would be 722 acres, or less than 0.1 percent of the trawlable area within 30 miles of Gloucester. If this were doubled to include the Neptune project, it would restrict less then 0.1 percent of trawlable area. Assuming that these 400 acres are not saturated with fishing effort, there is ample opportunity for mobile fishing effort to be moved elsewhere. These small percentages prove to be minor cumulative impacts on commercial fishing due to restricted zones around the NEG and Neptune ports.

Overall, the population and local economy would be slightly and favorably impacted by each of the proposed additional means of supplying natural gas to the New England markets, as well as by wage and tax income from each of the projects. Thus the construction and operation of the two projects, would contribute to wages, tax income, natural gas supply diversity and reliability. Cumulatively, the projects would contribute to the economic well-being of the New England area.

Transportation: If the NEG, Neptune, and AES Battery rock projects are constructed, there may be a tripling of the number of LNG vessels arriving to dock, regasify, and discharge natural gas into the New England pipeline system compared to the operation of the NEG Project alone. This may increase the number of large vessels in proximity to the Boston TSS and other shipping lanes. In the context of the existing 2,280 large ship calls per year into Massachusetts Bay, the three projects taken together would generate an approximate 8 percent increase in shipping traffic. However, that traffic associated with the NEG and Neptune Projects would not continue into the Harbor itself and would stop approximately 13 miles (21 kilometers) offshore. Therefore, cumulative impacts associated with vessel traffic would be minor.

Air Quality: Overall, it is anticipated that the cumulative impacts of the Project would be beneficial relative to scenarios without the Project that would require burning other fuels. The natural gas supplied by the Project to various facilities on land is a cleaner-burning fuel with respect to all air pollutants than the most likely alternative energy sources (coal or oil). EPA and MDEP's air quality planning process encompasses assessment of regional and localized air quality (including emissions from the construction and operation of the proposed NEG project), and evaluation of cumulative impacts of all major NOx sources in the region out to 50 km beyond the SIA (57.5 km) and all reasonably foreseeable air emissions in the vicinity of the proposed NEG port (e.g., emissions from other vessel traffic, direct and indirect emissions from the proposed Neptune project).

NOx and VOC emissions from construction of the NEG Project have not been accounted for in the Massachusetts SIP emission inventory or budget for growth. Therefore offsets are required for NOx and VOC construction emissions. USCG will evaluate project-related construction emissions in consultation with MDEP and EPA to determine the appropriate means of offsetting these emissions. Prior to issuance of the license, USCG/MARAD will issue a conformity determination consistent with 176(c) of the CAA and 40 CFR Part 93 Subpart B.

Noise: Based on the later construction period proposed for the Neptune project, there would be no additive construction noise impact. Based on the proposed locations of the two projects approximately 5 nautical miles apart, neither in-air nor underwater sound would be additive during operation. Therefore, when considered together with the potential Neptune impacts, there are no cumulatively considerable impacts from the NEG Project from noise.

Safety: Based on the Independent Risk Assessment (IRA) conducted by AcuTech (AcuTech 2006), there are low probability but potentially major risks associated with the transportation and handling of LNG in association with the proposed NEG and Neptune deepwater ports. The most extreme creditable modeling scenarios presented in the IRA identified a potential maximum hazard radius of approximately 3.8 miles (6.06 km) around each NEG buoy while occupied by an EBRV. Neptune would have a similar hazard area that would partly overlap with that of the NEG hazard area if both ports were operating simultaneously. This overlap would increase the hazard probability for vessels operating in the overlap area but there would be no cumulative contribution to the modeled extent or magnitude of any credible LNG accident scenario within that area.

Operation of any deepwater LNG port in the Massachusetts Bay would, by default, increase overall LNG accident probability from the current levels, but there would be no cumulative contribution to the modeled extent or magnitude of any credible LNG accident scenario from the operation of Neptune or NEG deepwater ports. By definition, increased risk probability would have a minor, long-term, adverse impact on safety in the vicinity of the ports. Because the ports would not share any resources that could be impacted by a credible unintentional LNG release scenario, there would not be cumulative safety impacts on any one resource.

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ACRONYMS AND ABBREVIATIONS

°C	Degrees Centigrade
°F	Degrees Fahrenheit
$\mu g/m^3$	Micrograms per cubic meter
ACHP	Advisory Council on Historic Preservation
ACOE	U.S. Army Corps of Engineers
AcuTech	AcuTech Consulting Group
AHV	Anchor Handling Vessel
Algonquin	Algonquin Gas Transmission, LLC
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ATBA	Area to be avoided
BA	Biological Assessment
BACT	Best Available Control Technology
Bcf	billion cubic feet
Bcfd	billion cubic feet per day
BMP	Best Management Practice
BO	Biological Opinion
BRAT	Benthic Resource Assessment Technique
CAA	Clean Air Act
CEQ	Council of Environmental Quality
Certificate	Certificate of Public Convenience and Necessity
CFR	Code of Federal Regulations
CO	carbon monoxide
CO2	carbon dioxide
CORMIX	Cornell Mixing Hydrodynamic Model
COTP	Captain of the Port
CWA	Clean Water Act
CY	cubic yards
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	Decibel
dBa	Decibel sound level
dBL	Linear broadband levels on the decibel scale
DOE	U.S. Department of Energy
DOI	Department in the Interior
DOT	U.S. Department of Transportation
DSV	Diving Support Vessel
DSV	Dive Supply Vessel
Dth	Decatherm
Dthd	Decatherms per day
DWPA	Deepwater Port Act
EBP	Early Benthic Phase
EBRV	Energy Bridge Regasification Vessel
EFH	Essential Fish Habitat

EIA	Energy Information Administration
EIS	Environmental Impact Statement
EIS/EIR	EIS/Environmental Impact Report
ELMR	Estuarine Living Marine Resource
ENF	Environmental Notification Form
EOEA	Massachusetts Executive Office of Environmental Affairs
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
Excelerate	Excelerate Energy Limited Partnership
FAV	Forced Air Vaporization
FEIR	Final Environmental Impact Report
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FFMZ	Federal Fishery Management Zone
FMP	Fishery Management Plan
FR	Federal Register
FSO	Facility Security Officer
FSP	Facility Security Plan
FSRU	Floating Storage and Regasification Unit
FWS	U.S. Fish & Wildlife Service
GBS	Gravity Based Structure
gpd	gallons per day
GRT	Gross Registered Tons
GT ITC	Gross Tonnage under International Conventions
HAP	hazardous air pollutant
HAZID	Hazards Identification Study
HubLine	Algonquin's HubLine Pipeline
Hz	hertz
IFV	Intermediate Fluid Vaporizers
IGC	International Gas Code
IMO	International Maritime Organization
IMO	International Maritime Organization
IRA	Independent Risk Assessment
ISO-NE	Independent System Operator- New England
ISPS	International Ship and Port Facilities Security
IWC	International Whaling Commission
JTTF	Joint Terrorism Task Force
kg	Kilograms
kW	kilowatt
LAA	limited access area
LAER	Lowest Achievable Emission Rate
Lb/MMBtu	Pounds per million British thermal units.
LDCs	Local Distribution Companies
LFL	low flammability limit
LNG	Liquefied Natural Gas
m^3	cubic meters
MAAQS	Massachusetts Ambient Air Quality Standards

MARAD	Maritime Administration
MARPOL	International Maritime Organization
MARSEC	Maritime Security
MBDA	Massachusetts Bay Disposal Area
MBDS	Massachusetts Bay Disposal Site
MBUAR	Massachusetts Board of Underwater Archeological Resources
MCMZ	Massachusetts Office of Coastal Zone Management
MDCR	Massachusetts Department of Conservation and Recreation
MDEM	Massachusetts Department of Environmental Management
MDEP	Massachusetts Department of Environmental Protection
MDER	Massachusetts Division of Energy Resources
MDMF	Massachusetts Division of Marine Fisheries
MEFSB	Massachusetts Energy Facilities Siting Board
MEPA	Massachusetts Environmental Policy Act
MGD	gallons per day
MHC	Massachusetts Historical Commission
MMBtu	Million British thermal units
MMcf	million cubic feet
MMcfd	Million cubic feet per day
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MMscf	Million standard cubic feet
MMscfd	million standard cubic feet per day
MP	Milepost
MSA	Magnuson-Stevens Fishery Conservation and Management Act
Mscfd	Thousand cubic feet per day
MSRA	Mandatory Ship Reporting Area
MSRS	Mandatory Ship Reporting System
MTSA	Maritime Transportation Security Act of 2002
MWRA	Massachusetts Water Resources Authority
NAA	No Anchoring Area
NAAQS	National Ambient Air Quality Standards
NARWC	North Atlantic Right Whale Consortium
NEFSC	Northeast Fisheries Science Center
NEG	Northeast Gateway Energy Bridge L.L.C.
NEG Pipeline Lateral	Northeast Gateway Energy Bridge Pipeline Lateral
NEG Port	Northeast Gateway Deepwater Port
NEGC	New England Governors Conference
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NGA	Natural Gas Act
NGA	Northeast Gas Association
NHESP	Massachusetts Natural Heritage and Endangered Species Program
NHPA	National Historic Preservation Act
nm	nautical miles

NMFS	National Marine Fisheries Service
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSR	New Source Review
NTU	Nephelometric Turbidity Unit
O_3	Ozone
OBE	Operating Basis Earthquake
OCRM	Office of Ocean and Coastal Resources Management
OCS	Outer Continental Shelf
ORV	Open Rack Vaporizers
ORV-STV	Open rack vaporizers - shell and tube vaporizer
ORW	Outstanding Resource Waters (Massachusetts Designation)
OSV	Offshore Supply Vessel
PAH	Poly Aromatic Hydrocarbons
PAH	Polycyclic aromatic hydrocarbon
PARS	Port Access Route Study
Pb	Lead
PBR	Potential Biological Removal
PEL	Probable Effects Level
PGA	Peak Ground Acceleration
PGD	Permanent Ground Displacement
PLEM	pipeline end manifold
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PPM	Parts per million
PSD	Prevention of Significant Deterioration
ROD	Record of Decision
ROV	Remotely Operated Vehicle
RPD	Redox Potential Discontinuity
Sandia	Sandia National Lab
SBNMS	Stellwagen Bank National Marine Sanctuary
scf	Standard cubic feet
SCR	Selective Catalytic Reduction
SCV	Submerged Combustion Vaporizers
Secretary	Secretary of Transportation
SHPO	State Historic Preservation Officer
SIL	Significant Impact Level
SIL	Significant Impact Level
SIP	State Implementation Plan
SO_2	Sulfur dioxide
SOLAS	Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SOx	Sulfur Oxide

SPCC	Spill Prevention, Control and Countermeasures Plan
SPCCP	Spill Prevention, Control and Countermeasure Plan
SPI	Sediment Profile Imagery
SSE	Safe Shutdown Earthquake
STL	Submerged Turret Loading
STL Buoys	Submerged Turret Loading Buoys
STV	Shell-and-Tube Vaporization
Tcf	trillion cubic feet
THPS	Tetrakis (hydroxymethye) phosphonium sulfonate
TOC	Total Organic Compound
tpy	Tons per year
TSS	Traffic Separation Scheme
USC	United States Code
USCG	U.S. Coast Guard
USGS	United States Geological Survey
VOC	Volatile Organic Compound
VSO	Vessel Security Officer
VSP	Vessel Security Plan
WHO	World Health Organization

1.0 INTRODUCTION

On June 13, 2005, Northeast Gateway Energy Bridge L.L.C (hereinafter referred to as NEG or applicant), a subsidiary of Excelerate Energy Limited Partnership (Excelerate), a private company formed in 2003 in Oklahoma, submitted an application to the U.S. Coast Guard (USCG) and Maritime Administration (MARAD) seeking a federal license under the Deepwater Port Act of 1974 (DWPA)[1] to own, construct, and operate a Deepwater Port for the import and regasification of liquefied natural gas (LNG)[2] in Massachusetts Bay, approximately 13 miles off of the coast of Massachusetts. The project, referred to as the Northeast Gateway Deepwater Port (NEG Port), was assigned Docket No. USCG-2005-22219.

On June 13, 2005, Algonquin Gas Transmission, LLC (hereinafter referred to as Algonquin), a subsidiary of Duke Energy Gas Transmission, submitted an application to the Federal Energy Regulatory Commission (FERC) for a Certificate of Public Convenience and Necessity (Certificate) under Section 7 of the Natural Gas Act (NGA), as amended, to construct, own and operate a 16.1-mile-long lateral pipeline that would interconnect the proposed NEG Port with Algonquin's existing offshore natural gas pipeline system (HubLine).[3] The project, referred to as the Northeast Gateway Pipeline Lateral (NEG Pipeline or Pipeline Lateral), was assigned FERC Docket No CP05-383-000. The two projects (NEG Port and NEG Pipeline) are referred to collectively in this document as the NEG Project.

This final Environmental Impact Statement (EIS) is intended to address the requirements of both the DWPA and the NGA and would be one element considered in the decisions on whether, or under what conditions, to grant a license for the NEG Port and a Certificate for the Pipeline Lateral. NEG would construct, own and operate the NEG Port. Algonquin would construct, own and operate the Pipeline Lateral. The EIS is also intended to support the licensing decisions of the U.S. Army Corps of Engineers (ACOE) and the U.S. Environmental Protection Agency (EPA).

The staff of the USCG prepared this EIS on the proposed NEG Project and is responsible for review of the NEG Port. The FERC is a cooperating Federal agency responsible for the review of the approximately 16.1-mile-long offshore pipeline lateral and the associated modifications to onshore facilities. This joint EIS satisfies the requirements of the National Environmental Policy Act (NEPA) of 1969, the DWPA, the USCG Commandant Instruction M16475.ID, the NGA, Section 10 of the Rivers and Harbors Act of 1899, and Section 402 of the Clean Waters Act (CWA). NEG has also filed an application for a permit under the Clean Air Act (CAA) with the U.S. Environmental Protection Agency (EPA).

The DWPA establishes a licensing system for ownership, construction, and operation of manmade structures beyond state seaward boundaries. The Act promotes the construction and operation of deepwater ports as safe and effective means of importing oil into the United States

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[1] Public Law (P.L. 93-627, Sec. 3, January 3, 1975, 88 Stat. 2127, as amended, codified to 33 U.S. Code (U.S.C) 1501-1524.

[2] LNG is natural gas that has been cooled to about minus 260 degrees Fahrenheit (°F) for efficient shipment and storage as liquid. It is more compact than its gaseous equivalent, with a volumetric differential of about 610 to 1.

[3] The HubLine is an existing 30-inch diameter interstate natural gas pipeline that was constructed by Algonquin and placed in service in 2003.

and transporting oil from the Outer Continental Shelf (OCS), while minimizing tanker traffic and associated risks. In 2002, the Maritime Transportation Security Act[4] (MTSA) amended the definition of "deepwater port" to include facilities for the importation of natural gas.[5]

While the Port would be located in federal waters, approximately 12.5 miles of the interconnecting Pipeline Lateral would be located in Massachusetts territorial waters. A portion of the project therefore falls under the authorities of the Commonwealth of Massachusetts and the Massachusetts Environmental Policy Act (MEPA). Therefore, staff developed this document to serve as a joint Environmental Impact Statement and Environmental Impact Report (EIS/EIR hereafter referred to as the EIS) to comply with the USCG and FERC NEPA requirements under the DWPA and NGA, respectively, as well as the Commonwealth's MEPA requirements. On behalf of the Commonwealth, the Massachusetts Executive Office of Environmental Affairs (EOEA) is a participating agency in this review under MEPA docket numbers EOEA No. 13473 (NEG Port) and EOEA No. 13474 (Pipeline Lateral). Appendix A of this EIS provides a copy of the *Certificate of the Secretary of Environmental Affairs Establishing a Special Review Procedure for the NEG Project.*

Under the DWPA, all deepwater ports must be licensed by the Secretary of Transportation (Secretary). The Secretary has delegated authority to the USCG and MARAD to process applications submitted by private parties to construct, own and operate deepwater ports. The USCG retains this responsibility under the Department of Homeland Security.[6] On June 18, 2003, the Secretary delegated authority to MARAD to issue, transfer, amend, or reinstate a license for the construction and operation of a deepwater port.[7] The responsibility for preparing the Project Record of Decision (ROD) and for issuing or denying the Deepwater Port License has also been delegated to MARAD. Hereafter, "the Secretary" refers to the Maritime Administrator as the delegated representative of the Secretary.

NEG proposes to locate the NEG Port site in Minerals Management Service (MMS) Lease Blocks NK 19-04 6625 and 6675, approximately 13 miles south-southeast of the city of Gloucester, MA, in federal waters, at depths of approximately 270 to 290 feet. This section of Massachusetts Bay is commonly referred to as Block 125. The proposed offshore Port facilities contained in the USCG and MARAD license application would consist of:

- Two subsea submerged turret loading buoys (STL™ Buoys)
- Two flexible risers
- Two pipeline end manifolds (PLEMs)
- Two subsea flowlines

Each STL Buoy would connect to a PLEM using the flexible riser assembly, and the PLEM would connect to the subsea flow line. A fleet of specially-designed Energy Bridge Regasification Vessels (EBRVs), each capable of transporting approximately 4.9 million cubic

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[4] P.L. 107-295.

[5] P.L. 107-295, Section 106, November 25, 2002, 116 Stat. 2064.

[6] Title XV (Transition) of the Homeland Security Act provides that "pending matters," including license applications currently being processed, will continue regardless of the transfer of USCG from the USDOT. Even though the function of processing applications has been transferred with USCG to the U.S. Department of Homeland Security, the Secretary of Transportation retains ultimate authority to issue, transfer, amend, or reinstate licenses under the Deepwater Port Act.

[7] Vol. 68, *Federal Register*, No. 117, Wednesday, June 18, 2003, pp 36496-97.

feet (138,000 cubic meters) of LNG, would connect to a STL buoy to deliver natural gas to the NEG Pipeline. The Port mooring system is designed to handle other potentially larger vessels with capacities up to 250,000 cubic meters, or 151,700 cubic meters during a 100-year storm.

Once connected to the STL buoy, the EBRVs would vaporize the LNG using a closed-loop shell-and-tube vaporization technique using recirculated, heated fresh water on-board. Natural gas would fuel the regasification facilities, as well as the turbine-generators to provide the vessel's electrical needs during offloading and hoteling operations. Section 2.1.1 provides a detailed description of the proposed NEG Port facilities.

In October 2005, NEG and Algonquin each supplemented their June 13, 2005 filings to the USCG and the FERC. The supplements shifted the proposed NEG Port buoys west approximately 235 and 956 feet, respectively, based on additional engineering and environmental studies conducted by NEG. Under this new proposal, the overall length of the Pipeline Lateral was reduced by 1,893 feet, or to a total length of 16.1 miles.

The proposed 24-inch diameter NEG Pipeline would connect the proposed NEG Port to the interstate pipeline system beginning at the existing underwater HubLine approximately three miles east of Marblehead, Massachusetts, and extending northeast to approximately Milepost (MP) 6.3, crossing the outer reaches of the territorial waters of the Town of Marblehead, the Cities of Salem and Beverly, and the Town of Manchester-by-the-Sea. At MP 6.3, the pipeline route would continue to the east and southeast, exiting territorial waters of Manchester-by-the-Sea, entering waters regulated by the Commonwealth of Massachusetts, and continuing approximately 6.2 miles to the south/southeast to MP 12.5, where it enters Federal waters. Upon entering Federal waters, the route would extend to the south/southeast for approximately 3.6 miles, terminating near the NEG Port. Figure 1-1 shows the general location of the proposed NEG Project. Section 2.1.2 provides a more detailed description of the pipeline and ancillary facilities.

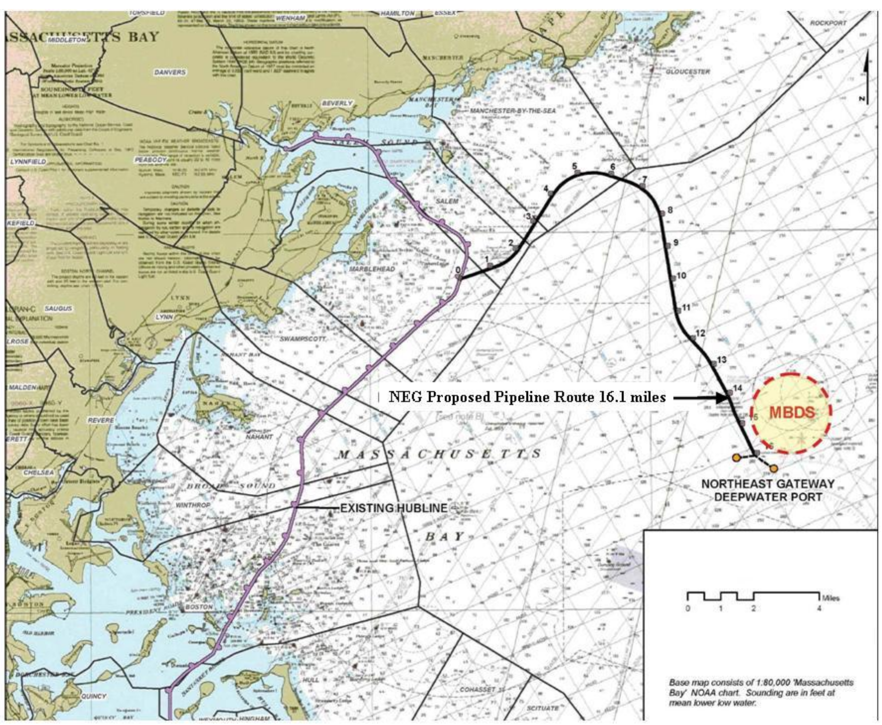

Figure 1-1. General Project Location

1.1 PURPOSE AND NEED

The purpose of licensing deepwater ports for importing LNG in the Outer Continental Shelf (OCS) is to provide a reliable and timely supply of natural gas that will increase energy diversity while considering impacts to the environment and mitigating safety concerns in order to serve the growing demand for residential, industrial and electric generation within Massachusetts and New England. This requires construction of appropriate facilities for receiving the LNG, revaporizing the LNG to a gaseous state, and interconnecting the facility to the transmission pipelines that can reach appropriate markets within the U.S.

The DWPA of 1974, as amended, was passed to promote and regulate the construction and operation of deepwater ports as a safe and effective means of importing oil or natural gas into the U.S. The DWPA requires the Secretary to approve or deny a deepwater port license application. In reaching this decision, the Secretary must carry out the Congressional intent expressed in the Deepwater Port Act, which is to:

- authorize and regulate the location, ownership, construction and operation of deepwater ports in waters beyond the territorial limits of the U.S.;
- provide for the protection of the marine and coastal environment to prevent or minimize any adverse impact that might occur as a consequence of the development of such ports;
- protect the interests of the U.S. and those of adjacent coastal States in the location, construction, and operation of deepwater ports;
- protect the rights and responsibilities of the States and communities to regulate growth, determine land use, and otherwise protect the environment in accordance with law;
- promote the construction and operation of deepwater ports as a safe and effective means of importing oil and natural gas into the U.S. and transporting oil and natural gas from the OCS while minimizing tanker traffic and the risks attendant thereto; and
- promote oil and natural gas production on the OCS by affording an economic and safe means of transportation of oil and natural gas to the U.S. mainland.

The Congressional intent is codified in nine requirements set forth in 33 U.S.C. §1503(c), as follows:

1. The applicant is financially responsible and will meet the requirements of the DWPA.
2. The applicant can and will comply with applicable laws, regulations, and license conditions;
3. Construction and operation of the deepwater port will be in the national interest and consistent with national security and other national policy goals and objectives, including energy sufficiency and environmental quality;
4. The deepwater port will not unreasonably interfere with international navigation or other reasonable uses of the high seas, as defined by treaty, convention, or customary international law;

5. The applicant has demonstrated that the deepwater port will be constructed and operated using best available technology, so as to prevent or minimize adverse impact on the marine environment;

6. The Secretary has not been informed, within 45 days of the last public hearing on a proposed license for a designated application area, by the Administrator of the EPA that the deepwater port will not conform with all applicable provisions of the Clean Air Act, as amended (42 U.S.C. 7401 et seq.), the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq.), or the Marine Protection, Research and Sanctuaries Act, as amended (16 U.S.C. 1431 et seq., 1447 et seq.; 33 U.S.C. 1401 et seq., 2801 et seq.);

7. The Secretary has consulted with the Secretaries of the Army, State, and Defense to determine their views on the adequacy of the application, and its effect on programs within their respective jurisdictions;

8. The Governor of the adjacent coastal State approves, or is presumed to approve, issuance of the license; and

9. The adjacent coastal state to which the deepwater port is to be directly connected by pipeline has developed, or is making at the time the application is submitted, reasonable progress, toward developing an approved coastal zone management program pursuant to the Coastal Zone Management Act of 1972 (16 U.S.C. 1451 et seq.).

The DWPA application currently under consideration is one proposed by NEG. In its application, NEG proposes to construct, own, and operate the NEG Port to receive and vaporize LNG and transport natural gas at a geographical location that allows it to connect into the Nation's Northeast natural gas market via the existing natural gas transmission infrastructure.

Energy demand in New England and the U.S. as a whole has been growing and continues to increase steadily. Part of the intent for the recent DWPA amendments was to provide mechanisms to ensure that the U.S. energy market could access worldwide natural gas supplies that the Federal government recognized would become a key supply source for the country's existing and projected natural gas demands over the next 10 years. The U.S. Department of Energy (DOE), Energy Information Administration (EIA) estimates that total energy consumption in the U.S. will increase 1.2 percent annually - over 27 quadrillion British thermal units (Btu) – or quads - per year - over the next 20 years, from 99.7 quads per year in 2004 to 127.0 quads per year in 2025 (EIA, 2006). The EIA projects that annual demand for natural gas in the U.S. could reach 26.9 trillion cubic feet (Tcf) by 2030, compared to an annual consumption of 22.3 Tcf in 2003 (EIA, 2006), due largely to projected increases in industrial demand and natural gas-fueled electrical power generation. Recent trends (Table 1-1) suggest that natural gas demand in the lower 48 states has exceeded supply in 7 out of the past 14 years to date, raising concern over the ability to continue to meet projected demand growth regionally and nationally. Despite planning efforts to conserve and reserve natural gas supplies regionally, the Northeast Gas Association (NGA) is projecting that demand will exceed supply again in 2007 (Table 1-2). Table 1-3 shows projected U.S. natural gas supply and demand through 2030.

Table 1-1

Annual U.S. Natural Gas Supply and Demand in the Lower 48 Continental States (Trillion Cubic Feet)

	Year														
Demand	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Residential	4.96	4.85	4.85	5.24	4.98	4.52	4.73	5.00	4.77	4.89	5.08	4.88	4.84	4.48	4.88
Commercial[a]	2.86	2.90	3.03	3.16	3.21	3.00	3.04	3.18	3.02	3.14	3.18	3.14	3.06	2.91	3.06
Industrial [b]	8.87	8.91	9.38	9.68	9.71	9.49	9.16	9.40	8.46	8.62	8.27	8.35	7.66	7.76	8.13
Transportation	0.63	0.69	0.70	0.72	0.76	0.64	0.66	0.66	0.64	0.68	0.61	0.59	0.58	0.57	0.61
Electric Power	3.47	3.90	4.24	3.81	4.06	4.59	4.82	5.21	5.34	5.67	5.14	5.46	5.80	5.85	5.81
Total Demand	**20.79**	**21.25**	**22.21**	**22.70**	**22.73**	**22.25**	**22.41**	**23.45**	**22.24**	**23.01**	**22.28**	**22.43**	**21.93**	**21.57**	**22.48**
Total Supply[c]	**21.17**	**21.11**	**22.85**	**21.66**	**21.74**	**21.54**	**22.54**	**23.61**	**22.12**	**23.02**	**22.24**	**22.10**	**22.97**	**21.59**	**22.46**

[a] Commercial consumption is gas used by nonmanufacturing establishments or agencies primarily engaged in the sale of goods or services such as hotels, restaurants, wholesale and retail stores and other service enterprises; and gas used by local, state and federal agencies engaged in nonmanufacturing activities.
[b] Industrial consumption includes natural gas used for heat, power, or chemical feedstock by manufacturing establishments or those engaged in mining or other mineral extraction, as well as consumers in agriculture, forestry, fisheries and construction.
[c] Total Supply includes total U.S. dry gas production, imports, exports, supplemental gaseous fuels and working gas in storage.

Source: Energy Information Administration/Short-Term Energy Outlook. July 2006.

Table 1-2
U.S. Regional[a] Natural Gas Demand
(Billion Cubic Feet per Day)

	REGION								
	New England	Mid-Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
2005									
Residential	0.537	2.404	3.828	1.174	1.255	0.520	0.853	0.930	1.754
Commercial	0.336	1.618	1.933	0.765	1.007	0.385	0.838	0.589	0.909
Industrial	0.236	0.935	3.151	1.151	1.433	1.223	6.460	0.808	2.656
2006									
Residential	0.488	2.191	3.469	1.072	1.116	0.469	0.777	0.882	1.810
Commercial	0.305	1.566	1.778	0.718	0.929	0.354	0.814	0.581	0.921
Industrial	0.229	0.943	3.107	1.172	1.462	1.262	6.578	0.818	2.744
2007									
Residential	0.541	2.370	3.836	1.202	1..243	0.518	0.866	0.937	1.847
Commercial	0.322	1.629	1.909	0.777	1.014	0.381	0.866	0.590	0.900
Industrial	1.251	0.976	3.260	1.158	1.523	1.308	7.112	0.822	2.888

[a] Regions refer to U.S. Census divisions.
Source: EIA, 2006a

Table 1-3
U.S. Natural Gas – Forecasted Supply and Demand
(Trillion cubic feet)

	2007	2010	2015	2020	2025	2030
Production	18.00	18.58	20.36	21.44	21.16	20.83
Consumption	22.07	23.00	25.54	26.54	26.60	26.48
Net Imports	4.00	4.35	5.10	5.02	5.37	5.57

Source: EIA, 2006.

Recent growth in natural gas demand has been fairly consistent throughout New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont) across sector and by state. The region experienced record demand for natural gas over the past several winters and projections show retail natural gas demand continuing to grow. Within New England, annual natural gas demand is split between residential and commercial consumers (40 percent), industrial consumers (17 percent), and power generators (43 percent) according to data from the New England Governors' Conference (NEGC, 2003). On a seasonal basis, 77-79 percent of natural gas demand on a peak winter day is from traditional gas consumers (traditional subscribers), with the remaining 21-23 percent used by power plants in the region.[8] The number of retail gas

[8] "Traditional" subscribers include homes and businesses that buy gas on a firm, year-round basis from a local gas utility company (also referred to as local distribution companies) and cannot readily switch to another fuel. Local gas distribution companies are obligated to plan for and provide gas to these customers on a "firm" supply basis, without involuntary disruptions in supply. Large industrial consumers that are able to switch to another fuel when natural gas prices are relatively expensive or in low supply often buy gas on a non-firm basis. Gas-fired power plants either buy gas from a local distribution company on an interruptible or firm basis, or bypass the local system by interconnecting directly with the interstate gas pipeline. Some power plants are capable of operating on alternate fuel and

customers in Massachusetts alone increased by nearly 300,000 new customers between 1992 and 2000. According to the Northeast Gas Association (2005), natural gas is the predominant fuel of choice for heating in 70 percent of new homes constructed in the continental U.S. (excluding Alaska), including the Northeast (New England and New York and New Jersey), and it has grown consistently in popularity across the region over the past 20 years.

New England's electric sector is also highly dependent on natural gas. In the late 1990s and early 2000s, more than twenty new natural gas-fired combined cycle power plants were constructed and placed into operation in New England. In 2003, approximately 40 percent of New England's electricity was generated by natural gas. As a result, natural gas represents the largest component of the regional power generation fuel portfolio and accounts for approximately 43 percent of the region's annual natural gas demand. The Northeast Independent System Operator (ISO-NE) projects that New England could experience a shortage of approximately 430 MW during the 2006-2007 winter, growing to approximately 1,800 MW by 2010-2011 (Hibbard, 2006).

Currently, LNG meets approximately 20 percent of New England's annual gas demand while, on average, the five interstate pipelines that supply the region provide the remaining 80 percent. During winter peak demand periods when natural gas demands sap pipeline capacity throughout the region, LNG supplies well over 30 percent of New England's natural gas needs (NEGC, 2005). The all-time peak day gas sendout to retail customers in New England (through the winter of 2004) occurred in January 2004 and was 12 percent higher than the previous all-time peak. As shown in Table 1-4, local gas distribution companies currently rely on LNG for a significant share of the supplies needed to meet peak requirements.

Table 1-4

LNG as Percent of Peak Day Design

Company	Percent
Bay State Gas	23%
CT Natural Gas	30%
KeySpan	36%
NE Gas Co.	38%
NSTAR	44%
Southern CT Gas	23%

Source: New England Governors Council, 2004.

The DOE projects a 1.4 percent annual growth rate in natural gas consumption in New England, outpacing total energy consumption growth projections (1.2 percent) in the region, with projected natural gas demand increasing from 0.8 Tcf to 1.07 Tcf between 2003 and 2025. The forecast attributes 68 percent of this regional increase in consumption (0.19 Tcf) to the electric power generation sector. With domestic production of natural gas projected to be fairly constant over the same time frame, DOE projects that the major increase in national import supply would come from LNG, which is expected to grow from less than 1 Tcf per year in 2003 to over 6 Tcf per year by 2025 (DOE, 2005).

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have the ability to switch back and forth between gas and an alternate fuel (generally oil) if gas supplies are limited.

The proposed NEG Deepwater Port would add between 150 to 175 Billion cubic feet (Bcf) of natural gas to New England annually, or approximately 400 million cubic feet per day (MMcfd), depending on operational conditions, by the winter of 2007-2008, when several of the recent studies indicate that additional gas supplies will be needed. This increase would represent an approximate 8 percent increase in the region's overall delivery capacity. Operation of the Port would deliver natural gas directly to Massachusetts consumers and to the rest of New England via Algonquin's HubLine.

There are currently multiple proposals by private developers to provide additional LNG supplies from new LNG terminals throughout New England and into the Mid-Atlantic region. As a result, the New England Governors requested that the Power Planning Committee of the NEGC perform an analysis of the region's future demands for natural gas, the resource development scenarios that might address them, and the impacts that might occur as the result one or more of those scenarios. Their 2005 report found that regional demand for natural gas is growing, "though not as fast as some forecasters have suggested," and noted that, "[a]ssuming current LNG storage and vaporization capacity remains available and usable, the [New England] region has adequate delivery infrastructure to meet winter peak gas demands through 2010 under both normal and high estimates of growth in gas demand." However, the report also notes that if current LNG storage and vaporization were not available on a peak demand day following extended high-demand, cold-weather days draining storage, then the region could face insufficient gas supplies to meet customer space heating and some key electric generators needs. Additionally, the report found that while "expansion of fuel switching,[9] energy efficiency and renewable energy programs may be the least expensive ways to improve gas supply reliability while improving fuel diversity… expansion of LNG delivery and storage terminals provide considerably greater improvements to gas supply reliability than those scenarios" (NEGC, 2005).

The NEGC report concluded that given the time required for LNG project development, the region must substantially reduce demand or start now to develop infrastructure to ensure reliable delivery of natural gas in the winters beyond 2010. A report from the Special Commission for New LNG Infrastructure in Massachusetts and New England predicts a regional shortage in natural gas supply as early as 2007 and as late as 2010 (Tierney, 2005).[10] The earlier 2007 demand and supply imbalance predicted in the Tierney report is also supported by studies done by ISO-NE, which projects that natural gas-fired generators could experience a negative operable capacity margin of approximately 430 MW during the 2006-2007 winter (Hibbard, 2006). Figure 1-2 shows both the NEGC and Alliance Group (Tierney) forecasts of natural gas need in New England.

[9] Fuel switching assumes that natural gas-fired electric generating plants that are capable of generation using oil, would switch to oil for limited time periods to meet peak day demand.

[10] The difference between the predicted dates for natural gas shortage between the two reports results from the use of different baseline data. The NEGC's forecast of winter peak-day demand uses NGA-reported design-day demand for regional local distribution companies (LDCs) as its "high" forecast scenario, with a downward adjustment to that design-day level to serve as the estimate of the "normal" forecast scenario (Hibbard, 2006). Because design-day demand is typically the level of demand to which LDCs are required to plan to reliably meet firm customers' needs, the Tierney report used the design-day demand in the base case - not the "high case" – forecast (Hibbard, 2006). Regardless of which scenario is used, it is evident that new gas supplies are needed to meet demand growth.

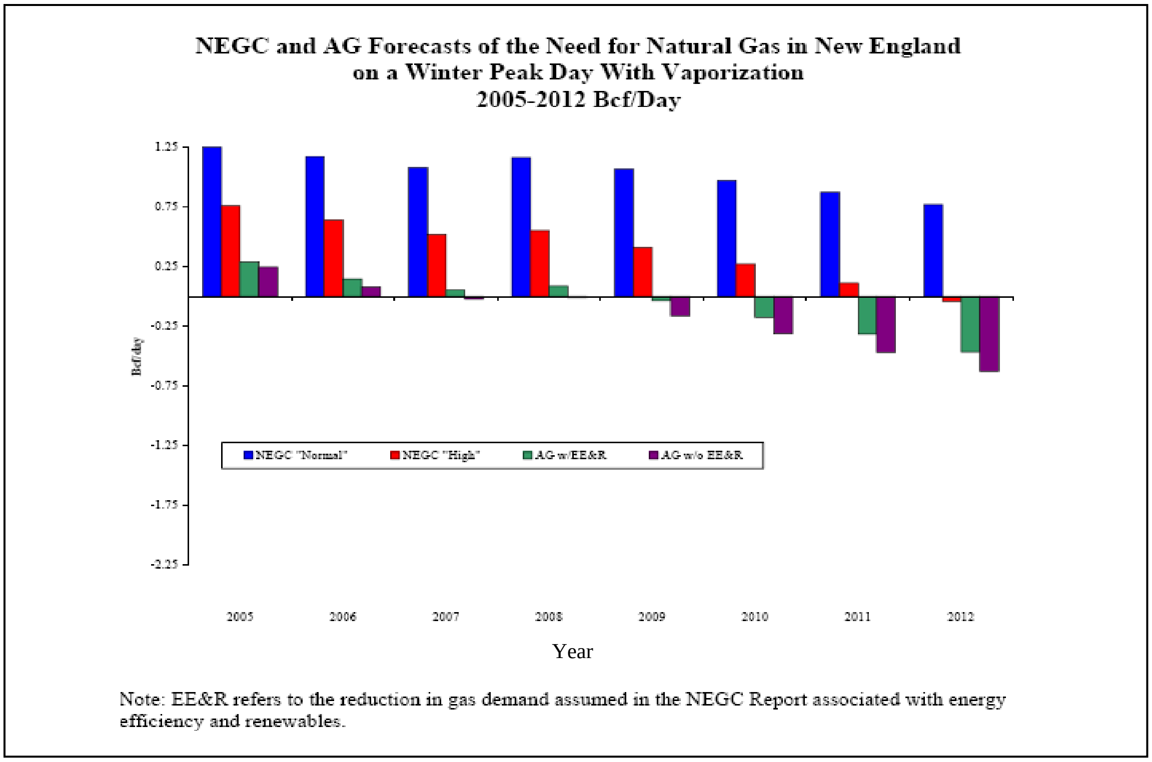

Figure 1-2. Forecasts of Natural Gas Needs for a Peak Winter Day in New England

The New England Council and the New England Energy Alliance have both called for the addition of new natural gas delivery infrastructure, "as it is vital to the quality of life of both the state and the region" (Tierney, 2006). A recent report to the Massachusetts Special Commission Relative to LNG Facility Siting and Use notes that:

> "Both supply and delivery capacity are needed soon – by as early as 2007 and as late as 2010. Given lead times necessary to permit, finance, and construct facilities, the region needs to act now to assure adequate gas supplies in the future… Long distances combined with economically sized pipeline additions will be difficult, time-consuming and expensive, with on-going transportation charges needed to pay for bringing the gas here. Another option is to assume that new LNG facilities will be built close by, either in Massachusetts or somewhere else in New England, incurring approximately the same LNG costs, difficult and time-consuming permitting processes, but with lower pipeline delivery charges…"(Tierney, 2006).

At present, 97 percent of the gas consumed in the U.S. comes from North America: 81 percent from domestic resources, 16 percent from Canada, and 3 percent from imported LNG (NGA, 2006).

Options for increasing natural gas supply in New England are limited. Supplies from traditional U.S. and Canadian sources have fallen and natural gas prices have risen to all-time highs recently because of increased demand and limited supplies. U.S. production of natural gas was 7 percent below its 2001 level in 2005, "with less than half of that decline reflecting the impact of hurricanes Katrina and Rita" (Bernanke, 2006). Between 1988 and 2001, net imports from Canada tripled, but have since leveled off and presently represent about 16 percent of all natural gas consumed in the U.S., and while rising 16 percent in 2005 compared to 2004 for New England, it still only provides 35 percent of the gas supply to the region (NGA, 2006). Both U.S. and Canadian gas fields have matured and are yielding smaller increases in output, despite the incentive of high prices and a substantial increase in the number of drilling rigs in operation (Bernanke, 2006).

New England has virtually no known native sources of natural gas and no capacity for storing gas in large geologic repositories (such as salt caverns or depleted natural gas reservoirs). The region is essentially at the end of major natural gas pipeline transmission systems from the Gulf of Mexico region, western U.S., and western Canadian sources that serve as the primary source for natural gas in the region. Additional gas is obtained from Eastern Canada and LNG imports through the Distrigas terminal in Everett, MA. The region’s natural gas transmission system is composed of 5 major interstate pipelines, several intrastate pipelines and one of only four existing LNG facilities in the country, and the New England interstate pipeline system is currently operating at or close to capacity.

The ISO-NE reports that several gas pipelines experienced “numerous capacity constraints and operating restrictions” and its 2005 Regional System Plan noted that “pipeline capacity into and throughout the region is not sufficient to simultaneously satisfy the winter demand for gas by the local gas distribution companies (LDCs) and the burgeoning gas-fired electric power generation sector” (Hibbard, 2006). Four pipeline system expansion projects (Table 1-5) are either proposed or filed with the FERC that could add capacity to New England; three of which would transport additional gas from Canada and one would increase capacity from the existing Everett, MA LNG terminal. Only one of the proposed projects would be in-service in time to meet projected shortages for the winter of 2007-2008.

Table 1-5

Planned Enhancements to Northeast Pipeline Systems
(as of 7/17/06)

Project/Company	Description	Estimated In-service Date	Status
Essex-Middlesex Project / Tennessee Gas Pipeline – El Paso Corp.	7.8 miles of 24” pipeline in Essex and Middlesex counties in MA. Would provide increased capacity to transport 82,300 Dthd of gas from the Everett LNG terminal.	9/07	Filed with FERC 10/05
Maritimes & Northeast Pipeline Phase IV Expansion/Maritimes & Northeast LLC – Duke Energy Gas Transmission	1.7 miles of 30” pipeline in northern Maine and 5 compressor stations in Maine to transport natural gas from the planned Canaport LNG Terminal in Canada to the U.S. and increase Maritimes’ system capacity by approx. 418,000 Dthd.	2008	Filed with FERC 5/06
Atlantic Supply Expansion Project / Tennessee Gas Pipeline – El Paso Corp.	Open season for delivery of between 50 – 200 MMcfd into the Tennessee system from planned eastern Canadian LNG facilities to its Dracut, MA interconnection with the joint facilities of PNGTS and Maritimes & Northeast Pipeline.	11/09	Open season held 3/05
PNGTS Open Season / Portland Natural Gas Transmission System (PNGTS)	Open season for firm transportation capacity for moving gas to the northeastern U.S. and Eastern Canadian markets.	2008/ 2009	Open season held 6/05

Source: NGA, 2006a.

In a report of the Massachusetts Governor's Task Force on Electric Reliability and Outage Preparedness that was completed in 2004, the Task Force estimated that an incremental 120 MMcfd of natural gas would be consumed by electric power plants between 2003 and 2005. By the end of the decade (2010), the Task Force estimates that approximately 180 MMcfd is expected to be consumed on a peak summer day by the electric industry in New England. (Tierney, 2005).

Given the diminishing supply of natural gas from the traditional North American sources, LNG provides one alternative to meet the growing demand. LNG currently supplies about 30 percent of New England's peak day requirements and represents approximately 20 percent of New England's total annual gas supply. LNG imports to the region are historically from such countries as Algeria and Australia, and, more recently, from Trinidad & Tobago in the Caribbean (NGA, 2006). The estimated level of need for new natural gas supply infrastructure is forecast to grow to a level equivalent to 366 MMcfd in 2010 (Hibbard, 2006). The incremental increase in design day demand is projected to increase to nearly 1 Billion cubic feet per day (Bcfd) in 2015 and almost 3 Bcfd by 2030 (Hibbard, 2006).

The report to the Special Commission (Tierney, 2006) notes that, in addition to the need to match supply with demand, from an energy perspective, "there are advantages of siting LNG terminals within the region as compared to outside of the region: the farther away that LNG import facilities are located relative to the Massachusetts market, the higher will be the incremental gas transportation costs to enhance the pipeline system to enable it to bring these supplies into Massachusetts… Additionally, the in-region reliability benefits associated with an injection of gas supply directly into the local gas system will not occur if LNG import facilities are located outside of this region."

The proposed NEG Deepater Port would add between 150 Bcf to 175 Bcf of natural gas to New England annually, or approximately 400 MMcfd, depending on operational conditions, by the winter of 2007-2008 when several of the recent studies indicate that additional gas supplies will be needed. This would represent an approximate 8 percent increase in the region's overall delivery capacity.

1.2 SCOPE OF THE EIS

In processing DWPA applications, the Secretary (through MARAD and the USCG) is responsible for complying with numerous Federal and state regulations, including NEPA. As such, the purpose of this EIS is to provide an environmental analysis sufficient to support the Secretary's licensing decision; to facilitate a determination of whether NEG has demonstrated that the NEG Project would be located, constructed, operated, and, eventually upon retirement, decommissioned, using the best available technology necessary to prevent or minimize adverse impacts on the environment; and to encourage and facilitate involvement by the public and interested agencies in the environmental review process.

This EIS also assesses the potential environmental impacts associated with the installation, operation, and decommissioning of the proposed NEG Port and Pipeline Lateral. The affected environmental resource areas evaluated in this EIS include water quality, biological resources, cultural resources, sediment and geological resources, socioeconomics, transportation, air quality, noise, recreation and aesthetics, and public safety. The EIS describes the Proposed Action and potential alternatives (section 2.0), the affected environment as it currently exists (section 3.0), the probable environmental consequences that may result from construction, operation and decommissioning of the Port (section 4.0), public safety (section 5.0), and cumulative and other impacts (section 6.0).

Where applicable, this EIS considers safety but does not function as the final safety evaluation. All aspects of port safety would be addressed in the Port Operations Manual, which would require USCG approval prior to initiation of deepwater port operations. Financial responsibility is being evaluated within MARAD as a separate task that would be considered along with this EIS as part of the final licensing decision.

Impact Characterizations

In developing this EIS, the USCG adhered to the procedural requirements of NEPA, the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508), USCG procedures for implementing NEPA (Commandant's Instruction [COMDTINST] M16475.1D, *National Environmental Policy Act Implement Procedures and Policy for Considering Environmental Impacts*), the USCG's temporary interim rule for deepwater ports for LNG,[11] and to the extent possible, MEPA. The following elaborates on the nature of the characteristics that might relate to various impacts:

- *Short-term or long term.* These characteristics are determined on a case-by-case basis and do not refer to any rigid time period. In general, short-term impacts are those that would occur only with respect to a particular activity or for a finite period or only during the time required for construction or installation activities. Long-term impacts are those that are more likely to be persistent and chronic. For instance, certain air emissions associated with the Project construction would occur only during the construction period, while operationally, air emissions would extend for the duration of the Project license (25 years). Other types of long-term impacts, however, may persist even beyond the Port's operational life (i.e., the permanent loss of a certain habitat type).

- *Direct or indirect*. A direct impact is caused by a Proposed Action and occurs contemporaneously at or near the location of the action. An indirect impact is caused by a Proposed Action and might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action. For example, a direct impact of erosion on a stream might include sediment-laden waters in the vicinity of the action, whereas an indirect impact of the same erosion might lead to lack of spawning and result in lowered reproduction rates of indigenous fish downstream.

- *Minor, moderate, or major.* These relative terms are used to characterize the magnitude or intensity of an impact. Negligible impacts are generally those that might be perceptible but are at the lower level of detection. A minor impact is slight, but detectable. A moderate impact is readily apparent. A major impact is one that is severely adverse or exceptionally beneficial.

- *Adverse or beneficial.* An adverse impact is one having adverse, unfavorable, or undesirable outcomes on the man-made or natural environment; beneficial impacts would have the opposite effect. A single act might result in adverse impacts on one environmental resource and beneficial impacts on another resource.

[11] Vol. 69, *Federal Register*, No. 3, Tuesday, January 6, 2004, pp 723-87. The temporary interim rule amends 33 CFR Part 148, Deepwater Ports: General; 33 CFR Part 149, Deepwater Ports: Design, Construction, and Equipment; and 33 CFR Part 150, Deepwater Ports: Operations.

1.3 PUBLIC REVIEW AND COMMENT

The NEPA process promotes open communication between the public and the government and enhances decision making. All persons and organizations having a potential interest in the Secretary's decision whether to grant the DWPA license, the FERC's decision whether to issue a Certificate for pipeline construction and operation, or the Commonwealth's decisions related to its territorial waters pursuant to MEPA, are encouraged to participate in the decision-making process.

The USCG and MARAD initiated the public scoping process on September 21, 2005, with the publication of a Notice of Intent (NOI) to prepare an EIS in the *Federal Register*. The NOI described the project and the joint environmental review process, provided a preliminary list of issues to be addressed in the EIS, invited written comments on the environmental issues, and listed the dates and locations of two open houses and public scoping meetings to be held in communities in proximity to the project area. The NOI was also published in The Boston Globe, The Boston Herald, The Gloucester Daily Times, The Salem News, and The Daily News of Newburyport.

An "Interested Party" letter, the NOI published in the Federal Register, and a fact sheet describing the proposed project and announcing the location and dates of open houses and public scoping meetings were mailed to 106 interested parties on October 5, 2005. The USCG and MARAD sponsored open houses and public scoping meetings in Boston and Gloucester, Massachusetts, on October 18, and 19, 2005 that were also attended by the FERC and EOEA staff: In addition to comments received at the public meetings, the USCG received 22 comment letters in response to the NOI. Public comments submitted as part of scoping were considered in the development of the DEIS.

The DEIS was published in May 2006. In accordance with NEPA, the USCG and MARAD provided a 45-day period for the public and agencies to review and comment on the Draft EIS. The review period commenced on May 19, 2006, with the publication of the Notice of Availability (NOA) in the *Federal Register*. The May 19, 2006 *Federal Register* also provided notice of informational open houses and public hearings where public comments on the Draft EIS were invited. A NOA was also published in the Massachusetts Environmental Monitor on May 24, 2006 that invited the public to review and comment on the Draft EIS and to participate in the open houses and public hearings.

On June 14, and 15, 2006, the USCG, MARAD and EOEA held informational open houses and public hearings at Gloucester High School, Gloucester, Massachusetts and Salem State College, Salem, Massachusetts. A total of 30 individuals presented verbal or written comments at the public meetings. Transcripts of the public hearings are included in Appendix C. A total of 21individuals or non-government organizations and 16 public agencies or officials submitted comment letters to the Federal docket during the review period. A total of 36 comment letters were submitted to the MEPA docket. Comments submitted to the Federal docket as well as the USCG responses to all submitted comments are included in Appendix C. Comments submitted to MEPA and NEG's responses to those comments are included in Appendix A.

1.4 PERMITS, APPROVALS, AND REGULATORY REQUIREMENTS

As the lead agencies for administration of the DWPA, license application processing and issuance, and NEPA compliance, the USCG and MARAD are responsible for compliance with the provisions of numerous state and federal environmental laws that require consultation with other agencies concerning specific environmental resources. Examples of these include Section 7 of the Endangered Species Act (ESA), the Magnuson-Stevens Fishery Conservation and

Management Act (MSA), Section 106 of the National Historic Preservation Act (NHPA), and Section 307 of the Coastal Zone Management Act (CZMA). Described below are the various legal requirements and consultation obligations; where applicable, sections 3.0, 4.0, and 6.0 also discuss those requirements. Any enforceable conditions imposed as part of an approved license must be consistent with the appropriate and applicable regulations.

The Applicants would be required to obtain approvals related to, and comply with all applicable and appropriate permits, guidelines, and approvals as provided for in the CZMA, the CWA, and the CAA for any impacts on coastal resources, wastewater discharges, or regulated air emissions to the environment, respectively. The Applicant must also provide the licensing agency with the information necessary to evaluate potential compliance with the applicable regulations and guidelines.

Table 1-6 lists major Federal and state permits, approvals and consultation requirements required to construct and operate a natural gas deepwater port.

Table 1-6

NEG Applicable Permits and Consultations

Agency	NEG Port Applicable Permits and Consultations	Pipeline Lateral Applicable Permits and Consultations
Federal Agencies		
U.S. Department of Homeland Security, USCG	Review of Deepwater Port Application and Assessment of environmental impact under the National Environmental Policy Act (42 USC §§ 4321 et seq.).	Assessment of environmental impact under the National Environmental Policy Act (42 USC §§ 4321 et seq.).
Secretary of Transportation, as delegated to the Administration of MARAD	Issue Deepwater Port Record of Decision (ROD)	NA
Federal Energy Regulatory Commission (FERC)	NA	Environmental impact assessment under NEPA and issuance of a Certificate of Public Convenience and Necessity to construct, install, own, operate, and maintain a pipeline under Section 7(c) of the Natural Gas Act (15 USC § 717 (f) (c))
U.S. Department of Interior (DOI), Minerals Management Service (MMS)	Advise USCG and MARAD concerning potential impacts of the Port on OCS lease blocks, pipeline right-of-way, and coordinates on archaeological review.	Pipeline right-of-way

Table 1-6

NEG Applicable Permits and Consultations

Agency	NEG Port Applicable Permits and Consultations	Pipeline Lateral Applicable Permits and Consultations
U.S. Environmental Protection Agency (EPA), Region 1	CAA Preconstruction Permit	NA
	Title V CAA Permit	NA
	CAA General Conformity Determination	
	Section 402 Clean Water Act (CWA), National Pollutant Discharge Elimination System (NPDES) permit (hydrostatic testing)	Section 402 CWA, National Pollutant Discharge Elimination System (NPDES) permit (hydrostatic testing)
	Spill Prevention, Control and Countermeasures Plan (SPCC) (33 USC §1321 (j) and 40 CFR §112)	Spill Prevention, Control and Countermeasures Plan (SPCC) (33 USC § 1321 (j) and 40 CFR §112)
	Marine Protection, Research, and Sanctuaries Act consistency	Marine Protection, Research, and Sanctuaries Act consistency
US Army Corps of Engineers (ACOE)	CWA Section 404 (33 USC §§1344) permit for fill activities in waters of the U.S.	CWA Section 404 (33 USC §§ 1344) permit for any dredge and fill activities and work in waters of the U.S.
	Chapter 10, Rivers and Harbors Act of 1899 permit for construction of structures or work in navigable waters of the U.S.	Chapter 10, Rivers and Harbors Act of 1899 permit for construction of structures or work in navigable waters of the U.S.
US Fish and Wildlife Service (FWS)	Endangered Species Act, Section 7 consultation for onshore facilities	Endangered Species Act, Section 7 consultation for onshore facilities
National Oceanic and Atmospheric Administration (NOAA)/National Marine Fisheries Service (NMFS)	Endangered Species Act, Section 7 consultation and preparation of a Biological Opinion	Endangered Species Act, Section 7 consultation and preparation of a Biological Opinion
	Consultation on Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA)	Consultation on EFH under the MSA
	Consultation under the Marine Mammal Protection Act.	Consultation under the Marine Mammal Protection Act.
	Consultation under the Marine Sanctuaries Act relative to Stellwagen Bank National Marine Sanctuary	Consultation under the Marine Sanctuaries Act relative to Stellwagen Bank National Marine Sanctuary
Advisory Council on Historic Preservation/Massachusetts Historical Commission (State Historic Preservation Office (SHPO))	Cultural Resources Consultation under Section 106 of the National Historic Preservation Act, as amended	Cultural Resources Consultation under Section 106 of the National Historic Preservation Act, as amended
Massachusetts Agencies		
Governor of Massachusetts	Approve, disapprove, or notify MARAD of inconsistencies with state programs relating to environmental protection, land and water use, and coastal zone management for which MARAD may condition the license to make consistent.	Approve, disapprove, or notify FERC of inconsistencies with state programs relating to environmental protection, land and water use, and coastal zone management for which FERC may condition the Certificate to make consistent.
Executive Office of Environmental Affairs (EOEA)	Environmental impact assessment under the Massachusetts Environmental Policy Act (MEPA) and issuance of MEPA Certificate.	Environmental impact assessment under MEPA and issuance of MEPA Certificate.

Table 1-6

NEG Applicable Permits and Consultations

Agency	NEG Port Applicable Permits and Consultations	Pipeline Lateral Applicable Permits and Consultations
Office of Coastal Zone Management	Federal consistency determination under the Massachusetts Coastal Zone Management (MCZM) Program	Federal consistency determination under the MCZM Program
Department of Environmental Protection (MDEP)	Section 401 (CWA) Water Quality Certificate[12]	Chapter 91 Waterways License Section 401 (CWA) Water Quality Certificate
Massachusetts Division of Marine Fisheries	Section 7 ESA and MSA Consultation	Section 7 ESA and MSA Consultation
Massachusetts Board of Underwater Archaeological Resources	Section 106 NHPA consultation	Section 106 NHPA consultation
Massachusetts Energy Facilities Siting Board		Review and comment.
NA – Not Applicable		

Provisions of the Endangered Species Act (ESA)

Section 7 of the ESA mandates that any project authorized, funded, or conducted by any Federal agency should not "…jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined… to be critical." Under Section 7 of the ESA, the USCG and the FERC are required to consult with the U.S. Fish and Wildlife Service (FWS) and the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) to determine whether Federally listed or proposed endangered or threatened species or their designated critical habitat occur in the project area and may be affected by the proposed project. If these species or their habitat may be affected, the agency (in this case the USCG and MARAD) is required to prepare a biological assessment (BA) to identify the nature and extent of adverse impact, and to recommend measures that would avoid the habitat and/or species, or would reduce potential impacts to acceptable levels. After consultation, NMFS and/or FWS would issue a Biological Opinion (BO) on the potential for jeopardizing a listed species. At this time formal consultation has been initiated between MARAD, the USCG and FWS and NMFS. The USCG, FERC, FWS and NMFS have agreed that the biological sections of this EIS will serve as the BA for the Project. Appendix D provides correspondence with the FWS and NMFS with respect to the ESA.

[12] Although it would definitely be required for the Pipeline Lateral, it is not clear at this time whether or not Massachusetts' CWA Section 401 certification would be needed for licensing the NEG Port if it is located outside of state waters.

Provisions of Magnuson-Stevens Fishery Conservation and Management Act (MSA)

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), establishes procedures to identify, conserve, and enhance essential fish habitat (EFH) for those species regulated under a Federal fisheries management plan. The MSA requires Federal agencies to consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that might adversely affect EFH. NMFS recommends consolidated EFH consultations with interagency coordination procedures required by other statutes such as NEPA or the ESA (Title 50 CFR Section 600.920(f)) to reduce duplication and improved efficiency. Sections 3.4 and 4.4 of this EIS describe EFH and potential project related impacts. Appendix F presents a detailed assessment of EFH in the Project area.

Provision of the National Historic Preservation Act (NHPA)

Section 106 of the NHPA, as amended, requires the USCG and FERC to consider the effects of agency undertakings on properties listed on or eligible for listing on the National Register of Historic Places (NRHP), including prehistoric or historic sites, districts, buildings, structures, objects, or properties of traditional religious or cultural importance, and to allow the Advisory Council on Historic Preservation (ACHP) to comment on the undertaking. NEG, as a non-federal party, is assisting the agencies in meeting the requirements of Section 106 by preparing the necessary information and analysis as required by ACHP procedures (Title 36 CFR Part 800). The Cultural Resources sections of this EIS discuss the status of this review.

Coastal Zone Management Act (CZMA)

The CZMA calls for the "effective management, beneficial use, protection, and development" of the nation's coastal zone and promotes active state involvement in achieving those goals. As a means of reaching those goals, the CZMA requires participating states to develop management programs that demonstrate how these states would meet their obligations and responsibilities in managing their coastal areas. The Massachusetts EOEA, Coastal Zone Management Office is responsible for administering the Massachusetts Coastal Zone Management Program (CZMP). The Applicant must prepare a consistency certification, finding that its proposed activities would be fully consistent with the enforceable policies of the state's CZMP and submit it to the state for review.

Marine Protection, Research, and Sanctuaries Act (The Marine Sanctuary Act)

The Marine Protection, Research, and Sanctuaries Act (MPRSA), 33 United States Code (U.S.C.) 1401, regulates the ocean dumping of waste, provides a research program on ocean dumping, and provides for the designation and regulation of marine sanctuaries. The MPRSA regulates the ocean dumping of all material beyond the territorial limit (three miles from shore) and prevents or strictly limits dumping material that would adversely affect the human environment, ecological systems, or economic potential. Dumping does not include the construction of fixed structures or artificial islands in ocean waters or on or in the submerged lands under ocean waters for purposes other than disposal when the construction activity or action is regulated by Federal or state law.

The National Marine Sanctuary Program was established by Title III of the MPRSA. The MPRSA authorizes the Secretary of Commerce to designate discrete marine areas of special national significance as national marine sanctuaries. The purpose is to promote comprehensive long-term management of their conservation, recreational, ecological, historical, research, educational, or aesthetic values. National marine sanctuaries are built around the existence of distinctive natural and cultural resources, the protection and beneficial use of which require comprehensive planning and management. NOAA administers the National Marine Sanctuary Program through the Sanctuaries and Reserves Division (SRD), in the Office of Ocean and Coastal Resource Management (OCRM).

Clean Water Act (CWA)

The federal CWA, as amended in 1977, establishes the basic structure for regulating discharges of pollutants into the waters of the United States. The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation’s waters (33 USC Section 12151) and gives the EPA the authority to implement pollution control programs such as setting wastewater standards for industry. The CWA also sets water quality standard requirements for all contaminants in surface waters and makes it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit is obtained under its provisions. Three sections of the CWA are applicable to the NEG Project:

- Section 401, which requires federal agencies to obtain certification from the state, territory, or Indian tribes before issuing permits that would result in increased pollutant loads to a waterbody. Section 401 certification is issued only if such increased loads would not cause or contribute to exceedances of water quality standards;
- Section 402, which requires that developers obtain a National Pollutant Discharge Elimination System Permit (NPDES) for point source discharges into a surface waterbody.
- Section 404, which regulates the placement of dredge or fill materials into waters of the United States; and

Section 401 water quality criteria are developed by state agencies for receiving waters based on their beneficial uses. For this project, surface water quality standards for state waters are administered by the Massachusetts Department of Environmental Protection (MDEP). Although it would definitely be required for the Pipeline Lateral, it is not clear at this time whether or not Massachusetts’ CWA Section 401 certification would be needed for licensing the NEG Port if it is located outside of state waters.

The primary mechanism in the CWA regulating the discharge of pollutants is the National Pollutant Discharge Elimination System (NPDES), which is administered by the Environmental Protection Agency (EPA). Under the NPDES program, a permit is required from EPA or an authorized state for the discharge of any pollutant from a point source into the waters of the U.S. (section 402; 33 U.S.C. § 1342). This includes discharges associated with oil and gas development on federal leases beyond state waters. A NPDES permit for certain stormwater discharges also is required. In the case of discharges to the territorial sea or beyond, permits are also subject to the ocean discharge criteria developed under section 403 of the Act (33 U.S.C. § 1343). Permits for discharges into the territorial sea or internal waters may be issued by states following approval of their permit program by EPA; in the absence of an approved state permit program, and for discharges beyond the territorial sea, EPA is the permit-issuing authority.

The Section 404 permit program is administered by the U.S. Army Corps of Engineers (ACOE), but is subject to review by the EPA and other resource agencies such as FWS, NMFS and applicable state agencies. The EPA regulates and permits discharges to Massachusetts and OCS waters through the NPDES program under the Clean Water Act.

Clean Air Act (CAA)

The United States Congress passed the Clean Air Act in 1963, the Clean Air Act Amendment in 1966, the Clean Air Act Extension in 1970, and Clean Air Act Amendments in 1977 and 1990. The CAA requires EPA to set limits on how much of a pollutant can be in the air anywhere in the United States. The law allows individual states to have stronger pollution controls, but states are not allowed to have weaker pollution controls than those set for the whole country. The main or "criteria" air pollutants covered by the CAA are ozone, sulfur dioxide (SO_2), particulate matter (PM), lead, nitrogen oxides (NOx), and carbon monoxide (CO). The CAA includes specific limits, timelines, and procedures to reduce these criteria pollutants. The CAA also regulates what are called "hazardous air pollutants" (HAPs). SO_2 and NOx, which contribute to acid rain, are regulated by the CAA under a comprehensive permit program. The act protects stratospheric ozone by restricting the use of chlorofluorocarbons (CFCs) and regulating the use of volatile organic compounds (VOCs) in products.

Under the CAA, states have to develop state implementation plans (SIPs) that explain how each state will do its job under the Clean Air Act. A SIP is a collection of the regulations a state will use to clean up polluted areas. EPA must approve each SIP, and if a SIP isn't acceptable, EPA can take over enforcement of the CAA in that state.

New Source Review/ Prevention of Significant Deterioration (NSR/PSD)

The CAA requires all areas of the country to meet or strive to comply with the National Ambient Air Quality Standards (NAAQS). One of the key programs designed to achieve compliance with the NAAQS is the New Source Review (NSR) program, a preconstruction review process for new and modified stationary sources. The NSR program has two component parts: the Prevention of Significant Deterioration (PSD) program for attainment or "clean" areas typically requires new or modified sources to install state-of-the-art pollution controls to ensure that the ambient air quality will not degrade. The non-attainment area NSR program is designed to ensure that any new industrial growth in a non-attainment area will comply with stringent emission limitations (by requiring the most protective pollution controls and emission offsets), with the goal of improving air quality overall to meet the NAAQS. The NSR program requires companies to obtain a permit for new construction or major modifications that substantially increase a facility's emissions of the NAAQS.

Title V Permits

State environmental agencies issue air permits to large stationary sources of pollution such as power plants and factories. The permitting process requires a monitoring plan to be created and sets limits on the amounts and types of releases allowed. The information contained in this permit is made available to the polluter, other agencies, and the public. These permits are known as ‘title V’ permits because they are required by Title V of the 1990 Clean Air Act. The title V permit is meant to contain all the requirements for emissions from the permitted source. The permit requires reporting, monitoring, and annual certification of compliance, all of which is public information.

General Conformity

Section 176(c)(1) of the CAA requires that the Federal government not engage, support, or provide financial assistance for licensing, permitting, or approving any activity not conforming to an approved CAA SIP. For the NEG Project, the applicable plan is the SIP for the Attainment and Maintenance of the Ozone NAAQS, which has been approved by the EPA for the regulation of air emissions and enforcement of air quality rules to attain the ozone NAAQS. Although the proposed NEG Port would be located in Massachusetts Bay in an area that has not been classified for air quality, the northeast U.S. is classified as an ozone transport region and the MDEP has included emissions up to 25 miles from existing onshore ports in its SIP emissions inventories for commercial marine vessels. Therefore, NOx and VOCs are regulated as nonattainment pollutants for this Project since they are considered primary contributors in the formation of ozone (ozone precursors).

Massachusetts Environmental Policy Act (MEPA)

MEPA (301 Code of Massachusetts Regulations (CMR) 11.00), requires that state agencies study the environmental consequences of their actions, including permitting. It also requires state agencies to study alternatives to the proposed project, and develop enforceable mitigation commitments, which will become permit conditions for the project if and when it is permitted. Under MEPA implementing regulations, the MEPA unit in the Massachusetts EOEA administers reviews of proposed projects that require state permits. The MEPA unit coordinates state environmental reviews. For the NEG Project, the Secretary of EOEA has issued a Special Review Procedure to coordinate the MEPA review with the NEPA review (see Appendix A).

In addition to fully analyzing the alternatives to and the impacts from a project, the MEPA statute calls for formal "Section 61 findings" to be made by agency heads that state the project they are permitting satisfactorily meets the tests of avoidance, minimization and mitigation, which makes it permittable under the state environmental statutes. Therefore, the Secretary of EOEA and the MEPA review must go beyond simply identifying impacts to proposing what is reasonable mitigation to compensate for and/or minimize those impacts. The draft Section 61 findings for the proposed NEG Project can be found in Appendix A, along with the applicant proposed compensatory mitigation.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

This section of the EIS describes both the NEG Port and Pipeline Lateral as proposed by NEG and Algonquin, respectively (section 2.1), as well as design, location and operation alternatives to the proposed project (section 2.2). Those alternatives considered “reasonable,” from an environmental and engineering perspective, are identified at the end of this section and further analyzed in Environmental Consequences (section 4) of this final EIS. Alternatives that are not considered reasonable are not analyzed further.

2.1 DETAILED DESCRIPTION OF THE PROPOSED ACTION

Section 2.1.1 describes the design, location and operation of the proposed NEG Port and Section 2.1.2 describes that of Algonquin’s proposed Pipeline Lateral.

2.1.1 NEG Port

The NEG Port would consist of two completely configured sets of natural gas receiving facilities, each of which includes a subsea Submerged Turret Loading™ buoy (STL buoy), a flexible riser, a pipeline end manifold (PLEM), and a subsea flowline, that would facilitate the mooring and connection of a fleet of specially-designed Energy Bridge Regasification Vessels (EBRVs) that deliver LNG for unloading. The two receiving facilities would permit up to two EBRVs to unload natural gas into the Pipeline Lateral concurrently. Table 2-1 lists the major components of the NEG Port and Figure 2-1 shows the major components of the Port with a moored EBRV.

Energy Bridge Regasification Vessels (EBRVs)

EBRVs are standard LNG tankers that have been built to carry equipment for the vaporization of LNG and delivery of natural gas. Some EBRVs would be owned and operated by NEG’s parent company, Excelerate Energy, L.L.C. or affiliates with ownership interest. Others would be chartered under long-term contracts. The EBRVs are currently capable of transporting approximately 2.9 Bcf of natural gas condensed to 4.9 million cubic feet (138,000 m^3) of LNG. The current international trend is for larger LNG carriers, and the NEG Port is designed to accommodate a second generation of EBRVs with capacities of up to 150,900 m^3, and other potentially larger vessels with capacities of up to 250,000 m^3, in the future.[1] Table 2-2 lists the dimensions and capacity of NEG’s current and second generation EBRVs.

An EBRV would dock at the NEG Port at one of the two STL buoys. While connected to a buoy, thrusters would not be used to maintain EBRV position. Instead the STL buoy would serve as the anchor system for the EBRV, allowing it to swivel or rotate (referred to nautically as weathervane) about the axis of the buoy while moored. This allows the EBRV to safely respond

[1] The 2nd generation EBRVs, as well as any potentially larger EBRVs that use the Port in the future would be required to adhere to the water use and discharge, entrainment, air emissions, noise level, and other pertinent conditions of any permits and licenses granted for the Port. In all instances, the 2nd generation vessels are expected to provide equal or better performance in terms of air emissions and water intake / discharge than the 1st generation EBRVs.

to and minimize the effect of ambient environmental forces like wind, waves, and currents on the ship while unloading natural gas.

Table 2-1
NEG Port Components

Measurement	Standard Units	Metric Units
STL Buoys		
Water depth at buoys	270 to 290 feet	82 to 88 meters
Length	35 feet	11 meters
Width	26 feet	7.9 meters
Weight	181 tons	165 metric tons
Anchors and Mooring Spread		
Suction Anchor Diameter	20 feet	6 meters
Suction Anchor Length	40 feet	12 meters
Wire Rope Length (towards buoy)	557 feet	170 meters
Chain Length (towards anchor)	1,148 to 2,460 feet	350 to 750 meters
Anchor position radius	1,738 to 3,050 feet	530 to 930 meters
Anchor Spread Diameter	0.91 miles	1,460 meters
Flexible Riser		
Length	558 feet	170 meters
Inside Diameter	14.0 inches	0.4 meters
Outside Diameter	18.5 inches	0.5 meters
PLEM		
Width	40 feet	12 meters
Length	40 feet	12 meters
Flowline Including Spoolpieces		
Length	2,691 to 3,702 feet	820 to 1,129 meters
Diameter Range	18 inches	0.5 meters

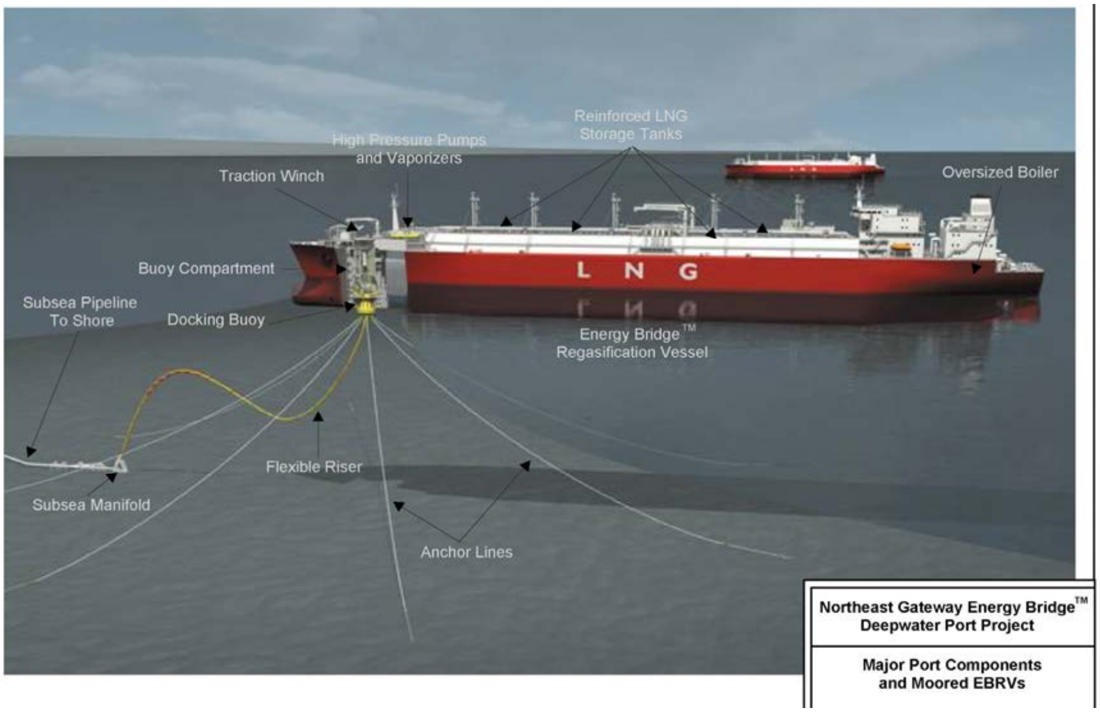

Figure 2-1. Major Port Components and Moored EBRVs

Table 2-2
EBRV Dimensions and Capacity
(First Generation EBRV and Second Generation EBRV)

Vessel Dimensions	**Standard Units** 1st Generation	**Standard Units** 2nd Generation	**Metric Units** 1st Generation	**Metric Units** 2nd Generation
Length	909 feet (ft)	955 ft	277 meters (m)	291 m
Beam	142.4 ft	142.4 ft	43.4 m	43.4 m
Draft	40.4 ft	40.7 ft	12.3 m	12.4 m
Capacity (LNG)	2.9 billion cubic feet (BCF)	3.2 BCF	138,000 cubic meters (m^3)	150,900 m^3

Source: NEG 2005a.

After docking with the buoy, the EBRV would commence regasification. LNG would be pumped from cargo tanks to a set of high pressure LNG pumps that would inject the LNG into deck-mounted shell-and-tube vaporizers used to warm and vaporize the LNG to natural gas. Approximately 2.5 percent of the EBRV's LNG would be used to fuel two on-board natural gas-fired boilers that would produce steam used to heat fresh water that would be circulated through shell-and-tube vaporizers to regasify the remaining LNG. Although the regasification system on existing EBRVs can operate in open-loop mode, closed-loop mode, or in a combination mode, only a freshwater-based closed-loop warming system is proposed by the applicant. This system would vaporize the LNG without any use or discharge of seawater for vaporization. Alternatives to closed-loop regasification are evaluated in section 2.2.

Prior to vaporization, high-pressure pumps would pressurize the LNG up to about 100 bar or 1,440 pounds per square inch (psi). Once vaporized, the gas would be delivered through the STL Buoy and associated subsea components, into the NEG Pipeline Lateral. The EBRVs do not contain nor require facilities for flaring natural gas. Second generation EBRVs would use identical systems for regasification as the first generation vessels. The major difference between the two vessels is size and LNG capacity. In all instances, the 2nd generation vessels are designed to provide equal or better performance in terms of air emissions and water intake / discharge than the 1st generation EBRVs.

STL Buoy and Mooring System

The NEG Port would include two STL Buoys, each approximately 35 feet (11 meters) in height, 26 feet (8 meters) wide and weighing approximately 181 tons (165 metric tons), to accommodate continuous delivery of natural gas from multiple EBRVs. To accomplish this, deliveries of natural gas would be scheduled consecutively. As delivery into one of the two buoys was finishing, a second vessel would arrive and attach to the other buoy to commence discharge of its cargo. When not in use, the STL Buoys would descend to an equilibrium position at a depth of approximately 82 feet (25 meters) below the water surface, and maintain that position until retrieved by an EBRV.

The two STL Buoys would be separated by approximately 1 nautical mile (1,850 meters), which would allow two vessels to weathervane without interference when moored simultaneously and also provide sufficient room for maneuvering.

The proposed mooring system design would use eight mooring lines and anchors to hold each STL Buoy in place with suction anchors. In service, wind, wave, and current loads on the EBRV are transmitted through the buoy into the mooring anchors. The EBRV would be permitted to weathervane and, in doing so, would naturally find a heading that minimized the overall loading on the system. While moored and connected to the buoy, the EBRV would not require power to maintain station (its position and readiness to unload). In order to connect the weathervaning vessel to the geo-stationary mooring lines and gas riser, a mechanical swivel (also denoted as the turret) and a fluid swivel would be used. The mechanical swivel would be part of the buoy system, while the fluid swivel would be maintained as part of the ship system.

Each mooring line connecting a suction anchor to the STLBuoy is a combination of wire rope in the mid-water span and chain on the seafloor. The horizontal distance from the center of the STL Buoy to the center of the anchors varies between approximately 1,738 feet (530 meters) to 3,050 feet (930 meters), with the longer distances located on the side from which the strongest waves and wind originate. The anchoring and mooring systems design criteria ensure that the buoy is capable of withstanding a 100-year return-period storm condition to provide a high degree of reliability.

A messenger line attached to each STL Buoy would have two lighted marker buoys attached to it. One marker buoy would have a height of 4 feet (1.2 meters) above the water surface, while the other would have a height of 1.8 feet (0.5 meters) above the water surface. The messenger line allows the EBRV to recover the submerged buoy upon arrival to facilitate connection of the EBRV to the mooring system. Scheduling of arriving and departing EBRVs would be such that two EBRVs would not be allowed to maneuver on or off of an STL Buoy at the same time.

Flexible Risers

Natural gas sent out from the EBRV would flow into a 14-inch (0.4-meter) inner-diameter flexible riser attached to each buoy. The flexible riser section would extend from the top of the STL Buoy down through the buoy to the PLEM on the ocean floor. The riser would have sufficient flexibility to allow the STL Buoy to move within the design range allowed by the moorings. The flexible riser uses buoyancy at specific points along its length to form an "S" curve that allows for flexure and extension. The riser is designed to remain out of contact with the seafloor in all but the most extreme storm conditions.

Pipeline End Manifolds (PLEMs)

PLEMs serve as a riser base and connection between the flexible risers and the flowline to the NEG Pipeline Lateral. NEG would prefabricate the PLEMs specifically for the physical conditions at the proposed NEG Port location. Forces that act on the PLEM include the flowline on one end, due to thermal and pressure loads on the steel in the flowline, and riser tension loads on the other end. These forces are counteracted by using gravity and a shear skirt approximately 3.6 feet (1.025 meters) in depth running around the PLEM perimeter, but a suction anchor system can also be used if soil conditions require.

Operators on the EBRV, once connected to the STL Buoy, control valves on the PLEM through a control umbilical installed in parallel with the riser. If the umbilical lost integrity for any reason, the surface-controlled valve, called a Fail-Safe Closed (FSC) valve, on the PLEM would close.[2] In addition to providing the connection between the flexible riser and the NEG Pipeline, the PLEM would also host manual valves and pigging equipment for use during installation. The PLEM would be located on the seafloor at a radius of approximately 312 to 377 feet (95 to 115 meters) from the centerline of the STL Buoy location and would occupy an area of approximately 40 feet by 40 feet (12 meters by 12 meters).

Flowline

An 18.5-inch (0.46-meter) outside-diameter flowline would connect each PLEM to its respective tie-in point along the NEG Pipeline Lateral. The distance from the proposed PLEM locations to the Pipeline Lateral requires a flowline distance of 3,702 feet and 2,691 feet (1,129 meters and 820 meters) for STL Buoys A and B, respectively.

The flowline would connect to the NEG Pipeline Lateral by a curved steel or flexible pipeline called a spoolpiece. The spoolpiece is made up of flanges and fittings that connect the flowline to the Pipeline Lateral, and the flowline to the PLEM. Figure 2-2 illustrates the flowline arrangement.

[2] This type of valve is called FSC because it requires power at all times to remain open, and if power is interrupted, it closes.

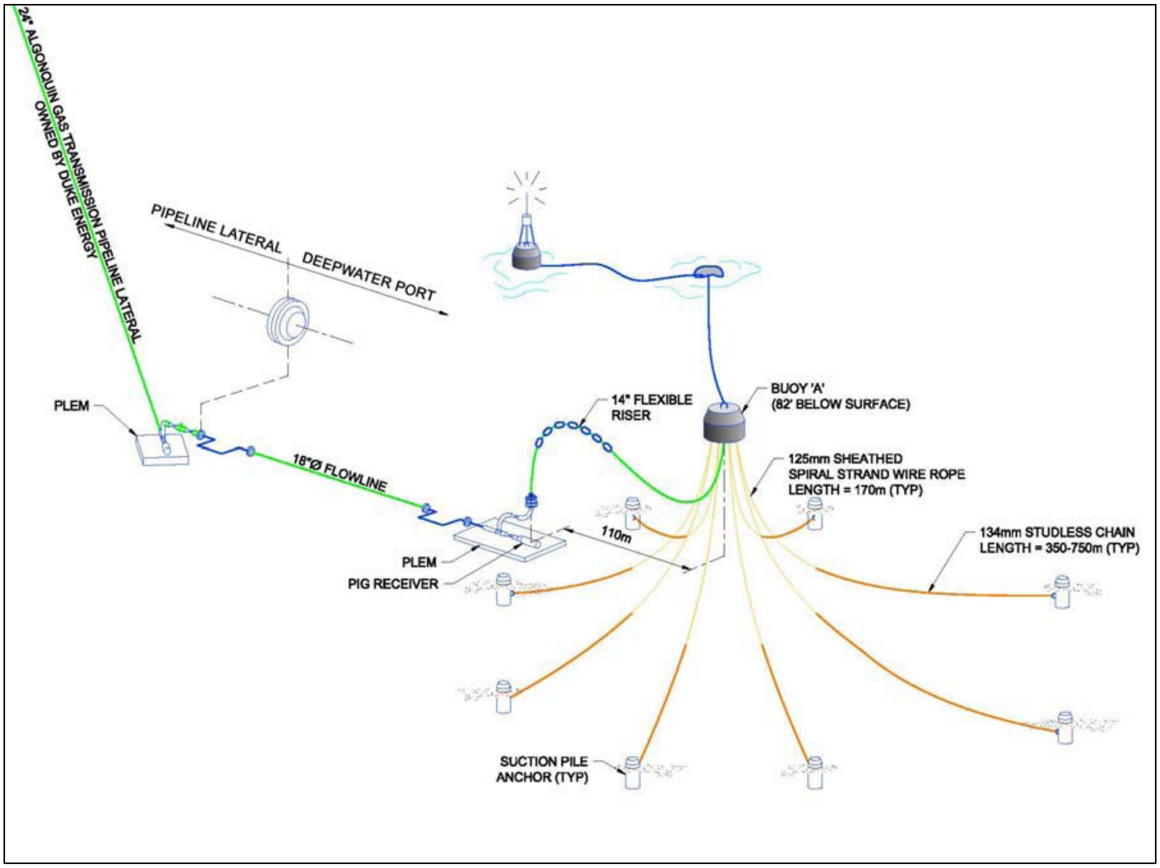

Figure 2-2. STL Buoy and General Flowline Arrangement (Source: NEG, 2005a)

2.1.1.1 NEG Port Construction

NEG proposes to lease existing space at an onshore location for the transfer of materials, equipment, and personnel to the offshore construction vessels working on the Port. While NEG has not identified a shore-based construction support site at this time, the selected site would provide existing marine facilities that have the infrastructure required to support the project.

Construction of each NEG Port buoy system would include the installation of the eight mooring anchors and steel flowline section, followed by installation of the PLEM, spoolpieces, riser, control umbilical and STL Buoy. NEG proposes to use a system of 20-foot (6-meter) diameter suction anchors in a star-shaped array to anchor each buoy. NEG would collect detailed meteorological and ocean data for the Project area to determine the specific location of each mooring anchor, and the mooring line design loads and the specific soil properties at each anchor location would determine the anchor size design. The final anchor position would be identified based on a detailed site-specific geotechnical soil survey, and final placement would be accomplished using a dynamically positioned installation vessel. Each suction anchor would disturb approximately 1,089 square feet (100 square meters) of the ocean floor.

The type of PLEM foundation required would be determined based on the results of final site-specific geotechnical surveys. Either NEG would lower and orient the PLEM on the seafloor using a gravity-based foundation, or it would lower and embed the PLEM using a suction-pile foundation. The procedure for installing the PLEM with a suction-pile foundation would be similar to that used to install the mooring anchors. However, since equipment fitted to the PLEM requires a vertical and heading-controlled orientation, each PLEM would be lifted by crane or by use of an A-frame support derrick set into the water, rather than lowered over the stern of the vessel.

After each suction anchor is embedded, NEG would temporarily lay a mooring chain, ranging from 1,148 to 2,460 feet (350 to 750 meters) in length on the sea floor, with the free end marked at the surface by a temporary retrieval buoy. A total of approximately 5 acres of seabed could be disturbed temporarily for all chain segments due to initial chain touchdown and tensioning. After final installation, the 16 chain segments would occupy approximately one acre of the seabed.

NEG would transport the STL Buoys to the proposed Port site from an onshore mobilization site and connect eight wire rope segments to the buoy while it is on the Dive Support Vehicle (DSV). The buoys would then be placed in the water and secured with synthetic lines to two of the mooring chains that are attached to the suction anchors. Once orienting the wire ropes on the seafloor in groups related to the mooring chains, the DSV would submerge the buoy using a temporary clump weight to minimize tensions in each mooring line during the connection of wire rope to chain and to reduce the effect of weather conditions on the connection process. Each wire rope would be connected to its respective anchor chain on the seafloor using a diver-operated connection frame and hydraulic cylinders to facilitate positioning. Once all of the eight lines are connected, the clump weight would be retrieved and the released buoy would float at its submerged draft.

The flexible risers would be transported on reels on a dynamically positioned installation vessel and unreeled over a lay arch (an installation aid that controls the curvature of the flexible riser) into position in the water. Divers would connect a temporary pull line, running through the center of the STL Buoy, to the end of the flexible riser to thread the riser through the center of the buoy where it would be secured. Divers would then lower the PLEM end of the riser to the seafloor and attach it to the PLEM.

The construction vessel that lays the Pipeline Lateral would likely install the flowline between the Pipeline Lateral and each PLEM. Each flowline would be temporarily laid on the seafloor within target boxes near the PLEM site and at the tie-in location with the Pipeline Lateral. The flowline would be buried from the PLEM to the pipeline lateral, with a targeted 3-foot of cover (minimum 18-inch cover). The flowline at the PLEM end would occupy approximately 0.09 acres of surface area for each buoy. Spoolpiece connections would be made by divers.

Following connection of the flowlines to the Pipeline Lateral, each flowline would be filled with seawater and hydrostatically tested. This operation would require the one-time use of 47,300 gallons (179 m^3) of seawater for the flowline to Buoy A, and 34,400 gallons (130 m^3) of seawater for the shorter flowline to Buoy B. Depending on the duration of the hydrostatic testing, NEG may need to inject a biocide into the pipeline in order to inhibit corrosion. Should a biocide be required, NEG would identify the need in its NPDES permit for the hydrostatic test discharges.

2.1.1.2 NEG Port Operations

During operation, the EBRVs would deliver LNG to the NEG Port. Upon arrival at the Port, each EBRV would retrieve and connect to one of the two permanently anchored submerged STL Buoys. Once connected to a buoy, the EBRV would begin to vaporize the LNG using the onboard regasification system, and deliver natural gas at pipeline pressures to the NEG Pipeline Lateral through the STL Buoy and flexible riser via the subsea flow line. It would take approximately 8 days for each EBRV to moor to the STL Buoy, regasify its cargo of LNG and send it to the NEG Pipeline Lateral, and disengage from the buoy.

The proposed Port facilities are designed to deliver approximately 800 MMcfd of natural gas at pipeline pressure. To deliver a continuous base-load supply of natural gas into the natural gas grid, NEG would need to continuously operate at least one EBRV. To maintain this rate, NEG would deliver a new cargo of LNG approximately every 7- to 8-days, with the incoming EBRV connecting to the unused buoy while the EBRV on the occupied buoy completed unloading. As a result, there will be an estimated 10% overlap of buoy occupancy as the vessels shuttle on and off the Port.

NEG would prohibit EBRVs from mooring to the STL Buoys if environmental conditions existed that could produce wave heights or wind speeds in excess of established criteria (e.g., a weather disturbance of greater intensity than a named tropical storm containing significant wave heights in excess of 26 feet). The EBRV Master and NEG Port Operator would continually monitor weather conditions and forecasts to ensure that unloading and transfer operations occurred within the safe operating parameters of the system.

Each EBRV requires some seawater intake for the main condenser cooling and other cooling systems, ballast water, and to maintain emergency water deluge and fire main systems. The total intake of seawater during each 8-day regasification period would average 39.78 million gallons with an average withdrawal of about 4.97 mgd. The EBRV would discharge an average of about 3.08 mgd of seawater during this period. The water quantities that would be retained would be used for ballasting purposes (14.96 million gallons, or an average of approximately 1.87 mgd) to offset the discharge of the LNG, as well as for steam plant and hoteling water usage. Ballast water would be exchanged outside the 200-nautical mile limit of U.S. waters with ballast exchanges recorded and reported in accordance with IMO and USCG requirements. While underway during cruise conditions, uptake of seawater would be on the order of 50 mgd.

Since each EBRV would also provide residential space for crew, operation would also produce galley, hotel services, and sanitary wastes. Only food waste that has been reduced to small fragments, gray water, and treated black water would be discharged at the Port location. NEG estimates that a total of approximately 0.005 mgd of treated wastewater would be discharged at the NEG Port. Other waste produced by the EBRVs would be retained aboard for disposal in accordance with MARPOL regulations. No bilge water would be discharged.

Water would be drawn through a total of four sea chests: starboard high, starboard low, port high and port low. Sea chests are recesses that have been built into the hull of each EBRV where vessel intake piping emerges to draw water to support the vessel’s engine cooling, ballast water, firefighting, hoteling, sanitary, and water curtain safety systems during operation at Port. Each sea chest has a number of grids through which water is withdrawn. Each EBRV has four high sea chest grids on the starboard side and eight on the port side. Each high sea chest grid has 37 metal gratings 0.20 inches in diameter with 0.83 inches of open space between the gratings. The high sea chests have an open area of 8.2 square feet (0.76 square meters) per grid and a total open area of 98.4 square feet (9.1 square meters). The high sea chests are about 23 feet (7 meters) below the surface of the water located on the rounded bilge portion of the hull and draw water horizontally through the grids.

The low sea chests are located farther down on the flat portion of the hull, with the centerline approximately 38 feet (11.5 meters) below the water surface, having six grids on the starboard side and eight on the port side. Each low sea chest has 17 metal gratings similar in design to the high sea chest gratings, with a slightly smaller open area of 6.9 square feet (0.6 square meters) per grid and a total open area of 96.6 square feet (9.0 square meters). Water would be drawn vertically through the low sea chests. The total open area for the high and low sea chests is 195 square feet (18.1 meters). Under normal operating conditions, the calculated through-screen velocity of the water withdrawn through the grates would be 0.82 feet/second, and would occur only on both the first and last day of each regasification process at the Port. Once the vessel commences operation under the Closed-Loop Heat Recovery and Exchange System the through-screen velocity would be reduced to less than 0.5 feet/second.

NEG currently projects approximately 65 EBRV arrivals per year at the NEG Port depending on downstream pipeline requirements. Prior to the arrival of an EBRV at the individual buoy location, NEG Port operators would inspect the STL messenger line and connect marker buoys by either an offshore service vessel (OSV) or by helicopter. There are no pilot or tug requirements associated with routine Port operation. NEG would perform weekly inspections of surface components of the Port facility by either a shore-based OSV transporting personnel to attend to specific Port needs, or by helicopter. The OSV would make approximately one trip per EBRV arrival from a base of operations on the mainland.

The NEG Port would require limited access areas that have varying degrees of vessel restriction and notification requirements. Limited access areas include:

- **Safety Zone –** Pursuant to the regulations of the DWPA, the USCG is authorized to establish a permanent mandatory Safety Zone around deepwater ports whether a vessel is present or not. The NEG Port Safety Zone would extend approximately 800 yards from the center of each Buoy in order to maintain distance from a moored EBRV as it weathervaned (rotated) around the buoy. The combined area of both buoy Safety Zones would be 415 acres. All unauthorized vessels would be prohibited from anchoring or transiting the Safety Zone at any time. The USCG would have primary jurisdiction for the NEG Port Safety Zone.

  No Anchoring Area (NAA) – if a License is granted, the USCG would designate a mandatory NAA to further facilitate Port operations, safety and security that would encompass an area within a 1,100 yard radius from the center point of each buoy. In total, the NAA would restrict 776 acres around each buoy, or a total area of about 1,200 acres (considering the overlap of the zones between the two buoys) from access.[3] The NAA is necessary to prevent vessels from anchoring (or bottom trawl line) within the Port's mooring system and either damaging the mooring system, the vessel itself or its equipment. Restrictions within the NAA include the following:

  - No deep draft vessel anchoring or bottom trawl fishing
  - Transiting allowed with pre-approved simultaneous operations management system
  - Fishing/lobstering allowed with pre-approved simultaneous operations management system
  - Speed restrictions may apply
  - Possible restricted access during LNG carrier movement
  - Possible restricted access during higher terrorist threat levels

[3] The two buoys are proposed to be separated by a distance of 2,023 yards.

A simultaneous operations management system (or protocol) would ensure coordination between Port operations and other vessels in the area and address such areas as:

- Communications plan
- Identification system
- Safety and security briefing/procedures
- Emergency notification/evacuation/response plan and procedures

- **Areas to be avoided (ATBA):** The applicant is recommending an area to be avoided of 1,367 yards radius around each buoy or an addition 267 yards beyond the NAA. Restrictions within this area would be as follows:

  - Same restrictions as NAA would likely apply
  - Movement or activities would not be restricted but reduced speed in transit may be required.

  It may be determined that certain additional areas in the vicinity of the Port have this designation as well.

- **EBRV Safety and Security Zone** –Pursuant to 33 CFR 165.110, a mandatory Safety and Security Zone would exist two miles ahead and one mile astern, and 500 yards on each side of any LNG carrier vessel while underway within the Captain of the Port (COTP) Boston zone. Figure 2-3 shows the COTP Boston Zone boundaries.

Shore-based office and warehouse space would be leased by NEG to support the operation of the Port. Although no sites have been identified at this time, NEG proposes to secure existing office and warehouse space.

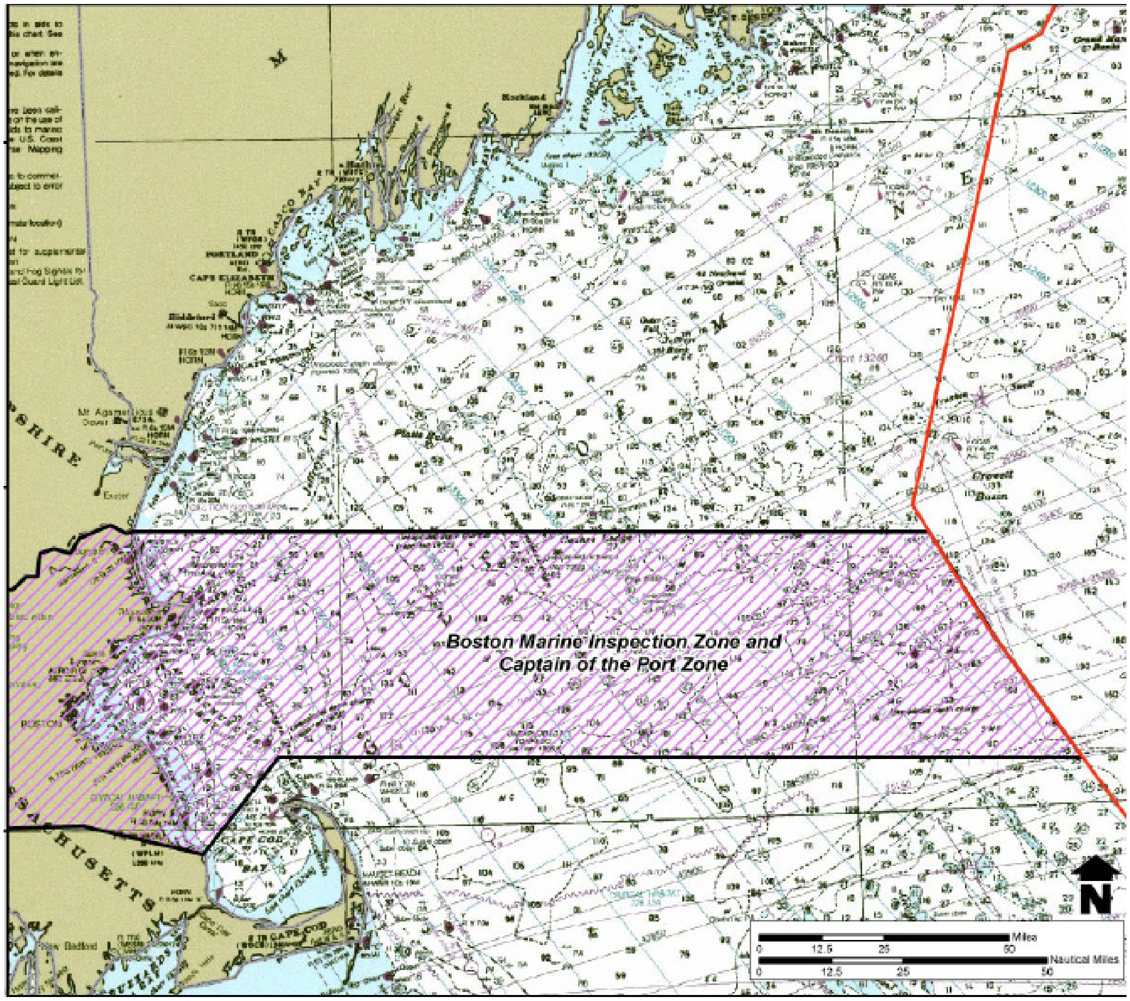

Figure 2-3. Boundaries of the Boston COTP Zone

2.1.1.3 NEG Port Decommissioning

If approved, the Port would operate under a license for a 25-year period, although the anticipated life of the proposed Port could be about 40 years. Operations continuing past the initial license would require review and approval of a new license term at that time. Upon the end of the useful life of the Port, the decommissioning of the NEG Port would involve the following steps:

- All Port components in the water column would be retrieved, including the STL Buoys, flexible risers, and wire rope mooring segments.
- Each suction pile anchor would be recovered by reverse pumping, with its respective ground chain segment retrieved.
- Spoolpieces connecting the PLEMs to the flowlines would be disconnected and retrieved to the surface.
- Each PLEM would be retrieved from the seabed.

- The portion of each flowline that was not buried would be recovered by mechanically severing each flowline where it began burial, and retrieving the unburied reach.

- Diver jetting operations would lower the end of each flowline to at least 18-inches below the mud line, and any depressions would be restored with sand or equivalent.

- Spoolpieces connecting the flowlines to the Pipeline Lateral would remain buried.

The intent of facility removal would be to remove obstructions at the mudline and to return the site to shared or common-area use access.

2.1.2 NEG Pipeline Lateral

Algonquin proposes to build and operate the Pipeline Lateral to interconnect the NEG Port to Algonquin's existing offshore HubLine, and to make modifications at two existing onshore meter stations. The proposed Pipeline Lateral would consist of approximately 16.1 miles (25.9 kilometers) of 24-inch (61-centimeter) outside-diameter natural gas pipeline. The maximum allowable operating pressure of the pipeline would be 1,440 psi. The Pipeline Lateral would originate at the existing HubLine pipeline (milepost [MP] 0.0) in waters approximately 3 miles (4.8 kilometers) east of Marblehead, Massachusetts. Figure 2-4 shows the proposed route of the Pipeline Lateral. Starting from MP 0.0 the proposed pipeline route would extend towards the northeast, crossing the outer reaches of the territorial waters of the Town of Marblehead, the cities of Salem and Beverly, and the Town of Manchester-by-the-Sea for approximately 6.3 miles (10.1 kilometers). The route would follow a path along the seafloor that has limited areas of hard materials such as cobble and coarse glacial till. No areas of bedrock have been identified along the proposed route. At about MP 6.3, the Pipeline Lateral would reach its most northerly point and start a bend to the east and southeast following a path of medium and fine-grained sediments. At this location the Pipeline Lateral would leave Manchester-by-the-Sea waters and enter waters regulated by the Commonwealth of Massachusetts. The Pipeline Lateral route would continue to the south/southeast for approximately 6.2 miles to MP 12.5, where it would leave state waters and enter federal waters. The route then would extend to the south for another approximately 3.6 miles, terminating at the proposed flowline of Buoy A for the NEG Port.

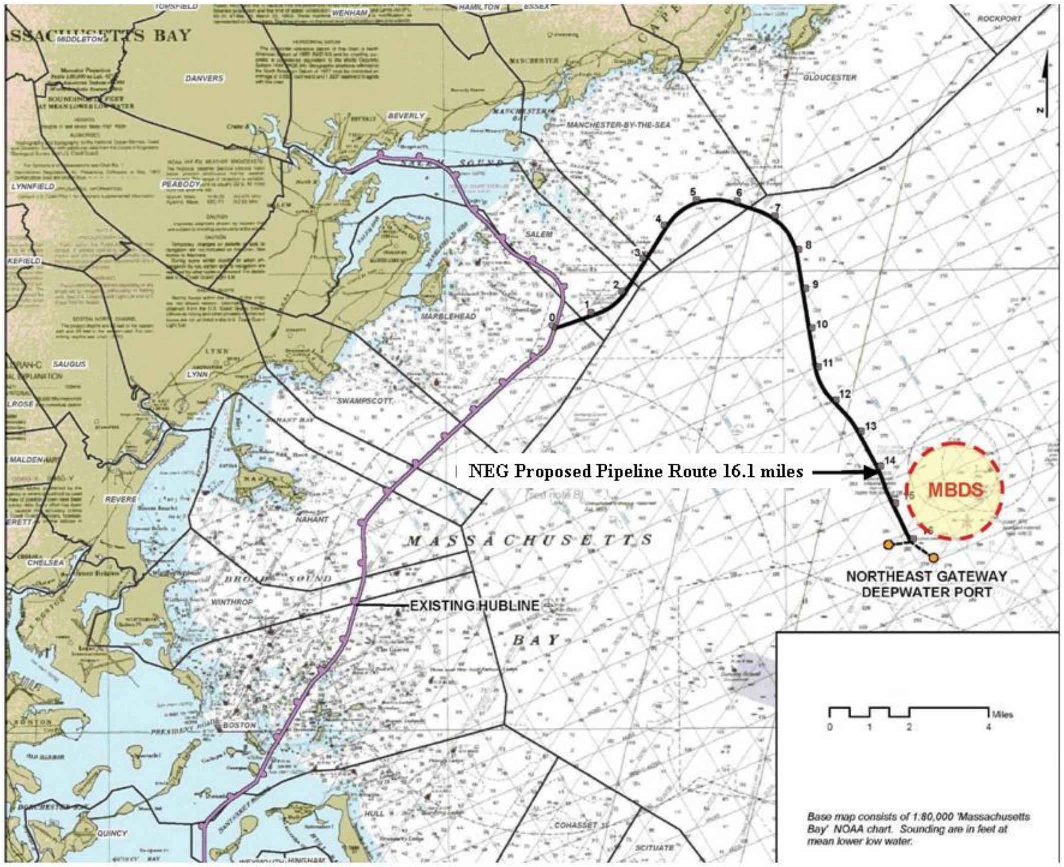

Figure 2-4. Proposed Pipeline Route

Meter Station Modifications

To accommodate the new gas supplies from the NEG Port, minor modifications would be made to two existing aboveground meter stations in Salem and Weymouth, Massachusetts, which are owned and operated by Algonquin. Table 2-3 identifies the proposed modifications at each site. Facility locations are shown on Figures 2-5 and 2-6. The proposed modifications would be located entirely within existing fenced portions of the stations.

Onshore Loadout Yards

Construction of the Pipeline Lateral would require the use of one or more loadout yards for the transfer of materials, equipment, and personnel from onshore to the offshore construction vessels working on the Pipeline Lateral. Algonquin is currently evaluating four potential locations (Figure 2-7) for use as loadout yards. Each of the potential locations is an existing marine facility that has the infrastructure required for the anticipated work and would not require any modifications or upgrades to accommodate anticipated Project activities.

Table 2-3

Proposed Modifications to Existing Meter Stations

Facility	Proposed Modifications
Salem Meter Station	◆ Install new 10-foot by 15-foot fiberglass meter building
	◆ Add 8-foot section to existing concrete building
	◆ Remove and reverse ultrasonic meter and add one new ultrasonic meter run
	◆ Install chromatograph
Weymouth Meter Station	◆ Install a 16-foot by 21-foot concrete meter building
	◆ Install a gas heater
	◆ Install a chromatograph
	◆ Install ultrasonic meters and install scrubber
	◆ Install pressure control valve

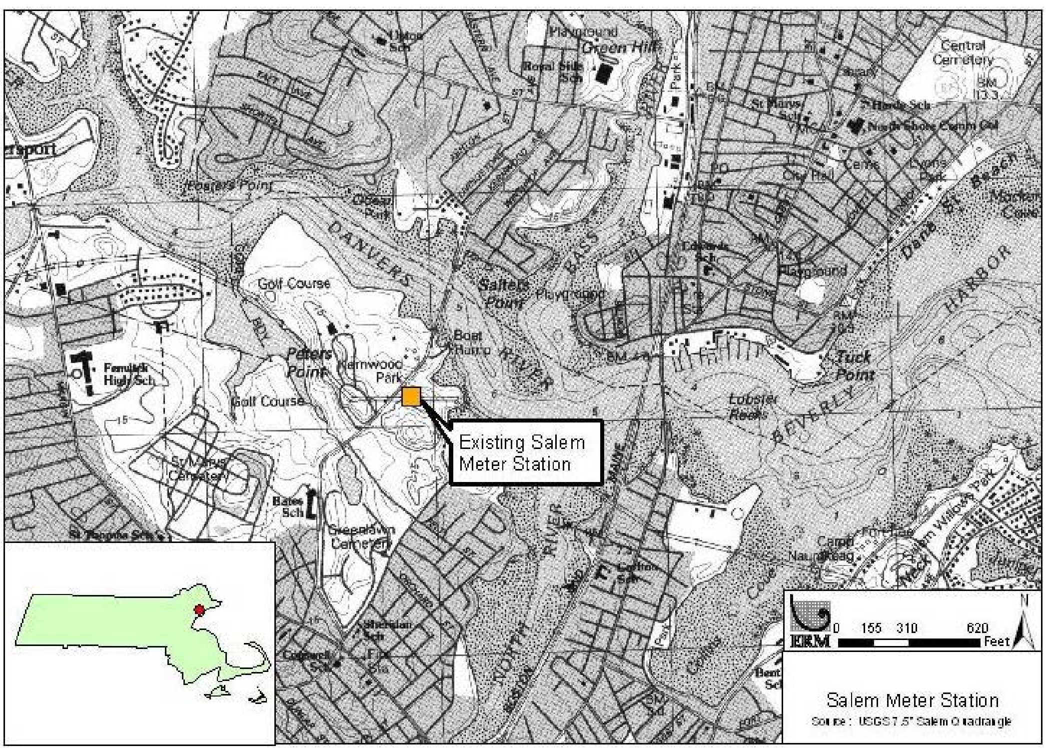

Figure 2-5. Salem Meter Station

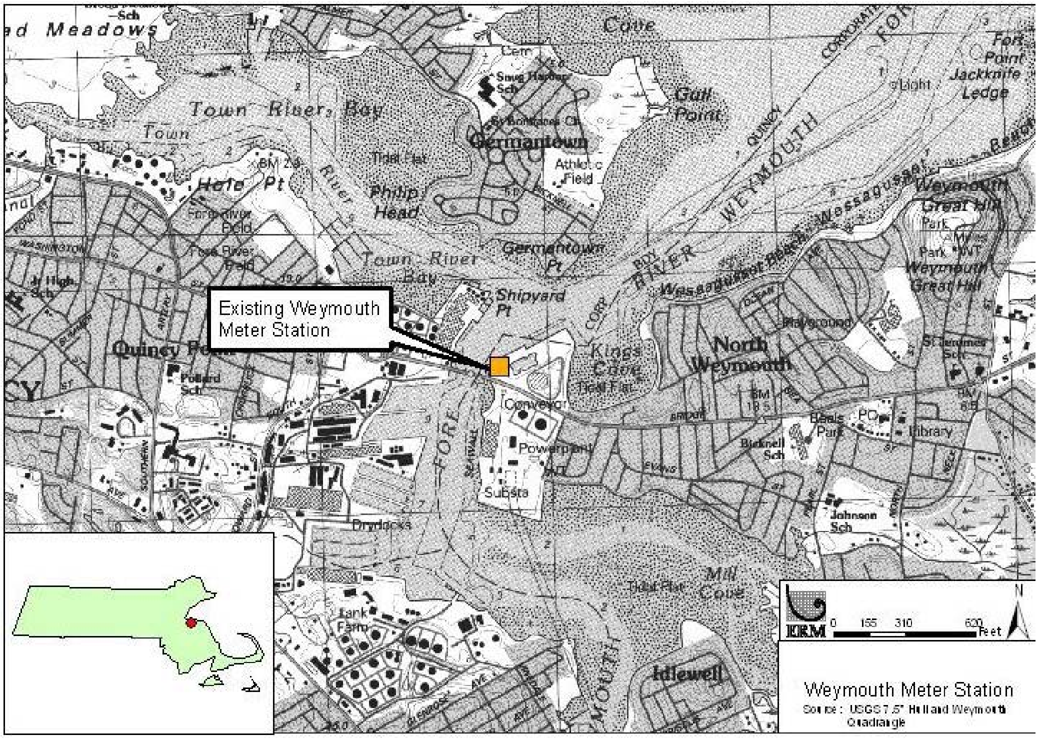

Figure 2-6. Weymouth Meter Station

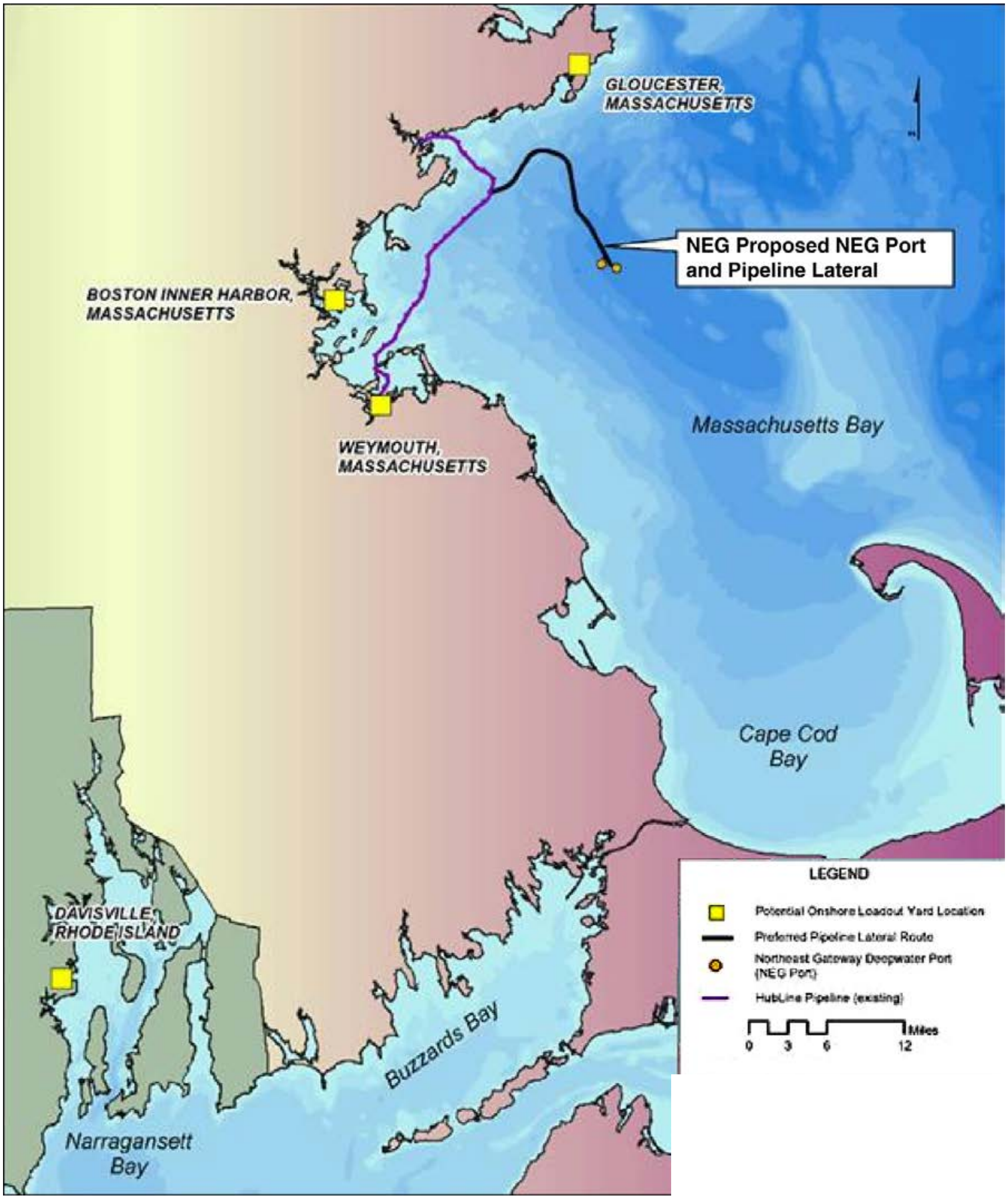

Figure 2-7. Potential Loadout Yard Locations

2.1.2.1 Pipeline Construction

Construction of the NEG Pipeline Lateral would include pipeline laying, plowing (to lower the pipeline below the seabed), backfill plowing (to cover the pipeline), and the tie-in of the Pipeline Lateral to the existing HubLine through a "hot tap" connection. Post-lay plowing is proposed as the primary method of pipe lowering for all segments of the Pipeline Lateral, with the exception of the connection to HubLine, the crossing of the Hibernia cable and a cable anomaly, connection assemblies for the NEG Port flowlines, and any unforeseen locations where surface lay may be required.

A review of geotechnical data indicates that the design and minimum target depths of 3 feet (1 meter) and 1.5 feet (.5 meter) below the seabed, respectively, should be achievable in one pass of the post-lay plow. Backfilling would be accomplished by using one pass of the backfill plow to return spoil to the trench so that a minimum of 1.5 feet of cover would be placed over the pipeline. The total amount of bottom environment that might be affected would be limited to a width of 80 feet or less, centered on the pipeline. A typical offshore pipeline plow barge spread is shown on Figure 2-8.

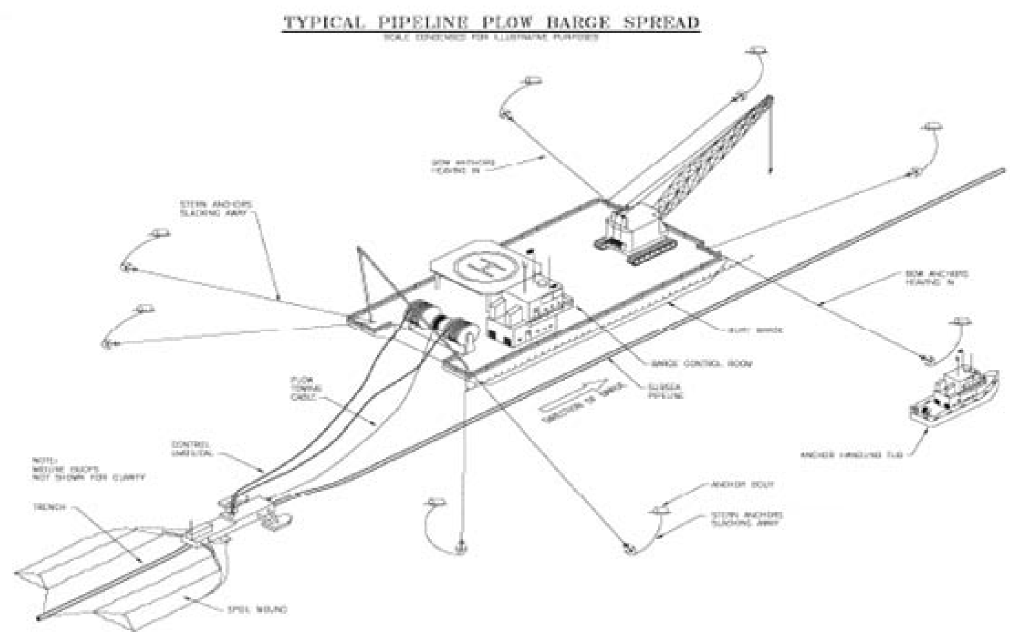

Figure 2-8. Typical Pipeline Plow Barge Spread (Source: NEG, 2005a)

At the location where the proposed pipeline would cross the existing Hibernia communications cable, the cable anomaly at milepost 15.3, and at sites where plowing would not be feasible due to unforeseen subsurface geologic conditions, the pipeline would be laid on the surface and armored with rock or concrete mats. Plowing operations would be discontinued approximately 300 feet (about 90 meters) before and would commence approximately 300 feet (about 90 meters) past the obstruction to ensure that the cable or the other fittings were not damaged.

Algonquin proposes to use a work barge with a suitable crane (to lift and position the approximately 100-180 ton plow) to support the pipe lay operation. At a minimum, an eight-anchor mooring system would be used by the vessel. The maximum anchor spread would be approximately 6,000 feet (1,829 meters), which would allow sufficient anchor line length for proper positioning of the vessel, acceptable station keeping, and required barge repositioning during construction. The towing vessel would be equipped with a survey spread comprising navigation and positioning equipment. Anchor handling tugs would also have navigational equipment including GPS.

The proposed installation method would involve positioning and anchoring the towing vessel on location over the pipeline to maximize the pulling force on the plow while retaining control of the vessel and then setting the plow on the ocean bottom over the pipeline. Algonquin would use a remotely operated vehicle (ROV) or divers as needed to assist in positioning the plow on the pipeline. Once the plow is in place, the towing vessel would move along the pipeline (pulling in the bow anchor lines and releasing the stern anchor lines) to a pre-determined distance ahead of the plow. The plow towing line would be secured and the towing vessel would commence the plowing operations. As the towing vessel moves forward by pulling and releasing anchor lines, the anchor handling tugs would begin the routine of moving the anchors ahead of the towing vessel. To reduce impacts to the seabed, mid-line buoys, positioned several hundred feet from the anchor end of the cables, would support the anchor cables extending from the lay and bury vessels to their anchors. Through the use of the buoys, the length of the cable that came in contact with the seabed would be minimized and impacts from anchor drag on the seabed would be reduced.

Towing speed would depend on the type of sediment, depth of cut and rate of “in-fill” occurring behind the plow and prior to the pipeline settling in the ditch. When initially set and pulled forward, the plow would travel from a level seafloor downward. The transition could be several hundred feet long and Algonquin proposes to subsequently remove by jetting the sediment remaining from the transition and the start distance from the fitting or crossing location (e.g., Hibernia cable) in order to lower the pipeline to the desired depth. A transition would be created as the plow was retrieved from the trench cutting depth to the sediment surface as it approached an obstruction or utility crossing. The spoil resulting from the plowing operation would be spread onto both sides by the mold boards immediately adjacent to the trench.

Pipeline installation would require a lay barge approximately 350 feet (10.7 meters) in length, 100 feet (30 meters) in width and 25 feet (8 meters) in depth, with a draft of 12 to 15 feet. The barge would provide onboard living quarters and dining facilities for a 150- to 300-person crew as well as the cranes that would be used for transferring pipe joints and other materials or equipment from transportation barges to a storage area on the deck of the vessel.

Pipeline construction would occur in assembly-line fashion on board the lay barge, and the pipe would be installed by an S-Lay installation process. To assist the line pipe in transitioning from the lay vessel to the seafloor, an adjustable structure called a “stinger” would be attached to the stern of the barge. A combination of tension and stinger positioning would ensure that the pipeline was not overstressed during the installation process. Figure 2-9 shows a typical pipeline lay barge spread.

The lay barge would require the assistance of one or more anchor handling tugs to assist in the anchor positioning and movement of the barge; transportation/pipe haul barges (including two additional tug boats dedicated to the haul barges) to supply the vessel with line pipe; and a supply vessel to ferry personnel, supplies, and fuel to and from the barge.

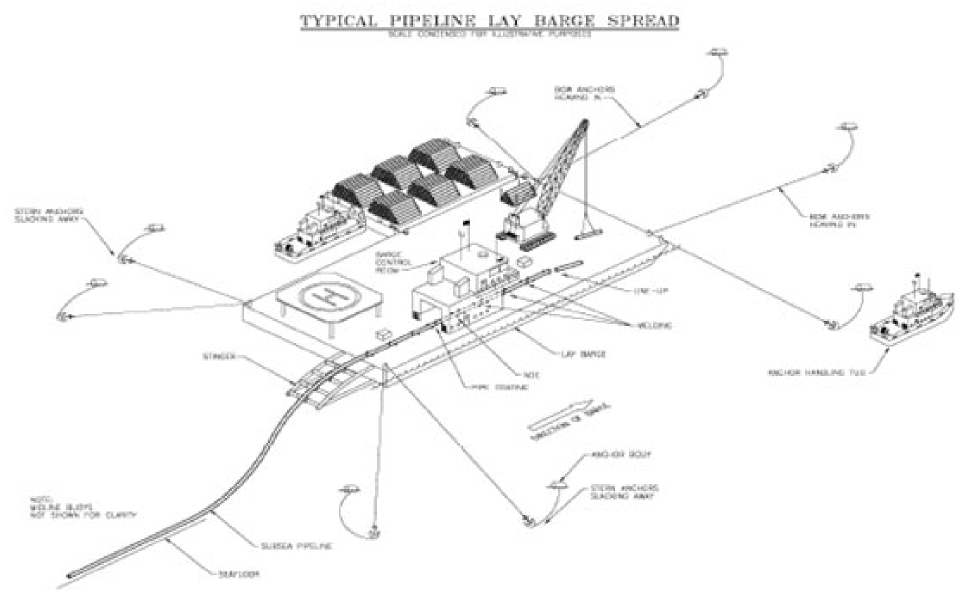

Figure 2-9. Typical Pipeline Lay Barge Spread (Source: Algonquin 2005.)

In the vicinity of the HubLine hot tap and any locations where the plow cannot lower the pipeline (excluding the Hibernia cable crossing and the cable anomaly), Algonquin would use a jetting tool to excavate the pipe trench. In these situations, the jet would be set over the pipeline and the water supply on the jet would be activated to open a ditch around the pipe. An ROV or divers would assist in positioning the jet on the pipeline. Once in place over the pipeline, the diving vessel would move the jet along the pipeline, activating the water and air supplies to the jet to begin the excavation process. Since jetting is proposed for very limited portions of the pipeline, support vessel movement should be minimal.

In certain areas (e.g., at the tie-in to the HubLine, the side taps, and the Hibernia and cable anomaly crossings), a diver-operated hand jet might be used to remove the sediment plug (that portion of the pipeline where the plowing or jetting device is removed from the pipeline as it approaches a cable or obstacle and sediment is still supporting the pipeline on the seafloor to lower the pipeline). In this process, a support vessel would provide pressurized water through a hose with a nozzle that is maneuvered by a diver who works the sediment under the pipe to create a trench into which the pipe would settle.

The backfilling operation would occur with one pass of a back fill plow (BFP). The BFP would return displaced spoil to the pipe trench to achieve a minimum of 1.5 feet (0.5 meter) of sediment cover over the pipeline to the extent possible based on the efficiency of the BFP and the geotechnical characteristics of the spoil. The BFP is designed with reversed mold boards that pull the displaced spoil back into the trench and is placed in the pipe ditch on the pipeline in generally the same way as the pipe lay plow. The BFP would be pulled along the pipeline by a towing vessel and removed from the pipeline approximately 300 feet (91 meters) from the ends of the pipeline, crossings with utilities, and the inline side tap flanges. An ROV or diver may be used to set the BFP on the pipeline and periodically monitor the operations.

Prior to backfilling, the pipeline would be filled with seawater (approximately 1.5 million gallons) to increase the specific gravity of the pipeline and increase the stability of the pipeline within the trench. The seawater would be evacuated during the running of the gauging pig prior to filling the pipeline for hydrostatic testing. Depending on the duration of this activity, a biocide may need to be injected into the pipeline in order to inhibit corrosion.

Upon completion of the lowering process, any additional material needed to refill the trench would be imported to the site by barge and deposited into the trench to achieve the desired cover. Methods of filling the trench would include placement of sand bags or concrete mats by divers and/or placement of sand or rock with a tremmie pipe. Only clean fill material would be used.

Should sections be found where the pipe can not be lowered to 1.5 feet below the sea floor, the pipe would be covered either with rock or one or more layers of 9-inch-thick concrete mats.

Upon completion of the lay, plowing, and backfill plowing operations, the pipeline would be gauged and hydrostatically tested. Seawater previously introduced into the pipeline would be discharged back into Massachusetts Bay following any treatment, if needed. Seawater would be used to fill the pipeline behind the pig and would serve as the hydrostatic testing medium. The water would remain in the pipeline following completion of the hydrostatic test, until the final tie-ins are made to the HubLine. Algonquin estimates that approximately 1.5 million gallons of seawater would be required for each fill of the pipeline.

Following the completion of tie-in activities, the Pipeline Lateral would be dewatered and then dried to a specific dew point to prepare it for the introduction of natural gas. Dewatering and drying operations would be performed from a dive vessel. Upon completion of the drying operations, the pipeline would be purged and filled with natural gas.

2.1.2.2 Pipeline Operation

Pipeline operations would require no additional onshore facilities. Algonquin would hire four staff to oversee pipeline operations, in particular the unloading operation with ongoing pipeline system operations. Any temporary access restrictions over the pipeline corridor during construction would be lifted upon completion of construction. Access over the pipeline would remain unrestricted during Port operation.

2.1.2.3 Pipeline Decommissioning

At the end of the pipeline's useful life, Alognquin would be required to obtain the necessary permission to abandon its facilities. Abandonment of the pipeline facilities would be subject to the approval of the FERC under Section 7(b) of the NGA. As currently identified, the pipeline would be purged and flooded with seawater. Blind flanges would be installed on each end and the pipe would be abandoned in place. An environmental review of any proposed abandonment would be conducted when the application to abandon is filed.

2.2 ALTERNATIVES

NEPA requires that Federal agencies evaluate reasonable alternatives to a proposed major Federal action. According to Council on Environmental Quality Guidance on NEPA, "(r)easonable alternatives include those that are <u>practical or feasible</u> from the technical and economic standpoint and using common sense, rather than simply <u>desirable</u> from the standpoint of the applicant." (*Questions and Answers about the NEPA Regulations* (1981)) The alternatives analysis is the "heart of the environmental impact statement" (40 CFR, Sec. 1502.14), it's purpose being to "…present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public." (40 CFR, Sec. 1502.14)

The Secretary's options under the DWPA are to approve, deny, or approve with conditions, the application as presented. In determining specific provisions of the license, the Secretary may consider alternative means to construct and operate a deepwater port. Below are the nine factors the Secretary must consider in making a final determination on a DWPA license application (33 U.S.C. 1503(c)).

1 The applicant is financially responsible and will meet the requirements of the DWPA.

2 The applicant can and will comply with applicable laws, regulations, and license conditions;

3 Construction and operation of the deepwater port will be in the national interest and consistent with national security and other national policy goals and objectives, including energy sufficiency and environmental quality;

4 The deepwater port will not unreasonably interfere with international navigation or other reasonable uses of the high seas, as defined by treaty, convention, or customary international law;

5 The applicant has demonstrated that the deepwater port will be constructed and operated using best available technology, so as to prevent or minimize adverse impact on the marine environment;

6 The Secretary has not been informed, within 45 days of the last public hearing on a proposed license for a designated application area, by the Administrator of the EPA that the deepwater port will not conform with all applicable provisions of the Clean Air Act, as amended (42 U.S.C. 7401 et seq.), the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq.), or the Marine Protection, Research and Sanctuaries Act, as amended (16 U.S.C. 1431 et seq., 1447 et seq.; 33 U.S.C. 1401 et seq., 2801 et seq.);

7 The Secretary has consulted with the Secretaries of the Army, State and Defense to determine their views on the adequacy of the application, and its effect on programs within their respective jurisdictions;

8 The Governor of the adjacent coastal State approves, or is presumed to approve, issuance of the license; and

9 The adjacent coastal state to which the deepwater port is to be directly connected by pipeline has developed, or is making at the time the application is submitted, reasonable progress, toward developing and approved coastal zone management program pursuant to the Coastal Zone Management Act of 1972 (16 U.S.C. 1451 et seq.).

Offshore vs. Onshore LNG Alternatives: Congress has passed statutes that distribute responsibility for the development of LNG facilities in the United States across different agencies within the Federal government. For offshore LNG facilities in Federal waters, the USCG and MARAD jointly share responsibility for evaluating and processing applications submitted under the DWPA. For onshore facilities or LNG facilities within state waters, that responsibility lies with the FERC under the Natural Gas Act. Nonetheless, in evaluating reasonable alternatives under NEPA for bringing LNG to the New England market, both offshore and onshore LNG facilities must be considered. Several onshore LNG facilities exist or are being proposed that target the New England market (see section 2.2.7.1). While these facilities provide alternatives for bringing LNG into New England, they are or will be the subject of their own FERC-developed EISs and is not be evaluated in detail in this EIS. Further, because proposed onshore and offshore facilities are independent of each other (i.e., they are not mutually exclusive), they are not considered to be alternatives to each other. Onshore facilities are discussed, however, under the No Action alternative, since they may be developed regardless of the outcome of any proposed DWPA application. Finally, this EIS does not address how many LNG facilities may be needed to meet the growing demand in New England because that decision will ultimately be based on market conditions.

The following discussion identifies the alternatives found to be reasonable, the alternatives found not to be reasonable, and, for the latter, the basis for such finding. This EIS does not evaluate in detail those alternatives considered but found not to be reasonable.

Alternatives concerning location, construction, and operation of a deepwater port for receipt and transfer of LNG must meet essential technical, engineering, and economic threshold requirements to ensure that a proposed action is environmentally sound, economically viable, responsive to vessel and facility operating needs, and compliant with governing standards. The following sections describe the alternatives evaluated:

2.2.1 – Alternative Deepwater Port Designs

2.2.2 – Alternative Deepwater Port Locations

2.2.3 – Alternative LNG Vaporization Technologies and Associated Equipment

2.2.4 – Alternative Foundation Designs

2.2.5 – Alternative Natural Gas Pipeline Routes

2.2.6 – Alternative Construction Schedules

2.2.7 – No Action Alternative

2.2.1 Alternative Deepwater Port Designs

There are five basic deepwater port concept designs that have been developed by industry and are currently considered commercially available for use as offshore LNG import terminals: gravity-based structures (GBS), fixed-platform-based units, floating storage and regasification units (FSRU), special purpose floating platforms such as the HiLoad LNG regas facility proposed for the Bienville deepwater port in the Gulf of Mexico, and special purpose vessels (SPVs), which includes the EBRVs and STL buoy system proposed for the NEG Port. This section describes the basic elements of two fixed-structure terminal designs, GBS and platform-based units, as well as three floating-structure terminal designs, FSRU, special purpose floating platforms, and SPVs.

Gravity-Based Structures (GBS)

GBS terminals are designed to store LNG on fixed platforms in relatively shallow water, typically 40 to 85 feet (12 to 26 m) in depth. Although GBS structures can be located in deeper water up to 200 feet, their economic feasibility is questionable in water depths greater than 85 ft (26 m). To ensure stability, the mass of a GBS structure below the water line must be of sufficient size and weight to compensate for the pressure of waves pushing against the portion of the facility that is located above the water line. As an example of the size of the structures associated with the GBS technology, the proposed Gulf Landing GBS is 1,100 feet (335 meters) long, 248 feet (76 meters) wide, and rises 114 feet (35 meters) above the sea floor. LNG would be offloaded from conventional LNG vessels to storage tanks within the GBS facility, regasified, and transported via pipeline to onshore markets.

Components of GBS terminal design include: a reinforced concrete structure that rests on the ocean bottom, LNG storage tanks, high-pressure pumps, vaporizer equipment, a transfer meter, and a subsea pipeline. The high-pressure pumps, LNG vaporizers, and transfer metering station would be located on the platform of the concrete structure that would remain above water at all times. Figure 2-10 includes an illustration of a GBS.

In the operational phase, LNG ships typically offload LNG to the GBS terminal with loading arms. The LNG ship pumping capacity, which can typically transfer a cargo of 145,000 m^3 in 12 to 14 hours, controls cargo offloading. The complete tanker unloading cycle is approximately 24 hours, including berthing, hook-up, offloading, disconnect, and disembarking.

The GBS terminal structure is a proven technology with existing examples in operation off the shore of eastern Canada and in the North Sea for petroleum storage. In addition, The Gulf Gateway and Port Pelican Projects, which will use GBS terminals in the Gulf of Mexico, have been approved by MARAD.

Fixed Platform-Based Terminal

Fixed platform regasification terminals can be erected in both shallow and deep water. Similar in structure to oil or gas exploration platforms, the regasification terminal is affixed to the sea floor by multiple legs that rise above the water to support a working platform, which is elevated above the surface to a level depending on metoceanic conditions. At the terminal, LNG is offloaded from conventional LNG vessels, regasified, and transported via pipeline to onshore markets. Depending on the size and location of the platform, there may be no storage of LNG on the terminal. Because these platforms are anchored using fixed-tower structures, they can be located in a broader range of water depths than a GBS.

Fixed platform terminals employ loading arms, high-pressure pumps, vaporizer equipment, a transfer meter, and a connection to a subsea pipeline. In the operational phase, LNG carriers typically offload LNG to the fixed platform regasification terminal via flexible loading arms. The LNG ship pumping capacity, which can typically transfer a cargo of 145,000 m^3 in 12 to 14 hours, controls cargo offloading. The complete tanker unloading cycle is approximately 24 hours, including berthing, hook-up, offloading, disconnect, and disembarking.

The fixed platform terminal structure is a proven technology in the oil and gas industry that is currently used in the Gulf of Mexico for the offloading of petroleum products. At present, no fixed platform terminals are in operation for LNG processing and regasification, although Crystal Energy LLC and Freeport-McMoRan Energy LLC have proposed modifying existing platforms for LNG projects off the coasts of California and southeast Louisiana, respectively.

Floating Storage and Regasification Unit (FSRU)

Floating storage and regasification units are specialized LNG vessels that store and regasify LNG onboard. The FSRU is a ship-like vessel that lacks a propulsion system but integrates LNG storage tanks within the hull, and regasification and unloading equipment on deck. The FSRU would be permanently anchored at the port site for the life of the project and receive LNG from standard LNG carriers. The FSRU would be connected to an external turret that would allow high-pressure gas to be sent out through a riser to the subsea pipeline. A weathervaning turret-mooring would most likely be used, unless a very sheltered location was available. The Broadwater Energy Project proposes to construct an FSRU LNG receiving terminal in Long Island Sound. The Broadwater FSRU would be 1,250 feet long (381 meters) and 200 feet (61 meters) wide. Conventional LNG vessels would transport LNG to the FSRU, and a ship-to-ship transfer of LNG would occur between the conventional vessels and the FSRU, where the LNG would be stored, regasified, and then either transported to onshore markets through a new pipeline to the shore or connect to an existing offshore pipeline system. The FSRU design for Broadwater Energy would provide the capability of receiving and storing approximately 350,000 m^3 of LNG. Because the terminal would be a floating vessel, it could be redeployed at a different geographic location, if not needed at the port location. Figure 2-10 includes an illustration of a FSRU.

A key issue for FSRU operations is differential movement between the FSRU terminal and LNG vessel during offloading operations. While offloading through a loading arm or some other special system for the transfer of LNG between the LNG vessel and the FSRU terminal, the stresses on the transfer system can be significant. As a result, heavy seas and severe weather conditions can adversely affect the operations and reliability of the FSRU.

Gravity Based Structure

Floating Storage Regasification Unit

HiLoad LNG Regas

Figure 2-10. GBS, FSRU, and HiLoad Regas Technologies

Special Purpose Floating Platforms (HiLoad LNG Regas System)

The HiLoad LNG Regas system is a specially designed floating unit that can connect to a conventional LNG carrier, unload, and regasify the LNG. This technology uses a single-point mooring (SPM) buoy, the HiLoad terminal with an integrated LNG regasification system, remote power controls, metering, a gas treatment facility, and a connection to existing pipeline infrastructure. Figure 2-10 includes an illustration of a HiLoad Regas System.

The LNG vessel docks on the L-shaped HiLoad terminal near the manifold using the HiLoad attachment system. The regasification units associated with this technology use seawater provided by submerged pumps to vaporize the LNG and high-pressure pumps to send out gas at the specified pressure. HiLoad can vaporize LNG at a rate of 0.25 to 1.4 Bcfd.

The proposed Dorado LNG Regasification Terminal design would use the HiLoad technology. This proposed project would be located about 35 miles (56 kilometers) off the coast of Mexico in the Gulf of Mexico. The Dorado Terminal uses proven components, but would be the first use of this technology for LNG applications. The proposed Bienville Deepwater Port Project, to be located in the Gulf of Mexico, has filed for a DWP license based on this design.

Special Purpose Vessel and Submerged Turret Loading (STL) Buoy System

The STL System technology includes a mooring buoy system, a pipeline end manifold (PLEM), flexible riser, and an undersea pipeline connected to existing natural gas pipeline infrastructure. LNG would be transported on a modified LNG carrier that has been designed and constructed to include onboard regasification equipment and a docking compartment for attaching the mooring buoy. After the LNG is regasified onboard the LNG carrier, it would be transferred off the vessel through a submerged turret buoy and flexible riser that leads to a seabed PLEM, and from there to an existing natural gas pipeline. The system design can use a variety of anchors to hold the buoy in place. When not in use, the buoy would drop and remain at a depth of approximately 80 to 100 feet (24 to 30 meters) below the surface, but above the seabed, until it is again retrieved by a servicing LNG vessel. This technology is currently in use in the Gulf of Mexico on the Gulf Gateway Port and has been successfully used in the North Sea for over a decade.

2.2.1.1 Evaluation Criteria

To be considered a reasonable alternative, the port design must:

- Not violate state and Federal standards for protecting environmental resources, as established by law and regulation;
- Be feasible from an engineering perspective; and
- Be reliable.

Environmental Effects

Because of the large amount of bottom disturbance caused by GBS terminals which rest on the ocean floor, use of a GBS port design would result in greater permanent loss of benthic and fish habitat than any of the other alternatives. Since it must be located in shallower water than the other options (optimum conditions are less than 85 ft deep), a GBS terminal would have to be close to shore where it would be highly visible, would adversely affect recreational boating and fishing in higher-use areas of the Massachusetts Bay, would impact sensitive shallow water habitats and fisheries, and potentially present human safety and therefore human environment issues for adjacent waters and communities in portions of the Bay where water depths of this magnitude lie closer to shore, where shore based and water-based human interactions and uses are more likely, and of a higher consequence. The GBS design could also cause major coastal impacts because of its requirement for an onshore graving dock for facility construction and sufficient water depth to float the facility to the port site once it is constructed.

Platform-based units that are designed for continuous supply of natural gas must have sufficient storage capacity on the platform to allow continuous vaporization between LNG deliveries. This requires multiple platforms or larger platforms than would be required to house just the vaporization equipment and related supporting facilities to accommodate storage tanks, and would result in greater foundation size and subsequent environmental impacts from bottom disturbance. Both GBS and platform-based unit port designs would be permanent fixed structures with large portions of the structures visible above the water line. The permanent facilities would have an industrial appearance that would be unique to that portion of Massachusetts Bay. In contrast, the buoys and anchors associated with the FSRU, special purpose floating platform, and STL systems are not visible when not in use and the LNG vessels that would access them, although larger that most vessels transiting Massachusetts Bay, would still be similar in appearance to other large vessels in the area.

Because of their potential for significant adverse environmental impact and greater visual contrast to existing visual conditions, the GBS and fixed platform alternatives do not represent reasonable alternatives and are not carried forward for detailed review.

Engineering Feasibility (compatibility with water depth and substrate)

GBS facilities are not economically viable in deep water, but are more appropriate for water depths between 45 and 85 ft (13.7 and 25.9 m). Other types of stationary structures, such as platform-based units can be located in deeper water. FSRU, STL designs similar to that proposed by NEG, and fixed platform designs require a permanently installed anchoring system and sufficient water depth (generally greater than 200 ft [60.1 m]) to accommodate mooring lines and a flexible riser connection between the unit and the subsea pipeline.

GBS structures must be located in areas where the seafloor is relatively level, lacking geologic hazards, and with satisfactory substrate characteristics to support the structure's foundation and weight. Platform-based and the HiLoad systems also must avoid areas with geologic hazards. The FSRU and STL concept designs have more flexibility on seafloor conditions because alternative anchoring methods are available to accommodate different types of substrate.

Because of its shallow depth requirements, GBS terminal design was not considered a reasonable alternative. The other port design alternatives were considered reasonable from an engineering perspective.

Reliability

Normal and severe weather conditions, specifically wind and wave conditions, in Massachusetts Bay have the potential to limit or interrupt terminal access to all of the terminal types under consideration. Reasonable alternatives are those that have the greatest ability to continue operations and accept LNG deliveries under all but the most severe weather conditions. Table 2-4 lists the occurrence of annual average wave heights in Massachusetts Bay. The FSRU port design would incur the greatest amount of downtime. The side-by-side unloading of LNG carriers at FSRU ports should be limited to a maximum wave height of 6.5 ft (2.0 m), which are commonly exceeded in the Project area especially between January and April when demand for natural gas is the greatest.

Severe weather conditions that are relatively common in the Project area would also interrupt LNG deliveries and undermine the reliability of platform-based terminals, which are designed for continuous supply of natural gas. The Main Pass Energy Hub Deepwater Port Project has been proposed as a platform based LNG terminal that would use a “Soft Berth” system of floating dolphins to moor the LNG carriers. This system would allow carriers to dock in seas up to 6.6 ft (2.0 m) and winds up to 25 knots, which, like FSRU terminals, would limit berth availability during the primary portion of the year that gas demand is highest.

Table 2-4

Occurrence of Wave Heights in Massachusetts Bay

Wave Height	Jan. – April	May – August	Sept. – Dec.	Annual Average
>11.5 ft (3.5 m)	1%	0%	1%	1%
<11.5 ft (3.5 m)	99%	100%	99%	99%
>6.5 ft (2.0 m)	13%	2%	9%	9%
<6.5 ft (2.0 m)	87%	98%	91%	92%

Floating platforms and the STL designs would both have a higher level of reliability in Massachusetts Bay than the FSRU and fixed platform options. Model tests on the floating platform design indicate capabilities for LNG carriers to dock with the platforms in seas up to 14 ft (4.5m). The STV design has been successfully used for over a decade in the North Sea with mooring capabilities in seas up to 20 ft (6 m).

Because of their sensitivity to weather conditions and their higher risk for interruptions in gas delivery, the fixed platform-based units and FSRU port designs were not considered reasonable options for development and were eliminated from further consideration.

2.2.1.2 Summary of Deepwater Port Design Alternatives

Table 2-5 provides a comparative summary of terminal alternatives. The Applicant proposes the STL system, using EBRVs that it currently owns and operates. Because this port design would meet the project purpose and need, is a proven technology, and meets environmental, engineering feasibility, and reliability criteria, the STL system is considered to be a reasonable alternative and has been carried forward for detailed analysis in this EIS. Although used in other applications and similar in design concept in many ways to the special purpose vessel design, the HiLoad design is unproven commercially as an LNG receiving terminal design to date. Offering no clear engineering or environmental advantages to the NEG Port design in terms of siting, design or operations, and due to the lack of commercial experience as an LNG deepwater port, staff determined that the HiLoad design was in this case not a reasonable alternative to the special purpose vessel design alternative.

Table 2-5

Summary of Terminal Alternatives

Criteria	Gravity-Based Structures	Fixed Platform-Based Unit	Floating Storage & Regasification Unit	Special Purpose Vessel (EBRV with STL Buoy System)	Special Purpose Floating Platform (HiLoad System)
Proven technology	Proven for oil and gas, but not for LNG storage and vaporization.	Proven for oil and gas, but not for LNG storage and vaporization	FPSOs (similar in design) have been proven for oil; no floating units have been proven for LNG storage/vaporization	Proven with over a decade of use in the North Sea and for one year in the Gulf of Mexico.	Unproven technology - currently has no operating units.
Water depth requirements	Preferred under 100 ft. Over 100 ft economics become questionable.	Suitable for depths over 200 ft.	Suitable for depths over 200 ft.	Suitable for depths from 115 ft to more than 3000 ft.	Suitable for depths over 80 ft.
Substrate constraints	Requires relatively level, geologic hazard free substrate.	Requires relatively level, geologic hazard free substrate.	Flexible due to alternative anchoring methods that can accommodate different substrate types.	Flexible due to alternative anchoring methods that can accommodate different substrate types.	Flexible due to alternative anchoring methods that are can accommodate different substrate types.
Bottom disturbance	Permanent removal of at least 10 acres (actual size dependent on facility size) of shallow water habitat.	Causes permanent removal of habitat where the structure is secured to seafloor.	Limited infrastructure result in minimal impact on sea bottom habitat.	Limited infrastructure result in minimal impact on sea bottom habitat.	Limited infrastructure with minimal impact to sea bottom.
Metocean considerations	Depends on the specific size and configuration and orientation of the GBS, which can act as a seawall to protect the LNG carrier during offloading.	Able to dock LNG carriers and offload in seas up to 14 ft.	Side-by-side unloading of SRVs should be limited to a maximum of about 6.6 ft (2.0-m) wave heights.	Can moor and unload under wave heights up to of 16.4 ft (5 m).	Docking and undocking has been successfully modeled but not actually tested in wave heights of up to 14 ft (4.5 m).
Visual Impacts	A large portion of the GBS is above the water surface and would be a new, industrial element in Massachusetts Bay views.	A large portion of the Fixed Platform is above the water surface and would be a new, industrial element in Massachusetts Bay views.	This facility, while permanently moored at the Port location, would be visually similar to other large ships in Massachusetts Bay.	The STL Buoys are not visible. EBRVs would be visually similar to other large ships that currently travel through Massachusetts Bay.	This option would require a permanent industrial looking structure with a large portion above water.
Storage capacity	Depends on facility size	Depends on facility size	Depends on facility size and location	None	None
LNG Carriers design	Uses standard design LNG carriers.	Uses standard design LNG carriers.	Uses standard design LNG carriers.	Requires special purpose vessels (e.g., EBRVs).	Uses standard design LNG carriers.

Although it would have nearly the same level of environmental impact as the special purpose vessel, the FSRU terminal's limit for offloading during severe weather conditions was considered a major flaw for use in this area and the FSRU alternative design was eliminated from further consideration. The GBS design was eliminated from consideration due to its requirement for siting in shallower water, its greater bottom disturbance and its potential for significant adverse impacts to nearshore fisheries and recreational boating and fishing. It would also be more visually intrusive than the other options due to its closer proximity to shore. Fixed platform units were also eliminated since they would be unreliable based on weather conditions in Massachusetts.

2.2.2 Alternative Deepwater Port Terminal Locations

Alternate terminal locations designed to meet the stated project purposes must consider options that are reasonably accessible to Massachusetts, can be developed in an environmentally acceptable manner, are feasible from an engineering and operations standpoint, and offer reasonably reliable alternate locations. This analysis evaluated a variety of areas off of the New England coast that could potentially provide offshore access to natural gas transmission facilities and would meet the growing demand for natural gas in Massachusetts and the larger New England region. The criteria used to screen alternate locations for an offshore terminal derive from DWPA, NEPA, MEPA, and other applicable Federal and state guidance.

Evaluation Criteria

USCG guidelines (Title 33 CFR Section 148.720) for siting LNG deepwater port terminals were considered in development of our evaluation criteria. The guidelines specify that an appropriate site for a deepwater port:

- Optimizes location to prevent or minimize detrimental environmental effects;
- Minimizes the space needed for safe and efficient operation;
- Locates offshore components in areas with stable seabottom characteristics;
- Locates onshore components where stable foundations can be developed;
- Minimizes the potential for interference with its safe operation from existing offshore structures and activities;
- Minimizes the danger posed to safe navigation by surrounding water depths and currents;
- Avoids extensive dredging or removal of natural obstacles such as reefs;
- Minimizes the danger to the port, its components, and tankers calling at the port from storms, earthquakes, or other natural hazards;
- Maximizes the permitted use of existing work areas, facilities and access routes;
- Minimizes the environmental impact of temporary work areas, facilities and access routes;

- Maximizes the distance between the port and its components and critical habitats including commercial and sport fisheries, threatened or endangered species habitats, wetlands, floodplains, coastal resources, marine management areas, and essential fish habitats;

- Minimizes the displacement of existing or potential mining, oil or gas production, or transportation uses.

- Takes advantage of areas already allocated for similar use, without overusing such areas;

- Avoids permanent interference with natural processes or features that are important to natural currents and wave patterns; and

- Avoids dredging in areas where sediments contain high levels of heavy metals, biocides, oil, or other pollutants or hazardous materials and in areas designated as wetlands or other protected coastal resource.

2.2.2.1. Phase 1 Site Screening – Regional Analysis

In evaluating coastal areas for potential sites, the initial criteria used to narrow the potential area of study included the following:

Locate in proximity to target market

NEG's target natural gas market is Massachusetts and New England. Given this market area, offshore coastal areas in southern Massachusetts/Rhode Island, Massachusetts Bay and Northern Massachusetts/New Hampshire would be most appropriate for terminal siting.

Locate in proximity to an existing offshore pipeline system

Candidate locations within close proximity of an existing offshore pipeline would be considered reasonable if they could minimize adverse environmental impacts related to construction of new pipeline corridors to access regional markets. A maximum distance of approximately 20 miles from a regional natural gas pipeline with the capacity to receive natural gas from a deepwater port and deliver gas to the target market was considered optimal. Regional natural gas transmission pipeline networks in New England include the HubLine, Maritimes and Northeast Pipeline, Tennessee Gas Pipeline, Iroquois Gas Transmission System and the Portland Natural Gas Transmission System.

To the south, potential pipeline interconnection options include the Algonquin system. To the north, the HubLine and Maritimes and Northeast Pipeline offer possible points of interconnection. All of these interconnections would have similar offshore pipeline requirements, but only connections with the subsea portion of the HubLine avoid onshore and nearshore pipeline construction. As a result, only Massachusetts Bay was considered a reasonable option and carried forward to the next tier for analysis.

Locate in an area with suitable metocean conditions

A primary objective of this project is to provide a reliable and dependable supply of natural gas to serve the increasing base-load demands for natural gas throughout the region. In ensuring that demand can be met with an offshore option, location of an offshore terminal in an area with metocean conditions that maximize the availability of the port and minimize interruptions to operations is essential. The analysis examined long-term metocean data from buoys in the region to determine the frequency of occurrence of wave heights and wind velocities that could prevent or interfere with docking/mooring and unloading operations. Massachusetts Bay provides offshore areas with protected waters that provide suitable metocean conditions for the STL terminal design.

Locate in suitable water depth

Although the proposed STL buoy technology could be used in water ranging from 110 feet to in excess of 1,000 ft, optimal operation is achieved at a depth of approximately 250 ft. As the desired depth decreases, the surface water and seabed exclusion areas increase. For example, at a depth of 110 ft, the area included within the no anchor zone for two buoys would increase from 1,758 acres (at 250 ft depth) to 3,956 acres. At this depth, the maximum area impacted from mooring line sweep would grow from 21 to 65 acres per buoy. In addition, the effects on the deepwater port are greater as the water depth decreases as follows:

- Wave drift forces on the EBRV increase and cause the need for stronger mooring systems, generally with longer line lengths that affect a larger area.
- Mooring system stiffness increases due to the loss of the catenary effect in the mooring lines, which must be compensated for by longer mooring line lengths. This also causes a larger seabed footprint.
- Shallower water requires the STL Buoy to float higher in the water to enable the flexible riser to be installed under it. As a result, the clearance between the ship and the STL Buoy decreases as the water becomes shallower in order to provide sufficient clearance to ensure that the buoy does not impact the seabed during adverse weather.
- With less room between the hull of the EBRV and the top of the buoy, higher buoy positioning in the water column reduces the operational range of sea conditions for connection and disconnection.

To minimize impacts, locations where water depth is below 200 ft were eliminated from consideration.

Summary of Phase 1 Analysis

Based on the above screening criteria, the only area within the region that is reasonable and feasible for siting an STL terminal would be within Massachusetts Bay. Advantages of Massachusetts Bay include:

- Close proximity to Massachusetts' markets;
- Close proximity to an existing offshore pipeline (the HubLine), which has the capacity to transport the gas and would eliminate the need to construct pipeline through sensitive onshore coastal resources; and
- Offshore areas with protected waters that provide suitable metocean conditions to ensure the reliability of the natural gas supply.

2.2.2.2 Phase 2 Site Screening – Local Analysis

The Phase 2 screening identified and applied more detailed criteria to compare the advantages and disadvantages of alternative locations within Massachusetts Bay. The objective during this stage was to eliminate locations where it would not be reasonable or feasible to locate a LNG deepwater port. The selection criteria included:

Locate within reasonable proximity of the HubLine

The HubLine is an existing 30-inch natural gas pipeline located in Massachusetts Bay that connects the Maritimes and Northeast Pipeline in Beverly, Massachusetts to the HubLine mainline in Weymouth, Massachusetts. It is the only subsea pipeline in the area that can provide adequate throughput capacity to the regional natural gas supply network. Connection with the HubLine in Massachusetts Bay would avoid having to make land fall and constructing an onshore pipeline to connect to the regional pipeline network.

Avoid designated shipping fairways

Since interference of LNG deepwater port operations with designated shipping lanes is prohibited, only locations within Massachusetts Bay that are located outside of the boundaries of the Boston Harbor Traffic Separation Scheme (TSS), including precaution areas, were considered as potential areas for the proposed LNG port. The Port Operations Committee recently proposed modifications that would move the TSS seven degrees to the north to minimize the risk of vessel collisions with marine mammals, including North Atlantic right whales. The screening considered avoidance of the proposed TSS route essential in identifying potential site areas, as well. While the port site needs to be located far enough outside of the TSS to ensure that there would be minimal risk of vessel collisions while the EBRVs were unloading, locating a site that would enable maximum use of the TSS by EBRVs traveling to and from the port was considered beneficial.

Avoid state and Federal marine sanctuaries

Massachusetts Bay contains several state and Federal marine sanctuaries, including the Stellwagen Bank National Marine Sanctuary (SBNMS), the South Essex Ocean Sanctuary and the North Shore Ocean Sanctuary. The SBNMS is one of 13 special marine areas selected for their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities under the Marine Protection, Research and Sanctuaries Act (NOAA, 2002a). The South Essex Ocean Sanctuary and the North Shore Ocean Sanctuary were established under the Massachusetts Ocean Sanctuaries Act to protect the ecology or the appearance of the ocean, the seabed and the seafloor from activities that would significantly alter or endanger the resources of the sanctuary. Construction and operation of the port within the sanctuaries would be disruptive to the resources the sanctuaries have been established to protect and should be avoided.

Avoid active or retired marine disposal sites

Massachusetts Bay contains several active and inactive disposal sites are that are considered unreasonable as potential port locations. Construction in a disposal site would have the potential to re-suspend contaminated sediments into the water column, which would cause increased impacts on marine resources. It would also increase construction costs due to the need to control and dispose of contaminated sediments.

Locate in an area of sufficient size for facility footprint

In order for a site to be viable, it must have sufficient surface area to enable placement of all port components in an acceptable configuration. Two buoys have been proposed for this project, with a combined footprint of 43 acres. To ensure safe navigation of the EBRVs to and from a buoy and to allow them to safely weathervane (rotate) while on the buoy, the two buoys must be separated by a distance of 1 nautical mile. Based on the footprint of each buoy coupled with the 1-mile separation between the buoys, the port would occupy a rectangular footprint of approximately 1.1 miles (1.8 km) by 3.2 miles (5.1 km).

Summary of Phase 2 Analysis

Figure 2-11 shows the results of the Phase 2 screening process. The figure identifies areas eliminated from consideration based on the avoidance criteria identified above, as well as the areas that are identified as suitable for siting based on water depth. Based on this analysis, one area was identified as reasonable for identification of individual sites. The area is a triangle bounded by SBNMS on the east, by the South Essex and North Shore Ocean Sanctuaries on the west and by the TSS on the south. A small triangular area to the south of the TSS (bounded by the TSS on the north, the SBNMS on the east and the boundary of the 200 ft contour for water depth on the southwest) was determined to be unreasonable due to the distance that the pipeline lateral would have to traverse to connect with the HubLine (more than 40 linear miles).

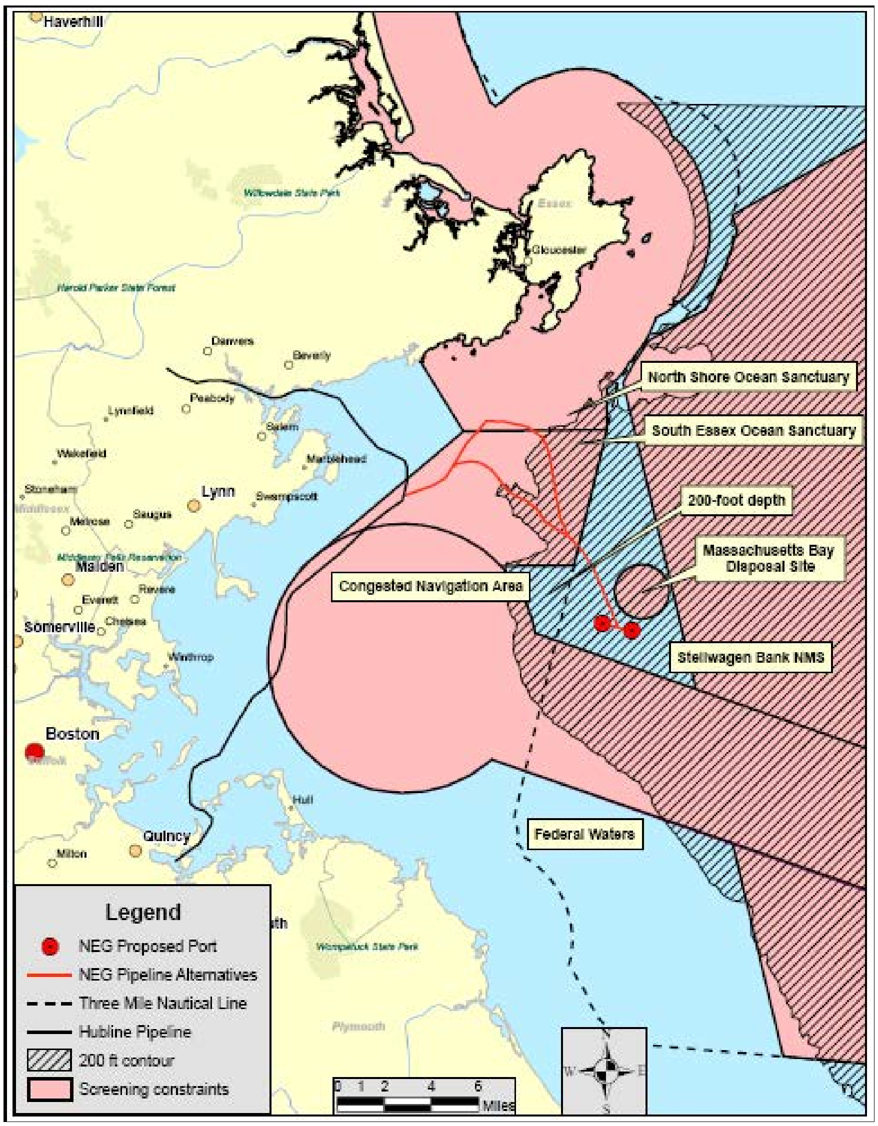

Figure 2-11. Results of Phase 2 Screening Analysis

2.2.2.3 Phase 3 Deepwater Port Site Selection

The two initial phases of the screening analysis identified a triangular area within Massachusetts Bay that is most feasible and reasonable for siting the LNG port. Within that triangular area, the Massachusetts Bay Disposal Site (MBDS) must be avoided along with inactive waste dumps in the area. As a result, two alternate Port locations (Locations 1 and 2) were identified as reasonable and feasible for the deepwater port development. Figure 2-12 shows the two alternate port locations.

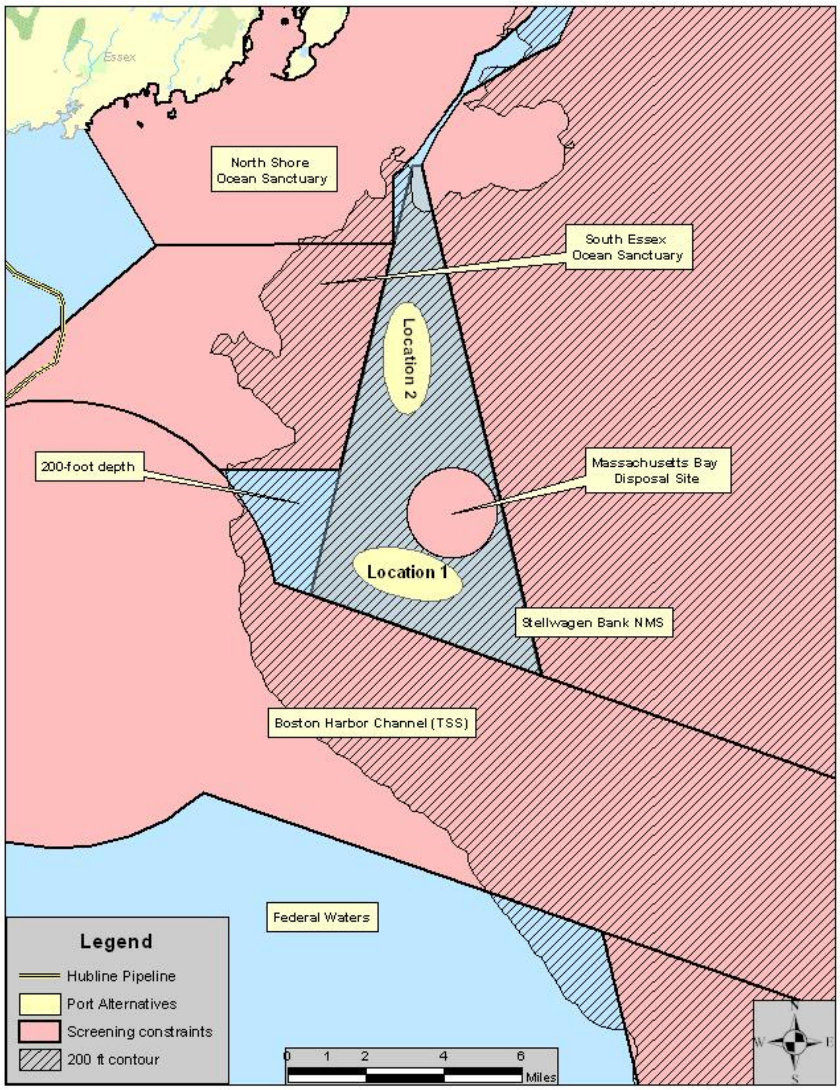

Figure 2-12. Alternate Port Locations

- Location 1 is located in the southern portion of the triangular area approximately 1.25 miles (2.0 km) west of SBNMS, 2 miles (3.2 km) southeast of the South Essex Ocean Sanctuary, 0.75 mi (1.2 km) south of the MBDS and approximately 1 mile (1.6 km) north of the Boston Harbor TSS.

- Location 2 is located in the northern portion of the triangular area approximately 1.25 miles (2 km) west of SBNMS, 1.35 mi (2.17 km) east of the South Essex Ocean Sanctuary, 0.87 mi (1.40 km) northwest of the MBDS, and approximately 5 mi (8.0 km) north of the Boston Harbor TSS.[4]

The two sites are compared in the following discussion.

Benthic Habitat/Essential Fish Habitat

Field studies were undertaken to assess benthic habitat at the two alternative port sites, including video surveys to determine habitat types and sediment profile imaging (SPI) to assess sediment conditions and the nature and health of infaunal assemblages. Both locations have a predominance of low complexity sandy mud bottom and a general lack of more complex hard-bottom habitat.

Results from the SPI survey revealed a low-energy, depositional environment with a relatively uniform sediment (primarily silt-clay with varying degrees of fine sand) over the entire area surveyed, except for three hard-bottom locations. The mooring anchors could be sited at both sites to avoid impacts on the hard-bottom areas from anchor installation or anchor line scouring.

The primary difference in potential benthic habitat impacts between the two alternate sites is the amount of area that would be disturbed by the proposed pipeline installation. Location 1 would require a longer pipeline to connect with the HubLine than Location 2, which could result in greater impacts to benthic habitat and EFH depending on bottom conditions within the pipeline corridor. Alternative pipeline routing is discussed in section 2.2.5.

Marine Mammal Occurrence

The analysis compared distribution of marine mammal sightings within the location alternatives using sighting data provided by SBNMS for the period 1979 to 2002. No sightings of North Atlantic right whales were reported in either of the alternative port sites. Fin whales and humpback whale sightings were reported at both locations, but the number of sightings of both species at Location 1 is slightly lower than at Location 2. This apparently less frequent occurrence of fin and humpback whales near the Location 1, just north of the existing Boston TSS, is part of a larger corridor of lower frequency sightings that extends across Stellwagen Bank and is the stimulus for the proposed shift in the TSS to lessen the risk of vessel strikes of marine mammals.

Commercial Fishing Use

Comparison of the proposed port site alternatives with respect to the potential effects of port construction and operation are difficult because of the lack of site-specific information on fishing effort and catch. Catch data reported to the government are compiled for large areas, and fishermen are generally reluctant to provide specific information on the locations of their preferred fishing grounds or landings from such areas. Thus, the comparison must be conducted using indirect information, such as presence of target species, suitable habitat, and fishing gear such as lobster traps. This type of information was gathered during the field surveys conducted during the summer of 2005, but this information represents only a limited period and season.

Geophysical surveys documented extensive trawling activity (as evidenced by shallow parallel, linear scour marks in the sediment, which were visible on sidescan sonar charts)

[4] Site Location 2 has been proposed by Suez for development of the Neptune LNG Project, which is being analyzed by the USCG in a separate EIS.

throughout most of the soft bottom areas at both port sites. The bottom substrate and habitats are very homogenous throughout both sites; therefore, fishery landings and value are expected to be similar. Thus, impacts due to exclusion of fishing during operation of the port would be nearly the same at both sites. Anecdotal evidence received in comments from fishermen in response to questions on preference in site locations indicated that Location 1 would have slightly less impact on commercial fishing operations that a site elsewhere in the triangular area.

Suitability of Substrate

Both port sites contain suitable substrate and bottom conditions for development of a deepwater port using the STL design. There are a number of bathymetric highs related to subcropping and outcropping of hard ground in each of the alternate sites where the soft sediment is either thin or absent. The areas of shallow sediment and outcroppings are sparsely distributed throughout the two alternative locations such that they would not pose constraints for anchor installation and flexibility in selection of exact anchor placement locations would enable these outcrops/thin sediment areas to be avoided, regardless of which site is selected. Therefore, substrate suitability is not a differentiating criterion in the comparison of the alternative port sites.

Proximity to Disposal Sites

The two alternative port sites are near the MBDS and two historical dump sites (Industrial Waste Site and the Interim Dredged Material Disposal Site) that overlap the MBDS. The proximity of the port sites to the MBDS could affect navigation. The ATBA surrounding the Port when an LNG vessel would be present would potentially require vessels transporting dredged material to the active disposal site to divert from a direct course. However, each of the alternative port sites could pose as a minor navigation obstruction for dump barges, depending on the originating port and the course followed by the vessels. Therefore, this aspect of proximity to the dump site does not appear to be a relevant selection criterion in the comparison of site alternatives. Figure 2-13 shows approach routes to the MBDS in relation to the ATBA for the proposed NEG Port location.

Sediment Contamination

Low levels of contaminants were detected at both proposed port sites; however, the types and levels of contaminants detected should not pose any limitations to the Project.

Proximity to Shipping Lanes

The proximity of the port to the regional commercial shipping lanes is a safety consideration; the closer a location to shipping lanes, the greater the risk for potential shipping interactions. For sites closer to the commercial shipping lanes, there could be greater risk of collision from vessels that might stray from the designated shipping lanes. Although closer to the shipping lanes than Location 2, Location 1 is considered to be a reasonable distance away and a viable site.

In contrast, assuming that the proposed TSS shift is implemented, being in relatively close proximity to the TSS would ensure that the LNG vessels minimized the length of travel outside of the designated travel lanes, which in turn, could reduce the potential for collision with marine mammals.

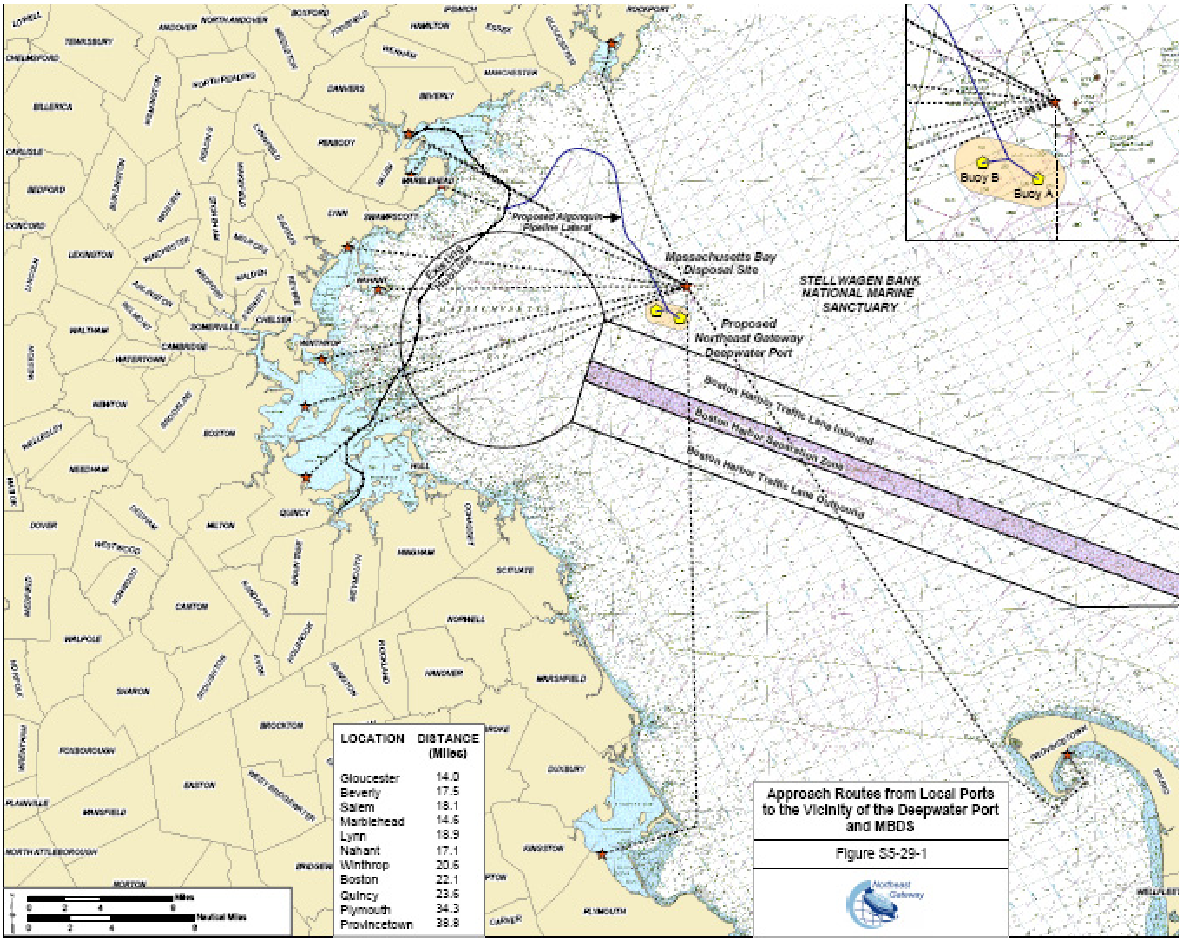

Figure 2-13. Approach routes to the MBDS from Local Ports

Phase 3 Conclusion

As discussed above, both alternative port locations have similar characteristics, with advantages and disadvantages associated with each. Because there are no clear environmental advantages to one site over the other, both sites are carried forward for analysis in this EIS. Location 1 is the reviewed in the general text of this document. Impacts associated with Location 2 are discussed in the alternatives portion of each resource section in section 4.

2.2.3 Alternative Vaporization Technologies

Several technologies are commercially available for LNG regasification, including:

- Open rack vaporizers (ORV);
- Submerged combustion vaporizers (SCV);
- Intermediate fluid vaporizers (IFV); and
- Shell-and-Tube Vaporizers (STV).

Open Rack Vaporization (ORV) Technology

This technology uses the heat from a continuous supply of process water to vaporize LNG and produce natural gas. For offshore terminals, seawater provides the supply of process water. Seawater at ambient temperature is pumped through a series of heat exchanges, treated with an oxidizer (e.g., sodium hypochlorite) to prevent fouling from marine growth, and is discharged back to the source at a cooler temperature. Vaporization effectiveness depends on seawater temperature, which must be at least 46ºF and preferably warmer. The amount of LNG processed determines the magnitude of this temperature difference, but the discharged water can be 20ºF (11ºC) cooler than the ambient temperature. This technology produces no combustion-related air emissions except for those related to pumping equipment. Because of the large volumes of water used, protecting the source and receiving waters is essential to the design and use of ORV intake and discharge.

Submerged Combustion Vaporizer (SCV) Technology

SCV is a highly efficient, bath-type vaporization technology where the LNG passes through submerged steel tube bundles. The heat source used to warm the process water comes directly from jetting combustion gases into the bath (with the combustion process fueled by 1.5 to 2.0 percent of the LNG cargo). SCV uses an open flame to heat the process water. In order to neutralize acidic conditions, the water must be treated with a caustic compound, which requires safeguards in transportation, storage, handling, and use. SCV technology requires a considerable amount of space, an open flame, and high fuel usage.

Intermediate Fluid Vaporizer (IFV) Technology

This closed-loop technology uses an antifreeze-type fluid, such as ethylene glycol or propane, referred to as the heat transfer fluid (HTF). Seawater flows through tubes in the bottom of a large boiler to heat the HTF. This fluid passes through a shell-and-tube vaporization unit to regasify the LNG, and then moves to a second heat exchanger where it condenses before being re-boiled. This two heat exchanger arrangement requires a large amount of space.

Shell-and-Tube Vaporization (STV) Technology (Applicant's Proposal)

STV technology uses a natural gas-fired heat exchanger or boiler in which tubes containing LNG pass through a counter-current of heated water or glycol/water. The natural gas to heat the water or glycol/water is extracted from the sendout from the system's vaporizers. The burning of natural gas results in NO_x and other air emissions. STVs can also be designed to use seawater as a heat source, in an open-loop system. STVs are suitable for use on floating platforms or ships that lack the stability of a fixed platform.

2.2.3.1 Evaluation Criteria

The alternative vaporization technologies were evaluated using the following criteria:

Proven Technology

The vaporization of LNG is a critical process at the deepwater port. The vaporization technology used should be proven by being already in use at an existing LNG terminal or approved for use in a deepwater port application. ORV technology has been approved for use on the Port Pelican and Gulf Landing Deepwater Ports in the Gulf of Mexico. The STV technology has been approved by the Secretary for the Gulf Gateway Energy Bridge Port and is now in operation. The SCV and IFV technologies have been successfully used on existing land-based LNG facilities. These technologies are considered proven, although they have not yet been adapted for use on an EBRV vessel.

Engineering Feasibility

The SCV and IFV technologies require a larger surface area than is available on the EBRV, and therefore were eliminated from further consideration. The ORV technology uses seawater as the heat source. Vaporization effectiveness is dependent on seawater temperature, which must be at least 46ºF and preferably warmer. The year round seawater temperature in the area of Massachusetts Bay containing the two alternate port locations averages 50.5 °F, but varies from a low of 37.4ºF to a high of 65.1ºF. As a result, this technology would only be viable for a few months each year. Because this technology is not compatible with the ambient water temperatures at the location of this project for much of the year, it was eliminated from further consideration.

NEG has designed its EBRV vessels to use STV vaporization system. Although it is only proposing to operate in the close-loop system, both closed- and open-loop STV vaporization systems appear to be reasonable and feasible.

Environmental Effects

The alternative vaporization technologies vary considerably in terms of potential effects on water quality, marine life, and air quality.

The ORV and IFV technologies use considerable volumes of seawater (>150 mgd) as a heat source to vaporize the LNG. Use of these technologies would result in the entrainment of icthyoplankton and small aquatic organisms at the water intakes. Once drawn into the system, entrained organisms are subject to physical damage, exposure to potentially toxic chemicals that are used to prevent biofouling, and exposure to significant changes in water temperatures. We assume that organisms entrained in the intake water would experience a 100 percent mortality rate.

Closed-loop STV vaporization is considered a viable alternative because it is a proven technology and is effective and reliable.

The year round seawater temperature in the area in which the alternate sites are located averages 50.5°F (10.3°C), and varies from a low of 37.4°F (3°C) to a high of 65.1°F (18°C). Seawater would only be viable as the sole source of heat to vaporize LNG for a few months of the year without some form of supplemental heating by burning fuel. Thus, in the northeastern U.S. winter marine environment, a hybrid system employing both seawater and supplemental fuel combustion would be required to vaporize LNG. This hybrid system would have impacts on the marine environment and atmosphere. The circulating seawater flow would remain the same throughout the year, but the requirement for supplemental heating through most months of the year would result in additional air impacts.

Open-loop systems would create greater marine impacts than closed systems. Based on seawater throughputs for STVs used by Gulf Gateway in the Gulf of Mexico of 76 MGD, an open-loop system on an EBRV in Massachusetts Bay would require an intake of at least the same volume for LNG heating purposes during the summer months (when peak water temperatures in Massachusetts Bay approach average Gulf of Mexico winter temperatures). This water would then discharge at a temperature of 11 to 17°C (20 to 30°F) cooler than ambient except during periods of low water temperatures when supplemental heating would be required. Marine organisms (eggs and larvae) would be entrained in the once-through system. None would likely survive due to physical damage of passing through the system, the temperature change, and the anti-fouling agents applied to the STL warming water system to retard marine growth. Secondary biological effects would include fish impingement on intake screens and cold water discharge plume from the open-loop system.

Because of the EBRVs space constraints, air vaporization is not technically feasible for supplemental heating and would not work in the colder winter months when ambient air temperature is at its coldest. Therefore, air vaporization is not considered further.

Although the STV closed-loop system would result in somewhat greater air emissions than open-loop, the marginal differences are not significant. The closed-loop system, however, is likely to have considerably less impact on marine resources. The water quality impacts from the hybrid open-loop shell-and-tube system using seawater to warm the LNG would be likely to be more significant. Impacts to air and water are regulated under the Clean Air Act and the Clean Water Act and are subject to EPA permits which would be available for public review. Therefore, both alternatives are considered reasonable at this time and are evaluated in this EIS.

2.2.4 Alternative Anchoring Methods

The two STL Buoys each require eight mooring lines to hold the buoys in place. Each of the 16 mooring lines terminate at the seafloor and require some form of foundation to anchor the lines in place, to accept its design loading, and to prevent it from pulling out of the soil. Alternative anchoring types include clump weights, drag-embedment anchors, driven pile anchors, jetted pile anchors, drilled and grouted pile anchors, and suction-embedment anchors (referred to as suction anchors). Regardless of the type of anchoring used, the seabed and near-surface soils provide the resistance to the anchoring loads, forming the foundation for the mooring. Each of the alternative mooring line foundation designs is described below.

Clump Weights

Clump weights are large weights set on the seafloor to provide friction that resists the pulling loads. In the NEG Port area, soil friction is low and the clump weight would have to be about ten times the pulling force in order to be secure, requiring significant weight and size for effective mooring.

Drag-Embedment Anchors

Drag-embedment anchors are mooring anchors that initially drag along the seafloor and then set by arching down into the soil. In order to obtain sufficient pulling resistance, multiple anchors are sometimes “piggy-backed” onto a single mooring line. They also require adequate soil depth to embed.

Driven Pile Anchors

Underwater pile-driving hammers can be used to drive cylindrical piles into place, where water depth and soil sediment thickness above bedrock permit. These piles typically require several hundred feet of embedment to develop the required pulling force.

Jetted Pile Anchors

Similar to a driven pile in appearance, an offshore drilling vessel can use high-pressure water pumps to jet a pile into soil. The jetting process washes out a significant area around each pile.

Drilled and Grouted Pile Anchors

An offshore drilling vessel can drill through both sediment and rock to a depth where a pile anchor could be used for the NEG Port. The tubular pile would be lowered into the drilled hole, and cement pumped into the annular space between the hole and the tubular. Once the cement set, the pile would draw strength from the soil and rock around it to resist pulling loads. The drilling process creates a washout area at the seafloor, and the material drilled from the hole creates a spoils area down current.

Suction-Embedment Anchors (Applicant's Proposal)

Suction-embedment anchoring, or suction anchors, can be used where there is soil of suitable strength, permeability, and sediment thickness above bedrock. Cylindrical in shape, the pile is approximately 16 to 20 feet (5 to 6 meters) in diameter and from 35 to 55 feet (11 to 17 meters) in length, depending on soil strength. The lower end of the pile is open and the top is capped. After lowering to the seafloor, the pile partially embeds due to its weight. Then a remotely operated vehicle (ROV) attaches a water pump to a fitting on the closed top and begins pumping out water from the inside of the cylinder; the pressure difference between the inside of the pile and the seawater, acting over the area of the capped top, embeds the pile. It creates no spoils, washouts, or other disturbance to the seafloor. At the time of project abandonment, the pile can be removed by reversing the installation process.

2.2.4.1 Evaluation Criteria

The alternative foundation designs vary in terms of their suitability given the physical conditions of the Project area, environmental effects, and structural permanence. Considerations for comparing alternative anchor designs included:

- Suitability of substrate;
- Extent of seafloor disturbance;
- Noise generated during construction; and
- Ability to remove upon port decommissioning.

Table 2-6 compares alternative anchor types based on these considerations.

Table 2-6
Comparison of Foundation Alternatives

	Clump Weights	Drag-Embedment Anchors	Driven Pile Anchors	Jetted Pile Anchors	Drilled and Grouted Pile Anchors	Suction Anchors
Suitability substrate in both alternate site locations	yes	no	no	no	yes	yes
Relative extent of seafloor disturbance	Major	Major	Moderate	Major	Moderate	Minor
Noise generated during construction	Minor	Moderate	Major	Major	Moderate	Minor
Removable at Project decommissioning	Yes	yes	no	no	no	yes

Suitability of Substrate

In order to be considered a reasonable alternative, the substrate must be suitable from an engineering perspective. Some of the alternative foundation designs are only applicable in certain physical settings. The Driven Pile Anchors and Jetted Pile Anchors need to be embedded in several hundred feet of sediment to withstand the design pulling force of the Port. The sediment thickness above bedrock in the area considered for port siting is not sufficient to use these types of foundation designs; therefore these two alternatives are not considered to be reasonable options.

Suitable bottom conditions exist at both potential port locations for the use of drilled and grouted pile anchors and suction anchors. Drilled and grouted pile anchors can be installed through sediments and rock. Suction anchors require sediments of suitable strength, permeability, and thickness above the bedrock. Sufficient sediment thickness appears to be available for the suction anchors, but additional sediment testing is needed to confirm sediment strength and permeability. Based on bottom conditions, clump weights, drilled and grouted pile anchors, and suction anchors are considered reasonable alternatives.

Relative Disturbance of Seafloor

The installation of the mooring line foundations would affect the environment, primarily through the direct disturbance of benthic habitat or the creation of sediment washout areas that can smother benthic organisms. All of the foundation designs would require some disturbance of the seabed. Clump weights and drag-embedment anchors would have the largest direct impacts on benthic habitats and water quality as they must be dragged to embed in sediments. The process required to install drilled and grouted pile anchors can wash out a large area around each pile and creates a spoils area down current that can smother benthic habitat, however the overall area of disturbance is small relative to clump weights and drag-embedment. Because water is sucked from inside of the cylinder to embed the anchors, suction anchors create no bottom disturbance (aside from the specific footprint of the anchor) and create no spoils. Overall, suction anchors would have the least impact on benthic habitat and are considered a reasonable alternative.

Noise Impacts

All anchor systems would require the use of construction vessels that would create underwater noise of varying levels and duration. Driven pile anchors, however, are installed by repetitive hammer blows that create sound pressure waves that have been demonstrated to cause behavioral changes and physiological damage to marine mammal's hearing ability, depending on proximity to the activity and the magnitude of the noise. Because of the significance of the marine mammal population in the Project area and the Port's proximity to SBNMS, potential impacts from pile driving could be major and this option was not considered to be reasonable.

Port Decommissioning

If approved, the NEG Port would be issued a 25-year license. At the time of decommissioning, all facilities (obstructions) above the mudline would be removed and the area returned to shared use. The Driven Pile, Jetted Pile, and Drilled and Grouted Pile anchors are not readily removable. These foundation designs would require abrasive jet cutting or explosive severing to achieve seafloor clearance and are not reasonable options. The Clump Weights, Drag-Embedment Anchors, and Suction Anchors can be easily and completely removed.

Summary of Alternative Foundation Designs

Table 2-6 provided a comparison of the foundation alternatives. Soil sediment thickness in the area of NEG proposed site is unsuitable for driven pile anchors or jetted pile anchors. Clump Weights and Drag-Embedment Anchors could be used, but would have the greatest areas of seafloor disturbance, and are, therefore, not considered to be reasonable options. Driven pile anchors are not considered to be a reasonable option based on the noise that would occur as the result of pile driving and the impacts that noise could have on marine mammals. Suction Anchors would have the least environmental impact of the anchor options and are readily removable, but additional site-specific sampling is required to confirm the sediments are suitable. Drilled and grouted pile anchors would also have less environmental impact then the other alternatives. Final selection of an anchor type would not be made until later in the design process, however, with the exception of the suction pile and drilled and grouted pile anchor alternatives, the other anchor options are not considered reasonable due to the level and extent of environmental impacts and/or noise that they could cause. Based on our review, only the suction anchors and drilled and grouted pile anchors are carried forward for analysis in this FEIS.

2.2.5 Alternative Natural Gas Pipeline Lateral Routes

In order to deliver the regasified LNG to the New England market, the NEG Port must interconnect with the existing natural gas transmission system. The proposed NEG Port is located approximately 11 miles from the existing HubLine natural gas pipeline.

Geophysical (e.g., sidescan sonar, multibeam sonar, subbottom profiling, vibracoring, and sediment profile imagery) surveys and sea floor backscatter intensity mapping of the potential pipeline corridor between the HubLine and the NEG Port revealed the presence of extensive amounts of rock and hard substrate and variable seafloor topography. Four potential alternative routes for the NEG Pipeline Lateral were identified (Figure 2-14).

Alternative Route 1

Alternative Route 1 extends approximately 10.9 miles from Port Location 2 to its connection point with the HubLine. This route traverses soft-bottom (clay and sand) habitats, with depth to bedrock or tills generally greater than 20 ft (6.1 m). Due to the predominance of soft soils, trenching and backfilling of this route would be expected to be up to twice as fast as for Route 2.

The route parallels the Hibernia cable for approximately 5.2 miles within 1,640 ft and would also cross the cable.

Route 1 crosses a historical waste disposal site that is located near the proposed interconnection point with the HubLine. Sampling done of this route found sediment contamination.

Alternative Route 2

Route 2 is approximately 8.99 miles in length and would provide a relatively direct route between Port Location 2 and the HubLine. This route crosses both soft-bottom (clay and sand) habitats as well as areas that are more variable and include bands of rock or till outcrops interspersed between the sandy and muddy areas. Approximately 3.1 mi (5.0 km), or 34%, of the route, primarily near the western end, passes through areas where surficial soils are less than 5 ft (1.5 m) thick. Within these areas, reworked glacial deposits would be encountered. This unit is likely to comprise poorly sorted sand gravels and cobbles in a silt/clay matrix. Boulders, stiff clay, and dense sands also might be encountered. Phase I geophysical and geotechnical survey results confirmed that this route is trenchable, however, there is a risk that, as with previous projects in Massachusetts Bay, trenching to a depth of 1.5 m (5 ft) or greater, and backfilling could encounter problems, which could lead to schedule delays and extensive remedial work.

Similar to Route 1, Route 2 would traverse a historical waste disposal site near the proposed interconnection point with the HubLine. It also crosses through a debris field that could represent waste material.

Alternative Route 3

Alternative Route 3 originates from the Hubline follows a northeasterly route until it turns to travel through a narrow corridor between rocky substrate and more variable terrain to connect with Port Location 1. This route shares a common HubLine tie-in point and initial 2.3 miles of pipeline route with Alternative Route 4, however, at MP 2.3 it deviates from Route 4 and makes a large bend shifting from a northeasterly orientation to a southeasterly orientation to get through a narrow corridor between rocky substrate and more steeply varying terrain. This alternative encounters surface boulders, glacial till, and potential bedrock and is approximately 13.2 miles in length.

Alternative Route 4

Alternative Route 4 (proposed by NEG) is 16.1 miles long and has the same HubLine tie-in point and initial 2.3 miles of pipeline route as Alternative Route 3. However, past 2.3 miles, Route 4 follows a more northerly course to tie in to Port Location 1 that avoids exposed bedrock and surface boulders. Geophysical surveys of the route indicate that it contains limited areas of cobble and coarse glacial till and is composed of primarily unconsolidated sediments. No areas of bedrock were identified along this route during geophysical surveys. Sediment grain-size distribution at pipeline construction anchor stations are predominantly fine-sand-silt-clay (<0.07mm). Spatially, there is no pattern in sediment grain-size distribution with most sample stations being composed of fine-grained sediments.

Anchoring of pipeline construction vessels along Route 4 would extend into the MBDS, however, no pipeline trenching would occur within the MBDS. Side-scan sonar surveys indicate that historic dumping occurred outside of the mapped boundaries of the MBDS starting at MP 13.5 and extending to the end of this alternate route.

Sampling of the corridor identified copper and zinc concentrations in surface sediments and showed six sample locations within the 6,000-foot construction vessel anchor corridor and one that is outside the anchor corridor, but within 500 feet. Only one of the locations is relatively close to the proposed centerline (within 500 feet), and none of the samples are located within the area that would be trenched.

2.2.5.1 Evaluation

The screening of pipeline route alternatives identified four route alternatives that provide reasonable options for connecting the Port with the Hubline. Experience gained from HubLine construction was considered in route analysis and the identification of reasonable route alternatives. The Hubline was constructed in a challenging near-shore marine environment that contained numerous complex geotechnical seafloor variations and multiple marine uses such as commercial and recreational fishing, recreational boating and commercial shipping Although the proposed project is located in an area that would encounter less complex conditions than the HubLine, environmental and engineering challenges related to that effort were considered relevant and were reviewed to identify and evaluate alternative routes that could be acceptable for this project.

Effects on benthic habitat and EFH

Pipeline construction can affect the environment in several ways. First, there is the obvious direct benthic habitat disturbance from laying the pipeline. Second, the type of habitat present along the pipeline route can affect the overall magnitude of the environmental effects. In general, soft sediments tend to provide less habitat complexity. Third, as discussed above, the nature of the substrate affects the construction methods used, which in turn can affect benthic habitat. For example, hard bottom or bedrock substrates typically require blasting, which can significantly modify the benthic habitat and may result in injury or death to both benthic organisms and finfish. In addition, species typically associated with hard bottom habitats have longer recovery times once disturbed when compared to species that are typically found in the softer sediment habitats. Fourth, the nature of the substrate also affects the duration of construction. It takes longer to lay pipe in bedrock and hard bottom substrates, which prolongs the effect on benthic organisms.

Field studies, including video surveys to determine sea floor conditions, benthic grab sampling to characterize sediment benthos, and sediment profile imagery (SPI) to characterize sediment benthos and chemical and physical attributes of near surface sediments were conducted of the pipeline route alternatives. Benthic habitats along Route 1 consist predominantly of low complexity sandy mud bottom. The Route 4 benthic habit is comprised largely of silt, sand and clay with no surficial bedrock. The more direct routes, 2 and 3, both contain more variable conditions and include bands of surface boulders, glacial till, and pebble/cobble bottom. Based on benthic habitat, Routes 2 and 3 appear to be more valuable than Routes 1 and 4.

Effects on marine protected resources

The South Essex Ocean Sanctuary and the North Shore Ocean Sanctuary were established under the Massachusetts Ocean Sanctuaries Act to protect the ecology or the appearance of the ocean, the seabed and the seafloor from activities that would significantly alter or endanger the resources of the sanctuary. The Act, however, specifically allows uses associated with properly licensed and approved power generation and transmission facilities (M.G.L. c. 132A § 16). All four alternate routes would traverse state marine sanctuaries. Route 1 would traverse 2.8 mi (4.5 km) of the North Shore Ocean Sanctuary and 7.1 mi (11.4 km) of the South Essex Ocean Sanctuary. Route 2 would cross 7.7 mi (12.4) of the South Essex Ocean Sanctuary. Route 3 would cross approximately 9.3 mi (15.6 km) of the South Essex Ocean Sanctuary. Route 4 would cross approximately 9.7 miles of the South Essex Ocean Sanctuary and 2.8 miles of the North Shore Ocean Sanctuary.

Effects on commercial fishing

Comparison of the proposed routes with respect to the potential effects of pipeline construction on fishing activities is difficult because of the lack of site-specific information on fishing effort and catch. Catch data reported to the government is compiled for large areas, and fishermen are generally unwilling to provide specific information on the locations of their preferred fishing grounds or landings from such areas. Thus, the comparison must be conducted using indirect information, such as presence of target species, suitable habitat, and fishing gear, such as lobster traps.

Geophysical surveys documented extensive trawling activity (as evidenced by shallow parallel, linear scour marks in the sediment, which were visible on sidescan sonar charts) throughout most of the soft-bottom areas on the four alternative routes. Although Routes 1 and 4 contain more soft-bottom sediments than Routes 2 and 3 and, therefore, might be used more extensively for trawling, the greater presence of hard-bottom habitats along Routes 2 and 3, as documented by both the geophysical and benthic surveys, provides more suitable habitats for lobster and groundfish. Furthermore, disturbances to the soft-bottom habitat from pipeline installation would have shorter-term effects on habitats and prey than on hard-bottom habitats, which take longer to repopulate.

Due to the soft, more easily plowed sediments that predominate along Routes 1 and 4, the duration of construction would be expected to be shorter than for Routes 2 and 3, which traverse more varied bottom conditions and may require more complex construction methods. The less time that fishing grounds are off limits to the commercial fishing fleet, the lower the adverse impact would be on that industry.

Sediment contamination

Adverse impacts on sediment and water quality could differ between the alternative pipeline routes, depending on the degree to which contaminated sediments are disturbed during pipeline construction. All routes contain some contaminants.

Routes 1 and 2 traverse a historical waste disposal site that is located near the proposed interconnection points with the HubLine. Sampling done of these routes found sediment contamination, with greater amounts along Route 2. Route 2 also crosses through a debris field that could represent waste material.

Sampling conducted in the Route 4 corridor particularly in the vicinity of the MBDS detected relatively low concentrations of metals, pesticides. Comparison of results to the NOAA SQUIRTs database reveal that all metals were below Effects Range Low (ERL) values except for two detections of mercury that were below Effects Range Median (ERM) levels. PCBs were well below ERL levels. Sediment contamination information was not available for alternate Route 3.

Effects on cultural resources

Based on remote sensing data from the geophysical surveys, two underwater shipwrecks were identified within the Route 1 anchor corridor for the pipeline lay barge. These features could be avoided during construction by implementing barge anchor plans. Two wrecks were also identified within the Route 2 corridor. Route 2 was adjusted to avoid the wrecks by a minimum of 500 ft (152.4 m). No cultural resources are located within the Route 3 or 4 corridors.

Geotechnical conditions

Soft substrates with relatively granular sediments are the easiest substrates in which to lay pipe. Traditional lay and backfill plow construction methods can be used, which affect a relatively narrow corridor and minimize sediment resuspension and transport. Areas with exposed bedrock, surface boulders, or glacial till can require blasting, dredging, or jetting to create a trench and then importation of backfill for pipeline burial, or a surface lay with armoring. Pipeline routes in rock substrates can increase the cost and duration of construction and can have significant environmental and economic effects.

Both Routes 2 and 3 would traverse restricted corridors that pass between morphological highs, where bedrock and glacial tills outcrop. The predominant soils encountered within the upper 6 feet are very soft clays within the eastern section of the routes and fine sands to the west (adjacent to the HubLine). Approximately 5.0 km (3.1 mi) (34 percent) of Route 2, primarily near the western end, passes through areas where surficial soils are less than 1.5 m (5 ft) thick. Within these areas, reworked glacial deposits would be encountered. Both routes are likely to comprise poorly sorted sand gravels and cobbles in a silt/clay matrix. Boulders, stiff clay, and dense sands also might be encountered. Review based on the Phase I geophysical and geotechnical survey results indicate that the Routes are trenchable. However, there is a risk that, as with previous projects in Massachusetts Bay, trenching to a depth of 1.5 m (5 ft) or greater and backfilling problems could be encountered, which could lead to schedule delays and extensive remedial works.

The surficial soils along Route 1 are predominantly fine marine silts and clay grading to fine sands inshore. The depth to bedrock or tills is generally greater than 6.1 m (20 ft). Route 4 follows a longer path than the other alternatives in order to be sited along a broad area of granular sediments. Geophysical survey data on Route 4 indicate a sea floor composed of largely silt/sand/clay with no surficial bedrock and very limited potential for subsurface rocks or boulders.

Route 1 parallels the existing Hibernia fiber optic telecommunications cable for a significant length (8.4 km [5.2 mi] within 500 m [1,640 ft] and 1.1 km [0.7 mi] within 91.4 m [300 ft]), while the Routes 2, 3, and 4 do not parallel the cable. All routes cross the cable.

Summary of Pipeline Alternatives

Although Routes 1 and 4 are longer than Routes 2 and 3, they traverse only soft-bottom habitats. Both Routes 2 and 3 traverse areas of hard bottom (gravel with cobbles). Given that soft-bottom habitats generally support fewer important commercial species and are more resilient to disturbance than hard-bottom habitats, the impacts on fish and marine resources would be less along the soft-bottom routes.

Construction within soft-bottom areas (Routes 1 and 4) would entail the simplest, most predictable and least sediment-disturbing construction methods. Given the presence of gravel, cobbles and other hard substrates and lack of thin surficial sediment layers within Routes 2 and 3, construction has a higher probability of requiring blasting, dredging or surface armoring. Additionally, more complex conditions present a higher potential for construction delays.

All routes traverse through areas of contamination, with minor variations in amounts and levels of contamination. As such, contamination is not considered to be a discriminator in evaluating the alternate pipeline routes.

Alternate Routes 1 and 2 both identified shipwrecks within their corridors that would have to be avoided during construction. Routes 3 and 4 contain no cultural resources.

Although all four alternate routes have positive and negative attributes associated with them, none has a fatal flaw that would preclude it from being a viable option. Routes 1 and 4 present more favorable conditions, with less hard bottom than Routes 2 and 3. As a result, all four routes carried forward for further evaluation in this EIS.

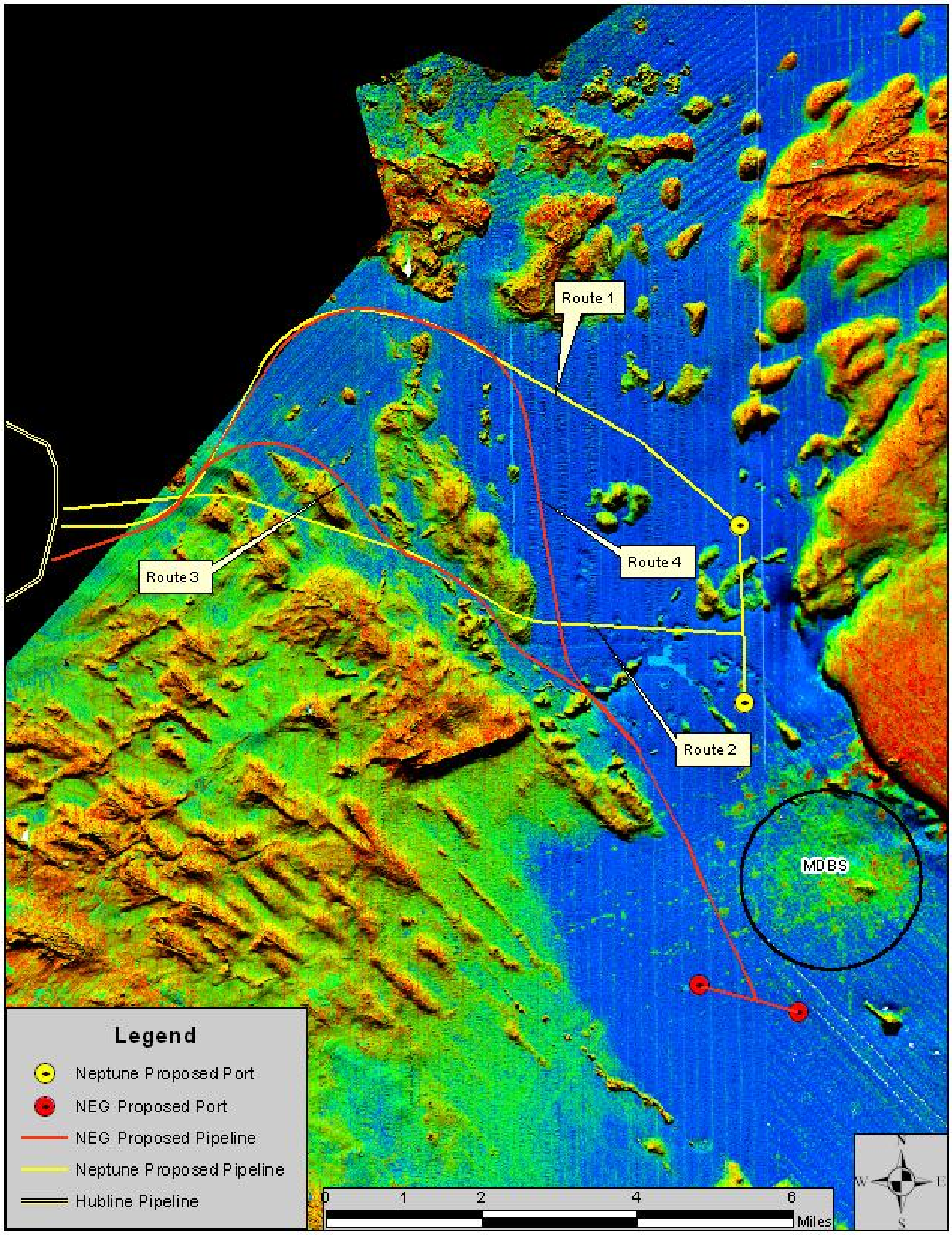

Figure 2-14. Potential Pipeline Route Alternatives

2.2.6 Alternative Construction Schedules

The applicants have proposed a seven month schedule from May through November for construction of the Port and Pipeline Lateral. The schedule includes an allowance for traditional weather downtime delays and an allowance for contractor notification prior to commencement of in-field work.

Activities associated with Pipeline Lateral construction would occur in the following sequence:

- Hot Tap: the hot tapping of the HubLine Pipeline
- Preparation of the Hibernia cable crossing and removal of any obstructions along the pipeline route.
- Lay Pipeline
- Lower Pipeline using a post-lay plow
- Fill pipe with seawater prior to backfilling
- Backfill plowing to cover pipeline
- Hydrotest/tie-in/dry pipeline
- Final backfilling and preparation of As-Built drawings

In addition to potential weather delays, the applicants have considered a number of other variables that have the potential to also impact the construction schedule and have identified the following contingencies in response.

- Delays in construction due to mechanical failure or unplanned scope variations: Multiple vessels would be deployed during construction including separate vessels for laying and plowing of the pipeline, use of two diving support vessels and use of independent survey vessels.
- Inability to achieve the minimum lowering depth after one pass of the plow: Use of a second plow pass, use of diver hand jetting to achieve the desired depth, or use of tremie-vessel placed rock or diver-placed concrete mats or sand/cement bags to provide the required cover.
- Inability to achieve the minimum cover after one pass of the backfill plow provided the pipeline was lowered to the minimum depth below the sea floor: Use of tremie-vessel to place sand or divers to place sandbags or concrete mats to provide the required cover over the pipeline.

Construction of the Port is slated to begin following completion of backfill plowing activities on the Pipeline Lateral. Sections 2.1.1.1 and 2.1.2.1 describe the construction activities required for NEG Port and Pipeline Lateral construction, respectively.

2.2.6.1 Evaluation Criteria

Construction has the potential to impact listed species of marine mammals and sea turtles, as well as commercially and recreationally important finfish and shellfish. Our analysis focused on identification of construction windows that would allow for the least impact based on the following criteria.

Lobster

Any lobsters that are located in or immediately adjacent to the pipeline trench during construction may be buried by spoil material, those directly under anchor strike locations would suffer mortality, and contact with anchor cables moving across the seafloor may kill or injure lobsters that are unable to avoid the cable. To minimize impacts to lobsters, construction scheduling should avoid the time periods when adult lobsters are migrating and are most abundant in the Project area. To minimize impact to planktonic and juvenile lobster, hydrostatic testing should avoid the periods when they are most prevalent in the area.

Commercial Lobstering

Lobsters are an important commercial species to the Massachusetts Bay commercial fishing industry and a considerable number of commercial lobstering occurs in and around the proposed pipeline corridor. To minimize impacts to the commercial lobster industry, construction should avoid the peak months when the catch is most productive.

North Atlantic Right Whale

Among the species listed as threatened or endangered in the Project area, the North Atlantic right whale is the only critically endangered species for which recent population modeling exercises by NOAA indicate that the loss of a single individual could have a negative effect on the survival of the species. As a result, NOAA has set a Potential Biological Removal value of zero for North Atlantic right whales. To minimize impacts to North Atlantic right whales, the construction should be timed to avoid periods when North Atlantic right whales are most abundant.

Recreational Boating

In addition to commercial fishing, some recreational boaters access the proposed Pipeline route and the Port site. The height of the season for recreational boating in Massachusetts Bay occurs in July and August. To minimize conflicts with recreational boaters, construction should be scheduled to avoid the peak boating season.

Ichthyoplankton

The only finfish life stages that would be susceptible to entrainment impacts during hydrostatic testing would be eggs and larvae. To minimize impacts to ichthyoplankton, construction scheduling should avoid bottom-disturbing activities during seasonal peaks (summer) when ichthyoplankton are most abundant.

Whale Watching

Numerous commercial whale watch cruise boats traverse the Project area in transit to and from Stellwagen Bank and other areas where whales occur. The peak whale watch season generally corresponds with the peak recreational boating season. Although whale watch vessels can navigate around the construction area, such course alterations could increase travel time to and from watch areas. To minimize impacts to commercial whale watch enterprises, to the extent possible, construction should be timed to avoid the peak whale-watch season.

2.2.6.2 Schedule Analysis

Port and Pipeline construction have the potential to affect listed species of marine mammals and sea turtles, as well as commercially and recreationally important finfish and shellfish. Through consultation with NOAA Fisheries, the U.S. Fish and Wildlife Service, and the Massachusetts Division of Fish and Wildlife, several species of concern were identified as having the potential to be affected due to the status of their populations and/or likelihood of occurring in the Project area, listing status, or particular aspects of the their life history.

Species of Concern

Consultation with the resource agencies identified the following eleven species of marine mammals and sea turtles, three species of finfish, one species of mollusk, and one species of crustacean as species of concern with respect to the proposed Project's potential impact on marine resources:

- Marine mammals and sea turtles – North Atlantic right whale, fin whale and humpback whale are primary concerns; additional species include sperm whale, blue whale, sei whale, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle.
- Finfish – cod, yellowtail flounder, Atlantic herring.
- Mollusks – sea scallops.
- Crustaceans – Atlantic lobster

Potential Impacts of the Proposed Project on Marine Species of Concern

Potential Project-related impacts to fisheries resources (commercially and recreationally important finfish, mollusks, and crustaceans) associated with construction activities would be primarily related to disturbance/loss of habitat, and entrainment of individuals in water intakes. Potential Project-related impacts to listed species (marine mammals and sea turtles) would be primarily related to disturbance, harassment, and ship strikes. Table 2-7 identifies the potential impacts, receptors and level of impact that could potentially occur as the result of NEG Port and Pipeline Lateral construction. Impact magnitude is expressed as combination of the severity of the impact, should it occur, combined with the likelihood that it would occur.

Table 2-7

Potential Impacts, Receptors and Impact Magnitude for NEG Project Construction

Impact	Primary Receptors	Magnitude
Direct mortality/injury for fish that come in contact with construction equipment	Fisheries Resources	Minor
Entrainment impingement of egg, larval, and juvenile life stages in hydrostatic test water	Fisheries Resources	Minor
Temporary loss of habitat for demersal species with a preference for soft-substrate during construction	Fisheries Resources; Marine Mammals	Minor
Temporary increase in turbidity	Fisheries Resources	Minor
Potential impacts of discharges of harmful substances or effects of thermal effluent	Fisheries Resources; Marine Mammals; Sea Turtles	Minor
Physical harassment caused by noise during construction	Fisheries Resources; Marine Mammals	Major for marine mammals, Moderate for fisheries resources
Increased risk of vessel strikes during construction	Marine Mammals; Sea Turtles	Minor
Discharge of refuse	Marine Mammals; Sea Turtles	Minor
Alteration of prey species and abundance	Marine Mammals	Minor

Construction Windows

Impacts associated with Project construction could be partially reduced by constructing the Port and Pipeline Lateral during periods when the abundance of species of concern is low. Seasonal construction “windows” are routinely required by NOAA Fisheries and the FWS to minimize the potential effects of habitat disturbance on sensitive species.

NEG has identified a construction schedule of seven months, which includes extra time built in as contingency for down time due to weather conditions that could prevent construction. Table 2-8 provides a generalized project schedule by month, and identifies the specific impacts that could potentially occur as a result of each major activity.

Table 2-8

Project-related Construction Activities by Month and Associated Impacts

Activity	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7
Hot Tap	HD, SS, AD						
Route Obstruction Clearance	HD, SS, AD						
Pre-Lay Utility Crossings and Flowlines	HD, SS, AD						
Lay Pipeline		HD, SS, AD					
Hot Tap Jetting		HD, SS, AD					
Flood Flowline/Jet Transitions/Set PLEM		HD, SS, AD					
Plow & Backfill Flowlines		HD, SS, AD	HD, SS, AD				
Plow & Backfill Pipeline Lateral		HD, SS, AD	HD, SS, AD	HD, SS, AD			
Flood Lateral			E				
Post Lay Utility Crossings/Jet transitions			HD, SS, AD	HD, SS, AD			
Hydrotest Flowlines			E	E			
Install side tap/jetting				HD, SS, AD			
Run caliper pig				N			
Dewater pipeline & flowlines/tie into PLEM					HD, SS, AD		
Tie flowlines to lateral/jet and backfill						HD, SS, AD	HD, SS, AD
Install Buoys A and B						HD, SS, AD	HD, SS, AD

N=None
HD=Physical Habitat Disturbance
SS=Ship Strike
AD=Acoustic Disturbance
E=Entrainment

During each month of the seven-month construction period, construction would create physical and acoustic habitat disturbance and increased potential for ship strikes. During the third and fourth months, construction activities would require water intakes that could entrain planktonic life forms. In order to identify the most effective construction window for minimizing impacts to species of concern, the relative abundance of susceptible life stages of the species of concern in the Project area was analyzed according to the schedule of construction activities by month. Table 2-9 presents the results of this analysis.

Table 2-9

Monthly relative abundance of the species of Concern in the Project Area

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fisheries												
Cod												
Adults												
Spawning Adults												
Juveniles												
Larvae												
Eggs												
Yellowtail flounder												
Adults												
Spawning Adults												
Juveniles												
Larvae												
Eggs												
Atlantic Herring												
Adults												
Spawning Adults												
Juveniles												
Larvae												
Eggs												
Mollusks												
Sea Scallop												
Adults												
Spawning Adults												
Juveniles												
Larvae												
Eggs												
Crustaceans												
Atlantic Lobster												
Adults												
Spawning Adults												
Juveniles												
Larvae												

Table 2-9

Monthly relative abundance of the species of Concern in the Project Area

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eggs						Common	Common	Common				
Marine Mammals												
Blue								Rare	Rare	Rare		
Fin				Abundant	Abundant	Common	Common	Common	Common	Common	Rare	
Humpback				Abundant	Abundant	Abundant	Common	Common	Common	Common	Rare	Rare
North Atlantic Right	Common	Common	Abundant & Critical Species	Abundant & Critical Species	Common	Common	Rare	Rare	Rare	Rare	Rare	Rare
Sei Whale			Rare	Rare	Common	Common	Abundant	Abundant	Abundant	Abundant		
Sea Turtles												
Green							Rare	Rare				
Hawksbill							Rare	Rare	Rare			
Kemp's Ridley	Rare				Rare	Rare	Rare	Rare	Rare	Rare	Rare	Rare
Leatherback					Rare	Rare	Common	Common	Common			
Loggerhead							Rare	Rare	Rare	Rare		

Key to abundance
- Rare
- Common
- Abundant
- Abundant & Critical Species

Based on the results of the month-by-month analysis of construction related effects, and the analysis of each species' and life stage's seasonal abundance in the Project area, it is not possible to select a single, continuous, seven-month construction window that optimizes protection of all species and life stages of concern concurrently. Allowing construction from November through May would minimize impacts to the greatest number of species of concern, and would be most protective of all Federally-protected species (marine mammals and sea turtles) as a group. Allowing construction from May through November would be most protective of the critically endangered North Atlantic right whale and fin and humpback whales, but would be less protective of sei whales, blue whales, sea turtles and some fish species.

The North Atlantic right whale is the only critically endangered species with habitat in the Project area. Recent population modeling exercises by NOAA indicate that the loss of a single individual would have a negative effect on the survival of the species. As a result, protection of this species must be given particularly careful consideration. Laist et al (2001) has documented that most vessel collisions occur at speeds over 14 knots. Construction vessels associated with the NEG Project would be traveling at speeds considerably lower than 14 knots and would be able to change course or stop if a North Atlantic right whale was spotted in its vicinity.

Seasonal abundance patterns and life histories of other species must be considered when identifying construction windows for the Project as well. Agency personnel and other stakeholders have raised concerns that the American lobster could be significantly impacted by the proposed Project. American lobsters have the potential to occur at any time throughout the Project area, although planktonic and juvenile lobsters would be most common from June through September. Potential mortality of planktonic early life stages of lobster would primarily be related to entrainment in water intakes, while potential mortality of adults would primarily be related to bottom disturbance associated with plowing and backfilling the trenches on the seafloor. Adults would be most common in the Project area from April through June and October through December, as they migrate between deep winter habitats near Stellwagen Bank and shallow inshore summer habitats. Due to their affinity for abrupt depth changes near ledges or other uneven bottom types, open trenches could potentially attract adult lobsters, and thus increase mortality during backfilling. Avoiding open trenches, to the maximum extent possible, during seasonal lobster migration periods, and avoiding hydrostatic testing during late spring and early summer, would minimize the potential impact of the Project on lobsters.

The only finfish life stages that would be susceptible to entrainment impacts would be eggs and larvae, and the eggs and larvae of all finfish species included in Table 2-9 have the potential to occur in the Project area. Of these species only the yellowtail flounder is strictly demersal, so the habitat-related effects of the Project would have the most potential to impact this species. Thus, the project schedule that would be most protective of finfish would avoid hydrostatic testing during seasonal peaks in ichthyoplankton abundance, as well as bottom-disturbing effects during peaks in juvenile and adult yellowtail flounder abundance.

Based on our analysis, three alternate construction schedules were identified and reviewed: 1) from January through July; 2) from November through May; and 3) from May through November.

2.2.6.2.1 Summary of Alternative Construction Schedules

<u>May through November Construction Alternative</u>

Scheduling construction of the project from May through November would minimize or avoid impacts on most critically imperiled species and the most important commercial fishing activities better than at any other time of the year. During this period, few North Atlantic right whales are likely to occur in the project area. Although construction would occur during peak spawning periods for several species of commercially important fish, the soft substrates along pipeline Routes 1 and 4 are not preferred egg deposition habitat for these fish species. Furthermore, sediment suspension caused by pipeline trenching would be minimized by the use of a plow, which would restrict the area and duration of bottom-disturbing activities when compared to the effects of dredging or jetting. Under the schedule alternative, bottom fishing and gillnetting would be prohibited in parts of the project area for May and June. The best weather of the year occurs in the summer months in Massachusetts Bay, therefore the duration of construction is least likely to be delayed due to bad weather than in any other season.

On the downside, construction from May through November would occur during the peak period for Atlantic Lobster, with larvae and eggs most common during June, July, and August. Under this construction schedule, hydrostatic testing would occur during July and August at the time when entrainment impacts could be most damaging to lobsters. It would also limit recreational boating and commercial fishing access in the vicinity of the pipeline construction during the peak period for recreational boating (Memorial Day through Labor Day).

<u>January through July Construction Alternative</u>

Juvenile and adult yellowtail flounder are common in the Project area year-round, so time-of-year restrictions would not be a useful tool for managing impacts to this species. Juvenile and adult lobsters reach seasonal population minimums in the Project area in late winter. Plowing and backfilling the pipeline lateral from January through April, as would occur under a January through July construction schedule, would ensure that the majority of bottom disturbance would occur during seasonal low points in lobster populations. Although this time window coincides with a greater abundance of the North Atlantic right whale, the speed at which the construction vessels travel should create minimal potential for impacts. Construction from January through July would also minimize potential impacts to sea turtles by avoiding construction when they are most abundant in the area. Under this schedule most construction activity outside the footprint of the Port would be completed by May, so this schedule would also minimize interference with commercial fishing operations during summer and fall. It would also minimize impacts to the fishing industry by occurring during rolling closures when fishing and gillnetting would be prohibited in April, May and June.

The January through July construction window would mean that hydrostatic testing would occur during spring when ichthyoplankton densities are increasing. This schedule would avoid periods of peak abundance for the eggs and larvae of lobsters and sea scallops, but would include the beginning of the spring peak of the eggs and larvae of yellowtail flounder, and the end of the winter peak of egg and larval stages of Atlantic herring. Impacts to ichthyoplankton may be mitigated by designing intakes to draw water from appropriate depths and at low velocities.

November through May Construction Alternative

A winter construction schedule, between November and May, would avoid the summer peak occurrence of, and fishing for, several pelagic fish species such as bluefin tuna, Atlantic herring, bluefish, and Atlantic mackerel. Bottom fishing and gillnetting would be prohibited in most of the project are for three of the seven months of construction (November, April and May), avoiding potential conflicts with fishing activities during almost half of the construction period.

As with the January through May construction period, the November through May period would coincide with the peak occurrence of North Atlantic right whales. Lobsters and lobster fishing in the Project area would be near its maximum levels during the fall (October and November) and Spring (April and May) months. Although peak spawning periods for several species of commercially important fish (hake, silver hake, and witch flounder) would be avoided, the period coincides with spawning of many other s (Atlantic cod, haddock, winter flounder, and Pollock). Additionally, severe storms occur frequently during this period. Thus, construction delays due to bad weather could be greater than a summer construction schedule.

Our analysis has found that each of the three alternate construction schedules has beneficial and adverse conditions associated with them and are considered reasonable options to consider. As a result, all three construction schedules are carried forward for analysis.

2.2.7 No Action Alternative

The No Action Alternative refers to the continuation of existing conditions of the affected environment, without implementation of the Project. Inclusion of the No Action Alternative is prescribed by the CEQ's NEPA implementing regulations and serves as a benchmark against which Federal actions can be evaluated. Under the No Action Alternative, the additional infrastructure proposed by the applicants would neither be built nor brought on line and the potential positive or negative environmental impacts identified in the EIS would not occur. The demand for additional volumes of natural gas would not be satisfied by the Project. Several onshore LNG facilities exist or are being proposed that target the New England market. Proposed onshore and offshore facilities are projects independent of each other (i.e., they are not mutually exclusive); therefore they are not considered to be alternatives to each other. Onshore facilities are discussed under the No Action Alternative, since they could be developed regardless of the outcome of any proposed DWPA application. The Neptune project is discussed in Section 6, Cumulative and Other Impacts, as a foreseeable action. Both the NEG and Neptune projects could be licensed by the Secretary - they are not considered to be alternatives to each other.

Similarly, if the Secretary were to deny or postpone the DWPA license, potential natural gas customers could be forced to seek regulatory approval to use other forms of energy. Other license or Certificate applications concerning proposals to satisfy demand for natural gas might be submitted to the Secretary or Secretary of the Commission, or other means might be used to satisfy the demand for energy in the United States, such as expansion or establishment of onshore LNG import terminals.

As described in Section 1.1, projected natural gas demand exceeds the currently available supply. Should the No Action alternative be adopted, potential customers could select other available energy alternatives, such as oil or coal, or would need to seek traditional non-LNG-derived natural gas to compensate for the reduced availability of natural gas to be supplied by the Project. The No Action alternative would avoid the potential for environmental impacts associated with Project construction and operation. Failure to provide additional LNG to the domestic market would cause reliance on other natural gas sources and increased prices or shortages for industrial use and electricity generation. As discussed below, use of other fuel sources could have negative economic or environmental effects, or both, regionally and nationally.

Failing to bring LNG into the region would most likely result in short-term natural gas shortages and increased reliance on other fuel sources (mainly fuel oil) to make up the difference, especially for use in electricity generation. Many natural gas power plants have the option of substituting fuel oil, should natural gas become unavailable or prohibitively expensive. The projected national increase in petroleum product consumption between 2002 and 2025 is similar to that for natural gas. Consequently, there is unlikely to be a surplus of petroleum fuel that could readily provide a cost-effective alternative to natural gas without significant new discoveries of crude oil.

It is possible that existing natural gas infrastructure supplying the proposed market area could be developed in other ways unforeseen at this point, including the further development of natural gas sources in North America and construction of associated pipeline projects. In some cases, potential customers of natural gas could select available energy alternatives such as oil, coal, wind, solar, hydro, or biomass to compensate for the reduced availability of natural gas. It is purely speculative to predict the resulting action that could be taken by the end users of the natural gas supplied by the Project and the associated direct and indirect environmental impacts.

2.2.7.1 Potential LNG Import Facilities

Numerous LNG import terminals are proposed for the northeastern United States and the Canadian Maritime Provinces, some of which could potentially be constructed and assist in meeting the growing regional demand for natural gas. Proposed LNG Terminals that target or overlap a portion of the NEG market area are identified and described in this section.

In the northeast United States, from Connecticut through northern Maine, seven new LNG terminals are currently proposed. Providence Peak Shaving Plant Expansion, KeySpan LNG's application to upgrade its facility in Providence, RI from a storage facility to a marine import terminal has been denied a license by the FERC and is not, therefore, included in this review. An additional four projects are either proposed, permitted, or under construction in eastern Canada. Figure 2-15 shows proposed, existing and permitted LNG terminals that could potentially provide natural gas to Massachusetts and New England. Table 2-10 lists the proposed and permitted LNG terminals in the region. More detailed descriptions of the individual proposals follow.

Of these proposed facilities, Broadwater, Crown Landing, and Cove Point Expansion would be located in areas that would not be able to serve the Massachusetts market. As discussed in section 1.1, the natural gas pipelines supplying New England from the south and west are limited. Competition for available supplies from the Mid-Atlantic states has limited the availability of additional gas to Massachusetts. The projects proposed for New York and New Jersey are unlikely to contribute significant quantities of gas to Massachusetts and are therefore not evaluated further.

Neptune LNG Deepwater Port (Massachusetts Bay) - US Coast Guard Docket #22611

Neptune LNG LLC (Neptune), a subsidiary of Tractabel-Suez, proposes to construct and operate a deepwater port for LNG approximately 22 miles (35 kilometers) east of Boston, Massachusetts, in federal waters approximately 3.5 miles from the proposed NEG Port site. The proposed port, using two submerged unloading buoys, would moor specially designed ships equipped to store, transport, and vaporize LNG. The two buoys would interconnect via a riser, PLEM, and pipeline with the existing HubLine. The average output would be 400 MMcfd and the ships would moor for 4 to 8 days, depending on vessel size, vaporizer throughput, and market demand. The Neptune application for a Deepwater Port License was determined to be complete and noticed in the Federal Register on October 7, 2005. Neptune estimates project startup for commercial operation in mid-2009.

As with the NEG Project, concerns identified to date for the Neptune LNG Deepwater Port Project include impacts to marine life, water intakes and discharges, benthic impacts, commercial and recreational fishing impacts, essential fish habitat, threatened and endangered species impacts, ship strikes of marine mammals, air emissions (particularly NOx), and safety. Commenting agencies such as the Massachusetts Energy Facilities Siting Board also have expressed the need for a comprehensive needs and siting analysis for the New England region.

Table 2-10

Proposed and Existing Northeastern LNG Terminals as of September 2006

Project/Owner	Location	Natural Gas Sendout	LNG Storage	Status
Northeast Gateway Energy Bridge, L.L.C.	Massachusetts Bay, Massachusetts	0.4 Bcfd	None	Application deemed complete by Coast Guard in June 2005. NEPA review in progress.
Neptune LNG / Tractabel and Leif Hoegh & Co.	Massachusetts Bay, Massachusetts	0.4 Bcfd	135,000 m^3	Application deemed complete by Coast Guard in October 2005. NEPA review in progress.
Weavers Cove LNG / Weavers Cove Energy LLC and Hess LNG	Fall River, Massachusetts	0.4 - 0.8 Bcfd	200,000 m^3	FERC approval issued July 2005; FERC decision reaffirmed in January 2006. Appeal filed in the 1st U.S. Circuit Court of Appeals in Boston by project opponents in January 2006.
Quoddy Bay LNG/ Quoddy Bay LLC and Sipayik Tribal Government	Pleasant Point, Maine	0.5 Bcfd	10 bcf	Bureau of Indian Affairs approved lease agreement for project July 2005. FERC pre-filing request approved January 2006.
Downeast LNG/ Kestrel Energy Partners, LLC	Robbinston, Maine	0.5 Bcfd	160,000 m^3	Pre-filing request approved by FERC January 25, 2006. Town of Robbinston passed referendum supporting project January 2006.
AES Battery Rock, LLC	Outer Brewster Island, Massachusetts	Not available	Not available	Project in preliminary stages requires 2/3 vote by MA legislators for site access before applying for other permits.
Calais LNG and Cianbro Corp.	Red Beach Village Calais, Maine	Not Available	Not Available	Announced in February 2006.
Broadwater Energy LNG / Shell and TransCanada	Long Island Sound, New York	1.0 Bcfd	350,000 m^3	Filed application with the FERC on January 30, 2006. DEIS pending.
Crown Landing LLC/BP Energy[l]	Logan Township, New Jersey	1.2 Bcfd	450,000 m^3	FERC issued a favorable environmental review on April 28, 2006.
Dominion Cove Point LNG, LP / Dominion Gas Transmission	Cove Point, Maryland	1.0 bcfd	u.8 bcf	FERC issued a favorable environmental review on April 28, 2006.
Bear Head LNG / Anadarko Petroleum Corp.	Point Tupper, Nova Scotia, Canada	1.0 Bcfd	480,000 m^3	Construction underway but slowed. In-service date delayed beyond 2008.
Canaport LNG / Irving Oil and Reptol YPF	St. John, New Brunswick, Canada	1.0 Bcfd	420,000 m^3	Site clearing completed in May 2005. On-shore construction to begin in Spring 2006. In-service date is 2008.
Cacouna Energy LNG / TransCanada and Petro Canada	Riviere-du-Loup, Quebec, Canada	0.5 Bcfd	320,000 m^3	Canadian government announced plans for full environmental review January 2006.
Nova Scotia Project / Keltic Petrochemical and Petrplus International BV[j]	Goldsboro, Nova Scotia, Canada	1.0 Bcfd	480,000 m^3	Application submitted

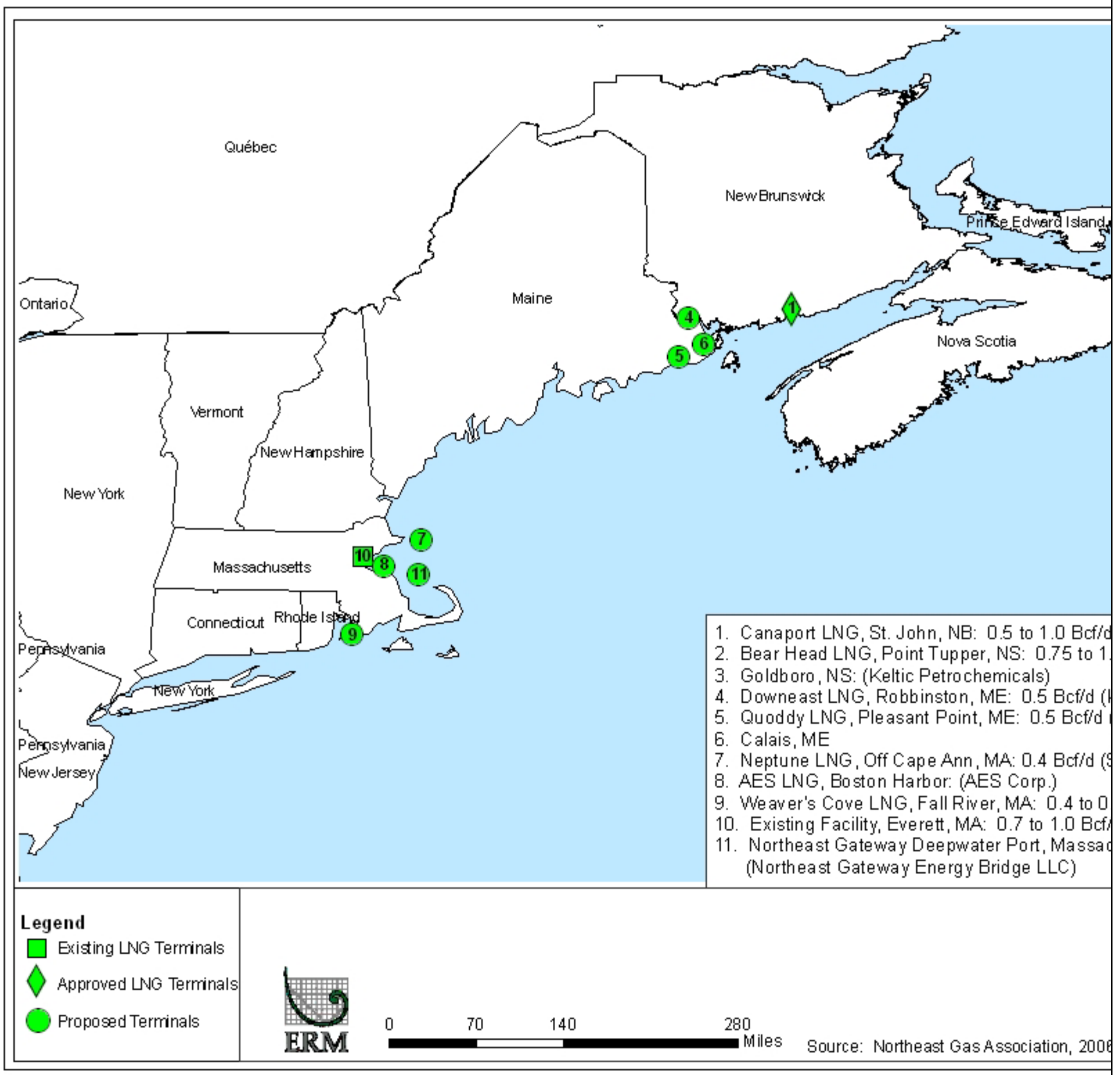

Figure 2-15. Proposed, Existing, and Permitted Facilities in New England and the Canadian Maritimes

Weaver's Cove LNG Terminal (Fall River, Massachusetts) - FERC Docket # CP04-36-000

Weaver's Cove Energy, LLC and Mill River, LLC filed an application with FERC on December 19, 2003, for an LNG import terminal and associated pipelines. Located on a 73-acre (30-hectare) site in Fall River, Massachusetts, the proposed facility includes an unloading berth; a 200,000-cubic meter storage tank and vaporization equipment for sendout of 400 to 800 MMcfd of natural gas; truck loading stations; and two pipeline segments totaling 6.1 miles (11.3 kilometers) of 24-inch (61-centimeter) pipeline.

Weavers Cove, LLC had proposed to start construction in mid- to late-2005 and be completed approximately 33 to 36 months later in 2008. The FERC issued an approval to construct and operate the Terminal on July 15, 2005. Appeals, filed by the City of Fall River, the

Rhode Island Attorney General, and the Massachusetts Energy Facilities Siting Board, and others, have delayed the process, but were denied in a January 19, 2006 FERC affirmation of its July 2005 decision. The January 2006 decision is being appealed in the 1st U.S. Circuit Court of Appeals in Boston by project opponents.

Concerns identified to date for the Weaver's Cove Project includes public safety, the amount of dredging that would be required for the project, and potential impacts to quahog and winter flounder habitat. State officials and local residents have expressed concern over the number of LNG vessels that would annually traverse the approach from the mouth of Narragansett Bay to the proposed facility, associated traffic and safety impacts, affects on real estate values, and the close proximity of the site to high population areas. The USCG is presently undertaking a Waterway Suitability Assessment to determine if the LNG ship transit plan is acceptable.

Downeast LNG Project (Robbinston, Maine) - FERC Docket # PF06-13-000

Kestrel Energy Partners, LLC proposes to construct an import terminal in the Mill Cove, near where the St. Croix River meets the Passamaquoddy Bay. Proposed project facilities include one 160,000 m^3 LNG storage tank, processing equipment, a new pier, and several small support buildings. A second storage tank may be constructed after operations begin. The facility would transport up to 500 million cubic feet per day to the regional pipeline system.

Downeast's prefiling request was approved by the FERC on January 25, 2006 and the project has received a vote of confidence from the people of Robbinston for terminal development. The project anticipates submittal of the 13 resource reports to FERC by June or July of 2006, and an in-service date of 2010.

The proposed terminal site is located just over three miles from the Town of St. Andrews, New Brunswick, Canada, a resort town that derives significant income from whale watching tours and other water related activities. The Town of St. Andrews has expressed concern over public safety, the industrialization of Passamaquoddy Bay and impacts to tourism Regional Canadian officials maintain that they have the right to block passage of ships into their sovereign waters and federal lawyers in the U.S. and Canada are reviewing relevant maritime laws. In addition to the issue of water access, potential issues include impacts to the lobster fishery, historic fish weirs, aesthetics, aquaculture operations, tourism, and safety relative to the tidal extremes, fogs and narrow channels of the area. The Save Passamaquoddy Bay 3-Nation Alliance has expressed concern that siting an LNG terminal in Mill Cove would violate best practices standards set forth by the Society of International Gas Tanker and Terminal Operators (SIGTTO).

Quoddy Bay LNG Project (Pleasant Point, Maine) – FERC Docket # PF06-11-000

Quoddy Bay LLC entered into a lease agreement with the Passamaquoddy Tribe at Pleasant Point to build an LNG terminal at Split Route, near Eastport, Maine. The project would include storage for up to 10 bcf of LNG with send-out capacity of 0.5 Bcfd. A request for commencement of the pre-filing process was approved by the FERC on January 25, 2006, and environmental assessments have been initiated in anticipation of resource report submittal by June or July of 2006. The project developers propose to transport gas from the facility in the Maritimes & Northeast Pipeline.

Given the proposed terminal location, LNG tankers heading into and out of the port would probably have to cross through Canadian waters. This project faces the same issue of Canadian water access for LNG transport as the Downeast LNG Project. In addition to the issue of water access, potential issues identified to date include impacts to the lobster fishery, lawsuits challenging the legality of the lease agreement, aquaculture operations, tourism, and safety relative to the tidal extremes, fogs and narrow channels of the area. The Save Passamaquoddy

Bay 3-Nation Alliance has also expressed concern that siting of this LNG terminal would violate best practices standards set forth by the Society of International Gas Tanker and Terminal Operators (SIGTTO).

Outer Brewster Island Terminal (Boston Harbor, Massachusetts)

AES Battery Rock LLC, a subsidiary of AES Corp., proposes to build an LNG storage and re-gasification terminal on Outer Brewster Island in Boston Harbor. The island is part of the Boston Harbor Islands National Park Area, a state and national park, and approximately 2 miles from the town of Hull, Massachusetts. The facility would include a new 1.2-mile undersea pipeline that would transport the gas from the facility to an existing Beverly-to-Weymouth gas line. AES proposes to build the LNG tanks in shafts quarried 80 feet into the island rock, which would limit the visible portions of the structures to about 20 to 30 feet above ground (The Boston Globe, 2005).

To develop the island, AES would need a two-thirds vote of the Massachusetts Legislature prior to pursuing other federal and state approvals. The proposal has been received with mixed reactions from public interest groups, and issues associated with park use and access, including impacts to recreational boaters and hikers from nearby waters and islands, are being raised. No applications have been filed for this project, so no information on its potential impacts is available. Therefore, with the exception of the consideration given to the project in Section 6, Cumulative Impacts, Battery Rock is not considered further in this evaluation.

Calais LNG Terminal (Calais, Maine)

A joint effort between Calais LNG and its business partner, Cianbro Corp, owned by the Passamaquoddy tribe, proposes to construct an LNG terminal on the St. Croix River between Devil's Head and St. Croix Island in the Red Beach area of Calais, Maine. The location is across from an active gravel pit and the Canadian shipping port at Bayside, New Brunswick. The project would include construction of a 1,700-foot jetty, two large storage tanks and a pipeline that would transport the gas to Baileyville, Maine, where it would connect with an interstate pipeline. The project was announced before a joint meeting of the Calais City Council and the planning board in the first week of February 2006, and is in the early stages of development.

As proposed, LNG tankers accessing the site would have to navigate Head Harbour Passage near Campobello Island, New Brunswick, Canada, before reaching the port in Maine. Issues of water rights-of-way have been raised. Regional Canadian officials maintain that they have the right to block passage of ships into their sovereign waters and federal lawyers in the U.S. and Canada are reviewing relevant maritime laws. In addition to the issue of water access, potential issues include impacts to the lobster fishery, aquaculture operations, tourism, and safety relative to the tidal extremes, fogs and narrow channels of the area. Bear Head LNG (Point Tupper, Nova Scotia, Canada)

The development would include marine offloading, LNG storage and re-gasification facilities to deliver gas into the Maritimes and Northeast Pipeline, which services the Eastern Canada and Northeast U.S. gas markets. The terminal was expected to be in commercial operation with 750 MMcfd to 1 Bcfd of send-out capacity in 2008. On March 14, 2006 Anadarko Petroleum Corporation announced it is rescheduling the onsite construction work of the LNG terminal to match the timing of LNG supply, which would be determined over the next few quarters.

Canaport LNG (St. John, New Brunswick, Canada)

Site clearing was completed for this facility in May 2005 and on-shore construction is scheduled to commence in Spring 2006. The facility is scheduled to be operational in 2008 initially delivering 1 bcf per day of regasified LNG into the market.

Cacouna Energy LNG

TransCanada Corporation and Petro-Canada propose to develop the Cacouna Energy LNG facility in Gros Cacouna, Quebec. The proposed facility would be capable of receiving, storing, and regasifying imported LNG with an average annual send-out capacity of approximately 500 million cubic feet a day of natural gas. The development is intended to help meet the energy needs of consumers in North America. No dredging for carrier access is necessary at this site which is in an area of low seismic activity and already contains some industrial development.

The EIS for this project was filed with provincial regulators in May 2005 and regulatory approvals are anticipated by the end of 2006. Construction is schedule between 0207 and 2009, and terminal operations are anticipated to start up by the end of 2009 or early 2010.

Nova Scotia Project (Goldsboro, Nova Scotia, Canada)

The proposed Nova Scotia Project would include three LNG storage tanks with a gross capacity of 160,000 m^3 each, providing a sendout capacity of 1.0 Bcfd (10.34 bcm/a). The site has sufficient space and utilities available to add three additional tanks for an increased total sendout capacity of 2.0 Bcfd (20.67 bcm/a). The Terminal is proposed to have the ability to receive LNG Carriers with capacities ranging from 75,000 m3 to the largest currently planned LNG carriers (250,000 m^3). The Project's re-gasification terminal is to be located adjacent to the Maritimes and Northeast Pipeline intake station at the Sable Island Gas Plant at Goldboro.

In January of 2006, the Minister of the Environment, and Minister responsible for the Canadian Environmental Assessment Agency, determined that a comprehensive study process is the most appropriate level of environmental assessment for the proposed Keltic Liquefied Natural Gas (LNG) project in Nova Scotia. The Canadian Environmental Assessment *Registry* does not have any published comments on this project at this time.

2.2.7.1.1 Comparison of LNG Projects – Safety and Environmental Considerations

As stated above, if the No Action Alternative is selected, then other LNG facilities may assist in meeting the need for natural gas in Massachusetts. The potential safety and environmental impacts associated with these facilities may be similar to or different than the impacts associated with NEG. To facilitate evaluation of the impacts of these facilities, five were selected as representative and evaluated in more depth. These are:

- Weaver's Cove (On shore Massachusetts)
- Quoddy Bay and Downeast (On shore Maine)
- Canaport and Bearhead (On shore Canada)

Descriptions of the facility's safety and environmental issues follow and are summarized in Table 2-11.

Table 2-11

Summary Comparative Onshore Site Characteristics

	Bearhead	**Cannaport**	**Quoddy Bay**	**Downeast LNG**	**Weaver's Cove LNG**
Exclusion zones in site footprint	Not found.	Not found.	993 feet thermal radiation exclusion zone. Assumed to fall outside of site footprint (assumed from Weaver's Cove).	993 feet thermal radiation exclusion zone. Accommodated within site footprint (assumed from Weaver's Cove).	993 feet thermal radiation exclusion zone. Assumed to fall outside of site footprint.
Residential density	43 ppl/sq. mile average in Nova Scotia.	819 ppl/sq. mile in Saint John, New Brunswick	448 ppl/sq. mile Eastport, ME	19 ppl/sq. mile Robbinston, ME	12,000 people live within 1 mile of proposed LNG site.
Berth location and safety	150 feet long, with a ship draft of 45 feet. Buffer zone 1150 feet wide.	Pier would be 1150 feet for off-loading. Tankers of various uses may dock at pier without occurrence.	1300 foot long pier, two berths with unloading platforms. Each berth will be approximately 1050 feet long	Single unloading berth with 3,862 foot long pier	Passes the exclusion zone.
Transit safety	No densely populated areas along transit route.	Populations won't be significantly affected by transit between Mispec and Saint John.	No densely populated areas along transit route	No densely populated areas along transit route.	Route passes under Braga Bridge. Passes medium density town of Fall River.
Interference with other marine uses	Effects on harbor access and local fishing grounds are not expected or are presumed to be relatively short in duration during construction and operation.	Exclusion zone or public vessel advisories will be used to ensure that public marine watercraft are not in the vicinity of LNG tankers.	Temporary security zone around each ship which may preclude some marine access, but would only last 10 minutes as ships would travel at 6 knots.	No public boat ramps or facilities, some boating activities will be restricted during transit and offloading.	Safety zones would disrupt Taunton River and Mount hope Bay traffic for approximately 60 minutes as vessels travel to and from site.
Maximum population potentially impacted by vessel transit	Transit is not through populated areas.	Transit is not through populated areas.	Ten minute delay expected for residential and commercial fishermen, whale watchers.	Ten homes within .5 mile radius of docked ships. Populations won't be significantly affected by transit.	Transit route follows along Fall River and Somerset shoreline.
Population potentially impacted at tanker berth	No residents at tanker berth. Zoned as an industrial area.	Relative size of birth, coupled with existing structures, will have no significant impact on existing populations.	Believed that no residents at tanker birth location.	Believed that no residents at tanker birth location.	Approximately 616 people reside within 2200 foot radius. Within 4800 foot radius, approximately 3167 people reside.
Credible worst case population potentially impacted by vessel transit	None expected.	Populations won't be significantly affected by transit between Mispec and Saint John.	None expected.	None expected.	Transit route already in use by other ship traffic, so no additional impacts expected.
Credible worst case population potentially impacted at tanker berth	No residents at tanker berth. No adverse long term effect on sea life and marine mammals.	Minimal impact, but local fish and aquatic mammals may suffer some impact in a worst case scenario.	Minimal impact, but local fish and aquatic mammals may be impacted.	Minimal impact, but local fish and aquatic mammals may be impacted.	About 3000 residents would be impacted. Local fish and aquatic mammals may be impacted.
Dredging volume	Not needed	Approximately 25,000 to 30,000 cubic meters to be swept and sidecast.	Not needed	Not needed	2.6 million cubic yards of sediment.

Table 2-11

Summary Comparative Onshore Site Characteristics

	Bearhead	Cannaport	Quoddy Bay	Downeast LNG	Weaver's Cove LNG
Dredging footprint	None	Approximately 9,375 square meters	None	None	Approximately 975,000 square yards.
Dredge sediment contamination	None	Slight, with effect on native mollusks and sea life.	None	None	Unknown.
Eggs	Herring, cod, haddock, Pollock, silver hake, white hake, sand lance, mackerel, redfish, cusk, yellowtail, north shrimp, lobster, crab, scallops. Specific species are designated "Atlantic".	Atlantic salmon, Atlantic wolfish, Atlantic cod, North Atlantic right whale, mussels, rock crab, shortnose sturgeon	Winter flounder, yellowtail flounder, windowpane flounder, American plaice, ocean pout, Atlantic halibut, Atlantic sea scallops	Winter flounder, yellowtail flounder, windowpane flounder, American plaice, ocean pout, Atlantic halibut, Atlantic sea scallops	Winter flounder, yellowtail flounder, windowpane flounder, American plaice, ocean pout, Atlantic halibut, Atlantic sea scallops, Atlantic lobster
Larvae	Herring, cod, haddock, Pollock, silver hake, white hake, sand lance, mackerel, redfish, cusk, yellowtail, north shrimp, lobster, crab, scallops. Specific species are designated "Atlantic".	Atlantic salmon, Atlantic wolfish, Atlantic cod, North Atlantic right whale, mussels, rock crab, shortnose sturgeon	Same as "Eggs" above plus Atlantic Cod, Pollock, and Atlantic sea herring	Same as "Eggs" above plus Atlantic Cod, Pollock, and Atlantic sea herring	Same as "Eggs" above plus Atlantic Cod, Atlantic salmon, Atlantic sea herring, and Blueback Herring.
Juveniles	Herring, cod, haddock, Pollock, silver hake, white hake, sand lance, mackerel, redfish, cusk, yellowtail, north shrimp, lobster, crab, scallops. Specific species are designated "Atlantic".	Atlantic salmon, Atlantic wolfish, Atlantic cod, North Atlantic right whale, mussels, rock crab, shortnose sturgeon	Atlantic salmon, Atlantic cod, Pollock, whiting, red hake, white hake, winter flounder, windowpane flounder, American plaice, ocean pout, Atlantic halibut, Atlantic sea scallops, Atlantic sea herring	Atlantic salmon, Atlantic cod, Pollock, whiting, red hake, white hake, winter flounder, windowpane flounder, American plaice, ocean pout, Atlantic halibut, Atlantic sea scallops, Atlantic sea herring	Atlantic salmon, Atlantic cod, Pollock, whiting, red hake, white hake, winter flounder, windowpane flounder, Blueback Herring, Atlantic halibut, Atlantic lobster, Atlantic sea herring.
Adults	Herring, cod, haddock, Pollock, silver hake, white hake, sand lance, mackerel, redfish, cusk, yellowtail, north shrimp, lobster, crab, scallops. Specific species are designated "Atlantic".	Atlantic salmon, Atlantic wolfish, Atlantic cod, North Atlantic right whale, mussels, rock crab, shortnose sturgeon	Atlantic salmon, Atlantic cod, Pollock, whiting, red hake, white hake, winter flounder, windowpane flounder, American plaice, ocean pout, Atlantic halibut, Atlantic sea herring, and Atlantic mackerel	Atlantic salmon, Atlantic cod, Pollock, whiting, red hake, white hake, winter flounder, windowpane flounder, American plaice, ocean pout, Atlantic halibut, Atlantic sea herring, and Atlantic mackerel	Atlantic salmon, Atlantic cod, Pollock, whiting, red hake, white hake, winter flounder, windowpane flounder, Blueback Herring, Atlantic halibut, Atlantic lobster, Atlantic sea herring, and Atlantic mackerel
Rare/endangered species present	No endangered, rare, or threatened species in vicinity	Atlantic salmon, Atlantic wolfish, Atlantic cod, North Atlantic right whale, mussels, rock crab, shortnose sturgeon	No endangered, rare, or threatened species in vicinity	No endangered, rare, or threatened species in vicinity	At proposed site, none. In Mount Hope Bay, Kemp's Ridley Sea Turtle.

Table 2-11

Summary Comparative Onshore Site Characteristics

	Bearhead	**Cannaport**	**Quoddy Bay**	**Downeast LNG**	**Weaver's Cove LNG**
Pipeline construction acreage	239 acres.	646 acres	246 acres	176 acres.	42 acres.
Highway access for construction traffic	Accessible by Bear Island Road	Accessible by Bay Side Drive, Red Head Road, and the Cannaport Access Road	Roads existing; distances unknown	Accessible by Route 1	Limited highway access to proposed site.
Marine transit distance (including 3 mile mark from provincial waters).	Approximately 22 miles.	Approximately 22 miles.	Approximately 11 miles.	Approximately 46 miles.	Approximately 21 miles.
Site acreage	160 acres	654 acres	42 acres	80 acres	73 acres
Storage tank size	2 tanks 180,000 cubic meters (Phase I with an addition tank for Phase II when market conditions are appropriate)	3 tanks, 140,000 cubic meters	3 tanks, 160,000 cubic meters	1 tank, 160,000 cubic meters	1 tank, 200,000 cubic meters
Pipeline connection distances to Maritime and Northeast Pipeline.	Approximately 77 miles	Approximately 91 miles.	35,8 -mile-long natural gas sendout pipeline	Approximately 30 miles.	Approximately 70 miles
Average throughput	NA	NA	NA	0.5 Bcfd	NA
Maximum throughput	0.5 Bcfd	2.0 Bcfd	2.0 Bcfd	1.0 Bcfd	0.4-0.8 Bcfd
LNG trucking	NA-transfer will occur via shipping vessels	NA-transfer will occur via shipping vessels	NA-transfer will occur via shipping vessels	NA-transfer will occur via shipping vessels	Approximately 100 trucks per day.

DOWNEAST LNG

Safety Considerations

The Downeast LNG site offers a remote location in Robbinston, Maine in Washington County near the intersection of the St. Croix River and Passamaquoddy Bay. The Proposed site would occupy 80 acres with 47 acres dedicated for the facility and a 33 acre buffer. There are approximately 20 inhabited homes within a 0.5 mile radius of the proposed facility and approximately 10 inhabited homes within a 0.5 mile radius of a possible docked ship; the population density is estimated at 19 people per square mile (Downeast LNG 2005a). The thermal radiation exclusion zone is based on the Weaver's Cover Energy LNG Project because of unavailable information for Downeast LNG. Based on these assumptions the thermal radiation exclusion zone on land would be 71 acres or 0.1 square miles which would not have the potential to affect adjacent populations. There will be no trucking of LNG that could affect traffic on Route 1 (the main highway access to Robbinston), and few traffic concerns would arise from the proposed project. Although tides can be quite high in the area, they are not expected to be a safety concern with docking and offloading.

The sendout capacity of this facility will be 0.5 Bcfd (Downeast LNG, 2005a). The site area is not routinely used for water related activities and there are no public boat ramps or facilities in the affected area. Some water activities will be restricted during transit and offloading of LNG because of the security zone which is estimated to be at least 500 yards. Ship transit from Head Harbor Passage to the pier is expected to take less than 2 hours, and offloading would take about 12–14 hours (Downeast LNG 2005a). The ship transit route would require passing through Canadian waters then through Passamaquoddy Bay by tug and would not pass under any bridges or have the possibility to pass through densely populated areas.

Environmental Considerations

There is no associated dredging possible from the proposed project. There is adequate depth in the St. Croix River and an ample turning radius of ¾ of a mile for LNG ships. Therefore there will be no dredging or resuspension of contaminated sediments. No threatened or endangered species or habitat is known to exist in the immediate vicinity of the proposed site. The presence of wading and shore birds is expected, but the project is not expected to have effects on these species based on the analysis of similar pier LNG projects (Downeast LNG 2005b). There is however Essential Fish Habitat (EFH) for several species of fish in the area affected by the proposed project (See Table 2.11). Effects on these fish populations are unknown. There is limited fishery activity in the immediate pier area and there is no indication that ship traffic would affect fishing resources (Downeast LNG 2005b).

At least 25 miles in pipeline would be constructed to tie in to the Northeast Maritimes Pipeline system along the most direct path, resulting in approximately 176 acres of impacts. The constructed lateral would cross the Moosehorn National Wildlife Refuge for 7.5 miles, resulting in approximately 52.8 acres of impacts. Preliminary surveying of the lateral pipeline indicated that approximately 19 acres of wetlands occur in the construction Right of Way. However this acreage total could be reduced during the final routing stages to alleviate impacts on wetlands (Saint John 2006). In order to accommodate this project, the Northeast Maritimes project would be required to add at least 5 compressor stations resulting in approximately 12 acres of impacts and to build a 1.7 mile looping project resulting in an approximately 2.5 additional acres of impacts.

Some project details are unavailable at this time, and impacts have been generalized through desktop surveys.

QUODDY BAY LNG

Safety Considerations

The proposed site for Quoddy Bay LNG would consist of 42 acres on the Passamaquoddy Tribal Reservation in Pleasant Point, ME. The closest city is Eastport, which has a population density of 448 people per square mile. This is considerably higher then the population density of Robbinston, ME near the Downeast LNG facility. The import facility will consist of a 1300 foot pier, 2 berths with unloading platforms, and a process platform. Each berth will be approximately 1050 feet long, running perpendicular to the pier. The send-out capacity of this facility would be 2.0 Bcfd (Quoddy Bay LNG 2006).

During transit there will be a temporary security zone around each ship. This security zone would likely be at least 500 yards. No land-based areas would be affected by the security zones during transit. The security zones could preclude some marine access to the Bay, but this impediment would last only ten minutes as ships would be traveling approximately 6 knots (Quoddy Bay LNG 2006) within the affected area. The thermal radiation exclusion zone is based on the Weaver’s Cover Energy LNG Project because of unavailable or limited information.

Based on these assumptions, the thermal radiation exclusion zone on land would be 71 acres, or .1 square miles, which could have the potential to affect approximately 4 people based on the population density of Eastport. The passage route for LNG vessels has been determined to have adequate depth and minimal boat congestion on the western edge of Passamaquoddy Bay (TRC 2005). There are no known areas with heavy marine boat traffic that lie along the intended route of this project (TRC 2005). In addition, no high density residential areas lie along the vessel route. Tugs will be assisting the LNG tankers through their transit route to assist service to the proposed facility.

During the first phase of operation regasifying will occur directly from the ship to the sendout pipeline. It could take up to 3 days to unload one ship with 2-3 ships expected per week (Quoddy Bay LNG 2006). Once the project site is fully operational, it will take approximately 12 hours to unload the LNG and transfer it to the storage facility. This approximates to 180 ships annually. (Quoddy Bay LNG 2006).

Environmental Considerations

There is no associated dredging possible from the proposed project. No threatened or endangered species habitat is known to exist in the immediate vicinity of the proposed site. However, there are many environmentally sensitive areas in the vicinity of the project area which include bird nesting sites, eelgrass beds, seal pupping ledges, and rich clam and oyster beds (TRC 2005). Other wildlife in this area of concern includes porpoises, seals, bald eagles, osprey, ducks and many types of sea birds making their home in the waters of Head Harbor Passage and Friar Roads (TRC 2005).

Impacts to fish and marine wildlife are unknown and any resulting impacts would be mitigated using best management practices. Security zones are not expected to significantly impact local fishing boats as the approximate security zone would be 500 yards and would only affect a marine area for an estimated 10 minutes. Some fishing vessels would be redirected to avoid collisions with LNG tankers (Quoddy Bay LNG 2006).

The lateral pipeline is approximately 35 miles in length, and would extend from Perry to Princeton, where it will meet the Maritimes and Northeast Pipeline (Quoddy Bay LNG 2006). The lateral pipeline would result in 246 acres of impacts. Impacts to the areas along the lateral pipeline are unknown at this time but blasting could be used to help trench the pipeline at 3-5 feet below the surface. There is little chance of wetland disturbance during construction of the 25 mile lateral. In order to accommodate this project, the Northeast Maritimes project would be required to add at least 5 compressor stations resulting in approximately 12 acres of impacts and build a 1.7 mile looping project resulting in approximately 2.5 additional acres of impacts.

Project details are unavailable at this time, and impacts have been generalized through desktop surveys.

BEARHEAD LNG

Safety Considerations

The Bear Head LNG project is under construction in the Point Tupper/Bear Head Industrial Park in Richmond County, Nova Scotia. This 160 acre project site is in a remote location on the Strait of Canso. The LNG terminal is being designed to safely berth LNG vessels with a 250,000 cubic meter capacity and would have a total output capacity of 1.0 Bcfd (ANEI 2004). The proposed site is an industrial park with no residents within the 1,150 foot tanker berth buffer zone (ANEI 2004). Because the area is in an industrial zone, there are no small towns or communities within approximately 1.4 miles of the project site. Adjacent populations would not be affected by the heat radiation level from the ignited cloud of a grounded ship (DK4 and ANEI 2004). There is no planned trucking of LNG and the site will be serviced by Industrial Park Road and Bear Island Road (ANEI 2004).

The probability of vessel collision is low due to the established shipping lanes and pilotage requirements when docking. The facility is in compliance with all federal safety standards in order to prevent vessel accidents. Additionally, a Facility Emergency Response and Contingency Plan for the LNG Terminal will be prepared and updated as needed to respond to possible vessel accidents and other emergencies (ANEI 2004).

Environmental Considerations

The Strait of Canso has a deep enough channel (approximately 60 feet) to avoid dredging. The water basin is wide enough to allow ships enough of a turning radius without man-made expansions necessary. Results of field surveys suggest that it is unlikely that any rare mammal species or sensitive mammal habitat are present in the study area. As such, no significant Project related adverse effects on rare mammals or sensitive mammal habitat are anticipated (ANEI 2004).

Effects on harbor access and local fishing grounds are not expected or are presumed to be relatively short in duration (ANEI 2004). The areas within the terminal footprint are not known to have importance for fish eggs and larvae (ANEI 2004).

The lateral pipeline to the Maritimes Northeast Pipeline would impact approximately 239 acres along the 34 mile pipeline. There are six wetlands that are contained within the project boundary, of which five would be impacted by the facility (ANEI 2004). Two of these wetlands would be partially filled which could affect the hydrology and sedimentation. Two others would have a security fence built through them which would temporarily disturb the wetland. These activities are not expected to significantly alter the functionality of these 4 affected wetlands. However, one of the wetlands could be significantly impacted by road and other construction activities (ANEI 2004). When possible, the applicant would use best management practices to mitigate impacts on these wetlands. In order to accommodate this project, the Northeast Maritimes project would be required to add at least five compressor stations resulting in approximately 12 acres of impacts and build a 1.7 mile looping project resulting in an additional 2.5 acres of impacts.

CANAPORT LNG

Safety Considerations

The Canaport LNG project is being built as part of the pre-existing Irving Canaport facility, which has operated as a deepwater oil terminal since the 1970's. The LNG facility is being built near St. John, New Brunswick. Upon completion, the facility will feature three storage tanks with a capacity of 140,000 cubic meters each. The facility will have a sendout capacity of 1.0 Bcfd (Irving, 2004). The pier from the LNG facility would extend approximately 980 feet from shore to depths of 82 feet (Irving, 2004). Due to the remote location of the facility, there is a low residential density near the industrial park.

Red Head Road services the Irving Canaport facility. The LNG terminal will be built in a transit area between Mispec and Saint John, where there is an increase in summer recreational fishing and boating. Navigation in the shipping lanes for LNG tankers would be compounded by existing traffic from ships known as "Very Large Crude Carriers," which offload at the existing Irving facility (Irving 2004). However, the probability of a vessel collision near the vicinity of the loading dock or pier is considered low (Irving 2004). The Canadian Coast Guard coordinates all vessel movements within the harbor and would make certain that appropriate communication between vessels is maintained (Irving 2004). To protect human health and safety, a detailed Emergency Response plan will be prepared according to industry guidelines.

Environmental Considerations.

The Canaport LNG terminal would require approximately 25,000 to 30,000 cubic meters of river bottom to be sidecast and swept to accommodate LNG ships. Possible contamination from sidecasting and sweeping activities is unknown from expansion of the channel. There are eight species that were determined to be in the vicinity of this project that are listed by the Committee on the Status of Endangered Wildlife in Canada. These species include four fish (Atlantic salmon, Atlantic cod, Atlantic wolfish, shortnose sturgeon); three mammals (blue whale, North Atlantic right whale, harbor porpoise); and one bird (Harlequin Duck) (Irving 2004). The applicant would take all necessary measures to mitigate the effects, however slight or significant, on these species. The wetlands are on private property already owned by the facility and are of limited public use. They do not belong to any protected area, park, or sanctuary (Irving 2004).

No blasting is expected to occur below the water line or within the inter-tidal zone. It is expected to occur for construction of the road down to the pier and for the pier trestle itself. This blasting may cause direct mortality of land and sea organisms while destroying adjacent fish habitat. These effects will be short in duration during construction and will not be permanent.

The lateral pipeline would travel 91.8 miles to connect to the Northeast Maritimes Pipeline. The area of impact is approximately 646 acres. There was one ecologically significant wetland that was avoided during siting of this project. There would be minimal disturbance of wetlands from this project, with no wetland greater than 2.5 acres that would be affected by the footprint of this project (Irving 2004). When possible, the applicant will take measures to mitigate impacts on these wetlands. In order to accommodate this project, the Northeast Maritimes project would be required to add at least five compressor stations resulting in 12 acres of impacts and build a 1.7 mile looping project resulting in 2.5 acres of impacts.

2.2.7.1.2 Environmental Considerations of Two or More LNG Projects

Maritimes & Northeast Pipeline

Maritimes & Northeast (M&NE) Pipeline would require expansion to handle increased capacity from two or more of the proposed LNG facilities in the Northeast U. S. and Canada (EIA 2006). To support the Canaport facility the M&NE Phase IV expansion (currently under review by the FERC) would include the installation and construction of five new compressor stations, upgrades to two existing compressor stations, and construction of a pipeline loop near the border of Canada. If additional capacity was needed to accommodate any one of the other terminals, M&NE would be required to add additional pipe to the system in the form of looping. Originally the M&NE Phase IV Project included an additional 146 miles of new pipeline looping to transport gas from both the Canaport facility and the proposed Bear Head facility. With the delay in construction at Bear Head, all but 1.7 miles of the looping was eliminated. It is assumed that the additional pipeline loop would be required at such time as that facility or one of the other Maine or Canadian facilities was completed. Nearly all of the proposed looping would be within or adjacent to the existing Joint Mainline or Phase II Mainline right-of-way or other utility or road rights-of-way (FERC 2006), which would. minimize additional impacts in the pipeline construction’s footprint. This expansion is contingent on the above mentioned LNG facilities being completed.

During construction of the five new compressor stations, 1623.7 square acres would be affected temporarily. Of that, only 442.1 square acres would be permanently affected (FERC 2006). The project also calls for the expansion of two compressor stations. Overall, environmental impacts are expected to be minimal and mitigation would decrease their effects even further. Wetland impacts for each compressor station are expected to be small, with exact acreage unknown. Maritime has composed a Spill, Prevention, Control and Countermeasure Plan to address the handling of construction fuel, debris, and other materials to be used by all construction employees to minimize effects of construction on wetland areas (FERC 2006). Animals may experience a slight loss of habitat as areas are cleared, but the initial impact is small. The Atlantic Salmon as a species of concern for three water crossings. They are currently undergoing consultation with Federal and state agencies to further identify Federal and state listed threatened or endangered species. A backhoe and ditching machine use will be minimized to only when soil consists of unconsolidated rock and earth, thereby mitigating air and noise pollution. Water discovered in the trenches will be pumped to vegetated areas upland or filtered and deposited nearby (FERC 2006). Temporary impacts to vegetation are expected in order to allow equipment access during construction. These impacts are expected to be short-term in nature, and the land contours will be returned to preconstruction grade or better. Erosion control measures are to be enacted within 10 days of backfilling trenches in order to minimize environmental damage. Air emissions from construction would comply with area air quality regulations. The five compressor stations will include units like low-NOx combustors, station suction scrubbers, natural gas-fired emergency generators, and other such preventative devices to reduce air emissions (FERC 2006). Noise levels would create little impact on the surrounding area's flora and fauna (M&NE 2006).

2.2.7.2 Fossil Fuel Development

If the NEG Deepwater Port is not constructed, other energy sources, including non-gas-fired fossil fuel generation, may be permitted, constructed, and operated. Over the next 20 years (2005 to 2025) the Department of Energy's Energy Information Administration (EIA) estimates that electric generating capacity in New England would grow from 31.54 gigawatts to 35.23 gigawatts (DOE/EIA, 2005).

According to the EIA, approximately 28 percent of the electric power consumed in New England in 2005 was generated with natural gas. The proportion of power generated with natural gas is forecast to grow substantially over the next twenty years at which time natural gas is anticipated to produce about 35 percent of the New England electrical generation (DOE/EIA, 2005). If the proposed NEG Port is not constructed, it is possible although not currently proposed, that new fossil fueled power plants could be constructed to meet some of the regional demand for energy. Additionally, New England contains almost 6,000 MWs of gas-fired generation that are permitted to switch from natural gas to oil, for limited time periods on peak demand days. As a means of conserving natural gas reserves, or should natural gas demand exceed supply, the number of days that these plants switch over to oil could increase. Assuming that all generating facilities that have the ability to switch from natural gas to oil did so, under normal demand it would increase reserve margins of natural gas in 2012 by 0.96 Bcfd or about 25 percent. Under high demand conditions fuel switching would only provide additional reserves of only about 0.15 Bcfd, or less than 1 percent (NEGC, 2005). The increased use of fuel oil would not only exacerbate the region's dependence on oil but also increase emissions of greenhouse gases and other pollutants over what would be anticipated with natural gas fired plants.

The 400 MMcfd of gas that would be supplied by the NEG Project could support approximately 1,000 MW of electric generation. As shown in Table 2-12, if coal or oil were used to generate the same amount of electricity, emissions of greenhouse gases and other pollutants (e.g. SO_2, NO_2, PM_{10}, and CO_2) would be substantially greater.[5]

Table 2-12
Fossil Fuel Generation Emissions

Pollutant	Emissions (tpy)[a] Gas Combined-Cycle Plant	Oil Combined-Cycle Plant	Coal Plant	Emissions Reduction (Percent) Oil vs. Gas	Coal vs. Gas
NOx	238	685	2,383	65%	90%
CO	149	494	2,978	70%	95%
VOC	45	283	214	84%	79%
SO_2	66	1,555	4,974	96%	99%
PM_{10}	357	1,489	536	76%	33%
CO_2[b]	3,503x103	4,964x103	7,496x103	29%	53%

[a] Assumes full year-round operation of 2,500 MW.
[b] CO_2 emissions based on emission factors in EPA's *Compilation of Air Pollutant Emission Factors* (AP-42)
Source: Northeast Gateway, 2005.

2.2.7.3 Nuclear Power

New England currently receives approximately 28 percent of its electricity from four nuclear power plants, Pilgrim Station (Massachusetts), Millstone (Connecticut), Seabrook (New Hampshire) and Vermont Yankee (Vermont). The Pilgrim Station in Plymouth, Massachusetts, currently provides approximately 10.4 percent of the electric power in Massachusetts. Assuming that another nuclear power plant could be financed and sited in New England, replacing non-gas electric generation with new nuclear generation would result in only modest reductions in peak day gas demand and would not resolve the need for additional gas supplies (New England Governors' Conference, Inc. 2005).

2.2.7.4 Renewables

Potential sources of renewable energy in New England include wind, hydroelectric, biomass, tidal/wave, and solar facilities. Renewables currently represent almost 9 percent (2,760 MW) of New England's electric generation (2,760 MW) and are predicted to grow to over 10 percent (3,740 MW) of total generation within the next twenty years. While conventional hydro, wood/waste wood and MSW/landfill gas are the large majority of renewables in this area, only wind power is projected to significantly support future energy demand in New England (DOE/EIA 2005).

According to the EIA, wind-powered generation in New England may increase from 10 MW in 2003 to 940 MW (approximately 2.6 percent of total generation) in 2025. A number of wind projects are proposed in New England that could provide a combined total about 850 MW

[5] The predicted emissions are based on emission limits specified in recently permitted Massachusetts power plants for natural gas and oil (assuming 0.05 percent sulfur distillate oil). Because there have been no recently permitted coal plants in New England, the coal plant emissions were based on permit limits contained in the recent Thoroughbred Project permit, a "clean coal" power plant located in Kentucky.

to the region. The most promising wind sites in this region, however, are located in the mountainous areas of northern Maine, New Hampshire, and Vermont where existing transmission line infrastructure is not capable of bringing power to the southern parts of New England. Although wind projects have no emissions, such developments can impact wildlife, avian, visual, and other environmental resources.

Because of significant environmental impacts and high construction costs of large impoundment projects, new hydroelectric projects are expected to be limited, with any future hydro projects in New England consisting of smaller run-of-river facilities. In New England, the best sites for hydro development are located in New Hampshire, Maine, and Vermont where the existing transmission system would require improvements to transmit power to load centers in the southern portions of the region. Overall, it appears that hydroelectric facilities would not provide substantial additional energy to New England in the foreseeable future.

Combustion of biomass is a proven technology using biomass feedstocks, which, if properly grown, represent a renewable resource. Existing wood and biomass plants in New England produce less than 50 MW of power out of a total 31,540 MW of generation in New England. The most probable areas for developing such facilities are in northern New England where biomass is most abundant. Again, however, the transmission system would require upgrading. Construction and operation of biomass power plants, transmission lines, and fuel harvest areas would have potential impacts on air, water, ecological, and other resources.

Wave energy technology is in the early stages of development and is not generally commercially available. In contrast, tidal power technology is proven, but due to tidal fluctuation requirements (in excess of 10 ft [3 m]) and presents limited potential to locations in New England. Two options currently exist for obtaining energy from tides, a tidal barrage or use of tidal streams. Tidal turbines or tidal fences consist of submerged turbines that create energy from tidal streams.[6] Since the entire facility is under water, this technology has no visual impact. It also has a smaller footprint than the tidal barrage and would create less bottom disturbance, but the moving blades of turbines could potentially affect fisheries. Tidal stream technology is still in its infancy, however, and there are no projects currently utilizing this technology. The tidal barrage option requires that a dam, or barrage, be built across an estuary or bay that experiences a tidal range in excess of 16 feet. The dam contains gates with turbines that allow the water to pass through. The movement of the tide causes the turbines to turn, similar to hydropower technology. However, because it only generates energy when the tide is actually changing, energy production to only about 10 hours each day. The downside of this technology is that it requires the body of water to be dammed, creating potentially substantial environmental impacts including a change in water level, sedimentation, and possible flooding that could affect vegetation around the coast and impact aquatic and shoreline ecosystems. Additionally the barrage could limit vessel traffic into and out of the estuary or bay. Due to the limited availability of sites, high capital costs (plant and transmission upgrades), and potential environmental impacts, it appears that wave and tidal technology would not provide substantial energy to New England in the near future.

Photovoltaic systems are not well suited for use for large-scale generation in New England due to relatively low direct insulation, higher capital costs, and lower efficiencies. In addition, large-scale solar projects require construction over a large area with associated land use, flora and fauna, wetlands, habitat, and other associated environmental impacts.

[6] Tidal streams are fast flowing volumes of water caused by the motion of the tide. They usually occur in shallow areas where a natural constriction exists that forces water to speed up.

2.2.7.5 Energy Conservation

Energy conservation and increased efficiency in energy production have been a component of the national energy agenda since the Arab Oil Embargo of 1973. However, while energy conservation can play a critical role in the future of the United States energy sector, growth projections continue to indicate that the demand for energy, and specifically natural gas, will outstrip cost-effective programs designed to stimulate energy conservation. A recent study found that "Investments in energy efficiency can help reduce projected natural gas demand for electricity generation in New England by between 4-25 percent in 2008 or as much as 7-45 percent by 2013" (Optimal Energy, Inc. 2004). It identified improved building energy codes and appliance efficiency standards as the cheapest way to realize a portion of New England's energy efficiency potential. Reduction of energy use, through enhanced electric energy efficiency programs, could reduce the demand for natural gas by reducing the potential peak needs of electric generating plants. However, because electric generation represents a small component of overall peak day gas demand, increased efficiency in electricity consumption would provide only a modest improvement in gas supply reserve margins.

2.2.7.6 Pipeline System Proposals

In addition to proposed LNG terminals, the demand for natural gas in New England could partially be met through pipeline expansion and construction. Natural gas is provided to the northeast region through the existing Massachusetts and New England interstate pipeline system, including;

- Algonquin, which delivers gas from the Gulf of Mexico Region;
- Iroquois Gas Transmission System (Iroquois) and Tennessee Gas Pipeline (part of El Paso Corp.), which deliver gas from the Gulf of Mexico region and Canada; and
- Maritimes & Northeast Pipeline, LLC and Portland Natural Gas Transmission System (PNGTS), which deliver gas from eastern and western Canada.

Construction of pipelines and additional compression facilities in New England could impact air and water resources, wetlands, vegetation, wildlife habitats, land use, transportation, and other resources. The impacts would be probably be greater in southeastern New England, where demand is highest and where existing and future development densities makes it difficult to site new pipeline infrastructure.

2.2.8 Alternatives Carried Forward

Based on the evaluation above, the following alternatives are considered reasonable and are evaluated in more detail in Section 4:

- LNG Terminal Design –the STL system using EBRVs;
- LNG Terminal/Port Locations –Port Location 1 and 2 (see Figure 2-12);
- LNG Vaporization System –STV technology using both closed- and open-loop;
- Mooring Foundation Technologies – suction-embedment anchors, and drilled and grouted pile anchors alternative;
- Pipeline Lateral – 4 Routes; and
- Construction schedule – 3 schedule options.

2.3 IDENTIFICATION OF THE AGENCIES' PREFERRED ALTERNATIVE

The CEQ regulations instruct EIS preparers to "[i]dentify the agency's preferred alternative or *alternatives*, if one or more exists, in the draft statement and identify such alternative in the final statement *unless another law prohibits the expression of such a preference"* (emphasis added) (40 CFR 1502.14(e)). Under the DWPA, MARAD has the decision making authority to approve, approve with conditions, or deny a license application for a deepwater port. Because MARAD is the decision making authority, identifying its Preferred Alternative could be interpreted as pre-decisional to the issuance of a license prior to the Secretary's assembling, reviewing, and analyzing all of the relevant information pertaining to the license application, as required under the DWPA. As such, the Secretary will defer identification of the agency's Preferred Alternative until a decision is made to approve or deny a deepwater port license. If the license is approved, the Secretary will indicate the agency's Preferred Alternative in its ROD issued under the DWPA.

3.0 AFFECTED ENVIRONMENT

3.1 WATER RESOURCES

3.1.1 Physical Oceanography

3.1.1.1 Waves

Massachusetts Bay is subject to waves that are generated by local winds (wind waves characterized by relatively short periods) and by distant storms (swell characterized by long periods). Waves that result from winds blowing over the region depend on wind speed and direction because the fetch is limited except to the east. Data collected from NOAA Buoy 44013 from 1986 to 2001, shown as monthly climatic data in Figure 3-1, reveal that the average monthly significant wave height (H_S), which is the average of the one-third highest waves measured over a given time period (usually 1 hour), are highest during December through March. On average, significant wave heights are two times smaller during the summer months. The most common occurrence of high waves was in between December and March, the highest recorded waves were measured in October at significant wave heights over 29.5 feet (9 meters).

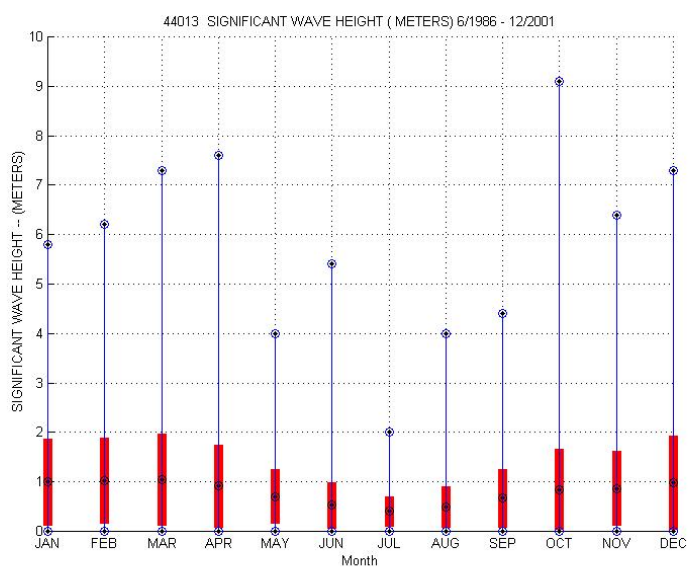

Figure 3-1 Average Significant Wave Height (1986-2001) Recorded at NOAA Buoy 44013

3.1.1.2 Currents

Massachusetts Bay circulation is influenced by the larger flow structure of the adjacent waters of the Gulf of Maine. Massachusetts Bay is partially separated from the Gulf of Maine by Stellwagen Bank, which forms a broad, shallow sill extending from off the tip of Cape Ann to the tip of Cape Cod (water depths from 70 to 100 feet; 21 to 30 meters). Stellwagen Bank is separated from Cape Ann in the north and Cape Cod in the south by channels with depths ranging between approximately 160 and 200 feet (49 to 61 meters). In the Gulf of Maine, water flows in a southwest direction throughout the year along the coasts of Maine and New Hampshire and largely bypasses Massachusetts Bay. However, periodically some of the flow moves into Massachusetts Bay through the channel south of Cape Ann. During most of the year, this drives a weak counterclockwise flow around Massachusetts and Cape Cod Bays.

Long-term observations (from December 1989 to September 1991) of ocean circulation in Massachusetts Bay (Butman *et al*., 2004) revealed that the mean current typically flows along the coast south through Massachusetts Bay and turns offshore into the Gulf of Maine (Figure 3-2). During much of the year this weak counterclockwise circulation persists in Massachusetts and Cape Cod Bays, principally driven by the southeastward coastal current in the Gulf of Maine. The current enters the bay south of Cape Ann, then proceeds south along the western shore, and then east out of the bay north of Race Point.

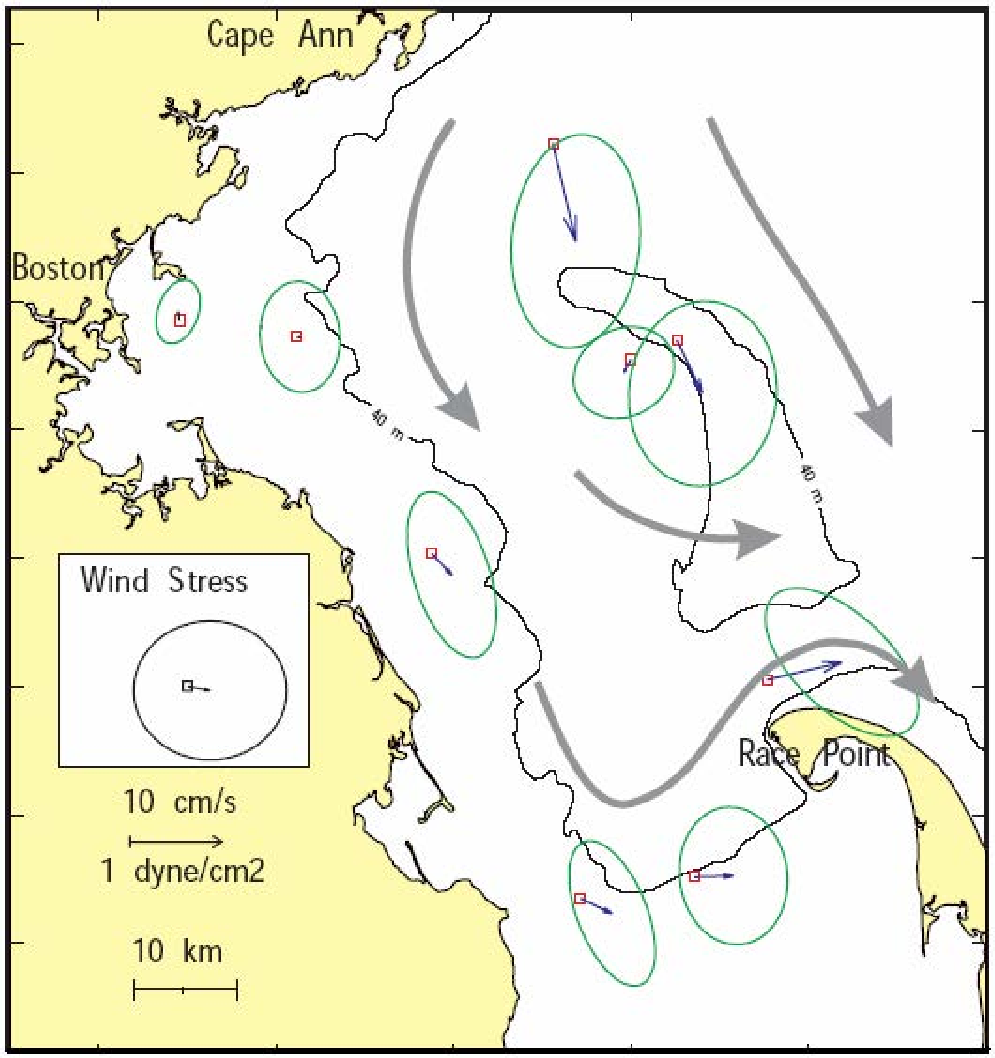

Figure 3-2. Observed mean current flow (blue arrows) and its variability (green current ellipses) measured between December 1989 and September 1991. The bold gray arrows indicate trajectories associated with the residual flow.

Source: Putman *et al.*, 2004

The proposed Port location is characterized by weak residual currents (1 to 5 cm/s) flowing south-southeast. On average, the magnitude of current fluctuations is greater than the magnitude of the residual flow. Mean current ellipses have major semi-axis in the range from 8 to 12 cm/s. These fluctuations of currents are caused by various physical processes. Circulation in Massachusetts Bay results largely from three influences, each working at different time scales: tidal currents; mean circulation driven by the circulation of the Gulf of Maine; and episodic wind-driven currents, which also result in coastal upwelling and downwelling (Geyer et al., 1992; Signell, 1996; and MWRA, 2003). In most areas, tides generate the strongest current magnitudes, but tidal currents are cyclical and, as a result, are less important than weaker, but steady, currents and wind events in determining the overall circulation of the Bay and the transport of water through the Bay system. These different processes work concurrently to produce the regional current structure, which is dominated by tides close to shore, but with more variability over a wider area of Massachusetts Bay.

Geyer et al. (1992) estimated that the typical residence time for surface waters of Massachusetts Bay was 20 to 40 days. The estimated residence time of bottom water varied considerably depending upon location in the Bay. The deepwater of Stellwagen Basin exhibits little horizontal exchange during the summer stratified season and, hence, is assumed to have a residence time of 6 months or greater. The residence time in western Massachusetts Bay, including most of the pipeline corridor, was estimated by Geyer to be about 3 to 10 days.

3.1.1.3 Wind-driven circulation

Currents set up by wind in Massachusetts Bay result in displacements that redistributes water within the Bay. Winds from the southwest cause upwelling by blowing the upper layer water away from the coast. Winds from the northeast cause downwelling. Seasonal variability of the wind pattern causes seasonal variations of the wind-driven circulation. This variability was modeled within the framework of the Cooperative Modeling Project between University of Massachusetts and the MWRA **(**http://alpha.es.umb.edu/faculty/mzh/files/web-model/ mass_bay_ model.htm). The results of the project revealed that during the spring, seasonal winds sometimes setup a southwest slow entering Massachusetts Bay south of Cape Ann as a strong (about 30 cm/s) current and proceeds southward along the coast with speeds of about 15 to 20 cm/s. Within the deep part of the bay, the currents are weaker, not exceeding 10 cm/s. The current intensifies (to about 30 cm/s) farther offshore over Stellwagen Bank.

In the summer, seasonal winds sometimes setup a circulation pattern in the bay characterized by an intense (about 20 cm/s) northward coastal flow. The current veers off shore south of Cape Ann forming a clockwise circulation feature. As in spring, the wind driven currents are weaker over the deep part of the basin (less than 10 cm/s). During the fall, the southward flow from the Gulf of Maine shifts toward the coast and the clockwise circulation cell shifts into Cape Cod Bay. During this period, the currents are toward the southeast (about 15 cm/s) in the proposed project vicinity. During the winter, the clockwise circulation cell entirely disappears and the main southward flow shifts closer to the shore.

3.1.1.4 Water properties (temperature, salinity, density)

The physical properties of Massachusetts Bay waters are most strongly influenced by seasonal variations in solar radiation and heat flux (temperature), and oligohaline inflow from the Gulf of Maine (salinity). Mean monthly sea surface temperatures measured at the NOAA Buoy 44013 over the period 1984 to 2001, ranged from a low temperature in February of 38°F (3.0°C) to a high in August of 64°F (17.5°C); the lowest and highest hourly measurements ranged from 31.5°F in May to 75°F in August (-0.3 to 23°C).

The warming of surface waters begins in April; by June, strong thermal stratification develops. Summer sea-surface temperatures throughout Massachusetts Bay are typically 60 to 64°F (15.5 to 17.5°C), while temperatures remain at 46 to 54°F (8 to 12°C) below a strong thermocline typically found at approximately 66 feet (20 meters) depth in the late summer. The position of the thermocline (pycnocline) largely depends on wind forcing and presence of internal waves. In September and October, the combined effect of decreasing heat flux and increased mixing by storms causes the breakdown of thermal stratification, and the water column returns to a thermally well-mixed state.

No major freshwater sources empty directly into Massachusetts Bay or Cape Cod Bay, although oligohaline water is seasonally transported into Massachusetts Bay from sources in the Gulf of Maine. The largest direct source of freshwater into Massachusetts Bay is the Charles River, with an average annual flow rate of only 225 million gallons per day (Geyer et al., 1992). The Merrimack River and other rivers of the western Gulf of Maine (including the Penobscot, Androscoggin, Kennebec, and Saco Rivers), discharge freshwater into the Gulf of Maine coastal current, which then carries lower salinity water into Massachusetts. Despite their lack of direct input to Massachusetts Bay, these rivers are the primary source of lower salinity water in Massachusetts Bay (Geyer et al., 1992). The discharge of the Merrimack, for example, is more than 20 times larger than that of the Charles River. Salinity stratification typically peaks in late spring when river discharges are at their highest. Temperature and salinity stratification of the water column varies with a well-mixed water column during late fall and winter. Salinity stratification is dominant in the spring and temperature stratification is dominant in the summer and early fall. During spring, summer, and fall, salinity varies in the vertical from 27 – 31 psu at the surface to 31.5 – 32 psu at the bottom. In winter, salinities vary in the range from 32 to 33 psu.

Thermal stratification begins in April and increases through the late spring and summer, reaching its maximum in August. In October, surface temperature decreases, but the bottom water continues to warm due to mixing of warmer surface water downward. In April, freshwater inputs begin to establish vertical and horizontal salinity gradients. Significant salinity gradients persist through August. The maximum density stratification occurs in August, with contributions from temperature and salinity. Deviations from the typical temperature/salinity pattern are found occasionally because of several factors, including storm-induced vertical mixing, breaking internal waves, upwelling and downwelling, and runoff events. Upwelling induced by southwesterly winds results in the rising of cold, deep (nutrient-rich) water to the surface along the western margin of the Bay, including the Project area. Conversely, downwelling, resulting from northerly or northeasterly winds, carries warm surface (oxygen-rich) water downward causing a weakening of stratification along the western margin.

3.1.2 Water Quality

The Massachusetts Water Resources Authority (MWRA) began collecting water quality data as part of the Harbor and Outfall Monitoring (HOM) Program in 1992, to establish baseline water quality conditions for the assessment of environmental effects of relocating effluent discharge from Boston Harbor to Massachusetts Bay in September 2000. As part of the HOM program nutrients, chlorophyll-a, and dissolved oxygen are measured along with bacterial indicators (fecal coliforms and Enterococcus). Surveys are performed in the area around the outfall site (nearfield) and at 27 farfield stations in Boston Harbor and Massachusetts and Cape Cod Bays. Information from the 2003 sampling (Libby et al., 2004) at the offshore stations, supplemented with the 1994 sampling results (Kelly, 1995) identify the NEG Project Area as a Class SA water. Class SA waters are designated as excellent habitat for fish, other aquatic life, and wildlife: are suitable for primary and secondary contact recreation; and have excellent aesthetic value. In approved areas (such as Massachusetts Bay), Class SA waters are suitable for shellfish harvesting without depuration (open shellfish areas).

In addition, the state has assigned specific criteria for all surface waters for aesthetics, bottom pollutants or alterations, nutrients, radioactivity, and toxic pollutants. These criteria are listed in Section 4.05(5) of the regulations.

3.1.2.1 Turbidity

The term “turbidity” is often used when referring to Total Suspended Solids, which are comprised of organic and inorganic particulate matter in the water column; however, turbidity is more correctly defined as an optical property of water referring to the blockage of light as it passes through water. The higher the levels of particulate matter, the higher the turbidity. In general, turbid water interferes with recreational use and aesthetic enjoyment of water (EPA, 1976). Higher turbidity also lowers water transparency, increasing light extinction (a measure of the penetration of light through water), and reducing the depth of the euphotic zone. This decreases primary production of biomass and decreases fish food. Thus, turbidity plays an important role in the behavior of phytoplankton in the study area. The two primary sources of particles in coastal waters are biogenic material (plankton or detritus) and suspended sediments.

Turbidity has been measured by the MWRA in its monitoring of Massachusetts Bay. Libby et al. (2004) evaluated turbidity to determine if particular material observed in the water column was phytoplankton or detritus and suspended sediments. Libby et al. (2004) observed elevated turbidity at harbor stations, with an inshore to offshore decrease in surface water attenuation. In general, the vertical and horizontal trends in turbidity in Massachusetts Bay depend on the input of particulate matter from terrestrial sources and the spatial and seasonal distribution of chlorophyll/plankton.

3.1.2.2 Dissolved Oxygen

The dissolved oxygen (DO) concentration of a water body indicates the capacity of the water body to support a balanced aquatic habitat. The propagation of fish and other aquatic animal life may be impaired and large mortalities may occur when DO concentrations are low. The state standard for Massachusetts Bay is set at 6.0 mg/L (Class SA criterion). EPA recommends an ambient DO concentration in cold water of 6.5 mg/L (30-day average), with a one-day minimum of 4.0 mg/L (EPA, 1986). Higher DO levels (9.5 mg/L – 7-day average and 8.0 mg/L – 1-day minimum) are recommended for early life stages.

The DO concentrations in Massachusetts Bay follow seasonal progressions in which the maximum concentrations occur in winter and decrease during the summer, reaching minimum levels just prior to the breakdown of stratification in the fall and the end of the winter/spring phytoplankton bloom (Libby et al., 2004). In 2003, maximum bottom water DO concentrations (11 mg/L) occurred in March at the offshore stations (Libby et al., 2004). Concentrations decreased throughout the summer and reached minimum levels in October (~7 mg/L), which were above the state and EPA standards.

Statistical analysis shows (Geyer et al., 2002) that bottom-water DO concentrations near the MWRA outfall are highly correlated with Stellwagen Basin and the northern Massachusetts Bay boundary, indicating that regional processes and advection are the primary factors governing bottom water DO concentrations in Massachusetts Bay. High-resolution time series of DO concentrations from the USGS mooring Site A, located near the Boston B Buoy, just southwest of the Project area, show large variations in DO concentrations over very short time scales in the spring and fall, which are probably indicative of vertical exchange and/or local biological processes.

3.1.2.3 Nutrients

Massachusetts Bay nutrient concentrations are highest in the winter when the water column is well mixed and decrease during the winter/spring phytoplankton bloom and with the onset of stratification (February to April) (Libby et al., 2004). In the summer, nutrients are generally depleted in surface waters, because of seasonal stratification of the water column (which prevents replenishment from deeper waters) and biological use. This stratification also leads to increasing nutrient concentrations with increasing water depth from increased respiration and remineralization of organic matter. Concentrations of nutrients in surface waters return to elevated levels following the fall bloom and the breakdown in water column stratification (NEG, 2005a; Libby et al, 2004).

Since the offshore MWRA outfall began discharging in September 2000, there has been a dramatic decrease in ammonium concentrations in Boston Harbor and an increase in ammonium concentrations within about 12.4 miles (20 kilometers) of the outfall in Massachusetts Bay (Libby et al., 2004). When the water column is well mixed, an ammonium signal from the effluent plume can be observed above the outfall where the plume reaches the surface. Under stratified conditions, the plume is contained below the pycnocline (the boundary between upper and lower stratified layers). The effluent nutrient signature is diluted to background levels over a few days and tens of kilometers. The MWRA outfall discharge has not affected ammonium concentrations at the offshore stations in Massachusetts Bay near the Project area (F16-F22), and the higher ammonium concentrations near the outfall have not caused significant increases in phytoplankton biomass (NEG, 2005a; Libby et al, 2004).

3.1.2.4 Chlorophyll-a

There are marked temporal and spatial variability in chlorophyll-a levels within Massachusetts Bay that occurs as the result of the spatial variability of available nutrients, and the temporal and spatial variability of other environmental parameters, such as water temperature, incident solar radiation, light transparency, and grazing pressure. Water temperature and solar radiation, two of the more important parameters that influence phytoplankton growth, have strong annual cycles.

The annual phytoplankton cycle in Massachusetts Bay is typically marked by winter/spring and fall blooms (Libby et al., 2004). Phytoplankton blooms occur in the winter/spring when nutrients and light are readily available. As the levels of available nutrients are consumed by phytoplankton, and grazing by zooplankton occurs, the phytoplankton populations decrease during the summer months. During the fall, another phytoplankton bloom occurs that coincides with decreased stratification of the water column, which replenishes oxygen and nutrients in the surface waters, and usually ends when light levels decline, thus limiting photosynthesis.

In 2003, a winter/spring (February) diatom bloom occurred that was most evident in Cape Cod Bay, Boston Harbor, and coastal and western nearfield stations (Libby et al., 2004). In addition, an extended Phaeocystis bloom occurred from February through April 2003 and was most prominent in northern Massachusetts Bay. These two substantial blooms caused elevated chlorophyll levels throughout the water column at nearfield and offshore areas. Chlorophyll concentrations measured at the offshore stations ranged from 2 micrograms per liter in February to ~5.5 micrograms per liter in April. Summer (June through August) chlorophyll concentrations were consistently low (~1 microgram per liter). A fall bloom also occurred over an extended period (late September into December), with chlorophyll concentrations measured at ~4 micrograms per liter at the offshore stations. Phytoplankton (1.0 to 2.3 million cells per liter) and productivity levels (<2,500 milligrams carbon per square meter per day) related with this bloom were relatively low compared to previous fall blooms.

3.1.2.5 Fecal Coliforms

MWRA performs monthly indicator bacteria surveys at the coastal stations and at a subset of the nearfield stations. In 2003, bacterial indicator concentrations at N04, the station closest to the proposed pipeline route, were undetected (<2 per 100 milliliter fecal coliform and <1 per 100 milliliters Enterococcus). These concentrations meet the EPA recommended criteria and state standard for unrestricted shellfishing (<14 fecal coliforms per 100 milliliters). Based on this information, it is unlikely that fecal pollution would be present in the water column at the proposed Project area.

3.1.2.6 Contaminants

As part of the MWRA outfall siting process, water chemistry sampling was conducted in April 1987 at two Massachusetts Bay locations (Wade et al., 1987). Concentrations of metals (arsenic, cadmium, chromium, copper, mercury, nickel, lead, vanadium, zinc) and poly aromatic hydrocarbons (PAHs) were measured as dissolved and particulate fractions at discrete depths in the water column. Particulate total PAH concentrations ranged from less than the detection limit to 0.74 mg/L and were dominated by PAHs characteristic of combustion sources. Concentrations of dissolved total PAHs ranged from 0.018 to 0.204 mg/L, with 60 to 70 percent of the PAHs being contributed by a fossil fuel source. Urban runoff appears to be the dominant source of dissolved PAHs in Massachusetts Bay, while atmospheric deposition and urban runoff of combusted PAHs largely influence the distribution of particulate PAHs in Massachusetts Bay (NEG, 2005a). Measured concentrations of dissolved metals were generally two to three orders of magnitude lower than the National Recommended Water Quality Criteria for Priority Toxic Pollutants (EPA, 1999). The only exception was mercury, which exceeded the water quality criteria of 1.8 mg/L in 11 of 16 samples.

Sediment sampling was conducted along portions of the HubLine route in November 2001 to determine the nature of the sediments located within a discontinued dumping site whose inshore boundary crosses the HubLine between MP 7.0 and MP 9.5. The proposed NEG Pipeline Lateral would cross this same discontinued disposal area between MP 0.0 and MP 2.8. Algonquin did not identify any contaminants of concern within this area. No information is available that specifies how or when this site was used, although the site coordinates appear on a list of historic dredged material disposal sites obtained from the Disposal Area Monitoring System (DAMOS) program. Considering that the Regulatory Branch of the New England District, ACOE has summarized all its available documentation of disposal sites used since 1970 and there is no mention of this site, it is unlikely that it has been used for disposal for at least 30 years. Based on the ACOE's historical practice of using multiple nearshore locations for disposal of harbor dredged material, dredged material from harbors in the Lynn to Salem area may have been placed at this site.

During the sampling program for the HubLine, vibracores were obtained to Project depth at 0.25-mile intervals between MP 7.0 and MP 9.5. Sediments along the area exhibited a high sand content in all samples to proposed project depth and had the visual appearance of a natural bottom with no observable material of anthropogenic origin (Algonquin, 2005). The organic and heavy metal chemical content of this material was low (Category 1A), with the exception of Category 2A arsenic in site-specific samples near MP 9.5 (Algonquin, 2005).

3.2 BIOLOGICAL RESOURCES

3.2.1 Benthic and Shellfish Resources

Benthic resources include marine vegetation, macrofauna, and shellfish. Two of these, macrofauna and shellfish, occur in the project area, and are discussed in this section. Benthic marine vegetation (macroalgae and seagrass) does not exist in the project area because light levels at depth are not adequate to support vegetative growth.

The description of benthic and shellfish resources in the project area is based largely on extensive site-specific surveys that were conducted during winter/spring 2004/2005, with supplemental surveys done in summer/fall 2005. The surveys included the following:

Benthic grab samples for infauna, grain size and total organic carbon (TOC) analysis initial survey done during December 2004 and January 2005, supplemental survey of areas within the MBDS in May and June, 2005;

Sediment Profile Imagery (SPI) for rapid assessment of physical, biological, and chemical conditions at the seafloor, done between early January and mid-February 2005; and

ROV video for imaging physical structure, benthic communities, and species, including mobile organisms at or near the seafloor, completed between late January, 2005 and mid-February, 2005 for the area from MP 0 to MP 12.5, on April 1, 2005 for the area from MP 12.5 to MP 14.5, and August 11, 2005 for the area from MP 14.5 to the end (MP 16.06)

The survey area is shown in see Figures 3-3 and 3-4[1]. The site-specific survey data were supplemented with information from a variety of other sources including a Stellwagen Basin benthic survey done in support of siting of the Massachusetts Bay Disposal Site (MBDS) (SAIC, 1987; Hubbard et al., 1988) and a benthic survey done in conjunction with designation of the Stellwagen Bank National Marine Sanctuary (SBNMS) (U.S. DOC, 1991).

[1] A full description of data from these surveys is available in the Appendices to the NEG Deepwater Port FERC Section 7 Application and the NEG Pipeline Lateral Environmental Report accompanying the Application (June 2005).

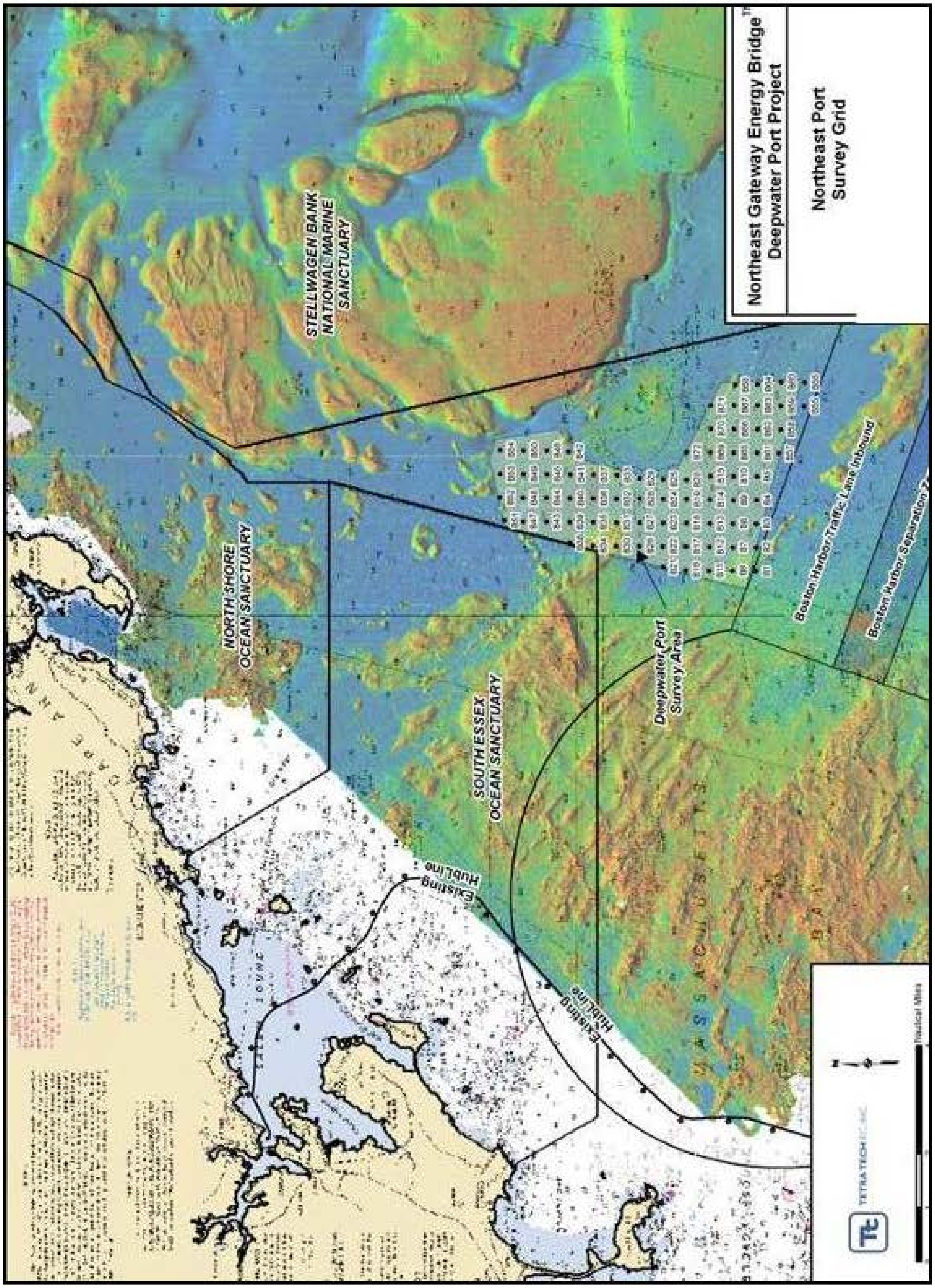

Figure 3-3. NEG Port Benthic Survey Grid

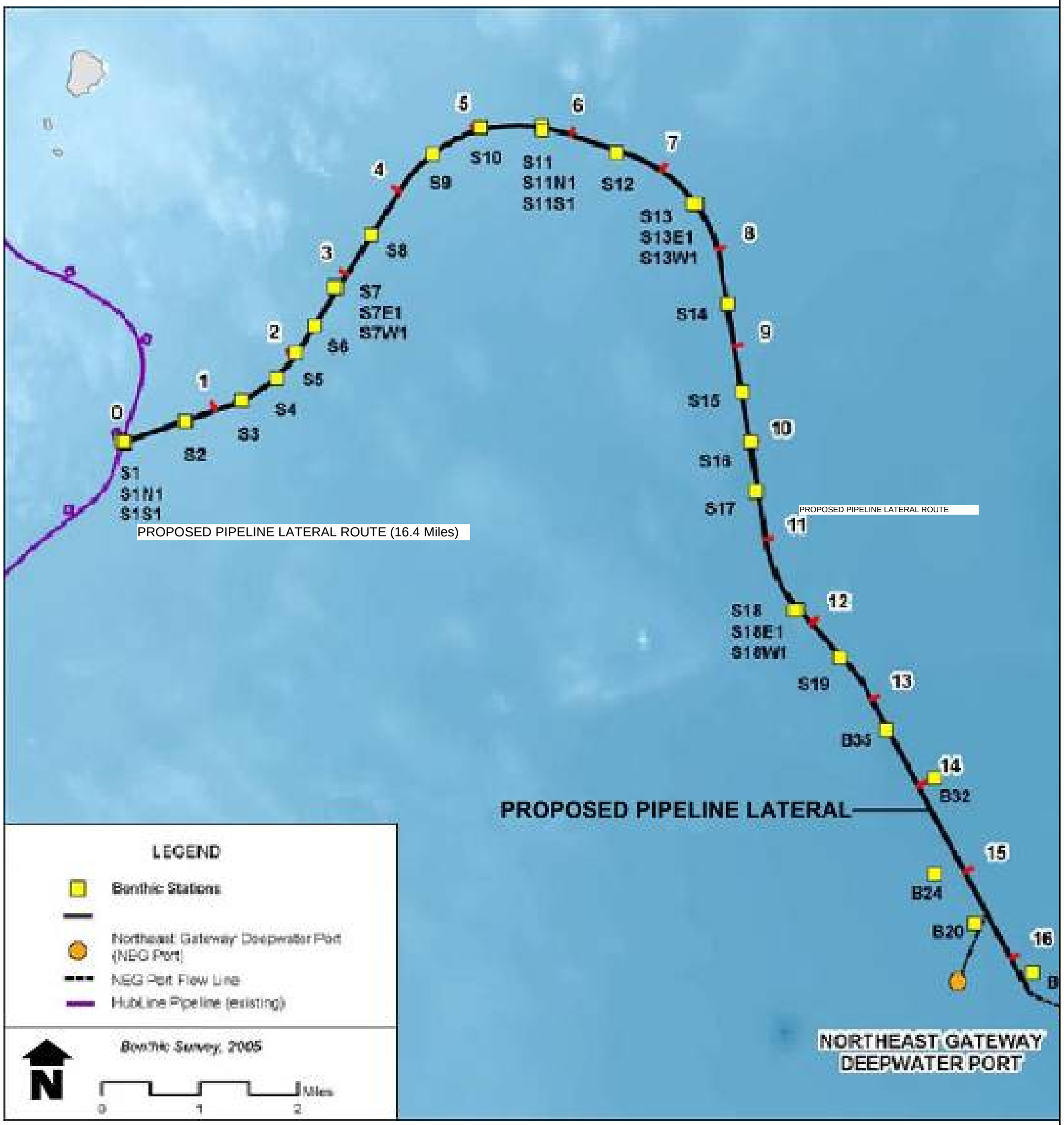

Figure 3-4. Benthic Survey Stations

3.2.1.1 Benthic Resources

NEG Port Area

Results from the 2004/2005 surveys provide a comprehensive picture of the soft-substrate habitat and the faunal communities that characterize them for each portion of the Project area.

Grab samples, SPI and ROV surveys show a well-developed benthic community on soft bottom sediments throughout most of the Port area. Surface (< 6 inches [15 centimeters]) sediment samples collected at 35 locations within the Buoy Survey Area (Figure 3-5) showed grain size at most stations averaging >95 percent silt-clay (Table 3-1).

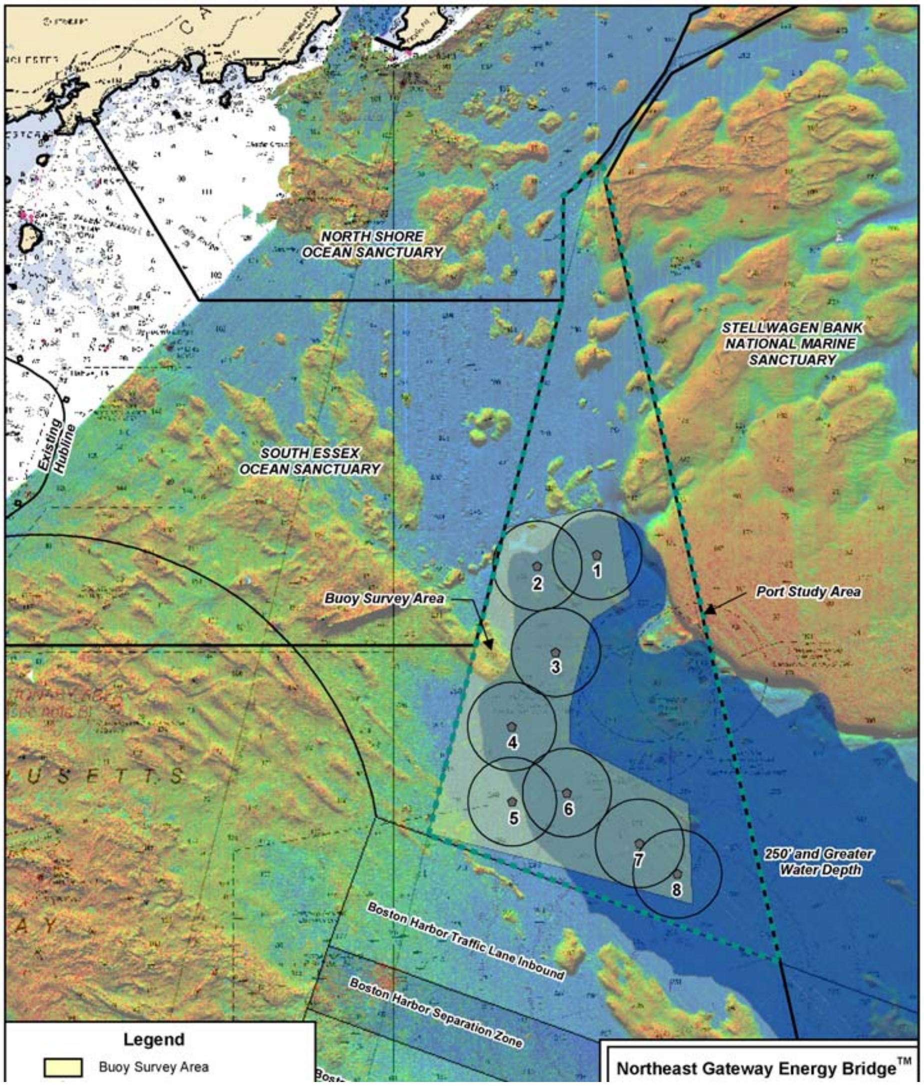

Figure 3-5. NEG Port Buoy Survey Area

Table 3-1

Average Grain Size and Total Organic Carbon Characteristics in the Buoy Areas

Buoy Area	All Samples Silt/Clay (%)	TOC (%)	Without Outliers Silt/Clay (%)	TOC (%)
1	95.44	2.17		
2	96.00	2.05		
3	95.85	2.32		
4	96.78	2.15		
5	93.37	2.36	97.65	2.40
6	98.10	2.17		
7	91.90	1.69	97.58	1.80

Note: Buoy areas are shown on Figure 3-5.

Total Organic Carbon (TOC) averaged slightly above 2 percent in most areas. These values are somewhat lower than observed by SAIC (1987) for the MBDS (2.70-3.05 percent) and mud reference site (2.67 percent; located to the southeast of the MBDS). Blake et al., (1993) noted a direct relationship between sediment grain size (percent fines [silt/clay]) and TOC in the vicinity of the MWRA outfall. Data from the buoy areas are consistent with that pattern.

Results from the SPI survey also showed sediments to be primarily fine sand-silt-clay. Sediments at one station (B34) located on the western boundary of the survey area near an apparent bathymetric high were cobbly, although the cobbles were covered with a heavy drape of fine sediment and animal tubes. Surface conditions at most stations were dominated by biogenic, rather than physical processes and all stations showed signs of infaunal organisms.

The benthic infaunal community is relatively homogeneous in the Port area. The mud bottom supports a polychaete-dominated infauna with relatively high abundance (ranging from 17,000 to 23,500 individuals per square meter, Table 3-2) and species richness (84 to 106 unique taxa within each area). Differences in species richness among the buoy areas are likely related to the differing number of stations representing each area. This is because there are numerous taxa with low abundances in the area. Most stations yielded 40 to 50 taxa per sample, but in each buoy area, 22-25 taxa comprise $\geq$ 85 percent of the total abundance.

In each buoy area, one or two taxa contribute a substantial portion (10 to 17 percent) of the total abundance. The ampharetid polychaete *Anobothrus gracilis* and the cirratulid polychaete *Chaetozone setosa* dominate in all three buoy areas of interest. Oligochaetes and the polychaetes *Aricidea quadrilobata* share dominance in area 7, and oligochaetes are also numerically important in area 6. In each area, 22 or more taxa represent at least 1 percent of the total abundance. Included among those taxa are several molluscan taxa. The rarer taxa comprise numerous arthropods, echinoderms, and other phylogenetic groups. These include maldanid and lumbrinerid polychaetes that burrow more deeply into the substrate and are considered to be indicators of a stable benthic community. In contrast, the dominant taxa are primarily oriented near the sediment surface. Dominant polychaetes include a number of different feeding types. Surface deposit feeders (*Anobothrus, Aphelochaeta, Aricidea, Chaetozone, Galathowenia, Levinsenia, Prionospio, Spio,* and *Terebellides*), subsurface deposit feeders (*Cossura, Dorvillea, Eteone,* Euclymeninae, *Heteromastus, Ninoe,* and *Sternaspis*), and carnivores (*Nephtys, Paramphinome,* and *Syllides*) (after Fauchald and Jumars 1979) were all found at the site. These findings provide another indicator of a balanced community. Table 3-2 shows the dominant species in each of the three buoy areas, as well as those found in the MBDS study area.

Results and conclusions from the infaunal analysis (i.e. that there exists a well-developed benthic community in the study area) were supported by the Applicant's SPI assessment. Coloration of the sediments, an indication of oxidation, indicates high levels of subsurface biological activity.

Within the three buoy areas of interest, all benthic grab stations analyzed were classified as Stage III, the equilibrium community stage (Rhoads and Germano, 1986). Stage III species include large tube-building species, head-down deposit feeding polychaetes, and large infauna. These organisms often burrow 3 to 5 centimeters below the sediment surface, actively mixing the sediments and providing a mechanism by which oxygen reaches subsurface sediments. Surface and subsurface conditions exhibited a high degree of bioturbation, consistent with Stage III fauna.

Table 3-2

Percent Composition of Dominant Taxa

(> 1% of Mean Abundance)

Taxon	Buoy Area 7	Buoy Area 6	Buoy Area 5	MBDS
Oligochaeta	11.2	10.5	4.6	a/
Anobothrus gracilis	10.0	13.5	17.2	a/
Aphelochaeta marioni	7.3	7.8	5.7	
Aricidea quadrilobata	11.1	7.6	5.0	a/
Chaetozone setosa	10.0	10.4	9.6	a/
Cossura longicirrata	2.8	2.6	2.2	a/
Euclymeninae	1.2	2.1	3.4	
Galathowenia oculata	1.5	1.9	2.4	a/
Heteromastus filiformis	1.8	2.0		a/
Levinsenia gracilis	3.3	2.9	1.5	a/
Nephtys incisa		1.6	1.3	a/
Ninoe nigripes	1.8	2.1	1.7	a/
Paramphinome jeffreysii	1.4	2.4	2.4	
Prionospio steenstrupi	2.7	3.8	3.5	a/
Spio limicola	4.5	4.8	5.0	a/
Sternaspis scutata			2.4	a/
Syllides longocirrata	1.7	1.1		
Terebellides sp.			1.4	
Bathymedon obtusifrons		1.1		
Crenella decussata			1.4	
Nucula tenuis	1.4	2.2	2.1	a/
Yoldia sapotilla	1.8	1.8	3.0	
Periploma papyratum	1.3	2.0	2.4	
Thyasira gouldii	4.1	3.0	3.3	a/
Onoba pelagica	1.5	1.1	2.0	
Emplectonematidae	1.0		1.1	
Tubulanus sp.	1.7		1.0	
Dentalium entale			1.2	
Cumulative Percent	85.1	88.3	86.8	
Mean abundance (no./m^2)	23,500	17,175	20,675	
Total No. of Taxa	106	84	103	
No. of Taxa $\geq$ 1%	22	22	25	

a/ dominant species (or closely related species) during MBDS site designation survey.

While few epifaunal organisms were actually observed in the ROV survey, the 2004/2005 site specific surveys show evidence of biological activity in the form of burrows, tracks, and trails that confirmed the interpretation of the SPI photographs. Burrows and slash-like tracks in the sediment suggest crustaceans, fish, gastropods and decapods. Evidence of species including flounders, starfish and snails was found. Organism Sediment Index (OSI) is used to characterize soft-bottom habitats. OSI values greater than 6 are considered to be indicators of good habitat conditions, representing substrates that are not heavily influenced by either physical or anthropogenic stresses (Rhoads and Germano, 1986). The stations within the three buoy areas all were rated with an OSI value of 11.

A comparison of the results of site-specific surveys with observations from the MBDS siting study (Hubbard et al., 1988)[2] shows similarities in the relatively abundant species, but differences in organism abundance and community structure. SPI from the MBDS study showed a stable benthic habitat characterized by head-down deposit feeders. Total abundance was about 4,300 individuals per square meter (SAIC, 1987), substantially lower than the abundances observed in the Buoy Survey Area (~25,000 individuals per square meter), although the number of species per sample was similar between the two surveys. In 1985-1986, the benthic community was dominated by annelids (about 90 percent of total abundance), with the most abundant species being *Levensenia (Paraonis) gracilis* (accounting for 20 to 38 percent), a small deposit feeder. Differences can be attributed to temporal and spatial variability and sample size.

In support of the MBDS study, a Benthic Resource Assessment Technique (BRAT) was performed (SAIC, 1987) in order to assess the value of the benthic infaunal community to finfish resources. This type of analysis includes looking at stomach contents from locally-caught fish species to evaluate the food value of benthic prey species in the area. The SAIC (1987) study can be used to assess the potential value of the Project area benthos as forage for certain fish. SAIC (1987) found that Hakes were feeding exclusively on pandalid shrimp, a species that cannot be effectively sampled with benthic grabs. American plaice fed primarily on echinoderms, a relatively small component of the community observed in the Project area. Witch flounder preyed mostly on polychaetes, including *Chaetozone*, *Spio*, *Sternaspis*, and *Tharyx*, three of which currently rank among the dominants in the Project area. The prey items of Atlantic cod included benthic amphipods, polychaetes, and other crustaceans. The Project area surveys showed several species of amphipods and other crustaceans in the project area, but they were not particularly numerous. SAIC (1987) also found that food availability (biomass) was somewhat elevated on dredged material, where the prey was concentrated near the substrate surface, compared to natural bottom, where the prey was slightly deeper in the sediment. Because the benthic community structure observed in the buoy area survey is similar to that during the MBDS site designation survey, it is likely that the buoy area would provide a similar value for demersally feeding fish as found at the MBDS.

NEG Pipeline Lateral Corridor

Descriptions of faunal communities present in the sediments within the NEG proposed pipeline corridor area are based on grab samples, SPI and ROV surveys. Data was collected primarily along the centerline of the pipeline and at certain Pipeline Lateral stations extending 100, 200, and 400 feet (30, 61, and 122 meters) perpendicular from the centerline.

Water depth and sediment structure were found to be important in shaping the benthic communities. Two rather dissimilar communities were found, with water depth the primary factor related to the differences in the faunal communities, and sediment texture secondarily related. Water depths range from approximately 135 feet to 290 feet (41 meters to 88 meters) proceeding west to east along the pipeline route. Sediment texture along the pipeline corridor is predominantly coarse (>75 percent sand + gravel) in the shallower portion, medium texture (~60:40 percent coarse: fine) approaching the middle section, and mostly fine (>70 percent silt + clay) along the deeper portion. In the deepest portion of the pipeline route, within about three miles of the proposed Port, sediments were very fine, with 95 percent to 99 percent silt + clay, as was seen at the Port area. These observations were confirmed by SPI analyses that showed

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[2] The MBDS siting study was done in 1985 and 1986 at Mud Reference Site (42°24.686’, 70°32.814’) southeast of the MBDS.

predominantly fine and medium sands in the shallower reaches of the Pipeline Lateral corridor and very fine sand and fine-sand-silt-clay in the deeper portions (Diaz and Battelle, 2005). The SPI also showed bedforms at about one-third of the stations, most located in water depths shallower than about 150 feet.

The TOC of the sediment along the Pipeline Lateral ranged from 0.2 percent to 2.4 percent (dry weight) and showed a strong negative correlation (Pearson $r = -0.79$, $p < 0.01$) with the coarse sediment fraction. The pattern of increasing TOC content with increasing depth reflects the transition from a physically dominated shallower part of the Pipeline corridor to the route's deeper, more depositional portion.

ROV images showed heavily rippled, coarse sand at shallower depths and faintly rippled, fine-silty sand at deeper depths. Physical and biological/physical processes primarily contributed to sedimentary structural features in the shallower reaches of the Pipeline Lateral corridor (MP 0 to 6), with physical processes predominant at the two shallowest stations (MP 0 to 1). In deeper areas of the Pipeline Lateral corridor, biological and biological/physical processes predominated. Sediment structure in the deepest portion of the Pipeline Lateral corridor (depths > 270 feet [82 meters]; about MP 13 to MP 16) was primarily affected by biological processes.

SPI provides an estimate of the apparent color redox potential discontinuity (RPD) layer depth, which is an estimate of the depth at which the sediment geochemical processes change from being primarily oxidative to being primarily anaerobic or reducing (Diaz and Battelle, 2005). Generally, deeper RPD depths are associated with higher habitat quality (Rhoads and Germano, 1986). Most stations along the Pipeline Lateral corridor had RPD values that exceeded 4 centimeters (Diaz and Battelle, 2005), indicating that sediments were well-oxygenated. Additionally, sediments below the RPD layer were relatively light gray in color indicating that intense reducing or sulfitic (dark gray-blue in color) sediments did not occur at any of the Pipeline Lateral stations.

Marks made by fishing gear were seen between MP 8 and MP 14.3. These marks usually consisted of gouges or furrows in the seafloor that had been smoothed over and were frequently overlain by faint ripples. The seafloor from MP 12.5 to MP 14.3 was predominantly structured by fishing activity, with some areas heavily gouged. In contrast, the seafloor between MP 12.5 and MP 16.4 was mainly structured by biological activity, and only rarely bore the imprint of fishing gear. The seafloor in this region consisted of a gentle hummocky, silty sediment that was marked by many fish and crab burrows, invertebrate and fish trails and tracks, and occasional craters created by benthic fish.

Shell debris, primarily from the ocean quahog (*Arctica islandica*), was more common in shallow waters than in deeper waters. Features attributable to biological activities, such as large excavations and large depressions caused by the activities of larger crustaceans and fish, were more noticeable in ROV images collected from deeper regions of the Pipeline Lateral corridor.

Statistical analyses of sediment grab samples showed two clearly distinguishable infaunal communities, and one outlier station in the sediments found along the pipeline route (TRC and Battelle, 2005a). Sediment types ranged from fine-grained silt and clay at the deeper stations to coarse and very coarse sand and gravel at the shallower and outlier stations. Total organic carbon ranged from moderately low at the deeper stations to very low at the shallower and outlier stations. Similarity (using the Bray-Curtis similarity index) between the three station groups was relatively low, with 37% similarity between the outlier and other two main infaunal stations, and 47% similarity between the two main infaunal stations. Species diversity was moderately high for Massachusetts Bay samples ranging from 13,600 at the outlier stations to 25,000 at the shallower stations (Table 3-3).

Table 3-3

General Description of Sediment Grab Samples at Outlier, Shallow, and Deep Stations from the NEG Project Area in Massachusetts Bay

Infaunal Station	MP	Depth (m)	Sediment	TOC (%)	Infaunal community (per sq. m)	Number of species
Outlier	Just before 1	43	v. coarse 90% sand & gravel	v. low 0.2	13,600	57
Shallow	0-6	41-51	Coarse 63% sand & gravel	v. low 0.5	25,000	66
Deep	7-16	54-88	Fine 85% silt & clay	mod. Low 1.4	19,600	51

Although in different order of importance, the top four dominant species *Anobothrus gracilis, Prionospio steenstrupi, Aricidea quadrilobata*, and *Spio limicola* were found at both the shallow and deep stations (Table 3-4). These characteristic fauna of the shallower and deeper pipeline route stations are similar to those typically found at one of the deeper MWRA stations, (station FF14), located about 2.6 miles (4.2 kilometers) southwest of grab sample Station 19 (about MP 12, Kropp et al., 2002; Maciolek et al., 2003).

Table 3-4

Dominant, Secondarily Important Species, and Distinguishable Benthic Species from Grab Samples at Outlier, Shallow, and Deep Stations in NEG Project Area

Infaunal Station	Top 4 dominant species (In descending order)	Percent Abundance	Secondarily Important species	Distinguishable species	% abundance
Outlier	*Exogone verugera* *Tharyx acutus* *Dipolydora socialis* *Owenia fusiformis*	42		Eudorella pusilla Phascolion strombi Astarte undata	16
Shallow	*Prionospio steenstrupi* *Spio limicola* *Anobothrus gracilis* *Aricidea quadrilobata*	44	*Thyasira gouldii* *Nucula tenuis* *Periploma papyratium* *Tharyx acutus* *Owenia fusiformis* *Aricidea catherinae*	Nucula tenuis Thyasira gouldii	11
Deep	*Anobothrus gracilis* *Prionospio steenstrupi* *Aricidea quadrilobata* *Spio limicola*	46	*Oligochaeta* *Spio thulini* *Galathowenia oculata* *Chaetozone setosa* *Alvania pseudoareolata* *Modiolus modiolus*	Nucula tenuis Thyasira gouldii	6

The two main infaunal communities (shallow and deep) were distinguished primarily by differences in the relative contributions of the four predominant polychaetes and in the secondary taxa that characterized them (see Table 3-4). Secondarily-important species within the shallower community were among those often found at coarse-sediment areas of Massachusetts Bay (Kropp et al., 2002; Maciolek et al., 2003). Small peracarid crustaceans were curiously lacking in numerical importance within either community. At shallower, sandy Massachusetts Bay stations sampled for the MWRA program, ranging from about 5 to 8 miles (465 kilometers) south to southwest of Station 1 (MP 0), crustaceans, such as *Crassicorophium crassicorne* and *Unciola inermis*, can be abundant periodically (Kropp et al., 2002; Maciolek et al., 2003).

SPI data showed that the sediments in the Pipeline Lateral region are highly bioturbated (i.e., well mixed by infaunal animals), with many surface feeding pits and mounds, and subsurface burrows and feeding voids. Larger infauna were occasionally seen. These observations indicate that, as was seen in the Port area, the infaunal communities in the region are predominantly comprised of fauna typical of successional stage III, the equilibrium community stage (Rhoads and Germano 1986). The deepest stations along the Pipeline Lateral (MP 13 to MP 16) also showed successional stage III faunal communities, although one station (near MP 15) also showed some evidence of pioneering Stage I fauna.

ROV images are particularly useful in capturing information about the larger or more motile surface-dwelling fauna than either of the other two sampling methods. The visible macrofauna changed gradually along the Pipeline corridor. Most of the species observed were found along the entire route, but their relative abundance varied with depth and substrate type. Invertebrates commonly seen in the rippled sand between grab sample Stations 1 and 3 (about MP 0 to 1) were sand dollars (*Echinarachnius parma*) and sea stars (*Leptasterias tenera* and *Asterias vulgaris*). Invertebrates commonly seen in the slightly siltier sand found between grab sample Stations 2 and 9 (about MP 1 to 4) included: burrowing cerianthid (*Cerianthus borealis*) and mud anemones (*Edwardsia elegans*), sea scallops (*Placopecten magellanicus*), and Cancer (*Cancer irroratus* and *C. borealis*) crabs. Sand shrimp (*Crangon septemspinosa*) were the most common invertebrates seen in the siltier areas found between grab sample Stations 10 and 19 (about MP 5 to 12). Sand shrimp (*Crangon septemspinosa*) and mud sea stars (*Ctenodiscus crispatus*) were the most abundant invertebrates encountered toward the Port end of the Pipeline Lateral, from MP 12.5 to MP 16.4. Sand shrimp were most abundant in the area impacted by fishing gear, where they were frequently near or on top of topographic highs. Other invertebrates encountered included a few scallops (*Placopecten magellanicus*), some Cancer crabs, one lobster (*Homarus americanus*), some cepahlopods, a few pandalid shrimp, and several unidentified sea stars and gastropods. Information on other benthic invertebrates (i.e., lobster and scallops) is included in section 3.2.1.2.

In summary, surveys of the Project area indicate that the shallower portions of the Pipeline corridor are dominated by physical processes (including higher currents and the effects of storm-generated waves), and deeper portions of the Pipeline corridor were more quiescent and dominated more by biological processes, such as bioturbation.

<u>Anchor Corridor</u>

The anchor corridor can be characterized by using the benthic data collected directly along the proposed Pipeline corridor, with some stations located as far as 400 feet (122 meters) to the side of the route. However, the environmental setting within the anchor corridor must be described by assuming that the faunal residents there would be very comparable to that located in similar substrates along the main pipeline route. Within the anchor corridor, soft sediments predominate, comprising about 86 percent of the total corridor area of about 13,300 acres (5,382 hectares). Along the shallowest part of the Pipeline Lateral (136 to 161 feet; 41 to 49 meters; MP 0 to MP 5), soft-bottom habitat comprises about 82 percent (about 3,551 acres; 1,437 hectares) of the available habitat. Infaunal communities in this part of the anchor corridor are likely to be very similar to that described above as the shallow community, except that any sandier substrates might house communities more similar to the outlier community described above for the area near MP 1. Along the middle portion of the corridor (154 to 233 feet; 47 to 71 meters; MP 5 to MP 10), soft substrates occupy about 90 percent (about 3,269 acres; 1,323 hectares) of the habitat area in the anchor corridor. The infaunal communities inhabiting soft substrates along this portion of the Pipeline Lateral are likely to be similar to that described above as the deeper community, not including that found among the deepest stations near the end of the pipeline route. Substrates in the anchor corridor between MP 10 and MP 16 (233 to 289 feet [71 to 88 meters] deep) consists mainly of fine sediments, with those near the deepest section (about MP 13 to MP 16) having a silt and clay fraction that exceeded 94 percent. Infaunal communities in this part of the anchor corridor should also be similar to that described above as the deeper community, especially those located near the end of the Pipeline Lateral.

Hard-bottom habitat in the shallowest region of the anchor corridor (MP 0 to MP 5) comprises about 18 percent of the available habitat (775 acres; 314 hectares). Most of this habitat consists of relatively large patches located between MP 1 and MP 3 on both sides of the pipeline route. Many smaller patches are located along the outer boundary of the anchor corridor between MP 3 and MP 5. Along the middle section of the anchor corridor (MP 5 to MP 10), hard-bottom habitat accounts for about 10 percent (354 acres; 143 hectares) of the area. Most of this is located near the outer boundaries of the anchor corridor on both sides of the pipeline route in the vicinity of MP 6 and MP 7. Smaller, more-scattered patches of hard bottom occur between MP 8 and MP 9. Along the eastern third of the pipeline route (MP 10 to MP 16), hard-bottom habitat occupies about 14 percent (741 acres; 300 hectares) of the area. One large area of hard bottom occupies about half of the area on the right side of the pipeline route between MP 10 and MP 11. Scattered patches of hard bottom are found on either side of the pipeline route in the vicinity of MP 12, with some patches very close to the pipeline. Another large hard-bottom region occupies about half of the area on the right side of the anchor corridor from about MP 13 to MP 14. Between MP 14 and MP 16, several smaller patches of hard bottom occur, with some being located directly on the proposed pipeline route.

Two areas of hard substrate, likely debris intended for the MBDS, were observed during the initial ROV survey along the Pipeline corridor at MP 15.15 and MP 15.5 at depths of about 270 feet (82 meters). The original Port location and pipeline lateral route were shifted slightly to avoid this material (see section 2.3.3 for details on the shift). Benthic communities in the new pipeline lateral route were characterized with grab samples from stations at about MP 14.9 and 15.4, which are closer to the newly proposed pipeline route than the original route. In addition samples collected at four stations slightly offset from the original route are close to the new route. Bray - Curtis similarity analysis indicated that these latter stations, and one station located at about MP 13.4 show high similarity. Therefore the benthic community along the revised route is considered to be virtually the same as that originally described in the deeper section of the pipeline lateral.

The fauna residing on any hard substrate along the pipeline lateral varies substantially by location and depth, and by the amount of sediment drape covering the rocks. Several species of sponges may occur along the Pipeline Lateral including *Polymastia* sp. (an unidentified sponge that is encrusting with raised areas), *Suberites ficus* (observed near MP 15), *Haliclona oculata* (finger sponge), and *Halichondria panacea* (breadcrumb sponge) (Barbara Hecker, unpublished information, personal communication with Algonquin’s consultants). Hydrozoans and upright bryozoans may occur at all depths, with hydroids often locally abundant. Sea anemones (*Metridium*, *Urticina*, and *Actinauge*) are likely to be found, but would become sparse as depth increases. Colonial and/or solitary tunicates may occur, but are not likely to be abundant. Motile fauna may include several species of sea stars including sun stars (*Crossaster papposus* and *Solaster endeca*), badge star (*Porania*), horse star (*Hippasterias phrygiana*), blood star (*Henricia sanguinolenta*), and slender-armed star (*Leptasterias tenera*) (Barbara Hecker, unpublished information, personal communication with Algonquin’s consultants).

In summary, all collected data showed good habitat quality along the Pipeline Lateral with little evidence of anthropogenic impacts, except for fish trawl scars between MP 8 and 12.5.

3.2.1.2 Shellfish

Shellfish species include crustaceans, mollusks, and echinoderms. Shellfish could occur in any portion of the Project area. Therefore they are described as occurring in the Project area, not separated out by Port and Pipeline Lateral. Where information exists suggesting certain species may be more abundant in a particular area, this is noted.

Shellfish that may occur in the Project area are listed in Table 3-5. Hubbard et al., (1988) reported a variety of crustacean shellfish occurring in the vicinity of the MBDS including American lobster (*Homarus americanus*), rock crab (*Cancer irroratus*), Jonah crab (*Cancer borealis*), red crab (*Geryon quinquedens*), and northern shrimp (*Pandalus borealis*). The same study showed molluscan shellfish including short-fin squid (*Ilex illecebrosus*), long-fin squid (*Loligo pealei*), sea scallops (*Placopecten magellanicus*), and ocean quahog (*Arctica islandica*). The winter 2005 ROV survey of the Project area provides some qualitative site-specific information regarding shellfish species. Lobsters, Cancer crabs, and northern shrimp were observed in the ROV survey of the buoy area. These species, along with sea scallops, were also observed in the ROV survey along the Pipeline Lateral. Because the videos, by necessity, cover only a small fraction of the Buoy Survey Area, absence of a particular species cannot be interpreted to mean the species does not occur in the area.

Table 3-5

Shellfish Species Potentially Occurring in the Vicinity of NEG Port and Pipeline Lateral

Species	Buoy	Pipeline Lateral
Crustaceans		
Lobster	observed, potentially abundant	observed, potentially abundant
Cancer sp. crabs	observed, potentially abundant	observed, potentially abundant
Deep sea red crabs	rare	rare
Northern shrimp	observed, potentially abundant	observed, potentially abundant in eastern end
Mollusks		
Sea scallops	unlikely, absence of suitable substrate	observed, areas of suitable habitat
Ocean quahogs	potential habitat	observed, areas of suitable habitat
Softshell clams	observed	mapped habitat
Short-fin squid	rare	rare
Long-fin squid	potentially abundant	potentially abundant
Echinoderms		
Green sea urchin	unlikely, absence of suitable habitat	unlikely, suitable habitat limited to portion of construction anchor corridor

Crustacean Shellfish

American Lobster (Homarus americanus)

American lobsters occur throughout Massachusetts Bay on virtually any type of substrate. Although juvenile and adult lobsters prefer shelter such as that available where there is a sand, gravel, or bedrock base with a rock overlay (Cooper and Uzmann, 1980), they are also common on soft substrates. On the soft substrates that occur in the Project area, they can either excavate burrows if the substrate is cohesive enough or make shallow depressions to provide some shelter. They forage opportunistically, feeding on a variety of living or dead invertebrates and vertebrates. While molting and growing a new carapace, lobsters are largely immobile and vulnerable and they typically take refuge in burrows or rocky crevices. After several hours, the new shell begins to harden. This is a critical period because mating takes place while the female's new shell is hardening. This soft-shell phase generally occurs during the summer months.

Lobsters produce free-swimming larvae that are phototactic and usually found near the water surface during the day (upper 1 meter) and at greater depth at night although in offshore waters, the larvae may occur throughout the upper mixed layer above the thermocline. Further detail on larval behavior is provided in section 3.2.2.2 (zooplankton). Lobster larvae are often concentrated in the areas of oceanographic fronts, and could potentially be found along the front caused by the upwelling along the edges of Stellwagen Bank. Lobster larvae are susceptible to limited entrainment. Analysis of lobster larvae entrainment and adult equivalent loss is presented in section 4.1.2.2 and Appendix E, Entrainment Modeling.

Older larvae (Stage IV, or postlarvae) settle to the bottom and actively select habitat for benthic life. They exhibit "bottom-testing" behavior where they swim to the bottom and alternately ascend from and descend to the substrate (Cobb et al., 1989). After several days of bottom-testing behavior, they would actively seek a preferred habitat. Newly settled, or early benthic phase (EBP), larvae seek complex habitat that provides shelter, preferably cobble beds (Palma et al., 1998). Descent through the water column is strongly influenced by the presence of thermoclines. A difference of 5 °C is sufficient to significantly reduce the likelihood of EBP larvae settling to the bottom (Boudreau et al., 1992). Several researchers (Lavalli and Kropp, 1998; Wahle and Steneck, 1991; Wilson and Steneck, unpublished data) have found that lobster settlement occurs primarily in shallow water (preferentially in depths of 33 feet or less), such as on the submarine banks and in nearshore waters.

Lobsters can migrate great distances, with migrations of up to 214 miles (344 kilometers) in 71 days being reported (Uzmann et al., 1977). An estimated 30 to 50 percent of the offshore lobster population moves from the outer shelf and upper slope to shallow water to molt, mate, and extrude eggs (MacKenzie and Moring, 1985; Cobb and Phillips, 1980). These lobsters live inshore during spring and summer; then return to deeper waters in fall and winter. Seasonal migrations are done to maintain optimal temperatures for molting and egg incubation. Data from the Lobster Conservancy (Diane Cowan personal communication, December 2005) indicates that females with eggs commonly move over 20km during a season. Anecdotal evidence from local fishermen indicates that lobsters travel through Stellwagen Basin during their migrations, following boundaries created by the hard bottom features to the west and Stellwagen Bank to the east. This is supported by preliminary tagging work done by MDMF during fall 2005. The MDMF study involved tagging 387 lobsters inshore areas of Massachusetts Bay in early October, with recapture of 26 in late October and November. Preliminary data analysis shows a general west to east movement, with four of the recaptures found in the Stellwagen Bank area, showing rapid movement to deeper water.

MDMF personnel suggest the most likely time for lobsters to be moving through the project area would be when water temperatures at depth approach 10 °C; that is, the inshore migration is most likely in late spring to early summer, and offshore migration in late fall (Bob Glenn, personal communication January 4, 2006).

Winter 2005 ROV surveys showed evidence of lobsters in the Project area. While very few lobsters were actually seen on ROV images, large, deep excavations or burrows could be seen in the deeper portions of the Project area. These were likely made by lobsters or other large organisms such as cancer crabs or fish. In Port areas A and B, the 800-foot (267-meter) long ROV transects yielded from 0 to 5 depressions and 5 to 17 burrows. The width of each transect averaged 3 feet (~1 meter). On average, there were 0.008 depressions per m^2 (32/acre) and about 0.045 burrows per m^2 (182/acre). If the conservative assumption that each depression and burrow supports a lobster is made, there may be as many as 215 lobsters per acre in the Port area in winter. For comparison, the state of Maine uses a criterion of 0.1 lobster per m^2 (400+/acre) as indicative of important lobster resource.

Along the pipeline, burrows were small and relatively scarce at the shallower end of the route and gradually became larger and more numerous toward the deeper end of the route. It is likely that the burrows at the shallower end were formed by small invertebrates, not lobsters. Burrows likely to have been created by lobsters were increasingly abundant with increasing depth.

In summary, lobsters occur throughout Massachusetts Bay both on soft substrate and more complex rocky bottoms. An important issue with lobsters, though, involves coordinating construction to avoid the lobster migration.

Cancer Crabs (Rock Crab – Cancer irroratus *and Jonah Crab –* Cancer borealis*)*

Cancer crabs, a by-catch fishery with modest consumer demand (Estrella, 2003), are present along the proposed pipeline route. Cancer crabs are distributed from Nova Scotia to the South Atlantic States (Estrella 2003). Rock crabs (*Cancer irroratus*) are found in rocky habitat, but can be displaced onto sandy areas by competition with lobsters for habitat. Jonah crabs (*Cancer borealis*) prefer exposed, rocky habitat, but are common on muddy substrates in deeper waters. Egg-bearing females prefer soft sediments, where they can dig and live in pits in the sediment (Canada Department of Fisheries and Oceans, 2003). Male crabs molt in the winter, and females molt just prior to mating in the fall. Females lay their eggs and keep them under their abdomen for about one year. Cancer crabs produce large numbers of eggs that hatch into planktonic larvae in the summer. The larvae (zoea stage) are present in the water column from mid-June to mid-September. In the fall, the larvae molt into small crabs (megalopes) and settle both in cobble and sand (Palma et al., 1998). Juvenile crabs (less than 0.6 inch carapace width) concentrate in sheltered areas in shallow depths (Canada Department of Fisheries and Oceans, 2003).

Rock crab and Jonah crab are both landed by fishermen, primarily lobstermen, from Massachusetts Bay. Rock crabs are generally considered to predominate near shore while Jonah crabs are more common in deeper waters, although they can co-occur (Krouse, 1980). In a study for NOAA evaluating the effects of a smooth bottom trawl on the seabed, Boat et al. (2003) examined mud and sand bottom areas in Massachusetts Bay. In this survey, Cancer spp. crabs were substantially more abundant on the mud bottom, suggesting that the Port Project area is likely to support this resource. Because rock crabs prefer rock, sand, or gravel bottoms it is likely that Jonah crabs are more abundant in the Project Area.

Deep Sea Red Crab (Chaceon (Geryon) quinquedens)

Trawl surveys conducted during designation studies for the MBDS collected a few specimens of the deep sea red crab (*Chaceon (Geryon) quinquedens)* (Hubbard et al., 1988). Distribution maps for this species show that juveniles have been found offshore of Massachusetts in waters west of 70°W (Steimle et al., 2001), but that the primary distribution is on the edge of the continental shelf and on the continental slope.

Northern Shrimp (Pandalus borealis)

SAIC (1987) quantified the occurrence of pandalid shrimp within the boundaries of the MBDS using a submersible vessel. The area covered by the survey included both natural silt/clay substrate, similar to conditions in the Project area, and dredged material. Abundance of large shrimp ranged from 0.5 to 2.3 individuals per square meter. Small shrimp ranged from 0.9 to 16.8 individuals per square meter. Northern shrimp exhibit a preference for mud or silt substrates in 50 to 500 feet of water (McInnes, 1986). This species was over harvested in the 1960s and has exhibited substantial interannual variability. Regardless, shrimp abundances in the Project area are likely to be similar to those in the MBDS. Northern shrimp were observed in the ROV surveys in the buoy area and along the Pipeline corridor.

Molluscan Shellfish

The entire NEG Project Area is designated as Essential Fish Habitat (EFH) for several mollusks: short-fin and long-fin squid, sea scallop, ocean quahog, and surf clam. The Pipeline Lateral also traverses “shellfish suitability areas” - areas within Massachusetts Bay deemed most likely to provide habitat for shellfish. Maps of these areas, developed by MDMF in collaboration with the. MCZM and the NOAA Coastal Services Center (CSC), show the approximate location of potential habitats suitable for ten species of shellfish along the Massachusetts coast. Based on this mapping, no potential molluscan shellfish habitat exists in the NEG Port area, but there is potential habitat for Atlantic sea scallop (*Pecten magellanicus*) and soft-shelled clam (*Mya arenaria*) along the proposed pipeline route (Figure 3-6). Other molluscan shellfish that potentially occur in the Project area include short-fin and long-fin squid, sea scallops, and ocean quahogs. All of these were observed by Hubbard et al. (1988) in the vicinity of MBDS.

Site specific surveys showed evidence of molluscan shellfish in the Project Area. Juvenile softshell clams were seen in at least 20 of the benthic grab samples in the pipeline lateral area and in several samples from the buoy area. Scallop and ocean quahog surveys conducted along the HubLine route in the proximity of the proposed tie-in for the NEG Pipeline indicate that these species are likely to be present at least along the inshore portion of the NEG Pipeline. For Those species likely to occur in the project area as described below. Species with designated EFH in the Project area are more fully described in section 3.4.

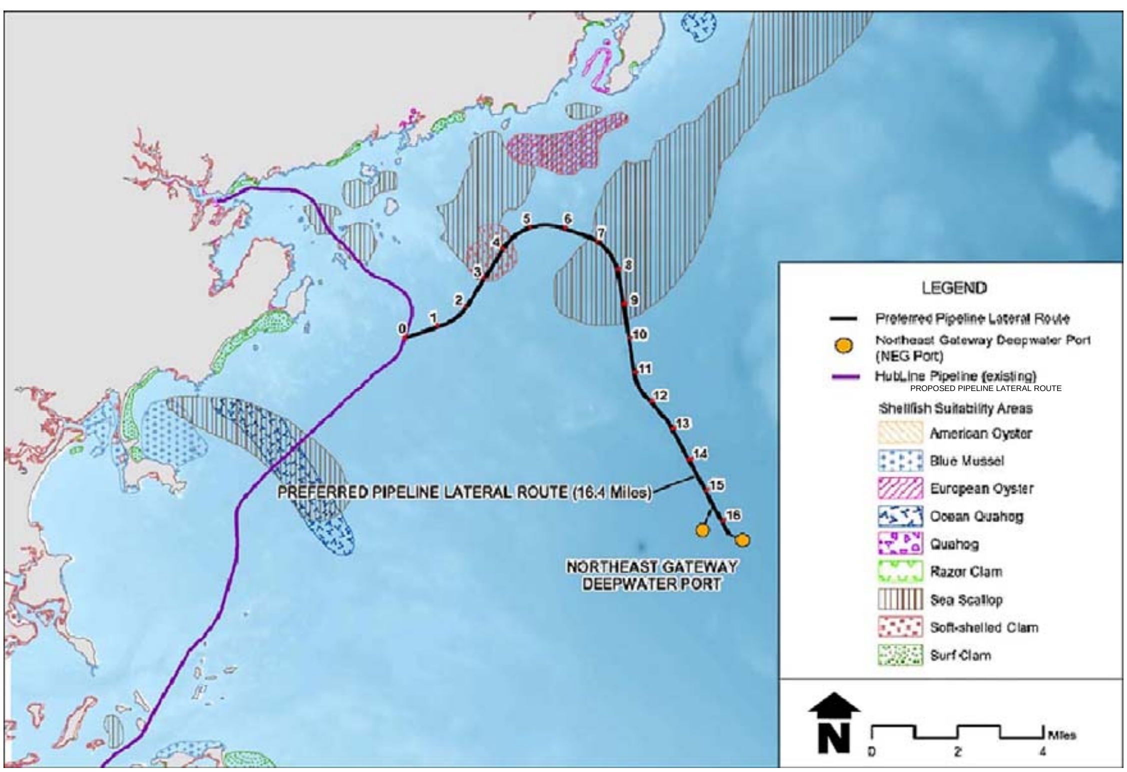


Figure 3-6. Shellfish Suitability Areas

Short-Fin (Ilex illecebrosus) and Long-Fin Squid (Loligo pealei)

Short-fin and long-fin squid are pelagic species that typically migrate between coastal and offshore waters. They are more common in deep waters in the summer and early autumn. Long-fin squid pre-recruits and recruits ($\geq$ 9 cm) are more abundant in the fall than spring in Massachusetts Bay, although this species is more common in Cape Cod Bay and south of Cape Cod (Cargnelli et al., 1999a). Long-fin squid make seasonal migrations apparently related to bottom temperatures, moving offshore in late autumn to overwinter along the edge of the continental shelf.

Short-fin squid appear to undergo a migration of 1,000 miles (1,609 kilometers) or more (Cargnelli et al., 1999b). This species occurred in low numbers in the Massachusetts Inshore Trawl Surveys from 1978 to 1994 (reported in Cargnelli et al., 1999b).

Sea Scallops (Placopecten magellanicus)

Sea scallops are unlikely to occur in the Port area. Adult sea scallops are typically found on sand to gravel and cobble substrates, although juveniles can be found on silt as well (Packer et al., 1999). No sea scallop spat were found in the benthic grab samples collected for either the buoy or the pipeline area survey. No scallops were observed during the ROV survey of the buoy area, but sea scallops were commonly observed in the ROV footage between MP 1 and MP 4 of the Pipeline Lateral. HubLine post-construction scallop survey completed in 2004 indicated that at the closest sample station to the tie-in location for the Pipeline Lateral (about 1.5 miles or 2.4 kilometers north of the interconnect location), density ranged from 1 to 2 scallops per 10 square meters. At this location, sediment type was characterized by divers as coarse-grained sediments, primarily coarse sand and gravel (TRC and NAI, 2005b).

Sea scallops spawn in September and October and larvae remain in the plankton for about a month. Limited swimming capability leaves the larvae at the mercy of the currents, thus even if adult scallops are not in the Project area, larvae may occur there.

Ocean Quahog (Arctica islandica)

Ocean quahog is the most likely bivalve of commercial interest in the Project area. Ocean quahogs live just below the sediment surface in fine-grained sediments. While fine-grained sediments predominate in the Buoy Survey Area, they are mostly silty-clay, finer than the medium- to fine-grained sands preferred by ocean quahogs (Cargnelli et al., 1999c). No quahogs or quahog shell hash was observed in the ROV of the Port area performed by NEG. No juvenile ocean quahogs were found in the grab samples collected during site investigations. However, NEG estimated 51 acres (0.21 km^2) of quahog habitat occur along the Pipeline Lateral based on sediment characteristics, along with data from the ocean quahog survey conducted prior to construction of the HubLine. The HubLine survey had several stations located in relative proximity to the western end of the proposed Pipeline Lateral (MP 0.0). HubLine station #5, located about 0.25 mile south of the proposed HubLine tie-in location, had an estimated density of 0.74 quahogs per square meter in 2002 (TRC and NAI, 2003). Sediments in this area consisted of 85 percent fine sand and 12 percent fines (silt/clay). Consistent with the HubLine survey, the ROV survey conducted in 2005 along the proposed Pipeline Lateral route noted that shell debris, consisting mostly of ocean quahog shells, was common between MP 0 and MP 2 near the inshore end of the proposed pipeline route). Like scallops, ocean quahogs have planktonic larvae. Whether or not adults are present, some larvae may be carried into the Project area.

While exact quahog densities are unknown, it is reasonable to assume that densities are lower than commercial quantities because no commercial harvest of the species has been reported.

At present harvesting of ocean quahog is prohibited in the area due to Paralytic Shellfish Poisoning closure, although the area has been open in the past.

Softshell Clam (Mya arenaria)

The softshell clam is found along the Atlantic coast from Labrador to South Carolina and inhabits the bottom sediments of intertidal and subtidal waters up to depths of 328 to 653 feet (100 to 199 meters) (Theroux and Wigley, 1983). They prefer fine sediments (soft mud and sand, compact clay) as well as coarse gravel and stones (Newell and Hidu, 1986). Softshell clams usually spawn when their shell length is greater than 0.79 inch long (Coe and Turner, 1938), with spawning peaking in the summer (June through September) (Ropes and Stickney, 1965). The planktonic larval stage of the softshell clam lasts for 12 to 14 days and begins when the fertilized egg hatches into a trochophore and then enters the early veliger stage and late veliger phase (Newell and Hidu, 1986). The larval stage (i.e., spat) then settles to the bottom, where it develops a foot and attaches to the bottom. The juvenile seed clams may migrate up to several hundred yards toward shore, with movement peaking in the fall (September and October) (Dow and Wallace, 1961). Adult clams are sedentary and burrow deep into the sediment up to a depth of 16 inches (41 centimeters). Their preferred diet is plankton (i.e., flagellates and diatoms), but they can also feed on bacteria and organic detritius (Eaton, 1983). Softshell clams may occur along the proposed pipeline route given the presence of suitable habitat between MP 3 and MP 4 and its potential distribution in deeper waters.

Echinoderm Shellfish

Sea Urchin (Strongylocentrotus droebachiensis)

The green sea urchin is harvested in certain areas within Massachusetts Bay. Green sea urchins are common in the rocky subtidal of the Massachusetts Bay and the Gulf of Maine in association with their primary food sources, foliose and coralline algae (Maciolek et al., 2004). Spawning occurs from January through April. Urchins are harvested from September through April both through dragging and diving. There is no management plan currently in effect for this species. Sea urchins are unlikely to occur along the pipeline centerline route because of the predominance of soft sediments. Further, foliose and coralline algae do not occur in the water depths occurring along the pipeline route, including the anchor corridor. Sea urchins have planktonic eggs and larvae that may drift through the Pipeline corridor area during summer months before settling on appropriate substrates in shallower water along the coast of Massachusetts.

3.2.2 Plankton

The term "plankton" refers to very small, usually microscopic, plants and animals that occupy the marine water column. They are divided in this section into phytoplankton (algae and protozoans) and zooplankton (tiny animals or life stages of larger animals, including eggs and larvae). The eggs and larvae of finfish (ichthyoplankton) are an important group within the zooplankton and are treated separately for the purposes of this analysis.

The plankton community in Massachusetts Bay has been well studied, and the general description of plankton provided here is drawn from published literature. A major source of information on the zooplankton comes from a comprehensive summary report from the NOAA Estuarine Living Marine Resources Program (ELMR) program (Jury et al. 1994). The ELMR program was aimed at development of a consistent database on the distribution, relative abundance, and life history characteristics of ecologically and economically important fishes and invertebrates in the nation's estuaries. The resulting report (Jury et al., 1994) report summarizes both published and unpublished data on planktonic life stages of various fish and shellfish species in Massachusetts Bay estuaries. Relative abundance and seasonal occurrence of a variety of species is given for the region. Though it is focused on estuarine environments, the Jury et al (1994) report is useful in providing an overview of the species expected in the general vicinity of the Project Area at various times of year. This general overview is supplemented with information from the published literature, and with data from monitoring programs in the vicinity of the Project area.

Data from two NOAA monitoring programs, EcoMon and MARMAP (2005) are used to describe the existing ichthyoplankton resource in the Project area. These data are discussed in section 3.2.2.3. NEG completed an analysis of ichthyoplankton in the Project Area for the Project Application using data from the Seabrook power generating station monitoring program. The Seabrook Station monitoring data is collected approximately 33 miles (53 kilometers) north of the Project area in water about 65 feet (20 meters) deep. Sampling occurs in waters shallower and farther inshore than the Project area. Therefore the Seabrook data are more representative of an inshore plankton community than the Project area, where depths are 250-270 ft. Subsequent to the Application the EcoMon and MARMAP datasets were identified, and were judged to be more applicable to the Project area. Data were provided by NOAA to the Coast Guard, and were used as the main source of data in the assessment of ichthyoplankton resources and potential impacts, and are presented in section 4.2.2.

Phytoplankton

Phytoplankton are free-floating microscopic algae and protozoans that drift at or near the surface of the ocean. They obtain energy through photosynthesis and form the basis of the food chain in the marine environment. They also have key ecosystem roles in the distribution, transfer, and recycling of nutrients and minerals. Phytoplankton serve as food for zooplankton, including some ichthyoplankton species, which in turn are consumed by larger crustaceans, small fish, and whales. Within Massachusetts Bay, phytoplankton abundance is controlled by both abiotic (i.e., nutrients, water temperature, light) and biotic (i.e., consumption) factors. Highest densities of phytoplankton occur in the photic zone (zone where light penetrates). In offshore waters, the depth of the photic zone is about 100 feet (30 meters) (Hubbard et al., 1988).

The phytoplankton community in Massachusetts Bay is a small part of the larger community characteristic of the Gulf of Maine. The plankton community in Massachusetts Bay is usually dominated year round by unidentified microflagellates (<10 microns in diameter) (Libby et al. 2004). The annual phytoplankton cycle is marked by blooms - large and abrupt increases in cell abundance in the winter-spring period (typically February) associated with increasing day length, and in the fall period (September through December), associated with the breakdown of the thermocline (thermal layering) and water column mixing that allows introduction of nutrients to surface waters. The winter-spring bloom is characterized by abundant numbers of diatoms, such as *Stephanopyxis turris*, *Thalassiosira nordenskioldii*, *Thalassionema nitzschioides*, and *Cylindrotheca closterium*. The summer phytoplankton community is a relatively stable, mixed assemblage of unidentified microflagellates, as well as unidentified cryptomonads (*Cryptomonas* spp. <10 microns long) and diatoms (various small-sized species of *Chaetoceros*). The fall bloom consists of a mixed community of diatoms (*Skeletonema costatum*, *Asterionellopsis glacialis*, *Dactyliosolen fragilissimus*), cryptomonads, and various dinoflagellates, but blooms of single species have also occurred. While species composition may vary from year to year, the general pattern has been documented in several studies starting in the early 1970s (Hubbard et al., 1988; NAI, 1998).

Blooms of harmful and nuisance algae occur in Massachusetts Bay. Blooms of the nuisance alga *Phaeocystis pouchetii* are a regional event that occur throughout Massachusetts and

Cape Cod Bays, usually in the spring (April). Annual blooms have occurred every year since 2000 (Libby et al., 2004). Prior to that, *Phaeocystis* blooms followed a 3-year cycle. A regional fall bloom of the potentially-toxic diatoms of the genus *Pseudo-nitzschia* occurred in Massachusetts Bay in 2003.

The toxic dinoflagellate, *Alexandrium tamarense*, which causes “red tide,” was, until recently, rare in Massachusetts Bay. However, 2005 brought the worst outbreak of *Alexandrium fundyense* since a massive outbreak occurred in 1972. *Alexandrium* is naturally distributed throughout northern New England waters, but the algae typically develop into large-scale blooms only in waters off Maine and Canada. In most years, natural current and wind patterns keep the cells from flowing into the nearshore waters of southern New England. Though the exact cause of the 2005 Alexandrium bloom is unknown, weather patterns have been implicated. The 2005 spring in New England was marked by unusual amounts of rain and snowmelt, and by a steady pattern of northerly and easterly winds, capped by nor’easters on May 8 and May 24. The unusual weather likely pushed an abundance of *Alexandrium* cells south into Massachusetts Bay and Cape Cod Bay. The record-setting winter and spring precipitation also flushed more fresh water and nutrients into the coastal region, creating prime conditions for the cells to grow and reproduce, and providing a buoyant transport pathway that carried cells down the coast. Finally, there may have been a larger source of cells in the Gulf of Maine at the start of the season, following an intense bloom off western Maine in autumn 2004.

3.2.2.2 Zooplankton

The zooplankton comprises three ecologically distinct fractions, the holoplankton (species present throughout all lifestages in the plankton), the meroplankton (typically larval stages of benthic invertebrates), and the hyperbenthos (species typically associated with the substrate, but which migrate into the water column on a regular basis or are spatially concentrated in the water immediately above the substrate). The zooplankton community is made up of an extremely diverse assemblage of microscopic free-floating animals, with most marine invertebrate phyla represented as eggs, larvae, or adults.

Zooplankton feed on phytoplankton, detritus, and other zooplankton, and provide a link between the primary production of the ocean (i.e., phytoplankton) and the higher trophic levels in the food web. Predators of zooplankton include fish, shellfish, whales, and other zooplankton. Most zooplankton are capable of movement within the water column and some species show a strong diurnal vertical migration in and out of the photic zone, while others tend to augment wind and tidal currents by “swimming” to move laterally.

The zooplankton community in Massachusetts Bay is a small part of the larger community characteristic of the Gulf of Maine (Kropp et al. 2003). The Massachusetts Bay community is dominated throughout the year by various species, including small (*Oithona similis*, *Pseudocalanus* spp., *Paracalanus parvus*, and *Microsetella norvegica*) and larger copepods (*Centropages typicus*, *Temora longicornis, Metridia lucens,* and *Calanus finmarchicus*) (Libby et al. 2004). *Calanus finmarchicus*, a species of particular interest because of its importance to Right whales, is present year-round as well, with abundances peaking in the winter/spring. Offshore, larger copepod taxa including *Centropages typicus, Temora longicornis*, and *Metridia lucens* are also present year-round (Libby et al. 2004c). These copepod species are widespread throughout the Gulf of Maine and are characteristic of the waters of the northwest Atlantic Ocean.

Data from the Massachusetts Water Resources Authority (MWRA) monitoring program can be used to examine the seasonal abundance of zooplankton in the general vicinity of the Project. Monthly data from the years 2000 - 2004 are presented in Table 3-6. Larvae of various species (e.g. barnacles in the spring and crustaceans and bivalves in summer) can be abundant in these collections at certain times of year.

Table 3-6

Mean Total Abundance (10^3 animals m-3) of Zooplankton in the Nearfield Stations of the MWRA Outfall Monitoring Program

Month	2000	2001	2002	2003	2004	Mean
Feb (early)	12.8	21.1	19.9	7.2	7.2	13.64
Feb (late)	14.5	12.1	21.7	6	14.9	13.84
March	26.9	19.4	28.3	9.9	15	19.9
April (early)	10.2	14.4	40.2	30.4	21.9	23.42
April (late)/May (early)	31.1	25.5	30.4	26.8	28	28.36
May (mid)	55.4	43.3	92.5	37.5		57.18
June	139.3	10.8	65.7	38.5	29.9	56.84
July (early)	115.2	24.7	nd[1/]	10.5		50.13
July (late)	274.4	30.3	nd	32.4	49	96.53
Aug (early)	66.6	48.9	nd	39.7		51.73
Aug (late)	28.4	63.1	nd	78.9	32.8	50.8
Sep (early)	34.8		nd	51.6	43.7	43.37
Sep (late)	10.4	34	nd	65.9	16.2	31.63
Oct (early)	23.9	16.2	nd	25.5		21.87
Oct (late)	14.6	26.3	nd	44.9	10	23.95
Nov	22.9	28.8	nd	29.6	16.4	24.43
Dec	19.8	28.25	nd	11.6		19.88

1/ nd = Report not available online.

Sources: Libby et al. 2000, 2001, 2002a, b, c, 2003, 2004 a, b, 2005

The annual cycle of zooplankton is influenced by both abiotic (i.e., temperature) and biotic (i.e., predation) factors. Seasonal zooplankton cycles are related primarily to fluctuations in temperature, rather than light and nutrients, as is the case for phytoplankton (Kropp et al. 2003). Zooplankton abundances are highest in mid-summer, lower in the spring and fall, and typically reach lowest levels in late winter, with variable seasonal trends for individual species. Some larger copepods (e.g., *Calanus finmarchicus*) and barnacle nauplii are colder-water taxa and are most abundant in the winter and spring. Warmer-water taxa, such as *Acartia tonsa*, *Centropages hamatus*, and *Paracalanus parvus*, reach peak abundances during summer. The summer and fall are often marked by blooms of ctenophores (*Mnemiopsis leidyi*), predators of zooplankton (Libby et al. 2004). As a result of these blooms, the abundance of copepods and other zooplankton species can substantially decrease during these periods. Large-scale regional and global factors, such as climatic changes (i.e., the North Atlantic Oscillation), appear to have a greater effect on zooplankton communities than do small-scale local factors.

Occasionally, strong pulses of meroplankton (i.e., organisms that spend only their larval and/or juvenile stages in the plankton community) can be important in the region. Species include barnacle nauplii, larval polychaetes, and mollusc veliger larvae. These benthic organisms have evolved planktonic larvae to aid in dispersal and colonization of new habitats through metamorphosis and settlement from the water column to the seafloor. The distribution of these plankton is highly dependent on time of year, with abundance increasing dramatically during and after spawning.

Jury et al. (1994) reported 12 species of meroplankton in Massachusetts Bay. These are typically most abundant in summer, though sea scallop are most abundant in fall and northern shrimp plankton are abundant in winter (Table 3-7). For comparison, data from the Seabrook Station (NAI, 2004) recorded eight species of bivalves that occur routinely in the area. One or more of these species has always been recorded during the April through October survey period. The Saxicave bivalve *Hiatella* sp., jingle shell (*Anomia squamula*) and blue mussel (*Mytilus edulis*) are by far the most abundant. Dominant arthropod species occurring in the meroplankton included the shrimp *Eualus pusiolus* and *Crangon septemspinosa*, the crabs *Cancer* sp., *Carcinus maenas* and *Pagurus* sp., and barnacle larvae.

Lobster larvae are most abundant from mid-June through late September in inshore waters of Massachusetts Bay (Jury et al. 1994). There are no abundance data available for the immediate project area. Seabrook power station monitoring studies provide the closest available data on lobster larval abundance. These data show average lobster larval densities of 4.2 to 4.6 larvae per 1,000 m^3 (all larval stages combined) between 1999 and 2003 (NAI, 2000, 2001, 2002, 2003, 2004a). Larvae were predominantly Stage I and Stage IV, and were present for 14 to 19 weeks, averaging 16 weeks. Though these data were collected from a relatively shallow, inshore area, these numbers suggest that lobster larvae could be moderately abundant in the project area. The abundance of lobster larvae at the project site, relative to that in the inshore area near Seabrook could be lower, since lobsters tend to spawn in waters shallower than that of the project area. However, there is no data on which to estimate the difference in larval abundance at the Project site relative to the Seabrook site.

Table 3-7

Seasonal Distribution of Meroplankton in Massachusetts Bay

Species	Lifestage	J	F	M	A	M	J	J	A	S	O	N	D
Blue mussel	egg				C	H	H	H	H	H			
Mytilus edulis	larvae				C	H	H	H	H	H	H		
Sea scallop	egg								C	C	C		
Placopecten magellanicus	larvae								C	C	C	C	
Northern quahog	egg						C	C	C				
Mercenaria mercenaria	larvae						C	C	C				
Softshell clam	egg			A	A	A	A	A					
Mya arenaria	larvae			A	A	A	A	A					
Daggerblade grass shrimp	egg					C	C	C	C				
Palaemonetes pugio	larvae						C	C	C				
Northern shrimp	egg	A	A	A	A							A	A
Pandalus borealis	larvae		A	A	A	A							
Sevenspine shrimp	egg				A	A	H	H	H	A	C		
Crangon septemspinosa	larvae				C	A	H	H	H	H	A		
American lobster	larvae						C	C	C	C			
Homarus americanus													
Jonah crab	larvae						C	C	C	C			
Cancer borealis													
Atlantic rock crab	larvae						C	C	C	C	C		
Cancer irroratus													
Green crab	larvae					C	C	C	C	C	C		
Carcinus maenas													
Green sea urchin	larvae					C	C	A	A	A	C		
Strongylocentrotus droebachiensis													

C = common, A =abundant, H = highly abundant

Source: Jury et al., 1994

3.2.2.3 Ichthyoplankton

Abundance of ichthyoplankton in the NEG Project area is documented by a combination of the previously mentioned surveys from Jury et al 1994, and NOAA/NEFSC's MARMAP Decade (MARMAP) and Ecosystem Monitoring (EcoMon) programs. Jury et al (1994) includes a compilation of general patterns of egg and larval abundance for 45 fish species in Massachusetts Bay estuaries. Of these 45 species, 25 were listed as common, abundant, or highly abundant (Table 3-8). Although the Jury et al. (1994) survey was conducted nearshore in estuaries, a different habitat than the offshore NEG Project area, the data is useful for examining relative abundance of various species, seasonality of occurrence, and evaluation of egg abundance. Egg data was not included in the EcoMon/MARMAP survey.

Site-specific ichthyoplankton data collected by the Applicant during October 2005-May 2006 has recently become available (NEG, 2006). Though the data was collected over less than a year, it offers the only data on ichthyoplankton in the immediate vicinity of the Project. The data show Atlantic cod, American plaice, and Pollock eggs in the vicinity of the Port area during winter 2005-2006. Eggs from certain species (cod/haddock, cod/withch flounder, and tautog/cunner/yellowtail were indistinguishable, complicating data interpretation. Larvae from Atlantic cod, Pollock, and Sand lance were relatively common in winter. In May, the last month of data supplied, more eggs and larvae were present. The most common eggs were American plaice, Atlantic mackerel, Cod/witch flounder (eggs not distinguishable) Rockling/hake (eggs not distinguishable), and tautog/cunner/yellowtail (eggs not distinguishable). Larvae found in the Project area during May included American plaice, Atlantic cod, Atlantic mackerel, Fourbeard rockling, Gulf snailfish, haddock, Lumpfish, Radiated shanny, and winter flounder.

Table 3-8

Relative Abundance and Seasonal Occurrence of Ichthyoplankton in Massachusetts Bay

Species	Life stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
American eel	Larvae				C	A	A	C					
	Egg												
Atlantic menhaden	Larvae						C	C	C	C			
	Egg					C	C	C	C	C			
Atlantic herring	Larvae	A	C	C	C	C					A	A	A
	Egg												
Atlantic cod	Larvae	C	C	C	C	C							C
	Egg	C	C	C	C								C
Silver hake	Larvae					C	C	C	C	C	C		
	Egg					C	C	C	C	C	C		
Pollock	Larvae	C	C	C									C
	Egg	C	C	C									C
Red hake	Larvae						A	A	A	A	C	C	
	Egg						A	A	A	A	A		
White hake	Larvae			A	A	A	A	A	A	A	A	A	
	Egg			A	A	A	A	A	A	A	A		
Mummichog	Larvae					C	C	C	C				
	Egg					C	C	C	C				
Atlantic silverside	Larvae				C	H	H	A	C				
	Egg				A	H	H	C					
Northern pipefish	Larvae				C	C	C	C	C	C			
	Egg												
Grubby	Larvae	C	C	C	C	C							
	Egg	C	C	C	C	C							C
Longhorn sculpin	Larvae	A	A	A	C	C	C						
	Egg	A	A	C	C								C
Tautog	Larvae						C	C	C	C			
	Egg					C	C	C	C				
Cunner	Larvae						H	H	H	A	C		
	Egg						H	H	H	A			
Ocean pout	Larvae								C	C	C	C	
	Egg												
Rock gunnel	Larvae	C	C	C	C	C	C						
	Egg	C	C	C	C								C
American sand lance	Larvae	A	A	A	A	A	A	C					C
	Egg	A	A	A	A	A	C					A	A
Atlantic mackerel	Larvae				C	A	A	A					
	Egg				C	A	A	A					
Butterfish	Larvae												
	Egg						C	C	C	C			
Windowpane	Larvae					C	C	C	C	C	C		
	Egg					C	C	C	C	C			
American plaice	Larvae			C	A	A	A	A					
	Egg			A	A	A	A						
Winter flounder	Larvae		A	H	H	H	A	C					
	Egg	C	A	A	A	A	A	C					
Yellowtail flounder	Larvae				C	A	A	A	A	C			
	Egg				C	A	A	A	C	C			

C= Common; A = Abundant; H = Highly Abundant
Source: Jury et al., 1994

EcoMon and MARMAP Data

Data from EcoMon and MARMAP were judged to be broadly representative of the Project area by NOAA representatives, and are used to describe ichthyoplankton abundance and potential entrainment of eggs and larvae in seawater uptake. MARMAP was an intensive monitoring program that examined both zooplankton and ichthyoplankton dynamics in the northeast U.S. continental shelf ecosystem from the 1960's to 1987. MARMAP ended in 1987, and was followed in the early 1990's by EcoMon. The sampling effort of EcoMon is less intensive than MARMAP, but follows the general protocol and samples many of the same species.

The current strategy samples 30 stations within the Gulf of Maine 6 times per year. EcoMon sampling is done with a paired 61-cm bongo frame with 330 μm mesh nets, one for zooplankton and one for ichthyoplankton. During the early years of EcoMon, only a small number of ichthyoplankton samples were processed. However, starting in 2000, regular processing of EcoMon ichthyoplankton samples began. Eggs and larvae are removed, larvae are identified to lowest possible taxonomic level and the standard length of a sub-sample of up to 50 of each taxa are measured.

EcoMon sampling stations are bounded by the latitude/longitude coordinates 42.05° to 42.70° N and 70.00° to 70.70°W, encompassing an area from the outer portion of Massachusetts Bay to an area east of Stellwagen Bank. Sampling locations used to represent the Project area are shown in Figure 3-7. During each sampling cruise, 30 locations within the Gulf of Maine are randomly selected. Therefore, the area closest to the NEG Project area was not sampled during every cruise. However, this area was sampled numerous times over the course of five years (Table 3-9), so it can be used to represent the expected ichthyoplankton population densities and seasonality in the Project Area.

Table 3-9

Summary of Seasonal Distribution of Sampling Effort During EcoMon Cruises in the Vicinity of the NEG Project Area Station Number (water depth, m)

Year	January	April	June	August	October	November
2000	Not Surveyed (ns)	242 (72) 254 (64)	119 (27)	61 (35)	ns	120 (34)
2001	ns	316 (84)	ns	60 (84) 61 (51)	309 (84) 313 (92)	115 (87) 120 (49)
2002	1 (66)	315 (43)	124 (64) 125 (20) 126 (94)	121 (39) 122 (54)	265 (55) 324 (136)	109 (34)
2003	2 (91)	305 (61)	ns	60 (70)	285 (53) 287 (91)	69 (30) 70 (67)
2004	ns	319 (107) 326 (58)	119 (53) 129 (79)	127 (113) 128 (52) 129(32) 130 (51)	ns	92 (68)

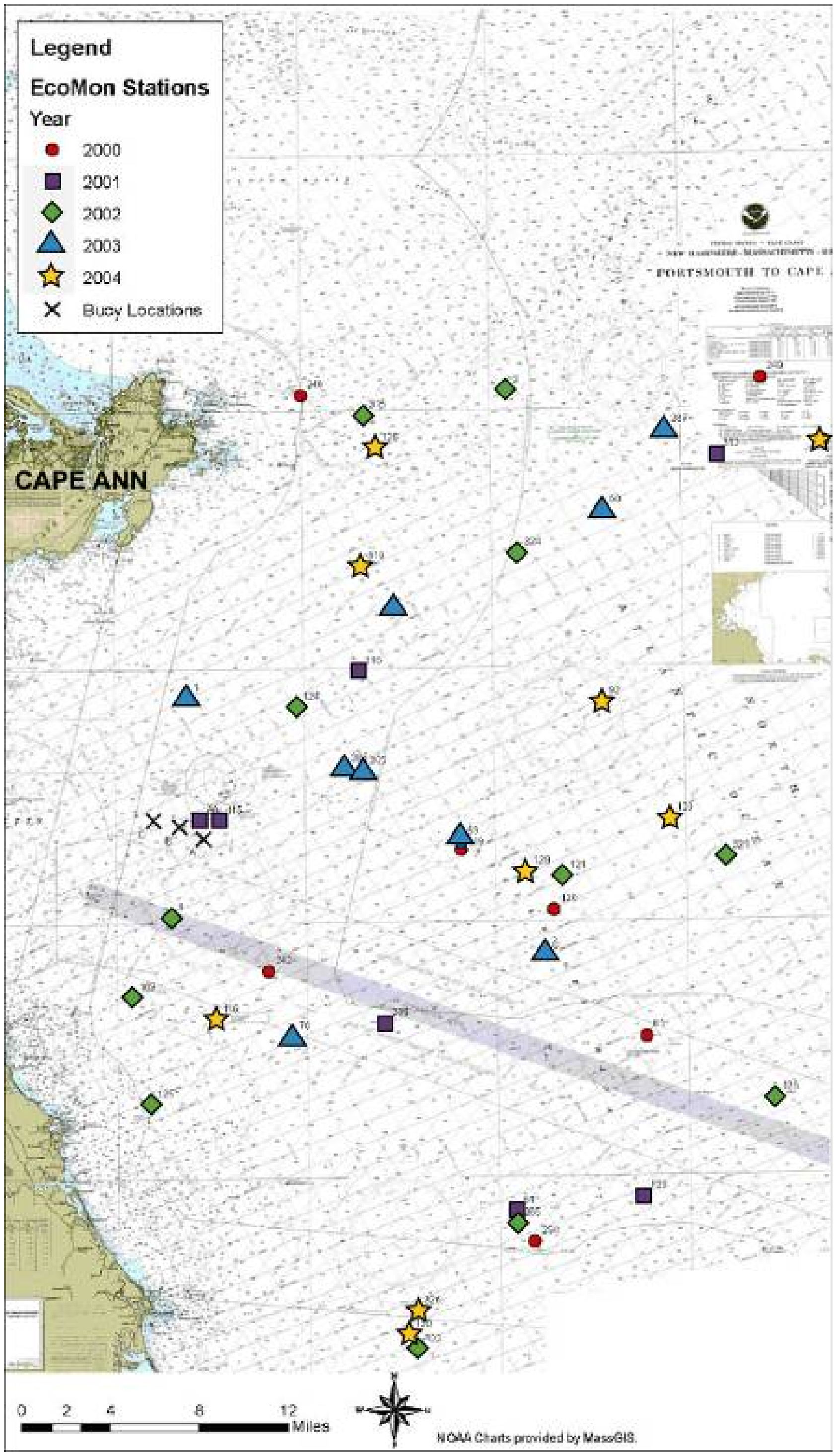


Figure 3-7. EcoMon Sampling Stations

The EcoMon/MARMAP survey includes overall monthly mean densities of 52 taxa of larval fish from 1960 to 1987 and the early 1990s and 2004. These monthly mean densities were converted to qualitative categories (rare, common, abundant, and highly abundant) similar to those in Jury et al 1994 for comparative purposes (Table 3-10).

Table 3-10

Relative Abundance and Seasonal Occurrence of Ichthyoplankton in Massachusetts Bay, NEG Project Area, based on EcoMon and MARMAP Data

Taxa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Merluccius bilinearis							p	C	C	r	p	r
Sphyraena sp.								p				
Centropristis striata								p				
Tautogolabrus adspersus						r	r	C	r	p		
Tautoga onitis								p		p		
Scomber scombrus					p	A	r	p				
Peprilus triacanthus								r	p			
Sebastes sp.				p	p	p	p	p	p			
Cyclopteridae				p	r	r		p				
Liparis spp.				p		p						
Liparis atlanticus				p		p						
Liparis coheni				p								
Myoxocephalus aenaeus				p								
Myoxocephalus octodecemspinosus		p		p								
Aspidophoroides monopterygius				p	p							p
Ammodytes sp.	H	H	A	C	r	p						A
Pholis gunnellus					p							
Stichaeidae				p		p						
Ulvaria subbifurcata					p	r		p	p			
Lumpenus sp.						p			p			
Lumpenus maculatus				p								
Lumpenus lumpretaeformis		p	p		r	p						
Stichaeus punctatus								p		p		
Cryptacanthodidae			p									
Etropus sp.									p			
Hippoglossina oblonga								p	p			
Paralichthys dentatus				p						p	p	
Pleuronectidae				p		r						
Pseudopleuronectes americanus				p	p	p						
Hippoglossoides platessoides				r	C	r	p	p				
Limanda ferruginea				p	p	C	r	r	p	p		
Glyptocephalus cynoglossus				p	p	r	r	p	r	p	p	
Scophthalmus aquosus						p		p	p		p	
Symphurus sp.										p		
Lophius americanus								p	p			

H = Highly abundant, >100 per tow
A = Abundant, >25 per tow
C = Common, 5-25 per tow
r = rare, <5 per tow
p = present, <1 per tow

General patterns of abundance

Based on Jury (1994), the most abundant larval fish and eggs found in Massachusetts Bay estuaries in the early 1990s were winter flounder, cunner, Atlantic silversides, and white hake in decreasing order of abundance. In contrast, American sandlance, Atlantic herring, pollock, and hake species were the most abundant larval fish in decreasing order of abundance found in the EcoMon/MARMAP data. Differences can be attributed in part to sampling locations. The Jury et al. (1994) data comes from inshore areas whereas the EcoMon/MARMAP data comes from offshore sampling sites.

Qualitative ichthyoplankton results from EcoMon/MARMAP and Jury et al 1994 surveys were compared in Table 3-11. As expected, there are both similarities and differences in abundance data. A few of the most noteworthy differences are the abundance or high abundance of winter flounder, American eel, longhorn sculpin, and Atlantic silversides in the Jury et al 1994 data set compared to the scarcity (0 to <1 mean number per tow) in the EcoMon/MARMAP area (Table 3-10). The above mentioned fish are generally more abundant in inshore waters, as they are all considered to show one of the following characteristics 1) inshore species (silversides), 2) known to use estuaries for part of their lie cycle (winter flounder and American eel), or 3) common in both inshore and offshore waters (longhorn sculpin). Conversely, four-beard rockling are more common offshore (abundant in EcoMon/MARMAP) and are not expected to be found inshore (not present in Jury et al 1994).

Table 3-11

Highest Overall Qualitative Category of Larval Fish Based on EcoMon and MARMAP Data in the Project Area, Massachusetts Bay and (Jury Et Al. 1994) in Massachusetts Bay Estuaries

EcoMon/MARMAP	Larval fish Taxa	Jury et al 1994
p	**'Tautoga onitis*	C
A	*Scomber scombrus*	A
r	*Peprilus triacanthus*	
p	*Sebastes sp.*	
r	Cyclopteridae	
p	*Liparis spp.*	
p	*Liparis atlanticus*	
p	*Liparis coheni*	
p	**Myoxocephalus aenaeus*	C
p	**'Myoxocephalus octodecemspinosus*	A
p	*Aspidophoroides monopterygius*	
	**Macrozoarces americanus*	C
H	*Ammodytes sp.*	A
p	**'Pholis gunnellus*	C
p	Stichaeidae	
r	*Ulvaria subbifurcata*	
p	*Lumpenus sp.*	
p	*Lumpenus maculatus*	
r	*Lumpenus lumpretaeformis*	
p	*Stichaeus punctatus*	
p	Cryptacanthodidae	
p	*Etropus sp.*	
p	*Hippoglossina oblonga*	
p	*Paralichthys dentatus*	
r	Pleuronectidae	
p	**'Pseudopleuronectes americanus*	H
C	*Hippoglossoides platessoides*	A
C	*Limanda ferruginea*	A
r	*Glyptocephalus cynoglossus*	
p	**'Scophthalmus aquosus*	C
p	*Symphurus sp.*	
p	*Lophius americanus*	

* Notable difference in estimates (see text for details)

H = (Highly abundant) Species numerically dominant relative to other species with similar life modes

A = (Abundant) Species often encountered in substantial numbers relative to other species with similar life modes

C = (Common) Species frequently encountered but not in large numbers

H = Highly abundant, >100 per tow
A = Abundant, >25 per tow
C = Common, 5-25 per tow
r = rare, <5 per tow
p = present, <1 per tow

From Tables 3-10 and 3-11 it is apparent that ichthyoplankton are present in Massachusetts Bay estuaries and the NEG Project area year round. At least one species is listed as “abundant” each month in Massachusetts Bay estuaries and either “highly abundant, abundant, or common” each month in the NEG Project area.

The seasonal distribution of ichthyoplankton is important in that construction would affect different species depending on how the construction schedule coincides with seasonal abundance of various species. Following are larval fish and eggs that are expected to be within the NEG Project area for each season based on a combination of the two surveys Jury et al. (1994) and EcoMon/MARMAP.

Winter (January – March)

Based on Jury et al. (1994) white hake, longhorn sculpin, American sand lance, American plaice, and winter flounder eggs were considered abundant in the winter ichthyoplankton community in Massachusetts Bay estuaries (Jury et al., 1994). However, EcoMon/MARMAP data show no larvae of any of the above fish except American sand lance and longhorn sculpin (less than 1 per tow) from January through March. These eggs are demersal and therefore not expected to be found in the surface tows taken for EcoMon/MARMAP. According to EcoMon/MARMAP, American sand lance and pollock larvae were highly abundant and abundant respectively, and can be expected in the winter months.

Spring (April – June)

Jury (1994) found red hake, white hake, Atlantic silverside, cunner, American sand lance, American mackerel, American plaice, winter flounder, and yellowtail flounder eggs were abundant in spring months. In contrast, only American plaice, and Atlantic mackerel larvae were abundant, and cunner and yellowtail flounder larvae were common in the EcoMon/MARMAP survey. These latter species and can be expected to be found in the Project area in spring. The other species were either found in very low numbers (less than 1 per tow) or not at all, and neither eggs or larvae would be expected from April to June.

Summer (July – September)

Jury et al. (1994) reported that red hake, cunner, Atlantic mackerel, and yellowtail flounder eggs were abundant in Massachusetts estuaries in the summer. Yellowtail flounder larvae were rarely found in EcoMon/MARMAP survey, and may be found in low numbers in the NEG area. In the EcoMon/MARMAP survey, hake species (*Urophycis spp*., including red and white hake), silver hake, cunner, fourbeard rockling, cod, and mackerel larvae were either commonly or abundantly found in the summer months, and would be expected in the NEG sampling area.

Fall (October – December)

Jury et al. (1994) found that Atlantic herring, red hake, white hake, and American sandlance eggs were abundant in the fall. According to EcoMon/MARMAP data, Atlantic herring and American sandlance were likewise highly abundant and abundant respectively. Pollock was also highly abundant and these three larval species would be expected in the NEG sampling area from October through December.

Data from the Seabrook station suggests that significant annual differences in the ichthyoplankton community of the western Gulf of Maine have occurred in recent years. Starting in 1988, Atlantic mackerel, cunner, and yellowtail founder eggs have increased in abundance while hake eggs have decreased in the Seabrook monitoring data (NAI, 2004b). In the larval community, starting in 1989, cunner and fourbeard rockling larvae became much more abundant while abundance of Atlantic mackerel decreased to a lesser degree. These data suggest long-term changes in the plankton community in the region, but the reason for the changes has not been determined.

3.2.3 Finfish (Fisheries) Resources

Finfish resources of the NEG Port and Pipeline Lateral are discussed in this section. No site-specific field data of finfish were collected in the pipeline corridor. The information contained herein is based on a review of existing literature and data from various sources. A description of finfish that could occur in the Project area, including the seasonal distribution and relative abundance is given. Both federally managed species (Essential Fish Habitat or EFH species) and non-EFH species are discussed. Non-EFH species are described in this section, whereas full descriptions of EFH species are given in Appendix F Essential Fish Habitat.

An important source of information presented in this section is the ELMR North Atlantic report for species occurring in Massachusetts Bay (Jury et al., 1994). Other data sources include fisheries data from the National Atmospheric Administration (NOAA) and the Masschusetts Department of Marine Fisheries (MDMF). In addition, data from assessments of two disposal sites in Massachusetts Bay (NAI, 1995) and fisheries data from the Massachusetts Bay Disposal Site (Hubbard et al., 1988) are included.

3.2.3.1 Massachusetts Bay Fish Community

The fish community of the Gulf of Maine is among the most studied and best described in the world. The Gulf of Maine supports resident or migratory populations of 252 known species of fish in 118 families (Collette and Klein-MacPhee, 2002). Cape Cod forms the southern border of the Gulf of Maine and is a major biogeographic boundary separating boreal northern fishes from temperate fishes in the Mid-Atlantic (Briggs, 1974). There is substantial seasonal variation in the ichthyofauna (fish) of the Gulf of Maine due to the large seasonal variation in water temperatures. Most of the pelagic species (i.e., Atlantic herring, Atlantic mackerel, bluefish, bluefin tuna) exhibit seasonal migratory movements in response to changes in water temperatures, while seasonal movements among demersal species (i.e., Atlantic cod, haddock, cusk, and flatfish) are generally confined to shifts within the overall Gulf of Maine (NOAA, 1991). Despite the long-standing assumption that the Gulf of Maine is dominated by boreal, non-migratory species, recent analysis of fishes now known from the Gulf of Maine shows that only about a third of the species are year-round residents in the Gulf; another third are seasonal visitors from the south that travel around Cape Cod during the summer; and the final third are visitors from the north in the deeper water offshore (Collette and Klein-MacPhee, 2002).

Based on temperature, depth, latitude, and ecology, the common fishes of the Gulf of Maine can be divided into four ecological groups (Murawski, 1993):

Shallow-Water Sedentary (23 species) such as little skate, winter skate, longhorn sculpin, American sand lance, winter flounder, yellowtail flounder, and windowpane;

Deepwater Sedentary (23 species) such as thorny skate, pollock, white hake, Acadian redfish, witch flounder, and American plaice; this group is composed of fishes with boreal affinities;

Warmwater Migratory (92 species) mostly found in summer and autumn. These include northern sea robin, bluefish, scup, black sea bass, butterfish, summer flounder; these species are primarily mid-Atlantic and make inshore and northward migrations in late spring and return migrations in late fall; and

Pelagic (9 species) including Atlantic herring, Atlantic mackerel, striped bass and bluefish.

Some common species such as spiny dogfish and goosefish do not fit neatly into any of the four categories. Spiny dogfish are the most abundant shark in the Gulf of Maine. They are usually found epibenthically but move throughout the water column including surface waters and are distributed in both inshore and offshore shelf areas (Collette and MacPhee, 2002). Goosefish are familiar bottom fish throughout the Gulf of Maine both along the shore and on the outer fishing banks. They range from just below the tide line to depths of at least 840 m from 0 to 24^{o}C (Collette and MacPhee, 2002).

System boundaries for many fish species may be provided by the circulation patterns of the Gulf of Maine. Massachusetts Bay, located between Cape Ann and Cape Cod, in the southwest corner of the Gulf of Maine, is at the southwestern end of the coastal distribution pattern and acts as a "catch basin" for a variety of species (NOAA, 1991). The Bay's most prominent submarine feature, Stellwagen Bank, is located at the Bay's eastern edge. Stellwagen Bank is a shallow (65 to 300 feet; 19 to 914 meters), glacially-deposited, primarily sandy feature with high biological productivity that provides habitat for a number of fish species.

Table 3-12 shows the fish species present at various times of year in Massachusetts Bay, as reported in Jury (1994). Species classified by Jury et al. (1994) as highly abundant in Massachusetts Bay during at least one lifestage, and during at least one month of the year include: silversides (*Menidia* spp.), cunner (*Tautogolabrus adspersus*), American plaice, and winter flounder (*Pseudopleuronectes americanus*). Species likely to occur in the Project area with lifestages classified as "abundant" in Massachusetts Bay include spiny dogfish (*Squalus acanthias*), skates (*Raja* spp.), American eel (*Anguilla rostrata*, <1 per tow in the project area), Alewife (*Alosa pseudoharengus*), Atlantic menhaden (*Brevoortia tyrannus*), Atlantic herring (*Clupea harengus*), rainbow smelt (*Osmerus mordax*), pollock (*Pollachius virens*), red hake (*Urophycis chuss*), mummichog (*Fundulus heteroclitus*, not present in the project area), longhorn sculpin (*Myoxocephalus octodecemspinosus*), American sand lance (*Ammodytes americanus*), Atlantic mackerel (*Scomber scombrus*), and yellowtail flounder (*Limanda ferruginea*) (Jury et al., 1994). Spiny dogfish, skates, Atlantic herring, pollock, red hake, Atlantic mackerel, and yellowtail flounder have essential fish habitat designations in the Project area and are discussed further in Appendix F (EFH Assessment). Species classified as "abundant" in Massachusetts Bay by Jury et al. (1994) that are not discussed in Appendix F are discussed below.

Table 3-12

Relative Abundance, Temporal Distribution, and Habitat (pelagic or demersal) Preferences of Fishes by Lifestage in Massachusetts Bay

			Relative Abundance by Month[b/]											
Species	**Habitat[a/]**	**Life Stage**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Spiny dogfish	D	Adults						C	A	A	A	C		
		(Spawning)	NA											
	D	Juvenile						C	A	A	A	C		
Skates	D	Adults	C	C	C	A	A	A	A	A	A	C	C	C
		(Spawning)	C	C	C	C	C	C	C	C	C	C	C	C
American eel	D	Adults									C	C		
		(Spawning)												
	D	Juvenile				C	A	A	C					
Blueback herring	P	Adults					C	C	C	C	C	C		
		(Spawning)												
	P	Juvenile					C	C	C	C	C	C	C	
Alewife	P	Adults				C	A	A	C	C	C	C		
		(Spawning)												
	P	Juvenile				C	C	A	A	A	A	C	C	
Atlantic menhaden	P	Adults					C	C	A	A	A	C	C	
		(Spawning)					C	C	C	C				
	P	Juvenile					C	C	C	C	C	C	C	
Atlantic herring	P	Adults	A	A	A	A	C				C	C	A	A
		(Spawning)												
	P	Juvenile	A	A	A	A	A	C	C	C	A	A	A	A

Table 3-12

Relative Abundance, Temporal Distribution, and Habitat (pelagic or demersal) Preferences of Fishes by Lifestage in Massachusetts Bay

			Relative Abundance by Month[b/]											
Species	**Habitat[a/]**	**Life Stage**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Rainbow smelt[c/]	P	Adults	C	C	C	C	C	C				C	C	C
		(Spawning)												
	P	Juvenile	A	A	A	A	A	A	A	A	A	A	A	A
Atlantic cod	D	Adults			C	C	C	C				C	C	C
		(Spawning)	C	C	C	C	C							C
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
Silver hake	D	Adults				C	C	C	C			C	C	
		(Spawning)					C	C	C	C	C			
	D	Juvenile				C	C	C	C	C	C	C	C	
Atlantic tomcod	D	Adults			C	C	C	C	C	C	C	C	C	
		(Spawning)												
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	
Pollock	P/D	Adults	C	C	C	C	C	C			C	C	C	C
		(Spawning)	C	C										
	P/D	Juvenile	C	C	C	A	A	A	C	C	A	A	C	C
Red hake	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		(Spawning)						C	C	C	C	C		
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
White hake	D	Adults			C	C	C	C	C	C	C			
		(Spawning)												
	D	Juvenile			C	C	C	C	C	C	C	C	C	
Mummichog[c/]	D	Adults	C	C	C	A	A	A	A	A	A	A	A	C
		(Spawning)					C	C	C	C				
	D	Juvenile	C	C	C	A	A	A	A	A	A	A	A	C
Silversides[c/]	P/D	Adults	C	C	A	A	H	H	H	H	H	H	A	C
		(Spawning)				C	H	H	A					
	P/D	Juvenile				A	H	H	H	H	H	H	H	C
Fourspine stickleback[c/]	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		(Spawning)												
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
Threespine stickleback	P/D	Adults	C	C	C	C				C	C	C	C	C
		(Spawning)												
	D/P	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
Northern pipefish	D	Adults			C	C	C	C	C	C	C	C	C	
		(Spawning)				C	C	C	C	C				
Northern searobin	D	Adults					C	C	C	C				
		(Spawning)												
	D	Juvenile					C	C	C	C				
Grubby	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		(Spawning)	C	C	C	C								C
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	
Longhorn sculpin	D	Adults	A	A	A	A	A	A	A	A	A	A	A	A
		(Spawning)	A	A	C	C								C
	D	Juvenile	A	A	A	A	A	A	A	A	A	A	A	A
Shorthorn sculpin	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		(Spawning)	C	C	C									C
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
Striped bass	P	Adults				C	C	C	C	C	C	C		
		(Spawning)												
	P	Juvenile				C	C	C	C	C	C	C		
Bluefish	P	Adults						C	C	C	C	C		
		(Spawning)												
	P	Juvenile						C	C	C	C	C		
Scup	D	Adults												
		(Spawning)												
	D	Juvenile							C	C	C			
Tautog	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		(Spawning)					C	C	C	C				
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
Cunner	D	Adults	A	A	A	A	A	A	A	A	A	A	A	A
		(Spawning)						A	A	A	A			
	D	Juvenile	A	A	A	A	A	A	A	A	A	A	A	A

Table 3-12

Relative Abundance, Temporal Distribution, and Habitat (pelagic or demersal) Preferences of Fishes by Lifestage in Massachusetts Bay

			Relative Abundance by Month[b/]											
Species	**Habitat[a/]**	**Life Stage**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Ocean pout	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		(Spawning)								C	C	C		
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
Rock gunnel	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		(Spawning)	C	C	C									C
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
American sand lance	D/P	Adults	C	C	C	A	A	A	A	A	A	A	C	C
		(Spawning)	C	C	C								C	C
	D/P	Juvenile	C	C	C	A	A	A	A	A	A	A	C	C
Atlantic mackerel	P	Adults					C	C	C	C	C	C		
		(Spawning)					C	C	C	C				
	P	Juvenile					C	C	C	C	C	C		
Butterfish	P	Adults							C	C	C			
		(Spawning)												
	P	Juvenile							C	C	C			
Windowpane	D	Adults			C	C	C	C	C	C	C	C	C	
		(Spawning)					C	C	C	C	C			
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
American plaice	D	Adults	H	H	H	H	H	H	H	H	H	H	H	H
		(Spawning)			H	H	H	H						
	D	Juvenile	H	H	H	H	H	H	H	H	H	H	H	H
Winter flounder	D	Adults	H	H	H	H	H	H	H	H	H	H	H	H
		(Spawning)	C	A	A	A	C	C						
	D	Juvenile	H	H	H	H	H	H	H	H	H	H	H	H
Yellowtail flounder	D	Adults	A	A	A	A	A	A	A	A	A	A	A	A
		(Spawning)				A	A	A	A	A				
	D	Juvenile	A	A	A	A	A	A	A	A	A	A	A	A

[a/] D= Demersal, P= Pelagic
[b/] H= Highly Abundant A = Abundant C= Common, blank= not present or rare
[c/] Inshore distribution and not likely to occur in Project area

Source: Jury et al., 1994

3.2.3.2 Non-EFH Species Descriptions

Silversides

Adult and juvenile silversides are highly abundant from May through October. Adults occur year-round in Massachusetts Bay, although they are most abundant during warmer months. Atlantic silverside (*Menidia menidia*) are common inhabitants of intertidal creeks, marshes, and shore zones of estuarine embayments during spring, summer, and fall (Collette and Klein-MacPhee, 2002) and are not expected to be numerous in the Project area. In winter, Atlantic silverside migrate offshore to continental shelf waters beginning in November in the Gulf of Maine (Conover and Murawski, 1992) where as many as 90% or more typically die. Most offshore captures were within 31 miles (50 kilometers) of the shoreline at water depths of 31 to 164 feet (10 to 50 meters).

Cunner

Adult and juvenile cunner are abundant throughout the year in Massachusetts Bay, particularly during June, July, and August (see Table 3-12). Cunner occur primarily in coastal habitats, usually within 2 miles (3 kilometers) of shoreline and are most abundant from just below the low tide mark to about 98 feet (30 meters) (Collette and Klein-MacPhee, 2002). Cunner live near the bottom, are strongly associated with structure, and often move very little. They are frequently observed around submerged aquatic vegetation, rocky outcroppings, pilings, wharves, boulders, and just about any other object offering shelter (Olla et al., 1979). Their numbers drop off rapidly just a short distance from cover. On metamorphosis, juveniles settle to the bottom and suffer extreme post-settlement mortality in less structurally complex habitats (Levin, 1991). Juveniles are typically associated with rocky bottom, pilings, debris, eelgrass, or macroalgae beds.

American Eel

American eel is a catadromous species common in streams, rivers, lakes, tidal marshes, and estuaries throughout the Gulf of Maine. American eel adults are common in Massachusetts Bay in summer and juveniles in late spring and early summer in depths ranging from 0 to greater than 6000m (AMSFS, 2000; see Table 3-12). After spawning in the Sargasso Sea, leptocephalus larvae drift at sea for up to a year and are transported north by the Gulf Stream. Leptocephali transform into early juveniles called glass eels as they approach the North American coast. Glass eels occur in Massachusetts Bay from March through June; however they are not abundant (see Table 3-12). As glass eels enter estuaries and ascend to brackish habitats, they undergo another metamorphosis and begin the elver stage. Elvers occupy a wide range of coastal habitats including eelgrass, tidal flats, marshes, harbors, barrier beach ponds, coastal rivers, and streams (Able and Fahay, 1998). Juveniles and adults primarily occur in estuarine and freshwater habitats and are therefore not likely to occur in the deeper waters of the Project area.

Alewife

Alewife (*Alosa pseudoharengus*) and the closely related blueback herring (*Alosa aestivalis*) comprise the commercially important river herring fishery in the Gulf of Maine. Both species are anadromous and form large schools during their spawning migrations into coastal rivers in the spring. Both species are euryhaline, coastal pelagic fish that spend most of their lives at sea, approaching the shore and returning to freshwater only to spawn (Collette and Klein-MacPhee, 2002). Blueback herring occur year-round in Massachusetts Bay and adults and juveniles are considered “common” from May through November (see Table 3-12). Alewife adults and juveniles also occur year-round and are more abundant than blueback herring in Massachusetts Bay from April through September (see Table 3-12). Spawning and early life history stages for both species occur in coastal rivers and estuaries, so disturbance of the substrate by construction activities would not affect egg and larval habitat. Juveniles of both species emigrate from fresh and brackish waters during late summer and fall and overwinter in areas near their estuarine nurseries (Millstein, 1981). Both juvenile and adult alewife and blueback herring are highly migratory, pelagic, plankton feeders not associated with benthic habitats.

Atlantic Menhaden

Atlantic menhaden (*Brevoortia tyrannus*) inhabit pelagic, euryhaline waters of estuaries and bays as well as polyhaline coastal waters on the inner continental shelf (Collette and Klein-MacPhee, 2002). Menhaden form large schools both as juveniles and adults. Atlantic menhaden are a summer seasonal species in the Gulf of Maine. Seasonal appearance and disappearance of menhaden into and out of the Gulf of Maine in spring and fall, respectively, is a result of migration around Cape Cod and is a well-documented annual event (Collette and Klein-MacPhee, 2002). In years when menhaden reach the Gulf of Maine, they usually appear in Massachusetts Bay about mid-May, when coastal waters have warmed to $10^{o}C$ or more (Collette and Klein-MacPhee, 2002). Atlantic menhaden eggs are common in Massachusetts Bay from May through September (see Table 3-12). Larvae enter estuaries where they transform into juveniles (Able and Fahay, 1998). Juvenile and adult menhaden occur in Massachusetts Bay from May through November; adults are abundant from July through September (see Table 3-12). Both juvenile and adult menhaden are migratory, pelagic, filter-feeding fish consuming phytoplankton and zooplankton. Atlantic menhaden are not associated with benthic habitats.

Rainbow Smelt

Rainbow smelt (*Osmerus mordax*) are pelagic and anadromous, usually found in coastal waters (Collette and Klein-MacPhee, 2002). Many smelt spend the whole year in estuaries and are not expected to be abundant in the Project area or the pipeline corridor. Their summer habitat varies in different parts of the Gulf of Maine, depending on water temperature and perhaps food supply (Collette and Klein-MacPhee, 2002). Most rainbow smelt leave the harbors and estuaries of Massachusetts Bay during the warmest season, but they probably move out only far enough to find cooler water at a slightly greater depth (Collette and Klein-MacPhee, 2002). Adults are rare in Massachusetts Bay in the summer and common throughout the rest of the year (see Table 3-12). Juveniles can be abundant throughout the year. In the fall, as water temperatures drop, juveniles move into the upper estuary, concentrating in channels, where they mix with the adult population (McKenzie, 1964; Clayton, 1976). Although smelt are mobile, pelagic fish they do occur in benthic habitats such as eelgrass (Crestin, 1973; Wyda et al., 2002) and they feed on benthic invertebrates such as amphipods, shrimp, and polychaetes as well as fish. However, smelt are not reported more than 1.2 miles (2 kilometers) from shore or in water depths greater than 20 feet (6 meters) (Bigelow and Schroeder, 1953), so they are not likely to occur in the Project area.

Mummichog

Mummichog (*Fundulus heteroclitus*) is a euryhaline fish found in shallow waters throughout the Gulf of Maine. Mummichog adults and juveniles occur in Massachusetts Bay year round and are abundant April through November (see Table 3-12). Mummichog spawn in intertidal estuarine areas and demersal eggs are deposited in crevices in the substrate, between empty mussel shells, and on vegetation or mats of detritus (Able and Fahay, 1998; Collette and Klein-MacPhee, 2002). Juveniles and adults are most abundant in shallow estuarine habitats such as saltmarsh tidal creeks and eelgrass and are not likely to occur in the deep waters of the Port Project area or along the Pipeline Lateral corridor. Bigelow and Schroeder (1953) note “So closely, indeed, do they hug the shore that a line drawn 100 yards out from land would probably enclose practically all the mummichogs in the Gulf of Maine.”

Longhorn Sculpin

Longhorn sculpin (*Myoxocephalus octodecemspinosus*) are benthic, slow-moving fish that are common in coastal waters throughout the Gulf of Maine from the shoreline to the offshore banks (Collette and Klein-MacPhee, 2002). In Massachusetts Bay, longhorn sculpin adults and juveniles are common year-round (see Table 3-12). Presumably the spawning season is the same in the Gulf of Maine (Collette and Klein-MacPhee, 2002). Spawning occurs inshore in estuaries and shallow enclosed areas on rocky bottoms (Scott and Scott, 1988). Juvenile and adult longhorn sculpin are caught in considerable numbers down to 90 meters and are likely to occur in the Project area or pipeline corridor.

American Sand Lance

American (or inshore) sand lance (*Ammodytes americanus*) adults and juveniles occur year-round in Massachusetts Bay and are abundant from April through October (see Table 3-12). Many aspects of the ecology of *Ammodytes* spp. along the east coast of the United States are potentially confounded by taxonomic problems differentiating between *A americanus* and the offshore sand lance *A. dubius* (Nizinski et al., 1990). American sand lance are primarily found in shallow (6 feet or less; 2 meters or less) coastal waters and estuaries, and are seldom seen along rocky shores (Collette and Klein-MacPhee, 2002). Sand lance are most often found on sandy or fine gravel bottoms in which they burrow. American sand lance are believed to spawn in the Gulf of Maine on the continental shelf from November to March (Collette and Klein-MacPhee, 2002; Auster and Stewart, 1986). Larval fish survey data indicate that spawning occurs principally inshore, although some evidence exists of offshore spawning activity (Auster and Stewart, 1986). Schools of 500 to 10,000+ have been observed on Stellwagen Bank (Meyer et al., 1979) which may provide spawning habitat for this species (NOAA, 1991). The habitat of young of the year is poorly known (Able and Fahay, 1998). Sand lance are an important trophic link between zooplankton production and fishes of commercial importance (Auster and Stewart, 1986). They have been found in the stomachs of a wide variety of species including Atlantic Cod, haddock, silver hake, white hake, and yellowtail flounder, as well as cetaceans (Auster and Stewart, 1986). This species is pelagic much of the time, but is capable of diving into sandy substrates very quickly.

3.2.3.3 State and Federal Fisheries Monitoring and Survey Data

Data from Massachusetts Division of Marine Fisheries (MDMF) and NOAA National Marine Fisheries Service (NMFS) are used in this section to describe fish found in the vicinity of the Project. These data provide a general overview of the species and their relative abundance in the region. Data from the MDMF Semi-Annual Trawl Surveys, National Marine Fisheries Survey (NMFS)/MDMF Industry-based survey, and NOAA's bottom trawl survey are provided.

MDMF Semi-Annual Trawl Survey

The MDMF conducts an inshore bottom trawl survey during the spring and fall using an otter trawl with a 50.8-foot (15.5-meter) footrope and a tow duration of 20 minutes. Results of the MDMF spring and fall trawl surveys in the general area of the proposed Pipeline Lateral are summarized for the period from 1978 through 2004 in Table 3-13 (includes all species whose mean biomass > 1.0 or abundance > 5/tow in either spring or fall). Dominant species in terms of biomass and abundance varied between seasons. During the spring, biomass was highest for Atlantic cod, American plaice, yellowtail flounder, ocean pout, and winter flounder. Spiny dogfish dominated the biomass during the fall. Other dominants included American plaice, red hake, Atlantic cod, winter flounder, and silver hake. Numerical dominants during the spring included American plaice, yellowtail flounder, Atlantic cod, winter flounder, ocean pout, longhorn sculpin, red hake, and silver hake. In the fall, numerical dominants included American plaice, silver hake, Atlantic cod, red hake, longfin squid, and winter flounder. Over the duration of the survey, MDMF recorded a total of 59 species in this area, of which 46 species occurred in the spring and 53 species occurred in the fall.

Results of the MDMF spring and fall trawl surveys in water depths similar to the proposed Port area are averaged over the period from 1978 through 2004 in Table 3-14 (includes all species whose mean biomass > 1.0 or abundance > 5/tow in either spring or fall). Seasonal differences are apparent in both biomass and abundances per station. In the spring, the highest catches in terms of biomass were American plaice, Atlantic cod, yellowtail flounder, ocean pout, and red hake. In contrast, during the fall survey, spiny dogfish yielded the highest biomass, followed by American plaice, red hake, and silver hake.

Table 3-13

Average Biomass (kg/station) and Number (per station) during the Massachusetts Department of Marine Fisheries Annual Spring and Fall Trawl Surveys (1978-2004) in the General Area Crossed by the NEG Pipeline Lateral

Species	Spring: Average Biomass (kg/station)	Spring: Average Number/station	Fall: Average Biomass (kg/station)	Fall: Average Number/station
Acadian redfish	0.3	4.1	1.0	5.3
Alewife	0.4	7.8	0.2	3.3
American lobster	7.4	18.5	13.5	40.8
American plaice	89.1	1033.6	65.6	964.0
Atlantic cod	94.2	137.6	31.4	192.5
Atlantic herring	0.5	6.0	2.6	34.4
Atlantic rock crab	0.3	1.5	4.3	39.9
Atlantic wolfish	2.0	0.7	0.6	0.2
Butterfish	0.0	0.0	1.4	41.3
Cunner	0.1	0.9	0.3	5.0
Daubed shanny	0.1	21.6	0.0	0.5
Fourbeard rockling	0.1	2.9	0.3	5.4
Fourspot flounder	0.4	2.0	1.9	8.8
Goosefish	0.9	0.9	4.7	3.3
Haddock	4.2	6.4	0.4	19.6
Jonah crab	0.1	0.6	1.1	5.1
Longfin squid	0.0	0.0	0.8	103.7
Longhorn sculpin	7.0	68.7	3.1	32.6
Northern shortfin squid	0.0	0.0	0.9	6.9
Ocean pout	37.0	74.9	3.5	16.0
Red hake	6.7	60.4	32.8	143.3
Sea raven	1.2	1.1	0.6	1.3
Silver hake	2.9	53.3	21.1	277.3
Snakeblenny	0.4	9.2	0.1	3.6
Spiny dogfish	3.5	1.5	76.4	47.3
Thorny skate	1.7	2.9	4.1	5.6
White hake	1.6	10.1	4.4	29.1
Windowpane	0.5	5.8	0.1	0.4
Winter flounder	19.3	107.0	26.1	102.4
Witch flounder	2.7	6.0	4.7	7.8
Yellowtail flounder	44.0	143.3	8.0	29.2

Relative abundance data shows a slightly different picture than does data on biomass. During the spring, American plaice was the most abundant species, followed by silver hake, red hake, yellowtail flounder, and daubed shanny. American plaice was also the most abundant species caught in the fall. Silver hake, red hake, Atlantic herring, and spiny dogfish were subordinate numerical dominants. During the 26-year survey period, MADMF recorded a total of 58 species in waters greater than 180 feet deep; 45 species were collected during the spring and 56 species were collected during the fall.

Table 3-14

Average Biomass (kg/station) and Number (per station) during the Massachusetts Department of Marine Fisheries Annual Spring and Fall Trawl Surveys (1978-2004) in Water Depths Greater than 180 feet

Species	Spring: Average Biomass (kg/station)	Spring: Average Number/station	Fall: Average Biomass (kg/station)	Fall: Average Number/station
Acadian redfish	0.5	5.3	1.4	10.8
Alewife	0.9	19.8	0.2	3.5
American lobster	9.7	26.8	12.4	37.1
American plaice	152.9	1724.7	110.1	1379.3
Atlantic cod	29.9	35.5	5.8	28.0
Atlantic herring	1.1	10.1	14.2	124.2
Atlantic mackerel	0.0	0.0	0.3	7.3
Atlantic rock crab	0.1	0.5	1.6	10.9
Atlantic wolfish	1.6	0.5	0.0	0.0
Butterfish	0.0	0.0	0.7	11.3
Daubed shanny	0.5	51.3	0.0	1.0
Fourbeard rockling	0.4	8.7	0.7	14.2
Goosefish	1.9	1.8	10.3	7.8
Haddock	2.2	3.9	0.5	2.5

Industry-Based Survey

MDMF has been conducting an Industry-Based Sampling (IBS) program directed at Atlantic cod in the Gulf of Maine since late 2003 and data have recently become available to the public (https://fish.nefsc.noaa.gov/ibs). Data from 2003 through 2005 are used to characterize the fisheries resources in and near the Project area, and on nearby Stellwagen Bank. Sampling stations from this program were subset for Massachusetts Bay and Stellwagen Bank to provide a description of the fish resources in the vicinity of the Port and Pipeline Corridor, and to provide a comparison with Stellwagen Bank. Table 3-15 presents rectangular definitions of Massachusetts Bay and Stellwagen Bank used to subset the data. Massachusetts Bay consisted of two contiguous rectangles that encompass the substrate conditions and depths represented in the NEG Project area. The Stellwagen Bank rectangle includes part of Tillie’s Bank.

Table 3-15

Geographic definitions of the Massachusetts Bay and Stellwagen Bank Stations

Area	North of:	South of:	East of:	West of:
Massachusetts Bay	42.20°	42.31°	70.57°	70.44°
Massachusetts Bay	42.31°	42.58°	70.68°	70.44°
Stellwagen Bank	42.10°	42.70°	70.44°	70.24°

Each annual survey consisted of several "legs". One leg was reported for 2003 (December), five legs in 2004 (January, February and March, March and April, April and May, November), and three legs in 2005 (January and February, February and March, March and April). Number of tows collected ranged from 5 to 10 per leg on Massachusetts Bay and 9 to 24 on Stellwagen Bank. The number of species collected per leg ranged from 24 (Leg 3) to 35 (Leg 5) in Massachusetts Bay and from 25 (Leg 2) to 36 (Leg 5) on Stellwagen Bank. Data presented in Table 3-16 are biomass (lbs/tow; count data were not accessible on the website) for common commercially or ecologically significant fishes and American lobster, and all fish combined at the Massachusetts Bay stations and Stellwagen Bank stations. These data are presented as mean biomass per tow for each leg across the three sampling years.

Table 3-16

Mean Biomass/Tow of Fish Collected at the Massachusetts Bay and Stellwagen Bank Stations

A. Massachusetts Bay			**Leg**			
Speciesa	**1 (Jan-Feb)**	**2 (Feb-Mar)**	**3 (Mar-Apr)**	**4 (Apr-May)**	**5 (Nov-Dec)**	**Average**
Acadian redfish	43.3	3.2	4.3	3.6	81.1	27.1
American lobster	9.2	3.8	6.8	3.1	13.0	7.2
American plaice	28.4	9.1	166.0	287.0	125.0	123.1
Atlantic cod	65.1	126.0	79.9	116.0	40.0	62.7
Atlantic herring	6.5	29.4	0.7	152.0	136.0	64.9
Atlantic mackerel	11.3	0.0	0.0	0.0	1.1	2.5
Haddock	1.2	1.6	31.3	112.0	23.1	33.8
Longhorn sculpin	25.3	45.0	27.8	5.3	17.0	24.1
Ocean pout	6.0	8.1	32.2	48.0	6.3	20.1
Silver hake	8.2	0.1	1.3	0.9	63.1	14.7
Spiny dogfish	4.3	0.0	0.0	307.0	1403.0	342.9
White hake	1.1	0.0	0.1	0.0	2.2	0.7
Winter flounder	49.8	38.2	82.8	30.4	63.5	52.9
Witch flounder	0.1	0.1	0.4	0.3	2.5	0.7
Yellowtail flounder	11.2	6.1	72.4	12.3	24.0	25.2
TOTAL	299.0	291.0	533.0	1111.0	2120.0	870.8
B. Stellwagen Bank			**Leg**			
Species**a**	**1**	**2**	**3**	**4**	**5**	**Average**
Acadian redfish	1.2	65.6	108.0	256.0	45.4	95.2
American lobster	4.4	3.0	2.4	5.8	8.2	4.8
American plaice	17.5	9.3	26.5	21.3	29.6	26.8
Atlantic cod	54.7	109.0	56.6	140.0	80.4	88.1
Atlantic herring	1.0	0.1	5.6	30.6	62.5	20.2
Atlantic mackerel	64.9	0.0	0.0	0.0	5.0	14.0
Haddock	3.9	2.1	29.8	110.0	30.5	35.3
Longhorn sculpin	24.3	40.8	53.5	46.3	19.0	36.8
Ocean pout	24.3	9.6	42.7	40.0	4.3	24.2
Silver hake	1.5	1.0	0.5	0.3	10.5	2.8
Spiny dogfish	25.9	0.0	26.3	52.7	844.0	189.8
White hake	0.4	0.0	0.2	0.0	0.6	0.2
Winter flounder	35.4	28.6	34.8	35.1	56.9	38.2
Witch flounder	0.1	0.1	0.1	0.2	2.4	0.6
Yellowtail flounder	18.1	8.7	29.2	41.7	32.6	26.1
TOTAL	310.0	289.0	435.0	818.0	1357.0	641.8

a Species whose mean biomass/tow was > 5 percent of the mean total biomass in any leg in either area or is a commercially important species (American lobster, silver hake, white hake, witch flounder).

Total biomass/tow was substantially greater during legs 4 (spring) and 5 (late fall) at the Massachusetts Bay stations than at the Stellwagen Bank stations, primarily due to the higher catches of spiny dogfish in Massachusetts Bay (see Table 3-16). During the other legs, when spiny dogfish were rare, total biomass/tow was similar between the two areas. Average biomass/tow across all legs was higher at the Massachusetts Bay stations even when spiny dogfish biomass is excluded.

At the Massachusetts Bay stations mean biomass/tow among the selected species was greatest for spiny dogfish, American plaice, Atlantic herring, Atlantic cod, and winter flounder. On Stellwagen Bank, mean biomass/tow was greatest for spiny dogfish, Acadian redfish, Atlantic cod, winter flounder, longhorn sculpin, and haddock. Mean biomass/tow of spiny dogfish, American plaice, and winter flounder was substantially greater at the Massachusetts Bay stations compared to Stellwagen Bank. Mean biomass/tow of Acadian redfish, Atlantic cod, and longhorn sculpin was substantially higher at the Stellwagen Bank stations.

During Leg 1 biomass/tow at the Massachusetts Bay stations was greatest for Atlantic cod, winter flounder and Acadian redfish. Mean biomass/tow of each of these fishes was greater at the Massachusetts Bay stations than the Stellwagen Bank stations where Atlantic mackerel was ranked first in biomass/tow.

During Leg 2 at the Massachusetts Bay stations, Atlantic cod, longhorn sculpin, winter flounder, and Atlantic herring had the greatest biomass/tow whereas at the Stellwagen Bank stations, Atlantic cod, Acadian redfish, and longhorn sculpin dominated the catch.

At the Massachusetts Bay stations, American plaice, winter flounder, Atlantic cod, and yellowtail flounder were dominant in biomass/tow during Leg 3. Acadian redfish, cod, longhorn sculpin, and ocean pout contributed the highest biomass/tow at the Stellwagen Bank stations on this leg.

Biomass/tow of spiny dogfish, American plaice, Atlantic herring, Atlantic cod, and haddock was greatest during Leg 4 at the Massachusetts Bay stations. At the Stellwagen Bank stations, mean biomass/tow was highest for Acadian redfish, Atlantic cod, haddock, and spiny dogfish.

Spiny dogfish was the predominant species caught in both locations during Leg 5. Subordinate dominants at the Massachusetts Bay stations included Atlantic herring, American plaice, and Acadian redfish.

In general, mean biomass/tow was greater (870.8 lbs/tow) at the Massachusetts Bay stations compared to the Stellwagen Bank stations (641.8 lbs/tow). Mean biomass/tow averaged over the five legs was similar between the two areas for several species, including haddock, ocean pout, witch flounder, and yellowtail flounder. Fish that preferred a rocky substrate such as Acadian redfish were most common on the Stellwagen Bank stations while fish that preferred softer substrate such as American plaice were dominant at the Massachusetts Bay stations. Mean biomass/tow of cod, mackerel, and longhorn sculpin was also higher at Stellwagen Bank stations than Massachusetts Bay stations. The remaining species exhibited higher mean biomass/tow at the Massachusetts Bay stations.

NMFS Bottom Trawl Survey

Area-specific data from the NMFS bottom trawl survey data. These data are summarized in Table 3-17. Seventeen trawls were done in the vicinity of the Project Area. Note that the trawls included in this summary most likely contain hard bottom substrate that is not typical of the Project area, so they don't represent the project area perfectly. In these trawls almost all of the 14 dominant species were demersal species except Atlantic herring and spiny dogfish. This is to be expected because the otter trawl most effectively samples demersal species.

Table 3-17

Biomass per Trawl of Important Species from NOAA Fisheries-NEFSC Spring and Fall Bottom Trawl Survey (2000 through 2004)

Species (lifestyle)[a/]	Average Biomass (pounds) per Trawl Spring	Fall
American plaice (D)	73	27
Atlantic cod (D)	80	91
Atlantic herring (P)	11	0
Haddock (D)	8	18
Longhorn sculpin (D)	5	0
Ocean pout (D)	21	0
Redfish spp. (D)	5	1
Red hake (D)	1	12
Silver hake (D)	2	10
Spiny dogfish (P)	0	352
White hake	0	1
Winter flounder (D)	50	58
Witch flounder (D)	0	2
Yellowtail flounder (D)	72	8
Other	32	143
Total	359	740

[a/] D= Demersal, P = Pelagic

Source: NOAA Resource Survey Reports, Bottom Trawl Surveys, 2000-2004

Another source of information on fish in the vicinity of the Project is a study conducted by the ACOE at MBDS during 1985 and 1986 (Hubbard et al., 1988). This study documented the occurrence of 35 fish species (Table 3-18) at the MBDS. Species composition was similar to the NMFS and MDMF surveys. American plaice, witch flounder, and redfish were the predominant non-migratory, demersal species at MBDS (Hubbard et al., 1988). The resident finfish community on the muddy bottom of the MBDS is dominated by American plaice and witch flounder (Hubbard et al., 1988). Silver and red hake are abundant, commercially important seasonal migrants at MBDS (Hubbard et al., 1988). Hard bottom communities at MBDS (approximately 25 percent of the total area) are likely dominated by redfish, ocean pout, cusk, and Atlantic wolffish. The fish community described at MBDS by Hubbard et al. (1988) is likely to be generally representative of the community found in the deepwater areas of the proposed NEG Port adjacent to the MBDS, although stock assessments over the past 20 years have shown changes in relative abundances.

Table 3-18

Frequency of Occurrence of Fish Species in NMFS and MDMF Bottom Trawls in the Vicinity of MBDS

Abundance[a/]	Spring Trawls	Fall Trawls
Common	American plaice (100)	American plaice (100)
	Witch flounder (100)	Witch flounder (100)
	Yellowtail flounder (100)	Red hake (100)
	Atlantic cod (100)	Silver hake (100)
	Ocean pout (89)	Alewife (84)
	Red hake (89)	Ocean pout (77)
	Silver hake (78)	Longhorn sculpin (69)
	Longhorn sculpin (78)	Atlantic cod (69)
	Sea raven (66)	White hake (69)
	Winter flounder (66)	
	Blueback herring (66)	
	Alligator fish (66)	
	Daubed shanny (66)	
Occasional	Thorny skate (56)	Sea raven (60)
	Snakeblenny (56)	Thorny skate (54)
	Fourspot flounder (56)	Atlantic herring (54)
	Fourbeard rockling (44)	Goosefish (54)
	Haddock (44)	Fourbeard rockling (38)
	White hake (44)	Butterfish (38)
	Alewife (33)	Haddock (38)
	Goosefish (33)	Redfish (38)
		Cunner (38)
Infrequent	American sandlance (11)	Alligator fish (31)
	Pollock (11)	Snakeblenny (31)
	Atlantic herring (11)	Yellowtail flounder (31)
	Redfish (11)	Wrymouth (23)
	Winter skate (11)	Winter flounder (23)
		Mailed sculpin (23)
		Daubed shanny (23)
		Blueback herring (15)
		Atlantic mackerel (15)
		Fourspot flounder (15)
		American shad (15)
		Pollock (15)
		Windowpane (8)
		Cusk (8)
		Scup (8)
		Spiny dogfish (8)

[a/]Frequency refers to the percentage of trawls where fish were caught, regardless of the number of individuals caught in each tow

Source: Hubbard et al., 1988

Because pelagic species are highly mobile and not closely associated with bottom habitats, they are not as vulnerable to trawling gear as demersal species. While the majority of available information regarding the fish community of Massachusetts Bay is based on bottom trawls, there is limited information on pelagic species. A study done in October 1994 and May 1995 used gill netting to capture and describe the fisheries resources at two potential dredge disposal sites in Massachusetts Bay (NAI, 1995). The first site, Meisburger 2, was located approximately 3.2 miles (5.1 kilometers) east of Great Point in Nahant in about 100 feet (30 meters) of water. A second site, Meisburger 7, was located about 9 miles (14 kilometers) east of Deer Island. Both sites were sampled with two four-panel experimental gill nets. One net was set just off the bottom and the other was set near the surface. Catch per unit effort was expressed as the catch per 24-hour set for both nets combined.

At the Meisburger 2 site, Atlantic mackerel were the most abundant fish in fall (October) followed by cunner and longhorn sculpin (Table 3-19). Alewife and winter flounder were also collected. In spring (May), overall Catch Per Unit Effort (CPUE) was greater and was primarily driven by large catches of Atlantic herring. Cunner and yellowtail flounder were common and longhorn sculpin, Atlantic cod, and winter flounder were collected. At Meisburger 7, overall CPUE in October was similar to Meisburger 1, although more species were collected. Atlantic mackerel was the most abundant species collected followed by Atlantic cod, hake spp., skate spp., and longhorn sculpin (Table 3-19). Alewife, cunner, scup, and silver hake were also collected. In May, catches were greatly reduced and species composition differed. Atlantic cod, sea raven, and winter flounder were the most abundant fishes. Atlantic herring, longhorn sculpin, ocean pout, and yellowtail flounder were also collected.

When data from both stations were combined, Atlantic herring (spring) and Atlantic mackerel (fall) were the dominant pelagic fish, comprising 73 percent of the total (Table 3-19). Both species are federally managed and are discussed further in Appendix F.

Table 3-19

Catch per 24-hour set (CPUE) in Gill Net Collections from Massachusetts Bay, October 1994 and May 1995

	Station CPUE					
	Meisburger 2		Meisburger 7			
Species	**October**	**May**	**October**	**May**	**Total CPUE**	**Percent Species Composition**
Alewife	0.7		0.3		1.0	0.8
Atlantic cod		0.3	1.3	1.3	2.9	2.4
Atlantic herring		71.7		0.3	72.0	58.4
Atlantic mackerel	6.3		12.3		18.6	15.1
Atlantic menhaden		0.3			0.3	0.2
Cunner	3.0	3.0	0.3		6.3	5.1
Hake spp.			1.0		1.0	0.8
Lobster	5.0	2.0	4.3	1.3	12.6	10.2
Longhorn sculpin	2.0	0.7	0.7	0.3	3.7	3.0
Ocean pout				0.3	0.3	0.2
Sea raven				0.7	0.7	0.6
Scup			0.3		0.3	0.2
Silver hake			0.3		0.3	0.2
Skate sp.			0.7		0.7	0.6
Winter flounder	0.3	0.3		0.7	1.3	1.1
Yellowtail flounder		1.0		0.3	1.3	1.1
Total	17.3	79.3	21.5	5.2	123.3	100.0

Source: NAI 1995

An active commercial fishery exists in the southwestern Gulf of Maine, including areas within the Project area. Landings data for Massachusetts certain fish species are shown in Table 3-20. Data for both commercial and recreational fishing activity are included. These data are generated from information on where fish were landed, rather than where they were caught, so they do no necessarily represent fish abundance in the project area. However they do indicate relative abundance of species potentially found in the general region, and they illustrate the active fishery in the region.

Table 3-20
Average (1990-2004) Massachusetts Commercial and Recreational Landings for Assessed Species

Species	Massachusetts Commercial Landings (lbs)	Massachusetts Recreational Landings (lbs)	Total Massachusetts Landings (lbs)
Atlantic Herring	45,341,890	0	45,341,890
Atlantic Cod	29,851,707	2,922,842	32,774,549
Haddock	5,750,278	0	5,750,278
Silver Hake	4,864,613	0	4,864,613
Pollock	5,656,206	180,012	5,836,217
Red/White Hake	3,911,211	0	3,911,211
Cunner	496	18,145	18,641
Yellowtail Flounder	10,034,420	0	10,034,420
Butterfish	66,022	0	66,022
Atlantic Mackerel	7,521,613	1,422,596	8,944,209
Winter Flounder	9,229,976	147,993	9,377,968

3.2.4 Marine Mammals

Marine mammals known to traverse or occasionally visit the waters within the Project area include both threatened or endangered species, as well as those species that are not threatened or endangered. This section discusses only those marine mammals that are not listed as threatened or endangered under the ESA, but are protected under the Marine Mammal Protection Act of 1972 as amended in 1994 (MMPA). A more complete description of threatened and endangered mammals is given in section 3.3. Included below are detailed descriptions of marine mammal biology, habitat use, abundance, and distributions and existing threats within the Project area.

3.2.4.1 Protected Areas

The proposed locations of the NEG Port and the Pipeline Lateral in Massachusetts Bay are within areas known to be visited by marine mammals. Both the federal government and the Commonwealth of Massachusetts have designated protected areas within the Bay to serve the interests of marine mammals and their habitats. The locations of these protected areas with respect to the proposed NEG Port and Pipeline Lateral are shown in Figure 3-8. As shown, the NEG Port is located outside the boundaries of all protected areas, while the Pipeline Lateral is proposed within portions of the South Essex and North Shore Ocean Sanctuaries. Table 3-21 provides a summary of the federal and state protected areas within the vicinity of the Project.

Under the MMPA, the federal government has the responsibility to protect marine mammals whose habitat is in waters under the jurisdiction of the United States (MMPA, 1972). The Act prevents the "taking" of marine mammals in certain situations (MMPA, 1972). The term "take" is statutorily defined to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal" (MMPA, 1972). Harassment is defined as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild; or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption or behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. The Endangered Species Act of 1973 (ESA) also further protects some species of marine mammals, which are covered in section 3.3. In addition, the National Marine Sanctuaries Act (NMSA) prohibits the destruction, loss of, or injury to any sanctuary resource managed under law or regulations for the sanctuary in question and any violation of the act, any regulations, or permits issued thereunder. Section 304(d) of the NMSA requires Federal agencies to consult with the Secretary of Commerce, through NOAA, on Federal agency actions internal or external to any national marine sanctuary that are likely to destroy, cause the loss of, or injure any sanctuary resource. For the Stellwagen Bank National Marine Sanctuary (SBNMS), the threshold for consultation is "may affect" sanctuary resources (Public Law 102-587 section 2202).

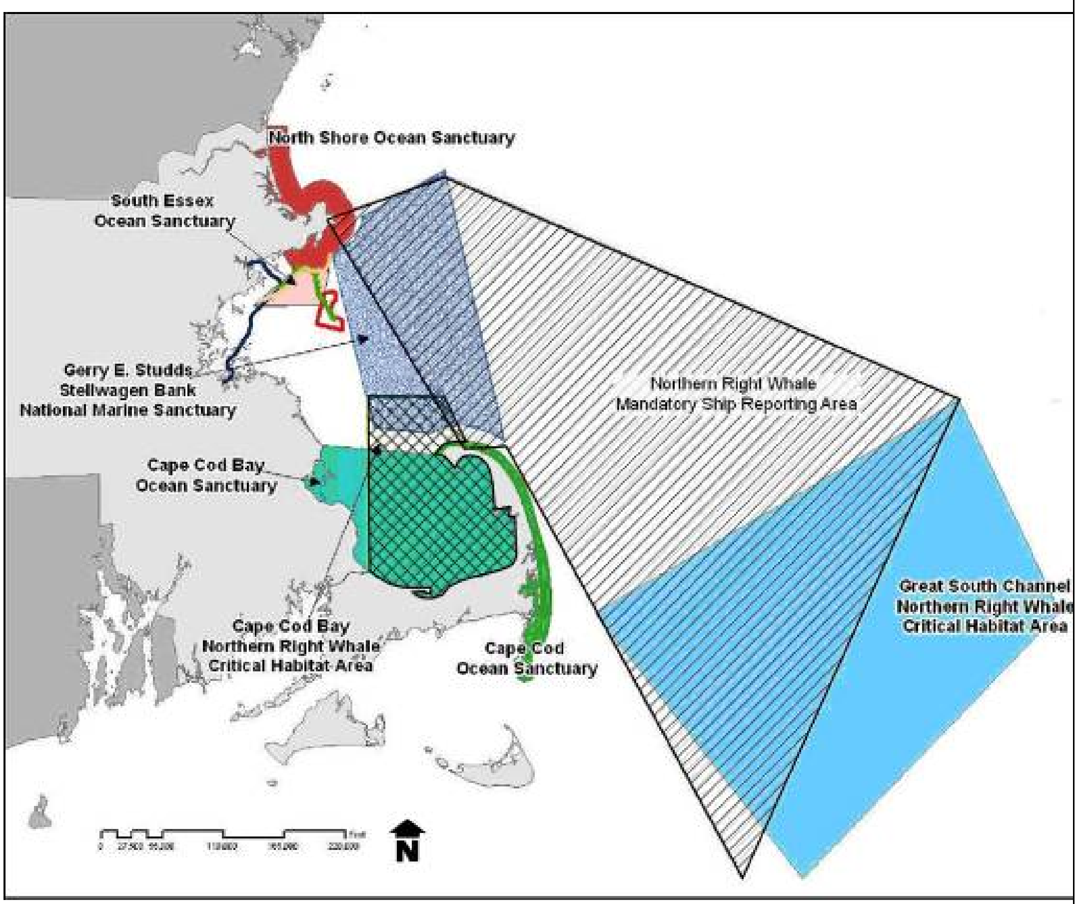


Figure 3-8. Location of the NEG Port and Pipeline, Marine Protected Areas, Sanctuaries, and Northern Right Whale Reporting Area

Table 3-21

Federal and State Marine Mammal Protected Areas in Project Region

Managing Agency	Site Name	Size (Sq. M)	Location
NOAA, NMSP	Gerry E. Studds Stellwagen Bank National Marine Sanctuary	842	Mouth Of Mass. Bay Between Cape Cod And Cape Ann On Stellwagen Bank; Just East Of Project Area
NOAA, NMFS	Great South Channel Northern Right Whale Critical Habitat Area	3,321	East Of Cape Cod And Nantucket And West Of Georges Bank; Approx. 71 Miles South Of Project Area
NOAA, NMFS	Cape Cod Bay Northern Right Whale Critical Habitat Area	643	North End Of Cape Cod Bay; Approx. 21 Miles South Of NEG Port
MASS. DCR	North Shore Ocean Sanctuary	175	Northern Mass. Coast From NH Border To Manchester-By-The-Sea; Pipeline Lateral Within Southern End Of Sanctuary
MASS. DCR	South Essex Ocean Sanctuary	56	Mass. Coast From Manchester-By-The Sea South Through Swampscott; Pipeline Lateral Within Sanctuary
MASS. DCR	Cape Cod Bay Ocean Sanctuary	616	Entire Cape Cod Bay; Approx. 21 Miles South Of Project Area
MASS. DCR	Cape Cod Bay Ocean Sanctuary	189	East Of Cape Cod Along Entire Outer Cape Cod Peninsula; Approx. 27 Miles South Of Project Area

The federally designated Great South Channel and Cape Cod Bay Northern Right Whale Critical Habitat areas have been designated specifically to protect habitats important to the North Atlantic right whale. The other protected areas and ocean sanctuaries protect natural habitats, which indirectly protect right whales and all other marine species encountered within the protection boundaries.

3.2.4.2 Non-Endangered or Threatened Marine Mammals

Table 3-22 lists the marine mammals protected under the MMPA (but not the ESA) encountered in the waters off of the Massachusetts coast. This list includes fourteen species of whales, porpoises, dolphins, and seals. Six additional species of whales are protected under the ESA of 1973, and are discussed in section 3.3, accordingly. Also shown in Table 3-22 are the times of year these species are generally found in Massachusetts Bay, as well as the NMFS status as “non-strategic” or “strategic”. The term “strategic stock” means a marine mammal that meets the following criteria: (i) the level of direct human-caused mortality exceeds the potential biological removal level, and (ii) which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA of 1973 within the foreseeable future, or (iii) which is listed as a threatened species or endangered species under the ESA of 1973, or is designated as depleted under this Act.

The evaluation of non-endangered or threatened marine mammals in the vicinity of the Project site used data and information from many sources including sightings databases from the Whale Center of New England (Weinrich and Sardi, 2005) and the North Atlantic Right Whale Consortium (NARWC), as well as published articles and books on marine mammals in the Massachusetts Bay, Cape Cod Bay, and Stellwagen Bank.

Table 3-22

**MMPA Protected Marine Mammals
Sighted in the waters off the Massachusetts Coast
(excluding those listed pursuant to the ESA)**

Common Name	Scientific Name	NMFS Status	Time of Year in Massachusetts Bay
Toothed Whales (Odontoceti)			
Atlantic White-Sided Dolphin	Lagenorhynchus acutus	Non-strategic	Year Round
Bottlenose Dolphin	Tursiops truncatus	Non-strategic	Late Summer, Early Fall
Short-beaked Common Dolphin	Delphinus delphis	Non-strategic	Fall and Winter
Harbor Porpoise	Phocoena phocoena	Non-strategic	Year Round (Sept-April peak)
Killer Whale	Orcinus orca	Non-strategic	July-September
Long-Finned Pilot Whale	Globicephala melaena	Strategic	Year Round (Sept-April peak)
Risso's Dolphin	Grampus griseus	Non-strategic	Spring, Summer, Autumn
Striped Dolphin	Stenella coeruleoalba	Non-strategic	Year Round
White-beaked Dolphin	Lagenorhynchus albirostris	Non-strategic	April-November
Baleen Whales (Mysticeti)			
Minke Whale	Balaenoptera acutorostrata	Non-strategic	April-October
Earless seals (Phocidae)			
Gray Seals	Halichoerus grypus	Non-strategic	Year Round
Harbor Seals	Phoca vitulina	Non-strategic	Late September-Early May
Hooded Seals	Cystophora cristata	Non-strategic	January-May
Harp Seals	Phoca groenlandica	Non-strategic	January-May

Source: (NMFS, 1993, NMFS, 2003; Waring et al., 2004; Wilson et al., 1999)

Much of the information regarding marine mammals within the Project area was obtained from the NMFS stock assessments (Waring et al., 2004). These assessments include a description of the species and their geographic range, population estimates and trends, estimates of human-caused mortality by source, descriptions of commercial fisheries that interact with the stock, as well as estimates of potential biological removal (PBR) levels and classification as "non-strategic" or "strategic".

Mammal distribution information was obtained from the following two primary sources: Whale Center of New England (Weinrich and Sardi, 2005) and North Atlantic Right Whale Consortium. The Whale Center of New England sightings data are collected by observers on whale watch boats out of Gloucester, Salem, Boston, and Provincetown, as well as one dedicated research vessel out of Gloucester. The NARWC maintains sightings data collected by government and private right whale researchers. While both datasets provide a wealth of information on mammal distribution in the NEG project area, they also contain biases. For example, the Whale Center of New England data collected using whale watch boats is biased towards humpback whales (endangered species - Section 3.3) and other whale species that spend time in proximity to humpbacks, since humpbacks are preferred over other species for this activity. The sightings data also provide better definition of mammal distributions along the western side of the aggregation areas, since the vessels are transiting to and from the west. The NARWC database is biased towards right whale critical habitat, and also against species other than right whales (endangered species – Section 3.3) within those habitats. However, these two databases combined together, along with the NMFS stock assessments, provide the most up-to-date information available on marine mammal distributions in the NEG project area.

Cetaceans inhabit all of the world's oceans and are found in coastal, estuarine, and highly pelagic habitats. The majority of cetaceans in the western North Atlantic Ocean are found in continental shelf waters and their distribution is often closely correlated with the distribution of their prey (Wilson and Ruff, 1999). The western margin of the Gulf of Maine is the most intensely used cetacean habitat on the northeast U.S. Continental Shelf (Kenney and Winn, 1986). This is primarily because the biological productivity of the area provides a variety of food for these whales. In general, use of the Gulf of Maine habitat areas by cetaceans increases in the spring and summer, and decreases in the fall and winter.

Whales are strong swimmers and are known to travel long distances during migrations between feeding and breeding areas. The smaller species are shallow divers, while the larger whales are capable of deep dives. There are two groups of cetaceans, toothed whales and baleen whales. The toothed whales (Odontoceti) all possess teeth, are very gregarious, generally feed on fish and invertebrates, and use echolocation for orientation and prey detection. Baleen whales, (Mysticeti) do not have any teeth, but use a filtration system, consisting of keratinous baleen plates, to sieve prey from the water. Their prey primarily consists of zooplankton and small schooling fish. They usually forage in the upper 650 feet (198 meters) of the water column. Baleen whales are known to maintain small, unstable groups or remain as solitary individuals (Wilson and Ruff, 1999).

All cetaceans communicate by emitting a variety of underwater sounds. Most marine animals can perceive underwater sounds over a broad range of frequencies from about 10 hertz (Hz) to more than 150,000 Hz (150 kHz). Many of the dolphins and porpoises use even higher frequency sound for echolocation and perceive these high frequency sounds with high acuity. Whales respond to low-frequency sounds with broadband intensities of more than 120 dB re 1 μPa, or about 10 to 20 dB above natural ambient noise at the same frequencies (Richardson et al., 1991). Toothed whales create three types of sounds: tonal whistles; pulsed sounds of short duration to be used in echolocation; and less distinct pulsed sounds, such as cries, grunts, and barks. Toothed whales become very vocal when together, especially when interacting with each other. Peak underwater sound detection in most baleen whales, including the endangered species discussed in section 3.3, is assumed to be in the range of frequencies in which their calls have the greatest energy, below 1,000 Hz (Ketten, 2000). The whales use these low-frequency sounds primarily for long-range communication.

Pinnipeds include seals, sea lions/fur seals, and walrus. These animals are globally distributed aquatic mammals with some specializations for terrestrial life (Gentry, 1998). There are up to 37 pinniped species, which includes eared seals (family Otariidae), true or earless seals (family Phocidae), and walruses (family Odobenidae) (Berta, 2002). Pinnipeds are primarily adapted for life in the water, but their limbs allow them to haul out on to intertidal rocks and beaches where they sun themselves or rest. They are mainly known for their deep dives and long underwater stays. Smaller species dive on average for 10 minutes. Larger pinnipeds can dive for over an hour. Maximum depths vary from less than 100 m (328 ft) to over 1500 m (4,921.2 ft) (Berta, 2002).

Hearing capabilities and sound production is highly developed in all pinniped species studied to date. Pinnipeds rely heavily on sound and hearing for breeding activities and social interactions, and vocalizations are mainly heard during mating season (Schusterman, 1978; Berta, 2002; Frankel, 2002; Van Parijs and Kovacs, 2002; Wilson and Ruff, 1999). They are able to hear and produce sounds in both the air and the water. Sensitivity to sounds at frequencies above 1 kHz has been well documented. However, there have been few studies on their sensitivity to low frequency sounds. Studies have examined the hearing capabilities of some pinniped species, particularly ringed seals, harp seals, harbor seals, California sea lions, and northern fur seals

(Mohl, 1968; Terhune and Ronald, 1972; Terhune and Ronald, 1975; Kastak and Schusterman, 1996; Kastak and Schusterman, 1998).

Non-Endangered or Threatened Toothed Whales

Atlantic White-Sided Dolphin (Lagenorhynchus acutus)

The Atlantic white-sided dolphin has black, gray, and white coloring and is 7 to 9 feet (2.1 to 2.7 meters) long with an acutely pointed dorsal fin (Ward, 2000). They are found at depths of approximately 330 feet (100 meters) in the cool temperate and subpolar waters of the North Atlantic, generally along the continental shelf between the Gulf Stream and the Labrador current to as far south as North Carolina (Bulloch, 1993; Reeves et al., 2002). NMFS recognizes three stocks of the Atlantic white-sided dolphin in the western North Atlantic: a Gulf of Maine stock, a Gulf of St. Lawrence stock, and a Labrador Sea stock (Waring et al., 2004). The Gulf of Maine stock occupies regions of both the Gulf of Maine (usually in the southwestern portion) and Georges Bank throughout the entire year. Calving occurs during the summer months (Waring et al., 2004).

Estimates of population size were calculated by summing the results of two separate aerial surveys. Results indicate that the population of the Gulf of Maine stock is approximately 51,640 individuals (Waring et al., 2004). Population estimates in U.S. shelf waters suggest approximately 30,000 individuals. An additional 12,000 animals have been estimated to summer in the Gulf of St. Lawrence (Reeves et al., 2002).

This species is highly social and is commonly seen feeding with fin whales. They feed on a variety of fish such as herring, hake, smelt, capelin, and cod, as well as squid (NMFS, 1993). Atlantic white-sided dolphins are known to vocalize through whistles. Whistles are produced at a dominant frequency of 6 to 15 Hz (Richardson et al., 1995).

The biggest human-induced threat to the Atlantic white-sided dolphin is bycatch because they are occasionally caught in fishing gillnets and trawling equipment. Approximately 100 dolphins each year were killed by human activities during 1997 to 2001 (Waring et al., 2004). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as “non-strategic” (Waring et al., 2004). The term "potential biological removal level" means the maximum number of animals, not including natural mortalities that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. Potential biological removal is derived from the product of the minimum population size of the stock, one-half the maximum productivity rate, and a “recovery” factor of between 0.1 and 1.0 which is unique for each stock (MMPA Section 3.16 U.S.C. 1362; Wade and Angliss, 1997).

Bottlenose Dolphin (Tursiops truncatus)

The bottlenose dolphin is a light- to slate- gray dolphin, roughly 8 to 12 feet (2.4 to 3.7 meters) long with a short, stubby beak. Because this species occupies a wide variety of habitats, it is regarded as possibly the most adaptable cetacean (Reeves et al., 2002). It occurs in oceans and peripheral seas at both tropical and temperate latitudes. In North America, bottlenose dolphins are found in surface waters with temperatures ranging from 50 to 90 °F (10 to 32 °C).

There are two distinct bottlenose dolphin populations: shallow water and deepwater population. The shallow water, coastal population resides along the inner continental shelf and around islands. These animals often move into or reside in bays, estuaries, and the lower reaches of rivers (Reeves et al., 2002). The deepwater population is the only one found in the northern latitudes of the North Atlantic, typically in Gulf Stream waters. This deepwater population extends along the entire continental shelf-break from Georges Bank to Cape Hatteras during the spring and summer months, and has been observed in the Gulf of Maine during the late summer and fall. The NMFS species stock assessment report estimates the population of western North Atlantic offshore bottlenose dolphin stock at 29,774 individuals (Waring et al., 2004).

Bottlenose dolphins feed on a large variety of organisms, depending on their habitat. The coastal, shallow population tends to feed on benthic fish and invertebrates, while deepwater populations consume pelagic or mesopelagic fish such as croakers, sea trout, mackerel, mullet, and squid (Reeves et al., 2002). Bottlenose dolphins appear to be active both during the day and night. Their activities are influenced by the seasons, time of day, tidal state, and physiological factors such as reproductive seasonality (Wells and Scott, 2002).

Bottlenose dolphins hear underwater sounds in the range of 150 Hz to 135 kHz (Johnson, 1967; Ljungblad et al., 1982). Their best underwater hearing occurs at 15 kHz, where the hearing threshold level is 42 to 52 dB re 1 μPa at 1 m (Sauerland and Dehnhardt, 1998). Bottlenose dolphins also have excellent sound location capabilities and are most sensitive when sounds arrive from the front (Richardson et al., 1995).

The biggest threat to the population is bycatch because they are frequently caught in fishing gear, gillnets, purse seines, and shrimp trawls (Waring et al., 2004). They have also been adversely impacted by pollution, habitat alteration, boat collisions, human disturbance, and are subject to bioaccumulation of toxins. Scientists have found a strong correlation between dolphins with elevated levels of PCBs and illness, indicating certain pollutants may weaken their immune system (ACSonline, 2004). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al., 2004).

Short-Beaked Common Dolphin (Delphinus delphis)

Short-beaked common dolphins are very colorful, with an hourglass pattern on the side of their body. They are 6 to 8 feet (1.8 to 2.4 meters) long and can either be short- or long-beaked (ACSonline, 2004). They can be found along the 200 to 2,000 meter (650 to 6,500 foot) isobaths over the continental shelf and in pelagic waters of the Atlantic and Pacific Oceans. They are present in the western Atlantic from Newfoundland to Florida. The short-beaked common dolphin is especially common along shelf edges and in areas with sharp bottom relief such as seamounts and escarpments (Reeves et al., 2002). They show a strong affinity for areas with warm, saline surface waters. Off the coast of the eastern U.S., they are particularly abundant in continental slope waters from Georges Bank southward to about 35 degrees North (Reeves et al., 2002). They are only occasional visitors to the Massachusetts Bay area as they usually inhabit more tropical and warm-temperate waters (Waring et al., 2004). The long-beaked dolphin is more common in coastal waters, where the short-beaked dolphin inhabits offshore waters. When encountered feeding in the Massachusetts Bay area, it is usually during the fall and winter (NMFS, 1993). According to the species stock report, the population estimate for the western North Atlantic common dolphin is 30,768 individuals (Waring et al., 2004).

These dolphins typically gather in schools of hundreds of thousands, although the schools generally consist of smaller groups of 30 or fewer. The short-beaked common dolphin feeds on small schooling fish and squid. They have been known to feed on fish escaping from fishermen's nets or fish that are discarded from boats (NMFS, 1993).

Hearing studies show that common dolphins hear underwater sounds equal to or louder than 120 dB re 1 μPa @ 1 m in the range of less than 5 kHz to 150 kHz. The best underwater hearing of the species occurs at 65 kHz, where the threshold level is 53 dB (Popov and Kishin, 1998).

The short-beaked common dolphin is also subject to bycatch. It has been caught in gillnets, pelagic trawls, and during longline fishery activities. During 1997 to 2000, 190 dolphins were killed each year by human activities. Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al., 2004).

Harbor Porpoise (Phocoena phocoena)

This dark gray/dark brown porpoise has a blunt snout and is 4 to 6 feet (1.2 to 1.8 meters) long. They inhabit shallow, coastal waters, often found in bays, estuaries, and harbors. In the western Atlantic, they are found from Cape Hatteras north to Greenland. They are common visitors to Massachusetts Bay from September through April. During the spring, they are found from the Bay of Fundy to south of Cape Cod. They concentrate in southwestern Gulf of Maine, Great South Channel, Jeffrey's Ledge, and coastal Maine during the mid-spring months. After April, they migrate north towards the Gulf of Maine and Bay of Fundy. According to the species stock report, the population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 89,700 individuals (Waring et al., 2004).

Harbor porpoise generally eat small schooling fishes such as mackerel, herring, and cod, as well as worms, squid, and sand eels (ACSonline, 2004; NMFS, 1993).

Harbor porpoise can hear sounds in the range of 100 Hz to 140 kHz for sounds 120 dB re 1μPa or louder (Andersen, 1970; Kastelein et al., 2002).

The most common threats to the harbor porpoise are fishing activities, especially from bottom-set gillnets. These activities result in a high level of incidental mortality. It has been demonstrated that the porpoise echolocation system is capable of detecting fishing net fibers but they fail to avoid the nets for unidentified reasons (Reeves et al., 2002). Roughly 365 harbor porpoises are killed by human-related activities each year. In 1999, a Take Reduction Plan to reduce harbor porpoise gillnet bycatch was implemented in the Atlantic waters of the United States. The plan pertains to the Gulf of Maine and focuses on sink gillnets and other gillnets that catch groundfish in New England waters. The ruling implements time and area closures, some of which are complete closures, as well as requiring pingers on multispecies gillnets. In 2001, the harbor porpoise was removed from the candidate species list for the Endangered Species Act of 1973; a review of the biological status of the stock indicated that a classification of "Threatened" was not warranted (Waring et al., 2004). The species was recently downgraded in 2002 from a NMFS rating of "strategic" to "non-strategic" because its current average annual fishery-related mortality and serious injury does not exceed its potential biological removal (Waring et al., 2002).

Killer Whale (Orcinus orca)

The black-and-white killer whale is the largest member of the dolphin family, roughly 22 to 30 feet (6.7 to 9.1 meters) long and nearly 9,000 pounds (4,080 kilograms). This species is found in all of the world's oceans with highest densities in the high latitudes (Wilson and Ruff, 1999). Killer whales do not maintain a regular migration route because they generally migrate towards viable food sources, which are likely to be schools of bluefin tuna. Killer whale presence in the waters off the east coast of the United States is considered uncommon (Katona et al., 1988; Waring et al., 2004). When encountered, they are seen in the southwestern Gulf of Maine from mid-July to September. Killer whales have been found to overwinter in the Gulf of Maine and were seen on Jeffreys Ledge, between the Isles of Shoals and Stellwagen Bank (NMFS, 1993). They feed on a variety of fish, including tuna, herring, and mackerel, and have also been known to attack seals, seabirds, and other cetaceans such as large baleen and sperm whales (NMFS, 1993; Blaylock et al., 1995). According to the species stock report, the population estimate for the western North Atlantic stock of killer whales is unknown (Baylock et al., 1995).

Killer whales have a diverse diet, feeding on a variety of fish species, cephalopods, pinnipeds, sea otters, whales, dolphins, seabirds, and marine turtles (Hoyt, 1981; Gaskin, 1982; Jefferson et al., 1991).

Killer whales can hear underwater sounds from less than 500 Hz to 120 kHz (Bain et al., 1993; Szymanski et al 1999). Their best hearing occurs between 15 and 42 kHz, where the hearing threshold level is near 34 - 36 dB re 1 μPa (Hall and Johnson, 1972; Szymanski et al 1999).

The killer whale is not endangered, although whaling or live-capture operations have depleted some regional populations. They are threatened by pollution, heavy ship traffic, and possibly reduced prey abundance. There have been no observed mortalities or serious injuries by NMFS Sea Samplers in the pelagic drift gillnet, pelagic longline, pelagic pair trawl, New England multispecies sink gillnet, mid-Atlantic coastal sink gillnet, or the North Atlantic bottom trawl fisheries (Blaylock et al., 1995). Recent evidence has also indicated that they are subject to biomagnification of toxic substances (ACSonline, 2004). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as “non-strategic” (Blaylock et al., 1995).

Long-Finned Pilot Whale (Globicephala melas)

The long-finned pilot whale is black to coal gray, 10 to 20 feet long, and has a distinct rounded head with a slight beak. They generally stay along the continental shelf edge in water depths of 330 to 3,300 feet (100 to 1,000 meters), choosing areas of high relief or submerged banks in cold or temperate shoreline waters. The Southern subspecies is circumpolar with northern limits of Brazil and South Africa. The North Atlantic subspecies ranges from North Carolina to Greenland (Reeves et al., 2002; Wilson and Ruff, 1999). In the western North Atlantic, long-finned pilot whales are pelagic, occurring in especially high densities in winter and spring over the continental slope, then moving inshore and onto the shelf in summer and autumn following squid and mackerel populations (Reeves et al., 2002). They frequently travel into the central and northern Georges Bank, Great South Channel, and Gulf of Maine areas during the summer and early fall in May and October (NMFS, 1993). The population estimate for the Gulf of Maine/Bay of Fundy long-finned pilot whale stock is 14,524 individuals (Waring et al., 2004).

Long-finned pilot whales feed preferentially on squid but would eat fish (e.g., herring) and invertebrates (e.g., octopus, cuttlefish) if squid are not available. Younger whales, in particular, also occasionally ingest shrimp and various other fish species. These whales probably take most of their prey at depths of 200 to 500 meters, although they can forage deeper if necessary (Reeves et al., 2002). These whales are very social animals and swim in pods of roughly 20 individuals. These small pods are thought to be formed around adult females and their offspring.

The long-finned pilot whales are subject to bycatch during gillnet fishing, pelagic trawling, longline fishing, and purse seine fishing. Approximately 215 pilot whales were killed or seriously injured each year by human activities during the period 1997 to 2001. Strandings involving hundreds of individuals are not unusual and demonstrate that these large schools have a high degree of social cohesion (Reeves et al., 2002). The species is rated as “strategic” by NMFS because the estimated average annual fishery-related mortality from1997 to 2001 exceeded the potential biological removal (Waring et al., 2004).

Risso's Dolphin (Grampus griseus)

Risso's dolphins are dark gray with extensive white scarring. They are 9 to 13 feet (2.7 to 4.0 meters) long and are usually found in offshore warm temperate and tropical waters of all oceans and large seas. In some areas, or possibly seasonally, they occupy a very narrow niche of the steep upper continental slope, where water depths usually exceed 1,000 feet (300 meters) (Reeves et al., 2002). They also move onto the shelf occasionally in response to squid availability. Although seasonal shifts in density occur, clear migratory patterns have not been defined. Risso's dolphins normally stay outside of the 100 foot (30 meter) contour south of Cape Cod, and are only occasionally encountered in Massachusetts Bay. The NMFS species stock report, estimates the population for the western North Atlantic stock of Risso's dolphin at 29,110 individuals (Waring et al., 2004).

Risso's dolphins are usually seen in groups of 12 to 40 individuals. Loose aggregations of 100 to 200, or even several thousand, are seen occasionally (Reeves et al., 2002). They can be playful and acrobatic during interludes of rest near the surface, with breaching and tail slapping fairly common.

Risso's dolphins are squid specialists but occasionally consume other cephalopods (octopus and cuttlefish); however, Risso's dolphins would eat fish or crustaceans if squid is not available (ACSonline, 2004; NMFS, 1993; Waring et al., 2004; Reeves et al., 2002). Much of their feeding takes place at night, possibly because some prey species migrate toward the surface at that time (Baird, 2002). Swim speeds from Risso's dolphins were recorded at 2-12 km/h (1.1 to 6.5 knots) (Shane, 1995).

Audiograms for Risso's dolphins show hearing capabilities from 1.5 to 100 kHz (Johnson, 1967; Au et al., 1995).

Risso's dolphin appears abundant, widely distributed, and not immediately threatened globally (Reeves et al., 2002). The biggest threats to Risso's dolphins are entanglement in fishing gear and pollution from coastal development (ACSonline, 2004). They are also subject to bycatch from getting caught in gillnets and during trawling activities. During the years 1996 to 2000, a total of 51 Risso's dolphins were killed or seriously injured from fishing activities (Waring et al., 2004). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al., 2004).

Striped Dolphin (Stenella coeruleoalba)

The striped dolphin is dark blue gray with black stripes running the body length which is 6 to 8 feet long (1.8 to 2.4 meters); and is found in warm, temperate, tropical, and subtropical waters. Striped dolphins frequent more temperate waters with seasonal upwelling and seasonal changes (Perrin et al., 1994). The northern limits of the striped dolphin range are Newfoundland and southern Greenland. There are numerous populations of striped dolphins that are isolated from one another. The species prefers pelagic waters along the edge of the continental shelf. Striped dolphins are not seen often, or in large numbers, inland of the continental shelf edge but become common in deeper slope waters. They are only occasionally encountered in Massachusetts Bay. The population estimate for the western North Atlantic stock of striped dolphins is 61,546 individuals (Waring et al., 2000).

Striped dolphins travel in dense schools that average about 100 animals but can contain as many as 500 (Reeves et al., 2002). Some schools have only adults, some only juveniles, and some both adults and juveniles. They have a fairly diverse diet but generally feed on fish less than 5 inches (13 centimeters) long and cephalopods less than 8 inches (20 centimeters) long (in dorsal mantle length) (NMFS, 1993; Ward, 2000; Reeves et al., 2002). Prey is consumed anywhere in the water column as long as it occurs in large, dense schools. Striped dolphins may be more active at night because the fish and cephalopods that they eat migrate to the surface at night. Average swim speed is 11 km/h (5.9 knots) (Archer II and Perrin, 1999).

Auditory brainstem responses indicate that striped dolphins hear underwater sounds equal to or louder than 120 dB re 1 μPa @ 1 m in the range of 10 to greater than 100 kHz (Popper, 1980). Behavioral audiogram results shows hearing capabilities from 0.5 to 160 kHz. The best underwater hearing of the species appears to be at from 29 to 123 kHz (Kastelein et al., 2003).

Striped dolphins remain abundant on a global scale but there is concern about the species' impacts from fishing activities including overfishing, habitat degradation, and stress from food shortages. The biggest threats to striped dolphins are entanglements in gillnets and trawling nets. Approximately seven striped dolphins were killed each year by fishery-related incidents during 1994 to 1998 (Waring et al., 2000). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al., 2000).

White-Beaked Dolphin (Lagenorhynchus albirostris)

The white-beaked dolphin is black with gray and white patches, 8 to 10 feet (2.4 to 3.0 meters) long, and is found in the North Atlantic from the waters of southern New England north to western and southern Greenland and Davis Straits. They are more common in European than American waters. Populations in eastern and western Atlantic waters are morphologically distinct and therefore probably do not often mix. In summer, white-beaked dolphins are found in subarctic and arctic waters that are ice-covered or at least ice-infested, but in winter, they move away from enclosed areas and ice formations near shore. They are often victims of ice entrapment in Newfoundland. According to the species stock report, the current abundance for the western North Atlantic stock of white-beaked dolphins is unknown, because the species has not been sighted during stock assessment surveys (Waring et al., 2004). Previous assessments estimated 6,000 white-beaked dolphins in the western North Atlantic (Waring et al., 2004)

White-beaked dolphins usually use the northern end of Stellwagen Bank between April to November, while feeding on sand eels, squid, and mesopelagic fish such as cod and whiting (Waring et al., 2004). Calving also occurs here during the summer months (Waring et al., 2004). They were once more common in the Gulf of Maine but in the mid-1970s, were displaced by Atlantic white-sided dolphins (Kenney et al., 1996). These animals are typically seen in groups of 5 to 50 and occasionally in schools of several hundred (Reeves et al., 2002). White-beaked dolphins are attracted to powered vessels, are active bow riders, and can be acrobatic above the surface. They frequently associate with feeding fin and humpback whales (Reeves et al., 2002).

A pronounced decrease in abundance has occurred since the early 1970s off the northeastern United States, while there seem to be increases in some areas off northwestern Europe (Reeves et al., 2002). The biggest threat to white-beaked dolphins is entanglement in gillnets, primarily in Canada. There is no evidence of fishery-related mortality or serious injury to this stock in the United States Exclusive Economic Zone (Waring et al., 2004). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al., 2004).

Non-Endangered or Threatened Baleen Whales

Minke Whale (Balaenoptera acutorostrata)

Minke whales, black to dark gray on top and white on the bottom, are 15 to 30 feet (4.5 to 9.0 meters) long and are the smallest of the baleen whales. They are among the most widely distributed of all the baleen whales. They occur in the North Atlantic and North Pacific, from tropical to polar waters. Currently, scientists recognize two subspecies of minke whales: the North Atlantic minke and the North Pacific minke. Generally, they inhabit warmer waters during winter and travel north to colder regions in summer, with some animals migrating as far as the ice edge. They are frequently observed in coastal or shelf waters and in the Massachusetts area, have been recorded in the shallow waters of Stellwagen Bank and southern Jeffrey's Ledge from April until October. According to the species stock report, the population estimate for the Canadian east coast stock of minke whales is 4,018 individuals (NMFS, 1993; Waring et al., 2004; Weinrich and Sardi, 2005; Wilson and Ruff, 1999).

Minke whale sightings data specific to Massachusetts Bay have been presented by Weinrich and Sardi (2005). Their data are shown in Figures 3-9 through 3-12, in two 5-year blocks (1995 to 1999; 2000 to 2004) for the spring and summer season (April through August) as well as the fall season (September to November). In all cases, minke whale sightings were concentrated over the shallow waters of Stellwagen Bank, to the east of the NEG Port site. Minke whale sightings were more widely distributed during the spring and summer periods, with a number of sightings in the shallower waters west of Stellwagen Basin (near the NEP Port site and to the west). Sightings during the fall periods were fewer, with the heaviest concentrations to the east of the NEG Port site over the shallow waters of Stellwagen Bank.

Minke whale abundances reach their highest level in late summer/early fall and are commonly associated with a rise in the fin whale population. As is typical of the baleen whales, minke whales are usually seen either alone or in small groups, although large aggregations sometimes occur in feeding areas (Reeves et al., 2002). Minke populations are often segregated by sex, age, or reproductive condition. Known for their curiosity, minkes often approach boats.

These animals feed on schooling fish (i.e., herring, sand eel, capelin, cod, pollack, and mackerel), invertebrates (squid and copepods), and euphausiids. Minke whales basically feed below the surface of the water and calves are usually not seen in adult feeding areas. Normal swimming speeds have been reported as 6.1 km/h (3.3 knots) (Lockyer, 1981). Dive times range from 1.5 to 7 minutes. Dive depths are not well known.

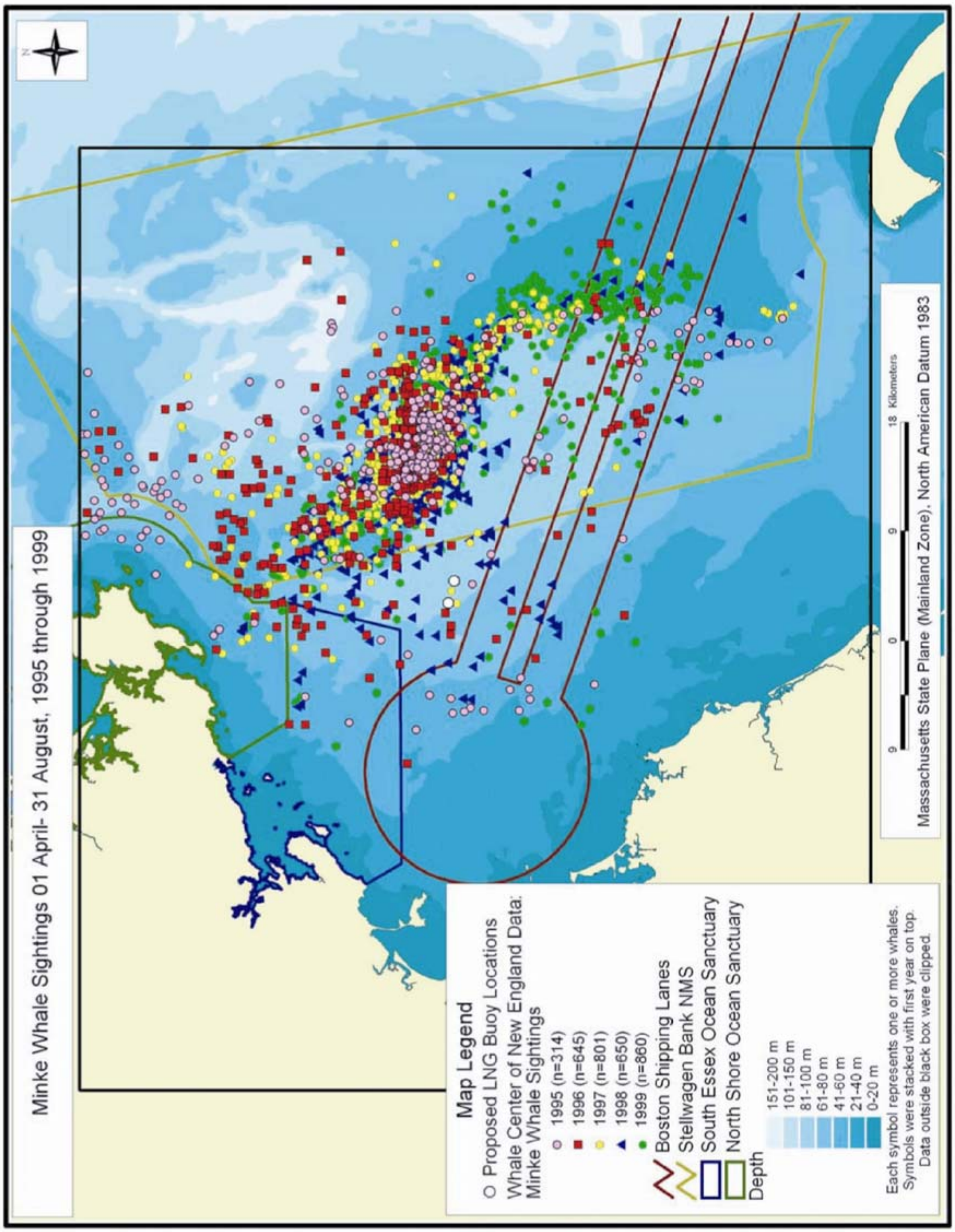


Figure 3-9. Minke Whale Sightings 01April – 31 August, 1995 through 1999

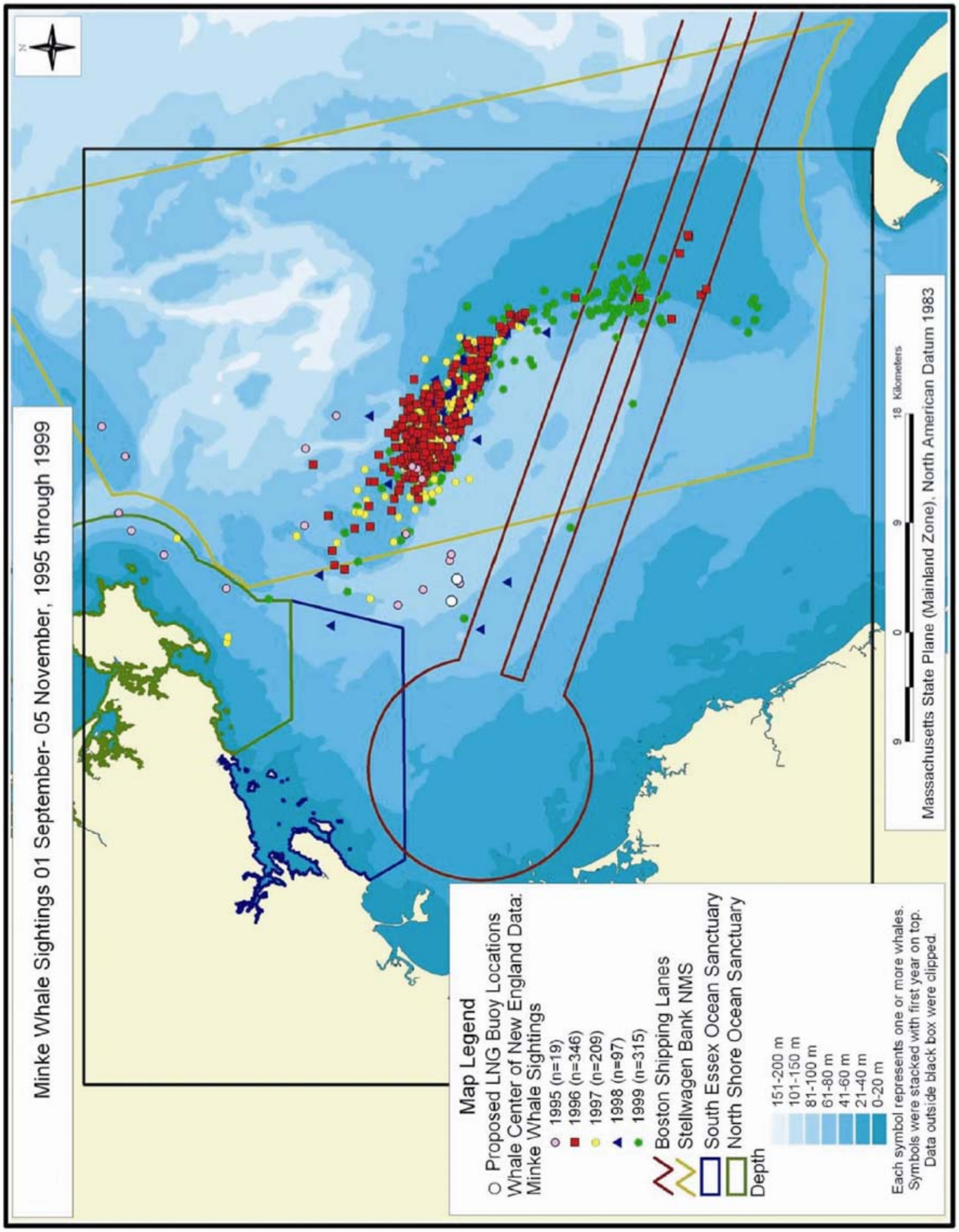


Figure 3-10. Minke Whale Sightings 01 September – 05 November, 1995 through 1999

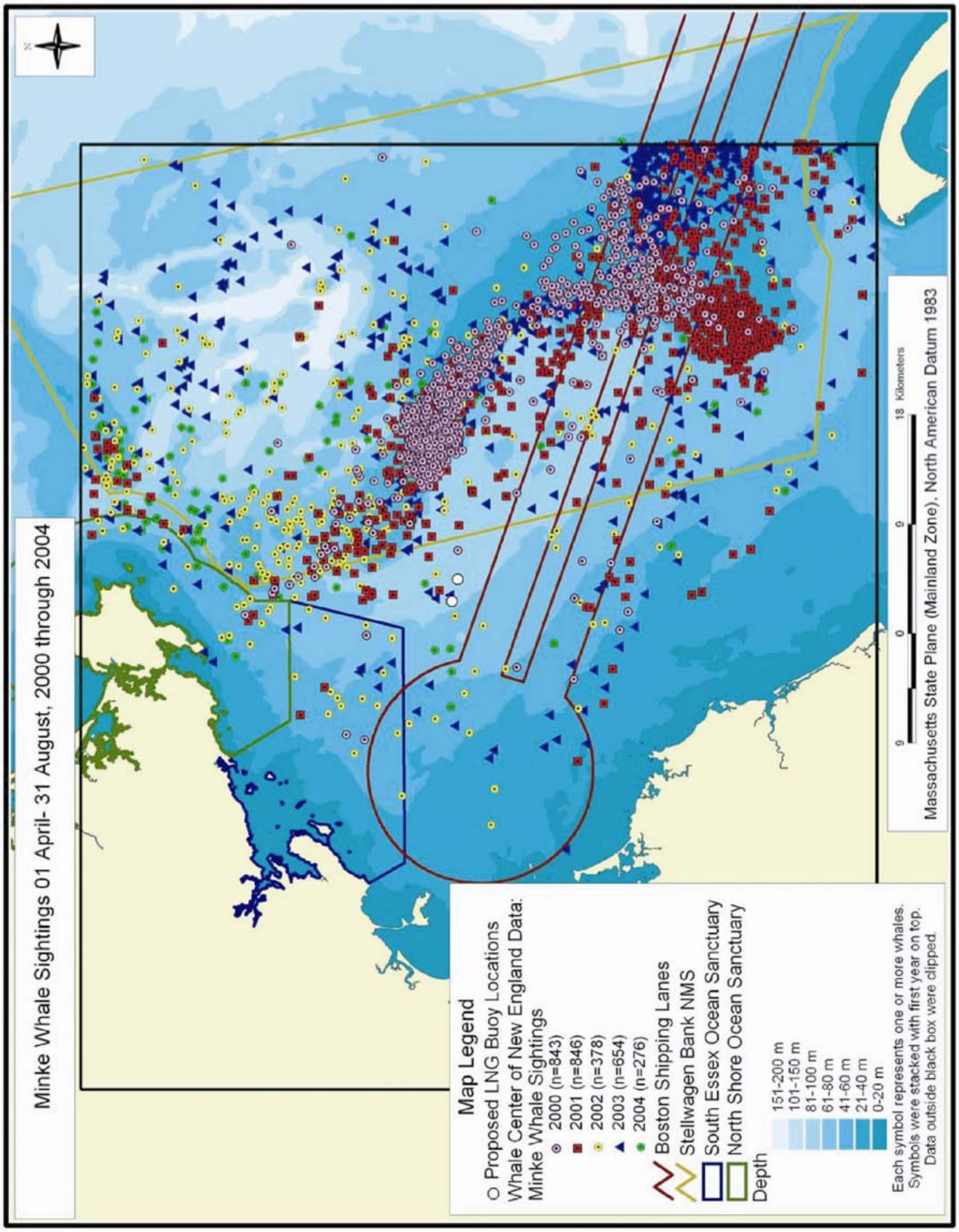


Figure 3-11. Minke Whale Sightings 01 April –31 August, 2000 through 2004

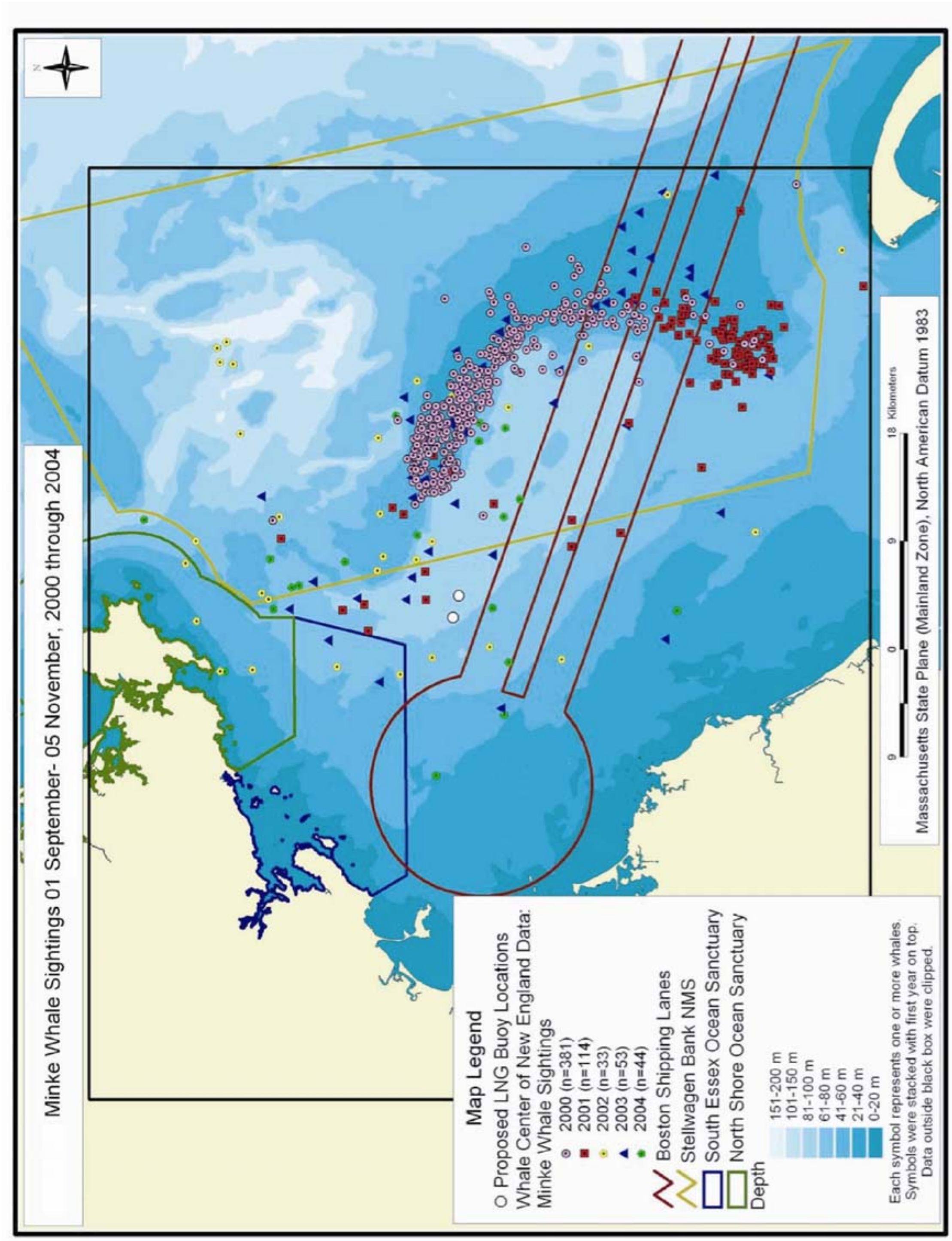


Figure 3-12. Minke Whale Sightings 01 September – 05 November, 2000 through 2004

Minke whales use many different types of vocalizations such as, down sweeps, upsweeps, grunts, clicks, thump trains, and ratchet sounds. Thump trains are believed to contain individual signature information. They last over one minute, are composed of 50 to 70 millisecond thumps, and have energy at 100 to 200 Hz. They are believed to use sounds to help identify each other and to maintain spacing (Richardson et al., 1995). Typical sounds produced by minke whales are listed in Table 3-23.

Table 3-23

Sounds Produced by Minke Whales

Signal Type	Frequency Range (Hz)	Dominant Frequency (Hz)	Source Level (dB re 1 μPa at 1 m)
Down sweeps	60 to 130		165
Moans, grunts	60 to 140	60-140	151 to 175
Ratchet	850 to 6000	850	
Clicks	3300 to 20,000	<12,000	151
Thump trains	100 to 2000	100-200	

Source: Richardson et al., 1995.

Minke whales are impacted by ship strikes and bycatch from gillnet and purse seine fisheries. Approximately four minke whales were killed or seriously injured per year by human activities during 1997 to 2001, with an average annual mortality from ship strikes of 0.2 (Waring et al., 2004). In addition, hunting for minke whales continues today, by Norway in the northeastern North Atlantic and by Japan in the North Pacific and Antarctic (Reeves et al., 2002). International trade in the species is currently banned. Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al., 2004).

3.2.4.2.3 Non-Endangered or Threatened Seals

Gray Seal (Halichoerus grypus)

Gray seals are gray, brown, and silver in coloration and inhabit both sides of the North Atlantic in both the temperate and subarctic waters (Morris, 2004). Scientists recognize three primary populations of this species, all in the northern Atlantic Ocean. The gray seals that reside in Nantucket Sound are part of the eastern Canada stock, which can be found from Cape Chidley in the Labrador Sea in the north to most recently Long Island Sound in the south (Katona et al., 1993). Gray seals form colonies on rocky island or mainland beaches, though some seals give birth in sea caves or on sea ice, especially in the Baltic Sea. Gray seals prefer haulout and breeding sites that are surrounded by rough seas and riptides where boating is hazardous. Pupping colonies have been identified at Muskegat Island in Nantucket Sound, Monomoy National Wildlife Refuge, and in eastern Maine (Rough, 1995). According to the species stock report, the population estimate for the western North Atlantic stock of gray seals is 143,000, but the Massachusetts population was reported as greater than 5,600 in 1999 (NMFS, 1993; Waring et al., 2004).

Gray seals are gregarious, gathering to breed, molt, and rest in groups of several hundred or more at island coasts and beaches or on land-fast ice and pack-ice floes. They are thought to be solitary when feeding and telemetry data indicates that some seals may forage seasonally in waters close to colonies, while others may migrate long distances from their breeding areas to feed in pelagic waters between the breeding and molting seasons (Reeves et al., 2002). Gray seals molt in late spring or early summer and may spend several weeks ashore during this time. Gray seals typically forage for one to five days, focusing on discrete areas that are within 40 km (24.9 mi) of their haul out site (Hall, 2002). Gray seals are demersal or benthic feeders and forage on a variety of fish species and cephalopods, mostly sand eels and sand lance (Hammond et al., 1994). Other prey species include herring, whiting, cod, haddock, saithe, flatfish, and the occasional bird. Swim speeds average 4.5 km/hr.

Gray seals have underwater hearing ranging from 2 kHz to 90 kHz, with best hearing between 20 kHz and 50 to 60 kHz (Ridgway and Joyce, 1975).

The biggest threats to gray seals are entanglements in gillnets or plastic debris (Waring et al., 2004). Approximately 300 gray seals were killed each year by human activities during 1997 to 2001 (Waring et al., 2004). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al., 2004).

Harbor Seal (Phoca vitulina)

Harbor seals, also known as common seals, are the most abundant seals in eastern United States waters. They have spotted coats that can be silver-gray to black or dark brown. They are found in all nearshore waters of the Atlantic Ocean and adjoining seas north of northern Florida, however their "normal" southern limit is New Jersey. In the western North Atlantic, they inhabit the waters from the eastern Canadian Arctic and Greenland, south to southern New England and New York, and occasionally as far south as South Carolina. Some seals spend all year in eastern Canada and Maine, while others migrate to southern New England in late September and stay until late May. According to the species stock report, the population estimate for the western North Atlantic stock of harbor seals is 99,340 individuals (Marine Mammal Center, 2002; NMFS, 1993; Waring et al., 2004).

Harbor seals forage in a variety of marine habitats, including deep fjords, coastal lagoons and estuaries, and high-energy, rocky coastal areas. They may also forage at the mouths of freshwater rivers and streams, occasionally traveling several hundred miles upstream (Reeves et al., 2002). They haul out on sandy and pebble beaches, intertidal rocks and ledges, and sandbars, and occasionally on ice floes in bays near calving glaciers.

Except for the strong bond between mothers and pups, harbor seals are generally intolerant of close contact with other seals. Nonetheless, they are gregarious, especially during the molting season, which occurs between spring and autumn, depending on geographic location. They may haul out to molt at a tide bar, sandy or cobble beach, or exposed intertidal reef. During this haulout period, they spend most of their time sleeping, scratching, yawning, and scanning for potential predators such as humans, foxes, coyotes, bears, and raptors (Reeves et al., 2002). In late autumn and winter, harbor seals may be at sea continuously for several weeks or more, presumably feeding to recover body mass lost during the reproductive and molting seasons and to fatten up for the next breeding season (Reeves et al., 2002).

Harbor seals are opportunistic feeders feeding on squid and small schooling fish (i.e., herring, alewife, flounder, redfish, cod, yellowtail flounder, sand eel, and hake). Shrimp may be particularly important in the diet of pups (Burns, 2002). They spend about 85 percent of the day diving, and much of the diving is presumed to be active foraging in the water column or on the seabed. Harbor seals are capable of foraging in deep waters, greater than 500 m (1,640.4 ft). Their diet varies by season and the region. Maximum swim speeds have been recorded over 13 km/hr (Bigg, 1981).

The harbor seal can hear sounds in the range of 75 Hz to 180 kHz (Mohl, 1968; Terhune, 1991; Kastak and Schusterman, 1998), and are the least vocal of all pinnipeds currently known to vocalize. Underwater, some low-frequency pulse sounds were recorded to threaten other males (Reeves et al., 2002).

Historically, these seals have been hunted for several hundred to several thousand years. Harbor seals are still killed legally in Canada, Norway, and the United Kingdom to protect fish farms or local fisheries (Reeves et al., 2002). According to the stock assessment reports, 955 seals are taken in gillnets each year. The other human-caused mortalities, in order of frequency, were “other” (6.1), non-observed fishery-related (4.8), power plant entrainment (4.4), and boat strikes (1.6). On average, 1,000 harbor seals were killed each year by these activities during 1997 to 2001 (Waring et al., 2004). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as “non-strategic” (Waring et al., 2004).

Hooded Seal (Cystophora cristata)

The hooded seal is named so because of the large nasal cavity or “hood” extending from the nostrils to the forehead. The hood looks like a large black rubber ball, and is only present on adult males. Hooded seals in the western North Atlantic have an estimated population abundance of 400,000-450,000 individuals (Stenson, 1993).

Hooded seals are solitary animals except when breeding or molting and are found in the deeper waters of the North Atlantic, primarily off the east coast of Canada, Gulf of St. Lawrence, and Newfoundland (Wynne and Schwartz, 1999). Their winter distribution is poorly understood, but some seals inhabit the waters off of Labrador and northeastern Newfoundland, on the Grand Bank, and off of southern Greenland (Reeves et al., 2002). They are associated with the outer edge of pack ice and drifting ice. They congregate on ice floes for both mating and pupping. Hooded seals are a migratory species and are often seen far from their haul outs and foraging sites. These animals frequent New England waters from January to May. During the summer and autumn months, there are records of sightings in the waters off the Southeastern United States and in the Caribbean (Waring et al., 2004).

Minimal information is available describing their foraging behavior, but they are known to feed on squid, polar cod, Greenland halibut, redfish, Atlantic cod, wolffish, amphipods, and krill (Haug et al., 2000).

Hooded seals produce a variety of distinct sounds ranging between 500 Hz and 6 kHz (Frankel, 2002).

Most of the hooded seals stranded along the Northeastern United States between the years 1997 and 2001 were found in Maine. Massachusetts had the second highest number of strandings (Waring et al., 2004). The stranding data also indicated that there is limited interaction between hooded seals and humans (Waring et al., 2004).

The potential biological removal for this species is unknown.

Harp Seal (Phoca proenlandica)

Harp seal adults range from patterns of white and gray to black. At birth, the pups are covered with a long, fluffy white fur from which they derive their common name of “whitecoats.” Adult male harp seals grow to about 1.7 m and 130 kg; females are slightly smaller. The harp seal is a highly migratory species that occurs throughout much of the North Atlantic and Arctic Oceans; however, in recent years, numbers of sightings and strandings have been increasing off the east coast of the United States from Maine to New Jersey (Waring et al., 2004). These appearances usually occur in January-May, when the western North Atlantic stock of harp seals is at its most southern point of migration. This distribution shift is thought to be a result of a combination of many factors including environmental conditions, collapse of fish stocks, and changes in the distribution of prey in the Canadian portion of the Atlantic Ocean (Waring et al., 2004). The most current estimate of the western North Atlantic is 5.2 million harp seals (Waring et al., 2004).

Gregarious by nature, harp seals haul out in dense herds to give birth and moult. Females and males reach sexual maturity at approximately 4-6 years of age. A single pup weighing about 10 kg (22 lbs) is born each year from mid February to March. Mating occurs after the pups are weaned at about 12 days. Harp seals consume a wide range of prey species and their diet appears to vary with age, season, location and year. Harp seals ingest foods, including capelin, polar cod, herring, Arctic cod, Atlantic cod, haddock, saithe, crustaceans, Northern prawn, and krill (Haug et al., 2000).

Behavioral audiograms indicate that harp seals can hear sounds from 700 Hz to 100 kHz with frequencies of best hearing from approximately 1-30 kHz (Terhune and Ronald, 1972).

Harp seals are hunted annually. Over-exploitation, particularly in the Northwest Atlantic, and an expanding and unregulated trade in seal products remain a threat. Other potential threats include: proposals to cull harp seal populations to benefit fisheries; reduced food availability due to human overfishing or climate change; incidental catches in fishing gear; and, possibly, environmental contaminants. The stranding data show very few seals with signs of human interactions (Waring et al., 2004, such as marks from fishing gear. Between the years 1997 to 2001, most of the strandings along the United States occurred on the Massachusetts coast (Waring et al., 2004).

The potential biological removal for this species is unknown.

3.2.5 Avian Resources

This section describes the existing condition of the marine avian habitats found in the vicinity of the proposed NEG Project. The Project area for the NEG Port and Pipeline Lateral includes the ports and harbors along the shoreline of Massachusetts Bay closest to the Project, the waters of Massachusetts Bay extending east to boundary of the SBNMS, Gloucester to the north, and on the south to the edge of the in-bound Boston Harbor traffic lane. Both the NEG Port and Pipeline Lateral would require onshore loadout yards for offshore construction materials located at existing industrial or commercial sites. The Pipeline Lateral also includes modifications at two existing onshore aboveground facilities located in the City of Salem and the Town of Weymouth.

3.2.5.1 Avian Habitats

The Massachusetts Natural Heritage Endangered Species Program (NHESP) and the USFWS have reviewed the potential locations of the Project. The locations do not fall within any Estimated or Priority Habitats for listed species, and none of the avian species that could occur in the Project area is listed under the ESA.

The Project area is adjacent to the federally protected SBNMS, which includes Stellwagen Bank and portions of the adjacent Stellwagen Basin. Stellwagen Bank is approximately 118 square miles (306 square kilometers) and contains a strong upwelling zone along the edge of the bank that provides a zone of high productivity in an otherwise nutrient-limited region of the Gulf of Maine. The SBNMS Site Characterization Report (1995) and SBNMS Management Plan (1993) provide a list of offshore birds that may potentially use the waters of the region. Species that could be affected by the Project are anticipated to constitute a subset of this list.

The minimum water depth crossed by the Pipeline Lateral would be about 100 feet mean low water, thus the Project would not affect breeding or foraging habitat (eelgrass beds, intertidal flats, saltmarsh habitat) for shorebirds. In general, the subtidal environments within the Project area are typical of the continental shelf in Massachusetts Bay and consist primarily of sandy/muddy substrata with occasional rock outcroppings (SBNMS, 1995). In places where the rocky outcroppings occur at depths of less than 100 feet (30 meters), typically the limits of the photic zone, beds of kelp or other algae can be found (Hubbard and Penko, 1988). In water deeper than 100 feet (30 meters), the substratum is predominantly sand and mud (Hubbard and Penko, 1988).

Marine bird habitats occurring in the Project area include the nearshore and offshore waters. Nearshore marine bird habitats comprise open waters within 3 miles (4.8 kilometers) of the shoreline. Offshore marine habitats include the waters of the Massachusetts Bay farther then 3 miles (4.8 kilometers) from shore. This list does not include migratory terrestrial birds. Although the Project is located within the Atlantic flyway, migrating passerines typically use ponds, thickets, mudflats, marsh, or estuarine habitats for stopover areas (Veit and Petersen, 1993). Spring and fall migration may bring estimates as high as millions of migrating land birds across the area, most of them in the midst of long-distance flights at high elevation. The Project location does not include habitat for foraging, feeding, roosting, or nesting for these species. Night-migrating songbirds may pass over the site; however, the transient nature of their presence in the area would minimize any potential interaction with the Project.

3.2.5.2 Avian Populations

Populations of coastal birds are greatly depressed compared to 100 years ago due to loss of habitat, including marshes, estuaries, and wetlands, and loss of prey items (USFWS as cited in MCZM, 2004). Because breeding species of shorebirds are dispersed across wide, inaccessible areas, accurate estimation of population sizes is difficult. Many populations of shorebirds are in decline based on limited studies made of migrations and breeding colonies (MCZM, 2004). Bird populations present in nearshore and offshore habitats in Massachusetts Bay are discussed below.

Site-specific seabird studies were performed during the assessment of the MBDS from 1980 to 1985 (Hubbard and Penko, 1988). Observers from the Manomet Bird Observatory performed species surveys from boats traversing the waters near the MBDS location. This site lies immediately to the northeast of the Project area. Additionally, the Northeast Fisheries Science Center (NEFSC) of NMFS in coordination with Manomet Bird Observatory conducted a Cetacean and Seabird Assessment Program in shelf and shelf-edge waters of the northeastern United States from 1980 to 1987. Observations were made from research vessels conducting standardized surveys. A list of marine birds that occur in the Project area is provided in Table 3-24.

Table 3-24

Marine Birds Having the Potential to Occur in the Project Area

Common Name	Scientific Name	Reference
Common Loon	*Gavia immer*	1, 2, 3, 4
Red-throated Loon	*G. stellata*	1, 2, 3, 4
Horned Grebe	*Podiceps auritus*	2, 3, 4
Red-necked Grebe	*P. grisegena*	2, 3, 4
Long-tailed Duck/Oldsquaw	*Clangula hyemalis*	1, 3, 4
Brant	*Branta bernicla*	1, 2, 3
White-winged Scoter	*Melanitta fusca*	1, 3, 4
Black Scoter	*M. nigra*	1, 3, 4
Surf Scoter	*M. perspicillata*	1, 3, 4
Red-breasted Merganser	*Mergus serrator*	1, 2, 3, 4
Northern Fulmar	*Fulmarus glacialis*	1, 3, 4
Cory's Shearwater	*Calonectris diomedea*	1, 3, 4
Greater Shearwater	*Puffinus gravis*	1, 3, 4
Sooty Shearwater	*P. griseus*	1, 3, 4
Wilson's Storm petrel	*Oceanites oceanicus*	1, 3, 4
Leach's Storm petrel	*Oceanodroma leucorhoa*	1, 3, 4
Northern Gannet	*Sula bassanus*	1, 3, 4
Great Cormorant	*Phalacrocorax carbo*	1, 2, 3, 4
Double-crested Cormorant	*P. auritus*	1, 2, 3, 4
Red Phalarope	*Phalaropus fulicaria*	1, 4
Northern Phalarope	*P. lobatus*	1, 3, 4
Parasitic Jaeger	*Stercorarius parasiticus*	1, 3, 4
Pomarine Jaeger	*S. pomarinus*	1, 3, 4
Herring Gull	*Larus argentatus*	1, 3, 4
Great black-backed Gull	*L. marinus*	1, 3, 4
Glaucous Gull	*L. hyperboreus*	1, 3, 4
Iceland Gull	*L. glaucoides*	1, 3, 4
Laughing Gull	*L. atricilla*	1, 3, 4
Ring-billed Gull	*L. delawarensis*	1, 3, 4
Bonaparte's Gull	*L. philadelphia*	1, 3, 4
Sabine's Gull	*Xema sabini*	1
Black-legged Kittiwake	*Rissa tridactyla*	1, 3, 4
Roseate Tern	*Sterna dougallii*	1, 3, 4
Royal Tern	*S. maxima*	1, 4
Sandwich Tern	*S. sandivicensis*	1, 4
Sooty Tern	*S. fuscata*	1
Bridled Tern	*S. anaethetus*	1
Arctic Tern	*S. paradisaea*	1, 3, 4
Common Tern	*S. hirundo*	1, 3, 4
Least Tern	*S. antillarum*	1, 3, 4
Black Tern	*Childonias niger*	1, 4
Razorbill	*Alca torda*	1, 3, 4
Thin-billed Murre	*Uria aalge*	1, 3, 4
Thick-billed Murre	*U. lomvia*	1, 3, 4
Dovekie	*Alle alle*	1, 3, 4
Black Guillemot	*Cepphus grylle*	1, 3, 4
Osprey	*Pandion haliaetus*	1, 3
Sharp-shinned Hawk	*Accipiter striatus*	1
Peregrine Falcon	*Falco peregrinus*	1
Great Skua	*Catharacta skua*	1

1 = SBNMS 1995; 1993.
2 = MCZM 2001; 2002.
3 = Hubbard and Penko 1988.
4 = Gusey 1977.

Nearshore Birds

The open, shallow waters of Massachusetts Bay and associated sounds and harbors are important wintering and migration-staging areas for sea ducks, waterfowl and shorebirds, some of which feed primarily on bottom-dwelling invertebrates, others on fish that can vary seasonally. The Project would not be located within waters shallow enough to allow for feeding, nesting, or roosting of most shorebirds or waterfowl. These species are discussed briefly below due to the possibility of their inclusion as transitory migrants or as diurnal migrants moving between feeding and roosting areas. The nearshore avian habitat consists of water in excess of 100 feet (30 meters); however, there are locations along the pipeline corridor that are in the vicinity of surface features such as rocks and rocky island outcrops that could be important for use in nesting, roosting, and sunning. Several of the species described below and in the following section nest in colonies on small islands near the coast that are protected from human disturbance.

From the data sources described above, those shorebirds/wading birds, waterfowl, and coastal seabirds whose typical population distribution and habitat data may include habitats within the Project region are described in the following paragraphs.

Shorebirds/wading birds are those species that are migratory and use estuaries and freshwater habitats for breeding, summering, and wintering (MCZM, 2004). Plovers (Family Charadriidae), sandpipers (Family Scolopacidae), avocets (Family Recurvirostridae), and oystercatchers (Family Haematopodidae) are common shorebirds along the coast and islands of Massachusetts Bay. Wading birds such as herons and egrets (Family Ardeidae) and ibis (Family Threskiornithidae) are also common (Duke Energy, 2000). Species can include piping plover (*Charadrius melodus*), purple sandpiper (*Calidris maritima*), great blue heron (*Ardea herodias*), black-crowned night heron (*Nycticorax nycticorax*), snowy egret (*Egretta thula*), and glossy Ibis (*Plegadius falcinellus*). Depending on food preferences, species use a variety of habitats including mudflats, marshes, sandy, pebbly or cobbly beaches, or the rocky coast (Levinton, 2001).

Species richness and abundance is typically highest at low tide during late summer to early fall, corresponding to the overlap between the summer and year-round residents and the autumn migration of birds that winter along the shores (Forster 1994). Shorebird diets consist mainly of polychaetes, amphipods, and mollusks obtained from tidal flats, intertidal rocks, and shallow subtidal bottoms (Levinton, 1982).

Waterfowl spend a majority of their time in the water and have specific physiological characteristics such as webbed feet that enable them to swim (MCZM, 2004). These birds use coastal wetlands and estuaries for breeding, as a winter habitat, or stopover for rest during migration. Sea ducks (Family Anatidae) such as eiders, scoters, mallards, brant, geese, and merganser can be found along the coastal embayments of northern Massachusetts Bay (MCZM, 2004). Species can include brant (*Branta bernicla*), Canada geese (*Branta canadensis*), redhead (*Aythya americana*), red-breasted merganser (*Mergus serrator*), black scoter (*Melanitta nigra*), white-winged scoter (*M. fusca*), common eider (*Somateria mollissima*), and long-tailed duck (*Clangula hyemalis*). Surface-feeding ducks can also be found foraging in littoral waters for aquatic vegetation and invertebrates and can include species such as black duck (*Anas rubripes*) and American widgeon (*Anas americana*). Most species are typically absent during the summer and early fall (Leahy, 1994). The overlap between those transient species that breed farther to the north or inland but spend most or all of the winter in the region, and the species that breed locally but migrate to southern waters to overwinter, causes species richness and total abundance to be highest in the early spring and late fall (Forster, 1994). Fall migration is more prolonged, although it often occurs farther from shore.

Northbound spring migrants characteristically follow the shoreline. Large numbers of waterfowl may pass through the region during spring. Loons (Family Gaviidae), cormorants (Family Phalacrocoracidae), grebes (Family Podicipedidae), gulls, and terns (Family Laridae), although often grouped as seabirds, represent a separate grouping from the more offshore seabirds discussed below because they tend to be located closer to coastal and nearshore areas. With the exception of gulls and terns, these birds are usually not found during the summer, but range from rare to locally common during the winter (Veit and Petersen 1993). Species including common loon (*Gavia immer*), red-throated loon (*G. stellata*), horned grebe (*Podiceps auritus*), and rednecked grebe (*Podiceps grisegena*) (Veit and Petersen 1993; Forster 1994; ACOE 2004) feed on fish caught while diving in open waters in either nearshore (littoral) or offshore zones. Double-crested cormorants (*Phalacrocorax auritus*) and great cormorants (*P. carbo*) can be present throughout the year, but the former is most abundant in the summer and the latter is most abundant in the winter (MCZM, 2001; Duke Energy, 2000). Gulls can include herring (*Larus argentatus*), great black-backed (*L. marinus*), glaucous (*L. hyperboreus*), Iceland (*L. glaucoides*), laughing (*L. atricilla*), ring-billed (*L. delawarensis*), Bonaparte’s (*L. philadelphia*), and Sabine’s gulls (*Xema sabini*). Terns are similar to gulls in that they forage for fish at or near the sea surface, and in the Pipeline Lateral area can include common (*Sterna hirundo*), Arctic (*S. paradisaea*), roseate (*S. dougallii*), and least Terns (*S. antillarum*) (Hubbard and Penko, 1988; Duke Energy, 2000).

Offshore Seabirds

Offshore birds include those typically referred to as seabirds (MCZM, 2004). These species spend most of their lives on the open oceanic waters and come to land for breeding only. Foraging habitat for marine birds can be widespread and diffuse. Due to the large expanse of shallow coastal shelf in the Massachusetts Bay, divers and surface-feeders may disperse over a great distance. Nearshore birds may cross waters far off the coast to feed, while typically offshore species can roam close to the coast to do the same. Typically, offshore species feed primarily on fish and marine invertebrates, which may be picked off the water surface or obtained by diving and plunging. They can spend up to 90 percent of their lives at sea and typically migrate to follow the seasonal abundance of a distinct group of prey. They are necessarily tied to land to reproduce but can travel significant distances to do so. Within the offshore region of Massachusetts Bay, the distribution and abundance of birds is variable and can be loosely associated with the availability of food items (SBNMS, 1995). Such species can include shearwaters, fulmars, and storm petrels (Family Procellariidae) including northern fulmar (*Fulmarus glacialis*); Cory’s (*Calonectris diomedea*), greater (*Puffinus gravis*), and sooty shearwaters (*P. griseus*); and Wilson’s (*Oceanites oceanicus*) and Leach’s storm petrels (*Oceanodroma leucorhoa*). Gannets (Family Sulidae) such as northern gannet (*Sula bassanus*); phalaropes (Family Scolopacidae) including red (*Phalaropus fulicaria*) and northern (*P. lobatus*); alcids (Family Alcidae) including thin-billed (*Uria aalge*) and thickbilled murre (*U. lomvia*), dovekies (*Alle alle*), and black guillemot (*Cepphus grylle*); and jaegers and skuas terns (Family Laridae) including parasitic (*Stercorarius parasiticus*) and pomarine (*S. pomarinus*) could also be present, as could Jaegers great skua (Catharacta skua) and black-legged kittiwake (Rissa tridactyla) (Duke Energy, 2000; Hubbard and Penko, 1988).

3.3 THREATENED AND ENDANGERED MARINE MAMMALS AND SEA TURTLES

This section reviews the natural history of those species that are listed as threatened or endangered under the ESA. Threatened or endangered species that are known to traverse or occasionally visit waters within the NEG Port area and the Pipeline Lateral include both threatened or endangered marine mammals and sea turtles. Included below are detailed descriptions of marine mammal and sea turtle biology including feeding habits, reproduction, recruitment, and habitat use. Also discussed are the natural histories of these species including population status, seasonal movements, critical habitats, and existing threats within the NEG Port and Pipeline Lateral areas.

3.3.1 Protected Areas

The ESA provides for protection of species that are endangered or threatened throughout all or a significant portion of their range, as well as conservation of the ecosystems on which they depend. The ESA requires federal agencies to consult with the USFWS/NMFS to ensure any action they authorize/permit, fund, or implement would not likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat. Two typical consultation processes occur between the federal agency and USFWS/NMFS: informal and formal ESA Section 7 consultation. The Applicants have already initiated an informal Section 7 consultation process through submittal of a request letter dated February 17, 2005.

The proposed locations of the NEG Port and the Pipeline Lateral in Massachusetts Bay are within areas known to be visited by endangered and threatened marine mammals and sea turtles. Because of their presence in these waters, both the federal and state governments have designated protected areas within the Bay intended to protect the interests of these species and their habitats. The locations of these protected areas with respect to the proposed NEG Project are shown in Figure 3-8 and described in Table 3-21.

3.3.2 Identified Species and General Characteristics

Information provided by the NMFS during the informal Section 7 consultation process was used to develop a list of endangered and threatened species potentially impacted by the proposed Project (Table 3-25). This list includes six species of endangered cetaceans and five species of endangered or threatened sea turtles (Colligan, 2005). One species, the Hawksbill sea turtle, was included due to the possibility of being encountered within the shipping lanes of the LNG vessels traversing to the NEG Port area. During informal consultation with the USFWS, no endangered or threatened species under their jurisdiction were identified for further review (Amaral, 2005).

Table 3-25

NMFS Identified Endangered and Threatened Species Potentially in the Project Area

Common Name	Scientific Name	Status	Protected By
Toothed Whales (Odontoceti)			
Sperm Whale	*Physeter macrocephalus*	Endangered	ESA & MMPA
Baleen Whales (Mysticeti)			
Blue Whale	*Balaenoptera musculus*	Endangered	ESA & MMPA
Fin Whale	*Balaenoptera physalus*	Endangered	ESA & MMPA
Humpback Whale	*Megaptera novaeangliae*	Endangered	ESA & MMPA
North Atlantic Right Whale	*Eubalaena glacialis*	Endangered	ESA & MMPA
Sei Whale	*Balaenoptera borealis*	Endangered	ESA & MMPA
Sea Turtles			
Green Sea Turtle	*Chelonia mydas*	Endangered	ESA
Hawksbill Sea Turtle	*Eretmochelys*	Endangered	ESA
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Endangered	ESA
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	ESA
Loggerhead Sea Turtle	*Caretta caretta*	Threatened	ESA

Source: NMFS, 2005a, 2005b, 2005c, 2005d, 2005e; NOAA, 1993a; Waring et al., 2004

3.3.2.1 Endangered Whales

The majority of cetaceans in the western North Atlantic Ocean are found in continental shelf waters and their distribution is often closely correlated with the distribution of their prey (Wilson and Ruff, 1999). The western margin of the Gulf of Maine is the most intensely used cetacean habitat in the northeast U.S. continental shelf (Kenney and Winn, 1986). This is primarily because the biological productivity of the area provides a variety of food for these whales. Within the continental shelf habitat, species habitat is distinguished by their prey preferences. The piscivorous fin and humpback whales overlap in their distribution, and are primarily found in the western Gulf of Maine and the mid-shelf area east of Chesapeake Bay. Within this general area, Stellwagen Bank, Jeffreys Ledge, Cape Cod Bay, and the Great South Channel are considered important high-use cetacean habitats. The planktivorous whales (right, sei, blue, and sometimes fin whales) tend to inhabit the western Gulf of Maine and the southwestern and eastern portions of Georges Bank, where upwelling drives high production of phytoplankton and zooplankton. The squid-eating sperm whale is typically found offshore along the edge of the continental shelf and beyond (Kenney and Winn, 1986). It should be noted that groupings of piscivorous and planktivorous whales are not rigid, but based on the dominant prey species. For example, sei whales are typically planktivorous, yet they are also known to take piscine prey (Waring et al., 2004).

In general, the use of these habitats by whales increases in the spring and summer, and decreases in the fall and winter. Some female right whales and their newborn calves are seen off the coasts of Georgia and Florida in winter to early spring, and the majority of humpback whales migrate to the West Indies during the same period (NMFS, 1991a). The whereabouts of the majority of fin, blue, sei, right, and sperm whales during the winter months is unknown. The springtime influx of whales into coastal waters is correlated with a simultaneous increase in primary productivity.

Although the entire continental shelf is important to these endangered species, a few specific areas have been identified as being extremely important habitat for cetaceans. Cape Cod

Bay, the Great South Channel, and the coastal areas of Georgia and northern Florida have been designated as critical habitat for the northern right whale (NOAA, 1993b). Stellwagen Bank National Marine Sanctuary has also been identified as an important feeding area for whales including the humpback, fin, and right whales.

The North Atlantic right whale, humpback whale, and fin whales are known to visit the NEG Project Area (NEG Port and Pipeline Lateral areas), while sperm whales occur off Cape Cod, mainly in water depths of 3,200 feet (975 meters) or greater, and have not been sighted in the Project area. Blue and sei whales occur only rarely in the area of Stellwagen Bank and the western Gulf of Maine, and are generally considered transients in the region. The seasonal distribution of cetaceans in Massachusetts Bay is shown in Table 3-26 and described more fully below.

Table 3-26

Seasonal Distribution of Endangered and Threatened Species in Massachusetts Bay

Species	J	F	M	A	M	J	J	A	S	O	N	D
Blue Whale								R	R	R		
Balaenoptera musculus												
Fin Whale				A	A	C	C	C	C	C	R	
Balaenoptera physalus												
Humpback Whale				A	A	A	C	C	C	C	R	R
Megaptera novaeangliae												
North Atlantic Right Whale	C	C	A	A	C	C	R	R	R	R	R	R
Eubalaena glacialis												
Sei Whale			R	R	C	C	R	R	R	R		
Balaenoptera borealis												
Sperm Whale												
Physeter macrocephalus												
Green Sea Turtle							R	R				
Chelonia mydas												
Hawksbill Sea Turtle							R	R	R			
Eretmochelys imbricata												
Kemp's Ridley Sea Turtle	R				R	R	R	R	R	R	R	R
Lepidochelys kempii												
Leatherback Sea Turtle					R	R	C	C	C			
Dermochelys coriacea												
Loggerhead Sea Turtle							R	R	R	R		
Caretta caretta												
Species abundance by month categorized (blank=not present, R=rare, C=common, A=abundant)												

Sources: NMFS, 2005a, 2005b, 2005c, 2005d, 2005e; NOAA, 1993a; Waring et al., 2004, 2002; Wilson and Ruff, 1999

Distribution information for endangered and threatened whales was obtained from the Whale Center of New England (Weinrich and Sardi, 2005) and North Atlantic Right Whale Consortium datasets, as well as the NMFS stock assessments. Details of these datasets were discussed in section 3.2.4.2 for marine mammals. These data show that the fin whale, humpback whale, North Atlantic right whale, and sei whale, have been sighted within the proposed construction area from May to November. Actual data on the presence of these species in the Project area between December and March are limited because of the limited number of surveys conducted during the winter months. The most severely Endangered species, the North Atlantic right whale, migrates toward Cape Cod Bay in February, with most of the whales arriving in the bay during April. The whales continue to travel south towards the Great South Channel during April and remain there through June; then migrate north to the Bay of Fundy/Nova Scotian Shelf in the summer, remaining there till late fall when they return back to their wintering grounds. Humpback whales have been observed utilizing the shallow waters of Stellwagen Bank, along with the deeper areas to the west and northeast of the Bank. Fin whales, which do not use the shallower waters as often as the humpbacks, have been observed in the deeper waters to the west, north, and northeast of the Bank (Weinrich and Sardi, 2005).

All cetaceans communicate by emitting a variety of underwater sounds. Most marine animals can perceive underwater sounds over a broad range of frequencies from about 10 Hz to more than 150,000 hertz (150 kHz). Many of the dolphins and porpoises use even higher frequency sound for echolocation and perceive these high frequency sounds with high acuity. Whales respond to low-frequency sounds with broadband intensities of more than 120 dB re 1 μPa, or about 10 to 20 dB above natural ambient noise at the same frequencies (Richardson et al., 1991). Toothed whales create three types of sounds: tonal whistles; broadband clicks of short duration to be used in echolocation; and less distinct pulsed sounds, such as cries, grunts, and barks. Toothed whales become very vocal when together, especially when interacting with each other.

Peak underwater sound detection in most baleen whales, including the endangered species discussed herein, is estimated in the range of 10 to 10,000 Hz, with greatest peak sensitivity below about 1,000 Hz (Ketten, 2000). The lowest recorded frequencies produced by baleen whales come from fin whale rumbles of 10-30 Hz (Richardson et al., 1995; Edds, 1998). The whales use these low-frequency sounds primarily for long-range communication. Determination of the function of baleen whales sounds is hampered by the difficulties in keeping and studying them in captivity; however, a majority of sounds are thought to function in social contexts (Richardson et al., 1995).

3.3.2.2 Threatened and Endangered Sea Turtles

Sea turtles are highly migratory marine reptiles that have a wide geographic range in tropical, sub-tropical, and temperate waters. Active turtles must surface to breathe every 5-10 minutes, but they can remain underwater for much longer periods of time (30-40 minutes) when they are resting (Keinath, 1993). Migrating turtles usually dive at shallow depths, less than 20 m (65.6 ft) (Luschi et al., 2003), making it difficult to spot sea turtles in the open ocean. Sea turtles migrate often for long distances for feeding grounds, to mate, and to nest (Wynne and Schwartz, 1999). Turtles are the longest living aquatic vertebrates. Recently developed aging methods speculate that turtles live between 50 to 100 years. They spend most of their lives in the water, coming to shore only to bask in the sun or lay eggs. Sea turtles breed in the tropics or subtropics and their eggs (85 to 150 in number) are laid at night in holes dug on sandy beaches (Hodge, 2001).

All sea turtle species that have been occasionally encountered in Massachusetts Bay are protected by the U.S. Government under the ESA. The leatherback was listed as Endangered throughout its range on June 2, 1970 (NMFS, 2005e). The loggerhead turtle was listed as Threatened throughout its range on July 29, 1978 (NMFS, 2005f). The Kemp’s ridley was listed as Endangered throughout its range on December 2, 1970 (NMFS, 2005d), and the Floridian and Mexican breeding populations of the green turtle were listed as Endangered on July 28, 1978, while the rest of the population is listed as Threatened (NMFS, 2005c). The Hawksbill Sea Turtle was listed as Endangered throughout its range on June 2, 1970 (USFWS, 2005a).

3.3.2.3 Endangered Toothed Whales

Sperm Whale (Physeter macrocephalus)

Sperm whales are large, dark, brownish gray whales. The ventral side of the body is a lighter gray with white patches. Males can reach lengths of up to 60 feet (18 meters), and are larger than females, which rarely exceed 40 feet (12 meters). Sperm whales have an extremely large, square head that can be one-third the length of the entire body. The long, narrow, lower jaw contains 20 to 50 conical teeth, and the interior of the mouth and part of the skin around the lower jaw are white. There are no teeth in the upper jaw. The sperm whale has no dorsal fin but instead a dorsal hump is followed by a series of bumps or "knuckles" along the dorsal surface of the tail stock. Sperm whales have a single exterior blowhole that is asymmetrically situated on the forward, left corner of the head (USEPA, 1993).

Sperm whales are social animals and their dominant vocalizations are clicks produced at a frequency range of 0.1 to 30 kHz, with a dominant frequency of 2-4 kHz and 10-16 kHz, with source levels ranging from 160 to 236 dB re µPa @ 1m (Richardson et al., 1995; Madsen and Møhl, 2000; Mohl et al., 2000; Thode et al., 2002; Mohl et al., 2003). Regular click trains and creaks have been recorded from foraging sperm whales and may be produced for echolocation (Whitehead and Weilgart, 1991; Jaquet et al., 2001; Madsen et al., 2002; Thode et al., 2002). A series of short clicks, termed "codas," have been associated with social interactions and are thought to play a role in communication (Weilgart and Whitehead, 1993; Pavan et al., 2000). Recent audiograms measured from a sperm whale calf resulted in an auditory range of 2.5 to 60 kHz, most sensitive between 5 and 20 kHz (Watkins and Schevill, 1975; Watkins et al., 1985; Ridgway and Carder, 2001). Measurements of evoked response data from one stranded sperm whale have shown a lower limit of hearing near 100 Hz (Gordon et al., 1996).

The International Whaling Commission (IWC) recognizes only one stock for the whole North Atlantic region. The stock assessment report gives a population estimate for the western North Atlantic of 4,702 (Waring et al., 2002). The distribution of sperm whales on the east coast follows the edge of the continental shelf, where the largest abundance of their favorite food of squid, is located (Wilson and Ruff, 1999). Accordingly, information from the sightings data (NARWC, MWRA, and Whale Center of New England), show no historical evidence of sperm whales in the Project area (Kenney, 2001; Short and Schaub, 2005; Short et al., 2004; McLeod et al., 2003, 2000; McLeod 2002, 2001, and 1999).

In the spring, the sperm whale would migrate from the warmer waters east and northeast of Cape Hatteras towards Delaware and Virginia. In the summer they are found east and north of Georges Bank and into the Northeast Channel region and over the continental shelf south of New England. They remain south of New England during the fall (Waring et al., 2002).

Sperm whales are at the top of the food chain, feeding primarily on cephalopods (squid and octopi) and secondarily on both pelagic and benthic fish (Reeves and Whitehead, 1997; Whitehead, 2002).. They consume 3 to 3.5 percent of their body weight each day. They are suction feeders, swallowing the prey whole by sucking it into their mouths (Wilson and Ruff, 1999). Their muscle is high in myoglobin content, which allows them to dive for long periods of time and for great distances (Wilson and Ruff, 1999). Dive durations range between 18.2 to 65.3 minutes (Watkins et al., 2002). Sperm whales may have the longest and deepest dives for any marine mammal, with recorded dives of over 2 hours to depths of 3,000 m (9,842 ft) (Clarke, 1976; Watkins et al., 1985). Foraging dives last about 30 to 40 minutes and descend to depths from 300 to 1245 m (984 to 4,085 ft) (Papastavrou et al., 1989; Wahlberg, 2002). Swim speeds of sperm whales range from 1.25 to about 4 km/h (0.7 to 2.2 knots) (Jaquet et al., 2000; Whitehead, 2002).

There are two types of sperm whale groups, matrilinear schools and bachelor schools. Breeding schools consist of females of all ages as well as immature and sub-adult males. Average schools size is 20 to 40 individuals, but groups have been found ranging from 4 to 150. Females are born into a group and remain in it for their entire lives. Each breeding school has one large male during the breeding season. Breeding season in the Northern Hemisphere goes from January to August, with a peak from March through June.

A bachelor school consists of up to 50 sexually mature males. Membership in the bachelor school is thought to be transient. Males start puberty between seven and eleven years old, and they do not become sexually mature until they are 18 to 21 years old. The largest males are often solitary and are rarely seen in groups of more than six individuals, unless they are associating with a breeding school (Wilson and Ruff, 1999).

There were no sperm whales killed by ship strikes and fishery related incidents during 1996 to 2000, yet there were three sperm whale entanglements between the years 1993 to 1998. The species has also been subject to accumulation of pollutants caused by eating contaminated prey (Waring et al., 2002). The species is listed as Endangered due to the depletion of its population from whaling (Waring et al., 2000). There is currently no recovery plan for this species.

3.3.2.4 Endangered Baleen Whales

Blue Whale (Balaenoptera musculus)

The blue whale is the largest living mammal on Earth, growing to between 25 and 100 feet (8 to 30 meters) long. Its body is a mottled bluish-gray color, slender in shape with a small dorsal fin that sits closer to the tail than in other baleen species. The blue whale also has a “U” shaped head. Research has estimated that blue whales live roughly 80 to 90 years (Wilson and Ruff, 1999; NMFS, 1998; NOAA, 1993a).

Blue whales have some of the deepest voices in the animal kingdom. Their voices travel for thousands of miles in the deeper ocean regions. They are thought to use sound to help navigate. Blue whales produce moans at a frequency of 12 to 390 Hz, with a dominant frequency of 16 to 25 Hz and a source levels measured at 188 dB re 1µPa @ 1. Blue whales also produce two types of high frequency clicks, the first are in the 6,000 to 8,000 Hz frequency range, with two source levels recorded 130 and 159 dB re 1µPa A 1 m. The second type of click is in the 21-31 kHz range with a dominant frequency of 25 kHz (Richardson et al., 1995). The most typical signals are very long, patterned sequences of tonal infrasonic sounds in the 15 to 20 Hz range (Stafford et al., 1998). The seasonality and structure of the sounds suggest that these are male song displays for attracting females and/or competing with other males. There is no direct measurement of auditory threshold for the hearing sensitivity of blue whales (Ketten, 2000; Thewissen, 2002).

Blue whales live in all of the world’s oceans. There are a total of ten stocks of blue whales, with two occurring in the North Atlantic: western and eastern. Little is known about the blue whale population size, although Kemf and Phillips (1994) report a population range of 1,000 to 2,000 for the Northern Atlantic Ocean. Best estimates suggest 308 animals in the western North Atlantic (Sears et al., 1987). The range of the blue whale in the North Atlantic is from the subtropics north to Baffin Bay and the Greenland Sea. In the Massachusetts latitudes, their distribution is generally in the offshore waters, but twice in the mid-1980s, they were found feeding on/over/near Stellwagen Bank (NMFS, 1993). According to the Blue Whale Recovery Plan, the U.S. east coast does not appear to be a region of importance to blue whales and only occasional sighting and strandings have been reported for this area. Occasional sighting of blue whales have occurred further from the Project area, in waters off Cape Cod, during the summer and fall.

In the North Atlantic blue whales migrate to northern polar regions to spend the summer months feeding and then move into the open seas in the winter months off Long Island and as far south as Florida. They have been known to have very low local resident times, only spending about ten days in a particular area. The distribution of blue whales is thought to be dependant on food and populations are seasonally migratory. Blue whales are either seen alone, in groups of two to three individuals, or accompanying fin whales. There has been a noticed decrease in the number of sighting of blue whales in the eastern North Atlantic. It is not known if these are a result of a change in the historic distribution and migratory patterns, or if it is due to a decrease in population size (NMFS, 1998).

Blue whales feed almost exclusively on euphausiids, which are shrimp-like zooplankton, and krill. They consume roughly six to seven ton of food a day (NMFS, 1998; NOAA, 1993a; Waring et al., 2002; Wilson and Rudd, 1999). In the eastern North Atlantic, the zooplankton species *Thysanoessa inermis* and *Meganyctiphanes norvegica* are the most important food source for the blue whale. Fish and copepods have also been identified as potential food sources, but they do not comprise as large a percentage of the blue whale's direct as the euphausiids (Wilson and Ruff, 1999). The average surface speed for a blue whale is 4.5 km/h (2.4 knots), with maximum speeds of 7.2 km/h (3.9 knots) (Mate et al., 1999).

Females give birth every two to three years and the gestation period is ten to eleven months long. Mating occurs during the winter months which results in calves being born in the late fall and winter. Young calves nurse for approximately seven to eight months. No specific breeding grounds are known for this species.

Recent threats to blue whales include entanglement in fishing gear, vessel strikes, and loss of feeding habitat due to habitat degradation (NMFS, 1998). At least one blue whale in the Stellwagen Bank area was seen trailing fishing gear (NMFS Cetacean Entanglement Database, Record #87, August 9, 1987). Blue whales have occasionally been killed or injured after colliding with ships, and increased vessel traffic represents the greatest concern for potential impacts to these species. The species is listed as endangered due to the depletion of its population from whaling. A recovery plan has been written and is currently in effect (NMFS, 1998).

<u>Fin Whale (Balaenoptera physalus)</u>

The fin whale is a sleek, light gray to brownish-black baleen whale that can grow to between 30 to 70 feet (9 to 21 meters) long. They are long-bodied and have a prominent dorsal fin set approximately two-thirds of the way back on the body (Reeves et al., 1998; Wilson and Ruff, 1999). The ventral sides of the belly, flukes and flippers are white. Fin whales are typically identified by their natural marks and scars.

Fin whales vocalize at low frequencies. The most common fin whale sound is a 20-Hz sound about one second in duration. These sounds are heard in the spring, summer and fall and occur in a series of one to five pulses. Repeated stereotyped patterns are heard in the winter. The typical 20-Hz sound is a downsweep from roughly 23 to 18 Hz over one second. The frequency sweep is shorter for Atlantic fin whales than it is for Pacific fin whales. Most of the 20-Hz sounds have source levels of roughly 180 to 190 dB re 1 μPa at 1 m, with maximums of 200 dB and minimums less than or equal to 140 dB (Thompson et al., 1992; McDonald et al., 1995; Charif et al., 2002; Croll et al., 2002). These sounds are emitted during their reproductive season from autumn to early spring and are believed to be an acoustic display associated with reproduction. Calls have been detected 16 miles (25 kilometers) away from the whale producing the sound in deeper waters and 5 to 6 miles (8 to 10 kilometers) in shallow water. Fin whales also produce sounds at frequencies up to 200 Hz, (Richardson et al., 1995). There is no direct measurement of auditory threshold for the hearing sensitivity of fin whales (Ketten, 2000; Thewissen, 2002).

Of the North Atlantic subspecies of fin whale, there are two management stocks found in the western North Atlantic: Nova Scotia and Newfoundland. However, the stock identity of North Atlantic fin whales has received relatively little attention, and whether the current stock boundaries define biologically isolated units has long been uncertain. There is often confusion in the appearance of fin whales, sei whales, and Bryde's whales; therefore it has been difficult to determine fin whales distribution and actual population size (Reves et al., 1998). Fin whales are the most common large baleen whale species in the Gulf of Maine and Massachusetts Bay area. They have the largest standing stock and the second largest food requirements (blue whales have the largest daily prey biomass requirements), thus having the largest impact on the ecosystem of any cetacean species (Croll and Kudela, 2004; Reeves et al., 1998; Waring et al., 2004; Wilson and Ruff, 1999). The population estimate of fin whales in the outer continental shelf waters off the eastern United States from Cape Hatteras to the Canadian is approximately 5,000 individuals in the spring and summer, and about 1,500 in the fall and winter. According to the most recent stock assessment report, the population estimate for the western North Atlantic stock of fin whales is 2,814 (Waring et al., 2004). Even though some whales overwinter near Cape Cod, their abundance near Stellwagen Bank peaks between April and October.

Fin whales have been sighted within the Project area (Figures 3-13 through 3-17) (Short and Schaub, 2005; Short et al., 2004; Weinrich and Sardi, 2005; McLeod et al., 2003 and 2000; Kenney, 2001; McLeod, 2002, 2001, and 1999). The Weinrich and Sardi (2005) data (Figures 3-13 through 3-17) provide specific information on seasonal and long-term temporal sightings over the 10-year period from 1995 through 2004. The regional data in Figure 3-13 shows large numbers of fin whales in an arc extending from the Great South Channel, northwestward along the 130 to 160 foot (39 to 49 meter) contour east of Cape Cod from Chatham to Provincetown, Cape Cod Bay and Stellwagen Bank, east of Cape Ann to the northeastern tip of Jeffreys Ledge. They are common in waters 650 feet (198 meters) deep, but rarely are sighted in water deeper than 6,000 feet (1829 meters). Sixty-five percent of sightings are in water depths of 60 to 330 feet (18 to 100 meters). During the summer months, fin whales extend their distribution to the central and northern parts of the Gulf of Maine and the periphery of Georges Bank. The Weinrich and Sardi (2005) data from Massachusetts Bay (Figures 3-13 through 3-17) show a strong clumping of sightings on Stellwagen Bank during all but the 2000 to 2004 fall time period. Significant numbers of fin whales were also sighted in the deeper waters west and north of the Bank itself, especially during the 2000 to 2004 fall period. The data shown in Figure 3-17 suggest increased use of the NEG Port site in the fall of each year since 2001, possibly exploiting a planktivorous prey source along with the humpback whales. More recent data from the Whale Center of New England collected during the period August through November 2005 support the earlier finding that fin whale distributions during the late summer and fall have expanded to the west of Stellwagen Marine Sanctuary.

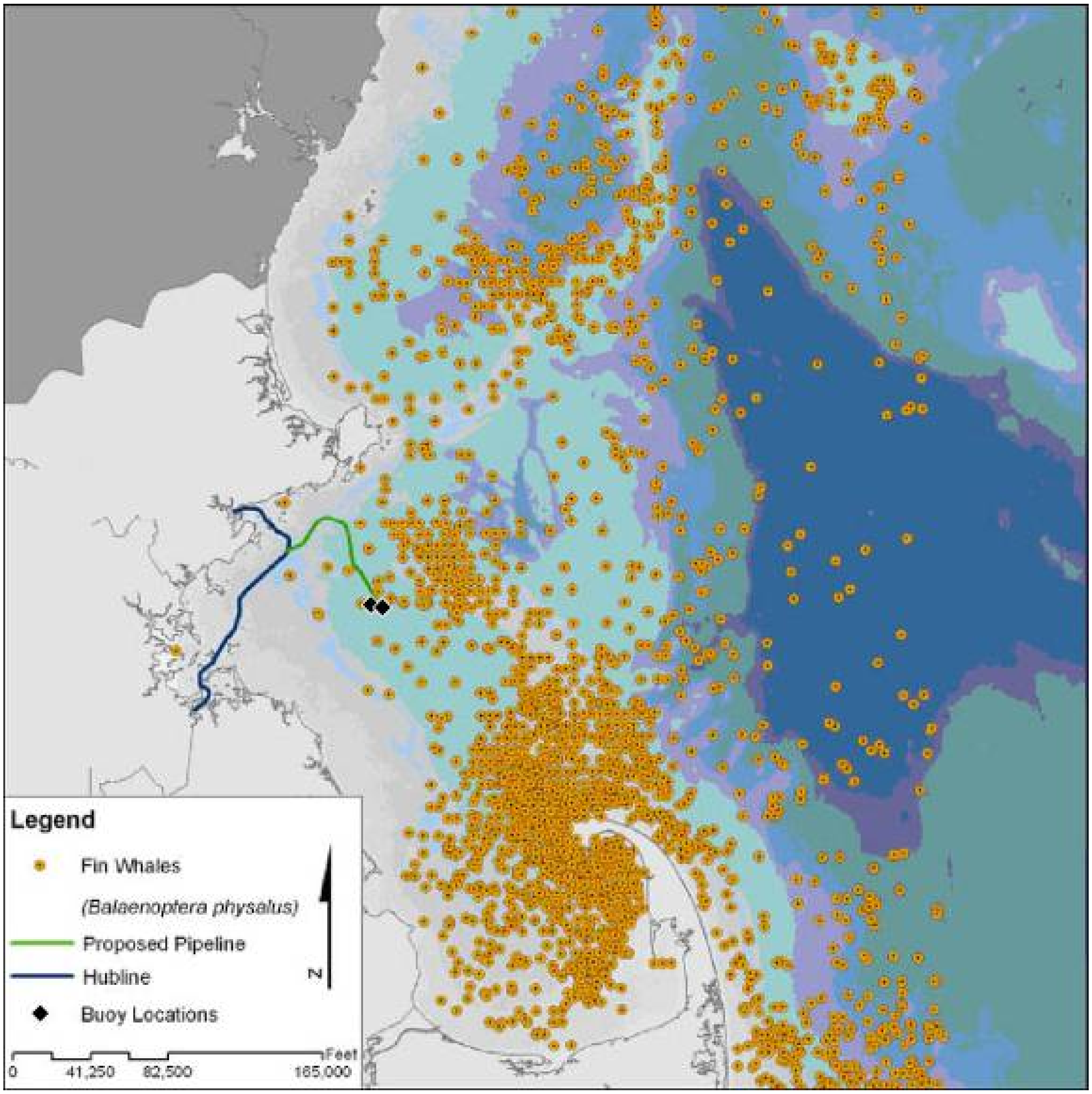


Figure 3-13. Fin Whales Observed in the Vicinity of the NEG Project Area

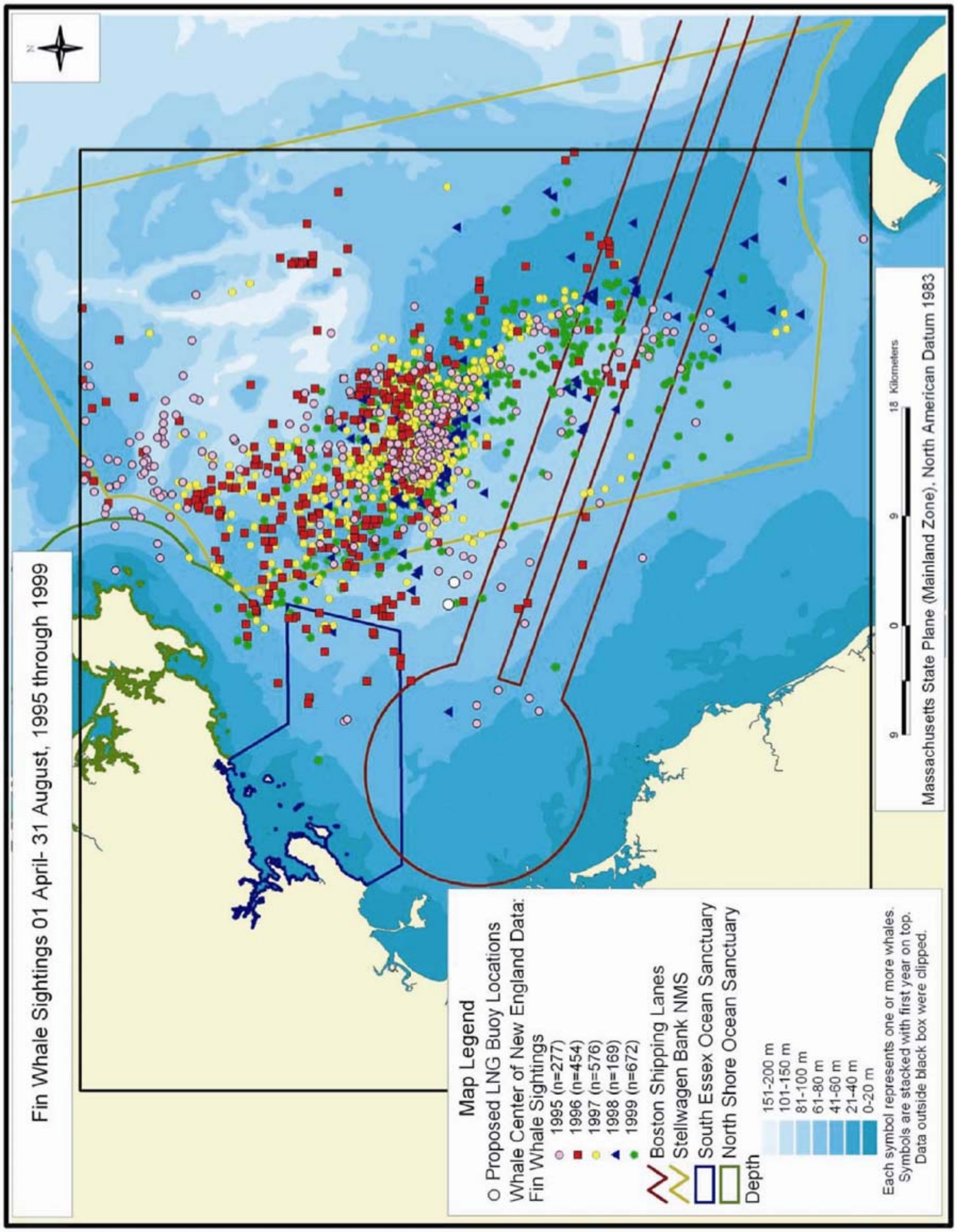


Figure 3-14. Fin Whale Sightings 01 April – 31 August, 1995 through 1999

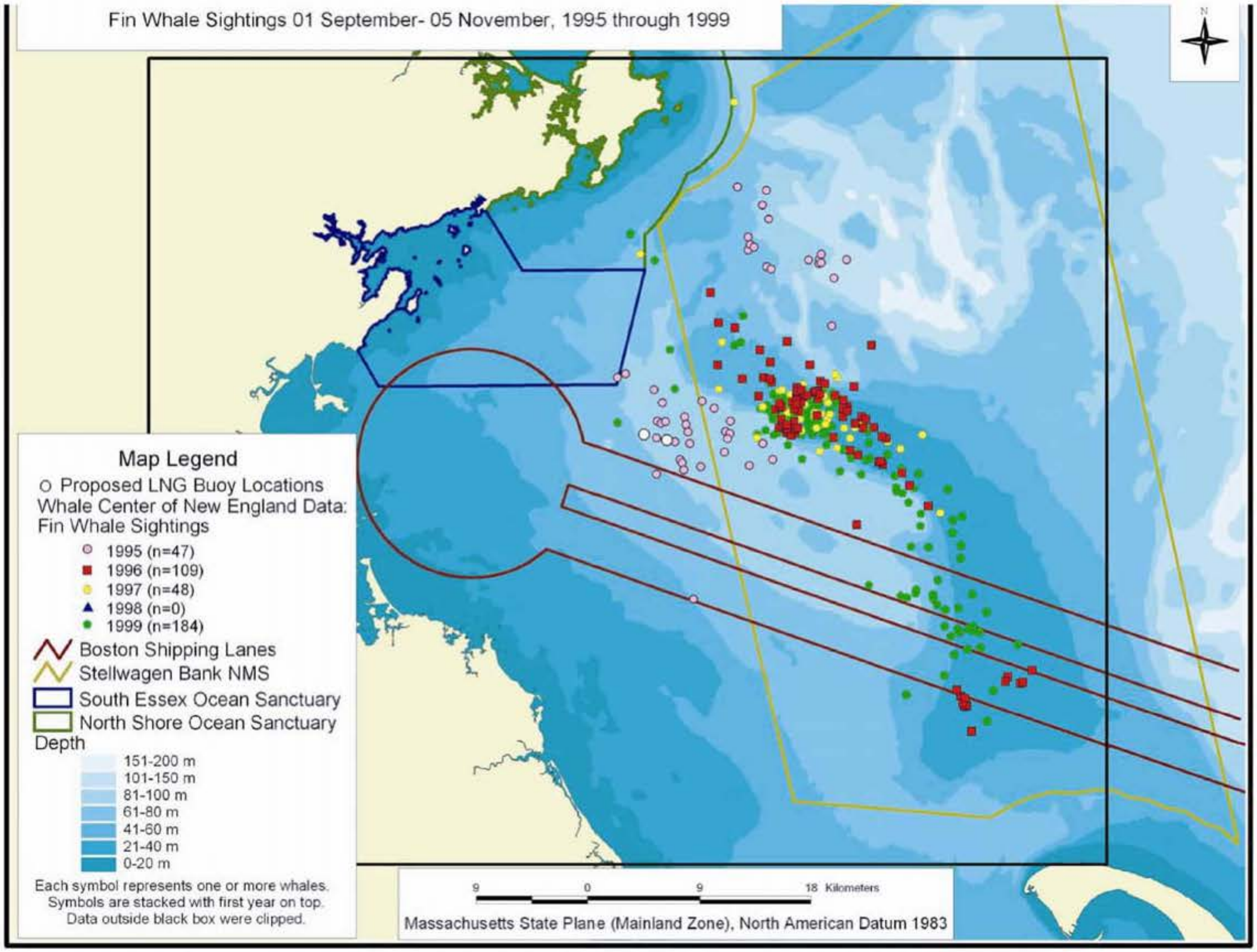


Figure 3-15. Fin Whale Sightings 01 September – 05 November, 1995 through 1999

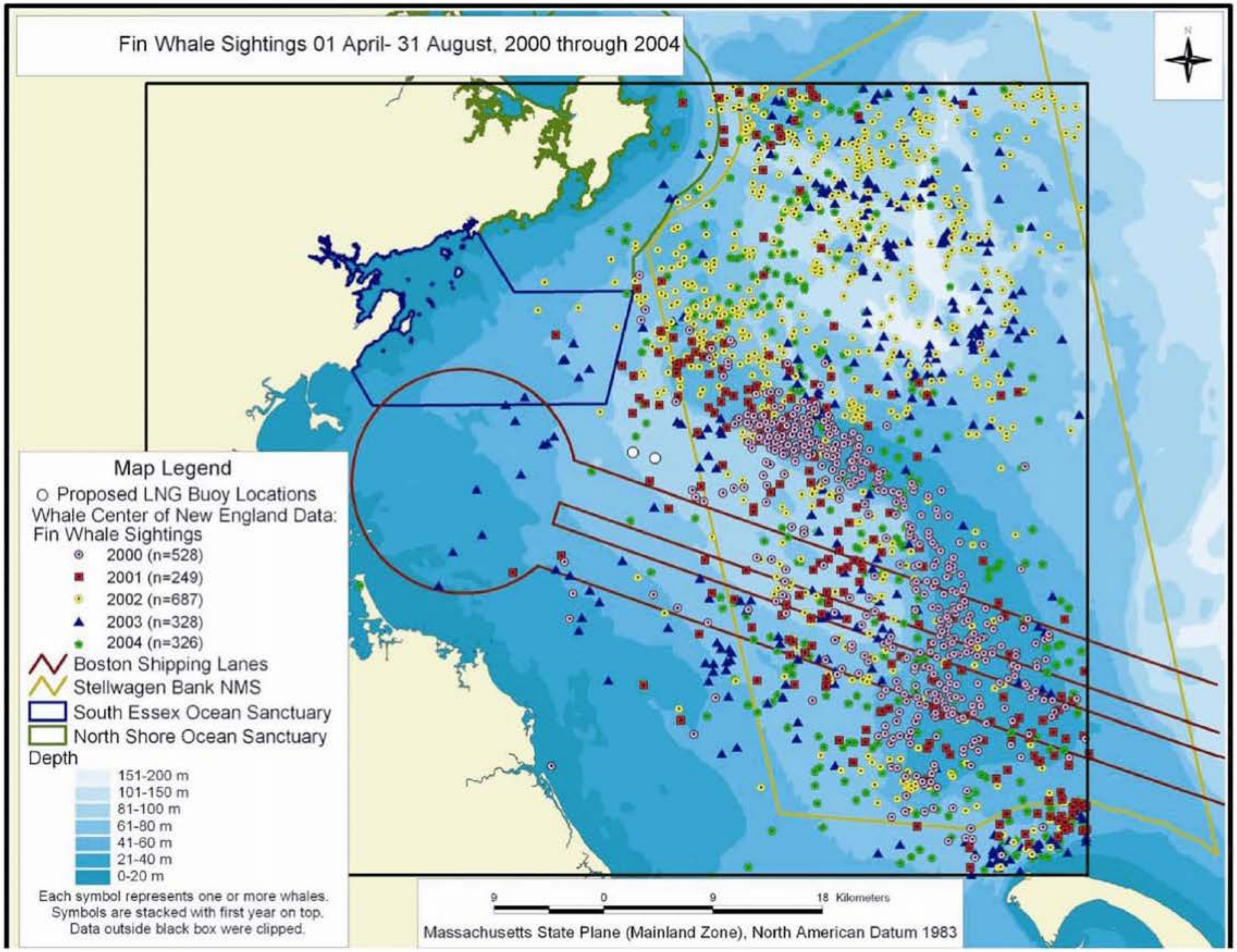


Figure 3-16. Fin Whale Sightings 01 April – 31August, 2000 through 2004

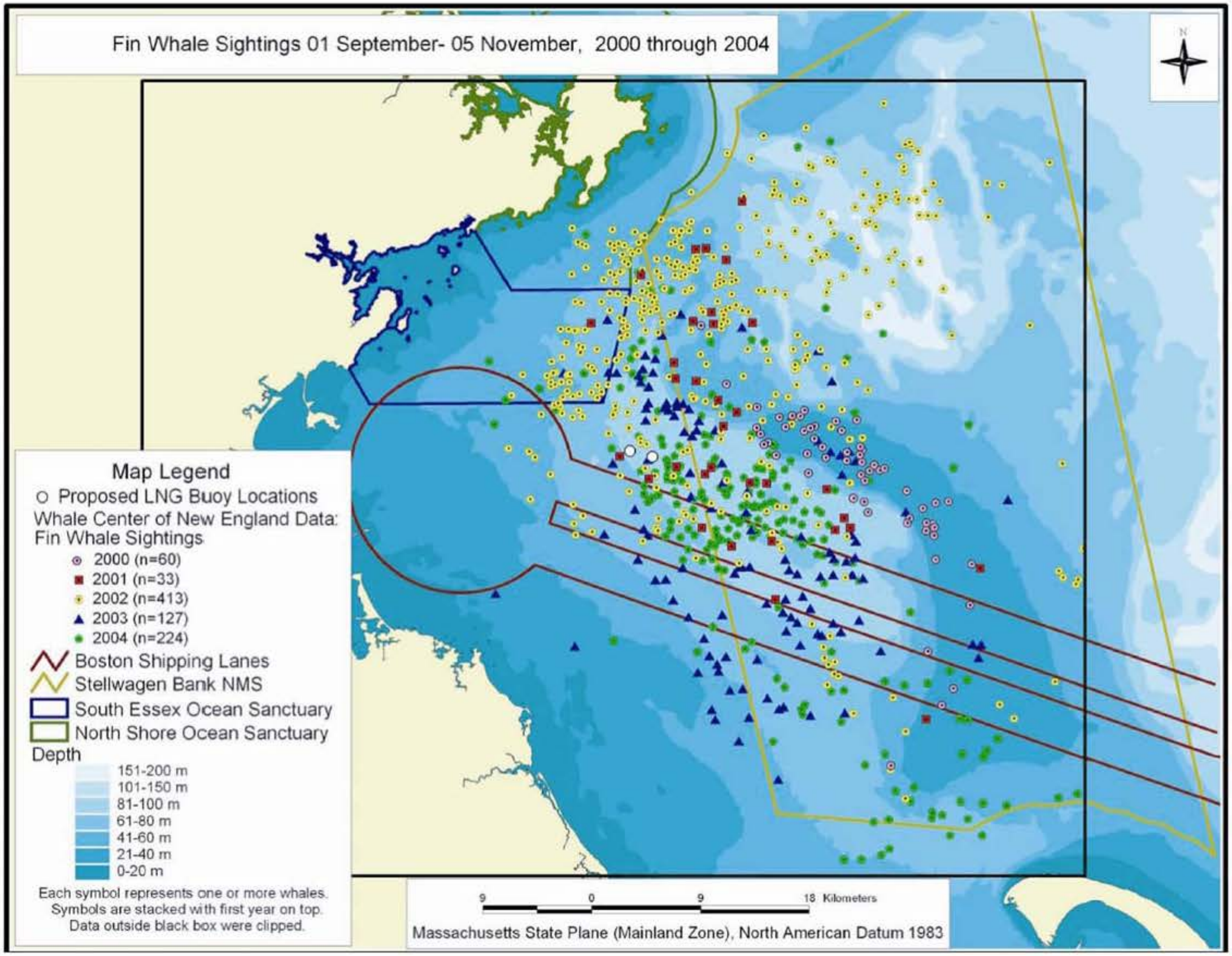


Figure 3-17. Fin Whale Sightings 01 September – 05 November, 2000 through 2004

The summer range of the western North Atlantic stock of fin whales includes most of the New York Bight, the Great South Channel, the Gulf of Maine, shelf water of Nova Scotia, the Gulf of St. Lawrence, Labrador, Newfoundland, Greenland, and Iceland. Limited migration generally occurs in shelf water from Cape Cod north as far as Labrador during the peak summer feeding period.

Only about 30% of the fin whales present in the summer remain in New England waters during the fall and winter. However, during the winter, they maintain their elevated summertime abundances in specific areas between Cape Ann and Cape Cod, particularly Stellwagen Bank and along the eastern perimeter of Georges Bank. During this period, they largely abandon the northern Gulf of Maine, Jeffreys Ledge, and the area immediately east of Cape Cod (CETAP, 1982; USEPA, 1993).

During the summers of 1986 and 1987, major changes occurred in the abundance and distribution of all great whales, including fin whales, in Massachusetts Bay, particularly Stellwagen Bank and Basin. The abundance of fin whales declined by an approximate order of magnitude. This shift may have been caused by a large decrease in the abundance of sand lance in the area during the summers of 1986 and 1987. Most of the fin whales (and humpback) moved to the Great South Channel area, where sand lance and other shoaling fish remained abundant (USEPA, 1993). As described above, a noticeable shift occurred again in 2001, when the distribution of fin whales shifted to the west of Stellwagen Bank into waters of Stellwagen Basin and the NEG port site (Weinrich and Sardi, 2005).

The waters off New England are an important feeding ground for the fin whale. Typical prey species of fin whales include sand lance, capelin, krill, herring, copepods, and squid. The distribution of sand lance has a strong influence on the distribution and movement of fin whales along the eastern coast (Reeves et al., 1998; Wilson and Ruff, 1999). Hain et al., (1992) has estimated that a "typical" 25.7-ton fin whale eats about 1,170 pounds (533 kg) of prey daily during the summer feeding period. This is about 2% of their body fat. Based on these estimates, the entire fin whale population of the northeast coast of the U.S. consumes about 150,000 metric tons of prey during the fall and winter, and 494,000 metric tons during the more active spring and summer feeding periods (USEPA, 1993). In the Massachusetts Bay area, fin whales have been observed both surface and sub-surface feeding. While surface feeding, the whales were observed swimming in areas where and lance or herring were visible (Weinrich and Sardi, 2005).

Swimming speeds average between 1 to 16 km/h (Watkins, 1981). Fin whales feed primarily upon planktonic crustaceans (particularly euphausiids), fish and squid (Gambell, 1985; Aguilar, 2002).

Fin whale mating normally takes place mid-winter (November to March with a peak from December to January), but evidence of out of season births along the U.S. eastern coast exists. Gestation lasts for about one year with calves being born while the fin whales are offshore, either in the tropics or in warm temperate waters. Nursing of the young calves typically lasts for six to eight months.

The biggest threats to fin whales are entanglements in gillnets and ship strikes. During 1997 to 2001, a total of seven fin whales of the western North Atlantic stock were killed by ship strikes, and three whales were injured/killed from entanglement in fishing gear (Waring et al., 2004). Fin whales react strongly to low-frequency ship sounds which are near the frequency of their own vocalizations (15 to 100 Hz), and there is some evidence that they actively avoid approaching vessels, diving to avoid contact (Richardson et al., 1995). Still more recent studies have shown that fin whales have accommodated to small vessel activity, often approaching to investigate (USEPA, 1993).

Humpback Whale (Megaptera novaeangliae)

The humpback whale is black in color on the dorsal side and a mottled white and black on the ventral side. A defining characteristic of humpback whales is their extraordinarily long flippers with white undersides. These whales can grow up to 30 to 60 feet (9 to 18 meters) in length. The top of the head and lower jaw have rounded, bump-like knobs, each containing at least one stiff hair. The purpose of these hairs is not known, though they may allow the whale to detect movement in nearby waters. There are between 20-50 ventral grooves which extend slightly beyond the navel and are clearly seen during feeding behaviors (Wilson and Ruff, 1999).

Humpbacks are most well known for their melodious song which ranges from 20 Hz to over 10 kHz. Humpback whales produce three types of sounds: songs in the late fall, winter and spring by solitary males; social sounds made by groups on their winter grounds; and feeding sounds made by individuals while on their summer feeding grounds. Songs are produced by solitary males and are thought to be produced as a reproductive display. The songs are composed of numerous themes that very in length, and songs are sung continuously for hours. All of the males from the same population sing the same basic song, but it does vary over the course of a single season and between years. Feeding sounds are generally made while feeding. Some believe that these could be a form of prey manipulation and not due to feeding coordination, while alternative explanations indicate these sounds are attractive and appear to rally animals to the feeding activity (D'Vincent et al., 1985; Sharpe and Dill, 1997). In the Pacific stock, it was found that summer feeding sounds are approximately 20 to 2000 Hz with mean durations of 0.2 to 0.8 seconds, and estimated source levels of 175 to 192 dB re 1 μPa at 1 meter (Richardson et al., 1995). Social sounds in the winter breeding areas are produced by males and extend from 50 Hz to more than 10,000 Hz with most energy below 3000 Hz (Tyack and Whitehead, 1983; Richardson et al., 1995). These sounds are associated with agonistic behaviors from males competing for dominance and proximity to females. They have been shown to elicit reactions from animals up to 9 km (4.9 nm) away (Tyack and Whitehead, 1983).

There is no direct measurement of auditory threshold for the hearing sensitivity of humpback whales (Ketten, 2000; Thewissen, 2002). Because of this lack of auditory sensitivity information, Houser et al. (2001) developed a mathematical function to describe the frequency sensitivity by estimating position along the humpback basilar membrane with know mammalian hearing data. The results predicted the typical U-shaped audiogram with sensitivity to frequencies from 700 Hz to 10 kHz with maximum sensitivity between 2 to 6 kHz. Humpback whales have been observed reacting to LF industrial noises at estimated received levels of 115-124 dB (Malme et al., 1985). They have also been observed to react to nonspecific calls at received levels as low as 102 dB (Frankel et al., 1995).

Western North Atlantic humpbacks winter in the Lesser and Greater Antilles Islands of the eastern Caribbean Sea. During the spring and summer, whales from these wintering areas split into several feeding aggregations that migrate to and feed along the coasts of Iceland, southwestern Greenland, Newfoundland, Labrador, the Gulf of St. Lawrence, and the Gulf of Maine (NMFS, 1991a). Some whales from the St. Lawrence River estuary and Canadian Maritimes feeding aggregations migrate through New England waters during their biannual migrations between summer and winter habitats. Nevertheless, only about 10% of the current day North Atlantic population of humpback whales regularly visits New England waters (USEPA, 1993). According to the species stock assessment report, the population estimate for the Gulf of Maine stock of humpback whales is 902 individuals (Waring et al., 2004), and the best estimate for the entire North Atlantic population is 10,600 (Smith et al., 1999).

Humpback whales reach their peak abundance in New England waters in May and June and remain abundant there well into October during most years (CETAP, 1982). The areas of greatest abundance follow a broad arc extending from the Great South Channel northward along the 330 foot (100 meter) contour, over Stellwagen Bank, and north to Jeffreys Ledge. Humpback whale distribution and abundance is variable between years, but a dramatic increase in the use of Stellwagen Bank by adult humpback whales has occurred during the September 1-Novemebr 5 2000-2004 period, apparently due to the increased feeding on previously unexploited prey sources (Weinrich and Sardi, 2005).

According to the sightings data, humpback whales are plentiful in the Project area (Figure 3-18 through 3-22; Short and Schaub, 2005; Short et al., 2004; Weinrich and Sardi, 2005; McLeod et al., 2003 and 2000; Kenney, 2001; McLeod, 2002, 2001, and 1999). Both the regional map in Figure 3-18, as well as the Massachusetts Bay specific maps produced by Weinrich and Sardi (2005) shown in Figures 3-18 through 3-22 indicate the distribution of humpback whales has focused primarily on the shallow waters of Stellwagen Bank. The regional data also show large numbers of humpback whales in the Great South Channel area off Cape Cod (Figure 3-18). The more recent Weinrich and Sardi (2005) data from 2000 to 2004 indicate an expansion of feeding humpback whales into the deep waters of Stellwagen Basin, and into the immediate vicinity of the NEG project site during the late summer to fall time period (Figure 3-22). Additional data collected during the late summer and fall of 2005 support this finding.

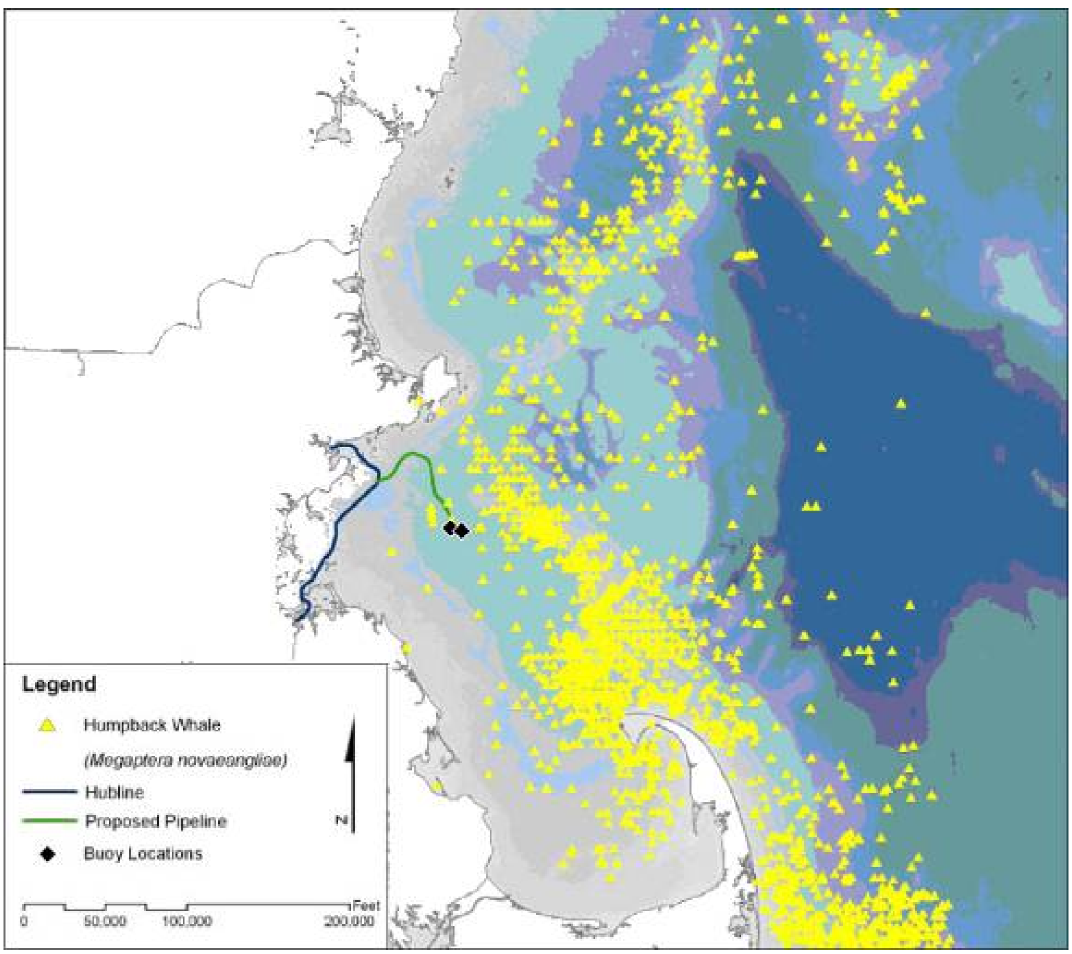


Figure 3-18. Humpback Whales Observed in the Vicinity of the NEG Project Area

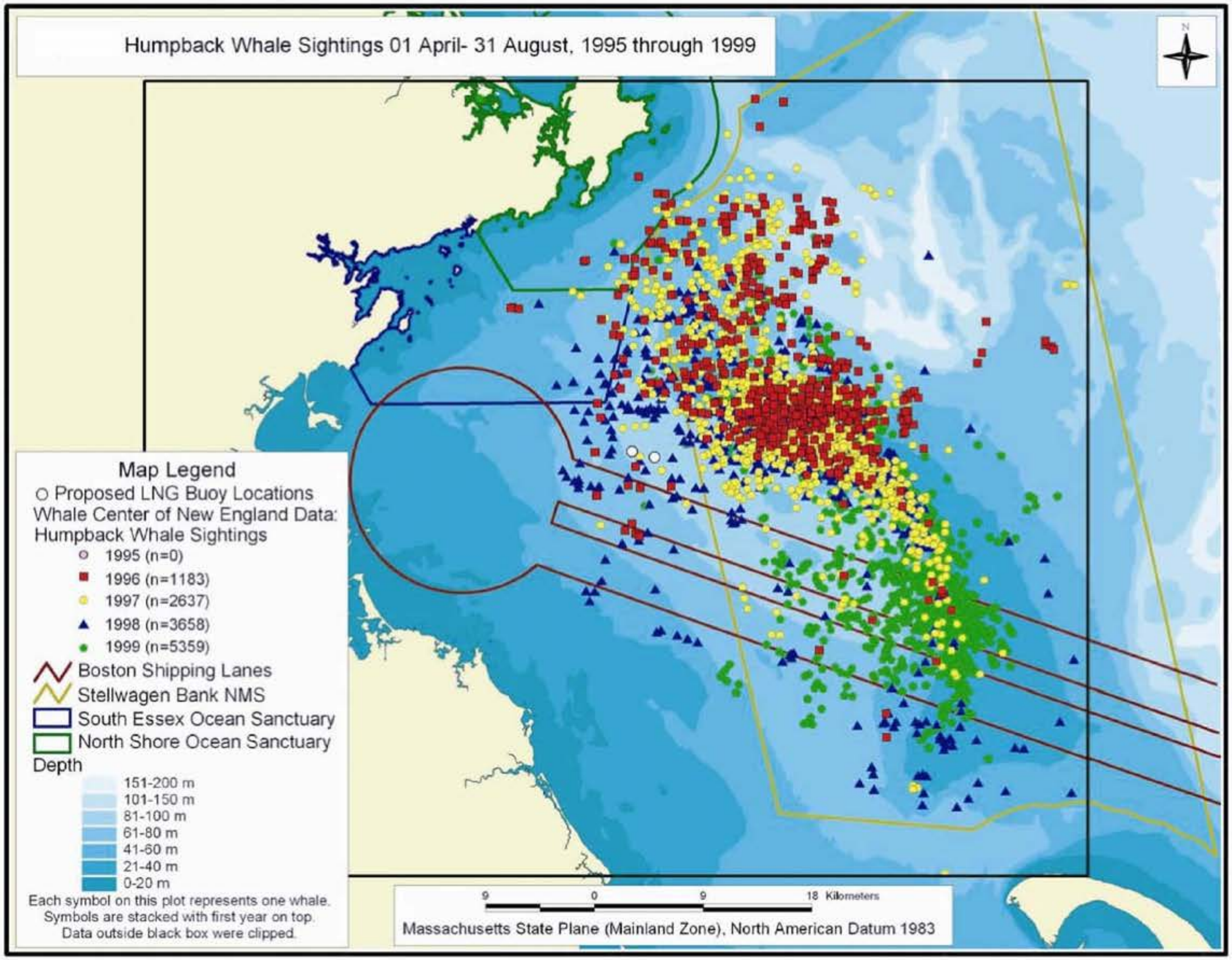
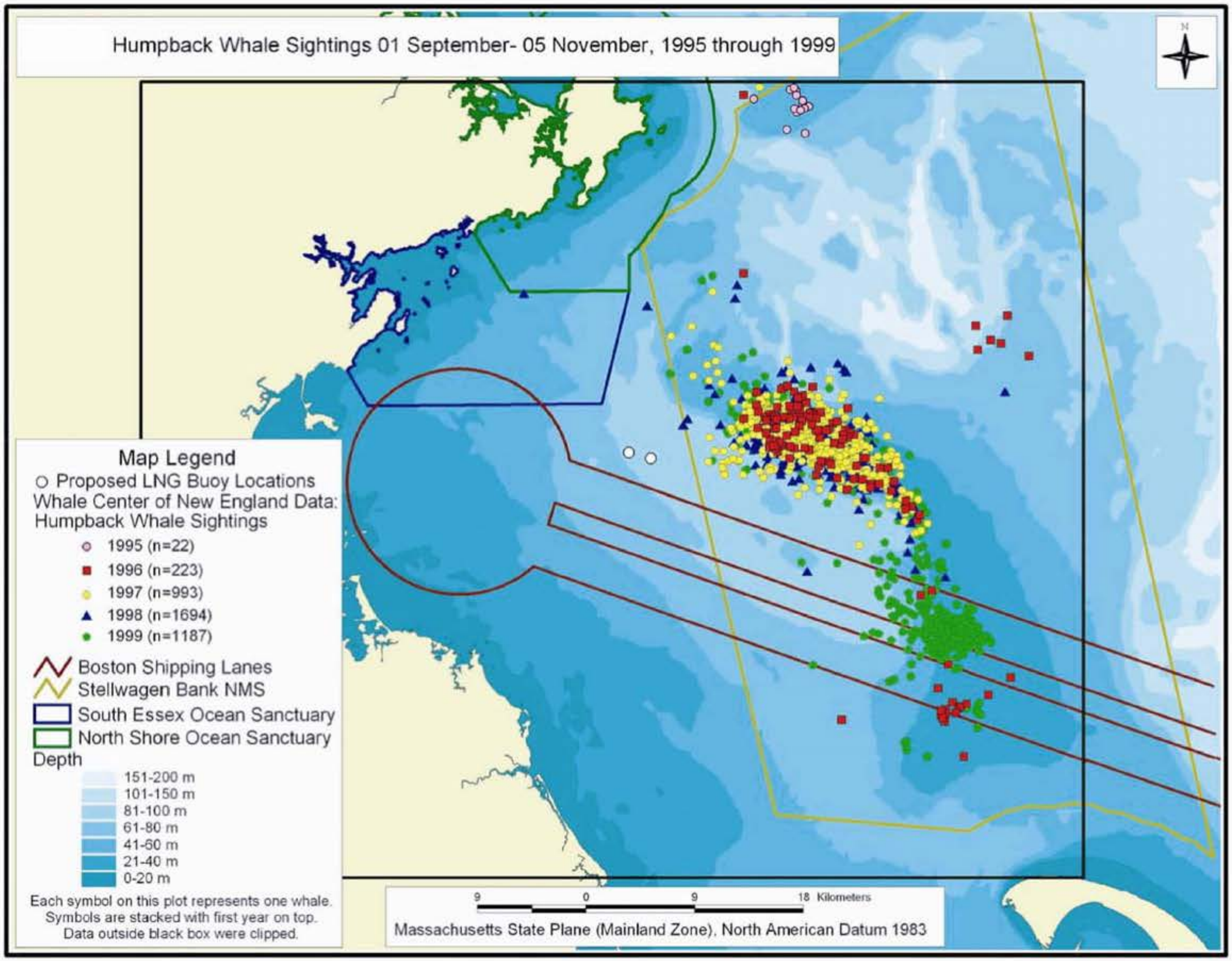


Figure 3-19. Humpback Whale Sightings 01April – 31August, 1995 through 1999

Figure 3-20. Humpback Whale Sightings 01 September – 05 November, 1995 through 1999



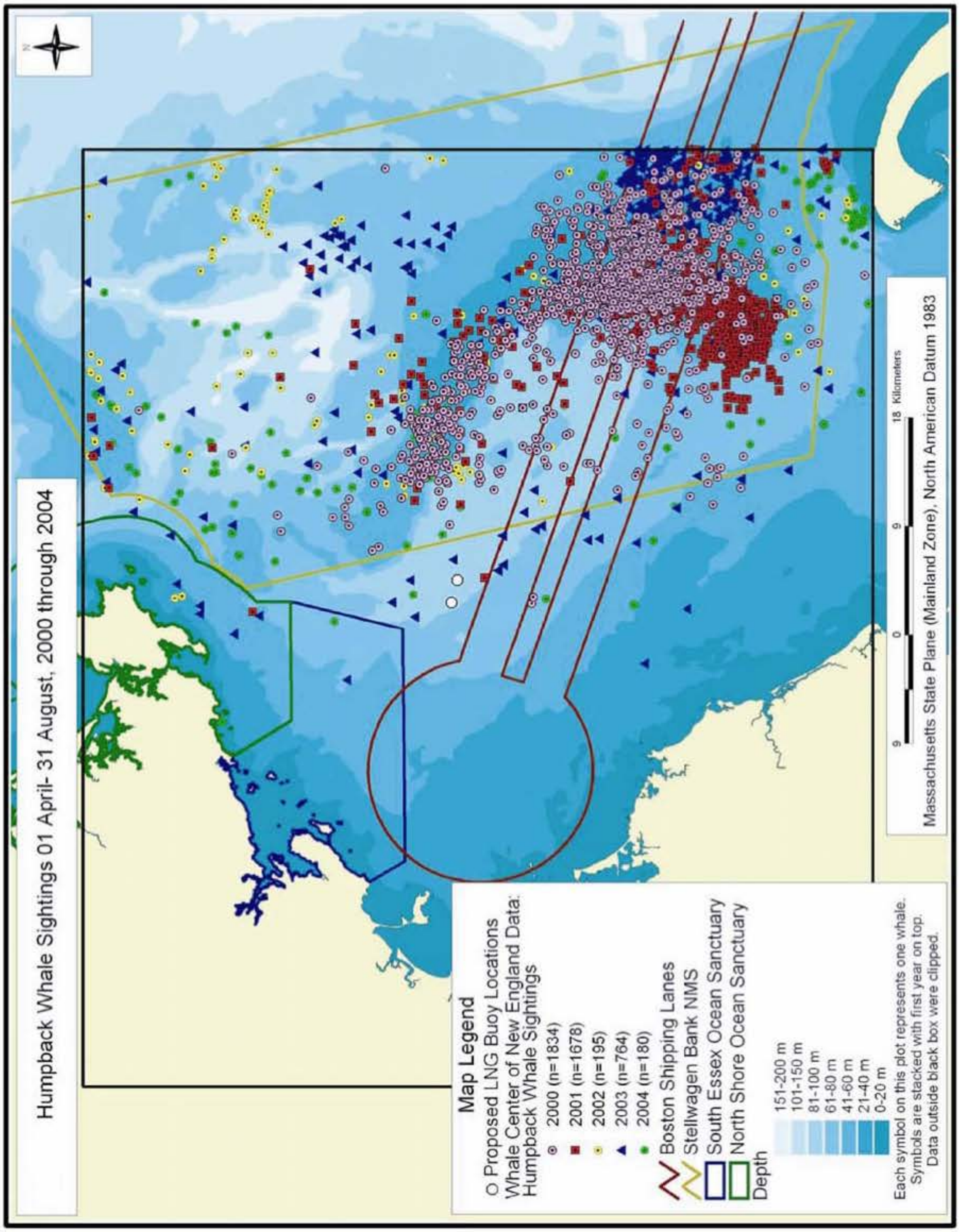


Figure 3-21. Humpback Whale Sightings 01 April – 31 August, 2000 through 2004

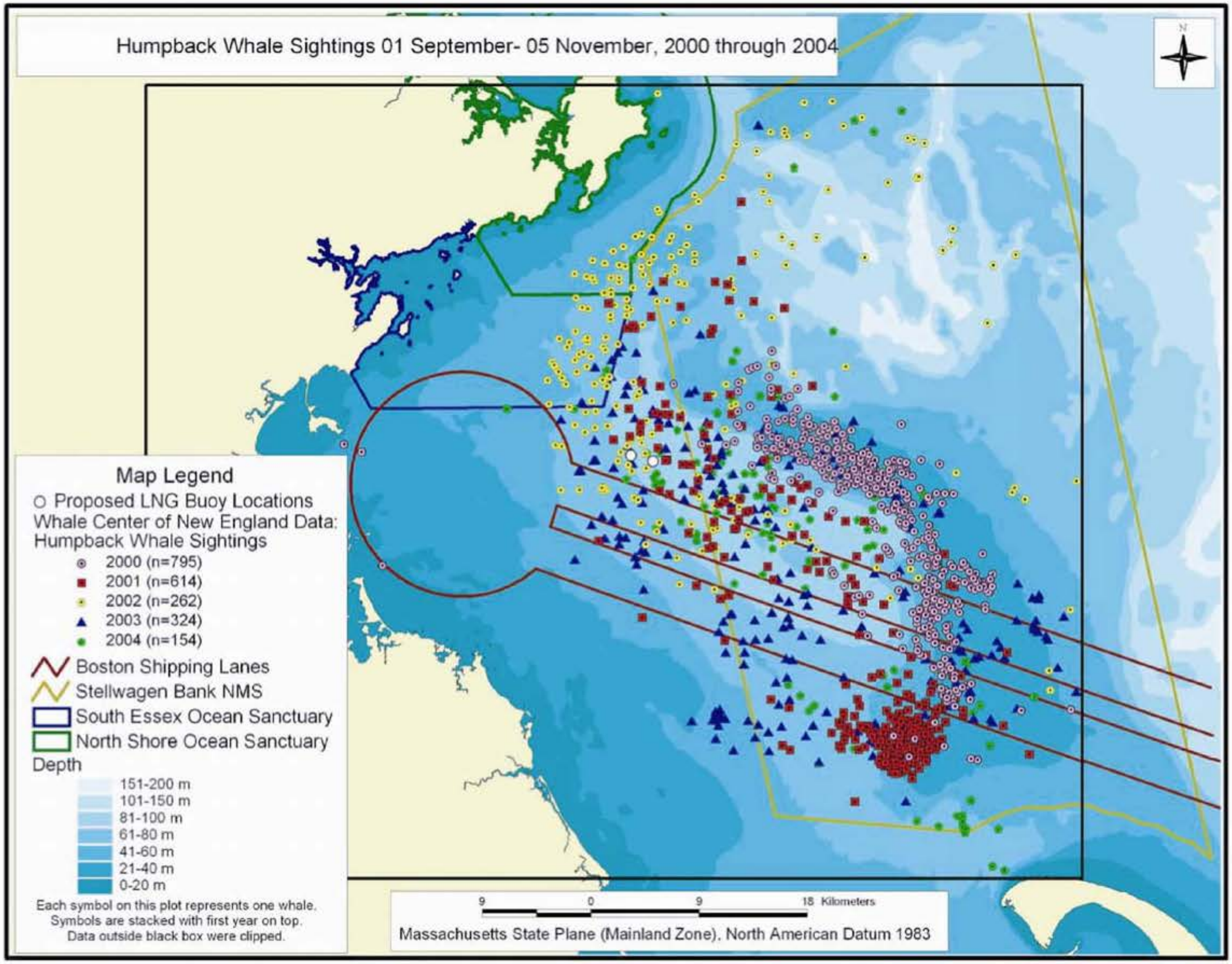


Figure 3-22. Humpback Whale Sightings 01 September – 05 November, 2000 through 2004

Humpback whales are found along the U.S. east coast during the spring, summer and fall months. They spend their winters in the lower latitudes and begin to arrive in early March in Massachusetts Bay. By early April they move to the Stellwagen Bank where they remain until mid-November. However, data indicate that not all animals migrate during the fall from summer feeding to winter breeding sites and that some whales remain year-round at high latitudes (Christensen et al., 1992; Clapham et al., 1993). Because humpback whales feed in areas of high productivity, their distribution is patchy. They are typically found in areas of upwelling, along the edges of banks, and all along the continental shelf and other physically dynamic areas.

Shifts in humpback distributions have been linked to change in prey abundance. Historically, humpback whales were most abundant in the northern Gulf of Maine, where herring and mackerel were plentiful. However, in the 1970s, stocks of the fish declined while sand lance stock in the southern Gulf of Maine increased. Consequently, there was a shift in the distribution of humpbacks to exploit this alternative food source (Payne et al., 1986, 1990; Kenney et al., 1996).

Humpback whales are thought to feed mainly while in summer feeding areas, with little feeding known to take place in their wintering grounds. Humpbacks consume roughly 95% small schooling fish and 5% zooplankton (e.g. krill), and they migrate throughout the summer habitat to locate prey (Kenney et al., 1985). Sand lance is the most important prey species, supplemented by euphausiids, herring, and mackerel when abundant. They also eat haddock, capelin, small Pollack, cod, and hake. Humpback whales swim below the thermocline to pursue their prey, so even though the surface temperatures might be warm they are frequently swimming in cold water. Movement within their summer range is greatly dependant on the distribution and abundance of prey species (NMFS, 1991a). Mean swim speeds are close to 4.5 km/h (2.4 knots) (Gabriele et al., 1996).

Breeding for humpback whales is completely seasonal, with most of the activity occurring in the mid-winter. Gestation periods are generally one year with the majority of calves being born between January and March. Young calves nurse up to ten months and then separate from their mothers after about a year. Both males and females attain sexual maturity at an average age of five.

The biggest threats to humpback whales are gear entanglements and ship strikes. Approximately three humpback whales were killed each year by human activities such as ship strikes and fishery related incidents during 1997 to 2001. During one study of humpback whale carcasses, human activities either contributed to or caused the death of 60 percent of the stranded whales (Wiley et al., 1995 as reported in Waring et al., 2004). Another study found that humpbacks are also affected by the bioaccumulation of toxins (Taruski et al., 1975 as reported in NMFS, 1991a). Increase in ambient noise levels and boat presence has also had an impact on their utilization of habitats; humpback whales have demonstrated a short-term avoidance of areas with increased whale-watching activity (Corkeron, 1995). The species is listed as Endangered due to the depletion of its population from whaling (NMFS, 1991a). A recovery plan has been written and is currently in effect (NMFS, 1991a).

North Atlantic Right Whale (Eubalaena glacialis)

The North Atlantic right whale is a large, slow-swimming, baleen whale that grows to roughly 45 to 55 feet (14 to 17 meters) long. They typically weigh 60 to 70 tons, but can weigh up to 100 tons. The North Atlantic right whale is black all over, except for a white patch on its belly. They have a broad and deeply notched tail, but no dorsal fins. Right whales have horny bumps on their heads and lower jaws called callosities. Callosities are used as a feature to differentiate right whales from other baleen whales and to identify specific individuals. The North Atlantic right whale is one of the most endangered large whale species in the world.

North Atlantic right whales produce a variety of sounds. Low frequency moans have frequencies that range from 70 to 600 Hz (Vanderlaan et al., 2003; Matthews et al., 2001; Clark, 1982). Broadband sounds have been recorded during surface activity and are termed “gunshot slaps” (Clark, 1982; Matthews et al., 2001). Source levels of North Atlantic right whale tonal sounds have been measured from approximately 140 to 190 dB (IFAW, 2001). Right whales use 50 to 200 Hz up-calls that are thought to maintain physical contact and 100 to 200 Hz down-calls thought to maintain acoustic but not physical contact. Other sounds produced by right whales are tones, high-frequency tonal frequency modulated sweeps, complex amplitude-modulated pulsatile sounds, mixtures of amplitude and frequency modulation, noisy broadband blows, and impulsive slaps. Whales would increase the number of sounds when grouped together and the sounds produced are dependant on the activity, size, and sexual composition of the right whale group. These sounds are well documented for the southern right whale, and it is known that the northern right whale makes similar sounds (Cummings et al., 1972; Clark, 1982).

The 2003 United States Atlantic and Gulf of Mexico Marine Mammal Stock Assessments reported only 291 North Atlantic right whales in existence, which is less than what was reported in the Northern Right Whale Recovery Plan written in 1991 (NMFS, 1991b; Waring et al., 2004). The distribution and relative abundance of right whales in Cape Cod Bay remained relatively stable between 1975 (when intensive observations programs began) and 1986. Right whales are most abundant each spring in the eastern part of Cape Cod Bay. However, occasional individuals or groups were seen in Massachusetts Bay, and many right whales were sighted both north and east of Cape Cod in 1985 and 1986 (USEPA, 1993).

The North Atlantic right whale is found in coastal or shelf waters where their food is available (NMFS, 2005f). NMFS has designated the following three critical habitats for the North Atlantic right whale: Cape Cod Bay/Massachusetts Bay, the Great South Channel, and Southeastern United States (Waring et al., 2004). These areas are considered to be “essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of the northern right whale population” (NOAA, 1993b). Sightings data indicate that the North Atlantic right whale has been found in the Project area (Figure 3-23 through 3-27) (Short and Schaub, 2005; Short et al., 2004; Weinrich and Sardi, 2005; McLeod et al., 2003 and 2000; Kenney, 2001; McLeod, 2002, 2001, and 1999).

The regional sightings data shown in Figure 3-23 show the highest concentration of North Atlantic right whales to be in Cape Cod Bay and the southwest corner of Stellwagen Marine Sanctuary. Other lower concentrations are also shown over the north end of Stellwagen Bank, west of Jeffreys Ledge, and near the southeastern corner of Stellwagen Marine Sanctuary. The specific data to Massachusetts Bay, prepared by Weinrich and Sardi (2005) (Figures 3-24 through 3-26) show that North Atlantic right whales are sporadic visitors to the study area during the April to November time period. The spring and summer sightings indicate a preference for the deeper waters to the west and north of Stellwagen Bank, rather than the shallow waters of the Bank itself. The data also show a shift in North Atlantic right whale sightings from the deeper waters north of Stellwagen Bank during the 1995 to 1999 period (Figure 3-24), to the Stellwagen Basin area in the vicinity of the NEG project site during the 2000 to 2004 period (Figure 3-26). The Massachusetts Bay data indicate a significant drop in sightings of North Atlantic right whales during the fall months (Figures 3-25 and 3-27); however, Weinrich and Sardi (2005) point out that this could be due to increased focus on the Jeffreys Ledge area to the north, and lack of effort to determine use in Massachusetts Bay during the fall time period.

The North Atlantic right whale is a highly migratory species. They range from wintering and calving grounds in coastal waters of the southeastern U.S. to summer feeding and nursery grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf (Waring et al., 2004). Right whales are found in Cape Cod Bay during all months, but are most common from January to mid-late April, peaking in late March (Knowlton et al., 2001; NMFS, 2005f). As many as 70 right whales have been observed in Cape Cod Bay in a single day and nearly half the total catalogued population may visit Cape Cod and Massachusetts Bays for periods of one day to a few weeks each spring (Hamilton and Mayo, 1990).

New England waters are a primary feeding habitat for the North Atlantic right whale. The primary prey for North Atlantic right whales off the coast of Massachusetts are zooplankton (i.e., copepods, krill) (Kelly, 1998). Copepod patches usually occur at or near the water surface in Cape Cod Bay, where the whales are often seen skim-feeding as they swim along the surface (Kenney et al., 2001; Mayo and Goldman, 1992; USEPA, 1993). A number of studies have shown that dense *Calanus* concentrations occur in areas of convergence near a persistent tidal mixing front which separates water masses of differing temperature, salinity and biological properties (CETAP, 1982; Wishner et al., 1995). Deep plankton patches are also consumed by foraging right whales (Baumgartner et al., 2003). Right whales are considered grazers as they swim slowly with their mouths open. They are the slowest swimming whales and can only reach speeds up to 10 miles (16 kilometers) per hour.

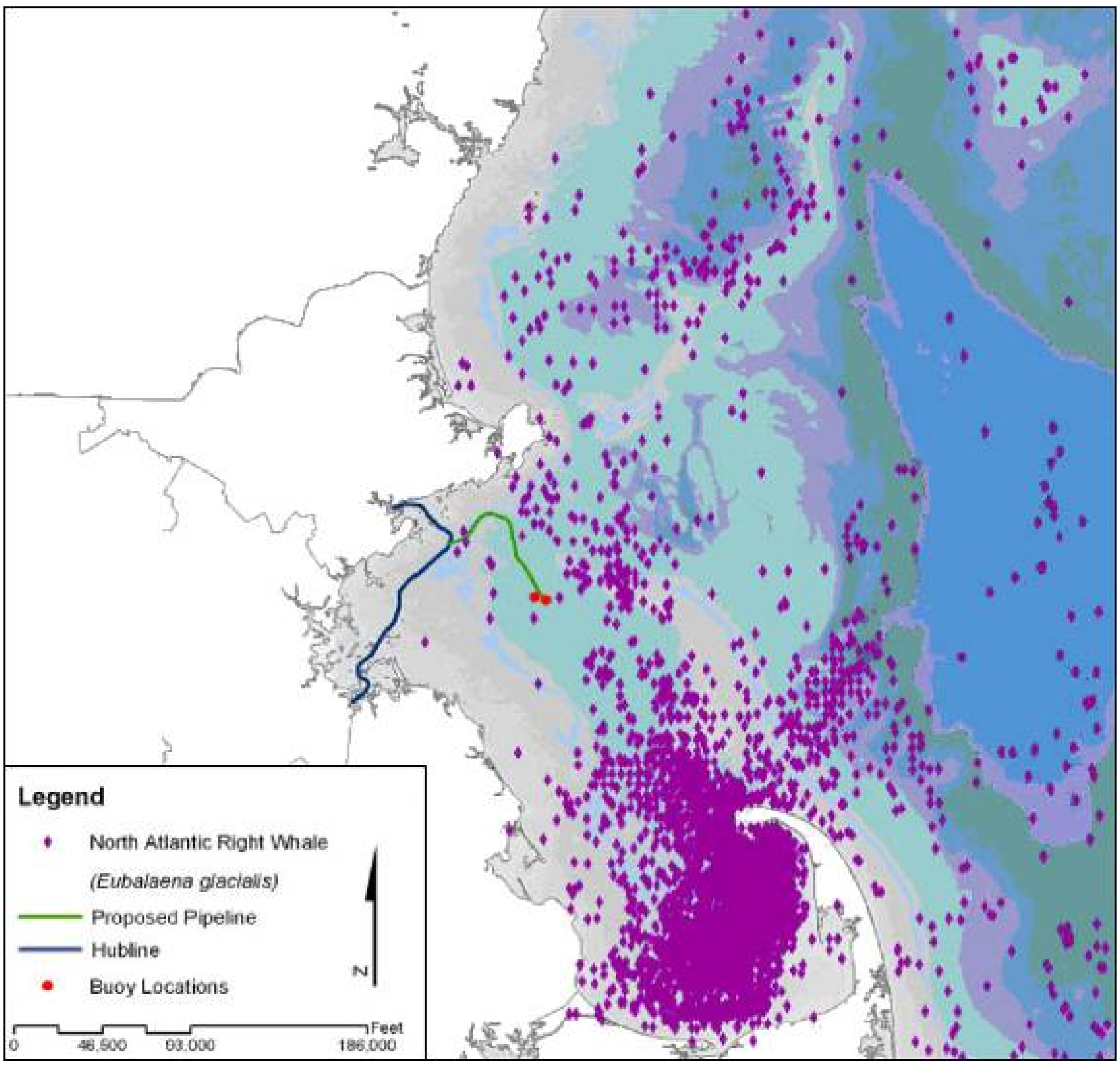


Figure 3-23. North Atlantic Right Whales Observed in the Vicinity of the NEG Project Area

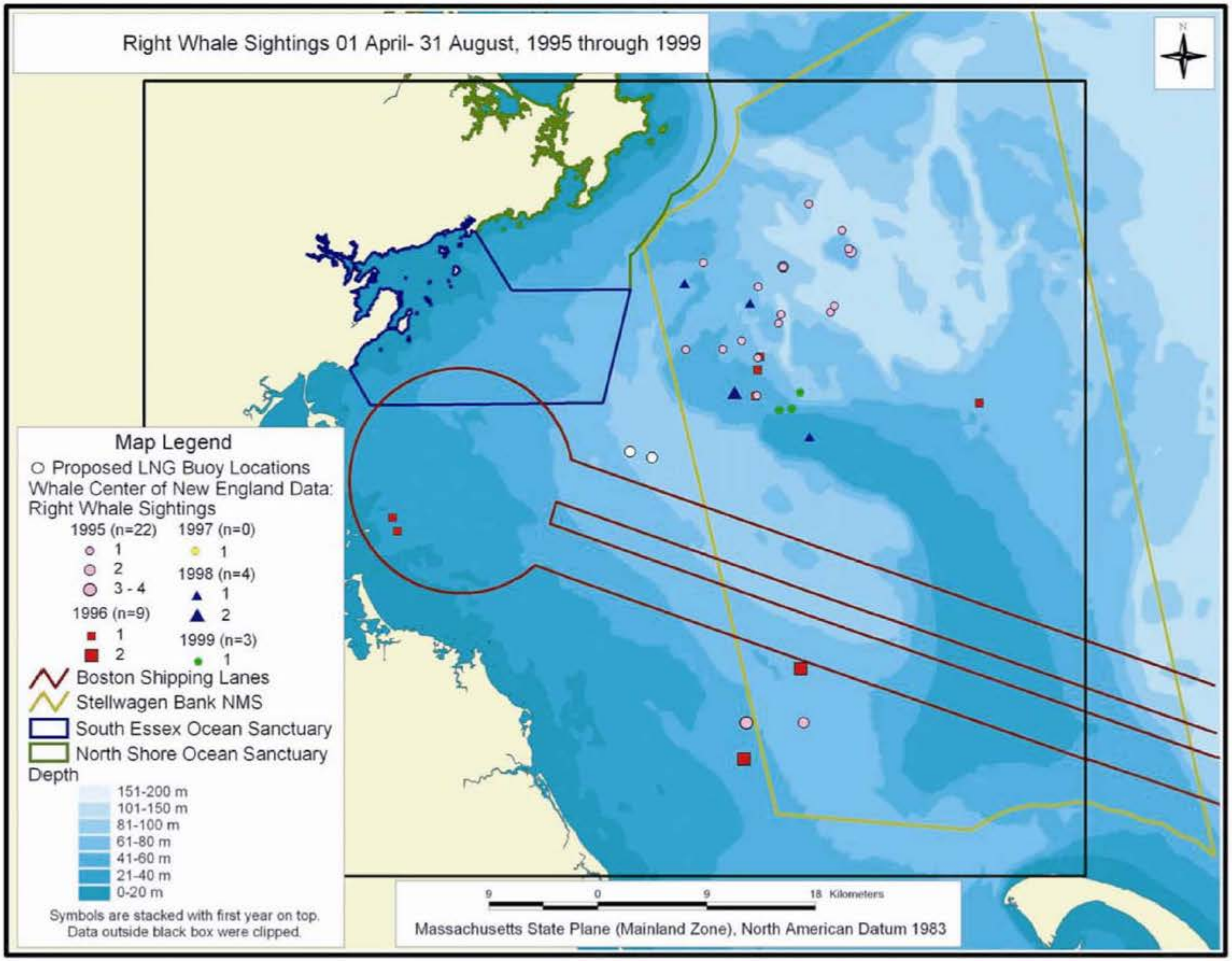


Figure 3-24. Right Whale Sightings 01April – 31 August, 1995 through 1999

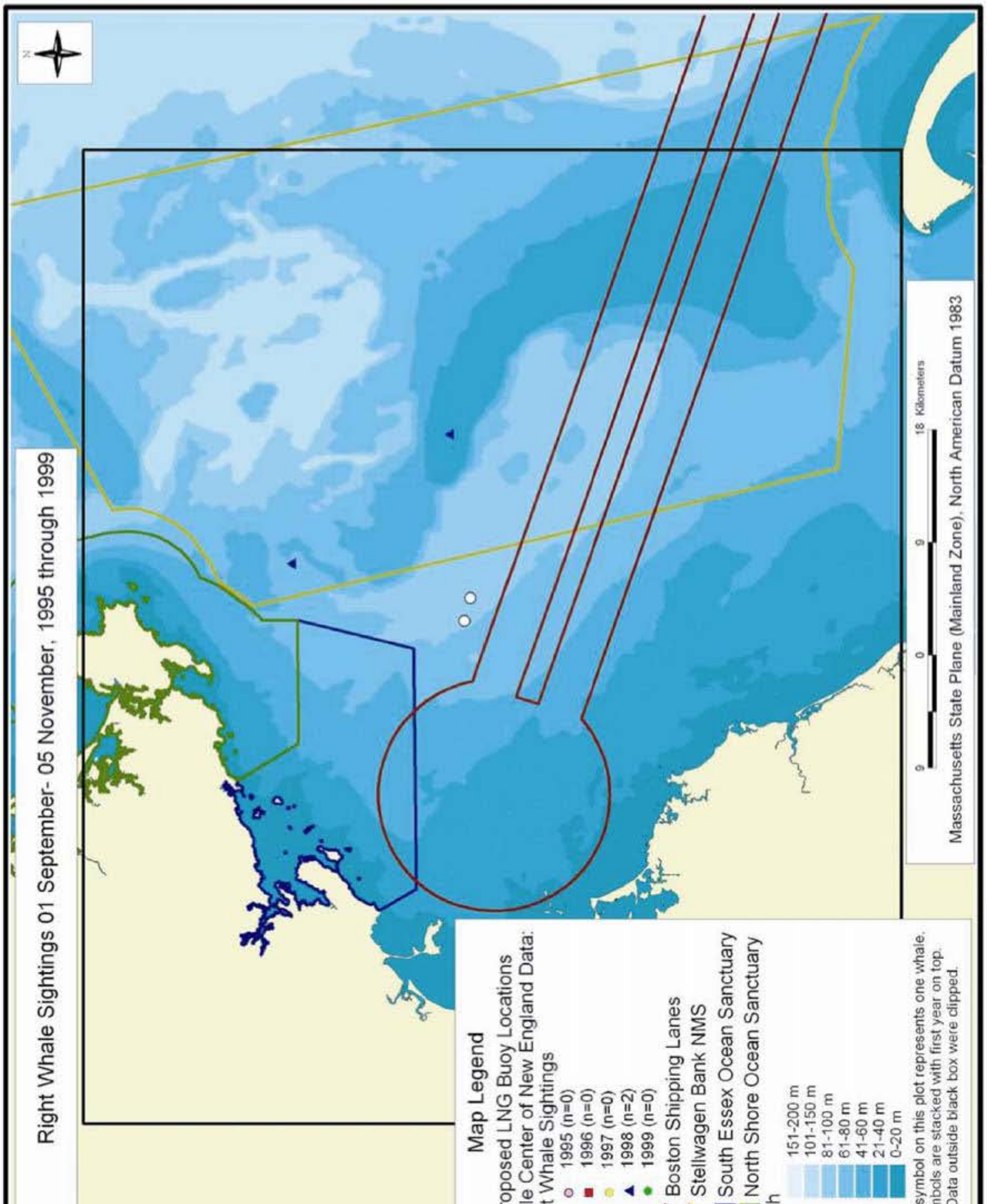
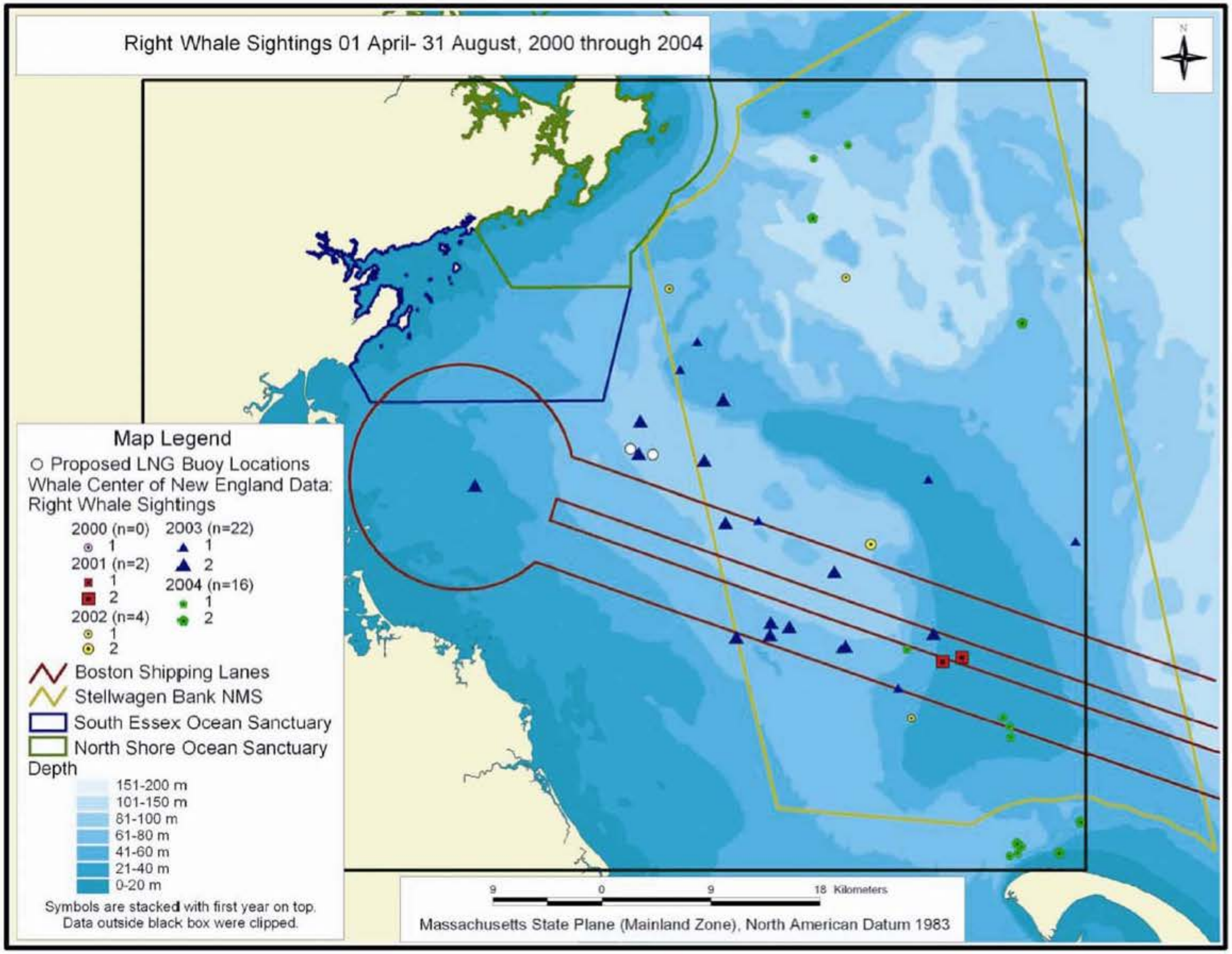


Figure 3-25. Right Whale Sightings 01 September – 05 November, 1995 through 1999

Figure 3-26. Right Whale Sightings 01 April –31 August, 2000 through 2004



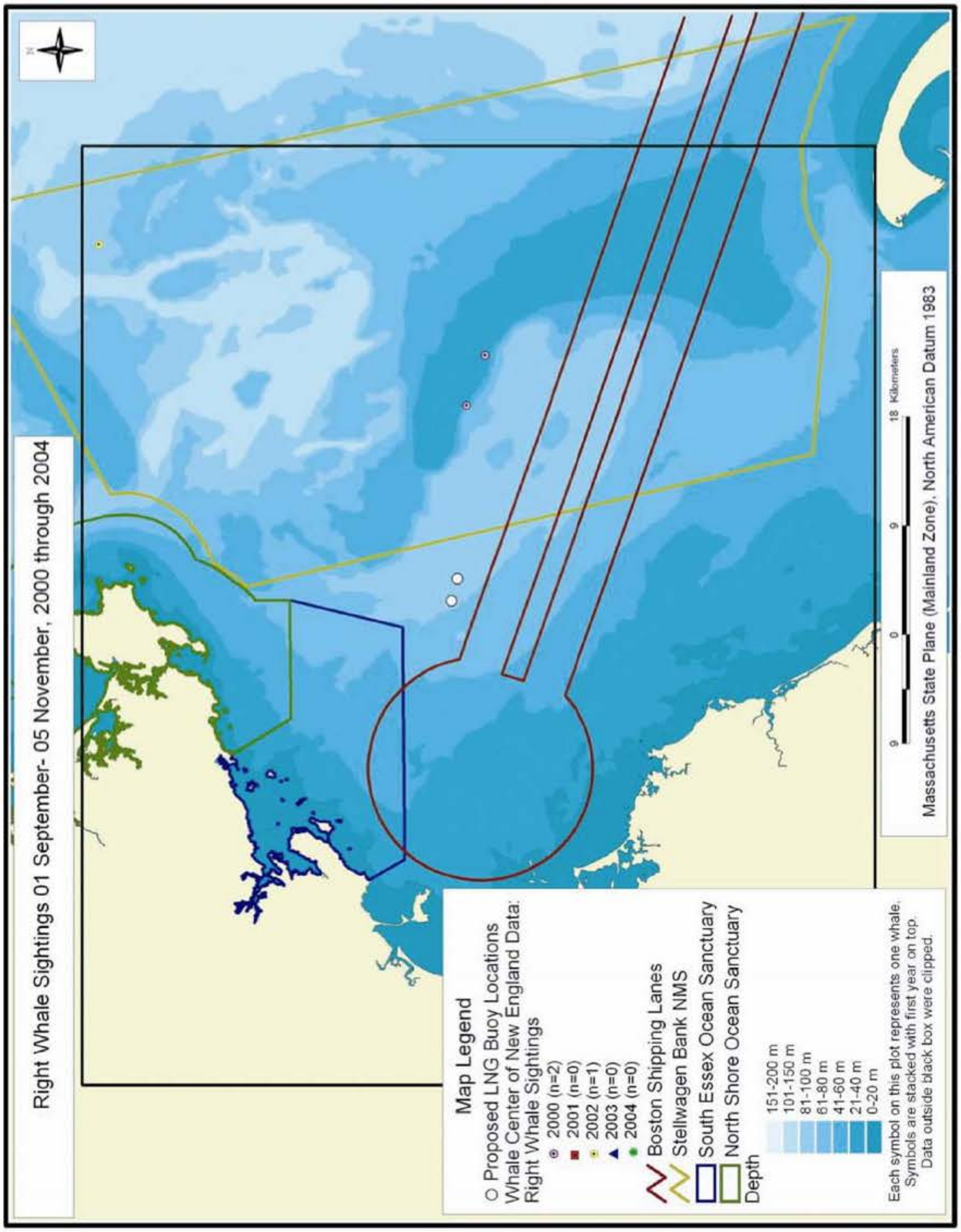


Figure 3-27. Right Whale Sightings 01 September – 05 November, 2000 through 2004

Right whale courtship behavior has been observed in every season throughout their range, but precise breeding times and locations are unknown. Surface activities possibly related to mating have been observed in Cape Cod Bay and the Great South Channel during late winter and spring. They calve between the northeast coast of Florida and southeastern Georgia (IFAW, 2001; Vanderlaan et al., 2003). Calves average 15 feet in length, and gestation takes approximately 1 year and records for weaning indicate that it takes from 8 to 17 months to rear the calf to maturity. Right whales reach sexual maturity between 3-5 years of age. Reproductively active females give birth to only one calf every 3-5 years.

Fishing gear entanglement and vessel collisions have been labeled the greatest threat to North Atlantic right whales (NMFS, 2005f). Most ship strikes are fatal to the North Atlantic right whales (Jensen et al., 2003). Right whales have difficulty maneuvering around boats. North Atlantic right whales spend most of their time at the surface, feeding, resting, mating, and nursing, increasing their vulnerability to collisions. Mariners should assume that North Atlantic right whales would not move out of their way, nor would they be easy to detect from the bow of a ship for they are dark in color and maintain a low profile while swimming (WWF, 2005a). In the Massachusetts Bay area between the period 1976 and 2001 there and been six right whale strikes recorded; five out the six resulted in mortality (Jensen and Silber, 2004; Waring et al., 2004).

Sei Whale (Balaenoptera borealis)

Sei whales, which are easily confused with Bryde’s whale, are bluish-gray baleen whales with white on their underside and can be between 25 to 50 feet (8 to 15 meters) long. This 40 ton whale is the third largest baleen whale after the blue and fin whales. The dorsal fin is prominent and positioned on the back within the rear third of the whale’s overall body length (Reeves et al., 1998; Wilson and Ruff, 1999). The sei whale is often identified by its V-shaped water spout.

Very little is known about sei whale vocalizations. Feeding sei whales were recorded off eastern Canada, making sounds consisting of two phrases of 0.5 to 0.8 seconds duration spaced 0.4 to 1 second apart. Each phrase consisted of 10 to 20 frequency modulated sweeps in the 1.5 to 3.5 kHz range (Knowlton et al., 1991; Richardson et al., 1995). There is no direct measurement of auditory threshold for the hearing sensitivity of sei whales (Ketten, 2000; Thewissen, 2002).

There is evidence of two stocks of sei whales in the western North Atlantic, a Nova Scotia stock and a Labrador Sea stock. The Nova Scotia stock inhabits the continental shelf waters of the eastern U.S. and extends northeastward to south of Newfoundland. There are no recent abundance estimates for the sei whale in the Gulf of Maine. In the late 1970s, it was reported that the Nova Scotia stock was estimated to be between 1,400 and 2,200 individuals (Reeves and Kenney, 2003). The status of the North Atlantic population is near 10,000 in the central and northeastern Atlantic Ocean (Horwood, 2002). According to the sighting data, only one sei whale has been seen in the Project area, and that whale was feeding (Figure 3-28) (Kenney, 2001; Short and Schaub, 2005; Short et al., 2004; Weinrich and Sardi, 2005; McLeod et al., 2003 and 2000; Kenney, 2001; McLeod, 2002, 2001, and 1999).

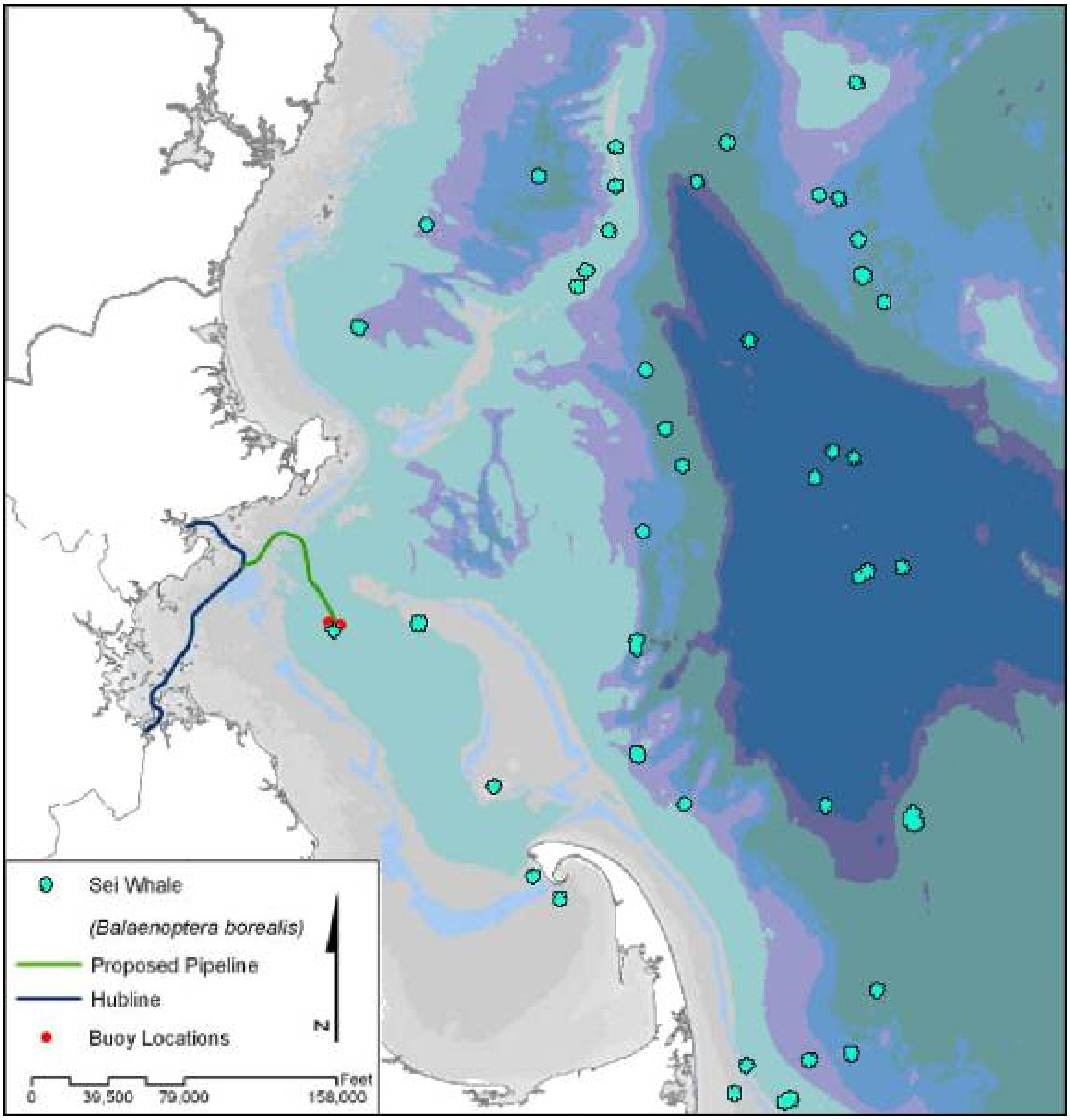


Figure 3-28. Sei Whales Observed in the Vicinity of the NEG Project Area

The distribution of sei whales is poorly known. They are solitary animals which inhabit temperate waters, going as far north as Iceland and as far south as Florida in the North Atlantic. Research has indicated that their migration is determined by where their food source is located, but there is also a seasonal pattern to their movement. There is evidence of pole-ward migrations during the summer feeding periods, and winter migrations to warm temperate or subtropical areas. Sightings are sporadic and involve lone individuals or small groups of up to six individuals. Sightings have been in Georges Bank, Northeast Channel, and Browns Bank by mid to late June, off the southern coast of Newfoundland in August and September, and migrating west and south along the Scotian Shelf from mid-September to mid-November (Reeves et al., 1998).

Sei whales eat primarily calanoid copepods, but also consume euphausiids, squid and small schooling fish. When feeding, they may be found in large numbers but normally stay in small groups (Wilson and Ruff, 1999). If more prey is available in the inshore regions, they would migrate toward these areas from the deeper waters of the continental shelf (Wilson and Ruff, 1999; Waring et al., 2004). Sei whale swim speeds have been recorded at 25.7 km/h (14 knots).

Female sei whales are slightly larger than males and sexual maturity occurs between five to fifteen years. Females give birth every 2-3 years, and calves are normally born during the fall months of November and December. Mating occurs from December to April. Gestation lasts about one year, and nursing lasts for six to nine months occurring during the summer or autumn.

The biggest threats to sei whales are ship strikes. There were no recorded fishery related deaths or serious injuries between the years 1997 to 2001 (Waring et al., 2004). However, considering that whales favor the deepwater areas, the sei whale is less likely than any other baleen whale species to collide with a ship (Reeves et al., 1998). The only record of a sei whale strike in Massachusetts Bay resulted from collision with a cruise ship in 1994 (Jensen and Silber, 2004). The species is listed as Endangered due to the depletion of its population from whaling (Reeves et al., 1998). A recovery plan has been written and is awaiting legal clearance (Waring et al., 2004).

3.3.2.5 Threatened and Endangered Sea Turtles

Sea turtles are highly migratory marine reptiles that have a wide geographic range in tropical, sub-tropical, and temperate waters. Active turtles must surface to breathe every 5-10 minutes, but they can remain underwater for much longer periods of time (30-40 minutes) when they are resting (Keinath, 1993). Migrating turtles usually dive at shallow depths, less than 20 m (65.6 ft) (Luschi et al., 2003), making it difficult to spot sea turtles in the open ocean. Sea turtles migrate often for long distances for feeding grounds, to mate, and to nest (Wynne and Schwartz, 1999). Turtles are the longest living aquatic vertebrates. Recently developed aging methods speculate that turtles live between 50 to 100 years. They spend most of their lives in the water, coming to shore only to bask in the sun or lay eggs. Sea turtles breed in the tropics or subtropics and their eggs (85 to 150 in number) are laid at night in holes dug on sandy beaches (Hodge, 2001).

All sea turtle species that have been occasionally encountered in Massachusetts Bay are protected under the ESA. The leatherback was listed as Endangered throughout its range on June 2, 1970 (NMFS, 2005e). The loggerhead turtle was listed as Threatened throughout its range on July 29, 1978 (NMFS, 2005f). The Kemp’s ridley was listed as Endangered throughout its range on December 2, 1970 (NMFS, 2005d), and the Floridian and Mexican breeding populations of the green turtle were listed as Endangered on July 28, 1978, while the rest of the population is listed as Threatened (NMFS, 2005c). The Hawksbill Sea Turtle was listed as Endangered throughout its range on June 2, 1970 (USFWS, 2005a).

Green Turtle (Chelonia mydas)

Green turtles are Endangered due to over harvesting. Current population estimates for the Atlantic stock is between 200 and 1,100 nesting females (NMFS, 2005c). The green turtle is black-brown to greenish-yellow and grows to be 5 feet (1.5 meters) long and 400 pounds (180 kilograms) (WWF, 2005b). They use three habitat types: beaches for nesting, convergence zones in the pelagic habitat for migration, and benthic feeding grounds in shallow, protected waters. Green turtles routinely dive to 20 meters with average dive times of 40 minutes. Travel speeds are typically 0.95 km/hr. The migration and development of the turtle is not well known; tag returns have indicated that turtles return to nest on their natal beach (NMFS et al., 1992).

However, there are no known nesting sites in the United States or in any of its territories. Green turtles are primarily coastal as juveniles and adults, but make long pelagic migrations between foraging and breeding areas (Bjorndal, 1997; Pritchard, 1997). The hearing range of green sea turtles is 200 to 700 Hz, with peak sensitivity at 400 Hz (Ridgway et al., 1969).

Green turtles in Cape Cod waters are three to four year old sub-adults, 24 to 30 inches (61 to 76 centimeters) long, weighing about 50 pounds (23 kilograms), and usually occur during the summer months (Prescott, 2000). Green turtles adults are the only truly herbivorous marine turtles, feeding mainly on seagrasses or macroalgae. Juveniles are believed to be omnivorous, allowing them to obtain enough energy to sustain a high growth rate. It is thought that the turtles would transition to herbivores when the turtle is large enough to escape predators (WWF, 2005b). Anthropogenic impacts to the turtle include, dredging, ingestion of marine debris or oil, entanglement in fishing gear, ship and propeller strikes, coastal development, and accumulation of toxins (NMFS, 2005c). A recovery plan for this species has been written and is currently in effect (NMFS et al., 1991a). Critical nesting habitat has also been designated on the Isla de Culebra (NMFS, 2005a).

Hawksbill Turtle (Eretmochelys imbricata)

Hawksbill turtles were listed as Endangered starting in 1970 when the population of nesting females indicated a drastic decline in population size. It is believed that commercial exploitation drove the population numbers down. Hawksbill turtles have an unusual physical appearance. Their scutes (the hard bony plates comprising the shell) are overlapping, and are streaked and marbled with amber, yellow, and brown colors. They are roughly 2 to 3 feet (0.6 to 0.9 meter) long and between 90 to 130 pounds (40 to 60 kilograms). Hawksbill turtles routinely dive to 7-10 meters with average dive times of 56 minutes. They are known to dive both during the day and night. Travel speeds are typically 0.74 km/hr. This turtle is a solitary nester, therefore population trends and estimates are difficult to obtain. There are currently approximately 8,000 nesting females worldwide (NMFS, 2005d; WWF, 2005c).

The Hawksbill turtle is found in tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. The species has been found along the eastern seaboard as far north as Massachusetts, but sightings north of Florida are rare (NMFS et al., 1993). "The hawksbill, a truly tropical turtle, rarely visits New England waters. Many historical sightings have been recorded, but close examination suggests the references were to the similarly-appearing Kemp's ridley. At present, only two records (sightings) of hawksbill turtle exist for Massachusetts; we can assume that the hawksbill [is] unlikely to be a regular visitor" (Prescott, 2000).

Anthropogenic impacts to the Hawksbill turtle include dredging, ingestion of marine debris or oil, entanglement in fishing gear, ship and propeller strikes, accumulation of toxins, habitat degradation, and illegal consumption and trade (NMFS, 2005d). A recovery plan for this species has been written and is in effect (NMFS et al., 1993).

Kemp's Ridley (Lepidochelys kempii)

Kemp's ridley turtle is the most Endangered sea turtle. This is the rarest turtle with the most restricted distribution. The population crashed between the years 1947 and 1970 as a result of over harvesting eggs and incidental mortality to juveniles and adults that were caught in trawling nets. Pre-exploitation numbers were 99.5 percent greater than population estimates in the 1990s (USFWS et al., 1992). Today, there are approximately 1,000 nesting females (WWF, 2005d).

Kemps' ridley is the smallest sea turtle, normally 12 to 15 inches (30 to 38 centimeters) in length and weighing about 7 pounds (3 kilograms). Its color changes throughout its life, starting as gray-black in hatchlings and becoming olive-gray as adults. Kemp's ridley turtles routinely dive to 50 meters with average dive times between 13 and 18 minutes. Travel speeds range between 1.0 and 1.4 km/hr. The turtles are found along the coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean. Kemp's ridley turtles hatch on the beaches of the northeastern coast of Mexico. As juveniles/sub-adults they are found along the eastern seaboard of the United States and the Gulf of Mexico. Atlantic juveniles/sub-adults travel northward with vernal warming to the coastal waters of the United States, as far north as New England, and travel south to the Gulf as the water turns cold. They are found as adults in the Gulf of Mexico and along the eastern seaboard of the United States. Juveniles are found in bays, coastal lagoons, and river mouths; post-pelagic stages are found along crab-rich sandy or muddy bottoms (USFWS et al., 1992). There are consistent reports of large concentrations of mating adults at sea, suggesting breeding aggregations well offshore (NRC, 1990).

The Kemp's ridley turtles found in Cape Cod waters are juveniles, coming directly from hatching in the southeast coast of Mexico. The southern New England waters are important feeding areas and are considered important habitat for the turtles. The Kemp's ridley turtles are shallow water, benthic feeders, feeding on blue mussels and crabs while in Cape Cod Bay (Prescott, 2000; NMFS, 1993; USFWS et al., 1992). Kemp's ridley turtles north of Cape Cod Bay are rare, avoiding the colder water temperatures extending northward along the Atlantic coast north of Cape Cod.

The threats to Kemp's ridley turtles in the marine environment consist of bycatch in pound nets, trawls, gillnets, hook and line, grab traps, longlines, oil spills, ingestion of marine debris, incidental take during dredging activities, degrading water quality/clarity, and altered current flow (NMFS, 2005f). A recovery plan has been written for this species and is currently in effect (USFWS et al., 1992).

Leatherback Turtle (Dermochelys coriacea)

Leatherback turtles, the largest living turtle, are an Endangered species due to over harvesting and incidental mortality from fishing. They are a black, warm-blooded, 400- to 800-pound (180- to 360-kilogram) sea turtle. Their range in the Atlantic extends from Nova Scotia to Puerto Rico and the U. S. Virgin Islands. This turtle species maintains its own body temperature, which is why it is found in the arctic waters during the summer months. Worldwide there are population estimates of 34,000 nesting females; the current population size of the Atlantic stock is unknown (WWF, 2005e; NMFS, 2005g; NMFS et al., 1992).

Leatherbacks prefer the water temperature to be between 14 and 16° C (57 and 61° F) for foraging, though they exhibit extraordinary thermal tolerance and are often observed in much colder water. They feed primarily on cnidarians, tunicates, and jellyfish mostly in deeper waters, but it has also been observed at the surface (Plotkin, 1995). They are deep, nearly continuous divers (Eckert et al., 1996). Average dives are to depths of 250 meters (820.2 ft), with the deepest dive recorded at 1,230 m (4,035.4 ft) (Hays et al., 2004). Typical dive durations are 9 to 15 minutes, both during the day and night. Leatherback turtles rarely stop swimming and individuals have been monitored swimming in excess of 13,000 km (7,014.8 nm) per year (Eckert, 1998; Eckert, 1999). Average swim speeds are on the order of 2.21 km/hr.

Nesting areas of the leatherback turtle are distributed between New Jersey and Argentina. The location of the leatherback's hatchling and juvenile years is unknown, but adult turtles are sometimes found stranded along the U.S. coastline. Scientific research has indicated that during the spring and summer, the leatherback turtle migrates to waters with cooler temperatures. They are usually seen in the Cape Cod area during August and September on their return to their breeding areas in Central and South America. They are surface feeders usually feeding on different types of jellyfish. Their greatest threats are entanglement in lobster pots and fishing lines, eating plastic bags which look like jellyfish, and collisions with boats (Prescott, 2000; NMFS, 1993).

A recovery plan for this species has been written and is currently in effect (NMFS et al., 1992). Critical habitat has also been designated on St. Croix Island to protect Threatened nesting habitat (NMFS, 2005b).

Loggerhead Turtle (Caretta caretta)

Loggerhead turtles are Threatened world-wide. The turtles were listed as Threatened due to declining population numbers, which was due to incidental takes during shrimping activities (NMFS, 2005h). The carapaces of adult and sub-adult loggerheads are reddish-brown and they range in size from 15 to 36 inches (38 to 91 centimeters), weighing 75 to 100 pounds (34 to 45 kilograms). Loggerhead turtles routinely dive to 2-5 meters with average dive times of 17 to 30 minutes. Up to 75% of their time is spent in the upper 5 meters of the water column. Average travel speeds are on the order of 1.2 to 1.7 km/hr. They can be found in both temperate and tropical waters of both hemispheres. Loggerhead turtles inhabit the continental shelves and estuarine environments of the Atlantic, Pacific, and Indian Oceans. They are found as far north as Newfoundland and as far south as Argentina and Chile. Loggerheads generally nest in lower latitudes, but their nesting activities are concentrated in the north and south temperate zones and subtropics (NMFS et al., 1991b).

Post-hatchling loggerheads would enter accumulations of floating seaweed and remain there for a few years until they are big enough to abandon their pelagic habitat. They would then migrate to near-shore and estuarine waters along the continental margins as they develop into sub-adults. Little is known about the seasonal movements of loggerheads before their adult stage, when they become migratory due to breeding activities (NMFS et al., 1991b). Loggerhead turtles feed on hermit and spider crabs, whelks, blue mussels, and moon snails (Prescott, 2000). They are generally absent from the shelf waters north of Cape Cod; it appears the water temperature of Massachusetts Bay is at the tolerance limit of this species. They may also be encountered in the mid-summer to fall along the outer edge of Cape Cod and associated islands (Prescott, 2000; NMFS, 1993).

It is estimated that there are 34,000 nesting female loggerhead turtles, which includes both the Pacific and Atlantic populations (WWF, 2005f). It was reported in the 1980s that there were 14,150 nesting females in the Atlantic population (NMFS et al., 1991b). Anthropogenic threats to loggerhead populations consist of the following: disturbance and destruction of nesting areas; underwater explosions and dredging of feeding areas; ingesting marine debris, toxic prey, oil or tar; caught as bycatch; entanglements in gillnets, trawling gear, hooks, and longlines; entrapment in power plant intake systems; and strikes by ships or ship propellers (NMFS, 2005h). A recovery plan for this species has been written and is currently implemented (NMFS et al., 1991b).

3.4 ESSENTIAL FISH HABITAT

Several of the finfish species likely to be present in the NEG Project area are covered under the Magnuson-Stevens Fishery Conservation and Management Act (MFCMA)[3]. As such, it is necessary to describe existing Essential Fish Habitat (EFH) in the Project Area, and to assess potential impacts on EFH and EFH-managed species in the area.

The proposed Project crosses four of the 10-minute by 10-minute quadrats that have been designated EFH for various species (Table 3-27). Within the area, EFH has been designated for 28 species of finfish, two species of squid, and three shellfish (Table 3-28). Each quadrant was assigned an arbitrary reference number (1-4) for this discussion. Quadrats 1 (northwest) and 2 (northeast) and 3 (southwest) encompass the Pipeline Lateral, while quadrat 4 (southwest) includes the Port area and part of the Pipeline Lateral.

Table 3-27

Locations of Essential Fish Habitat Quadrats, and Components of the Project that are Proposed for each Quadrat

Reference Number	Quadrat Name	Project Component (Mileposts)[A]	Latitude/Longitude Coordinates of Boundaries: North	East	South	West	Total Area (acres)	Area within Trenching Affected Zone
1	Northwest	Pipeline Lateral (2.67-7.29)	42°40.0'N	70°40.0'W	42°30.0'N	70°50.0'W	3404	29.1
2	Northeast	Pipeline Lateral (7.29-8.51)	42°40.0'N	70°30.0'W	42°30.0'N	70°40.0'W	828	51.2
3	Southwest	Pipeline Lateral (0.0-2.67)	42°30.0'N	70°40.0'W	42°20.0'N	70°50.0'W	2673	11.1
4	Southeast	Pipeline Lateral and Port (8.51-16.42)	42°30.0'N	70°30.0'W	42°20.0'N	70°40.0'W	6397[C]	81.4[C] 43.0[D]

[A] Milepost 0.0 is the junction with the HubLine pipeline
[B] Trenching Affected Zone is defined as the direct disturbance width for plowed areas of 75 feet and jetted area of 400 feet
[C] Area of pipeline trenching.
[D] Area of sediment disturbance for Port construction.

[3] The MSFCA is administered by NOAA-NMFS. The MFCMA of 1976 was established to promote conservation of marine fishery (shellfish and finfish) resources. The 1986 and 1996 amendments to the MFCMA, renamed the Sustainable Fisheries Act, recognized that many fisheries are dependent on nearshore and estuarine habitats for at least part of their lifecycles, and included evaluation of habitat loss and protection of critical habitat. The Act mandates that NMFS coordinate with other federal agencies to avoid, minimize, or otherwise offset adverse effects on EFH that could result from proposed activities. To delineate EFH, coastal waters were mapped by regional Fishery Management Councils and superimposed with 10-minute by 10-minute coordinate grids or quadrats.

Table 3-28

Summary of Species and Lifestages with Designated Essential Fish Habitat in the NEG Project Area

	EFH Quadrat			
Species	**Eggs**	**Larvae**	**Juveniles**	**Adults**
American plaice (*Hippoglossoides platessoides*)	1,3,4[a]	1,3,4	1,2,3,4	1,2,3,4
Atlantic bluefin tuna (*Thunnus thynnus*)			1,2,3,4	1,2,3,4
Atlantic cod (*Gadus morhua*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Atlantic halibut (*Hippoglossus hippoglossus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Atlantic herring (*Clupea harengus*)		1,2,3,4	1,2,3,4	1,2,3,4
Atlantic mackerel (*Scomber scombrus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Black sea bass (*Centropristis striata*)	[b]			1,2
Bluefish (*Pomatomus saltatrix*)			1,3	1,3
Butterfish (*Peprilus triacanthus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Goosefish (*Lophius americanus*)	2,3,4	2,3,4	2,4	2,4
Haddock (*Melanogrammus aeglefinus*)	1,3,4	1,3	1,2,3,4	
Little skate (*Leucoraja erinacea*)			1,2,3	1,2,3
Longfin inshore squid (*Loligo pealei*)[d]	N/A	N/A	1,2,3,4	1,2,3,4
Northern shortfin squid (*Illex illecebrosus*)[d]	N/A	N/A	1,2,3,4	1,2,3,4
Ocean pout (*Macrozoarces americanus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Ocean quahog (*Artica islandica*)[d]	N/A	N/A	2	2
Pollock (*Pollachius virens*)	1,3	1,3	1,3	1,3
Red hake (*Urophycis chuss*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Redfish (*Sebastes fasciatus and S. mentella*)	N/A[c]	1,2,3,4	1,2,3,4	1,2,3,4
Scup (*Stenotomus chrysops*)			1,2,3	1,2,3
Sea scallop (*Placopecten magellanicus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Silver hake (*Merluccius bilinearis*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Smooth skate (*Malacoraja senta*)			4	
Spiny dogfish (*Squalus acanthias*)	N/A[c]	N/A	3	3
Summer flounder (*Paralichthys dentatus*)				1,2
Surf clam (*Spisula solidissima*)[d]	N/A	N/A	1,2,3	1,2,3
Thorny skate (*Amblyraja radiate*)			1,2,3,4	4
White hake (*Urophycis tenuis*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Windowpane (*Scopthalmus aquosus*)	1,3,4	1,3,4	1,3	1,3
Winter flounder (*Pseudopleuronectes americanus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Winter skate (*Leucoraja ocellata*)			1,2,3	2
Witch flounder (*Glyptocephalus cynoglossus*)	3,4	2,3,4	2,4	3,4
Yellowtail flounder (*Limanda ferruginea*)	1,3,4	1,2,3,4	1,2,3,4	1,2,3,4

[a] The proposed facilities cross four of the designated EFH 10-minute-by-10-minute squares of latitude and longitude. The numbers presented in this table for each species and life stage represent the project-assigned square number where the species and specific life stage have designated EFH.

[b] Empty spaces denote that EFH has not been designated within the square for the given species and life stage.

[c] N/A indicates no data available, or the life stage is not present in the species/reproductive cycle.

[d] Juveniles and adults correspond to pre-recruits and recruits, respectively.

Of the species for which the Project area has been declared EFH, 11 appear to prefer the soft substrates, based on the habitat descriptions found in the EFH source documents. Of these, seven were dominant in the NOAA resources surveys (Table 3-29), and might be expected to be more common in the project area. The other four apparently have occurred in the Project area and have an affinity for soft substrates.

Table 3-29

Numerically Important Fishes that Prefer Soft Substrate and are Likely to be Found in the Port Area

Species (lifestyle)[a]	EFH Lifestage[b]	Average Biomass (pounds)/ Trawl in NOAA Survey	
		Spring	Fall
Butterfish (P-D)	J, A	ND[c]	ND
Goosefish (D)	J, A	ND	ND
Redfish spp.	L,J,A	5	1
Red hake (D)	J, A	1	12
Silver hake (D)	J, A	2	10
Smooth skate (D)	J	ND	ND
Thorny skate (D)	A	ND	ND
White hake (D)	J, A	0	1
Winter flounder (D)	A	50	58
Witch founder (D)	J, A	0	2
Yellowtail flounder (D)	J, A	72	8

a/ D= Demersal; b/ J = juvenile, A= adult; c/ ND = not dominant, P = Pelagic

Appendix F presents a species specific account of the habitat requirements and life history characteristics of species and lifestages with designated EFH in the Project area. Species and lifestages with designated EFH in the Port area and along the Pipeline Lateral corridor are discussed and potential impacts are described for each species.

3.5 SEDIMENTS AND GEOLOGICAL RESOURCES

This section describes the regional and local sediments, geology, geologic hazards, and mineral resources in the Project area. Geological resources are defined as naturally occurring earth materials that have intrinsic, academic, or economic value. These resources may include regional and local geologic history and features, quarry material, sand and gravel, minerals, topographic features, and paleontological resources.

Regional and local geology includes:

- bedrock or sediment type and structure;
- unique geologic features;
- depositional or erosional environment; and
- age or history of rock and sediment and their associated structures.

Topography includes the geomorphic characteristics (land shapes) of the land surface and/or seafloor including elevations, relationships with adjacent features, and geographic location. Mineral resources may include usable geologic materials of economic value such as construction sand and gravel, quarry stone, coal, petroleum, etc. Paleontological resources consist of the fossilized remains of organisms, or trace evidence of organisms. Active geologic processes or conditions, such as unstable soil conditions, landslides, seismicity, or liquefaction could pose a geologic hazard to a proposed development and are also considered within the definition of the geologic resources of a region.

3.5.1 Regional Geology

The geology of New England is built upon several crustal blocks and microplates of Precambrian-age metamorphic rocks. These crustal plates, referred to as basement rock, interacted in a variety of tectonic settings during the Paleozoic and Mesozoic eras. Tectonic events are recorded in the geological record and readily observed in the patterns of sedimentation, deformation, volcanism, plutonism, and metamorphism. These tectonic events have welded the different basement segments together with igneous and metamorphic rocks of Paleozoic age and then have been overprinted by Mesozoic age tectonics (generally brittle) to form the Appalachian orogen. The Appalachians have remained intact throughout the Cenozoic era as the relatively stable eastern margin of North America. Locally, Post Cenozoic tectonic activity is documented by both historical and instrumental earthquakes.

The Atlantic Coastal Plain, extending from the Gulf of Maine through southeastern New Jersey forms the continental shelf beneath the Atlantic Ocean to the continental rise. This province is a low elevation section composed of loosely consolidated sediments of Cretaceous and Cenozoic age resting on basement rocks which constitute the on-strike extensions of the Precambrian, Paleozoic, and Mesozoic terranes of the upland areas.

The Seaboard Lowlands are characterized by extensive deposits of ice contact and outwash sands overlying till. Seismic reflection surveys in offshore areas indicate that till, ice contact, outwash, and glacio-marine clay and silt deposits are also distributed throughout the northern marine region. The southern terminus of the last glacial advance is defined along the southern New England coast and Long Island by east-west elongate deposits of terminal moraine tills. To the south of the glaciated region, the continental shelf is blanketed by a veneer of Holocene clastic sediments, with local occurrences of deep channel fillings on an irregular pre-Pleistocene erosion surface.

Boston Harbor and Boston Basin

Boston Harbor and the harbor islands is a glacially carved estuary that lies within a faultbounded structural basin known as the Boston Basin. Within the Boston basin, bedrock consists mostly of volcanic and sedimentary rocks of Precambrian to earliest Cambrian age (Oldale and Bick, 1987). The rocks along the coast north of the Boston basin are mostly granites of Precambrian age. Cape Ann is underlain by granite of Ordovician to Silurian age (Oldale and Bick, 1987).

Block faulting and volcanism that occurred during the Proterozoic created the Boston Basin, into which nonmarine clastic type sediments eroded from the surrounding highland areas were deposited. Additional deformation of the area occurred during late Paleozoic and Mesozoic time as faults in the basin were reactivated. The Cretaceous and early Tertiary were marked by deposition of nearshore coastal plain type deposits into the basin. During the late Tertiary, in response to a worldwide low stand of sea level, the area was subaerially exposed and eroded.

The surficial sediments on the inner shelf of Massachusetts Bay are largely of glacial origin and have been extensively reworked by shallow marine and subaerial processes during advances and retreats of the shoreline across this area. Today, the surficial sediments and features are reworked and shaped by tidal and storm-generated currents that erode and transport sediments from the shallow areas into the deeper basins. Over time, the shallow areas affected by these processes have become coarser as sand and mud are removed and gravel remains, and the deeper basins have been built up as they receive the sand and mud (Gutierrez et al., 1992). Knebel and Circe (1995) have identified areas of erosion, sediment reworking, and deposition in this region. These features are important examples of seafloor variability (morphology and texture), over scales of a few kilometers or less, caused by both natural and anthropogenic processes.

The topography, surface features, and surficial sediment texture are results of glacial processes, reworking during the last rise in sea level, reworking by modern processes, and the disposal of dredged and other material in this region over the last century.

3.5.2 Local Geology and Sediment Characteristics

Massachusetts Bay includes hundreds of islands formed of glacial drift and moraine deposits (drumlins, eskers) left there by the receding ice sheet 18,000 and 24,000 years ago. These features continue below the waterline as submerged mounds of coarse glacial till (boulders, cobbles) with intermittent outcrops of bedrock. More recent deposits of finer marine sediments (sand, silt, clay) infill depressions in the scoured glacial surface. Nearshore these sediments are products of variable sea level rise along the New England coast, while in deeper waters offshore, bottom materials have accumulated under a marine depositional environment.

Detailed geophysical investigations were conducted within a 200-foot wide corridor to characterize and evaluate sea floor conditions and underlying shallow stratigraphy in the NEG Port Pipeline Lateral construction areas. Studies included:

- Hydrographic survey;
- Subbottom profile survey;
- Sidescan sonar survey;
- Geotechnical investigation; and
- ROV inspections.

Three primary sedimentary environments have been recognized that show direct correlation with processes of erosion, deposition, and sediment reworking. Figure 3-29 provides an overview of the sedimentary environments recognized in the area.

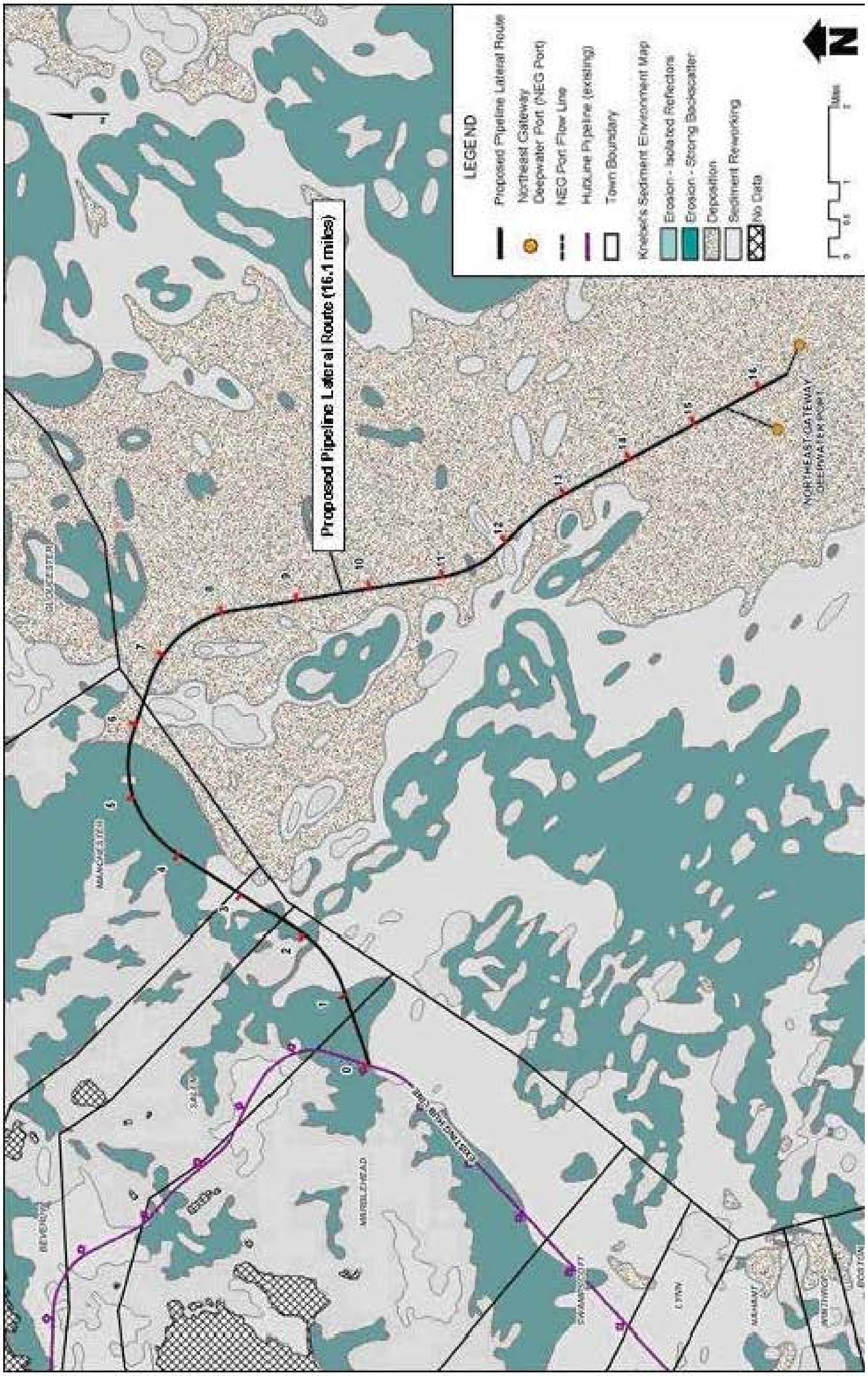


Figure 3-29. Sedimentary Environments Map of Massachusetts Bay

3.5.2.1 NEG Port Area

Water depths in the vicinity of Buoy A and associated flowline range from about 278 to 290 feet. Surface sediments in the area are dominated by Class 1 and 2 materials (clay-gravel), although an area of Class 3 materials is located 4,500 ft to the east of the buoy location. Table 3-30 provides the definition and characteristics of each sediment classification. Linear features that appear to contain Class 5 materials (non-native material/debris with sediments) stretch across the area from southwest to the northeast towards the disposal site. Sediment grain size analysis indicated that the surface sediments in this area were predominantly silt-clay. Analysis of subbottom profiling results indicated that unconsolidated sediments were a minimum of 58 feet thick in this area and ranged up to 135 feet thick.

Buoy B and its flowline are located in an area with water depths ranging from 266 to 275 feet. The sediments are dominated by Class 1 and 2 materials, although linear features made up of Class 5 materials stretch across the area towards MBDS. Sediment grain size analysis indicated that the surface sediments in this area were predominantly silt-clay. Analysis of subbottom profiling results found that the thickness of the surface layer of unconsolidated sediments was a minimum of 58 feet in this area and ranged up to 112 feet thick.

Table 3-30

Sediment Classification

Class	Definition	Characteristics
Class 1	Low reflectivity, uniform texture. Smooth appearance likely related to the abundance of fine grained sediments. Few if any natural bedforms, bottom undulations predominantly man made.	Finer sediments with a dominant size ranging from clay to medium sand; may include fractions of coarser sediments and isolated boulders.
Class 2	Moderate to high reflectivity, moderately variable texture, and isolated individual reflectors. Increased sonar signal strength generated by the coarser sediments and some natural bedforms (ripples).	Medium sediments with a dominant size ranging from medium sand to gravel; may include fractions of finer and coarser sediments as well as individual boulders.
Class 3	High reflectivity, variable texture, individual reflectors prominent. The disturbed appearance of the sea floor is related to the presence of coarse glacial till.	Coarser sediments grained materials with a dominant size ranging from gravel to boulders; may include fractions of finer sediments with bedrock in the shallow subsurface.
Class 4	High reflectivity, solid textural appearance, strong reflectors exhibiting high relief present. Only basement rock units are capable of maintaining the steep slopes evident in these areas.	Bedrock outcrops on the sea floor; rock surface may include depressions filled with fine, medium, and coarse grained sediments
Class 5	Moderate to high reflectivity, variable texture, strong isolated reflectors common. Increased sonar signal strength generated by coarser sediments (sand, gravel, boulders), man made objects, and/or other unknown materials.	Combination of Classes 1, 2, and 3 sediments with unknown non-native material; these areas may be associated with activities at the Massachusetts Bay Disposal Sites.

Subsurface seismic profile data for the original anchor locations were analyzed to estimate sediment thickness at each of the anchor locations. The thickness of Unit C, defined as the soft sediments above the glacial till layers, appears to be present at all of the proposed anchor locations for Buoy A except for anchor location 1.

The sediments at the original Buoy B location are dominated by Class 1 and 2 materials (clay to gravel) while linear features believed to contain Class 5 materials (a combination of clay to gravel and non-native material/debris) stretch across the area from west to east towards the disposal site. Estimated Unit C thickness at proposed anchor locations 1, 2, 3, and 8 are below the desired amounts.

The soil borings and coring that are planned for the detailed design of the suction anchor system would provide information on suitability of Unit C at these revised locations, or would indicate the need for modification of the planned suction anchor system at these locations.

3.5.2.2 NEG Pipeline

The sedimentary environment described above is the proposed host of the Pipeline Lateral. The first 6 miles of the Pipeline Lateral crosses the inner shelf of Massachusetts Bay, which is located from the coastline out to the 50 meter (164 foot) isobath (west of about 70º 40'W). The inner shelf sea floor has been glaciated at least twice and is characterized by a varying topography having relief of 33 to 50 feet (Butman et al., 2004). According to the investigations by Oldale and Bick (1987), the sea floor in this area consists of fluvial and estuarine deposits composed of sand, silt and clay and may include some gravel and peat. The remaining 10.4 miles of the Pipeline Lateral heads generally to the south and southeast into Stellwagen Basin, which lies directly west of Stellwagen Bank.

3.5.3 Geophysical Investigation

The results of site specific geophysical surveys (i.e. hydrographic surveys: Sub-bottom survey, Side-Scan Sonar Survey; Magnetometer Survey, and ROV Inspections) showed that the proposed NEG Port site is located in an area consisting mostly of soft sediments (sand, silt, and clay).

Geophysical investigation of the route centerline and tracklines spaced at a 100-foot offset to either side of the centerline were conducted to characterize and evaluate sea floor conditions and underlying shallow stratigraphy. The area outside this corridor was also surveyed out to a distance of approximately 3,000 feet from the centerline on either side. This additional corridor was surveyed with tracklines spaced 165-foot apart to identify and evaluate any potential issues associated with the anchoring of construction vessels.

Sea floor samples were collected with a vibratory corer from the upper 10 feet of the stratigraphic column to ground truth acoustic data (i.e. surficial side scan sonar and subbottom profiles) and provide information for pipeline engineering, construction and biological characterization. In general, cores were collected along the route at an interval of every 0.25 miles, as well as any location where the subbottom profiles suggested that coarse glacial till deposits might rise to within 10 feet below the sea floor.

Side scan sonar imagery contains five main types of returns that exhibit different reflectivity and texture (see Table 3-30). The return types were categorized based on the sonar records, vibracores and grab samples, as well as ROV video imagery.

The following discussion describes the sea floor environment along the Pipeline Lateral route from west to east, referenced to the distance along the route centerline from the HubLine tie-in point at MP 0.0 to MP 16.4. The text is separated into sections exhibiting different sea floor geomorphology. Most of the results are derived from interpretation of the acoustic data (sidescan sonar and subbottom profiles) and remote sensing (ROV) data. Some information on surficial sediments was obtained from visual inspection of the cores' top surface in the field and grab samples. The descriptions generally correspond to the information provided in Table 3-30.

MP 0.0 to MP 2.0

The first 2 miles of the proposed Pipeline Lateral route consist primarily of Class 1 sediments on the sea floor, specifically fine sand. More sand is probably in this nearshore portion of the route due to its proximity to the shore and the sediment dynamics of the shallow water coastal zone. Water depths between MP 0.0 and MP 2.0 range from approximately 130-160 feet. Farther along the route in this pipeline section, depths shoal from 159 feet at MP 1.6 to less than 150 feet near MP 1.9. This shoal continues west-northwest away from the route in this area, and is likely underlain by coarse glacial till and bedrock at depth. Subbottom profiles and vibracore sample analysis results indicate there is no apparent coarse glacial till or bedrock in the upper 10 feet of the stratigraphic column in this portion of the route. Only traces of gravel were identified in some of the cores, with thin lenses of shell material less than 3 inches thick also present.

MP 2.0 to MP 2.2

Between MP 2.0 and MP 2.2, the Pipeline Lateral would turn northward around a rocky sea floor immediately to the west of the route in water depths between 150-155 feet, following a narrow path containing mostly Class 1 materials. Sand and silt are located within the proposed pipeline corridor, but coarser material (Class 2-3) was detected to the west.

MP 2.2 to MP 5.0

The section of proposed Pipeline corridor between MP 2.1 and MP 5.0 crosses a relatively clear stretch of sea floor void of natural obstruction and composed of Class 1 finer unconsolidated sediments (mainly fine sand). The water depths in the area range from 145 feet to 165 feet. Several isolated bedrock highs exist just west of the proposed route from MP 2.6-3.0, which were purposely avoided by the applicant based on Phase I survey data. Vibracore data verified results interpreted from the geophysical records by recovering fine unconsolidated sediments throughout all the samples collected.

MP 5.0 to MP 5.2

At MP 5.0 to MP 5.2, the Pipeline Lateral would turn to the northeast to avoid exposed rocks on the sea floor immediately north-northwest of the route. Sidescan sonar imagery collected by Algonquin in this area correlates well with the U.S. Geological Survey (USGS) multibeam backscatter map, both of which identify these rocks as a low relief mound of highly reflective material on the bottom that is likely a glacial drift deposit comprised of boulders, cobbles, gravel and sand. Three vibratory samples recovered in this segment consisted of primarily silty sand, Class 1, type sediment with the bottom of one core (Core Vibratory Core [VC] 20) containing dominantly sand. This material extends toward the south under the pipeline route. However, Class 1 type sediments (mainly fine sand) remain the dominant constituent on the surface. The water depth at this location is approximately 150 to 152 feet.

MP 5.2 to MP 11.6

This is a lengthy portion of the proposed route alignment which exhibits generally fine unconsolidated sediments (mainly silt, with fine sand and clay in places) in the Class 1 category. Vibratory samples collected along the route revealed fine grained silt and clay in the upper 10 feet of the sea floor bed. Grain size analyses of cores completed to date verified that Class 1 type sediments cover this entire stretch of the route, and suggest that a finer scale gradational boundary between dominantly sandy versus silty surface sediments may be found in the vicinity of MP 8.0.

Fewer sidescan sonar targets and magnetic anomalies were identified in this section of the route, presumably due to the heavier concentration of bottom fishing that occurs in these soft sediment areas. Trawling essentially clears the sea floor of most debris protruding above the bottom. Water depths in this region slope gradually offshore from approximately 150 feet at MP 5.1 to 250 feet at MP 11.6.

MP 11.6 to MP 12.0

The proposed Pipeline Lateral route turns toward the southeast at MP 11.6 and passes through a gap in a rock ridge from this location to about MP 12.0. The surficial matrix of the sea floor in this area appears to be comprised primarily of Class 1 sediments (primarily fine sand and silt). However, scattered coarse glacial till (boulders, cobbles) is present on and below the bottom along with apparently abandoned fishing gear.

MP 12.0 to MP 13.8

This segment of the route enters Stellwagen Basin and is covered by generally finer unconsolidated sediments of Class 1 type in water depths in the 260 to 285 foot range.

MP 13.8 to MP 16.4

The last leg of the proposed Pipeline Lateral route, from MP 13.8 to MP 16.4, continues through predominantly Class 1 type sediments interpreted from the sonar imagery. Grab samples collected in this area reveal primarily silt and clay at the surface. Water depths range from 275 to 285 feet with the deepest point along the pipeline route located near MP 14.0. The sea floor slopes gradually up from this point to MP 15.4 (~275 feet) and levels off for 0.5 miles before descending gradually to the end at MP 16.4 (~278 feet). Bottom topography is generally flat and featureless except where foreign material has apparently been deposited.

The sea floor in this area is characterized as Class 1 sediments with patches of Class 5 substrate that contains non-native coarse material with man made objects associated with the MBDS. Much of the debris has likely been dredged from the harbors and rivers in and around the Boston area. Although mostly scattered along this section of the route, there are two larger Class 5 deposits of non-native materials concentrated at MP 15.1 and MP 15.5.

3.5.4 Geologic Hazards

Potential geological hazards in the Project area include earthquakes, soil liquefaction and lateral sediment movements caused by earthquake vibrations, slope instability, storm wave action and storm surge. Other geologic hazards associated with karst terrain, avalanches, floods, and volcanism are not attributed to the geologic conditions in the Project area.

3.5.4.1 Earthquakes

The Project area is located within the North American tectonic plate at large distances from active plate margins in an intraplate environment. Intraplate environments experience substantially fewer earthquakes than interplate tectonic environments (such as the San Andreas Fault) where plates dynamically interact. Nevertheless, moderate and large earthquakes have been observed and are considered in seismic design applications for construction projects in eastern North America.

Earthquakes are scaled according to their energy equivalent (magnitude) and by their ground motion impacts (intensity). Earthquakes with a magnitude (M) of 3 and larger can be felt by local populations, but are not damaging. Magnitude 5 and larger earthquakes can damage structures, and M 7 and larger earthquakes can produce catastrophic damages. Damage levels are described on a 12 level intensity scale (Modified Mercalli Intensity Scale of 1931) ranging from I (not felt) to XII (total destruction). Onset of earthquake damages are attributed an MMI intensity VI (cosmetic damages to plaster, glass), and MMI VII – VIII for damages to weaker masonry structures.

Seismic activity in the project region is documented since early colonial settlement in the 1600's. The largest earthquakes in the Project region include events in 1727 and 1755 that were located just offshore of northeastern Massachusetts. The larger of these, the 1755 Cape Ann Earthquake, is estimated to have had a magnitude of about 6 ±¼ and produced damages assessed at MMI VIII. This earthquake was felt over an extensive area from Halifax, Nova Scotia to Maryland to eastern New York State and to an ocean vessel approximately 200 miles (320 kilometers) east of Cape Ann. Although seismicity of the New England region is considered to be low to moderate, the occurrence of the 1755 earthquake demonstrates that damaging earthquakes can occur, but with an assessed low annual probability of occurrence. Critical structures, including power plants, dams, bridges, and LNG or gas storage and receiving terminals located in New England typically have incorporated seismic designs able to resist ground motions associated with local occurrence of an earthquake similar in magnitude to the 1755 Cape Ann event.

The largest earthquakes in the broader region (i.e., the Atlantic coastal plain) include the Grand Banks earthquake (M=7) of 1929, the Charleston, South Carolina earthquake (M=6.8) of 1886. These earthquakes caused fatalities and produced catastrophic damages due to strong ground shaking and, with the 1929 event, a tsunami.

Seismic hazard maps for the New England region developed by the US Geological Survey (2002) illustrate a zone of higher hazard that extends from central New Hampshire through northeastern Massachusetts into the adjacent offshore waters. The NEG Project site is located in a zone for which the seismic hazard level is quantified by a peak horizontal acceleration of about 0.18g for 2% probability of exceedance in 50 years. It is noted that critical facilities located in eastern and southern New England have adopted seismic designs that range from about 0.1 to 0.3g peak horizontal acceleration. These seismic design levels have probabilities of exceedance in the range of about 10% to less than 1% in 50 years determined in site-specific probabilistic seismic hazard studies. Currently, the Commonwealth of MA Building Code includes a minimum seismic design level of 0.12g. Seismic design levels have not been regulated for offshore facilities beyond state jurisdiction.

Eastern Massachusetts is cut by metamorphic and post metamorphic fault zones and systems that are projected into the offshore environment. These faults systems have a complex tectonic history and are mapped with numerous senses of movement. Movement histories range from Cambrian to Cenozoic. Overprinted on this tectonic fabric is a system of joints related to post Mesozoic tectonic and post glacial strain.

A working hypothesis that has emerged over the past several decades of siting studies conducted for critical facilities in New England is that the contemporary seismicity occurs on deep-seated or buried faults that produce no discernable surface expression. No clear evidence exists that any of the numerous faults mapped in the region is an "active fault" in the present stress environment. Spatial associations of varying strengths however exist between the mapped surface faults, subsurface discontinuities, and clusters of earthquake epicenters. A tectonic province model that associates seismic activity with zones of faulted terrain rather than individual faults is preferred for performance of earthquake hazard studies.

The largest earthquake known for New England, the Cape Ann 1755 earthquake of magnitude 6, is spatially associated with offshore extensions of faults of the Bloody Bluff and Clinton-Newbury system of faults.

3.5.4.2 Soil Liquefaction

Liquefaction involves one or more of several related phenomena. These can be summarized as follows:

- Cyclic shear loading on a saturated soil causes an increase of pore pressure. If the soil is loose enough, the pore pressures can increase to exceed the overburden stress. The occurrence of sand boils or sand volcanoes are manifestations of this phenomenon.
- The excess pore pressures generated by the cyclic load reduce the effective stress and hence, the shear strength of the soil. The result can be a failure of a foundation.
- A "contractive" soil in a sloping surface is subjected to shear stresses. An increase in loading (waves, seismic) can induce additional shear stresses that raise the overall shear stress beyond the peak strength of the material. In some cases the soil would fail.

Liquefaction is related to several phenomena and must be considered during design of critical structures in areas where there is a potential for ground liquefaction. The potential for ground liquefaction needs to be assessed to determine the behavior of suction anchors and other critical structures during the design earthquake using one, or a combination of, the following two methodologies:

- Shear Strain Approach (Dobry et al., 1982)
- Shear Stress Approach (Youd et al., 2001) including SPT, CPT and Shear Wave velocity field investigations.

A conservative approach should be used in the determination of the cyclic shear stresses and cyclic shear strains necessary to evaluate level ground liquefaction for the OBE seismic exposure. This approach uses the MCE as outcrop rock input motion to perform the level ground liquefaction analyses.

3.5.5 Mineral Resources

Review of the most current USGS topographic maps and NOAA Nautical Charts indicated that no mines, quarries, prospects, or sand and gravel operations are located within 0.25 nautical mile (approximately 1,500 linear feet or 0.46 kilometers) of the proposed Project area.

According to Stubblefield and Duane (1988) there are two principal areas in Massachusetts Bay and the surrounding waters where sand and mixed aggregate are known to occur in significant quantities and could potentially be mined. The first is in the inshore waters off Boston Harbor between Hull and Plymouth. The second area is Stellwagen Bank. More recently, Stellwagen Bank has been identified by the Minerals Management Service (MMS) as a potentially favorable area for possible mining activities, primarily for sand deposits. Most of the sand and gravel resources on the Bank occur in less than 130 feet (40 meters), indicating the feasibility of recovery using currently available mining technology.

The proposed Project would not be located in either of the areas identified as possible sources of sand and mixed aggregate.

3.5.6 Sediment Quality

Sediment samples collected at the proposed pipeline construction anchor locations fall within MDEP chemical Class 1. No metals or PCBs were reported above NOAA PELs with the exception of cadmium and nickel in VC-301 and nickel in VC-302.

PAHs were reported above NOAA TELs at every pipeline construction anchor location, but no PAHs were reported above NOAA PELs. For many PAH compounds, the laboratory MDLs were above the applicable NOAA TELs and some were also above the applicable NOAA PELs, therefore, some uncertainty exists regarding the concentration of several PAHs at many sample locations.

Four pesticides were reported above NOAA TELs at 4 of the 5 sample locations, but no pesticides were reported above NOAA PELs.

The results described above are based on grab samples collected using a Van Veen grab sampler, which collects sediments to a depth of up to 13 cm and covers a surface area of 0.1 m^2 at each sample location.

3.6 CULTURAL RESOURCES

Cultural resources consist of prehistoric and historic sites, structures, buildings, objects, or features that have been made or modified by humans. Under Section 106 of the National Historic Preservation Act, as amended, prior to authorizing an undertaking, federal agencies must take into account the effect that a proposed undertaking may have on cultural resources listed or eligible for listing in the National Register of Historic Places (NRHP).

3.6.1 Cultural Resources Project Area

For cultural resources, the Project Area, including the NEG Port and Pipeline corridor and anchor spread, is described as the “Area of Potential Effect” (APE). The APE for the NEG Project was established through consultation between the Massachusetts Historical Commission (MHC), the Massachusetts Board of Underwater Archeological Resources (MBUAR) and the applicants. The APE for the Port includes an approximately 12.9 square mile area (33.41 square kilometers) that covers all areas within which construction activities may occur. The APE for the Pipeline is limited to a 200-ft-wide corridor (i.e., trench and spoil area) and a 6,000-ft-wide corridor (3,000 ft to either side of the pipeline corridor) anchor spread zone.

3.6.2 Cultural Context

The Mystic, Neponset, and Charles Rivers of Southeastern Massachusetts, which feed into Massachusetts Bay Basin, were focal points of Native American occupation for over 9,000 years. The Boston Harbor Islands National Register Historic District currently supports the best-preserved concentration of pre-contact archeological sites in the metropolitan Boston area, with 60 documented sites spanning the Early Archaic to Late Woodland Periods distributed among its 21 islands (NEG, 2005a). At the time of European-Native American contact, the Boston Harbor area was part of the Massachusett tribal territory and the north shore was the territorial boundary between the Massachusett and Pennacook-Pawtucket Indian groups. During the Contact Period (1500 to 1620 AD) these groups were actively fishing and shellfishing coastal waters for food.

Prior to settlement, the initial Europeans moved into eastern Massachusetts and were primarily focused on fishing, expanding fur trapping, exploration and limited trade in the region. John Smith explored Cape Ann, Cape Cod, Massachusetts Bay, and other New England locations in 1614.

The first European settlements in the region occurred in Plymouth in 1620. This was shortly followed by settlements in Salem in 1629 and Boston in 1630. Three primary industries in the region were ironworks, cloth making and shipbuilding. Shipbuilding was initiated in 1631 with the launching of John Winthrop's first new England-built vessel. Winthrop, the governor of the Massachusetts Bay Colony, encouraged the settlement of trained shipwrights in the North American colonies since early transportation was almost solely by water. Small vessels were built for fishing and coastal and inland trade, while larger vessels were constructed for trade with the Old World. Oceangoing vessels of this period consisted primarily of ships, barks, and pinks, which were approximately 60 feet in length and seldom more than 100 feet. Coastal vessels were generally 30 to 40 feet in length (NEG, 2005a).

By 1755, 15 shipyards were operating in Boston and producing a variety of vessels, especially larger ships for the transoceanic export trade (NEG, 2005a). Major classes of maritime occupations in eastern Massachusetts during this period were: commerce, fishing, whaling, the slave trade, and privateering and piracy.

Because of its location, Boston was a premier shipping port. The primary trade network engaged in by Massachusetts merchants during the colonial period was the infamous "Triangle Trade," in which sugar, molasses, rum, and slaves were transported between Africa, the Caribbean Islands, and the North American colonies. Export of natural resources, such as animal pelts and lumber were also major sources of wealth.

During the Federal period (1775 to 1830), maritime trades such as commerce and whaling were almost destroyed by British predation and raids. While the surrounding towns continued to be major shipbuilding centers, Boston had only four or five dockyards during this period, which were used primarily for repairs. There were, however, as many as 80 wharves in operation, indicating the importance of commerce, rather than shipbuilding to the area's economy. During the last decades of the eighteenth century, Yankee merchants opened trade with the Orient.

The Early industrial period (1830 to 1870) saw a decline in commercial fishing, especially whaling, as production of petroleum began to replace whale oil, however, lobstering emerged as a source of income for fishermen. Additionally, aggressive trade with Europe and the Orient, as well as the Gold Rush, provided opportunities for maritime trade.

During the late industrial period (1870 to 1915) coastal Massachusetts began to see the development of summer and resort industries aimed at individuals wealthy enough to vacation along with a shift from commercial to recreational fishing in towns like Beverly, MA. Despite this shift, commercial fishing and maritime trades remained a major source of employment in the area.

Following World War II, drastically improved navigational aides and the presence of radios combined with radio-dispatched tugs made it easier for mariners to stay out of or get out of harm's way. These tools, plus addition of more reliable power sources which kept vessels off of rocks, significantly reduced the mortality rate at sea during this period.

3.6.3 Existing Conditions

Between about 14,000 and 12,000 before present (BP), deglaciation of Massachusetts Bay was followed by a rapid regression in relative local sea level. During this time, the relatively gently sloping sea floor in Massachusetts Bay was exposed (horizontally) at a rate of about 40 feet per year before sea level reached a low-stand of approximately 165 feet below present sea level in 12,000 BP. Based on this low-stand in sea level within Massachusetts Bay, only the shallower western portion of the Pipeline corridor may have the potential for containing remnants of a formerly exposed inhabitable postglacial paleo-landscape where pre-contact archeological deposits could be present. A review of MHC and MBUAR site files identified no known pre-contact sites in the APE. Based on the depth of the project area and the results of the research conducted for this project, the APE is considered to have a low archeological sensitivity (low probability) for containing pre-contact period archeological resources.

File searches identified more than 25 wrecks/obstructions that appear on current navigation charts and numerous others that are listed in the Automated Wreck and Obstruction Information System (AWOIS), Northern Shipwreck Database (NSWDB), and MBUAR shipwreck and obstructions inventory, some of which may qualify as National Register Eligible resources.

A total of 614 linear miles of seafloor were surveyed between January 15, 2004 and April 9, 2005 within the buoy survey polygon (see Figure 3-3). Based on the survey and further evaluation, a final inventory of 7 targets was identified that have a moderate to high potential for representing submerged cultural resources. Five of the seven targets are located well outside of the APE of the proposed Port, while two of the targets are located within or in proximity to the proposed location of Buoy A.

An additional approximately 700 linear miles of seafloor were covered by the marine archeological survey of the NEG Pipeline study area. The survey of the pipeline identified 13 targets within the anchor spread that were considered to have moderate to high potential for being submerged Post-Contact Period archeological deposits. Subsequent visual inspection with an ROV determined that the targets were not significant cultural resources.

3.7 OCEAN USES, RECREATION, LAND USE, AND VISUAL RESOURCES

This section describes ocean uses, land use, recreation, and visual resources potentially affected by the NEG Deepwater Port and lateral pipeline. Ocean uses include specially designated zones such as marine sanctuaries, the MBDS and miscellaneous other uses, as well as water-based activities. Land uses involve alterations to existing aboveground metering stations in Salem and Weymouth, as well as increased use of selected existing dock facilities during construction.

3.7.1 Ocean Uses

The waters in and around the study area are used extensively for a variety of commercial and recreational activities including boating, fishing, sailing, diving and whale watching. Federal and state marine and ocean sanctuaries, navigation areas, and the MBDS are located near the proposed NEG Port site. This section describes the major ocean uses in and around the vicinity of the proposed port and pipeline lateral.

3.7.1.1 Marine Sanctuaries

Federal and State maritime sanctuaries in the vicinity of the proposed action are shown in Figure 3-8 in section 3.2.4.1 and are discussed below.

Stellwagen Bank National Marine Sanctuary (SBNMS)

The Port area is 2.5 to 3.5 statute miles (2 and 3 nautical miles) west of the boundary of SBNMS. This 842-square-nautical-mile sanctuary is located in Massachusetts Bay, and is one of 13 sites in a system of special marine areas selected for its “conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities” under the National Marine Sanctuary Act (NOAA, 2002a). The designation was made in 1992 to facilitate long-term protection and management of the resources to ensure protection for succeeding generations.

SBNMS is a major offshore natural feature of local, regional, and national significance, and was selected as a sanctuary for its historical importance as a commercial fishing ground. Additionally, SBNMS balances education, science, and research with multiple uses such as whale watching, bird watching, and recreational fishing. Several species of whales and other marine mammals frequent SBNMS, including endangered humpback, northern right, and finback whales (NOAA, 2003).

Many large vessels cross the SBNMS within the Boston Harbor Shipping Lanes (see section 3.9 for more detail about port calls for Boston Harbor), although there are no prohibitions against crossing at other locations. Fishing is permitted in SBNMS, but permanent and seasonal (rolling) closures place significant limits on the amount of fishing that can be done here (see section 3.7.3.4 for further detail.)

There are ongoing efforts to expand the boundaries of SBNMS to include Jeffrey's Ledge, to the north of the existing sanctuary, because the two systems can act as a buffer for each other (The Whale Center of New England, 2002).

South Essex and North Shore Ocean Sanctuaries

The NEG Port is located about 2.9 statute miles (2.5 nautical miles) southeast of the boundary of the Massachusetts-designated South Essex Ocean Sanctuary (SEOS) and approximately 8.1 statute miles (7 nautical miles) south of the North Shore Ocean Sanctuary (NSOS). The NEG Pipeline would cross approximately 9.7 statute miles (8.4 nautical miles) of the SEOS and approximately 2.8 statute miles (2.4 nautical miles) of the NSOS.

Established under the Massachusetts Ocean Sanctuaries Act (OSA), the SEOS lies offshore of the coast of the Nahant/Lynn corporate boundary in the south, to the town of Manchester-by-the-Sea in the north, while the NSOS lies offshore of the coast from the southeastern most point of the town of Manchester-by-the-Sea extending northward up to the Massachusetts/New Hampshire border. The purpose of the SEOS and NSOS under the OSA is to protect the ecology or the appearance of the ocean, the seabed and the seafloor from activities that would significantly alter or endanger the resources of the sanctuary.

The SEOS and NSOS are under the care and control of the MDCR within the EOEA. There is no separate permit or authorization for construction or operation required by the OSA; rather, the provisions of the Act and its regulations are implemented through the permitting reviews by other state agencies, including by the MDEP, and through the federal consistency review by the MCZM Program. The OSA prohibits certain activities within a sanctuary, and sets forth permissible activities.

The statute and regulation authorize a number of activities, including projects that are licensed under G.L.C. 91 because they are deemed to be of public necessity and convenience, as well as facilities that are associated with the generation, transmission and distribution of electrical power, as long as they would not seriously alter or otherwise endanger the ecology or appearance of the ocean, the seabed or subsoil thereof. Authorized activities have included the HubLine and other infrastructure projects such as fiber optic cables.

3.7.1.2 Massachusetts Bay Disposal Site

The MBDS is a 2.3-statute-mile (2-nautical-mile) diameter circular area located 17 nautical miles east of the entrance to Boston Harbor and adjacent to the boundary of SBNMS. The NEG port site is 656 feet (200 meters) south of the boundary of the MBDS. The pipeline route is approximately 1,312 feet (400 meters) from the MBDS boundary at its closest point (near MP 15.4). This disposal site has been used as a repository for dredged material, rock debris, sunken vessels, munitions, and construction debris. It was officially designated a dredged material disposal site by the EPA in 1993.

Approximately one barge per day uses the dredge disposal site. The MBDS has the capacity to accommodate anticipated maritime disposal needs for the next 50 to 100 years (ACOE, 2005). According to the ACOE, adjacent uses would be allowed if measures were taken to ensure a buffer to protect against potential spillover effects of the MBDS, navigation tolerances for towing and collision are evaluated, and no loss of available capacity occurs (ACOE, 2005).

3.7.1.3 Other Ocean Uses

Scientific Research

Long-term benthic ecology monitoring stations are located at Halfway Rock, which is situated approximately 1.5 miles (2.4 kilometers) north of the Pipeline Lateral's interconnect with HubLine (MP 0.0). In addition, the Northeastern University Marine Science Center monitors three areas near Halfway rock. The Massachusetts Water Resources Authority (MWRA) performs periodic water quality sampling, benthic sampling, and monitoring on board vessels in Massachusetts Bay. MWRA also uses a few of the fixed buoys associated with the Gulf of Maine Ocean Observing System (GoMOOS). None of these monitoring locations and buoy locations are in the project area (Rex 2005; MWRA 2004; www.GoMOOS.org), although some are located nearby. See section 3.1 for more detailed information about these research activities.

Offshore Utility Crossing

There are no known foreign utilities in the vicinity of the proposed Port. However, the proposed NEG Pipeline would cross the Hibernia communications cable at MP 5.7. The HubLine crosses the Hibernia Cable farther to the south. An additional cable has been identified by Algonquin that crosses the NEG Pipeline route at MP 15.5. The ownership of a cable is unclear as is the status of its operation.

3.7.2 Land Uses

3.7.2.1 Meter and Regulator Stations

To accommodate the new gas supplies from the proposed actions, modifications would be required at existing Algonquin Meter station facilities located in Salem and Weymouth, MA. In addition, construction of the proposed NEG Port and Pipeline would require temporary use of onshore dock facilities as load-out yards. Algonquin is considering port facilities in Gloucester, Charlestown, and Quincy, MA, and North Kingstown, R.I.

The Salem Meter Station (see Figure 2-4) is located in the City of Salem, MA on the east side of Kernwood Street, adjacent to McCabe Park. The existing Salem Station sits on a level, crushed stone substrate and is surrounded by security fencing. The area surrounding the station consists of recreational uses including a public boat ramp to the north, a city park to the east, and a private golf course to the south and west.

The Weymouth Meter Station (see Figure 2-5) is located in the town of Weymouth, MA, adjacent to the Route 3A bridge on the east side of the Weymouth Fore River. The existing Weymouth Station, which is located on industrial property occupied by the MWRA and the Excelon Energy Generation Station, sits on a level, crushed stone substrate, and is surrounded by security fencing.

The proposed load-out yards would be used to store and stage equipment and personnel during construction.

3.7.2.2 Wharfs

The Americold Wharf, located in Gloucester, MA, is an existing cold storage facility that handles frozen fish products for local, regional, and national companies. The site consists of paved parking and storage areas and as well as pier consisting of a concrete and asphalt deck with wood pilings that is capable of berthing a variety of sea vessels.

Pier 11, located in Charlestown, MA, consists of large storage facilities, open paved areas, and a pier made up of a concrete and asphalt deck with wooden pilings.

The Quincy Ship Yard is located in Quincy, MA and is presently used as a large commercial port. The yard consists of storage facilities and a large concrete pier.

The yard and existing pier at the Davisville Industrial Park is located in the Town of North Kingstown, RI and encompasses approximately 54 acres of flat open space with large areas of broken pavement. The pier that may be used at this site is one of three within the Quonset Davisville Port and Commerce Park. The pier consists of a concrete and asphalt deck and wooden pilings.

3.7.3 Recreation Resources

3.7.3.1 Onshore Recreation Facilities

Massachusetts offers many types of onshore coastal recreational opportunities for the public. Table 3-31 lists towns along the shoreline of Massachusetts Bay and representative onshore recreational resources. A few of the towns surrounding Massachusetts Bay also include future potential recreation facilities and plans that involve coastal recreation resources. Table 3-32 lists the towns with planned coastal recreation facility developments or extensions to existing developments.

Table 3-31
Existing Recreation Facilities by Town

Town	Name of Facility	Type of Facility	Distance to NEG Port Site
Beverly	David S. Lynch Memorial Park Beach	City Park/Beach	17 miles
Boston	Harbor Walk	City Trail	22 miles
Gloucester	Good Harbor Beach	Beach	13 miles
Hull	Nantasket Beach Reservation	State Reservation	16 miles
Lynn	Lynn Heritage State Park	State Park	17 miles
	Lynn Beach	Beach	17 miles
	Nahant Beach and Lynn Shore Reservation	State Reservation	17 miles
Manchester-by-the-Sea	Coolidge Reservation/Point	State Reservation	13 miles
	Singing Beach	Beach	13 miles
Marblehead	River Beach	Beach	13 miles
Nahant	Nahant Beach	Beach	16 miles
Quincy	Wollaston Beach Reservation	State Reservation	19 miles
Salem	Winter Island	Island	16 miles
Revere	Revere Beach Reservation	State Reservation	19 miles
Weymouth	Webb Memorial State Park	State Park	18 miles
Winthrop	Winthrop Beach	Beach	18 miles
Boston	Harbor Walk	Trail Expansion	22 miles
Nahant	Lowlands Trail	Trail	16 miles
Revere	Park	City Park	19 miles
Winthrop	Winthrop Shores Reservation	State Reservation	18 miles

Table 3-32
Potential Future Recreation Facilities by Town

Town	Name of Facility	Proposed Facility	Distance to NEG Port Site
Boston	Harbor Walk	Trail Expansion	22 miles
Nahant	Lowlands Trail	New Trail	16 miles
Revere	Park	City Park	19 miles
Winthrop	Winthrop Shores Reservation	State Reservation (Renovation)[a]	18 miles

[a] As described at http://www.mass.gov/mdc/winthropBEACH.htm

3.7.3.2 Offshore Recreation

Offshore recreational opportunities near the proposed port include a variety of seasonal and year-round activities geared towards local residents and tourists. The primary offshore recreational opportunities include the Boston Harbor Islands National Recreation Area, recreational fishing, whale watching, boating and sailing, diving, and casino cruises.

Boston Harbor Island National Recreation Area

Boston Harbor Islands National Recreation Area encompasses 34 islands located in the Greater Boston Harbor that were included in the National Park System by Congress in 1996. Management of Boston Harbor Islands falls under the guidance of a 13-member partnership, which includes the National Park Service and other state, local, and private representatives responsible for the development and implementation of the Park's management plan (Boston Harbor Islands, 2005). The closest visited island to the proposed action is Graves Island and lighthouse, which is approximately 9 miles (14 kilometers) from the closest point of the proposed pipeline lateral and 12 miles from the proposed port.

The islands provide a diversity of cultural, historic, and natural experiences geared towards both local residents and tourists. Popular recreation opportunities include beaches, hiking trails, camping and picnicking areas, views of Massachusetts Bay and the Boston skyline, and historic structures including a Civil War-era fort and a lighthouse (Boston Harbor Islands, 2005).

The islands are open daily from May to October and on weekends throughout the year, although special arrangements can be made during the off-season (Boston Harbor Islands, 2005). Visitation is highest between July and August on weekends (Algonquin Gas Transmission Company and Duke Energy LLC, 2000). Access to Georges Island is provided by passenger ferries from mainland piers and park shuttle boats provide additional transportation to Little Brewster Island (Boston Light Station), Thompson Island, and the outer harbor for guided tours. Private boats are also permitted to anchor offshore (Boston Harbor Islands, 2005).

Recreational Fishing

Sportfishing is a significant recreational activity in Massachusetts Bay. The Marine Recreational Fisheries Statistics Survey (MRFSS) indicates that in 2003, approximately 36 percent of all fish caught recreationally in Massachusetts Bay were caught in Massachusetts. Some 51 percent of fishing was done from private or rental boats, 45 percent from the shore, and 4 percent via party or charter boat (NMFS, 2000). Charter boats operate from both Gloucester and Lynn for recreational fishing for cod and others species in the deeper waters (Koutrakis, 2005; Hoffman, 2005).

The recreational fishery can be categorized by three types of commercial vessels (NOAA 1991): 1) Party boats, usually 50 feet or longer and carrying 20 to 80 passengers who pay a set fee for their trip; 2) Charter boats generally measuring 25 to 30 feet (8 to 9 meters) and carrying an average of six paying passengers; and 3) Private boats measuring 20 feet (6 meters) or longer used by individual anglers and their guests.

Additional information on recreational fisheries was obtained through review of data from the MRFSS, discussion with the MDMF (Hoffman 2005), and discussion with bait and tackle shop owners in municipalities along Massachusetts Bay for anecdotal information (Koutrakis, 2000, 2005; Begley, 2005). The MRFSS data for Massachusetts is not area specific, and instead covers the entire state. The economic aspects of the sportfishing industry are discussed in section 3.8.

Sport fishermen near MBDS typically target Atlantic cod, cusk, haddock, striped bass, Atlantic mackerel, bluefish, and bluefin tuna. Wolf fish, flounder, and pollock are also caught (Hubbard et al., 1988). MRFSS data give a general overview of frequently encountered species and the makeup of saltwater fishing trips by fishing mode. During 1998 (NMFS, 2000), the three most frequently encountered fish were striped bass, Atlantic cod (*Gadus morhua*), and bluefish (*Pomatomus saltatrix*). Table 3-33 shows the most popular recreational fishing targets and their respective seasons.

Table 3-33
Recreational Fishing Season and Type Locations for Popular Target Species in the Project Area

Species	Open Season	Recreational Fishing Season	Location Types
Blue fish	All year	June-mid October	Coast surf, inshore bars, tide rips, estuary
Cod	All year	All year. Spring and Fall are good.	Coast deepwater, inshore while water is cold. Sea mounts, pinnacles, ledges and shoal areas offshore
Mackerel	All year	May-September	Deep water to shallow bays, beaches, bridges, and jetties.
Striped bass	All year	Mid-April-October	Coast surf, inshore bars, tiderips, bays, estuaries

Source: Hoffman, 2005; Koutrakis, 2005, 2000.

The Salem Sound study (MDMF, 2000) provides some MRFSS data, which is based on interviews and data available for Salem Sound recreational fisheries. The data show few or no intercepts during the winter/early spring months of January to April or during the late fall/winter months of November to December. The MRFSS data for Salem Sound does not break down recreational fishing data by specific catch locations. Anecdotal information reveals that species in the area near the proposed port are typically associated with deeper waters that are further from shore. Popular fishing spots include Stellwagen Bank and Jeffries Bank.

Winter flounder fishing is usually done closer to shore in small boats. Some fishermen do seek yellow tail flounder beyond 2.5 miles (4.0 kilometers) (Koutrakis, 2005). Fishing for tuna has increased in popularity within the past couple of years throughout the Stellwagen Bank between August and October when the tuna move closer to shore. Shark fishing is also increasing in popularity and usually takes place more than 10 miles off shore (Koutrakis, 2005).

In addition to recreational fishing for finfish, there is a recreational lobster fishery near the shore. The Commonwealth of Massachusetts issued 11,134 recreational lobster licenses in 2002, and recreational lobster landings for 2002 were reported to be 1.6 percent of the commercial landings (Dean et al., 2004).

Whale Watching

Massachusetts Bay is considered one of the top ten whale-watching sites in the world according to the World Wildlife Fund. Whale-watching locations are generally more than 10 miles out to sea and mainly on Stellwagen Bank and Jeffrey's Ledge, but whales are occasionally seen closer to shore (Frontierro, 2005). Currently, over 90 percent of all whale-watching efforts in New England occur within the SBNMS (NOAA, 2002b). According to SBNMS, there are no known specific whale-watching routes used by charter boats. The charter boats instead follow the last reported whale sighting information. Once in SBNMS, the boats tend to zigzag in and out of the sanctuary looking for whales.

Whale watching cruises are an important economic activity near the proposed port site, as well as a source of educational, and scientific opportunities. Whale watch cruises operate annually from mid-April through October, with a peak period occurring during July, August, and September (Weinrich, 2005). Since its inception in Massachusetts Bay in 1976, the commercial whale-watching industry has grown in popularity and revenue (NOAA, 2002b). In 1997, whale watching in New England generated approximately $21 million in direct sales revenues.

Companies that offer whale-watching tours in the vicinity of the Port are operated out of Provincetown (five companies), Barnstable (1), Plymouth (3), Quincy (1), Boston (5), Salem (1), Gloucester (4), Rockport (1), and Newburyport (1) (NOAA, 2005). Few of these operators are devoted exclusively to whale watching, and many also provide fishing, sightseeing, and transportation services. Whale-watching vessels range in size from 50 feet to over 140 feet long, and can accommodate a capacity ranging from 35 to 400 passengers (NOAA, 1993), although most boats carry between 150 and 250 passengers when full.

In addition to the commercial boats using the bay, a large fleet of smaller, private craft also engage in whale-watching activities, with as many as 40 boats using on SBNMS simultaneously (NOAA, 2005). During the peak (summer) season when tourism is the primary market, commercial operators often make two trips per day per boat. In September and October, trips are usually limited to one daily trip on weekends. During the 1996 season, the most recent year for which data were available, approximately 864,000 individuals participated in whale-watching tours in SBNMS, (NOAA, 2002b). For additional information concerning whale populations, see sections 3.2 and 3.3.

Recreational Boating and Sailing

Massachusetts Bay is a popular destination for recreational fishing boats, sailboats, and powerboats (NOAA, 2002b). There are approximately 25,000 permitted, publicly administered and 10,000 privately maintained slips, moorings, and docks used for recreational boating along the Massachusetts coastline (Massachusetts Marine Trades Association, 2001). Among the coastal communities of Gloucester and Scituate, located closest to the Port, a recent listing of marinas and yacht clubs (Charternet, 2005) indicated that there were 66 such facilities providing seasonal and transient mooring for both power and sail boats. In the Salem, Danvers, Beverly, Marblehead, and Manchester area there are over 5,600 berths (Chase et al., 2002). Services provided by these facilities range from mooring to fuel and marine repair to dining and lodging. Public boat launches are located in all coastal towns in the study area (Boston Boating, 2005).

Recreational boating in Massachusetts Bay is a seasonal activity with most marinas and yacht clubs launching boats starting in mid-April and hauling them out by mid-October. Much of the sailing within the Bay occurs within a few miles of shore, or within the more protected harbors along the shoreline. As with other forms of recreational boating, most sailing events are held during the summer months. Table 3-34 lists the towns between Gloucester and Scituate that house one or more yacht clubs, as well as the major on-water events and locations associated with those clubs.

Table 3-34

Yacht Clubs and Hosted Events

Town	Yacht Club	Major Events	Approximate Location
Marblehead	Boston Yacht Club	Hodder Regatta, Commodore's Cup race, Marblehead-to-Halifax race, Beringer Overnight race between Marblehead and Provincetown	In and around Marblehead and Salem Harbors and from Marblehead to Halifax and Marblehead to Provincetown
	Eastern Yacht Club Corinthian Yacht Club		
Salem	Salem Wouldows Yacht Club	Fourth of July sailboat race, fishing tournament, heritage day race	In and around Salem Sound
Beverly	Jubilee Yacht Club	Annual jubilee regatta, Phil Small race	In the vicinity of Beverly Harbor
Gloucester	East Point Yacht Club	Cape Ann Challenge, Downeast Challenge	From Annisquam Bay, around Cape Ann to the East Point at the edge of Gloucester Harbor, and from Gloucester Harbor to Rockland, Maine
Manchester-by- the-Sea	Manchester Yacht Club	Patton Bowl race, Fall Series	In Salem and Manchester Bays
Scituate	Scituate Harbor Yacht Club	Corinthian 200, Gill and Magoon Trophies, junior regatta	Scituate to Marblehead and in Scituate Harbor
Hingham	Hingham Yacht Club	Junior regatta, local sailing events	Hingham Bay

Diving

Diving opportunities in Massachusetts Bay include diving for shipwrecks, shellfish,, cave exploration, underwater photography, and marine life observation. Charter and shore-based providers offer guided trips as well as diving training, and are based out of Boston, Winthrop, Gloucester, and Revere (Charternet, 2005). Although diving primarily occurs between April and October, some limited diving does occur during the winter.

There are no popular dive locations within the area proposed for construction of the proposed NEG Project. The closest popular dive spots are Saturday Night Ledge, located about one-half mile north of Pipeline MP 6.0; Newcomb Ledge, approximately one half mile west of MP 3.0; and Halfway Rock (Henry, 2005). Additional opportunities for advanced ocean diving occur in the SBNMS, where diving conditions are variable and often characterized by strong currents and cold temperatures (NOAA, 2005). Diving in the sanctuary is limited to two general areas, including Jeffrey's Ledge, located northeast of Cape Ann approximately 15 miles offshore, and at the northern end of SBNMS.

Casino Cruises

During the summer months, two commercial casino cruises operate out of Lynn and Gloucester, Massachusetts. The vessels travel eastward to the limits of state territorial waters and remain there while gaming activities take place. The vessels are 186 feet in length and hold 500 passengers each (Horizon's Edge Casinos, 2005).

3.7.4 Visual Resources

The onshore visual setting between Gloucester and Scituate is framed by rocky shores and beaches, and bounded by seaside communities, many with a large summer residential populations. Various city and state parks, beaches, and other recreational areas are found along the shoreline where residents and tourists come to recreate and enjoy views of the ocean. Marinas and other commercial land use areas also are present. Views to the east across the Atlantic Ocean typically dominate the landscape. Topography varies from broad flat sandy beaches to high rocky outcroppings near the waters edge. Vegetation found along the immediate coastline consists of mixed deciduous and coniferous tree cover that varies from heavily wooded areas with dense tree canopy and understory, to landscaped residential properties, to sparsely vegetated beachfronts. Views of Massachusetts Bay from locations between Gloucester and Scituate extend to the horizon and often include oceangoing commercial vessels, as well as charter and other recreation boats.

3.8 SOCIOECONOMICS

This section describes the socioeconomic resources that could be affected by the construction and operation of the proposed NEG Port and Pipeline Lateral, including commercial fishing, tourism, recreational boating, housing, public services, and tax revenues.

The project area considered in this DEIS for socioeconomic resources (referenced as the "socioeconomic project region" or "socioeconomic region") includes the cities and towns and ports and harbors along the shoreline of Massachusetts Bay closest to the proposed NEG Port site, the waters of the Massachusetts Bay extending east to the boundary of the SBNMS, Gloucester to the north, and on the south to the edge of the in-bound Boston Harbor Traffic Lane.

3.8.1 Population

The population within the socioeconomic region encompasses roughly 17% of Massachusetts' population. As Table 3-35 below shows, the range of population figures across these municipalities in 2000 is wide, ranging from 5,228 people in Manchester-by-the-Sea to 589,141 in Boston.

Table 3-35

Population and Education Statistics

		Age			Age 25 or older			Age 25-34
	Total Population	**Age 18 and over**	**Age 60 and over**	**Age 65 and over**	**Less than 9th grade education**	**Percent of high school graduates or higher**	**Percent with bachelors degree or higher**	**Percent with bachelors degree or high**
Massachusetts	**6,349,097**	**76.4**	**17.3**	**13.5**	**5.8**	**84.8**	**33.2**	**41.4**
Beverly	39,862	78.3	19.2	15.6	2.6	90.8	36.5	47.7
Boston	589,141	80.2	13.5	10.4	9.1	78.9	35.6	51.8
Cohasset	7,261	72.1	19.4	15.3	0.2	97.2	60.7	69.7
Gloucester	30,273	78.0	19.8	15.6	5.2	85.7	27.5	28.9
Hingham	19,882	72.3	18.6	14.1	1.0	96.0	57.5	66.6
Hull	11,050	77.9	16.6	12.0	2.2	90.1	30.1	36.8
Lynn	89,050	73.0	16.2	12.8	10.1	74.2	16.4	18.3
Manchester-by-the-Sea	5,228	76.1	21.7	16.4	0.9	96.0	56.0	41.6
Marblehead	20,377	76.1	20.0	15.6	1.0	96.4	61.5	76.8
Nahant	3,632	81.4	23.8	19.4	1.3	94.6	47.5	54.7
Quincy	88,025	82.5	20.4	16.3	5.2	85.2	31.8	49.3
Salem	40,407	79.8	17.8	14.1	5.9	85.2	31.1	42.0
Scituate	17,863	73.9	20.1	15.3	0.9	95.8	47.6	52.3
Swampscott	14,412	76.0	21.9	17.7	1.9	94.8	50.2	57.0
Weymouth	53,988	78.0	19.5	15.4	2.2	90.5	26.0	37.3
Winthrop	18,303	81.4	20.6	16.5	2.3	90.0	29.0	43.9

Source: US Census, 2000

The City of Boston contains the highest population density in the region with approximately 11,753 people/square mile. With an estimated 578 people/square mile, Manchester-by-the-Sea had the lowest population density. Estimates indicate that populations in Essex, Norfolk, and Plymouth Counties increased between 2000 and 2004 by about 2.2 percent, 0.5 percent, and 3.8 percent, respectively, while the population in Suffolk County, which includes Boston, decreased by 3.5 percent.

3.8.2 Employment and Unemployment

3.8.2.1 Employment

Among employed residents in municipalities in the socioeconomic region, the largest number of workers is employed in professional jobs while the majority of the remainder of workers is employed in service and sales/office jobs. Farming, fishing and forestry employs the fewest workers, less then 1 percent, in all but one municipality in the region. As listed in Table 3-36, of the communities in the socioeconomic region, Gloucester contains the highest percentage (2 percent) of workers employed in the farming, fishing and forestry industries, with Scituate second with approximately 0.9 percent.

Table 3-36

Distribution of Employed Residents Among Occupation Categories (percent)

	Professional and related occupations	Service occupations	Sales and Office occupations	Farming, Fishing and Forestry occupations	Construction, extraction and maintenance occupations	Production, transportation and material moving occupations
Massachusetts	41.1	14.1	25.9	0.2	7.5	11.3
Beverly	42.4	13.2	28.9	0.1	6.5	9.0
Boston	43.3	17.8	25.6	0.1	4.9	8.3
Cohasset	57.2	8.6	27.0	0.4	3.1	3.6
Gloucester	36.1	15.1	25.4	2.0	8.0	13.4
Hingham	57.3	7.3	25.4	0.1	6.7	3.2
Hull	39.3	13.6	27.5	0.2	9.5	9.8
Lynn	25.8	19.9	28.2	0.3	8.7	17.2
Manchester-by-the-Sea	52.0	8.9	27.9	0.3	3.8	7.1
Marblehead	57.0	7.8	26.0	0.0	4.5	4.7
Nahant	52.7	11.7	21.7	0.0	6.6	7.3
Quincy	40.1	15.0	29.7	0.1	7.2	7.9
Salem	37.4	15.1	29.5	0.2	6.0	11.9
Scituate	50.6	11.8	24.2	0.9	7.1	5.5
Swampscott	52.3	9.3	27.5	0.5	4.7	5.7
Weymouth	36.5	12.6	31.5	0.0	10.7	8.6
Winthrop	38.6	14.1	30.4	0.2	7.2	9.5

Source: US Census, 2000

Table 3-37 summarizes the three largest employment sectors in municipalities within the region of interest. As the table shows, a majority of employers are in the industry areas of retail trade; health care and social assistance, or in accommodation and food service. Table 3-38 lists per capita income and employment data for the municipalities within the socioeconomic region.

Table 3-37

Three Largest Employment Sectors Among Industries in Counties Comprising the Socioeconomic Region

Municipality	Manufacturing	Wholesale trade	Retail trade	Professional, scientific and technical services	Health care and social assistance	Accommodation and food service
Gloucester	1		3		2	
Manchester-by-the-sea	N/A					
Beverly	2		3		1	
Marblehead			2		1	3
Salem			2		1	3
Swampscott			1		3	2
Lynn	1		3		2	
Nahant	N/A					
Winthrop			2		1	3
Boston				2	1	3
Quincy			3	2	1	
Weymouth			2		1	3
Hingham		3	1		3	
Hull			3		2	1
Cohasset	N/A					
Scituate			3		2	1

N/A denotes data now available

Source: Massachusetts Division of Career Services and the Massachusetts Division of Unemployment Assistance

Table 3-38

Employment in the Project Region

County/Town	2000 Civilian Labor Force	2000 Unemployment Rate (percent)	Top Employment Sector*
Essex County	**366,715**	**4.6**	**E, H & SS**
Lynn	41,842	3.8	E, H & SS
Marblehead	10,960	2.1	E, H & SS
Salem	22,920	5.4	E, H & SS
Beverly	22,131	6.9	E, H & SS
Manchester-by-the-Sea	2,672	1.8	P, S, MA & WMS
Gloucester	16,097	4.9	E, H & SS
Swampscott	7,634	2.0	E, H & SS
Nahant	1,957	1.5	E, H & SS
Suffolk County	**354,808**	**7.1**	**E, H & SS**
Boston	308,107	7.2	E, H & SS
Winthrop	9,983	4.1	E, H & SS
Revere	22,506	5.9	E, H & SS
Norfolk County	**348,566**	**3.2**	**E, H & SS**
Cohasset	3,564	1.5	E, H & SS
Quincy	49,585	3.4	E, H & SS
Weymouth	29,590	4	E, H & SS
Plymouth County	**7,844**	**2.6**	**E, H & SS**
Hingham	9,894	2.6	E, H & SS
Hull	6,123	4.0	E, H & SS
Scituate	2,562	3.7	E, H & SS
Socioeconomic Region Total (Towns Only)	**568,127**	**5.8**	**E, H & SS**
Massachusetts Total	**3,312,039**	**4.6**	**E, H & SS**

***Education, Health & Social Services (E, H, & SS); Professional, Scientific, Management, Administrative & Waste Management Services (P, S, MA & WMS).**

3.8.2.2 Unemployment

In 2004, the unemployment rate in Boston, Gloucester, Hull, Lynn, Quincy, Salem, Weymouth and Winthrop exceeded that of the state. Lynn and Gloucester experienced the highest unemployment rates, which were 6.5% and 6.2% respectively (Table 3-39). Between 1994 and 2004, unemployment rates decreased in all socioeconomic region municipalities except Beverly, Cohasset, Marblehead, and Manchester.

Table 3-39

Unemployment in Project Area Municipalities in 1994 and 2004

Area	1994	2004	Percent Change
Massachusetts	6.2	5.1	-21.6%
Beverly	4.7	4.8	2.1%
Boston	6.0	5.5	-9.1%
Cohasset	3.4	4.1	17.1%
Gloucester	9.9	6.2	-59.7%
Hingham	4.2	3.9	-7.7%
Hull	7.5	5.6	-33.9%
Lynn	7.4	6.5	-13.8%
Manchester-by-the-Sea	3.5	4.2	16.7%
Marblehead	3.7	3.9	5.1%
Nahant	5.4	4.3	-25.6%
Quincy	5.9	5.2	-13.5%
Salem	5.7	5.3	-7.5%
Scituate	4.5	4.1	-9.8%
Swampscott	5.0	4.2	-19.0%
Weymouth	5.7	5.1	-11.8%
Winthrop	6.3	5.1	-23.5%

Source: Massachusetts Division of Career Services and the Massachusetts division of Unemployment Assistance

Unemployment in the Farming, Fishing and Forestry Occupations

Unemployment data is not available for the fishing industry alone; however, it is available in a grouped category of farming, fishing and forestry. Unemployment survey data from 2003 to 2005 indicates that most claimants in this category experienced 5 to 14 weeks of unemployment, with 8 to 36 percent being unemployed for 15 or more weeks. The time period with the highest levels of unemployment generally occurs in the spring and early summer months. Table 3-40 lists unemployment statistics for the municipalities in the socioeconomic region.

Table 3-40

Massachusetts Unemployment Data for the Farming, Fishing and Forestry Categories

	Survey	Claimants	1-2 weeks	%	3-4 weeks	%	5-14 weeks	%	15+ weeks	%
2003										
January	1,118	1.0%	244	21.8%	315	28.2%	477	42.7%	82	7.3%
February	1,200	1.0%	205	17.1%	182	15.2%	693	57.8%	120	10.0%
March	1,049	0.9%	132	12.6%	96	9.2%	621	59.2%	200	19.1%
April	841	0.8%	191	22.7%	87	10.3%	349	41.5%	214	25.4%
May	691	0.8%	203	29.4%	87	12.6%	199	28.8%	202	29.2%
June	454	0.5%	86	18.9%	40	8.8%	174	38.3%	154	33.9%
July	470	0.5%	124	26.4%	92	19.6%	160	34.0%	94	20.0%
August	443	0.5%	107	24.2%	80	18.1%	190	42.9%	66	14.9%
September	491	0.6%	149	30.3%	82	16.7%	178	36.3%	82	16.7%
October	534	0.7%	205	38.4%	87	16.3%	168	31.5%	74	13.9%
November	647	0.8%	255	39.4%	117	18.1%	201	31.1%	74	11.4%
December	811	0.9%	261	32.2%	180	22.2%	304	37.5%	66	8.1%
2004										
January	1,333	1.2%	289	21.7%	386	29.0%	549	41.2%	109	8.2%
February	127	1.1%	154	12.6%	135	11.0%	766	62.4%	172	14.0%
March	1,101	1.0%	185	16.8%	93	8.4%	570	51.8%	253	23.0%
April	679	0.8%	148	21.8%	58	8.5%	225	33.1%	248	36.5%
May	651	0.9%	220	33.8%	57	8.8%	193	29.6%	181	27.8%
June	429	0.6%	90	21.0%	34	7.9%	172	40.1%	133	31.0%
July	422	0.5%	120	28.4%	85	20.1%	127	30.1%	90	21.3%
August	464	0.6%	129	27.8%	78	16.8%	178	38.4%	79	17.0%
September	416	0.7%	127	30.5%	61	14.7%	161	38.7%	67	16.1%
October	476	0.8%	163	34.2%	109	22.9%	139	29.2%	65	13.7%
November	506	0.8%	196	38.7%	86	17.0%	160	31.6%	64	12.6%
December	699	0.9%	230	32.9%	174	24.9%	239	34.2%	56	8.0%
2005										
January	1,072	1.1%	243	22.7%	354	33.0%	401	37.4%	74	6.9%
February	1,205	1.2%	178	14.8%	197	16.3%	714	59.3%	116	9.6%
March	1,117	1.1%	143	12.8%	104	9.3%	659	59.0%	211	18.9%
April	589	0.8%	124	21.1%	55	9.3%	218	37.0%	192	32.6%
May	539	0.8%	164	30.4%	72	13.4%	148	27.5%	155	28.8%
June	349	0.6%	106	30.4%	25	7.2%	125	35.8%	93	26.6%
July	358	0.5%	111	31.0%	70	19.6%	116	32.4%	61	17.0%
August	454	0.7%	169	37.2%	83	18.3%	153	39.7%	67	14.8%
September	475	0.8%	144	30.3%	98	20.6%	173	36.4%	60	12.6%
October	624	1.1%	166	26.6%	124	19.9%	261	41.8%	73	11.7%
November	624	1.1%	166	26.6%	124	19.9%	261	41.8%	73	11.7%

Source: Massachusetts Division of Career Services and the Massachusetts Division of Unemployment Assistance

3.8.3 Economics

The coastal aspect of Massachusetts Bay has had a significant impact on regional growth, drawing residents and serving to spur both housing development and various marine-related industries. Notably, nearly three-quarters of the state's population lives within 10 miles from the ocean shore, and roughly 75 percent of new development occurs in the state's coastal regions. The coastal aspect of the state is further reflected in three of the key industries in the socioeconomic region; the commercial port industry, coastal tourism and the seafood industry.

3.8.3.1 Economy

A study of the Commonwealth's marine economy (Georgiana, 2000) provides perspective on the relative contribution of the seafood, transportation, tourism and construction industries over the past 10 years. In 1997, employment and earnings in the marine seafood sector of the economy (which encompasses fresh caught and raised fish, and frozen imported fish) was larger than that of marine transportation, tourism and recreation. The marine seafood sector registered $659 million in revenues and employed 37,585, while the marine transportation, tourism and recreation sectors earned $629 million and employed 30,471 workers. The coastal construction and real estate sectors earned $177 million in revenues and employed 4,512 employees in 1997.[4] Figure 3-30 shows the employment and earnings of these industries.

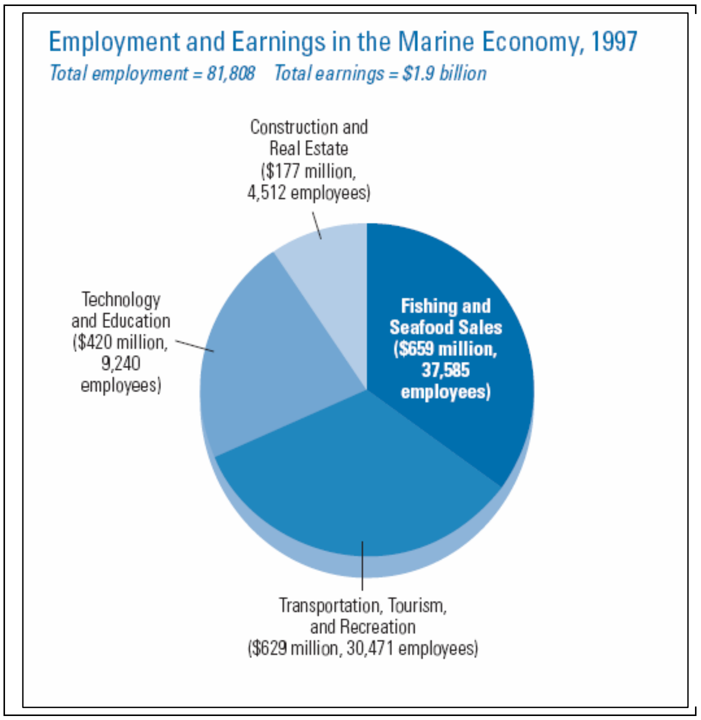


Figure 3-30. Employment and Earnings in the Marine Economy, 1997

Source: Center for Policy Analysis, University of Massachusetts, Dartmouth, 2000

Port of Boston

The Port of Boston serves as the transport hub for a number of commercial activities, including container shipping, natural gas imports, automobile imports, and cruise ship docking, in addition to serving as a site for ferry docks, marinas and the USCG's facilities.

[4] The seafood industry encompasses commercial fishing and related supplies, marine aquaculture, seafood processing and wholesaling and retail and food service seafood sales. The water transportation, tourism, and recreation category includes transportation (e.g. freight (container) transport and cargo handling), shipbuilding, coastal tourism, and recreational boating and fishing (Georgiana, 2000).

In 2004, the Port of Boston handled approximately 1.3 million tons of general cargo, 1.5 million tons of non-fuel bulk cargo and 12.8 million tons of bulk fuel cargo. Additionally, the Port of Boston's natural gas terminals received LNG imports that constitute 90% of Massachusetts' petroleum consumption needs (Port of Boston, date unknown).

Tourism

Tourism plays a significant role in the Massachusetts economy. In 2003, the state drew 27 million visitors, which contributed approximately $17.9 billion to the Commonwealth's economy (MA Tourism, 2003a). Coastal tourism is considered an important aspect of state tourism. In 2003, 18 percent of tourists visited Massachusetts for beach activities and 7 percent for water sports and boating (MA Tourism, 2003b).

Tourism supports thousands of jobs and draws millions in tax revenues in the municipalities within the region and provided employment for approximately 62,000 people in 2003, or roughly 50 percent of individuals employed in tourism state-wide. The combined state and county tax revenues from tourism related activities in the counties encompassing the socioeconomic region was estimated to be $170 million in 2003 (MA Tourism, 2003a). Table 3-41 indicates the domestic revenues and employment impact of tourism on these counties.

Table 3-41
Economic Impact of Tourism on Project Counties

County	Expenditures ($M)	Payroll ($M)	Employment	State Tax Receipts	Local Tax Receipts
Essex	535.62	150.36	6,600	30.78	13.72
Norfolk	642.42	231.35	9,500	36.07	13.46
Plymouth	353.14	84.73	3,700	18.56	15.89
Suffolk	4,528.67	1,181.55	42,200	29.99	11.39

Source: Massachusetts Office of Travel and Tourism, 2003

Fishing

The commercial fishing industry is active in the region and provides socioeconomic benefits to boat servicers, fish processors, wholesalers and retailers. However, the seafood industry has seen an economic decline over time. Over the past 20 years commercial fish stock levels have declined and the government has placed restrictions on fish catches and access to some productive fishing grounds in order to increase stock levels; these two factors have reduced fish landings by more than one-third in both volume and real value since 1982, thereby causing a decline in the fishing industry in general and forcing processors, wholesalers, retailers and consumers to buy more imported fish (Georgianna, 2000).

Fishing Industry Practices

Fishing vessels out of towns within the region are typically owned by families who target specific species or groups of species (Georgianna, 2000). In general, a family member skippers the boat while other family members and non-family members constitute the crew. Vessel owners and their crew share both the vessels operating costs as well as the revenues. While a variety of arrangements are made, a typical example would allot costs such as fuel, ice, food and water to the crew while the owner handles insurance, maintenance and the mortgage.

Another important component of the regional fishing industry is fish processing. Fish processors either focus on frozen or fresh fish and the future of the fresh fish processing industry closely tied to the health of the commercial fishing business, as there is a high level of coordination that takes place between fishermen and processors to enable fresh fish to be delivered quickly (Georgianna, 2000). Fish that is not processed is generally sold at auction. The largest fish auctions in the region are located in Gloucester and Boston.

Significant Areas

As discussed in section 3.2, Massachusetts Bay contains significant fish resources. The MDMF has produced a trawl survey that is updated semiannually (during the spring and fall) in two areas of the Massachusetts Bay that reflect the fish resources in the vicinity of the proposed Port and Pipeline corridor. Data from 2003 and 2005 indicate that, among commercially or ecologically significant fishes, species that are most abundant during the spring include, in descending order of abundance, American plaice, silver hake, red hake, yellowtail founder and daubed shanny; all but the shanny, constituted the highest catches in term of biomass. In the fall, the most abundant species are American plaice, which, in addition to spiny dogfish, American plaice, red hake and silver hake, also constituted the highest catches in terms of biomass. In total, 59 species were recorded in the area; 46 of which were present during the spring trawl, while 53 were present in the fall.

Data that records the activities of commercial fishing vessels with Vessel Monitoring Systems (VMS) indicates that fishing vessels with VMS made roughly 3,400 trips to Area 514 in 2005.[5] Notably, this dataset does not encompass all permitted vessels. VMS applies to vessels with permits for scallops, herring, monk and groundfish, but not all vessels with such permits are required to have VMS onboard. As of September 2006, there roughly 5,300 vessels held active permits issued by the northeast division of NMFS, while only roughly 1,410 vessels of those vessels had VMS. VMS data for calendar year 2005 indicates that the 3,400 trips were undertaken by 137 vessels, which ranged in length from 36 feet to 106 feet.

As Table 3-42 indicates, 517,058 pounds of multispecies and 358,439 pounds of lobster were landed that were caught in the vicinity of the proposed Project in fishing year 2002. In fishing year 2003, 503,790 pounds of multispecies and 327,160 pounds of lobster were caught in the general area.

By contrast, approximately 81 million pounds of multispecies and 12 million pounds of lobster were caught in the "outside effort" area[6] in 2002, while 81,143,342 pounds of multispecies and 11,071,696 pounds of lobster were caught in the "outside effort" area in 2003. This data indicates that the port and pipeline area have yielded less than 1 percent of multispecies and roughly 3% of the lobster caught by federally permitted vessels whose landings were reported in Massachusetts in the larger surrounding area as documented by NMFS.

While this reflects an area that does not completely overlap with the footprint for the NEG data and port, it does reflect an area that is relatively close (within 5 nautical miles) to the NEG footprint. This relatively low percentage of catch within the Neptune port and pipeline area indicates that while the project area at large is a relatively productive fishing ground, closure of the project area itself for construction and operation would have a relatively minor impact overall on total landings in Massachusetts. Even if the NEG project area landings were twice as large as those in the Neptune area, the percentage of catch would still be in the range of 2-6% of landings from the larger "outside effort" area.

[5] .Statistical Area 514, which largely encompasses Massachusetts Bay, is enclosed by following coordinates: Pt 1. 52.50N, 70.48W; Pt 2. 42.50N, 9.40W; Pt 3. 42.20N, 69.40W; Pt 4. 42.20N, 70.0W; Pt 5. 41.59N, 70.0W.

[6] Defined by NMFS as the area between 70.6 to 70.61667 degrees West longitude and 42.44167 to 42.495 degrees North longitude that does not include the pipeline and LNG terminal.

Table 3-42

Monthly and Annual Landings of Multispecies, Lobster and Other Species in the Project Vicinity in Fishing Years 2002 and 2003

Area 20 (Pipeline)

Species Category	Fishing Year	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Annual
		Month												
Multispecies	2002	0	73,016	38,931	14,535	19,791	15,863	48,804	57,287	11,061	3,181	31,475	0	313,404
	2003	0	76,836	29,122	25,051	17,569	17,242	16,805	35,748	5,892	2,331	56,234	613	284,333
Lobster	2002	3,464	10,813	28,394	39,322	54,799	58,839	44,243	18,846	6,953	1,128	1,546	3,288	271,635
	2003	4,796	3,033	20,612	33,830	54,410	65,778	45,573	20,280	6,551	2,377	1,593	5,643	264,476
Other Species	2002	12,170	9,393	9,421	6,148	4,166	21,297	171,480	2,104	174	65	628	0	237,046
	2003	0	12,163	15,249	9,547	4,508	5,421	188,425	621	30	429	837	0	237,430
Area 21 (LNG Terminal)														
Multispecies	2002	0	68,556	12,074	9,844	10,228	3,200	5,892	48,443	19,315	9,659	16,443	0	203,654
	2003	0	70,625	23,221	12,197	23,319	1,612	1,082	35,470	12,433	4,604	24,894	0	219,457
Lobster	2002	2,854	1,697	806	2,263	9,964	23,484	30,070	7,114	2,867	1,970	1,571	2,144	86,804
	2003	1,728	1,950	1,454	1,323	6,196	7,490	20,586	8,747	4,735	2,223	2,503	3,759	62,684
Other	2002	3,461	20,625	4,320	2,518	2,111	19,004	169,783	4,534	1,835	0	468	0	228,659
Species	2003	0	8,822	6,452	2,691	4,297	1,530	408	1,409	425	168	628	0	26,830
Outside Effort*														
MultiSpecies	2002	7441867	8,559,920	6,177,788	5,535,155	5,773,777	5,738,461	4,878,264	6,801,864	5,684,299	5,914,735	8,902,477	9,482,788	80,891,395
	2003	6967362	9,762,735	7,636,689	6,243,138	5,286,102	5,647,279	7,061,092	6,549,947	4,826,705	5,938,325	6,158,474	9,065,484	81,143,342
Lobster	2002	528,113	902,811	1,708,267	1,808,388	1,755,998	1,789,456	1,363,770	885,735	500,097	245,027	401,288	458,234	12,347,182
	2003	492,982	723,465	1,200,265	1,727,371	1,856,561	1,530,744	1,366,382	781,888	432,652	328,141	399,175	432,070	11,071,696
Other Species	2002	22,093,08 4	37,576,11 9	39,781,26 4	45,853,81 5	35,316,18 0	28,696,65 9	32,814,43 0	22,248,99 7	21,486,824	15,892,045	19,524,323	19,989,04 1	341,272,781
	2003	30286583	32,571,49 7	54,529,01 7	45,538,45 8	25,452,88 8	29,830,87 0	33,761,33 7	30,322,88 6	29,908,983	20,339,753	11,840,720	9,438,137	352,820,929

* Defined by NMFS as the area between 70.6 to 70.61667 degrees West longitude and 42.44167 to 42.495 degrees North longitude that does not include the pipeline and LNG terminal.

**Multispecies includes species regulated under the northeast multispecies fishery management plan (Atlantic cod, haddock, yellowtail flounder, American plaice, winter flounder, white flounder, windowpane, redfish, white hake, and pollock).

***This data reflects the landings from 61 federal permits, 58 of which are from vessels registered in Massachusetts.

*** * The NMFS data cited in this table captures the activities of Federal permit holders, but may not capture the activities of State permit holders. Data listing the number of vessel trips by State permit holders could not be readily obtained.

Source: NMFS data

Table 3-43 identifies annual landings of multispecies and lobster caught by all vessels with federal permits whose catch was landed in Massachusetts. Of those landings, about 1.5 million pounds and 1.1 million pounds were landed by vessels licensed in Massachusetts in 2002 and 2003, respectively. The MDMF has established statistical areas within the territorial waters of the Commonwealth and within outlying waters, to tabulate lobster landings. The proposed NEG Port would be located in Area 19. The proposed route of the pipeline lateral passes primarily through statistical Area 3, with the northern portion of the pipeline route crossing slightly into Area 2, and the eastern end crossing into Area 19. The MDMF data indicates that roughly 10 percent to 12 percent of lobster landed in Massachusetts from state and federally permitted vessels (according to dealer data) comes from state-permitted vessels operating in Area 19.

Table 3-43

Annual Landings of All Vessels with Landings (in pounds) Reported in Massachusetts

	Fishing Year 2002	Fishing Year 2003
Multispecies	84,658,000	71,528,000
Lobster	12,471,071	11,544,322

* Defined by NMFS as the total amount of multispecies and lobster landed in Massachusetts during fishing years 2002 and 2003 .

**Multispecies includes species regulated under the northeast multispecies fishery management plan (Atlantic cod, haddock, yellowtail flounder, American plaice, winter flounder, white flounder, windowpane, redfish, white hake, and pollock).

*** The NMFS data cited in this table captures dealer data, thus it captures landings from federal and state permitted vessels.

Source: NMFS data

Table 3-44 below reflects gear types used in the Project area as well as “outside effort”. In the Project area, commercial fishing vessels with permits to fish use dredges, gill nets, hand line/rod & reel, longlines, otter trawls, crab pots, hag pots, lobster pots and purse seines. Table 3-45 provides a breakdown of gear type used in fishing years 2002 and 2003. As the table shows, otter trawls and the lobster pots were the most frequently used gear in the area; the otter trawl, which is used to capture groundfish, were used during 23 percent of vessel trips. Lobster pots were used during 36 percent of vessel trips to the area. Lobster pots and otter trawls were also the most frequently used gear types in the “outside effort” area.

Table 3-44

Number and Frequency of Usage of Various Fishing Gear in Fishing Years 2002 and 2003

	Area 20 (Pipeline)		Area 21 (LNG Terminal)		Outside Effort	
Gear Type	Number of Vessels	Frequency	Number of Vessels	Frequency	Number of Vessels	Frequency
DIVING GEAR	1	1%	0	0%	6	0%
DREDGE, SCALLOP, SEA	2	2%	2	2%	282	10%
GILL NET, DRIFT, LARGE MESH	0	0%	0	0%	3	0%
GILL NET, RUNAROUND	0	0%	0	0%	5	0%
GILL NET, SINK	21	16%	16	17%	241	8%
HAND LINE/ROD & REEL	21	16%	13	14%	893	30%
HARPOON	0	0%	0	0%	21	1%
LONGLINE,BOTTOM	4	3%	3	3%	81	3%
OTTER TRAWL, BOTTOM, FISH	29	23%	26	27%	574	20%
OTTER TRAWL, MIDWATER	1	1%	1	1%	20	1%
OTTER TRAWL, BOTTOM, SHRIMP	0	0%	0	0%	129	4%
POT, CRAB	1	1%	0	0%	4	0%
POT, FISH	0	0%	0	0%	55	2%
POT, HAG	1	1%	0	0%	4	0%
POT, LOBSTER	46	36%	34	36%	587	20%
POT, OTHER	0	0%	0	0%	3	0%
PURSE SEINE	1	1%	0	0%	8	0%
TRAP	0	0%	0	0%	7	0%
WEIR	0	0%	0	0%	5	0%
Total	128	100%	95	100%	2,928	100%

* Defined by NMFS as the area between 70.6 to 70.61667 degrees West longitude and 42.44167 to 42.495 degrees North longitude
**Includes species regulated under the northeast multispecies fishery management plan (Atlantic cod, haddock, yellowtail flounder, American plaice, winter flounder, white flounder, windowpane, redfish, white hake, and pollock).
*** Number of vessels is defined as number of vessels using a certain type of gear as their primary gear.
****The NMFS data cited in this table captures the activities of Federal permit holders, but may not capture the activities of State permit holders. Data listing he number of vessel trips by State permit holders could not be readily obtained.

Source: NMFS data

Table 3-45 identifies the number of vessels with Massachusetts commercial fishing permits using gillnets and pots/traps in the vicinity of the project by vessel size. Tables 3-46 to 3-47 list trips by fishing vessels in the vicinity of the Project area in the 2002 and 2003 fishing years. As Table 3-48 indicates, there were roughly as many vessels in the area with small vessels (i.e., Vessel Sizes I and II) as there were of large vessels in fishing years 2002 and 2003. Notably, vessels using bottom trawls, which Table 3-47 indicates is one of the most frequently used fishing gear types, are not represented in this table.

Table 3-45

Vessels Using Gillnets and Pots/Traps in the NEG Project Area Vicinity

	Gillnets		Pots/Traps	
Vessel Length	**Fishing Year 2002**	**Fishing Year 2003**	**Fishing Year 2002**	**Fishing Year 2003**
I (0-29 ft)	0	0	1	1
II (30-40 ft)	1	1	1	1
III (41-50 ft)	1	1	1	1
IV (51+ ft)	1	1	1	1
Unknown	0	1	0	0

*Defined by MDMF as Area 19
**This data does not reflect data from vessels using dragging gear (e.g., otter trawls) as this is not collected by MDMF. This data was not readily obtainable from NMFS, which collects this data.
Source: MDMF

Table 3-46

Number of Vessel Trips within the NEG Project Area (2002 and 2003 Fishing Years)*

	Species Category		
Trip Category	**Lobster**	**Multispecies**	**Other Species**
Commercial	553	591	407
Party	0	7	3
Charter	0	3	4
Total	**553**	**601**	**414**

* The NMFS data cited in this table captures the activities of federal permit holders, but may not capture the activities of state permit holders. Data listing he number of vessel trips by state permit holders could not be obtained.
Source: NMFS

Table 3-47

Number of Vessel Trips within the NEG Pipeline Lateral Area*
(2002 and 2003 Fishing Years)***

			Species Category			
Trip Category	**State**	**Port of Landing**	**Lobster**	**Multispecies****	**Other Species**	**Total Permits**
Commercial	Ma	Beverly	895	112	46	997
		Boston	1	0	0	1
		Chilmark	1	0	0	1
		Gloucester	640	723	629	1,283
		Green Harbor	0	1	0	1
		Manchester	317	5	4	322
		Marblehead	258	14	34	290
		Marshfield	0	7	1	7
		Plymouth	0	1	1	1
		Rockport	5	0	1	5
		Salem	100	0	1	101
		Scituate	2	4	2	5
		Total	2,219	867	719	3,014
	ME	Portland	0	0	1	1
		Total	0	0	1	1
	NH	Hampton	1	1	1	1
		Portsmouth	0	0	5	5
		Rye	1	1	1	1
		Total	2	2	7	7
Total commercial			2,221	869	727	3,022
Party	MA	Gloucester	0	8	8	11
		Salisbury	0	1	1	1
		Total	0	9	9	12
Total party			0	9	9	12
Charter	MA	Gloucester	0	6	1	6
		Marshfield	0	0	2	2
		Rockport	0	1	1	1
		Scituate	0	0	1	1
		Total	0	7	5	10
	NH	Portsmouth	0	1	1	1
		Total	0	1	1	1
Total charter			0	8	6	11
Total, all trip categories			2,221	886	742	3,045

* Defined by NMFS as the area between 70.61667 and 70.78333 degrees west longitude and 42.533333 and 42.45 degrees north longitude
**Includes species regulated under the northeast multispecies fishery management plan (Atlantic cod, haddock, yellowtail flounder, American plaice, winter flounder, white flounder, windowpane, redfish, white hake, and pollock).
*** The NMFS data cited in this table captures the activities of Federal permit holders, but may not capture the activities of State permit holders. Data listing he number of vessel trips by State permit holders could not be readily obtained.
Source: NMFS

Local Fishing Economy

Table 3-48 summarizes the number of fishing establishments, employees and revenues from 2001 to 2004 in each of the counties that contain municipalities in the socioeconomic region. An extrapolation of the average weekly wage figures in the table below to the year level (assuming full employment over 52 weeks per year) indicates that the lowest weekly wage in the table, that of $535/week, and highest weekly wage, that of $1,680 per week, yields a yearly income estimate range of $27,820 to $87,360.

Table 3-48

County Fishing Industry Data from 2001 to 2004

Year	County	Number of Establishments*	Total Wages	Average Monthly Employment	Average Weekly Wages
	Plymouth				
2001		11	$471,604	14	$644
2002		12	$595,592	15	$759
2003		15	$762,939	24	$616
2004		15	$869,592	27	$629
	Norfolk				
2001		6	$1,024,617	16	$1,264
2002		6	$1,111,978	15	$1,475
2003		7	$1,078,512	17	$1,251
2004		7	$989,889	11	$1,680
	Suffolk				
2001		10	$1,952,340	70	$535
2002		11	$3,185,885	93	$661
2003		11	$3,210,862	76	$814
2004		11	$3,072,886	70	$849
	Essex				
2001		115	$9,930,820	262	$728
2002		117	$11,492,515	261	$847
2003		118	$11,108,917	266	$803
2004		116	$11,347,897	262	$833

* Establishments refer to fishing companies

As shown in Table 3-49, the number of establishments and monthly employment numbers have remained relatively steady or increased slightly from 2001 to 2004. However, the fishing industry has experienced structural adjustments as a result of tightening of the regulatory environment associated with declining fish stocks. These regulations have had the effect of significantly reducing the number of commercial fishermen in the four counties in the late 1990s (see Fishing Restrictions section below). To assist fishermen, Massachusetts used U.S. Department of Labor National Emergency Grants to provide Fishermen and Families Assistance Centers. These centers, located in Gloucester, New Bedford, Cape Cod and the islands (Nantucket and Martha's Vineyard), provide fishermen with retraining opportunities and reemployment support. The alternative careers for which fishermen have been retrained at the Gloucester Center include: Able Seaman (e.g., merchant navy sailor), Sea Captain, Certified Nursing Assistant, Computer Technician, Marine Surveyor, Medical Office Administrator, Oil and Gas Technician, and Truck Driver.

Table 3-49

2002 Commercial Fishermen and Landings by Homeport (excludes seasonal licenses)

	Lobstermen		Landings (lbs)
Town	**Number**	**Rank**	**Territorial**
Beverly	42	10	441,991
Danvers	8	33	56,392
Salem	5	45	18,712
Boston	58	6	401,714
Gloucester	195	1	1,015,385
Lynn	6	42	71,420
Manchester	26	18	224,610
Marblehead	45	9	363,044
Nahant	27	16	271,014
Saugus-Revere	27	16	213,732
Swampscott	24	19	166,381
Winthrop	17	24	77,029
Total			**3,244,395**

Source: Modified from Table 5, Dean et al., 2004

Of the municipalities included in the socioeconomic region, Gloucester is the most prominent in terms of its fishing industry. In a 2001 study, Gloucester was notable in the level of fishing infrastructure as well as the embeddedness of fishing in the town's identity and economy. Boston also has significant ties to the fishing industry, though primarily in terms of support services such as seafood brokerages and transport (Hall-Arber et al., 2001).

As of June 2005, 283 vessels held federal permits that listed Gloucester as their principal port. According to this data, the Gloucester fishing community is dominated by small and medium vessels. Among those federally permitted vessels that cited Gloucester as their principal port, roughly 68 percent were small vessels less than 40 feet in length, 25 percent were medium sized vessels between 40 and 70 feet, and 6 percent were large vessels greater than 70 feet (Gloucester 2005). At the state level, small vessels in Massachusetts accounted for 63 percent of all vessels, and medium and large vessels constituted 23 percent and 14 percent respectively (NMFS, 2005).[7] Small and medium boats typically fish inshore over a 1 to 3 day period, while large boats typically fish 5 to 7 days further offshore.

Regulatory Closures and Other Fishing Restrictions

Permanent closures near the proposed NEG Port site include the Western Gulf of Maine Closure Area, which is permanently closed to multispecies fishing. Seasonal closures surround the permanent closure at various times throughout the year could include portions of the study area, which is located in Block 125. Seasonal closures were implemented by the New England Fisheries Management Council to protect stocks of Gulf of Maine groundfish from overfishing, and to allow the populations of these species to regenerate to a healthy level. Table 3-50 describes seasonal fishing closures as they relate to the Project. Figure 3-31 shows the location of Block 125 relative to the Project area.

[7] " NOAA Fisheries Northeast Region Vessel, Dealer, and Tuna Permit Data" June 15, 2005, National Marine Fisheries Services. http://www.nero.noaa.gov/ro/doc/vesdata1.htm

Table 3-50

Seasonal (Rolling) Fishing Closures

Type of Species	Dates of Closure	Location of Closure	Exemptions
Multispecies (groundfish)[a]	April 1 to May 31	Blocks 124-125 and 132-133	Closed to all fishing vessels except those vessels with federal NE multispecies permits (and fishing only in State waters); charter, party, or recreation vessels; vessels fishing with spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, mid-water and shrimp trawls, surf clam/quahog dredge gear, sea scallop dredge gear, and pelagic hook, line, longline, and gillnets.
Multispecies (groundfish)	June 1 to June 30	Blocks 124-125 and 132-133	Same as above
Multispecies (groundfish)	Oct 1 to Nov 30	Blocks 124-125	Same as above

[a] Multispecies include Atlantic cod; witch, yellowtail, winter, and windowpane flounder, American plaice, haddock, Pollock, redfish, white hake, Atlantic halibut, and ocean pout.

Source: NOAA, 2004b.

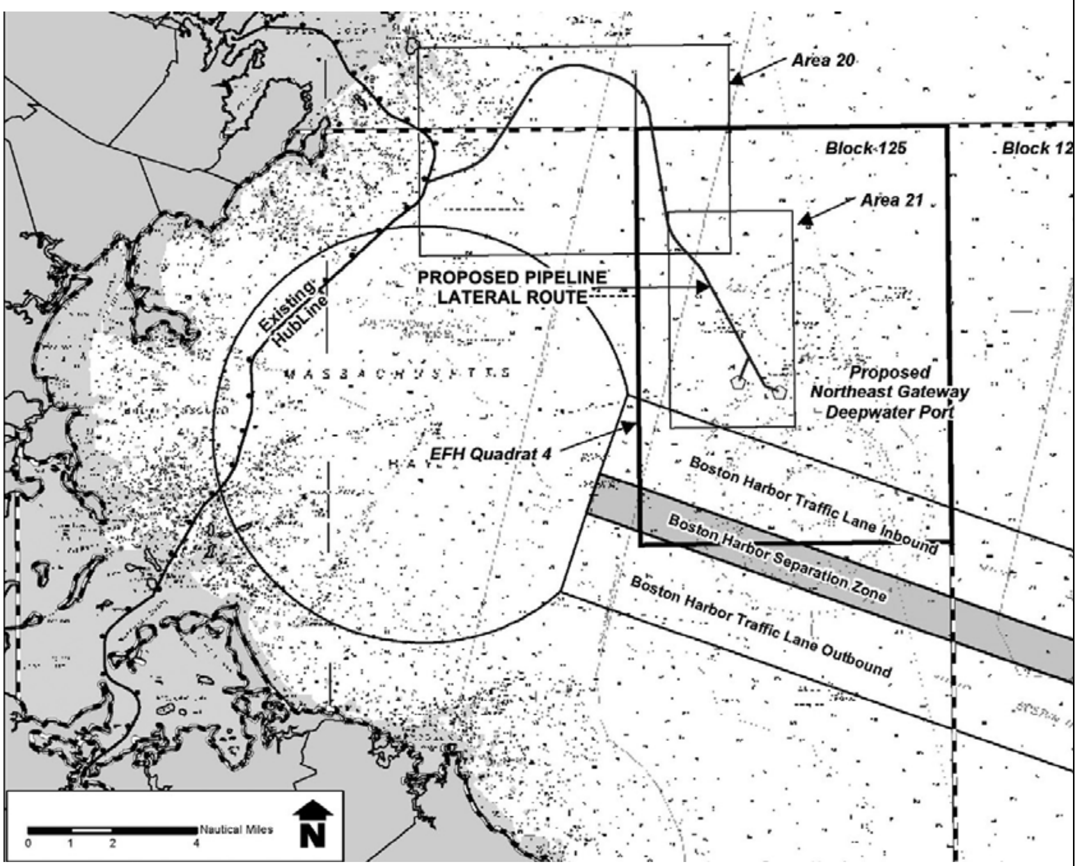


Figure 3-31. Boundaries of Block 125, Area 21, Area 20 and EFH Quadrat 4

In the Gulf of Maine Seasonal Rolling Closure Areas, seasonal closures occur from March 1 to April 30 and September 1 to November 30 every year. The southeastern portion of SBNMS is located in one of the year-round fishing closure areas. A letter of authorization is required for charter and party vessels to fish in these areas. The proposed route of the NEG Pipeline Lateral is also located in the federal Gulf of Maine/Georges Bank Inshore Restricted Roller Gear Area. In this area, the maximum diameter of any part of the trawl footrope, including discs, rollers, or rockhoppers may not exceed 12 inches (30.5 centimeters). Sea urchin dragging is exempted from mobile gear restrictions because the dragging gear does not dig into the substrate, and is therefore different from a dredge. There are no seasonal restrictions on lobstering in the vicinity of the proposed action.

In 1994, the New England Fishery Management Council imposed various restrictions to limit catch, such as species quotas, allowable types of fishing gear, and days of fishing, called Days-at-Sea (DAS) per year. Another relatively recent (1997) measure imposed on commercial fishing was the U.S. Department of Commerce's program to buy and scrap fishing vessels; approximately $25 million was spent buying and scrapping vessels that caught approximately 20% of the fish stock.

With the decline in fish stocks and structural adjustments to the industry, such as the rolling closures and the vessel buy-out program, there has been a reduction in the number of fishermen and changes in the overall fishing infrastructure in the region. These changes have affected downstream operators (e.g., wholesalers and processors), many of whom have turned to the frozen imported seafood industry for their fish supply. Commercial fishermen in Massachusetts Bay continue to be challenged by declining fish stocks and government restrictions and, as a result, many have turned to lobstering, which has not seen a similar decline to that of finfish.

The most recent proposed regulation is Framework Adjustment 42 to the Northeast Multispecies Fisheries Management Plan, which is expected to be introduced before the end of 2006. This regulatory change would limit the DAS, and counts actual time spent fishing at a rate as high as 2:1 for most of the inshore areas in the Gulf of Maine (which encompasses Massachusetts, New Hampshire and Maine). Thus, a large number of fishing vessels that operate in the regulated areas would in effect have their Days-at-Sea allotments reduced by half if this regulation is approved.

The *Analysis of Impacts* for the final proposed Framework 42 contains results from a modeling exercise of the cumulative effects of the DAS counting changes, permanent closures and rolling closures that indicates that the regulation would not affect all regulated vessels equally. At the port level, median adverse impacts on total fishing revenues exceeded 25 percent for vessels whose homeports were in Gloucester, North Shore towns, and South Shore towns. The study also indicates that the impact on vessels would also depend on vessel size. The median reduction in total revenues would be highest, 16 percent, for small vessels (less than 50 feet), while medium (50-70 ft) and large (greater than 70 ft) vessels would have median impacts on their total revenues of -12 percent and -9 percent respectively. At the 10th percentile, impacts on total revenues were as high as -44 percent, -37 percent and -21 percent for small, medium and large vessels, respectively. Finally, the study also notes that many vessels have limited range and may not be able to fish elsewhere without relocating to another homeport. Only large vessels typically have a large enough range to travel to areas that are not part of the proposed DAS counting scheme (NEFMC, 2006).[8] In short, small and medium vessels face the biggest challenges from the existing and proposed regulations.

3.8.4 Income

Of the municipalities in the socioeconomic region, Lynn had the lowest per capita income in 2000 ($17,492); and Manchester-by-the-Sea has the highest ($47,910). As noted earlier, the range in estimated yearly per capita income for fisherman is $27,820 to $87,360; thus the range of incomes for fisherman appears to be wider, with a higher maximum income, than that of individuals in the state.

As Table 3-51 shows, in 2000 roughly 75 percent of the municipalities in the region had per capita incomes that exceeded the Massachusetts state average; those that fell under the state average include Boston, Gloucester, Lynn, Salem and Weymouth. All but three of the municipalities have poverty rates that are lower than that of the state; exceptions include Lynn, Salem and Boston.

Table 3-51

Income and Poverty Data for the Project Area Municipalities

	Household Median Income	Family Median Income	Per Capita Income	Median Male Income	Median Female Income	Below Poverty Level
Massachusetts	50,502	61,664	25,952	43,048	32,059	9.3
Beverly	53,984	66,486	28,626	45,348	35,659	5.7
Boston	3,629	44,151	23,353	37,435	32,421	19.5
Cohasset	84,156	100,137	42,909	79,045	41,397	2.8
Gloucester	47,722	58,459	25,595	41,465	30,566	8.8
Hingham	83,018	98,598	41,703	66,802	41,370	3.5
Hull	52,377	62,294	26,331	43,030	34,738	8.3
Lynn	37,364	45,295	17,492	34,284	27,871	16.5
Manchester-by-the-Sea	73,467	93,609	47,910	68,466	37,981	4.8
Marblehead	73,968	99,892	46,738	70,470	44,988	4.3
Nahant	64,052	76,926	41,807	52,045	46,522	2.6
Quincy	47,121	59,735	26,001	40,720	34,238	7.3
Salem	44,033	55,635	23,857	38,563	31,374	9.7
Scituate	70,868	86,058	33,940	60,322	40,200	2.6
Swampscott	71,089	82,795	35,487	56,541	38,690	3.7
Weymouth	51,665	64,083	24,976	42,497	35,963	5.8
Winthrop	53,122	65,696	27,374	42,135	36,298	5.5

Source: US Census, 2000

3.8.5 Tax Revenue

Information on tax revenues for municipalities within the project area is presented in Table 3-52. Tax rates were highest in Revere (14.15 percent) and lowest in Nahant (7.26 percent). Total tax revenues ranged from $9 million n Nahant to $1.9 billion in Boston. Total expenditures ranged from $8.2 million in Marblehead to $2.7 billion in Winthrop.

[8] *Framework Adjustment 42 to the Northeast Multispecies Fishery Management Plan And Framework Adjustment 3 to the Monkfish Fishery Management Plan Including an Environmental Assessment Regulatory Impact Review Initial Regulatory Flexibility Analysis* Prepared by the New England Prepared by the New England Fishery Management Council in consultation with the Mid-Atlantic Fishery Management Council National Marine Fisheries Service, April 21, 2006.

Table 3-52

Tax Rates, Total Revenues, and Total Expenditures for Municipalities

Municipality	2004			2003	
	Number. of Single-Family Parcels	Tax Rate	Average Single-Family Tax Bill	Total Revenues	Total Expenditures
Beverly	8,251	10.92	4,703	91,850,203	79,617,322
Boston	No Data	No Data	No Data	1,918,208,865	1,826,508,429
Cohasset	2,217	11.89	7,396	30,916,979	25,717,519
Gloucester	7,123	9.61	3,928	77,225,406	66,097,590
Hingham	6,040	10.68	5,469	61,080,684	52,826,786
Hull	3,656	10.07	3,535	31,801,947	26,578,483
Lynn	11,172	11.43	2,618	229,180,669	15,129,149
Manchester-by-the-Sea	1,500	7.26	6,535	17,563,858	43,924,694
Marblehead	6,096	8.48	5,011	52,025,600	8,231,280
Nahant	1,101	8.44	3,961	9,045,189	198,808,362
Quincy	13,614	12.56	3,639	222,710,032	86,535,670
Revere	4,587	14.15	2,580	99,008,817	89,063,229
Salem	4,730	11.71	3,413	102,374,665	37,374,191
Situate	6,507	10.00	4,040	47,540,467	34,997,697
Swampscott	3,378	12.12	5,496	40,155,052	99,119,264
Weymouth	13,034	12.69	2,693	122,515,073	30,970,256
Winthrop	2,258	10.46	3,157	38,740,900	2,721,499,921
State Totals	**1,280,537**	**12.46**	**3,300**	**16,721,962,244**	**79,617,322**

Source: Massachusetts Department of Revenue, Division of Local Services, Municipal Data Bank (2005)

3.8.6 Public Services

All of the major cities and towns within the project area have police and fire departments. The Maritime Incident Resources Training Partnership was formed to train local fire departments in emergency maritime incident procedures (USCG, 2005). Local authorities are responsible for maintaining the capability to fight fires involving vessels at waterfront facilities. The Safety/Special Operations Unit of the Boston Fire Department includes a specially trained 19-member SCUBA team that is equipped to respond to waterborne fires.

The USCG and auxiliary units assist in fighting major onboard fires and at waterfront sites when necessary, but are not a primary fire responder. Under the provisions of the Ports and Waterways Safety Act of 1972, the role of the USCG is to respond to all fires and distress calls, with fire suppression activities focused on saving lives, not property.

3.9 TRANSPORTATION

This section describes transportation resources and activities in the vicinity of the proposed action, focusing primarily on marine traffic, and primarily on traffic that transits the area. Marine traffic includes commercial fishing vessels, commercial deep-draft vessels, charter boats (small passenger vessels for hire), and recreational vessels.

This section considers marine traffic from the ports and harbors along the shoreline of Massachusetts Bay closest to the NEG Project area, the waters of Massachusetts Bay extending east to the boundary of the SBNMS, Gloucester to the north, and on the south to the edge of the in-bound Boston Harbor TSS Lane. Transportation resources in and around onshore loadout facilities to be used for the NEG Project are also be discussed herein.

3.9.1 Regional Transportation Network

Boston and the surrounding area has a robust transportation network that includes a regional network of highways and major arterials, mass transit, and air service. Major arterial roads serving coastal communities include Routes 3 and 95, parts of which run parallel to the coast, and provide access to areas surrounding Massachusetts Bay including three intermodal, waterborne freight facilities in Gloucester, Salem, and Boston Harbors.

Public transportation within eastern Massachusetts is provided by the Massachusetts Bay Transportation Authority (MBTA). The MBTA provides commuter rail, rapid transit, light rail, water ferry, and bus service to 175 communities in eastern Massachusetts. The system includes "four subway lines, thirteen commuter rail lines, five boat routes, and 170 bus routes" (MBTA, 2005). The regional commuter rail system also operates along the coast of Massachusetts Bay, serving most of the communities from Rockport to Plymouth.

Year-round commuter boat service is provided by the Massachusetts Bay Transportation Authority and other private operators that carry over 5,000 passengers daily (EOTC, 2001). Services connect Boston's Inner Harbor and Logan Airport to the communities of Hingham, Hull, and Quincy, as well as provide transportation within the Inner Harbor. During the summer months, water passenger services increase with the availability of additional ferry services from Boston to Gloucester and Provincetown and within Boston Harbor to the Harbor Islands. The Port of Boston's Black Falcon Terminal, which serves as a homeport and port-of-call for cruise ships, was visited in 1999 by 73 ships with international destinations including Europe, the Caribbean, Nova Scotia, Newfoundland, and Bermuda (EOTC, 2001).

3.9.2 Commercial and Recreational Boating Traffic

The main ports and harbors near the NEG Project area include Scituate, Cohasset, Boston, Lynn, Marblehead, Salem and Gloucester. Each is described below.

3.9.2.1 Harbors

Scituate Harbor

Scituate Harbor is primarily a recreational and summer-use port, home to recreational deepwater fishing charter boats, several whale watching vessels, and numerous pleasure boats. Scituate also supports a small fleet of working commercial fishing vessels.

Cohasset Harbor

Cohasset contains a small harbor that is used primarily by year-round and summer residents. In addition to its large private recreational fleet, the harbor also supports a small coastal lobster fleet, ranging in size from small skiffs to 40-foot (12-meter) lobster boats. Currently, Cohasset Harbor can support approximately 469 vessels with 244 moorings and 225 slips and has a maximum allowable vessel length of 45 feet (14 meters).

Port of Boston

The Port of Boston, the largest seaport in Massachusetts, currently handles more than $8 billion worth of goods, employs over 9,000 people, and is the largest handler of container cargo in New England, shipping and receiving 1.2 million tons each year (NEG, 2005a). More than 25 container shipping lines connect the Port of Boston with the world's major markets.

While fishing-related business is dwarfed by other commerce in Boston, fishing is nonetheless significant for its importance in serving dispersed, smaller communities throughout Massachusetts Bay and New England that are more directly dependent upon fishing and fishing-related businesses. Boston remains an essential provider of fishing-related support services. The Port of Boston is also a center for the international transshipment of fishery products throughout New England. The only other major point of transshipment in this region is New York City. However, Boston is more central to the overall flow of produce, and boasts a large number of seafood brokers as well as larger seafood companies with fleets of trucks and major facilities.

Small passenger vessels, sightseeing, and charter fishing boats, account for a significant amount of traffic in and around the Port of Boston. In 2002, the ACOE reported over 19,000 trips by passenger boats with less than 18 feet (5 meters) of draft (ACOE, 2002).

Lynn Harbor

Lynn Harbor accommodates approximately 300 recreational vessels, 60 small commercial vessels, and 10 commercial passenger ferries. According to the harbormaster, 40 percent of vessel traffic is commercial with the remaining 60 percent recreational uses. Traffic density is seasonal, with a dramatic increase for both commercial and recreational vessels starting mid-April and continuing through the beginning of November. Ten percent of the commercial fishing vessels transit the harbor on the average of twice daily in season and once daily during the off-season.

Recreational activity is heavy during the season, with the local yacht clubs hosting many events including fishing tournaments, regattas, and rendezvous. Recreational vessels cruise between Portsmouth, New Hampshire and Cape Cod Bay. Commercial fishing vessels use a similar pattern to the recreational vessels including the route to Stellwagen Bank. Passenger vessels are primarily charter boats that cruise the waters from Lynn, to Minot's Light to the South and Cape Ann to the North, often traveling to and from Stellwagen Bank for cruising, fishing, or whale watching.

Marblehead and Salem Harbors

Marblehead Harbor is primarily a recreational, summer-use port with various size vessels, ranging from a 13-foot (4-meter) Boston whaler to a 100-foot (30-meter) motor yacht. The harbormaster issues 2,200 mooring permits annually. A large number of boaters day sail from Marblehead Harbor throughout the spring, summer, and fall. During these seasons, sailboat races are held every weekend in the waters outside of the harbor. According to the harbormaster, approximately 30 commercial fishermen work out of Marblehead Harbor 10 months of the year.

Salem Harbor is primarily used for recreational purposes with limited commercial traffic delivering coal and petroleum products to the Salem Power Plant. There are 1,400 registered moorings in Salem Harbor. Within Salem Sound (which includes Salem Harbor and neighboring Danvers and Marblehead harbors), there are 10,000 recreational boats. Various yacht clubs within Salem Sound hold races and regattas throughout the spring, summer, and fall.

Gloucester

Gloucester Harbor, marked on its eastern side by Eastern Point Light, contains an outer and inner harbor, the former having depths generally of 18 to 52 feet (5.5 to 7.5 meters), and the latter depths of 15 to 24 feet (4.5 to 16 meters). Future plans include dredging the entire harbor to 26 feet (8 meters) at mean low water; renovating the Gloucester State Pier; and increasing ship berths and capabilities. The harbor has two 300-foot (91-meter) vessel berths, one 600-foot (183-

meter) berth, and one 800-foot (244-meter) berth. Available deep draft of 20 to 24 feet (6 to 7 meters) alongside the piers at mean low water and vessels of up to 300 feet (91 meters) in length can be accommodated (NEG, 2005a).

According to the harbormaster, there is a 250-boat fishing fleet in the harbor and occasionally boats from other ports call to Gloucester (NEG, 2005a). Depending on the season, harbor use is approximately 40 percent commercial and 60 percent recreational. In recent years, commercial cruise ships have begun calling at Gloucester Harbor. During peak season, six different whale watching companies operate out of the harbor.

Sixty to seventy groundfish boats were located in Gloucester in the summer of 1999, perhaps 15 percent of which lobster in the summer. Seventy-five to 80 lobster boats fish in federal waters, and approximately 50 to 60 boats fish in state water. Estimates of numbers of lobster harvesters vary widely ranging from 250 to 300 for Gloucester, and 400 to 800 for greater Cape Ann (including Gloucester, Beverly, and Essex). The midwater fleet consists of four to six vessels that fish for herring.

3.9.2.2 Commuter Ferry and Water Taxi Routes

There are no commuter ferries or water taxi routes within close proximity to the proposed NEG Port or pipeline (Gifford, 2005; Caulkett, 2005). All of these boat trips are near-shore activities and are not located in the Project area.

3.9.3 Commercial Shipping Traffic

Large commercial ships including tankers, container ships, dry bulk carriers, roll on-roll off (Ro-Ro) ships, gas carriers (including LNG carriers), and passenger ships make calls in the Port of Boston. Boston Harbor is home to the Conley terminal for cargo shipments and the Moran terminal, used for automobile imports. These two terminals handle more than 1.3 million tons of general cargo, 1.5 million tons of nonfuels bulk cargo and 12.8 million tons of bulk fuel cargos yearly. Gas carriers represent a substantial trade for the Port of Boston, and, Boston is one of the largest ports in the United States for receiving LNG.

The Black Falcon Cruise terminal, in the Boston Marine Industrial Park, served more than 210,000 cruise passengers in 2005. With more than 100 passenger ship calls in the 2005 season, Cruiseport Boston is now considered one of the fastest growing high-end cruise markets in the country. Cargo and cruise ship use the Boston Harbor Traffic Separation Scheme (TSS) (See Section 3.9.4) for travel into and out of the Port of Boston.

Large tugs and barges use Boston Harbor for deliveries of petroleum products and transit the port area enroute to ports to the north of Boston. Smaller tug and barge units are also employed to carry petroleum products within the Port of Boston. Tugs and barges also move dredged material from the Port of Boston and other nearby ports to the MBDS about 20 miles from the entrance to Boston Harbor.

Non-self propelled vessels, or barges, as well as the tugs that are used to provide motive power, are another source of traffic in and around the Port of Boston. Petroleum barges transiting from mid-Atlantic refineries to the Boston area and other Northeast ports comprise a large segment of the marine traffic in the area. Tugs and barges transporting dredged material from Boston Harbor and other nearby ports also add to the traffic mix. Approximately one barge per day transports dredged material from Boston Harbor to the MBDS.

Table 3-53 outlines the industrial and commercial vessel traffic in Massachusetts Bay on an annual basis (Massport 2006, Neptune 2006).

Table 3-53

Marine Traffic in Massachusetts Bay

Vessel Type	Number of One-Way Trips per Year (estimated)
Large Commercial Vessels (e.g., Container, Cruise, Bulk, and Tanker)	3,131
Medium commercial Vessels (e.g., Tugs)	7,000 *
Small Commercial Vessels (e.g., Whale Watching, Fishing "Party" Boats)	260,000
Large Commercial Fishing Vessels	10,000
Very Small Commercial Fishing Vessels/Recreational Vessels (40-225 horsepower engine)	2.65 Million
Other (e.g., Government, Military)	Unknown **

* Includes harbor escort tugs
** Government/Military vessel operations are not publicly tracked.

Source: Neptune, 2005

3.9.4 Existing Traffic Lanes and Navigation

3.9.4.1 Navigation Channels

Within Massachusetts Bay, commercial shipping vessel traffic consists primarily of vessels arriving at and departing from Boston Harbor via the Boston TSS (Figure 3-32) Large commercial ships arriving at and departing from Boston Harbor generally use the voluntary TSS. With the exception of the TSS, vessels operating in the vicinity of the Port of Boston are unencumbered with regard to track.

The TSS provides directed traffic lanes 2 miles (3.2 kilometers) wide each for inbound and outbound ship traffic, separated by a 1-mile (1.6 kilometer) wide separation zone. Ships operating in the TSS are expected to maintain their track within the appropriate lane. However, use of the TSS is voluntary and its presence does not alter the obligations on the part of vessels operating within the TSS to adhere to the appropriate Navigation Rules. For example, vessels operating along one of the traffic lanes are required give way to crossing vessels as appropriate and as prescribed by the Navigation Rules.

The TSS extends from the precautionary zone off Boston Harbor, approximately 42 miles (68 kilometers) east to a point off the tip of Cape Cod, and then another 125 miles (201 kilometers) along the eastern side of Cape Cod to the great south channel southeast of Nantucket Island. The Boston Harbor precautionary area, 5 miles (8 kilometers) in radius centered on Boston Lighted Horn Buoy B, is at the juncture of the inbound and outbound lanes on the approach to Boston Harbor (U.S. Coast Pilot, Chapter 11). Ships approaching Boston Harbor from the southeast typically head for the TSS at their earliest opportunity near Cape Cod. Ships arriving from the northeast and east typically make directly for the precautionary area. Ships routinely anchor in this area when awaiting entry into the harbor or good sailing weather for departure.

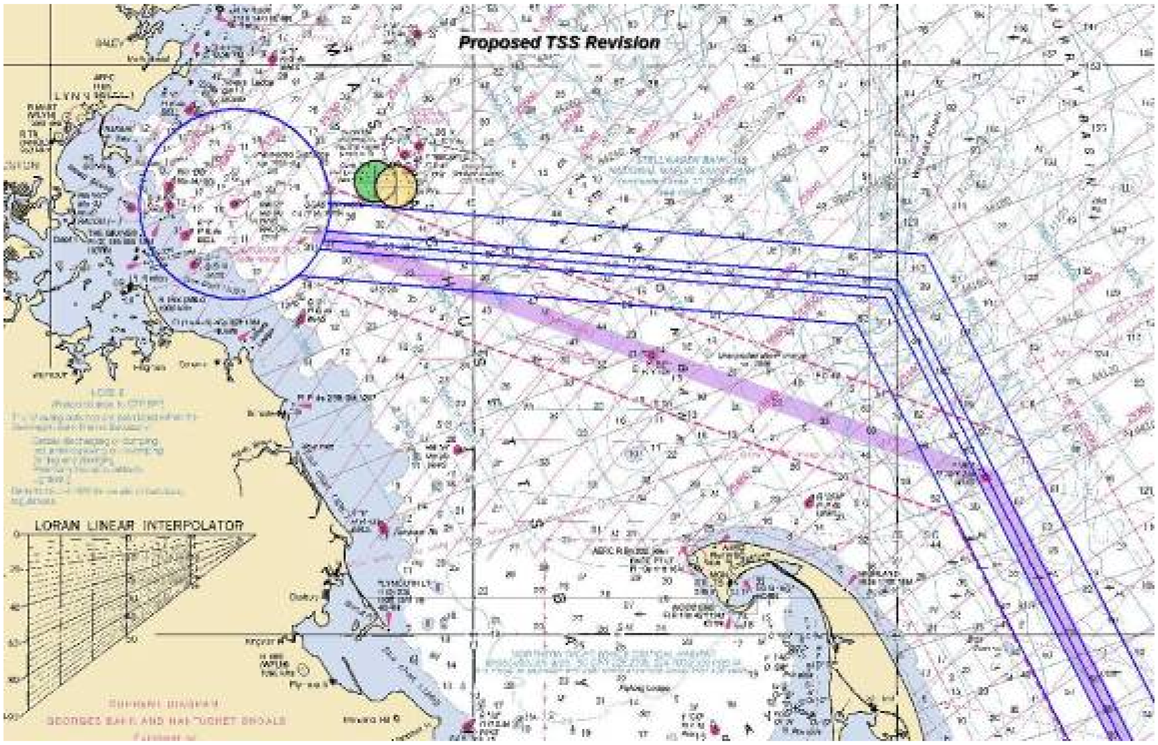


Figure 3-32. Existing Boston Harbor TSS (red/purple) and Proposed Shift in TSS Alignment (blue)

The TSS lanes carry upwards of 2,700 commercial vessels and barges through Massachusetts Bay to Boston each year (NOAA, 1993). Table 3-53 (above) shows the type and annual number of vessel transits of Massachusetts Bay. About half of the large commercial vessels carry liquid petroleum products, with the rest carrying bulk materials and automobiles. There does not seem to be any marked seasonal pattern to vessel traffic. Cruise ships, research ships, and military vessels also traverse the Gulf of Maine to Boston Harbor and Cape Cod (NOAA, 1993).

The proposed NEG port is not located within any designated commercial shipping lanes, and there are no NOAA navigational buoys in the area of the proposed action (NOAA chart Nos. 13274 and, 13275). The seaward end of the proposed action is about 1.4 statute miles (1.2 nautical miles) north of the inbound shipping lane to Boston Harbor at its closest point, and is approximately 3.0 statute miles (2.6 nautical miles) east of the Boston Harbor Precautionary Area.

There are currently no prohibited navigation areas in the vicinity of the NEG port (e.g., north of the Boston Harbor inbound TSS lane).

Changes have been proposed to modify the alignment of the Boston Harbor TSS and to establish limitations on certain vessels operating in the vicinity off Race Point and the Great South Channel (Sub-committee on Safety, 2006). These changes are part of an effort to reduce the high number of vessel strikes of whales, specifically North Atlantic right whales. This proposal must be formally evaluated prior to approval. The proposed TSS revision is shown in Figure 3-32.

3.9.5.2 Anchorage and Lightering Areas

The NEG port is outside of designated anchorage areas (NOAA Navigation Chart Nos. 13274 and 13275). The pipeline lateral is located seaward of all designated mooring areas associated with Salem, Beverly, Gloucester and other nearby harbors along the north shore (Gifford, 2005; McPherson, 2005; Caulkett, 2005).

There are no designated lightering areas in the vicinity of the proposed action. Lightering is described as at-sea ship-to-ship transfer of petroleum products, materials or other matter. It is performed in order to transfer petroleum products to smaller, shallower draft vessels that are able to enter harbors that are not able to accommodate larger commercial vessels.

In Salem Harbor, vessels unload their product at the wharf or on rare occasions, within Salem Sound outside of the NEG port and pipeline lateral construction area. Most vessels visiting the Salem Harbor Generating Station approach Gloucester Harbor to the north first for escort by a coastal pilot. These ships may periodically anchor offshore of Eastern Point in Gloucester (Gifford, 2005; Caulkett, 2005; Blair, 2005) awaiting high tide for proper access to Salem harbor. Oil barges coming from Cape Cod typically travel straight for Newcomb's ledge, and would cross the pipeline route (Blair, 2005).

3.9.5.3 Marine Casualties and Significant Marine Events in the Port of Boston

Table 3-54 shows recorded significant marine casualties inside the Port of Boston. In 1998, there was a collision between the Canadian Naval Ship *HMCS Glace B*ay and the *Matthew John* approximately 5 miles from the port element of the proposed action. Aside from this reported incident, no casualties had been reported to the Coast Guard in the vicinity of the proposed action according to a review of the USCG Marine Information System for Safety and Law Enforcement data for casualties around Boston Harbor and approaches.

Table 3-54

Recorded Marine Casualties in the Port of Boston

Type of Casualty	Vessel Name	Date
Collision	S/T Ventura and F/V Lynn	November 1951
Structural Failure	T/V Pendleton	February 1952
Explosion	Harold Reinauer	May 1952
Collision	Esso Chattanooga and F/V Albatross	June 1952
Explosion	M/V Black Falcon	November 1953
Grounding	SS Pilgrim Belle	June 1955
Grounding	M/V Global Hope	February 1978
Collision	M/V Posa Vina	June 2000

Source: NEG, 2005a

3.10 AIR QUALITY

Air quality in a given region is determined by measuring ambient concentrations of criteria pollutants. Air pollutant emissions are regulated by the EPA and delegated state agencies under the federal CAA. Pursuant to the CAA, the EPA has established NAAQS for six pollutants: carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (0_3), particulate matter (PM) (including particulates equal to or less than 10 microns in diameter (PM_{10}) and particulates equal to or less than 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb).

These pollutants are referred to as "criteria pollutants." The NAAQS were set at levels the EPA believed were necessary to protect human health (primary standards) including the health of "sensitive" populations such as asthmatics, children, and the elderly and public welfare (secondary standards) including protection against visibility impairment, damage to animals, crops, vegetation, and buildings. The state of Massachusetts has adopted all of the NAAQS. Table 3-55 summarizes the primary and secondary NAAQS.

When measured concentrations of regulated pollutants exceed the NAAQS, the area in which the exceedance occurred is designated "nonattainment" for that NAAQS. All other areas with measured concentrations below the NAAQS are designated "attainment" and areas with no measurements that are presumed to be in compliance with the NAAQS are designated as "unclassifiable."

Table 3-55

National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Period	NAAQS Primary ($\mu g/m^3$)	NAAQS Secondary ($\mu g/m^3$)
PM_{10}	Annual [a]	50	50
	24-Hour [b]	150	50
$PM_{2.5}$	Annual [c,d]	15	15
	24-Hour [e]	65	--
Sulfur Dioxide	Annual [f]	80	--
	24-Hour [g]	365	--
	3-Hour [g]	--	1300
Nitrogen Dioxide	Annual [f]	100	100
Carbon Monoxide	8-Hour [g]	10,000	10,000
	1-Hour [g]	40,000	40,000
Ozone	8-hour [h]	157	157
Lead	3-Month [i]	1.5	1.5

Notes: $\mu g/m^3$ = micrograms per cubic meter
ppm = parts per million
a Not to be exceeded by the expected annual arithmetic mean at each monitor within an area.
b Expected number of exceedances must be less than or equal to one each year (on average) over a 3-year period.
c Not to be exceeded by the 3-year average of the annual arithmetic means.
d Spatially averaged over designated monitors.
e Not to be exceeded by the 3-year average of the 98th percentile of 24-hour concentrations at each population oriented monitor in an area.
f Not to be exceeded by the annual arithmetic mean.
g Not to be exceeded more than once per year.
h Not to be exceeded by the 3-year average of the 4th highest daily maximum 8-hour averages at each monitor within an area.
i Not to be exceeded by the quarterly average.

3.10.1 Regional Climate

The Project site is in the mid-latitude region of North America with moderate winters and warm summers. The greater Boston area and Project site are dominated by the influence of the Atlantic Ocean; land and sea breezes have a moderating effect on summer and winter temperature extremes. During the summer months, the prevailing southerly winds bring warm moist air from the south while during the winter months the prevailing northwesterly winds bring cold arctic air to the region. The Boston area has a daily winter to summer temperature range from -18˚F to 103˚F, with a mean annual temperature of 51.6˚F and the area receives between 3 and 4 inches of precipitation each month on average, with an annual average snowfall of 42.53 inches. The most commonly reported storm events in the Greater Boston area are thunder storms with winds commonly in excess of 50 knots (57.5 miles per hour).

3.10.2 Existing Ambient Air Quality

Existing ambient air quality is protected by EPA's New Source Review (NNSR and PSD) regulations/program established from Title I for the federal CAA.

The Nonattainment New Source Review (NNSR) program is intended to improve existing air quality in nonattainment areas were measured concentrations of regulated pollutants exceed the NAAQS. Non-attainment NSR requires among other things that sources locating in non-attainment areas install the most effective controls and offset their emissions of non-attainment pollutants. Massachusetts is designated a non-attainment for ozone and is part of the OTR. Therefore, all major sources of ozone precursors (NOx and VOCs) in Massachusetts are considered nonattainment pollutants that may be subject to major NNSR permitting requirements for major sources of these pollutants.

The Prevention of Significant Deterioration (PSD) program is intended to preserve the existing air quality in attainment areas where pollutant levels are below the NAAQS. PSD regulations impose specific limits on the amount that new or modified stationary sources may contribute to existing air quality levels. The program established a set of increments of new air pollution that would be allowed over a baseline level. The increments were set for Class I, Class II, and Class III areas, although no areas were ever established as Class III. The Class I increment provides only a small increase over baseline, Class II a moderate increase, and Class III a greater increase. The CAA also established certain federal lands as mandatory Class I areas. Class I areas were selected in part because air quality was considered a special feature of those areas and the Class I designation protected those values by establishing a very small increment for future deterioration by new sources. While there are no Class I areas in Massachusetts, there are six Class I areas in Northern New England within 249 miles (400 kilometers) of the NEG project site. However, only one (the closest) of these Class I areas is within 124 miles (200 kilometers) of the Project site: the Presidential Range – Dry River Wilderness Area, in New Hampshire (approximately 196 kilometers from the Project site). A Class I increment analysis must be conducted if air quality modeling results in modeled ambient air concentrations above the USEPA Class I significance thresholds.

Air quality monitors are not in place in the Project area, which extends from about approximately 3 miles (4.8 kilometers) to the east of Marblehead Neck in Marblehead, Massachusetts (Pipeline Lateral) to approximately 13 miles (21 kilometers) off the coast of Massachusetts (Port). However, for the purpose of an environmental assessment, nearby onshore monitoring sites were used to conservatively characterize existing conditions. In most cases, the onshore data (excluding ozone) would include influences from nearby commercial, industrial, and vehicle activity that would have minimal impact on the Northeast port, 13 miles (21 kilometers) off the coast. The air quality data for each criteria pollutant selected as being most representative of the Project site are presented in Table 3-56. This table also shows the NAAQS and Massachusetts Ambient Air Quality Standards (MAAQS) that has been set as both primary and secondary air quality standards so as to be protective of health (primary standards) as well as welfare such as visibility and soiling (secondary standards).

As shown in Table 3-56, the estimated ambient air concentrations (background level) at the onshore stations closest to the Northeast port are below the NAAQS and MAAQS for all criteria pollutants except ozone. Four sites were selected to bracket the ozone concentrations representative of the proposed Project site: the Long Island site in Boston Harbor; the wastewater treatment plant in Lynn, Massachusetts; the Sunset Boulevard site in Newbury, Massachusetts; and Ocean Avenue in Kennebunkport, Maine. All four sites demonstrate similar 1-hour and 8-

hour concentrations demonstrating the regional nature of ozone. Of the 3 years of data, 2002 was the highest at these and other sites throughout the region. The data shown in Table 3-57 demonstrate that each of the sites is either meeting or close to meeting the 1-hour ozone NAAQS; however, each of the sites shows expected exceedances of the 8-hour standard. Massachusetts has been designated as moderate nonattainment for the 8-hour ozone standard, effective June 15, 2005.

Table 3-56

Existing Ambient Air Quality for the NEG Project Area

		Concentrations/Number of Exceedances										
						2002 Conc		2003 Conc		2004 Conc		
Pollutant	Monitor	Avg. Time	Units	NAAQS	MA AAQS	#	> Std	#	> Std	#	> Std	Back-ground Level[b]
PM_{10}	One City Square, Charlestown/ Boston	24-Hr (Max)	µg/m^3	150	150	69	0	61	0	68	0	69
		Annual	µg/m^3	50	50	30	0	25	0	25	0	30
$PM_{2.5}$	One City Square, Charlestown/ Boston	24-Hr (Max)	µg/m^3	65	65	54	0	48	0	42	0	54
		Annual	µg/m^3	15	15	13.4	0	12.4	0	12.8	0	13.4
SO_2	Long Island Boston Harbor	3-Hr	µg/m^3	0.5	0.5	0.027	0	0.035	0	0.021	0	0.035
		24-Hr	µg/m^3	0.14	0.14	0.014	0	0.019	0	0.004	0	0.019
		Annual	µg/m^3	0.03	0.03	0.004	0	0.004	0	0.004	0	0.004
NO_2	Long Island Hospital Road/ Boston	Annual	µg/m^3	0.053	0.053	0.012	0	0.009	0	0.007	0	0.012
CO	Kenmore Square Boston	1-Hr (Max)	µg/m^3	35	35	2.8	0	2.1	0	2.2	0	2.8
		8-Hr (Max)	µg/m^3	9	9	1.6	0	1.7	0	1.3	0	1.7
Pb	Kenmore Square Boston	Quarterly Mean	µg/m^3	1.5	1.5	0.02[a]	0	0.04[a]	0	0.02[a]	0	0.04
O_3	Long Island Hospital Road/ Boston	1-Hr (Max)	ppm	0.12	0.12	0.138	3	0.12	0	0.12	0	0.138
		8-Hr (Max)	ppm	0.08	0.08	0.128	10	0.102	1	0.102	0	0.128
	Wastewater Treatment Plant, Lynn	1-Hr (Max)	ppm	0.12	0.12	0.152	2	0.118	0	0.118	0	0.152
		8-Hr (Max)	ppm	0.08	0.08	0.123	13	0.1	3	0.1	2	0.123
	Sunset Blvd. Newbury	1-Hr (Max)	ppm	0.12	0.12	0.148	2	0.117	0	0.117	0	0.148
		8-Hr (Max)	ppm	0.08	0.08	0.126	9	0.099	2	0.099	2	0.126
	Ocean Ave Kennebunk-port, ME	1-Hr (Max)	ppm	0.12	0.12	0.136	5	0.109	0	0.109	0	0.136
		8-Hr (Max)	ppm	0.08	0.08	0.121	10	0.093	2	0.086	1	0.121

a Based on the highest quarterly value for each year
b Assumed to be the maximum value of the three years

3.11 NOISE

There are a wide variety of existing land uses and population densities along the coast that affect in-air sound levels. The lowest ambient sound levels range from about 30 to 50 dBA depending on the population density. This range corresponds to nighttime sound levels that occur at quiet rural locations through urbanized areas. Daytime ambient levels are higher. Other factors that increase ambient sound levels are: elevated wind speeds, surf pounding on the shore, motor vehicle traffic, and other human activities. In-air baseline sound levels on the water (on a boat or water craft) are generally higher than on land, due to boat engine and sail noise as well as the sound of the boat interacting with the waves. A conservative minimum range typically found onboard is 50 to 70 dBA.

Although ocean currents, sea animals, ship traffic, and low-level seismic activity create some underwater noise, ambient underwater noise is most directly correlated to atmospheric wind and the resulting wave action, but can also be strongly dependent on the physical characteristics of the area including water depth, ocean bottom topography, and the proximity to both the shore and active shipping lanes. Existing sound levels at the NEG Port site were estimated to range from 103 to 117 dBA depending on wind speeds and sea turbulence conditions. The lower value corresponds to calmer sea conditions.

Considering typical non-urban ambient sound levels measured at isolated coastal locations on Cape Cod, existing sound levels at the closest coastal sensitive areas are expected to be in the range of 27 to 70 dBA as L_{90} and 35 to 73 dBA for L_{eq} (Cape Wind 2000). The wind variation is primarily due to wind speed and direction. The lowest levels occur late at night under calm conditions when there is no wind, wave, or motor vehicle sounds at the coast. Higher levels occur during the day when these sound sources are present. Onshore winds produce higher background sound levels due to promotion of additional wave action at the shoreline.

For offshore ambient sound levels, data from two buoys in Nantucket Sound, collected for the Cape Wind Energy Project, reveal ambient sound levels from 35 to 37 dBA for L_{90} and 46 to 51 dBA for L_{eq} in open waters during light wind conditions.

Table 3-57 presents typical sound levels for common conditions or activities referenced to the dBA scale.

Table 3-57

Typical Sound Levels for Common Conditions and Activities

Condition or Activity	Noise Level
Loud Rock Band	110 dBA
Diesel Truck at 50 feet	85 dBA
Vacuum cleaner at 10 feet	70 dBA
Daytime Urban Area	55 dBA
Nighttime Suburban Area	45 dBA
Quiet Bedroom at Night	30 dBA

4.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND ACTION ALTERNATIVES

This section presents an analysis of potential direct and indirect impacts that the proposed action and each alternative would have on the affected environment as characterized in section 3.0. The discussion in each section is broken down by Project phase and component (e.g., Port or Pipeline Lateral). In sections where impacts do not differ between the two components of the Project, the discussion of impacts is combined for the Port and Pipeline Lateral.

Unless otherwise stated in the text, the following terms are used in this section:

- **Project Area** – the area to be specifically disturbed by offshore NEG Port and Pipeline Lateral construction, including the anchor spread for the plow barges (pipeline construction);
- **NEG Port area** – the footprint of the area to be specifically disturbed by offshore NEG Port construction, but doesn't include the Pipeline Lateral;
- **Pipeline Corridor** – the area to be disturbed by pipeline construction including the anchor spread for the plow barges; and
- **NEG Project Region** – the greater area including Massachusetts Bay and coastal communities bordering on Massachusetts Bay from Scituate, Massachusetts on the south to Gloucester, Massachusetts on the north.

Impacts are identified as follows:

Short-term or Long-term Impacts. Short- or long-term impacts do not refer to any defined time period. In general, short-term impacts are those that occur only for a limited period or only during the time required for construction or installation activities. A ban on fishing over the pipeline corridor during pipeline construction is a short-term impact that is strictly limited to the construction period. Long-term impacts are those that are likely to occur on a regular or permanent basis. Several impacts associated with ongoing operations of the proposed Project could occur for the life of the facility's license to operate. For example, a ban on non-port vessel access into the security zone around the Port would occur for the entire period of operation of the facilities and would be considered long-term.

Direct or Indirect Impacts. A direct impact is specifically caused by a proposed action and generally occurs simultaneously at or near the location of the action. An indirect impact is caused by a proposed action but might occur later in time, be farther removed in distance, or be the secondary result of a direct impact, but still be a reasonably foreseeable outcome of the action.

Minor, Moderate, or Major Impacts. Minor, moderate, or major impacts are relative terms used to characterize the magnitude of an impact. Minor impacts are generally those that may be perceptible but, in their context, are not amenable to measurement because of their relatively limited effect. Moderate impacts are those that are more perceptible and more measurable, and could benefit from mitigation. Major impacts are those that, in their context and due to their severity, have the potential to meet the thresholds for significance set forth in CEQ regulations (Title 40 CFR Section 1508.27) and, thus, warrant heightened attention and examination for potential means for mitigation in order to fulfill the policies set forth in NEPA.

Adverse or Beneficial Impacts. An adverse impact is one having unfavorable, or undesirable outcomes on the man-made or natural environment. A beneficial impact is one having positive outcomes on the man-made or natural environment. A single act might result in adverse impacts on one environmental resource and beneficial impacts on another resource.

Unless otherwise specified, our analysis of impacts focuses on the Project as proposed with alternatives called out and discussed at the end of each resource section.

4.1 WATER RESOURCES

This section discusses the potential impacts to water resources that could occur as the result of NEG Port and Pipeline Lateral construction and operation.

4.1.1 Evaluation Criteria

An adverse impact on water quality is considered major and requires additional mitigation if Project construction or operation would:

- cause a federal or state water quality criterion or a federally recognized international criterion to be exceeded;
- result in persistent degradation of the environment;
- cause a threat of danger or irreparable harm to human health or aquatic life; violate waste discharge requirements; or
- cause re-suspension of contaminated bottom sediments that would degrade the quality of water.

NEG's proposed site for the Port is located in federal waters and must comply with federal standards, while the pipeline is located in both federal and state jurisdictional areas and would have to meet the requirements of both jurisdictional entities.

4.1.2 NEG Port

4.1.2.1 Impacts of Construction

The primary physical impact of Port construction on the water column would occur as a direct or indirect result of the sediment plume that is created from setting the buoy anchors, installing the flowlines, and temporarily laying the mooring chain on the seafloor. Although temporary, plumes resulting from disturbance to the seafloor would be exposed to currents with the potential to carry them into the surrounding environment and strip nutrients and/or contaminants from the sediments and release them to the water column. The extent and duration of the turbidity plumes would be based on the strength of the currents at the location of the specific activity.

NEG proposes to use Suction-Embedment Anchors (suction anchors) at the NEG Port. Suction anchors use piles that open on the lower end and are capped at the top. After lowering to the seafloor, the pile would partially embed due to its weight and a remotely operated vehicle (ROV) would attach a water pump to a fitting on the closed top and begin pumping out water from the inside of the cylinder; the pressure difference between the inside of the pile and the seawater, acting over the area of the capped top, further embeds the pile. This option would create no spoils, washouts, or other disturbance to the seafloor. Suction anchor installations in similar sediment types indicates that installation of each of the 16 proposed anchors and the settling of the PLEM could cause a silt plume to rise off the seafloor approximately 10 to 20 feet and last up to 10 minutes before being dissipated by currents. Because of their relatively small footprint and limited duration of construction disturbance, installation of suction anchors would cause a direct, short-term, minor adverse impact.

Bottom-water dissolved oxygen (DO) concentrations are expected to change little, if any, from the proposed construction. Oxygen demand from construction would occur as a result of exposing bottom materials, which are oxygen deficient, to the available oxygen in the water column. Since the relative volume of disturbed material is small compared with the volume of oxygenated seawater above, there would be a direct, short-term, minor adverse effect on DO from construction of the proposed NEG Port facilities. This conclusion is supported by monitoring results from HubLine construction, which found no reduction in water-column DO concentrations during pipeline plowing, jetting, or backfilling activities.

Construction activities that disturb bottom sediments would release some nutrients from sediments. The 33 acres affected by Port construction is small enough for the impact to be diluted by the much larger surrounding area. Given the low volume and area of disturbance compared with the available dilution volume and nutrient dynamics, impacts are expected to be direct, short-term and minor. Additionally, the location of the Port in a well-mixed, dynamic open-ocean environment further eliminates the potential for persistent nutrient enrichment as might occur in a shallow embayment. Since nutrients are the primary driver for chlorophyll-a dynamics, the few nutrients that would be released during construction of the NEG Port should not affect chlorophyll-a concentrations in the water column.

Application of established Best Management Practices (BMPs), as required under MARPOL, would ensure that Port construction activities do not introduce fecal coliforms or pathogenic organisms into the water column. To ensure against such contamination, blackwater or graywater from construction vessels would be held in holding tanks and discharged to an approved shore facility, or disinfected, and discharged in the Project area as required by Annex IV of MARPOL. As a result, the Project would have a direct, short-term, minor adverse effect from fecal coliforms in the Project area.

NEG Port construction would have a direct, short-term, and minor adverse effect on water quality through the alteration of the water column temperature. Although the construction vessels would use seawater to cool the diesel electric motors, the thermal discharge would be minor because of the thermal dilution capacity and mixing dynamics of the open-ocean environment.

Sediments that were resuspended during NEG Port construction could release sediment-bound contaminants into the water column. Measured concentrations of dissolved metals in the Project area are generally two to three orders of magnitude lower than the National Recommended Water Quality Criteria for Priority Toxic Pollutants (EPA, 1999). The only exception is mercury, which exceeded the water quality criteria of 1.8 micrograms per liter (µg/l) in 11 of 16 sediment samples. Because of these low concentrations, the rapid dilution of the sediment plume and limited area it would occupy would keep these effects to a minimum.

Construction could potentially release resting cells of certain diatoms and dinoflagellates (Garrison 1984; Steidinger and Walker 1984). Although not documented, it is possible that some nuisance species, such as the toxic dinoflagellate *Alexandrium* or the diatom *Pseudo-nitzschia*, have resting cells in the Project area. If these cells are present in the sediments and disturbed by construction, they could be returned to oxic conditions, transported and made potentially biologically active. A bloom of such species could cause a major adverse impact. However, these toxic species can only contribute to phytoplankton community dynamics if they reach the photic zone. It is unlikely that any resuspension of sediments and associated resting cells would be detectable in the photic zone, since the cysts are denser than water and would simply resettle. Release of resting cells into the water column, therefore, would more likely result in a minor adverse effect. In addition, recent survey data from Woods Hole Oceanographic Institution shows a low density of cysts in Massachusetts Bay - probably not enough to cause an outbreak, despite the *Alexandrium* bloom of 2005 (WHOI press release April 13, 2006, online at *http://www.whoi.edu/mr/pr.do?id=11987*). Therefore, impacts associated with releases of harmful algae are considered minor, long-term, and adverse.

Once the flowlines are fully installed, their integrity would be hydrostatically tested. Hydrostatic testing of the two flowlines would require the one-time use of 81,722 gallons (309.3 cubic meters) of filtered seawater. Water would be withdrawn from surface waters, filtered to remove debris that could damage the valves, and piped into the flowlines where it would be held for as long as 2 days. It may be necessary to inject a biocide into the flowlines during these filling operations to inhibit microbially-induced corrosion. NEG proposes to use Tetrakis (hydroxymethyl) phosphonium sulfonate (THPS) if a biocide is required. THPS demonstrates low toxicity in aquatic organisms and rapidly breaks down in the environment through hydrolysis, oxidation, photodegradation, and biodegradation (World Health Organization [WHO] 2000). Discharge of the flowline hydrostatic test water would be local to one end of each flowline and would comply with applicable permits. Hydrostatic test water discharges are subject to NPDES permit requirements and application of EPA's ocean discharge criteria (in federal waters) or MA water quality standards for discharges into state waters. Given the relatively low volume of the discharge, high dilution rate, and rapid degradation of THPS in the environment, impacts from the discharge of THPS would be direct, short-term and minor, and limited to residual biocide in the nearfield zone of rapid initial dilution.

Accidental discharges of onboard contaminants, such as lubricants and solvents, could temporarily degrade water quality and violate water quality standards. All vessels working on the NEG Port construction would be required to establish and implement a Spill Control and Countermeasures (SPCC) Plan that conforms to established BMPs for similar Projects and activities, in compliance with applicable regulations.

The SPCC Plan would include measures to avoid or minimize the environmental impact of spills or releases of fuels, lubricants, or other hazardous materials within any waterbody during construction of the proposed Project. The SPCC Plan would typically include sections on planning, training, materials handling, reporting, and specifies spill prevention and cleanup measures. The plan would be developed in conjunction with the work execution plans of the contractors selected to construct the proposed facilities.

NEG and Algonquin completed sediment chemistry sampling and analysis for sea floor areas that would be disturbed during Port construction. No contaminants were identified above regulatory thresholds, and, therefore, no impacts to marine biota or water quality would be anticipated. Commercial fishing activity occurs in this area and there are no known fish advisories or other documented adverse impacts associated with sediment contaminants and the repeated disturbance of these sediments during commercial fishing activities.

4.1.2.2 Impacts of Operation

Routine Port operation would involve actions, such as buoy retrieval and EBRV weathervaning of the buoy that would slightly increase turbidity above the normal passive movement of anchor chain sweep. Given the large available volume of dilution water, short sediment suspension period and the background resuspension in a dynamic ocean bottom environment, NEG Port operation would have a direct, long-term, and minor adverse effect on turbidity. As a result, NEG Port operation would have a minor effect on turbidity.

Food waste, graywater, and disinfected sewage discharges contain organic matter that may increase the biological productivity of the area. The amount of waste discharged from the Port and its oxygen demand would be small compared with the available oxygen in the seawater in the Port area. The total discharge for these purposes from each EBRV would be 0.87 mgd. These wastes would likely mix rapidly within the water column, with some fraction sinking to the seafloor or being consumed by marine organisms. As a result, the amount of nutrient bearing material would be small compared with ambient organic matter deposition in the overall marine environment and would have a direct, long-term, minor adverse effect on DO and nutrient concentrations in the Port area or Project Region.

During operation at the Port, the EBRVs would generate galley, hotel services, and sanitary wastes. In compliance with the 1978 Protocol of the 1973/78 International Convention for the Prevention of Pollution from Ships (MARPOL, Annex IV), all comminuted food waste, graywater, and blackwater would be treated at an onboard sewage treatment facility. An average of 0.005 mgd of treated wastewater would be discharged per day at the Port location. All other wastes produced by the EBRV would be retained aboard until disposal could be made in accordance with MARPOL. In addition, no bilge water would be discharged. Assuming the establishment and application of appropriate BMPs, such as for pretreatment and disinfectant usage, Port operation would have direct, long-term, minor adverse effect on water quality through the introduction of fecal coliforms into the water column.

Ship operations would require the withdrawal of 39.78 million gallons of water during each 8-day regasification period (Table 4-1). NEG would discharge 24.64 million gallons during this period with the remaining water being used for ballasting, steam plant, and boiler purposes. Of this total discharge, 15.64 million gallons would be used in the closed-loop heat recovery and exchange system. Under the closed-loop heat recovery and exchange mode, a vessel would attach to its buoy and take in 11.58 million gallons of seawater in the first four hours of a regasification period. The ship would then go into its heat recovery mode and take in 2.77 mgd for ballast, generator and water curtain operations for the remainder of the regasification process. The remaining water that was taken up at the initiation period of the regasification process would be used first to warm the LNG for regasification. This would cool the water, and this water would be recirculated to cool the main condenser, which would then warm the water. The net result of this heat recovery process would be a final discharge of at the end of an 8-day regasification process of water that is a maximum of 0.61°C warmer than ambient conditions.

The NEG Port would use an average of 4.97 mgd of water for regasification and all other ship operations. NEG would operate the Port using a closed-loop heat recovery and exchange system for regasification that would limit overall intake to 11.58 million gallons for days 1 and 8 of its regasification process and overall discharge to 9.69 million gallons of seawater on the same days. The remaining 1.89 mgd would be retained for ballasting purposes. Once steady-state regasification was achieved, for the remaining amount of time an EBRV was regasifying at Port, vessel operations would be conducted in a closed-loop heat recovery and exchange mode that would reduce the EBRV's total seawater intake to approximately 2.77 mgd of seawater, and would reduce the discharge to approximately 0.88 mgd of water. Approximately 0.9 mgd of water would be withdrawn to maintain both the freshwater generator and the safety water curtain, of which 0.03 mgd would be retained for freshwater and the remaining 0.87 mgd would be discharged. Of the discharged amount, no more that 0.005 mgd would consist of treated wastewater. See Table 4-1 for a summary of total water use during ship operations.

Table 4-1

Summary of Water Intake and Discharge During Normal Operations

Operation	Intake	Discharge
Primary Regasification	1.955 mgd (average for 8 days) 7.82 mgd [a] (max – days 1 and 8) 0.0 mgd [b] (min – days 2 to 7)	1.955 mgd (average for 8 days) 7.82 mgd [a] (max – days 1 and 8) 0.0 mgd [b] (min - days 2 to 7)
Auxiliary Seawater Cooling	0.25 mgd (average for 8 days) 0.99 mgd [a] (max – days 1 and 8) 0.00 mgd [b] (min – days 2 to 7)	0.25 mgd (average for 8 days) 0.99 mgd [a] (max – days 1 and 8) 0.00 mgd [b] (min – days 2 to 7)
Ballast water intake	1.87 mgd (average)	0 mgd (retained for ballast)
Outfall 3 – Water curtain	0.60 mgd	0.6 mgd (untreated discharge)
Outfall 4 – Freshwater generator	0.30 mgd	0.27 mgd [c] (balance to freshwater)
Outfall 5 – Hotelling and sanitary treatment	0.0 mgd	0.005 mgd [d]
Total	4.97 mgd (average) 11.58 mgd (max – days 1 and 8) 2.77 mgd (min – days 2 to 7))	3.08 mgd (average) 9.69 mgd (max – days 1 and 8) 0.88 mgd (min – days 2 to 7)

[a] Per 4-hour initiation period of the EBRV closed-loop regasification systems and 4-hour preparation period for vessel departure from Port.
[b] Once steady-state regasification is achieved, EBRV would operate under the closed-loop heat recovery and exchange mode and would no longer require intake or discharge of seawater. EBRVs would operate under this system from 4 hours after steady-state regasification is achieved and until 4 hours prior to departure.
[c] Discharge would consist of brine water.
[d] Discharge would consist of treated wastewater.

The Cornell Mixing hydrodynamic model (CORMIX) was used to evaluate the initial mixing, transport, and dilution, of the potential thermal plume. The maximum increase in surface temperature would be 0.61 °C (summer conditions) with an estimated surface temperature elevation of 0.10 °C, at a distance of 1,640 feet (500 meters) downdrift from the discharge port. The model results indicate that the discharge would in fact be small compared with the available mixing volume, would mix quickly to near ambient temperatures, and should have a direct, long-term, minor adverse impact. Table 4-2 lists the results of the CORMIX model.

Table 4-2

CORMIX Model Results

	Summer		Winter	
Outfall	Max Surface Temperature Elevation (ΔT°C)	Surface Temperature Elevation 500 m Downdrift (ΔT°C)	Max Surface Temperature Elevation (ΔT°C)	Surface Temperature Elevation 500 m Downdrift (ΔT°C)
Main Condenser Cooling	0.61	0.10	0.12	<0.01
Auxiliary Cooling	0.46	0.04	0.12	<0.01

Anchor chains sweeping along the 43 acres of sediment surface during NEG Port operation might release sediment-bound contaminants into the water column. Based on available information, sediment contaminant concentrations within the Project area are low and the impacts would be minor due to the rapid dilution of the plume and limited area it occupies. Operation could potentially release resting cells of certain diatoms and dinoflagellates (Garrison, 1984; Steidinger and Walker, 1984). It is unlikely that any resuspension of sediments and associated resting cells would be detectable in the photic zone, so release of resting cells into the water column would likely result in a minor adverse effect. The accidental discharge of blackwater, graywater, or bilge water into the Bay could release contaminants, including oil, detergents, or human waste, that would temporarily degrade water quality. To minimize the potential for an accidental release of oil, blackwater, graywater, or bilge water, each EBRV is equipped with an oil monitoring system which detects oil in excess of the allowed percentages, and an approved Marine Sanitation Device which is required to be inspected annually by a qualified engineer. Such methods and procedures would also be part of the required SPCC Plan for the Project. NEG would be required to prepare and implement an SPCC plan, including a spill contingency plan and maintenance of Material Safety Data Sheets (MSDS) for all hazardous materials stored on board, to protect marine water quality at, and near, the Port. It would also be required to maintain absorbent materials on board to contain and clean up small spills.

The potential risk and impacts of an LNG leak are presented in section 5 of this FEIS. Any LNG released on top of or into the water column would form a pool on the surface of the water column and volatilize relatively quickly because of its high vapor pressure and low solubility. No significant impacts to water quality would be expected from accidental releases of LNG in the water column because it is primarily methane and would completely vaporize leaving no residue.

The EBRVs would also reballast with seawater prior to departure. Intake of ballast water would occur continuously to maintain EBRV stability as the LNG was regasified and pumped into the flowlines. A total volume of 14.98 million gallons per 8-day ship visit at the Port would be required. On average, each EBRV would require the intake of approximately 1.mgd depending on the duration of regasification. To avoid the introduction of nuisance species, the EBRV would not discharge ballast water within U.S. waters.

In total, all seawater withdrawals (both for ship operation and ballast water) would amount to approximately 39.78 million gallons for each 8-day regasification period, or an average of approximately 4.97 mgd. With the conservative estimate of 65 port visits annually, this would total 2,585.7 million gallons annually.

4.1.2.3 Impacts of Decommissioning

Decommissioning of the NEG Port would require the removal of the STL buoys and suction anchors, chains, cables, flexible riser, and the PLEM from the Project area. The flowline would be abandoned in place. The removal of Port components would essentially be identical to construction, but in reverse, with similar impacts to those described in section 4.1.2.1, for Port construction. Any turbidity caused by the removal of Port components would be of short duration and have a minor impact on the overall water quality of the Project area or region. In general, NEG Port decommissioning would have a minor adverse effect on water quality.

4.1.2.4 Impacts of Alternatives

Drilled and Grouted Pile Anchor Alternative

Drilled and Grouted Pile Anchors would be set by an offshore drilling vessel that would drill through both sediment and rock to enable a tubular pile to be lowered into the drilled hole and cement pumped into the annular space between the hole and the pile. The drilling process would create a spoils area down current. This option would be permanent and could not be removed upon Port decommissioning without significant disturbance. The main impact of this alternative on water resources would involve a turbidity plume that would result from the drilling of the anchors. This plume would be substantially larger than one created from installation of the suction pile anchors. The presence of a spoils area downcurrent would also be a more substantial impact.

Port Location Alternative

Along with the proposed action (Location 1), an alternative port site was carried through for analysis. Construction and operation impacts for the Location 2 would be similar to those described for the proposed Port site.

Grain-sized distributions for Location 2 are 30 percent MDEP Type B (60 to 90 percent silt and clay) and 70 percent MDEP Type C (greater than 90 percent silt and clay). Concentrations of metals, with the exception of arsenic and PCBs in sediment samples collected within the Northern Port Site were less than the MDEP Category One concentrations. Arsenic was detected in 6 of the 10 samples within the range of concentrations (10 to 20 mg/kg) for Category Two and detections in 8 of the 10 samples exceeded the ER-L of 8.2 mg/kg, with a maximum concentration of 15 mg/kg (Long et al., 1995). Although these eight samples exceeded the ER-L, the arsenic concentrations in all samples were much less than the ER-M of 70 mg/kg. Concentrations of nickel were less than the Category One level of 50 mg/kg, and 4 of the 10 samples contained concentrations of nickel (maximum of 25 mg/kg) above the ER-L of 20.9 mg/kg. However, the nickel concentrations in all samples were less than the ER-M of 51.6 mg/kg. Concentrations of all other metals analyzed were below the corresponding ER-L values. VOCs and PCBs were not detected in the sediment samples collected within Location 2 and total PAHs and pesticides were detected at concentrations less than the ER-L values. TPHs were detected in 1 of the 10 samples within this Port Site, and according to the Applicant for Location 2, the laboratory was not able to identify the petroleum products present because of the low level, which was just slightly above the detection limit.

From the perspective of water resources, the alternate location offers no benefit over the proposed location. Location 2 is viable because it avoids rocky outcroppings and has sufficient sediment depth to support the use of suction anchors.

Vaporization Alternatives

Although NEG has proposed to only operate in closed-loop mode, open-loop operation is a viable option for vaporization. In open-loop mode, STL would withdraw approximately 76 mgd of seawater from April through December and 4.97 mgd during the other months when the water would be too cold to operate in open-loop mode.

This option uses over 10 times the amount of seawater as the proposed closed-loop heat recovery system. Other discharges for other ship operations would be the same. Discharge temperatures would not be the same when operating in the two different regasification modes. When operating in the open-loop mode, seawater is drawn in through the sea chests, circulated through the shell-and-tube vaporizers to warm the LNG, and then discharged through outlets located on the bottom of the vessel at the bow of the ship. Water temperature data collected during regasification activities at Excerate's Gulf Gateway Port indicated a temperature decrease of less than 1 °C in proximity to the discharge, and an immediate return to ambient water temperatures within less than a ship's length from the seawater discharge. Presence of a minimal plume was attributed to near-surface agitation/mixing that was observed during the regasification process.

Schedule Alternatives

Water quality impacts would be essentially the same for all schedule alternatives.

4.1.3 NEG Pipeline Lateral

4.1.3.1 Impacts of Construction

The primary effect of construction of the NEG Pipeline Lateral on water quality would be the temporary increase in suspended solids and turbidity in the immediate vicinity of the work area that would occur as the result of plowing, backfill plowing and jetting. Anchoring of lay barges, plowing, jetting, and backfill plowing for pipeline construction would suspend some bottom sediments off the seafloor and into the water column. Impacts to the water column resulting from the presence of the sediment plume would be temporary and localized. The effects of lay barge anchors would be similar to the effects of anchors used for Port construction as described in section 4.1.2.1.

Pipeline Route 4, the applicant's proposed route, has a low probability of encountering rock requiring blasting, dredging or surface armoring. Geophysical survey data indicate a sea floor composed of largely silt/sand/clay with no surficial bedrock and very limited potential for subsurface rocks or boulders.

Of the options available for marine pipeline construction, plowing and backfill plowing are the least sediment disturbing means of creating a trench for the pipeline and returning cover over the pipe in the trench. To put these effects in perspective, expected turbidity can be estimated based on the results from HubLine monitoring. Monitoring during five HubLine plowing events (TRC 2004) showed limited resuspension of sediments in the water column. Turbidity measurements taken at varying intervals within 820 feet (250 meters) of the disturbance were generally low (did not exceed 10.1 NTU), and average values (0.94 to 5.06 NTU) generally did not exceed average reference site readings (0.5 to 2.56 NTU). Average turbidity readings for backfilling (7.65 to 8.11 NTU) and jetting (0.27 to 28.9 NTU) were generally higher than reference values (1.78 to 2.51 NTU and 1.06 to 2.11 NTU, respectively). The Massachusetts Surface Water Quality Standards do not specify a numeric standard for turbidity, but of the coastal states that do have numeric criteria for turbidity, most recommend that turbidity not exceed 5 to 50 NTU over background turbidity when background turbidity is 50 NTU or less (EPA 2003). Because HubLine monitoring showed turbidity readings below this level using construction techniques that are similar to those proposed for this Project, it is likely that the proposed Pipeline construction would yield similar results. The spatial extent of the plume that would be created by NEG Pipeline construction activities would be limited due to the short time period that material would stay in the water column and the rapid dilution that would occur in the open ocean setting. Because the plow and backfill plow would move along the length of the Pipeline route at rates potentially up to several miles a day, there would be little potential for generation of a dense, concentrated plume. Plowing and backfill plowing, therefore, would result in a direct, short-term, minor adverse impact to water quality due to re-suspension of sediments.

Algonquin proposes to trench by jetting in selected portions of the route where plowing would not be an acceptable construction method (i.e., the Hibernia cable crossing, unidentified cable crossing, hot tap and side-tap tie-in). Trenching through jetting would result in the suspension of larger quantities of bottom sediments and larger plumes than would occur from plowing operations. The size and extent of the sediment plume caused by jetting would be dependent on the nature of bottom sediments (particle size distribution and cohesiveness) and on current speed, turbulence intensity and water column particle interactions. While these factors make the prediction of the precise size, extent, or duration difficult, plume dilution and dissipation would be expected to limit the plume extent beyond the immediate vicinity of the construction activities. Jetting, therefore, would result in direct, short-term, moderate adverse impact due to re-suspension of sediment.

Appendix G provides the results of analysis of turbidity and sediment transport that could occur as the result of jetting required for NEG Project construction. The report includes results from sediment transport modeling with simulations at two potential jetting sites – MP 0.5 and MP 16. At MP 0.5, where soils were fine sand, model runs showed jetting would create high sediment concentration (5,000-20,000 mg/l) in the upper water column immediately above the jetting apparatus while jetting was ongoing. However, sediment concentrations were found to decrease quickly, reaching approximately 500 mg/L in two hours, and 200 mg/l in 3 hours. Near-background sediment concentrations were seen after 12 hours. The modeled aerial extent of impact was 1 x 0.35 miles (1.67-0.56 km) exceeding 20 mg/l in the water column. The aerial extent of sediment deposition over 2 cm was 800 x 300 ft, with maximum thickness approximately 10 cm. When the model was run with conditions at MP 16 (clay substrate), the resulting sediment concentration in the water column was lower (500-1,000 mg/l) and the layer of deposited sediment was thinner (less than 2cm maximum). In that case, the aerial extent of increased suspended sediment in the water column was seen to be larger (1 x 1.4 nautical miles for >20mg/l) and the duration was longer (approximately 30 hr). The difference in model results occurs because sediments have higher water content (higher bulk density) at MP 16, and because sediments are spread over a greater area due to simulated tides and greater water depth. Model results suggest that the effects of jetting on turbidity would be intense, but very short in duration and aerial extent.

Neither water-column DO concentrations nor bottom-water DO concentrations would be adversely impacted by pipeline construction. No reduction in water-column DO concentration was observed during the monitoring of plowing, jetting, or backfilling activities for the HubLine, and DO readings were at or near typical saturation levels, though releases of compressed air during jetting occasionally increased near-bottom DO concentrations (5.1 to 11.6 milligrams per liter) to greater than reference concentrations within 673 feet (205 meters) of the jetting activity (Algonquin, 2005).

Pipeline construction activities that disturb the bottom can cause the release of nutrients from sediments. Plowing would cause a minor amount of sediment resuspension, particularly when compared to dredging and jetting, since sediments would be cut out from under the pipe and rolled off to the side. Therefore, the release of nutrients from bottom sediments is expected to be temporary and small relative to the contribution of nutrients to Massachusetts Bay by other sources (i.e., runoff, spring freshet, and the Massachusetts Bay outfall from the Deer Island Wastewater Treatment facility) and impacts to water quality from nutrients released from the sediments should be minor.

Construction could potentially release resting cells of certain diatoms and dinoflagellates (Garrison 1984; Steidinger and Walker 1984). The impacts would be similar to those described in section 4.1.2.1 and, at worst, only result in a minor temporary adverse impact.

The Pipeline would be filled with seawater on two separate occasions. The first would occur just prior to backfilling with the backfill plow and the second would occur as part of the hydrostatic testing process. Algonquin proposes discharges totaling 81,722 gallons of seawater into Massachusetts Bay and may inject THPS into the pipeline during these filling operations to inhibit microbially-induced corrosion, if required. The effects of THPS use would be identical to those described in section 4.1.2.1. Algonquin would be required to obtain a NPDES permit for the discharge of hydrostatic test waters.

Water quality could be impacted from accidental spills and the unintentional release of substances such as diesel fuel, lubricants, hydraulic fluid and onboard ship wastewater. Impacts from pipeline construction would be similar to those described in section 4.1.2.1 for Port construction. Algonquin would be required to prepare a SPCC Plan specific to Project construction. The plan would include measures to minimize the potential for releases and the approved steps for addressing spills that did occur.

4.1.3.2 Impacts of Operation

Operation of the NEG Pipeline would have no effect on water quality since no water withdrawals or discharges would occur during operation.

4.1.3.3 Impacts of Decommissioning

At the end of the pipeline's useful life, Algonquin would be required to obtain the necessary permission to abandon its facilities. Abandonment of the pipeline facilities would be subject to the approval of the FERC under Section 7(b) of the NGA. As currently identified, the pipeline would be cleared of gas, capped, and abandoned in place. An environmental review of any proposed abandonment would be conducted when the application to abandon is filed. Impacts associated with the abandonment, however, would be minimal and of short duration.

4.1.3.4 Impacts of Alternatives

Pipeline Route Alternatives

In addition to Route 4, the Applicant's proposed route, three alternative pipeline routes were analyzed.

Route 1

This alternative (see Figure 2-14) would involve a shorter pipeline route, but would traverse more complex substrate. Relative to water resources, though, there is no difference between these two alternatives aside from length. Both would require hydrostatic testing and pose the same potential for impacts from biocide discharge. Short-term, minor, direct adverse impacts on water quality would be expected during the installation of the pipeline and associated components. Installation of the gas transmission pipeline, two riser manifolds, the gas flowline, and the transition manifold (HubLine hot tap tie-in point) would be the primary construction activities which would present potential impacts on the sediment (and subsequently the water column) along Route 1.

This route would result in a total area of impact of approximately 84.4 acres. An additional area of seafloor would be temporarily disturbed by the anchoring of construction vessels. The extent of this disturbance would depend on water depth, wind, currents, and chain length, as well as the size of the anchor and chain (MMS 2002b). The disturbed area would be larger if the anchors were dragged due to vessel movement.

Concentrations of metals, with the exception of arsenic, and PCBs in sediment samples collected within Route 1 were all less than the MDEP Category One concentrations. Arsenic was detected in 1 of 22 samples within the range of concentrations (10 to 20 mg/kg) for Category Two. The maximum concentration (20 mg/kg) was detected in the central portion of this route. Although the arsenic concentrations in 2 of the 22 samples exceeded the ER-L (8.2 mg/kg), the concentrations in all samples were much less than the threshold for Effects Range – Medium (ER-M 70 mg/kg). Concentrations of nickel were less than the Category One level of 50 mg/kg, and 1 of the 22 samples contained a concentration of nickel (22 mg/kg) above the standard for

Effects Range Low (ER-L 20.9 mg/kg). However, the nickel concentrations in all samples were less than the ER-M (51.6 mg/kg). Concentrations of all other metals analyzed were below the corresponding ER-L values. VOCs, PCBs, and TPHs were not detected along this route and total PAHs and pesticides were detected at concentrations less than the ER-L values. Grain size distributions were approximately 50 percent MDEP Type A (most favorable), 36 percent MDEP Type B, and 14 percent MDEP Type C (least favorable).

Due to the nature (plowing/trenching rather than conventional dredging) and short-term duration of the construction activities, the minimal amount of sediment resuspension anticipated, and the chemical characteristics of the sediments in the area of the pipeline, minor, short-term adverse impacts on water quality during installation of the pipeline would be expected.

Route 2

Impacts for pipeline Route 2 would be similar to the construction impacts along Route 1. However, as discussed in section 2 of this EIS, although both routes traverse a historic disposal site, this route is near two other former disposal sites and some documented areas of debris. Concentrations of contaminants in sediment samples collected along this route were slightly greater than in samples from the Route 1. Eight of the 18 samples collected along this route would be classified as MDEP Category Two and 1 sample would be classified as Category Three. Although slightly greater than routes 1 and 4, the impacts from construction of this alternative route would be minor and short-term.

Route 3

Pipeline Route 3 would be approximately 13.2 miles in length. This pipeline alternative would travel north from Route 4 and cross paths with Route 2. This alternative would be located near two former disposal sites and some documented areas of debris. Concentrations of contaminants in sediment samples collected along this route were slightly greater than in samples from Route 1. Construction along this route would have similar impacts to Route 3.

Alternative Construction Schedules

There are no differences between the alternate construction schedules relative to water resources.

Mitigation and Minimization – Water Quality

The following measures have been proposed as potential measures for mitigating and/or minimizing water quality impacts.

- Summer construction would reduce construction time because it would present fewer weather delays. This would reduce water quality impacts due to construction vessel discharges and would result in a shorter time period for construction-related seabed disturbances, sediment re-suspension and elevated turbidity plumes;
- Construct the Pipeline lateral through soft bottom because it is the soft and more easily plowed. Construction time and potential water quality impacts caused by construction and support vessel water discharges would be reduced by avoidance of gravel, cobble, and other hard substrates or areas with thin surficial sediment layers.
- Use a pipeline plow towed by a derrick/lay barge for trenching and burial of the gas transmission pipeline, which would minimize environmental impacts from sediment re-suspension.

- In limited areas where jetting techniques would be used, backfill the pipeline trench with sand, concrete mats, or other material. This material would be placed using a tremie tube or by divers to reduce turbidity.
- Excavate the HubLine tie-in location would using a diver-assisted jetting to minimize environmental impacts from sediment re-suspension.
- Use filtered seawater and an EPA approved dye for hydrostatic testing. .
- Intake design improvements include optimizing the size of intake sea chests to provide the minimum possible velocity, and linking ballast water intake to the cooling water system so that cooling water could be used to provide the all of the non-emergency ballast requirements during LNG offloading.
- No debris or sanitary wastes would be discharged from construction vessels.
- NEG and Algonquin would require their contractors to maintain individual SPCC Plans in place for construction vessels during construction.
- FERC staff is recommending that water quality monitoring be incorporated into a Monitoring and Mitigation Plan for the Project, developed through consultation with the appropriate regulatory agencies.

4.2 BIOLOGICAL RESOURCES

4.2.1 Benthic Communities

A number of construction and operation activities would impact benthic communities in the Project area. Impacts would occur through two major mechanisms: 1) disturbance or alteration of the substrate, and 2) entrainment of benthic larval stages in process seawater.

Benthic communities typically include vegetation as well as shellfish and other benthic fauna. In this case, however, the entire Project is located in deep water where light does not penetrate to the sea floor and there is little or no capacity for photosynthesis. Therefore the major types of benthos discussed in this document are general benthic fauna (organisms including polychaetes, tunicates, and others that live on the bottom and provide forage for fish and other species) and shellfish.

4.2.1.1 General Impacts of NEG Port Construction

NEG Port construction activities are described in section 2.1.1.2. Construction activities would cause minor to moderate, short-term, direct and indirect adverse impacts on benthic habitat via disturbance of approximately 33 acres (13.4 hectares) of the seafloor during flowline installation, placement of the suction anchors, and placement of the PLEMs. Flowline installation would create the largest amount of seafloor disruption (approximately 27 acres, not including temporary anchoring for barge move-ahead). Approximately 8,227 cubic yards of seafloor would be disturbed by installation of Flowline A and approximately 5,981 cubic yards for Flowline B.

Increased suspended sediment would also occur during construction. This would cause short-term, minor (plowing) to moderate (jetting), direct impacts on benthic communities.

Hydrostatic testing of the flowlines and buoys would cause minor, short-term, direct impacts to benthic fauna via entrainment of larval stages. Flowline and buoy testing would require a one-time use of 81,722 gallons of seawater (47,322 gallons for Flowline A; 34,400 gallons for Flowline B). Use of biocides in hydrostatic testing, if needed, could also cause a short-term, minor, direct impact on benthic fauna.

4.2.1.2 General Impacts of NEG Port Operation

Minor, long-term, direct and indirect adverse impacts on benthic habitat would occur during NEG Port operation. These impacts would include:

- loss of benthic habitat (in anchor chain and cable sweep areas);
- alteration of habitat conditions in isolated areas (conversion of soft- to hard substrate by anchors, flowlines, and PLEM);
- increased suspended sediment and reduction in water quality in the area of anchor chain and cable sweep;
- potential stirring up and release of toxic algal cysts from sediment by anchor cable sweep;
- entrainment of benthic larval stages in seawater used for Port operations; and
- indirect effects on benthic habitat outside the Project area via displacement of fishing effort from the Port area.

These impacts would persist for the duration of Port operation (25 years or more), and would occur over approximately 43 acres of substrate. These impacts would be minor because the area of impact would be relatively small compared to similar habitat in the Project area region (NEG's siting investigation revealed 21,000 acres of soft-bottom habitat in the area). The impact area of the Port is approximately 43 acres, or about 0.2 percent of the available substrate, and therefore represents a very small fraction of available habitat in the area.

The first five Impacts noted above are discussed in the following sections, and specific impacts on macrofauna and shellfish are described as appropriate. Disruption of benthic habitat, increased sediment in the water column, and alteration of habitat conditions are discussed in some detail in the following sections. General impacts associated with seawater use and displacement of fishing effort are discussed below. Table 4-3 summarizes potential impacts from NEG Port construction and operation.

Table 4-3

Summary of Construction and Operational Activities Potentially Impacting Benthic and Shellfish Resources

Activity	Benthos	Shellfish
Construction (temporary)		
Flowline installation	27.0 acres	27.0 acres
Suction anchor installation	0.4 acre	0.4 acre
PLEM installation	0.2 acre	0.2 acre
Anchor chains and cables	5.4 acres	5.4 acres
Hydrostatic testing of flowlines	minor direct	minor direct
Operation (permanent)		
Cable sweep	43 acres when EBRV on buoy;.4 when no EBRV on buoy	43 acres when EBRV on buoy; 4 when no EBRV on buoy
Anchor chain	4 acres	4 acres
Anchors	0.18 acre	0.18 acre
Flowlines	0.18 acre	0.18 acre
PLEMs	0.08 acre	0.08 acre
Daily water use	minor direct	minor direct
Ballast water intake	minor direct	minor direct
Displacement of fishing activity	minor indirect	minor indirect

Seawater Use

Use of seawater for ballast and normal operations would cause minor, long-term adverse impacts on benthos via uptake of larval stages. Section 4.2.2.1 discusses the water demand from NEG Port operation. A description of water demand can be found in Section 4.2.2.1. Impacts due to entrainment of larval stages are discussed below, and details on entrainment analysis are given in Appendix E.

Displacement of Fishing Effort

Displacement of fishing activity from the exclusion and safety zones around the port area could cause minor, long-term adverse impacts on benthic habitat in areas outside the NEG Port area. (See discussion later in this section.) Evaluating the ecological impact to benthic habitat as a result of displacement of fishing effort depends on the type of fishery and the type of habitat in areas where the displaced vessels relocate. Both mobile (trawl) and fixed (gill net and lobster pot) fishing gear are used in the area, and both are considered.

Mobile gear fishing comprises most of the fishing effort in the NEG Port area. Trawling effort displaced from the NEG Port area would probably be relocated to adjacent soft-bottom habitat (not onto SBNMS which has more rock substrate). Trawling can be destructive to bottom habitat, but the worst damage usually occurs on hard-bottom gravel, cobble, and structurally complex habitats (NREFHSC, 2002; Kaiser et al., 2001). On a softbottom habitat, Tuck et al. (1998) found an increase in the number of species and individuals in the polychaete community, but a decrease in diversity and species evenness in an area subject to otter trawling compared to a reference area. This change in the community is consistent with the response of a disturbed community.

Due to the nature of the fishing gear used in the NEG Port area, and the habitat in the area surrounding the proposed NEG Port, most, if not all of the mobile fishing effort displaced from the Port would move to the adjacent deepwater, soft-bottom habitat. Therefore, the ecological impact of exclusion of mobile fishing effort from the Port would be to concentrate this effort in the adjacent areas of similar habitat. Because the adjacent fishing grounds do not appear to be saturated with fishing effort due to temporal closures, the impact to the benthic community would be lessened.

Fixed fishing gear such as lobster traps and gill nets have less impact on benthic communities than trawling. The degree of impact caused by lobster traps to biological and physical structure and to benthic animals was judged to be present, but rarely large in a recent study (NREFHSC, 2002). Due to the territorial nature of the lobster fishery, lobster fishing effort displaced from the 830 acre safety zone would probably be transferred to adjacent areas. It is unlikely that fixed-gear fishing efforts such as lobstering would be displaced to SBNMS because lobstermen would probably prefer to remain in areas with habitat similar to what they are presently fishing.

Similar to lobster pots, the impact on the benthic community caused by gill nets was judged to be present, but rarely large (NREFHSC, 2002). Gill nets are usually fished on harder bottom habitat that is not generally available to mobile otter trawl fisheries. The habitat in the proposed NAA is primarily soft-bottom; therefore, it is expected that few gill nets are set in that area. The small amount of gill net fishing effort that currently takes place in the NAA would probably be transferred to adjacent areas, and not onto the shallower habitat of SBNMS

The impact of displaced fishing effort on benthic habitat would be minimal. NOAA landings data indicate that the level of fishing activity occurring in the Project area is low compared to overall fishing activity in Massachusetts or New England waters (see section 4.8). As a result, any fishing activity displaced from the Project area would create a minor increase in fishing effort in other areas. In addition, displaced gear would be subject to current and future use restrictions and conservation measures.

4.2.1.3 Detailed Impacts of NEG Port Construction

Macrofauna

Impacts of Port Construction

Seafloor disturbance associated with port construction would cause short-term, minor, direct, adverse effects on benthic macroinvertibrates. Macroinvertebrates in the 43-acre (13.4 hectare) construction footprint (flowline, suction anchors, PLEM, and anchor chains) would be unlikely to survive construction. Once the flowline was buried, however, approximately 37 acres of this area would be available for re-establishment of benthic communities. The relative homogeneity of the substrate and the benthic infaunal community indicates that there would be an available source of organisms to recolonize the disturbed substrate.

Complete recovery of this area to the equilibrium stage community (Stage III[1]) that presently exists in the area would take some time. Benthic community recovery rates for a given project are difficult to predict, but data from related studies can provide information on a likely timeframe for recovery. Rhoads et al. (1978) found that organisms colonized azoic sediments in

[1] Stage III benthic communities are characterized by infaunal species, generally found in seafloor areas with low disturbance, and typically larger-bodied organisms that feed in a head-down position deep in the sediment, which creates distinctive subsurface pockets or “feeding voids”. Such bioturbation of the sediments enhances oxygen penetration.

10 to 29 days in Long Island Sound. Dredged material at the Western Long Island Sound disposal site was colonized in 1 to 2 weeks (Murray and Saffert, 1999). Lewis (2003) examined recolonization of the benthos in a pipeline construction area and found recolonization by the dominant polychaete approximately one year after construction ended, whereas other species had only partially recovered after a year. Seven years after experimental plowing of deep-sea sediments, Borowski (2001) reported similar infaunal abundances at impacted and unimpacted areas. Diversity (total infauna and polychaetes only) was still somewhat diminished at the impact site, and community heterogeneity was greater in the disturbed area than in the reference areas.

Table 4-4 shows results of studies tracking the recovery of late-stage benthic communities. Recovery to Stage III community took from several months to 7 or more years, depending on the nature of the disturbance and the baseline characteristics of the habitat. Because recolonization would be expected to proceed over a period of months to several years, and because the area disturbed would be small relative to comparable benthic substrate in the region, construction impacts are considered minor.

Table 4-4

Summary of Studies Documenting Recovery of Soft Substrate Benthos to Equilibrium (Stage III) Community

Study	Location	Stressor	Time to Recovery
Germano et al. 1994	Coastal New England	Dredged material disposal	6 months to 1 year
Rosenberg 1971	Sweden	Paper mill (sulfite)	3 years
Rosenberg 1976	Sweden	Enrichment	5 years
Murray and Saffert 1999	Western Long Island Sound	Dredged material disposal	1 to 4 months
MWRA	Massachusetts Bay	Storms	1 to 2 years
Rhoades et al. 1978	Long Island Sound	Dredged material disposal	1 to 2 years
Rhoades et al. 1978	Long Island Sound	Azoic sediments	6 to 8 months
Borowski 2001	Peru Basin	Experimental deep-sea plowing	< 7 years for infaunal abundance
Lewis, 2002, 2003	Shallow bay in Ireland	Pipeline construction	1 year for certain species; longer for others
SAIC 2004	Long Island Sound	Dredged material disposal	≤ 5 years
TRC and Battelle, 2005a	Massachusetts Bay	HubLine Pipeline Installation	Months to years; Study ongoing*

It is unlikely that benthic resources would experience indirect impacts from construction. Hydrostatic testing is unlikely to affect benthic communities because withdrawal and discharge of water for hydrostatic testing would use surface waters, and water use is not likely to remove a significant number of larvae belonging to benthic species. Suspended sediment plumes resulting from construction would be temporary and limited in spatial extent. As a result, they would not be likely to cause significant indirect impacts on benthic communities. Any indirect impacts would therefore be considered minor.

Impacts of Operation

Port operation impacts include: 1) loss of habitat from anchor chain and cable sweep; 2) alteration of the habitat conditions (conversion of soft- bottom to hard substrate by anchors, flowlines, and PLEM); 3) increased suspended sediment in the area of anchor chain and cable sweep, and 4) potential resuspension of cysts of harmful algal species. These effects would last for the duration of the Port's license (i.e., 25 years), so they are considered long-term impacts.

However, the impacts would be small relative to the area of similar habitat available in Massachusetts Bay so they are considered minor to potentially moderate.

Loss or Alteration of Habitat

Under a 100-year storm conditions, anchor cable sweep would occur over 43 acres (including both buoys). Although benthic organisms could settle onto the disturbed substrate when the buoy was unoccupied, within a week of settlement, they would be likely to be disturbed by cable sweep. In all likelihood, the areas around the anchor cables would remain azoic, in terms of benthic infauna for the life of the Project. Mobile fauna, such as demersal fish and large crustaceans (lobsters and crabs) might cross these areas, but the absence of benthic food resources would decrease the attractiveness so that mobile species would be unlikely to stay in the cable sweep areas for any length of time. Those that did could be injured or killed by the cables when the buoy was occupied. To place the loss of this habitat function in perspective, the 43-acre anchor cable sweep area would be located within the boundaries of the 1200-acre NAA, an area that would probably no longer be subject to the level of fishing effort (including bottom trawling) that it currently receives. The absence of bottom disturbance from fishing activity might result in a more stable and more productive benthic community in the rest of the NAA. This impact would be minor, long-term, and adverse since the loss of 43 acres of substrate would be relatively small in relation to similar substrate in the NEG Project region.

Existing soft substrate would be permanently replaced by artificial hard substrate in about 0.44 acre of bottom (anchors, flowlines, and PLEM areas) which would be available for settlement by fouling organisms. Because each of the anchors would extend approximately 1.5 feet (0.5 meter) above the bottom, the 16 anchors potentially provide an additional 0.05 acre of attachment area. Hard bottom is relatively rare in the vicinity of the NEG Port, although there is a rock outcrop east of the Buoys. Studies have not been conducted on this feature to determine the structure of the fouling community. The NEG Port site is located in an area that is too deep to support vegetation, but it is likely able to support faunal communities, including such species as sponges, hydroids, and bryozoans. Conversion of soft- to hard-substrate of less than half an acre would be a minor impact.

Approximately 43 acres of seafloor would be affected by Port operations as the result of EBRVs weathervaning around the buoys. When the EBRVs were not at the Port, approximately 5.4 acres would be affected. However, any benthic organisms that settle in or on the substrate during the intervals when the buoys were unoccupied would be exposed to cable sweep within days of settlement, so these sediments would remain essentially azoic for the life of the Project. This impact would be minor, long-term, and adverse since the loss of 43 acres of substrate would be relatively small in relation to the available substrate in the NEG Project region.

Increased Suspended Sediment

Increased suspended sediment would cause minor, long-term adverse impacts on benthic macrofauna in the area of cable sweep. These could be adverse or beneficial effects, depending on the species considered.

Under a worst-case scenario (100-year storm event), the erosion area would be approximately 19.5 acres at each buoy (39 acres for the two buoys), and the volume of eroded sediments would be about 11,650 ft^3 for each anchor (see appendix H, Anchor Chain Turbidity Analysis). MetOcean data provided by Forristall (2005) and sediment transport study provided by ASA (2005) were used to calculate the amount of turbidity that could occur in the Port area during cable sweep. The most common occurrence of high waves was in the months of December and March, when wave heights exceeded 4 meters (13.1 feet) more than 10 percent of the time (Forristall, 2005). The period of anchor chain sweep erosion during high wave conditions was assumed to be 10 percent of 1 hour (6 minutes). This concentration would be encountered above the erosion wedge at each anchor, during extreme storm events in December and March. The horizontal distance of silt sediment transport was calculated to be 7,527 feet using a maximum settling distance of 141.5 feet and the normal tide flow rate (ASA, 2005). This degree of increased turbidity would only be expected during extreme storm events occurring in December and March, and would be limited in spatial extent. However, some increase in suspended sediment would be expected at all times.

Foraging could be impeded in the immediate area of the erosion wedge around each anchor cable. Many marine species rely on chemoreception to locate food and an area of increased suspended sediments might reduce their ability to detect prey. Based on the scour modeling discussed above, this effect would probably be limited to the area in the immediate vicinity of the anchor cables. If the level of suspended sediments was sufficient to act as a barrier or deterrent to mobile organisms from entering the scour area, it would minimize the risk of injury or death to these individuals.

In general, an increase in turbidity can have a wide range of effects on benthic communities – from beneficial (under short-term, low to moderate levels under specific conditions) to adverse (long-term heavy levels). A moderate, short-term increase in suspended sediment could be beneficial to filter feeders if prey items in sediment were dislodged and sent into the water column. However, an increase in the concentration of inorganic particles could also be detrimental because organisms expend energy dealing with more particles of low nutritional value. Generally, a large increase in organic or inorganic particles has detrimental effects by overloading feeding processes, damaging feeding structures, or smothering organisms. Because the benthic community in the area where cable sweep would occur would probably not recover between EBRV dockings, any potential beneficial effects from release of benthic prey items would not be likely to occur during the license term.

The result of a long-term, highly turbid area is generally a shift in community structure away from filter feeding animals to deposit feeding animals (www.ukmarinesac.org.uk). However, it is important to note that high turbidity exists in certain places under natural conditions as well. Examples of excessively high concentrations of suspended sediment reported under natural conditions include 570 mg/L in Indian River Bay, Delaware (Huntington and Miller 1989); 600 mg/L in the Chesapeake Bay (Brownlee et al. 1988); 3,000 mg/L in the Bay of Fundy (Grant and Thorpe 1991); and 10,000 mg/L in False Bay, Washington (Miller and Sternberg 1988). The maximum turbidity expected from the Port of 686 mg/L would be well below that of the Bay of Fundy and slightly higher than Chesapeake Bay. It would also be relatively well-contained, with silt transport limited to less than 8,000 feet even under storm conditions.

In the NEG Port area, natural storms offshore in the North Atlantic can be a cause of turbidity in the Port area. Offshore storms can result in long-period swells that propagate into Massachusetts Bay, with a period greater than 12.5 seconds (Forristall, 2005). These waves could impact bottom sediments at the mooring site and re-suspend bottom material. The extent of this cannot be precisely quantified, but it should be noted that high turbidity can be expected periodically as a result of storms.

Release of Harmful Algal Cysts

Anchor cable sweep could potentially release resting cells of certain toxic diatoms and dinoflagellates (Garrison 1984; Steidinger and Walker 1984). As described in section 4.1.2.1, it is unlikely that any resuspension of sediments and associated resting cells would be detectable in the photic zone, so release of resting cells into the water column would not be likely to cause major impacts. The overall impact is considered to be short-term, adverse and minor because the likelihood of releasing cysts of toxic algae, and their development into blooms, would be very low.

Displacement of Fishing Effort

Impacts that would result from displacement of fishing effort in the Project area would be the same as described in section 4.2.1.3.

Shellfish – Mollusks

Impacts of Port Construction (mollusks)

Construction would have minor, short-term, direct adverse impacts on any molluscan shellfish in the Port area. A video survey of the buoy areas conducted by NEG revealed few epibenthic mollusks, so population-level impacts would be minimal. Larvae of molluscan shellfish may be present in the Project area, and would be minimally affected by entrainment in hydrostatic test water. Assuming construction follows the applicant's proposed schedule, hydrostatic testing would occur in the late summer or early fall, avoiding peak periods of molluscan larval abundance.

Long-fin and short-fin squid are likely to occur in the Project area and could be subject to impingement during water withdrawal for hydrostatic testing. Squid that are impinged would probably be injured or killed. The extent of this impact cannot be precisely quantified because the distribution of squid is irregular throughout the Project area.

Impacts of Port Operation (mollusks)

Port operation would have minor, long-term, direct adverse impacts on molluscan shellfish. The loss of substrate area would not materially affect mollusk populations because they do not appear in significant numbers in the Project area. Long-fin and short-fin squid would be exposed to impingement impacts during operation, as described for the hydrostatic testing. However, withdrawal of seawater would occur at a relatively low through-section velocity (below 0.5 ft/second), except for the four-hour periods at the start and finish of a regasification event, when the through-screen velocity would be approximately 0.82 feet per second. Therefore squid may be able to swim away from the seawater intake areas and avoid impingement. The loss of substrate area would not materially affect mollusk populations because they do not appear in significant numbers in the Project area.

Shellfish - Crustaceans

Impacts of Port Construction (shellfish – crustaceans)

Construction would cause minor to potentially moderate, short-term direct effects on epibenthic (lobsters and crabs) and hyperbenthic (pandalid shrimp) crustacean shellfish. During construction, some individuals would be crushed or buried, although some would be able to escape. This direct contact effect is most likely along Flowline A where trenching would be accomplished by a diver-operated jet. Shellfish would also be susceptible to increased turbidity or burial with displaced sediment during construction.

During construction, disturbance of the substrate might attract lobsters and crabs, as benthic prey species are dislodged from sediment and made available in the water column. Accordingly, large infaunal organisms may become exposed to predation during and shortly after construction. Lobsters and crabs attracted to the area could be buried, but both are capable of excavation so some individuals might survive burial.

A Sediment Transport Study was conducted in April 2006, to analyze potential sediment transport during construction (see Appendix G). The study evaluated sediment concentrations in the water column and bottom deposition that could be caused by the hydraulic jetting operation using the ASA/USACE suspended sediment fate model SSFATE. Jetting, although it would rarely be used, is considered the worst-case scenario. Simulation results show hydraulic jetting resulting in a sediment concentration of about 500 to 1,000 mg/L and sediment deposition of less than 2mm maximum. The predicted overall extent of sediment dispersion for >20 mg/l was 1.4 nautical miles and persistence of the concentrations (>20 mg/L) was about 30 hours. This temporary increase in suspended sediment, and thin sediment deposition would cause short-term, minor (plowing) to moderate (jetting), direct effects on crustaceans.

Pandalid shrimp larvae are abundant in Massachusetts Bay in the spring, and could be exposed to entrainment losses during hydrostatic testing. Still, the one-time use of 81,722 gallons would have at most a minor effect on any benthic species in the Project area.

Impacts of Port Operation

Port operation would cause minor, direct, long-term adverse impacts on crustacean shellfish due to loss of habitat (where anchors, flowlines, and PLEMs occur), alteration of the habitat conditions (anchor chains and cable sweep), and water use (daily water use and ballast water intake).

Habitat loss would occur in areas where soft substrate was converted to hard substrate (anchors flowlines, and PLEM areas), as well as in areas of cable sweep. Since lobsters, crabs, and shrimp would be unable to make burrows in the hard substrate created by the anchors, flowline, and PLEMs, approximately 0.5 acre of existing habitat would be unavailable to these species. Port operations would make a maximum 43 acres (under the 100-year storm conditions) uninhabitable for crustacean shellfish. Some individuals would be killed by anchor chain sweep, although some may be able to escape by swimming into the water column and settling elsewhere.

Lobsters and crabs are motile and would be likely to traverse the area affected by cable sweep and could possibly feed on benthic organisms that are exposed by the cables. Lobsters and crabs in the area when an EBRV was on buoy could be injured or killed by the cables. They could also come in contact with the turbidity plume. The small area of habitat loss, relative to that in the region, renders this a minor, long-term, impact.

Operation water use and ballast water uptake would cause minor, long-term impacts on lobster, crab, and shrimp due to entrainment of early stages. During each 8-day regasification event, an EBRV would use approximately 40 million gallons of water, or a daily average of 5 million gallons (6,776 m^3). The location of the intake structures 20 to 30 feet (6 to 9 meters) below the sea surface would help minimize entrainment of crab, lobster, and shrimp larvae, which generally are found in surface waters (Appendix F, EFH Analysis). Entrainment analysis (Appendix E, Ichthyoplankton Assessment Model) showed that approximately 27,000 lobster larvae would be entrained in operations water annually. This would yield an adult equivalent loss of approximately 58 lobsters. Sensitivity analysis showed a range of 21-103 age-1 lobsters could be lost due to entrainment.

Impacts of Decommissioning (shellfish – crustaceans)

Decommissioning the NEG Port would cause minor, short-term adverse impacts. Decommissioning would involve removal of various Project components. All components in the water column would be retrieved, including the STL buoys, flexible risers, and wire rope mooring segments. Additionally, all of the suction pile anchors would be recovered by reverse pumping, and the PLEMs would be removed. Any portions of the flowlines that were not buried would also be removed during decommissioning. Impacts to benthic resources caused by physical disruption of organisms and habitat, increased turbidity, and accidental spills would be similar to those that would be encountered during Port construction. There would be no impacts from entrainment of larval stages, however, as seawater intake would not be required due to elimination of hydrostatic testing.

4.2.1.4 Detailed Impacts of Pipeline Lateral

Minor, short- term adverse impacts to the benthos would occur as the result of various construction processes including pipe-lay and trenching, anchoring to position and move the lay, plow and backfill plow barges, and returning cover over the pipeline. These construction processes would result in both direct and indirect impacts to benthic species and benthic habitat, and the nature and extent of these impacts would depend on the type of resource, the type of activity, and the timing and duration of the activity.

Approximately 7 to 8 percent of the sea floor within the 11,700-acre Pipeline Construction Corridor would be disturbed by activities associated with trenching for the pipeline. Plowing would disturb about 176 acres (95.7% of the length of the pipeline). Jetting would be required for less than 5% of the length of the pipeline, and would impact approximately 32 acres of the seafloor. The crossing of two existing cables (the Hibernia cable at MP 5.7 and an unidentified cable at MP 15.3) would result in concrete mat placement over the pipe and on top of sediments. Each of these would affect about 0.03 acres. Table 4-5 shows the trenching methods and percentage of total pipeline length required for each (see section 2.1.2.1 for a description of pipeline construction).

Use of anchors for barge move-ahead would disturb the largest area in the pipeline corridor. The precise locations of anchors and anchor cable sweep cannot be predicted prior to construction; so it is not possible to determine precisely the aerial extent of anchoring-related impact. The entire anchor corridor would be 16.1 miles long by roughly 6,000 feet wide (about 11,700 acres). However, not all of this area would be affected by anchoring and cable sweep. A single pass of an anchored barge would cause approximately 845 acres of anchor/cable sweep impact. Three such passes are proposed, with some overlap of impact area expected between passes. The degree of overlap cannot be precisely known prior to construction. Because the anchoring area would be small relative to available substrate in the region, and because the affected benthic communities would be likely to recover quickly, this impact is considered minor, short-term, direct and adverse.

Table 4-5
Length of Various Trenching Methods and Percentage of Total Pipeline Length

Trenching Method	Total Length (ft)	Percentage
CC-Mats – Surface Lay with Concrete Mat Cover	300	0.4%
Jetting – Mechanical Jetting	1,074	1.3%
Plow – Plow	81,129	95.7%
Plow/Jet – Transition Areas – Plow then Mechanical Jetting	1,950	2.3%
Jet/CC-Mats – Mechanical Jetting with Concrete Mat Cover	328	0.4%
Total	**84,781**	**100.0%**

Minor, short-term, direct adverse impact could occur from accidental spill or release of toxic or harmful substances. While no harmful substances would be discharged during pipeline construction, accidental spills would adversely affect the planktonic larvae of benthic species, either through toxicity or by contact and immobilization. Algonquin and its contractors would be required to perform construction under an approved SPCC Plan, which would serve to minimize the potential for adverse effects on planktonic lobster larvae from spills.

Impacts of Pipeline Construction - Macrofauna

The proposed primary trenching method is post-lay plow (PLP), which would be used for approximately 96 percent of the route (see section 2.1.2.1). Jetting is expected to be used only in small areas. Some jetting may be required during pipe-lay, and post-lay jetting could be required in certain places if sediment could not be removed from under the pipe by the plow, primarily at pipeline ends, foreign utility crossings, and the in-line sidetap flanges. Relative to jetting or dredging, plowing results in much less disturbance of the substrate and overlying water column. The lateral extent of disturbance to the sea floor from plowing and backfill plowing of the trench would be about 75 to 80 feet (23 to 24 meters) wide, and a total of approximately 1,000 acres would be affected by barge trenching and anchoring.

The immediate, direct adverse impact to the benthos would be from the localized removal, turnover, and sidecasting of sediment during the trench plowing. PLP would likely cause a complete turnover of the sediment as the material is excavated from the trench and sloughed over onto the sea floor adjacent to the trench. The net result of this is that sub-surface sediment would temporarily lay on the surface. Most benthic infauna and epifauna live on or within the upper six inches of the sediment surface. This sediment turnover would bury fauna living directly on or adjacent to the pipeline path. Because most infauna have limited capability to successfully emerge after burial by more than a few inches of sediment (Kranz, 1974, Maurer et al., 1986), much of the infaunal community along the pipeline would be lost. Some organisms that live near the outer edge of the spoil mound would probably be covered by less material and could be able to emerge from burial. Backfill plowing would return the sediment to the trench, but the sediments would still show some degree of turnover or mixing, with portions of more compact sediments from the bottom of the trench mixed with somewhat less compact surficial sediments. Depending on the length of time between the plowing and backfilling, some organisms might survive the trenching and backfilling process.

Minor (plowing) to moderate (jetting), short-term, direct adverse turbidity-related effects are expected from pipeline construction. During jetting, sediment would be put into suspension and settle out at varying distances from the trench, with heavier sediments settling closer to the trench. During jetting, spoil would be broadcast to both sides of the trench from a jet sled discharge point about 20 feet (6 meters) off the seafloor. Coarse sands and gravels would typically settle out within 10 to 25 feet (3 to 8 meters), but finer material would settle out at increasing distances on either side of the trench. This uneven settling of sands, gravels, and fines can be considered habitat conversion, as sediment grain size could change to predominantly larger or smaller than pre-impact size distribution, depending on distance from the discharge point.

Impacts to the soft-bottom benthos from jetting and plowing would be similar; however the spoil mound adjacent to the trench would be thicker with plowing, but would not extend as far from the trench as would be the case with jetting. In either case, the duration and extent of impact would be limited, and impacts from construction would be short-term, minor (plowing) to moderate (jetting) and adverse for benthos in the immediate vicinity.

Benthos that survived the trenching process, including burial, would likely experience indirect impacts. Probably the most important of these would be the increased energetic cost of recovering from burial under spoils that could result in decreases in reproductive output and increased susceptibility to predation (Hall, 1994). Changes in food availability resulting from the sediment turnover could also adversely impact individuals that survive the initial burial. These indirect impacts could result in changes in population densities, recruitment, and dispersal (Hall, 1994). Indirect impacts might not be immediately recognizable through traditional benthic monitoring. Zajac and Whitlatch (1989) found that although population abundance data for the polychaete worm, *Nephtys incise,* showed no differences between dredged material and reference sites in Long Island Sound, the populations had very different age and size-class structures that were related to dredged material disposal. Such changes are possible in this case as well.

If the Pipeline Lateral crossed unexpected surface or subsurface hard-bottom areas, the rock would not be removed and the pipe would be laid on or near the sediment surface and protected by rock cover or concrete mats. Based on the geophysical surveys of the proposed pipeline route (Route 4), surface rock does not occur along the route and armoring is not expected. However, in the event that it does become necessary, a narrow strip of new hard-substrate habitat would replace the previously existing soft-sediment habitat. Similarly, a short section of new hard-substrate habitat would replace previously existing habitat where surface armoring is currently planned at the crossings of the Hibernia cable at MP 5.7, and an unidentified cable at MP 15.3. The net change in the area is the elimination of a soft-bottom habitat and its replacement by an artificial hard-bottom substrate. The areas that would be impacted by these cable crossings are small, consisting of roughly 0.03 acre at each crossing. After a period of time, the concrete mats would likely be colonized by sessile epifaunal taxa similar to those found on hard bottoms in the area.

The anchors used to pull the barge along the Pipeline Lateral during construction would cause disruption to the benthos, the extent of which would depend on the size of the anchors and the degree to which they pull through the sediment as they set. The anchoring process is described in section 2.1.2.1. Anchor cables have the potential to create additional disturbance by sweeping along the bottom. Minor (soft bottom) to moderate (hard bottom), short-term, direct adverse impacts to seafloor communities from the barge anchoring process would result.

Impacts to soft sediments from anchoring for barge move-alongs have not been thoroughly monitored in prior studies, so a direct comparison of expected effects with other studies is not possible at this time. However, comparison with a study on impacts from recreational boat anchors may be helpful. One study examined small anchor (44-pound) impacts to soft-bottom areas and showed that some larger animals, especially clams, could be severely damaged by anchors and were then subject to attacks from scavengers (Backhurst and Cole, 2000). The study also showed that repeated anchoring in a given area created some local damage to the community, but did not significantly change the overall characteristics of the infaunal community from those observed for undamaged areas. Anchor scars persisted up to three months after the damage occurred. Impacts caused by anchoring the construction barges would probably be more extensive than that described by Backhurst and Cole (2000) because of differences in anchor sizes (15-ton Stockless anchors would be used during the pipe laying). The impacts also could be compounded by the anchors being dropped and set for each phase of the operation. The anchor scars created during pipeline construction would persist longer than those described for small anchors primarily because they would be much larger and heavier. Scars in shallower pipeline areas probably would not last as long as those in deeper areas because they would be more likely to be filled in by wave action and currents than scars in the deeper more quiescent portion of the route.

Impacts to hard-bottom habitats would result primarily from anchoring since there is no known hard-bottom sediment along the Pipeline route centerline. The main damage from anchoring in hard substrate areas would likely be attributable to the direct impact of the anchor on the substrate where it would crush attached epifauna and further imbed rocks and cobble into the sediment. Organisms that generally might be affected include the various species of sponges, anemones, and tunicates. Some motile epifauna, such as an occasional seastar, lobster, or crab, may be impacted, but there should not be noticeable impacts to the general populations. Damage from cable sweeps would likely occur as the cable struck the bottom and from scraping as the cable was dragged along the bottom. The potential for these impacts would be minimized by the placement of buoys on the cables to help keep them off the bottom. It is not possible to predict the precise damage to hard-bottom habitats because the exact locations of the anchor placements cannot be known prior to construction. The highest probability of damage to hard bottoms, however, would occur where their aerial extent is relatively extensive. These locations include the areas along the NEG Pipeline Lateral route from about MP 1.3 to MP 2.5, MP 5.7 to MP 6.4, MP 10 to MP 11, and MP 12.7 to MP 14. Because the expected area of impact in anchoring areas is relatively large, compared to that for pipelay, and because the bottom type along the anchor corridor is not precisely known, these impacts would be minor to potentially moderate, though short in duration and limited in spatial extent.

Disturbance-related impacts to the benthos are often temporary as the native community either recolonizes the area or a new community develops from the emigration of animals from nearby areas or from larval settlement. However, some long-term or cumulative effects to the benthos may result. The rate at which the fauna recolonizes a disturbed area depends on many physical and biological factors. One consideration is the texture of the plowed and back-filled material. Any substantial change in texture, or compactness, reduces the chances that the community present after backfilling would be similar to the one that was present before pipeline placement. Any portions of the back-filled sediments that are more compact than the native sediments they replaced may be more difficult for infaunal animals to recolonize. Also, sediments that have been turned over from 3-foot (1-meter) depths, or greater, may be hypoxic. Sediment Profile Imagery (SPI) data showed the redox potential discontinuity (RPD) along the pipeline ranged from about 1 to 3 inches (about 2 to 7 centimeters). Diffusion is the main process by which these sediments can become oxygenated because they may be compact and not inhabited by many infauna. Diffusion is a relatively slow process and is limited by how deeply it can penetrate the sediment (Diaz and Rosenberg, 1995). Thus, the initial recolonization of an area disturbed by pipeline construction might initially be slow, but could eventually occur (Lewis et al., 2002, 2003). Physical disturbance to the sea floor, such as storms in the shallower reaches of the pipeline route or fish trawling, could also affect the timing, and perhaps the nature, of recovery.

Biological factors strongly influencing recovery of the benthic community include the variability naturally inherent in the general Massachusetts Bay ecosystem. This variability is expressed by spatial and temporal differences in the availability of larvae, juveniles, or adults to colonize newly established habitats (Ólafsson et al., 1994). It is often presumed that larval recruitment constitutes the primary mechanism by which recolonization occurs. However, Zajac and Whitlatch (1988) found that the initial recruitment after sediment disposal may be facilitated by adults migrating from other areas. Subsequent population increases, then, would occur by recruitment of new age classes to the area. Importantly, Zajac and Whitlatch (1988) discovered that this recruitment rate may not be directly related to the disturbance event, but may be related to factors (e.g., temperature, dissolved oxygen) other than those arising from the disturbance. Post-recruitment processes, such as predation on larvae by resident suspension feeders, predation on infauna disturbed by physical events, variation in the food supply, and emigration and immigration, also influence the community that eventually develops in new habitats (Ólafsson et al. 1994). Thus, initial recruitment into and subsequent community development of the disturbed area may not follow predicted successional models. It is now recognized that more than one stable ecosystem type may occur in a given marine area, in which case the system is said to have multiple stable states (Knowlton 2004). If this is the case, it is difficult to predict the nature of the community that would eventually exist in a disturbed area, especially if historical information about the community is lacking. The eventual recolonization of a disturbed area may be compounded by secondary disturbances (e.g., storms, trawling over the recovering area) that happen while initial recolonization is occurring (Paine et al., 1998). Thus, the return to a completely similar predisturbance condition may be delayed or not occur at all but instead an alternative community may develop. However, Paine et al. (1998) also pointed out that the basic character of an ecosystem is not often transformed by large, infrequent disturbances.

Recently completed (2004) post-construction benthic monitoring of the HubLine construction area provides some insights into the impacts to soft-bottom habitats caused by the pipeline construction process in Massachusetts Bay. Data from the 2004 survey were compared to the pre-construction surveys. Although several of the measured infaunal parameters differed between the two surveys, few showed any direct link to the construction activities (TRC and Battelle, 2005a). Infaunal abundances and numbers of species found along the pipeline in 2004 following construction varied considerably, as is typical of benthic habitats in Massachusetts Bay (Kropp et al., 2002), but relatively well-developed infaunal communities were present at all stations. For example, in the Massachusetts Bay section of the HubLine Project that has more direct relevance to the Pipeline Lateral, infaunal abundance at most stations ranged from about 5,000 to 22,000 animals per square meter (per 10.7 square feet) and species numbers ranged from about 17 to 41 per station. The fauna was not dominated by an overwhelming abundance of opportunistic species, but rather was comprised of species characteristically found in the Bay. Sediment profile image data also showed little significant habitat change between 2002 (preconstruction) and 2004 (post-construction), indicated that soft-bottom habitats in the construction zone were not of poor quality, and showed substantial evidence of a viable benthic community (TRC and NAI., 2005b). These results suggest that the impact area associated with the construction of the proposed Pipeline Lateral would continue to support a viable benthic community shortly after construction, although the specific nature of that community may differ from the one that was present before construction. However, some differences in the rate of recovery of the sediment, and the colonizing species, along the NEG Pipeline Lateral route would be expected because of differences in the sedimentary environment and depth of the route compared to the HubLine.

Impacts of Pipeline Construction - Shellfish

In general, many of the impacts from pipeline construction that affect benthos may also impact shellfish populations in the NEG Project area. Resident individuals could be killed by direct contact with equipment and shellfish could be buried by sidecast spoil in the direct footprint of pipeline laying and trenching. Softshell clams and most other bivalves live on the sediment surface or just below it and may have limited ability to recover from burial. Substantial mortality (2 to 60 percent) has been observed in softshell clams buried at depths of 20 inches (50 centimeters) or more in sandy substrates (Emerson et al., 1990). In muddy sediments, a burial depth of 10 inches could be lethal. However, population-level impacts to softshell clams would be minor because only a small portion of the Pipeline Lateral route (MP 3 to MP 4) occurs within MDMF's "shellfish suitability areas" for softshell clams (see section 3.2.1.2.2).

Plowing spoils could potentially be too deep for other shellfish, such as ocean quahogs (*Arctica islandica*), that might burrow to the surface. However, HubLine post-construction monitoring revealed quahogs in the pipelay area just months after construction, suggesting that colonization had occurred to some extent in the first year following construction and/or that some organisms survived the pipe-laying and burial processes. The latter is likely in that large size individuals, likely older than one year, were observed (TRC and NAI, 2005a; TRC and NAI, 2005b). Recovery times may be highly variable, depending on the extent of disturbance, type of substrate impacted, and degree to which pipeline was successfully buried with the same substrate it disturbed. For this Project, the vast majority of pipeline area is in soft substrate, and successful burial would be expected throughout. This would minimize overall impact in the Project area and would help accelerate recovery times. In addition, a monitoring program, under development in consultation with resource protection agencies, would be initiated with a goal of assessing impacts and recovery of benthic habitats.

Increased water column turbidity, decreased light penetration, and the release of nutrients or contaminants from sediments could impact all life stages of shellfish. Such disturbances would cause minor (plowing) to moderate (jetting), short-term, direct and indirect adverse impacts. In particular, increased turbidity in the water column from plowing or jetting activities could interrupt feeding and respiration by filter-feeding bivalves. Most filter feeders stop feeding and reduce respiration while the sediment content in the water is high. Softshell clams might continue filtering if total suspended solids exceeded 300 milligrams per liter (Eaton, 1983), but individuals in laboratory tests were unable to obtain adequate nutrition and began metabolizing protein when exposed to suspended sediments of 100 to 200 milligrams per liter (Grant and Thorpe 1991).

Because average turbidity measurements taken during HubLine construction remained relatively low (maximum 28.8 NTU) (TRC, 2004), the turbidity plume generated during plowing of the proposed Pipeline Lateral would not be expected to impact the growth or survival of softshell clams in the Project area. Suspended sediments that might occur in any one area during construction would be for short durations, typically hours to no more than a few days, because the construction process involves movement along the pipeline corridor. In the small or discrete areas where specialized work, such as the hot tap or the Hibernia cable crossing would occur, a localized turbidity or sedimentation event would occur, affecting few shellfish.

Impacts to shellfish from anchors and cable sweep in areas of soft sediment would be similar to those described above for benthos. If plowing results in a substantial change in surficial sediment characteristics, larval settlement could be affected if the sediment no longer provided the correct settlement cues. Over time through natural processes, the sediment should provide suitable settlement habitat and allow for recovery. Impacts on shellfish from anchors and cable sweep would be short-term, minor to potentially moderate, direct and adverse.

Impacts of Pipeline Construction - Crustacean Shellfish

Crabs

Minor, short-term direct adverse impacts on crabs could occur. Some individuals may not be able to move rapidly enough to avoid construction areas and could suffer mortality or injury from plowing or burial in spoil material. One species of Cancer crab (*Cancer magister)* was shown to burrow to the surface in less than one day when buried by 4 inches or less of sand, but none reached the surface after burial by 8 inches (Chang and Levings, 1978). Burial experiments conducted by Maurer et al. (1981) found that the mud crab (*Dyspanopeus sayi*) could migrate vertically through 12.6 inches of sand and silt-clay but that mortalities increased greatly from burial depths of 6.3 inches to 12.6 inches of sand. Although Cancer crabs occur throughout the Pipeline Lateral route, they generally do not aggregate, so impacts to their populations are likely to be minor.

Lobster

Minor to potentially moderate, direct, short-term adverse impacts on lobster could occur as a result of pipeline construction. Though it is impossible to estimate precisely the population size in the NEG Project area, it is clear that lobsters migrate through the area, particularly during fall and spring and that there may be a sizeable resident population as well. Video data from a wintertime survey of the NEG Port area showed depressions in soft sediment that may have been made by lobsters. Based on these data, and using the conservative assumption that each depression was made by a lobster, there were an estimated 32-180 individuals/acre in the NEG Port area during the winter. This may be higher than the winter population along the Pipeline Lateral, because the number of depressions decreased with distance inshore from the Port.

However, more lobsters likely pass thorough this area than were seen during the one-time winter survey.

Lobster populations in the area vary a great deal both seasonally and annually. As discussed in section 3.2.1.2.1, molting and mating occur during the spring and summer in the warmer inshore waters, while offshore migration occurs in fall. If construction occurred from May through November, the end of the spring migration and beginning of fall migration would be affected. However, the construction process would be divided spatially and temporally so that the construction area would be relatively small in any given month. For instance, the last two months of construction (October-November for the proposed NEG schedule) would involve tie-in of flowlines to the pipeline lateral, and installation of the buoys. Therefore the construction area would be limited to distinct areas and interference with lobster migration would be relatively low.

A lobster survey was performed during HubLine construction while plowing, jetting and backfill plowing were occurring that offers some insight into the potential effects that could result from this Project (TRC and NAI, 2003). Video was collected by ROV in early June and August 2003 at 28 sampling stations along the HubLine, with divers visiting seven of those stations. Adult lobsters were observed all along the HubLine route, occurring on the seafloor, on the pipe, and in burrows. The greatest number of lobsters was observed in plowed trench areas (161 of 302 individuals) compared to jetted trench areas (126 of 302 individuals), and laid pipe (16 of 302 individuals). When the ROV data were standardized for the length of surveyed area (100 meters or 328 feet), surface laid pipe areas had a higher density of lobsters (2.8 lobsters/100m) than plowed trench areas (1.6 lobsters/100m) or jetted trench areas (1.2 lobsters/100m). The differences in lobster density may have to do with the construction schedule. Surface laid pipe areas had been undisturbed from late February until early June, while plowing (March to June) and jetting (May to July) occurred just prior to sampling in June and August. Lobsters were observed on the eastern (43 percent) and western (57 percent) sides of the pipeline, and crossing over the pipeline. These results suggest that lobster migration may not be significantly affected by the physical presence of the pipe or trench.

Though not directly applicable to this Project, a laboratory study of lobster response to underwater pipes (MARTEC, 2004) showed that lobsters might have difficulty scaling submerged pipes (note that submerged pipes were completely exposed, unlike the proposed Pipeline Lateral where all areas would be buried). When lobsters were offered food items on the top of a plastic 32- to 48-inch pipe, many were unable to scale the pipes, even when the pipes were partially buried or had a rough surface. The Pipeline for this Project, however, would be smaller (24 inch diameter) and would be fully covered, so it would not interfere with lobster migration or behavior once construction was finished.

Lobsters may be attracted to the trenched area following the initial plowing or jetting, and this could leave them vulnerable during backfilling. Impacts to lobsters occurring in the trenched area would include some mortality regardless of which construction method is employed. Vibrations associated with the plowing, jetting, and backfill operations may elicit an escape response, in which lobsters swim away from a threat using multiple rapid tail flips, thereby escaping burial or contact with the trenching equipment. Juvenile lobsters (soft- and hard-shelled individuals) and some adults (hard-shelled) show this behavior (Cromarty et al., 1991; Cromarty et al., 2000). However, lobsters that have acquired and retained shelter for an extended period of time become aggressive when threatened and tend to remain in their territories instead of fleeing (Cromarty et al., 1999). Therefore, lobsters inhabiting burrows along the pipeline route would be less likely to flee than non-resident lobsters (i.e., migrants). Minimizing pipelay duration by using a single pass of the plow, followed by a single pass of the backfill plow as proposed, would reduce the effect on lobsters that may take refuge in the trench.

Lobsters located immediately adjacent to the proposed NEG Pipeline trench may be buried by spoil material. The lobster's ability to burrow may enable it to escape from the spoil mounds, depending upon how deeply it was buried. Plowing and jetting of the seafloor could alter the habitat of juvenile and adult lobsters by disrupting and burying shelter and food resources. Varied bottom topography or substrate types have been identified as desirable locations to find lobsters. During the HubLine lobster monitoring survey, 56 lobsters (19 percent of total lobsters) were observed on spoil mounds (TRC and NAI, 2003).

Burrows, both with and without lobsters, were observed along most of the HubLine route following construction, indicating that recolonization of the pipeline corridor had occurred weeks to months after habitat disturbance ended. Early Benthic Phase (EBP) lobsters are not likely to be impacted by pipeline construction because they do not typically occur at the water depths found along the pipeline route (Wahle and Steneck, 1991; Lavalli and Kropp, 1998). In addition, the proposed pipeline route would avoid the cobble and glacial till areas that form EPB habitat (see section 4.4.1.2). Any cobble and glacial till found away from the pipeline centerline but within the anchor corridor occurs at water depths greater than typical EBP habitat.

Anchoring to position and move the barges during construction may impact lobsters within the anchor corridor as described above for benthos. Lobsters directly under anchor strike locations on the bottom would suffer mortality, and contact with anchor cables moving across the seafloor could kill or injure lobsters that were unable to avoid the cable.

Turbidity plumes that would be created during Pipeline construction would have a minor to moderate, short-term, adverse impact on lobsters. Lobsters are adapted to periodically high concentrations of suspended sediments in their natural environments during storms. Experimental studies have shown that lobsters can withstand a 24-hr exposure to clean estuarine silt at concentrations up to 3,200 ppm (Saila et al., 1968). Scarratt (2003) evaluated the turbidity-related effects on lobsters resulting from pipelay for the Sable Offshore Energy Inc (SOEI) pipelay project. During jetting for that project suspended solids were measured at 100mg/l at a distance 50m from the pipelay trench. No lasting effects on lobster populations were seen in the vicinity of the project, except for the immediate area where the pipe was laid. Scarratt (2003) concludes that, though immediate and temporary adverse effects may have occurred from jetting, pipelay, or pipe-lowering operations for the SOEI project, pipelay activities did not adversely affect lobster populations in the vicinity of the project.

Accidental spills and releases could cause minor, short-term, direct adverse impacts on the planktonic larvae of lobster, either through toxicity or by contact and immobilization. Algonquin and its contractors would be required to perform construction under an approved SPCC Plan, which would serve to minimize the potential for adverse effects on planktonic lobster larvae from spills.

4.2.1.5 Impacts of Decommissioning

As currently identified, decommissioning would involve clearing the Pipeline of gas, capping, and abandoning it in place. An environmental review of any proposed Pipeline abandonment would be conducted by the FERC when the application to abandon was filed. Impacts associated with abandonment are expected to be minor.

4.2.1.6 Impacts of Alternatives: Benthic Resources

Drilled and Grouted Pile Anchor Alternative

Drilled and grouted pile anchors are a possible alternative to the proposed suction anchors. The drilling process would create a washout area at the seafloor, and the material drilled from the hole would create a spoils area down current. Additionally, drilled piles are not removable, and at the time of Project abandonment would require abrasive jet cutting or explosive severing to achieve a seafloor clearance. Drilled and grouted piles are a Project contingency for the proposed Port. However, this method would have increased adverse impacts on benthic communities because of the initial disturbance to the seafloor, and the increased disturbance at Project abandonment.

Port Location Alternatives

Along with the proposed port location (Location 1), one alternate site (Location 2) is being considered for the Port. The major difference in potential impacts to benthic habitat impacts between the port sites is the amount of area that would be disturbed by the proposed pipeline installation, and the footprint of the proposed port. Location 1 would require a longer pipeline (16.1 miles) to connect with the HubLine than Location 2 (10.7 miles), which could cause greater impacts to benthic habitat depending on bottom conditions within the pipeline corridor. Port Location 2 would require a large footprint (63 acres) for bury placement and anchoring, resulting in a larger port than Location 1 (43 acres), which would adversely affect more benthic habitat. These differences are discussed in more detail in section 2.2.5.

Vaporization Alternative

As an alternative to the closed-loop Heat Recovery System proposed for this Project, it could be technically feasible to use open-loop STV. Open-loop mode requires significant amounts of seawater (roughly 76 million gallons per day from April to December). Vaporization alternatives would have no affect on benthic communities, except for the potential for entrainment of benthic larvae, which is discussed in section 4.2.2.

Pipeline Alternatives

Four alternate pipeline routes were reviewed for this Project (see section 2.2.5 for full description of alternate routes). Although Routes 1 and 4 are longer than Routes 2 and 3, they traverse only soft-bottom habitats. Both Routes 2 and 3 traverse areas of hard bottom (gravel and cobble). Given that soft-bottom habitats generally support fewer important commercial species and tend to recover more quickly after disturbance than hard-bottom habitats, the impacts on benthic resources would be less along the soft-bottom routes.

Construction within soft-bottom areas (Routes 1 and 4) would entail the simplest, most predictable, and least sediment-disturbing construction methods. The presence of gravel, cobble and other hard substrate, and lack of thin surficial sediment layers within Routes 2 and 3, indicate that they would have a higher probability of requiring blasting, dredging or surface armoring during construction. Additionally, more complex conditions present a higher potential for construction delays.

Discussions are currently underway between relevant agencies and the applicant concerning biological monitoring before, during and after construction. Requirements for monitoring would be included in the Project license as determined appropriate by MARAD.

Construction Schedule Alternatives

The resource that would be most affected by a different construction schedule would be lobsters. Lobster populations in the area vary a great deal both seasonally and annually. As discussed in section 3.2.1.2.1, molting and mating occur during the spring and summer in the warmer inshore waters, while offshore migration occurs in fall.

If construction occurred from November through May, the end of the spring migration and beginning of fall migration would be affected. Lobsters would be most affected by pipeline plowing and backfilling that would occur in December through February and affect the end of their fall migration. The beginning of their spring migration would be disturbed by installing the flowlines and buoys.

If construction occurred from January to July, the spring migration would be disrupted by the installation of the flowlines and buoys, but the fall migration would go undisturbed.

4.2.1.7 Mitigation and Minimization – Benthic Resources

The following measures have been proposed as potential measures for mitigating and/or minimizing impacts to benthic resources.

- Plowing would be used as the primary pipeline construction technique. This would minimize the footprint adjacent to the trench where material would be sidecast; thereby minimizing overall impacts on benthic communities.
- One-pass backfill techniques would be used to recontour bottom sediments so that benthic communities could reestablish in the shortest time possible.
- In consultation with Secretary of EOEA, NEG is developing a compensatory mitigation program (see appendix A) for habitats impacted by the Project and is currently engaged in discussions to structure such a mitigation program.
- FERC staff is recommending that a Monitoring and Mitigation Plan for the Project is developed through consultation with the appropriate regulatory agencies that includes:
    a. appropriate pipeline depth of burial and cover criteria; and
    b. measures to minimize construction impacts to migrating lobsters.

4.2.2 Plankton

Minor, short- and long-term direct and indirect adverse impacts on plankton would occur from Project construction and operation via seawater uptake for various purposes, or from changes in water quality (increased turbidity, thermal or wastewater discharge, or accidental spills). Each of these potential impacts is discussed for the NEG Port and Pipeline Lateral. Impacts are discussed for three components of the plankton community: phytoplankton, zooplankton, and ichthyoplankton.

Evaluation Criteria

Evaluation of impacts on plankton is based on a number of factors: 1) the ecological or scientific importance of the resource; 2) the proportion of the plankton community that would be affected relative to its occurrence in the region, 3) the sensitivity of the plankton to the proposed activities, and 4) the duration of the impacts.

Impacts are considered major if plankton communities would be adversely affected over large areas relative to species distribution and diversity within the Project area. Impacts would also be considered major if disturbances would:

- Cause reductions in regional population densities or changes in distribution of important species;
- Introduce new, invasive species to an area;

- Result in substantial long-term loss or deterioration of existing habitat (i.e. major or long-term adverse changes in water quality);
- Involve the use, production, or disposal of materials that pose a hazard to water quality or plankton communities in the Project area.

4.2.2.1 NEG Port

Impacts on plankton from NEG Port construction and operation could occur through two general mechanisms: 1) withdrawal of seawater for hydrostatic testing or other purposes, or 2) changes in water quality. Specific activities and potential impacts are described for each plankton component (phytoplankton, zooplankton, ichthyoplankton) in the following sections, and summarized in Table 4-6.

Table 4-6

Summary of Port Construction and Operational Activities Potentially Impacting Plankton Communities

Activity	Phytoplankton	Zooplankton	Ichthyoplankton
<u>Construction</u>			
Spool installation	minor indirect	minor indirect	Most species minor indirect
Flowline installation	minor indirect	minor indirect	Most species minor indirect
Suction anchor installation	minor indirect	minor indirect	Most species minor indirect
PLEM installation	minor indirect	minor indirect	Most species minor indirect
Flowline hydrostatic testing	minor direct	minor direct	minor direct
<u>Operation</u>			
Anchor sweep	minor indirect	minor indirect	Most species minor indirect
Daily water use	minor direct	minor direct	Most species minor direct
Ballast water intake	minor direct	minor direct	Most species minor direct

Phytoplankton

<u>Impacts of Construction</u>

Installation of the spools, flowlines, anchoring system and PLEM for the NEG Port would have no direct impacts on phytoplankton. Phytoplankton would not be affected by this activity because the anchors would be placed in water depths of 270 to 290 feet (82 to 88 meters), well below the photic zone of about 100 feet (30 meters).

Minor, short-term, direct adverse effects on phytoplankton would occur due to hydrostatic testing of the flowlines. Phytoplankton cells contained in the test water would likely stop growing, but may not be killed. Hydrostatic testing would result in a very minor net loss of phytoplankton from the ecosystem because the water volume is small, and this is a one-time event. No food web implications would be expected from this loss. In addition, phytoplankton turnover time is on the order of hours to days (Keller et al. 2001), so entrainment losses would be quickly offset by production. All phytoplankton would be returned to Massachusetts Bay when the test water was discharged so there would be no change in their contribution to the nutrient cycle.

Potential indirect impacts of construction on phytoplankton could occur through the release of sediment-bound nutrients into the water column. Release of nutrients from sediments is not expected to significantly affect phytoplankton for two reasons. First, most viable phytoplankton exist in a much higher portion of the water column (above a depth of 100 feet or 30 meters) than would be affected by construction-induced turbidity. Second, any release of nutrients from sediments due to construction would be limited spatially and temporally, likely remaining below the photic zone. Even if the introduction of nutrients did occur during the fall breakdown of the thermocline, so that nutrients were introduced to surface waters, the effect would be a minor increase in the nutrient concentration in the water column.

Construction could potentially release resting cells of certain toxic diatoms and dinoflagellates (Garrison 1984; Steidinger and Walker 1984) from sediments. As described in section 4.1.2.1, it is unlikely that any resuspension of sediments and associated resting cells would be detectable in the photic zone as a result of plowing, so release of resting cells into the water column would not be likely to cause major impacts. Therefore, impacts associated with releases of nutrients or harmful algae are considered minor, short-term, indirect and adverse.

Impacts of Operation

Seawater used for ship operations would be withdrawn from a depth of 20 to 30 feet (7 to 10 meters). Because this depth is in the upper third of the photic zone, this portion of the water column supports an active phytoplankton community. Future production of phytoplankton entrained in the ships' water systems would be lost from the Massachusetts Bay ecosystem, although dead cells would be discharged so that the nutrients they contain would be reintroduced to the water column.

Minor, long-term, direct adverse impacts on phytoplankton would occur due to entrainment in seawater used in ship operation. Using published data on phytoplankton concentrations in the general area, along with water use rates, it is possible to estimate the order of magnitude loss of phytoplankton due to seawater uptake. Libby et al. (2004) found that the total phytoplankton densities in Stellwagen Basin and Stellwagen Bank (Offshore Area in MWRA monitoring program) ranged from about 0.25×10^6 to 1.5×10^6 cells per liter (65,000-390,000 cells per gallon) over an annual cycle. Based on these numbers, seawater use by the Project would remove between approximately 2.6×10^{12} and 1.6×10^{13} phytoplankton cells during a typical 8-day regasification. The significance of this loss is difficult to grasp because of the large numbers of individual cells and their extremely small size. One way to put this loss of phytoplankton in perspective is to evaluate the loss of biomass from the system. Since phytoplankton cells typically weigh 10^{-10} to 10^{-11} grams (dry weight), the maximum biomass lost due to seawater intake would be just over 1.5 kg per typical 8-day regasification period (assuming the highest number of cells per volume of water and the largest biomass per cell).

Assuming 65 regasification events per year the estimated loss of phytoplankton biomass would be about 104 kg annually. The effect of this annual biomass loss on regional food webs can be evaluated in general by recognizing that approximately 10% of the biomass consumed by one trophic level is transferred up the food chain to the next level (Sumich, 1988). This suggests that a loss of 104 kg of phytoplankton would result in a loss of about 10.4 kg of zooplankton, 1.4 kg of small planktivorous fish, and 0.14 kg large piscivorous fish. Relative to the biomass of these trophic levels in the Project area, this biomass loss is minor.

The conclusion that the loss of biomass is minor is consistent with findings from impact analyses on phytoplankton entrainment for electric power production facilities. These analyses of facilities using much larger volumes of water than that proposed by NEG show that even large levels of entrainment do not lead to measurable effects on the local ecosystem. MRI and NEP (1982) found that estuarine phytoplankton growth rates were not affected by entrainment and passage through power plant condensers or the discharge canal.

The regular disturbance of the seafloor by anchor cable movement while the EBRVs are on buoy would cause regular near-bottom turbidity. As described in the Appendix H, Anchor Chain Sweep Analysis, the turbidity effect would be localized and focused in bottom waters. Therefore, this action would cause minor, indirect adverse impacts on the phytoplankton community.

Sea water temperature changes can affect the phytoplankton community. While the water withdrawn for ship use would be returned to Massachusetts Bay at a slightly elevated temperature, it would reach ambient conditions in less than five hours (see section 4.1.2.2 for a description of the CORMIX model results). Phytoplankton cells do not "reside" in a particular location under dynamic oceanographic conditions, and would not, therefore, be continuously exposed to elevated temperatures at the discharge. The heated discharge would therefore cause long-term, but minor, direct, adverse impacts on the phytoplankton community in the receiving water.

Zooplankton

Impacts of Construction

Installation of the spools, flowlines, anchoring system, and PLEM for the NEG Port would have minor, short-term adverse impacts on zooplankton, if any at all. Because the anchors would be placed in water depths of 270 to 290 feet (82 to 88 meters), most zooplankton species would be unlikely to be affected. Hyperbenthic species that regularly swim into the water column could be entrapped within the suction anchors and killed. However the volume of water entrapped in the anchors is small and the loss of zooplankton would be negligible relative to the regional population.

Hydrostatic testing of the flowlines and buoys would cause minor, short-term, direct adverse impacts through entrainment of zooplankton. Any individuals contained in the test water could be killed. Approximately 81,722 gallons of water would be used for hydrostatic testing of these Port components.

Using data on zooplankton abundance from MWRA's nearfield stations, along with hydrostatic test water volume, it is possible to calculate loss of zooplankton biomass. MWRA data indicate average abundances of zooplankton captured on a 102-micrometer mesh to be approximately 62,300 organisms per m^3 during July and August when testing is expected to occur. A mean high of 96,530 organisms per m^3 was recorded in late July (Libby et. al., 2000, 2001, 2002a, b, c, 2003, 2004a,b, 2005). Using the higher value (96.53×10^3 organisms per m^3) along with estimated seawater use of 81,722 gallons or 310 m^3, approximately 2.986×10^7 zooplankton would be lost in test water. To put this in perspective, the expected loss (3.0×10^7 zooplankton) multiplied by the mean weight of a copepod (0.63×10^{-6} g; Ara, 2004) equals approximately 19 grams of zooplankton biomass. Effects of this loss of biomass on other trophic levels can be evaluated generally by recognizing that approximately 10% of the biomass consumed by one trophic level results in additional biomass in the next level (Sumich, 1988). Therefore the one time loss of 19 grams of zooplankton could result in the loss of less than 2 grams of planktivorous fish. This one-time loss of biomass via hydrostatic testing would not have a measurable effect on local food supply or on food web structure.

Impacts of Operation

Port operation would entail seawater uptake, which would have a minor, long-term adverse impact from entrainment of zooplankton. As noted above, data from MWRA's nearfield stations indicate that monthly average abundance of zooplankton over the course of the year captured on a 102-micrometer mesh ranged from 19.88×10^3 organisms per m^3 in December to 57.18×10^3 organisms per m^3 in June (Libby et. al., 2000, 2001, 2002a, b, c, 2003, 2004a,b, 2005).

Assuming sea water use of 150,600 m^3 per ship and 65 ships per year arriving uniformly over time, then 3.42 x 10^{11} zooplankton organisms might be lost annually as a result of entrainment. Based on the estimate of 0.63 x 10^{-6} g per organism, these would amount to 215,680 grams or 475 pounds of zooplankton. Based on the 10% trophic transfer rate, 47.5 pounds of planktivorous fish and 4.75 pounds of piscivorous fish biomass might be affected annually.

Another way to place this impact in perspective is to look at zooplankton loss via entrainment at the Seabrook (New Hampshire) Power Generating Station. Seabrook Station included microzooplankton in its monitoring program for its 600 mgd (2.3 million cubic meters) intake, which is over 100 times the uptake of an EBRV. After 7 years of monitoring operations, it was determined that the effects of the plant's operation were not distinguishable from natural variability and the program was dropped from subsequent studies (NAI, 1998). Bivalve larvae and macrozooplankton (including the majority of the hyperbenthos and many meroplankton species) are still monitored for Seabrook, but 13 years of operational monitoring have not indicated that the station has affected these components of the ecosystem (NAI, 2004b).

The regular disturbance of the seafloor by movement of the anchor cables while the ship was connected to the buoy would cause regular near-bottom turbidity events (see Appendix H – Anchor Chain Turbidity Analysis). As described for sediment disturbance during construction, however, it is unlikely that this action would affect the zooplankton community.

Ichthyoplankton

Impacts of Construction

Disturbance of soft substrate during construction would cause short-term, minor, direct, adverse impacts on early life stages of fish species whose eggs are demersal (near or on the sea bottom). Winter flounder, American sand lance, and Atlantic herring are the only species common in Massachusetts Bay with demersal eggs. It is unlikely that eggs of either sand lance or winter flounder would be abundant in the Port area because both species preferentially spawn inshore. American sand lance spawns on gravel substrates at water depths less than 6 feet or 2 meters (Auster and Stewart, 1986) and winter flounder typically spawn in water depths of less than 15 feet or 5 meters (Pereira et al., 1999). Atlantic herring eggs have not been found in Massachusetts Bay (Jury et al. 1994) so these are not likely to be abundant in the Project area.

Hydrostatic testing of the flowlines would cause minor, short-term adverse effects on fish eggs and larvae due to entrainment. Table 4-7 summarizes losses of ichthyoplankton that could result from entrainment during hydrostatic testing (see Appendix E Ichthyoplankton Entrainment Model Methodology and Results).

Table 4-7

Estimated Number of Fish Eggs and Larvae, by Species, Potentially Entrained During Filling and Hydrostatic Testing

Species	Mean Density Per 100 m^3 of water July - August		Number potentially lost in fill and test water	
	Eggs	Larvae	Eggs	Larvae
Atlantic Herring	0.00	0.00	0	0
Atlantic Cod	1.06	3.85	3	12
Haddock	0.08	0.28	0	1
Silver Hake	3.40	4.11	11	13
Pollock	0.00	0.00	0	0
Hakes	38.40	7.49	119	23
Cunner	5.15	9.80	32	30
Sand Lance	0.00	0.00	0	0
Atlantic Mackerel	0.10	4.15	0	13
Butterfish	8.85	0.35	27	1
Winter Flounder	0.00	0.00	0	0
Yellowtail	0.35	1.65	2	5
Lobster larvae	-	0.66		2
Hydrostatic Test Water (m3)	309			

The majority of the ichthyoplankton in the Port area would not be exposed to construction-related turbidity because they are likely to be located in the upper layers of the water column, while suspended sediments would largely be restricted to deeper waters. Species with demersal eggs (winter flounder, sand lance, and Atlantic herring) could be affected. However, they are not likely to be numerous in the Port area, and so the impact would be minor as well as short in duration.

Impacts of Operation

In determining the impacts of Project operations on ichthyoplankton, an assessment model was used. To assess those potential losses, data for Massachusetts Bay were obtained from NOAA's Marine Resources Monitoring, Assessment and Prediction (MARMAP) Program and their subsequent ECOMON ichthyoplankton sampling programs. Monthly arithmetic mean densities per 100 m^3 of water for each life stage were averaged over the year to obtain an annual mean density. Annual mean densities were multiplied by 1,506**,** the expected eight-day water use of each ship while at port in units of 100 m^3. Assuming the port would be used uniformly over the course of a year's time, the resulting "per ship total" was multiplied by 65 ships, the expected annual number using the facility. All entrained eggs and larvae were assumed to die as a result of entrainment.

To consider uncertainty in the estimates of mean density upper and lower 95% confidence limits around the mean were also multiplied by 1,506 -100 m^3 units and 65 ships. This was done for six species – Atlantic herring, pollock, cunner, sand lance, butterfish, yellowtail flounder **-** those species with the highest numbers of age 1 equivalents.

The results of this modeling show that the use of seawater for daily EBRV operations and ballast would cause minor, long-term, direct adverse impacts on ichthyoplankton via entrainment. Estimated losses of ichthyoplankton, and adult equivalent loss estimates (including upper and lower 95 percent confidence limits for certain species) are given in Tables 4-8 and 4-9. Equivalent yield to the fishery in pounds is shown in Table 4-10. Losses due to the operation of the EBRVs would occur as long as the Port was in operation. Because seawater use would be relatively low, ichthyoplankton entrainment would be correspondingly low and impacts on ichthyoplankton would be minor.

Indirect impacts on marine food webs could potentially occur by impingement and entrainment of eggs and larvae in the seawater intake. Food web effects can be assessed qualitatively by estimating the amount biomass lost at various trophic levels as a result of ichthyoplankton entrainment. This is done using MARMAP data on ichthyoplankton abundance in the Project area, along with estimates of the weight of ichthyoplankton (weight per fish egg or larva), and trophic transfer efficiency. The following are assumed: (1) the average weight of an individual fish egg is 0.0000348 pounds and the average weight of an individual fish larvae is 0.000898 lbs[2], and (2) the efficiency of energy transfer between tropic levels (i.e., levels on a food chain) is 10 percent (i.e., consumers gain approximately 10 percent of the weight of the prey consumed, Sumich, 1988).

Based on the MARMAP data, an average of 208 eggs and 75.5 larvae occur in 100 cubic meters of seawater (7,880 eggs and 2,860 larvae occur in one million gallons of seawater) in the Project area (See Appendix E Ichthyoplankton Assessment Method and Results). Based on a seawater intake of 39.78 million gallons (150,583 cubic meters) per call at Port, approximately 313,466 eggs and 113,770 larvae would be entrained per regasification event. If 65 ships call at the Port each year, water use would be about 2.6 billion gallons annually (9.8 x 106 cubic meters). This would lead to an estimated loss of 2,047,136 eggs and 743,071 larvae each year. Multiplying by the average weight of eggs and larvae, 32 kilograms (71 pounds) of egg biomass and 303 kilograms (667 pounds) of larval biomass would be removed from the food web annually. This would lead to a loss of about 33.5 kilograms of planktivorous fish annually.

In the Gulf of Maine, planktivorous fish that may consume fish eggs and larvae include species such as Atlantic herring, Atlantic mackerel, northern sand lance, and butterfish (Link and Almeida 2000). Other larval fish may consume fish eggs and larvae. Gelatinous zooplankton such as medusae and ctenophores also feed on fish larvae. Piscivourous fish in the Gulf of Maine include species such as goosefish (or monkfish), weakfish (or sea trout), and bluefish. Spiny dogfish (which also feed on ctenophores), cod, and pollock also feed on fish, but other prey items as well. All species have fairly diverse diets and do not depend on any single species for survival. Because of the relatively low biomass entrained and the diverse diet of most planktovorous fish in the Project area, indirect impacts on the food web that would result from the entrainment of ichthyoplankton would be minor.

Increased turbidity resulting from anchor sweep would cause minor, long-term, indirect effects on ichthyoplankton, as discussed in the prior section on zooplankton.

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[2] These weights are based on the average weights of eggs and larvae of 24 marine species (USEPA 2002)

Table 4-8

Estimated Number of Eggs, Larvae, and Equivalent Age 1 Fish and Lobster Annually Lost During EBRV Operations at the NEG Port

	Number Potentially Entrained															
	Per Ship			Per Year Assuming 65 Ships			Key Months		Adjusted Survival Rates (S) to Age 1				Annual Equivalent Age 1 Fish from Entrainment of Life Stage			
Species	Eggs	Yolk sac Larvae	Post Yolk sac Larvae	Eggs	Yolk sac Larvae	Post Yolk sac Larvae	Eggs	Larvae	Eggs	Yolk sac Larvae	Post Yolk sac Larvae	Age 0 Juveniles	Eggs	Yolk sac Larvae	Post Yolk sac Larvae	Total
Atlantic Herring		17,624	4,003	0	1,145,586	260,195	-	Oct - Dec	7.6350E-05	1.3157E-04	3.2455E-04	4.1450E-03	0	151	84	235
Atlantic Cod	6,724	1,476	667	437,060	95,940	43,355	Jan, Jun, Jul, Dec	Jan, Jun, Aug	2.8109E-06	7.0428E-06	2.7503E-05	5.5900E-04	1	1	1	3
Haddock	849	61	47	55,185	3,965	3,055	Apr - May	Jun - Jul	5.9872E-06	3.8978E-05		1.6947E-02	0	0.3		1
Silver Hake	14,830	1,039	1,734	963,950	67,535	112,710	Jun - Oct	Aug - Dec	8.0250E-06	3.3408E-05	4.8675E-04	7.7262E-02	8	2	55	65
Pollock	109,479	6,451	3,571	7,116,135	419,315	232,115	Oct - Feb	Oct - Feb	1.2970E-05	4.5449E-04		7.7960E-03	92	296		388
Hakes	20,793	632	4,298	1,351,545	41,080	279,370	Jun - Oct	Aug - Dec	4.7848E-06	1.0642E-05	2.8920E-05	6.0250E-03	6	0.4	8	15
Cunner	7,947	1,976	1,453	516,555	128,440	94445	Jun - Aug	Jun - Sept	2.5966E-03	7.4750E-03	1.7020E-02	1.1446E-01	1,341	960	1,394	3,909
Sand Lance	0	62,529	16,049	0	4,064,385	1,043,185	-	Dec - Apr	1.1029E-03	4.7323E-03	2.3195E-02	4.8510E-03	0	19,234	24,196	43,431
Atlantic Mackerel	121,855	5,231	1,905	7,920,575	340,015	123,825	May - Jun	June-July	6.2577E-06	2.3731E-05	1.4356E-04	2.8350E-03	50	8	18	75
Butterfish	2,521	50	254	163,865	3,250	16,510,	Jun & Aug	Aug - Sep	2.3801E-04	1.1317E-03	1.3975E-02	5.2935E-01	39	4	231	273
Winter Flounder	0	460	234	0	29,900	15,210	-	April - June	3.8953E-06	2.2393E-05	2.8775E-04	3.9100E-04	0	1	4	5
Yellowtail	5,175	579	557	336,375	37,635	36,205	Apr - Jun	May - Aug	5.2855E-04	1.8068E-03			178	133		378
Lobster	0	413		0	26,845		-	Jun - Sep	-	2.3299E-03				63		63

Table 4-9

Estimated Numbers of Fish Eggs, Fish Larvae, Equivalent Age 1 Fish and Lobster Lost Annually During EBRV Operations at the NEG Port Based on Upper and Lower Confidence Limits Around Each Respective Species Monthly Means in Massachusetts Bay.

		Number Potentially Entrained						Annual Equivalent Age 1 Fish From Entrainment of Life Stage			
		Per Ship			Per Year Assuming 65 Ships						
Species	**Values Based On:**	**Eggs**	**Yolk-sac Larvae**	**Post Yolk-sac Larvae**	**Eggs**	**Yolk-sac Larvae**	**Post Yolk-sac Larvae**	**Eggs**	**Yolk-sac Larvae**	**Post Yolk-sac Larvae**	**Total**
Atlantic Herring	Lower 95% CL	0	1,660	1,306	0	107,900	84,890	0	14	28	42
	Upper 95% CL	0	33,664	6,709	0	2,188,160	436,085	0	288	142	429
Pollock	Lower 95% CL	2,538	250	3	164,970	16,250	195	2	7		10
	Upper 95% CL	328,136	13,238	8,337	21,328,840	860,470	541,905	277	637		914
Cunner	Lower 95% CL	0	119	339	0	7,735	22,035	0	58	375	433
	Upper 95% CL	16,574	4,826	2,723	1,077,310	313,690	176,995	2,797	2,345	3,012	8,155
Sand Lance	Lower 95% CL	0	335	97	0	21,775	6,305	0	103	146	249
	Upper 95% CL	0	150,580	35,188	0	9,787,700	2,287,220	0	46,319	53,052	99,370
Butterfish	Lower 95% CL	0	0	188	0	0	12,220	0	0	171	171
	Upper 95% CL	7,610	118	354	494,650	7,670	23,010	118	9	322	448
Yellowtail	Lower 95% CL	954	41	0	62,010	2,665	0	33	5		38
	Upper 95% CL	9,439	1,225	1,399	613,535	79,625	90,935	324	308		632
Lobster	Lower 95% CL	0	140		0	9,100		-	21		21
	Upper 95% CL	0	678		0	44,070			103		103

Note: The six top species plus lobster shown in Table 4-8 are included here.

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Table 4-10

Numbers of Equivalent Age 1 Fish Potentially Lost Annually During EBRV Operations at the NEG Port and Equivalent Yield in Pounds That Could be Attributable to Them.

Species	Age-1 Equivalent (Number)	Equivalent Yield (Pounds)
Atlantic herring	235	24
Atlantic cod	3	1
Haddock	1	1
Silver hake	65	7
Pollock	388	970
Red/White Hake	15	3
Cunner	3,909	1
Sand lance	43,431	N/A
Atlantic mackerel	75	4
Butterfish	273	10
Winter flounder	5	3
Yellowtail flounder	311	141
Lobster	63	1,165
TOTAL	**48,774**	**2,330**

4.2.2.2 NEG Pipeline Lateral

Phytoplankton

Impacts of Construction

NEG Pipeline construction would cause minor, short-term, indirect adverse impacts on phytoplankton due to sediment disturbance and its effects on water quality. The proposed construction schedule (May through November) would produce the greatest sediment disturbing activities during the summer. Phytoplankton are most abundant during the early spring (February through March) and fall (September through December) blooms. Therefore the construction would not co-occur with the phytoplankton peaks. In addition, the water column position of phytoplankton (upper levels) relative to construction activity (seafloor) would help minimize impacts. Lastly, the phytoplankton community is not unique to Massachusetts Bay, but is a small part of the larger community characteristic of the Gulf of Maine. Any phytoplankton mortality within the NEG Pipeline Lateral corridor would likely be quickly replaced by members of the larger Gulf of Maine population.

Disturbance of bottom sediments could also include the release of nutrients from sediments, potentially stimulating phytoplankton productivity. Pipeline trenching and backfilling activities for most of the pipeline route would advance at rates of approximately 1 and 2 miles per day, and therefore any sediment or nutrient release would be spread out over the length of the pipeline route (more than 16 miles). In addition, plowing would cause a minimal amount of sediment resuspension, compared to dredging and jetting, because sediments would be cut out from under the pipe and rolled off to the side. Therefore, the release of nutrients from pipeline plowing would be temporary, small, and localized relative to the volume of the water within the construction area, and any adverse impact would be minor in extent and of short duration.

In comparison, a substantial increase in ammonium concentrations in Massachusetts Bay (27.5 tons of ammonia per day) (Wu, 2003) caused by an offshore wastewater discharge has not resulted in significant increases in phytoplankton biomass (Libby et al., 2004). The contribution of nutrients from the Massachusetts Bay (MWRA) outfall is much larger than any anticipated release from bottom sediments. Therefore, Pipeline construction would be unlikely to measurably cause a nutrient release resulting in an increase in plankton community productivity.

Impacts of Operation

Normal operation of the NEG Pipeline would have no direct or indirect impacts on finfish eggs and larvae. If a section of pipe needed to be exposed for maintenance work, the sediment disturbance and turbidity would likely be negligible and would not harm these life stages to a level even measurable as adult equivalents.

Zooplankton

Impacts of Construction

Pipeline construction activities would have minor, short-term, adverse impacts on the zooplankton community within the construction area. Some zooplankton may occur within the turbidity plume associated with jetting, but these plumes would occur over a short duration and limited spatial extent. The rapid dilution of the plume, as detected during HubLine construction water quality monitoring (TRC and NAI, 2004) and the limited extent of the plume (see Appendix G for the Sediment Transport Study), would keep these effects to a minimum. In addition, the movement of construction vessels and equipment during pipe lay, trenching, and backfilling precludes the development of a large plume in any one location.

Some zooplankton may be entrained into the water used during jetting and, given the high velocity at the exit ports, would experience mortality. However, this effect is localized to the pump intakes in an offshore setting and would occur for a few days along short discrete portions of the pipeline. The loss of these zooplankton would not affect the overall zooplankton community or any species that rely on this community as a food source, because the percent of the entire Massachusetts Bay community lost to entrainment would be so small.

If contaminants are present in bottom sediments, they could be suspended in the water column and exhibit some acute toxicity on zooplankton life stages in the area. Sediment chemistry sampling and analysis conducted for seafloor areas to be disturbed during construction (see section 3.5) indicate generally low levels of all contaminants.

Because most of the sediments along the Pipeline Lateral route are silty clay, adsorption and colloid formation, characteristic of these sediments, would likely result in minimal dissolution of contaminants into the water column and minimal exposure to marine organisms.

These physical processes, combined with efforts to minimize dispersal of sediments by plowing rather than jetting wherever possible, would minimize effects of any contaminated sediment resuspension on zooplankton. Furthermore, the zooplankton community is not unique but is a small part of the larger community characteristic of the Gulf of Maine. Any zooplankton mortality within the Pipeline Lateral area would likely be replaced by members of the larger Gulf of Maine population.

Impacts of Operation

Normal operation of the NEG Pipeline would have no direct or indirect impacts on finfish eggs and larvae. If a section of pipe needed to be exposed for maintenance work, the sediment disturbance and turbidity would likely be negligible and would not harm these life stages to a level even measurable as adult equivalents.

Ichthyoplankton

Impacts of Construction

Construction-related disturbance of the substrate would cause minimal, short-term impacts on early life stages of fish species whose eggs are demersal. American sand lance, winter flounder, and Atlantic herring are the only species common in Massachusetts Bay with this life history strategy. It is unlikely that eggs of either sand lance or winter flounder would be abundant in the Pipeline Lateral area because both species preferentially spawn inshore.

Fish eggs and larvae within the water column may be entrained within the approximately 81,722 gallons of seawater to be withdrawn from near the sea surface for hydrostatic testing. Entrainment analysis estimating ichthyoplankton losses due to hydrostatic testing of NEG Port and Pipeline components are summarized in Table 4-7. Assuming that construction would be initiated in May and hydrostatic testing of the pipeline would take place in the summer, a one-time total of 195 fish eggs and 98 fish larvae might be entrained and lost. Estimates of age-1 equivalent losses from entrainment of early life stages would result in the loss of less than one, age-1 fish for each species evaluated. Losses due to these one-time hydrostatic tests would therefore be minor.

Effects on the food web from entrainment of ichthyoplankton were discussed in the section on NEG Port operation above. The losses due to hydrostatic testing would be much less than the losses associated with ship operation and would therefore be minor.

Discharge of the seawater would cause minor, short-term, adverse impacts resulting from a localized plume that would be rapidly diluted in the open water setting of the pipeline corridor. The discharge water would be non-toxic and would not degrade water quality to an extent that affects marine organisms, including ichthyoplankton. The discharge of a greater volume of flood and hydrostatic test water on the recently completed HubLine did not result in any observable or measurable harm to marine life, and fish were observed swimming within 10 feet of the end of the discharge pipe for many hours during the discharge.

Minor, short-term adverse impacts could occur because of the small, localized turbidity plumes resulting from construction. But these would occur largely outside the portion of the water column with high ichthyoplankton abundance. In addition, these plumes would be located near the bottom and would therefore affect a small percentage of ichthyoplankton, which are more oriented to mid and surface water depths. Lastly, because plumes would only persist in any one location for a short period as the construction progresses along the pipeline, the duration of exposure to suspended sediments would be short.

Impacts of Operation

Normal operation of the NEG Pipeline would have no direct or indirect impacts on finfish eggs and larvae. If a section of pipe needed to be exposed for maintenance work, the sediment disturbance and turbidity would likely be negligible and would not harm these life stages to a level even measurable as adult equivalents.

4.2.2.3 Decommissioning

Minor, short-term adverse impacts on plankton could occur with decommissioning. An environmental review of any proposed Pipeline abandonment would be conducted by the FERC when the application to abandon was filed.

4.2.2.4 Impacts of Alternatives: Plankton

Vaporization Alternative

As an alternative to the closed-loop Heat Recovery System proposed for this Project, it could be technically feasible to use open-loop regasification. Open-loop mode requires substantial amounts of seawater, but would only operate during relatively warm-water months. From April through December, the open-loop STV on each EBRV would have a cooling and ballast water intake of 76 mgd. From January through March, a single EBRV would have seawater intake of 4.97 mgd for cooling/ballast water. The impact from the average daily seawater intake associated with this alternative would be approximately 15 times higher than operations during April through December that would occur using closed-loop vaporization. Therefore, the plankton that are most abundant from April through December would be the most heavily impacted. For certain ichthyoplankton, age-1 equivalent and equivalent yield estimates were evaluated under this vaporization alternative. Appendix E describes the analysis. Results are further presented in section 4.2.3.4.

Port Alternative

Along with the proposed site, one alternate site is being considered for the Port location. Section 2.2.2 describes characteristics of each port location. Since the two locations are indistinguishable in terms of plankton communities, there are no differences between the two locations in terms of impacts on plankton.

Drilled and Grouted Pile Anchor Alternative

Drilled and grouted pile anchors are a possible alternative to the proposed suction anchors. This alternative would cause increased impact on water quality and therefore on plankton. Additionally, drilled piles are not removable, and at the time of Project abandonment require abrasive jet cutting or explosive severing to achieve a seafloor clearance. Impacts from the use of this anchor option would be short-term and minor.

Pipeline Alternatives

Four alternate pipeline routes were developed for this Project (see section 2.2.5 for full description of alternate routes). Although Routes 1 and 4 are longer than Routes 2 and 3, they traverse only soft-bottom habitats. Both Routes 2 and 3 traverse areas of hard bottom (gravel and cobble). Construction within soft-bottom areas (Routes 1 and 4) would entail the simplest, most predictable and least sediment-disturbing construction methods. Given the presence of gravel, cobble and other hard substrate, and lack of thin surficial sediment layers within Routes 2 and 3, construction has a higher probability of requiring blasting, dredging or surface armoring. Additionally, more complex conditions present a higher potential for construction delays.

Though pipeline construction causes little impact to the plankton community, the alternates that entail the simplest and least sediment-disturbing construction methods (routes 1 and 4) would cause less of an effect on water quality and on plankton.

Construction Schedule Alternatives

A November through May construction schedule would impact phytoplankton during the early spring, when they are most abundant. At this stage of the constructions schedule, though, the plowing and jetting for the pipeline lateral would be over so disturbance would come from hydrostatic testing and installing the flowlines as well as the buoys. The plowing in December would disturb the end of the fall bloom.

A January through July schedule would only impact the spring bloom and would impact phytoplankton through plowing and backfilling of the pipeline lateral, as well as hydrostatic testing of the flowlines.

4.2.2.5 Mitigation and Minimization – Plankton

The following measures have been proposed as potential measures for mitigating and/or minimizing impacts to Plankton.

- In consultation with Secretary of EOEA, NEG is developing a compensatory mitigation program to offset 'life cycle' impacts resulting from the Project and is currently engaged in discussions to structure such a mitigation program.
- If a license is issued, the applicant will implement a mitigation plan according to the specific requirements of the plan designed by MARAD to offset the base-case impacts of the facility on Species of Concern. These efforts should be reasonable, timely and practical and designed to specifically counter the base-case impacts associated with the operation of the Port. Based on the results of the on-going monitoring required by the license, if approved by MARAD and FERC, the mitigation plan may be modified over time to better compensate for specific impacts.

4.2.3 Finfish Resources

Minor to potentially moderate, short- and long-term adverse impacts to finfish resources would result from construction and operation of the NEG Project. Construction impacts would occur because of disruption of benthic habitat and increased water column turbidity. Operation impacts would be caused by disruption of habitat by cable sweep, uptake of ichthyoplankton in seawater withdrawn for ship operations and ballast, and discharge of heated water and wastewater. Impacts can be either direct or indirect. Direct impacts include those that directly affect fishery resources - for example smothering by sidecast sediment or entrainment in cooling water intake. Indirect impacts occur via impact on another resource that affects fishery resources. An example would be a reduction in benthic food sources for demersal species.

This section considers the following types of impacts:

- General impacts on finfish due to construction and operation activities;
- Potential for direct disturbance of both pelagic (water column-dwelling) and demersal (bottom-dwelling) fish species;

- Potential impacts on fish via ongoing disturbance of benthic habitat due to anchor chain sweep in the Port area;
- Potential impact on pelagic species via impingement and entrainment of early life stages (eggs and larvae) during withdrawal of seawater for construction and operation activities;
- Potential impacts of water quality changes from discharges of thermal effluent, wastewater, or accidental spills.

Note that effects on essential fish habitat are not discussed in this section. EFH is discussed in section 4.4 and Appendix F (EFH Analysis).

4.2.3.1 Evaluation Criteria

Evaluation of impact on fisheries resources is based on a number of factors: 1) the ecological, legal, commercial, recreational, or scientific importance of the resource, 2) the proportion of the resource that would be affected, relative to its occurrence in the region, 3) the sensitivity of the resource to the proposed activities, and 4) the duration of the ecological impacts.

Impacts on fisheries resources can be considered major if important resources would be adversely affected over large areas relative to a species' distribution or overall population diversity within the Project area. Impacts can also be considered major if disturbances would:

- cause reductions in population size or changes in distribution of important species;
- introduce new, invasive species to an area;
- result in substantial long-term loss of existing aquatic habitat;
- cause substantial deterioration of existing fish habitat;
- substantially interfere with the movement, range, spawning or nursery site of any resident or migratory fish; or
- involve the use, production, or disposal of materials that pose a hazard to fish populations in the Project area.

Impacts on fish are discussed in general terms in this section. More specific effects on each species are discussed in Appendix F, Essential Fish Habitat.

4.2.3.2 NEG Port

Impacts of Construction - Finfish

Minor, short-term direct and indirect adverse impacts to the fisheries resources would occur due to NEG Port construction. These impacts would include the temporary loss of the silt-clay habitat and disturbance of the surrounding areas due to increased turbidity. Fishes most likely to be affected by construction activities would be those that prefer soft substrate habitat in relatively deep water. There are 11 fish species present in the Port area that prefer soft substrate: butterfish, goosefish, redfish, red hake, silver hake, smooth skate, thorny skate, white hake, winter flounder, witch flounder and yellowtail flounder. The response of these species would vary depending on life history and behavior patterns.

Demersal species that are closely associated with the bottom such as the flounders and skates would be more directly affected than others. Impacts would likely include mortality, if they came in direct contact with construction activities. Fish that have a more pelagic lifestyle (e.g. butterfish, Atlantic herring, and Atlantic mackerel) are strong swimmers, and are expected to be able to avoid construction equipment and areas of high turbidity.

For some species, the temporary increase in turbidity associated with construction may cause minor to moderate, short-term adverse effects (see Appendix G for analysis of turbidity associated with pipeline construction). Quantifying the potential impacts of increased suspended sediments on fish is a challenge. In situ sediment characteristics, local hydrodynamics, and distribution of the organisms in space and time all interact to affect the "dose" or level of suspended sediment the local biota experience (Wilber and Clarke, 2001). Few relevant data are available for biological responses of adult offshore fish to suspended sediments within the range of concentration and exposure durations expected in the Project area. Existing data from studies of estuarine fish clearly show a high degree of variability in response, with reports of "no effect" made at concentrations as great as 14,000 mg/L for durations of 3 or more days (oyster toadfish and spot) while mortality was observed at a concentration/duration combination of 580 mg/L for 1 day (Atlantic silversides, Wilber and Clarke, 2001).

Laboratory study suggests fish exhibit avoidance behavior when exposed to high levels of suspended sediment. Newcombe and Jensen (1996) subjected a variety of fish species to suspended sediments at various concentrations. They then rated impacts on a scale that included no effects, behavioral effects, sublethal effects, and lethal and paralethal effects (Newcombe and Jensen, 1996). Usually, the severity of the impact increased with increasing suspended sediment concentration and duration of exposure. At low concentrations and exposure times, only behavioral effects such as avoidance and alarm reactions occurred. At extremely high concentrations, reduced growth rates and mortality occurred. These findings imply that most fish would use behavioral mechanisms to avoid areas of high suspended sediment that may cause lethal or paralethal effects, assuming that the turbidity plume is not so large as to completely prevent escape. Because of uncertainty in response, and because there would be a temporary sharp increase in suspended sediment concentrations in the water column (especially where jetting is required), this impact would be minor (plowing) to potentially moderate (jetting). This impact would only occur during construction and would not cause an extended adverse impact over time.

Entrainment of early stages (eggs and larvae) of pelagic species during hydrostatic testing of flowlines and buoys would cause a minor, short-term, adverse impact. This is further discussed in section 4.2.3.1.2, and Appendix E.

During construction, contaminants that could be mobilized by construction activities may affect fish directly, and/or accumulate in the food chain. However, this would be a very low probability event. Although there is a long history of disposal of dredged material and solid wastes in western Massachusetts Bay, the proposed Pipeline Lateral route avoids these areas. Site-specific sampling showed contaminant levels below the Probable Effects Level (PEL) for most of the construction area, and little risk of impacts on water quality or biological resources (see section 4.1.1.2).

Short-term, minor, indirect adverse impacts from Port construction include the reduction in benthic invertebrate food sources for demersal fishes. However, this would only occur if food resources were a limiting factor to production of demersal fishes, which may not be the case. Assuming the worst-case scenario that demersal fish production is limited by food resources, an estimated 33 acres (13.4 hectares) of soft bottom invertebrate habitat would be disturbed in the Port area and might not be available as a food resource during construction. Resultant impacts on fishes would be minor and of short duration.

Pelagic species such as Atlantic herring feed in the water column, so disturbance of bottom habitat would not be as important as the effect on bottom feeders. Pelagic species such as

Atlantic mackerel that can also feed on the bottom-dwelling organisms would be affected by the temporary loss of benthic habitat. Because the area of disturbance is small compared to adjacent available habitat, and because construction-related disturbance is temporary, adverse impact to both demersal and pelagic fishes in the area would be minor.

Impacts of Operation - Finfish

Port operation would cause minor, long-term, direct adverse impacts to finfish resources. During operation of the NEG Port, bottom sediments used by fish for feeding and spawning would be regularly or permanently disturbed by scour due to movement of the mooring wire rope and chains. When an EBRV was on the buoy, an estimated 43 acres (17.2 hectares) of bottom would be disturbed as the mooring equipment was dragged across the bottom due to the EBRV weathervaning into the prevailing wind. When disconnected, just 4 acres (1.6 hectares) would be disturbed because the mooring wire rope and chains would settle onto a relatively small footprint on the bottom.

The disturbance of soft substrate by the mooring wire rope and chain when the EBRVs are on the buoy would be the primary long-term adverse impact to bottom habitat due to the operation of the Port. If the two buoys were used consecutively, as is planned, the benthic community would be unlikely to recover between uses. This disturbance would continue for the life of the Port. Demersal fishes, including skates, sculpins, and flounders, that came in direct contact with the mooring wire ropes and chains could potentially be injured or killed, but would probably move clear of the area. Other demersal fishes that do not have such a close association with the bottom, such as members of the cod family and redfish, would be able to avoid the mooring wire ropes and chains. Operation of the NEG Port could, as a worst-case estimate, effectively exclude much of the demersal fish community from approximately 43 acres of habitat. Pelagic fishes would not be directly affected by this habitat exclusion because they occur in the water column and be able to avoid the mooring wire ropes and chains.

Impingement of fish in the seawater intakes of the EBRVs would cause minor, long-term, direct adverse impact. Seawater intake volume is discussed in section 4.1.2.2. For the majority of time, the through-screen velocity would remain below 0.5 ft/sec, which is low enough to allow most fish to take evasive actions and would minimize impingement effects. For four hours on the first and last day an EBRV was at the Port, however, water intake would be approximately 0.82 feet per second. Because the water intakes are located at depths of approximately 20 to 30 feet (7 to 10 meters), only pelagic fish would be subject to impingement, and in small numbers.

As discussed in section 4.2.2, use of seawater for daily EBRV operations and ballast would cause minor, long-term, direct adverse impacts on finfish due to entrainment of ichthyoplankton. Estimated losses of ichthyoplankton, and adult equivalent loss estimates are given in Tables 4-8 and 4-9. Methods used to calculate these losses are given in Appendix E.

To put entrainment mortality in perspective, it was compared to mortality due to the commercial and recreational fish harvest for Massachusetts in recent years. To do this, it was necessary to convert the number of fish entrained to the equivalent yield (biomass equivalent to the number of fish lost) for each species. Table 4-11 shows the comparison between the annual equivalent yield estimates and the average total harvest (commercial and recreational) for the Commonwealth of Massachusetts. Entrainment-related losses from Project operations would be measured in the tens of pounds, where losses due to fishing are measured in the thousands and millions of pounds

Table 4-11
Average (1990-2004) Massachusetts Commercial and Recreational Landings for Assessed Species

Species	Commercial Landings (lbs)	Recreational Landings (lbs)	Total MA Landings (lbs)	Equivalent Yield (lbs)
Atlantic Herring	45,341,890	0	45,341,890	24
Herring Confidence Limits				4 - 44
Atlantic Cod	29,851,707	2,922,842	32,774,549	1
Haddock	5,750,278	0	5,750,278	1
Silver Hake	4,864,613	0	4,864,613	7
Pollock	5,656,206	180,012	5,836,217	970
Pollock Confidence Limits				25 - 1,941
Red/White Hake	3,911,211	0	3,911,211	3
Cunner	496	18,145	18,641	1
Cunner Confidence Limits				<1 - 3
Sand Lance	0	0	0	N/A
Atlantic Mackerel	7,521,613	1,422,596	8,944,209	4
Butterfish	66,022	0	66,022	10
Winter Flounder	9,229,976	147,993	9,377,968	3
Yellowtail Flounder	10,034,420	0	10,034,420	141
Yellowtail Confidence Limits				17-286

N/A – Not Applicable because there is no commercial or recreational fishery for this species.

Concerns were raised over the appropriateness of using state landings as a means of comparison because of the large area the data covers when compared to the proposed Project NAA. A smaller area, NMFS reporting Area 21, was also analyzed for comparison with NEG entrainment losses since comparisons with state landings could underestimate potential impacts. Figure 4-1 shows the Area 21 reporting area that was used as a comparison for the Project area. Landings data for Area 21 were provided by NOAA Fisheries for the fishing years 2002 and 2003. This area is roughly 11,700 acres in size, and the loss predicted from the NEG Project would be less than 0.01% of the landings provided for Area 21 (Table 4-12). Therefore impacts on finfish resources would be minor.

Table 4-12
Total Landings for Immediate Project Vicinity

Species[2]	Fishing Year[3]	Annual Landings	NEG Equivalent Yield as a Percentage of NMFS landings for Area 21
Multispecies	2002	203,654	0.005%
Multispecies	2003	219,457	0.005%

[1]- NOAA, 2005 – Data provided by NOAA fisheries, for details see Appendix J
[2] - Species include fish regulated under Northeast Multispecies Fishery Management Plan: Cod, Haddock, Yellowtail flounder, American Plaice, Witch flounder, Windowpane, Redfish, White hake, and Pollock
[3]- Fishing year is from May to April (i.e. fishing year 2002 is May 2002 to April 2003)

Figure 4-1. Location of NMFS Reporting Area 21 in Relation to the NEG Port Site.

Indirect impacts of NEG Port operation would include disturbance of benthic invertebrate food sources for demersal fishes. However, this indirect impact would occur only if food resources limit production of demersal fishes. Assuming the worst-case scenario that demersal fish production was limited by food resources, an estimated acres (17.2 hectares) of soft bottom invertebrate habitat would not be available as a food source during the operational lifetime of the Port. Since this area is small relative to available area in the region, this impact would be minimal.

It is possible that the discharge of heated water from the EBRVs could cause pelagic fishes and their prey to avoid the discharge plume. Since the size of the plume would be small and the temperature rise minimal (see section 4.1.2.2), this would be a long-term, minor, indirect impact.

Displacement of Fishing Effort

Displacement of fishing activity from the NAA around the NEG Port could potentially cause increased fishing in adjacent areas. Evaluating the ecological impact to finfish as a result of displacement of fishing effort depends on the type of fishery, the areas to which displaced vessels move, and the extent to which the fishery intensifies in a given area, or changes as a result of displacement from the port area. Displaced fishing effort is not expected to be a major problem in the Project area for two reasons. First, the NAA is a small portion of the available fishing area (the geographic area of the NEG Port's NAA would be less than percent of the geographic area of Statistical Block 125). Second, NOAA landings data indicate that the level of fishing activity occurring in the Project area is low compared to overall fishing activity in Massachusetts Bay (See section 3.8), and as a result, any fishing activity displaced from the Project area would create a minor increase in fishing effort in other areas. In addition, displaced gear would be subject to current and future use restrictions and conservation measures.

Impacts of Decommissioning - Finfish

Decommissioning would require the removal of NEG Port structures, including the buoys, anchors, and flowlines (see section 2.2.1.4 for a discussion of Port decommissioning). Short-term, minor adverse impacts to fish and fish habitat that could result from decommissioning activities would be caused by physical disruption of substrate, increased turbidity, and fuel spills and would be similar to those encountered during Port construction.

4.2.3.3 NEG Pipeline Lateral

Impacts of Construction - Finfish

Short-term, minor to moderate, direct and indirect impacts on finfish resources would occur during pipeline construction. Direct impacts to fish species due to Pipeline Lateral construction would include 1) temporary loss of habitat within the trenching and spoil areas along the centerline and 2) disturbance of the surrounding areas due to increased turbidity and sediment deposition. Fishes that feed and spawn in clay to medium sand would be most affected by the construction, because the majority (approximately 92 percent) of the Pipeline Lateral would pass through clay to medium sand substrate (see sections 3.5 and 4.5 for a description of geology and soils in the Project area). Indirect impacts would include the temporary loss of benthic prey during construction.

Juvenile and adult demersal species with low mobility in the immediate path of the trench or the anchors could be killed, although noise and vibrations in the work area would probably cause them to avoid the area. Some individuals adjacent to the trench could be buried. Fish that feed by filtering microorganisms out of the water column, such as Atlantic herring, may experience clogging of gills when a construction-related turbidity plume passed near them. However, these fish would be able to avoid construction activities and the associated increases in turbidity (Newcombe and Jensen, 1996). In addition, the increase in turbidity would be minimal, since most of the pipeline installation would be done by plowing. Noticeable increases in turbidity would primarily occur within the relatively small areas of jetting. Plowing, in contrast, would not produce any major increases in turbidity. Monitoring during HubLine installation showed no significant increase in turbidity during plowing (TRC and NAI 2004).

Habitat for demersal eggs and adults would be temporarily disturbed in the immediate pipeline vicinity. Commercially-important species with demersal eggs include winter flounder (present January through June but generally in shallower in-shore waters), ocean pout (present August through December), and Atlantic herring (present July through December). However, the deep water and soft substrate found along the Pipeline Lateral corridor is not preferred habitat for egg deposition for any of these fishes. Late stage larvae of winter flounder (present February through August, although typically found inshore) and ocean pout, whose eggs hatch directly into juveniles (November through February), are also demersal. Short-term reductions in water quality, including increased turbidity and habitat loss, would have an adverse effect on larval life stages, as they are unable to move quickly away from adverse conditions.

Appendix G (Sediment Transport Study) provides information related to the extent of likely impact on demersal fish and eggs. The study showed that, in plowed areas, a temporary mound would exist on either side of the trench, extending approximately 10 ft on either side. This would be immediately placed over the pipe during backfilling, and would temporarily form a small mound, until it settled. Demersal eggs could potentially be smothered under the trench, though the aerial extent of trenching is small relative to available habitat in the region. Analysis of storm-induced erosion shows that these mounds are highly stable even under 100-yr storm conditions. In the few areas where jetting would be required, sediment dislodged due to jetting would fall farther from the trench. The extent of sediment transport and deposition thickness depends on tides and currents. Under slack tide conditions the sediment thickness would be greater, but dispersion would be less than that during ebb flow. Under both scenarios the maximum sediment thickness would be less than 2mm and the maximum dispersion approximately 1.5 nautical miles. This would cause short-term adverse impacts on demersal eggs and adults in the vicinity of jetting.

Adult demersal fish species that feed on benthic infauna and epifauna include Atlantic cod, haddock, pollock, yellowtail, windowpane, witch and winter flounders, American plaice, Atlantic halibut, hakes, scup, redfish, black sea bass, goosefish (monkfish), and silver hake (whiting). The temporary loss of benthic food due to sediment disruption or burial with sidecast material could cause a minor, short-tem, indirect adverse impact due to reduction in fish forage in disturbed areas along the pipeline corridor. However, this indirect impact would only occur if benthic food resources were a limiting factor to demersal fish production. Assuming the worst-case scenario that demersal fish production was limited by food resources, an estimated 1,000 acres of habitat would be disturbed in the Pipeline Lateral corridor and would not be available as a food source for demersal fishes during construction, and for a relatively short time after construction while recovery occurs. It should be noted that the actual area disturbed at any given time would be much less than 1.000 acres as construction proceeds along the pipeline. This impact would be minor for most species, but could be considered moderate if yellowtail or cod were affected. This would also last until recruitment and recolonization of sediments increased the abundance of benthic prey. Demersally feeding finfish that initially moved away from the construction area could be attracted back to the area because of short-term increased feeding opportunities due to disruption of benthic fauna.

With regard to pelagic fishes, the disturbance of bottom habitat would cause minor, short-term adverse impact, since benthic habitat is not as important for species that feed in the water column. Pelagic species, such as Atlantic herring, should not be affected. However some pelagic species, such as Atlantic mackerel, that can feed on the bottom-dwelling organisms could be affected by the temporary alteration of this habitat.

Pelagic larvae and adults would be minimally affected by physical contact with construction equipment. Adult species would avoid construction activities and be only temporarily displaced into nearby areas. Pelagic larvae might be unable to avoid increased turbidity and suspended solids and could therefore be adversely affected. However, diminished water quality would be temporary and restricted to a limited area near the construction zone.

In certain very small areas, permanent changes would occur in substrate (i.e., soft-sediment areas converted to hard substrate by the placement of concrete mats at the two cable crossings, about 0.06 acres in aerial extent). For the vast majority of the Pipeline Lateral route, however, habitat changes would be temporary.

Accidental spills and unintentional release of substances such as diesel fuel, lubricants, and hydraulic fluid could potentially cause minor, short-term, direct, adverse impacts on fish. However, the Project would be required to have an approved SPCC Plan which would serve to minimize potential for, and impacts from, spills.

Construction could cause disturbance of contaminated sediments and related effects on fish. As noted in the section above on NEG Port construction, this is unlikely and impacts would be minor.

During Pipeline Lateral construction, ichthyoplankton would be entrained in the hydrostatic test water. Estimated entrainment and adult equivalent losses are shown in Table 4-12, Appendix F, EFH Analysis, and Appendix E, Ichthyoplankton Assessment. Entrainment effects would be minor for all species evaluated.

Impacts of Operation - Finfish

For the vast majority of the operational lifespan of the pipeline lateral, no impacts to juvenile and adult fish, including commercially or recreationally important species, would occur. However, minor, short-term, adverse direct and indirect impacts could occur if and when any pipeline sections require maintenance.

Impacts of Decommissioning – Finfish

As currently identified, upon decommissioning the pipeline would be cleared of gas, capped, and abandoned in place. An environmental review of any proposed Pipeline abandonment would be conducted by the FERC when the application to abandon is filed. Impacts associated with abandonment, however, would be minimal.

4.2.3.4 Impacts of Alternatives – Finfish

Vaporization Alternative

As an alternative to the closed-loop Heat Recovery System proposed for this project, it would be technically feasible to use open-loop regasification. Open-loop mode requires significant amounts of seawater, but would only operate during relatively warm-water months. From April through December, the open-loop STV on each EBRV would have a cooling and ballast water intake of 76 mgd. From January through March, a single EBRV would have seawater intake of 4.97 mgd. The impact from the average daily seawater intake associated with warmer months would be approximately 15 times higher than operations during colder months.

Therefore, the plankton that are most abundant from April through December would be the most heavily impacted if the open-loop system were used. For certain ichthyoplankton, age-1 equivalent and equivalent yield estimates were evaluated under this vaporization alternative. Appendix E describes the analysis. For comparison, Table 4-13 also presents equivalent yield as a percentage of average Massachusetts landings from 1990-2004. Table 4-14 shows equivalent yield as a percentage of landings in Area 21.

Table 4-13

Age-1 Equivalent and Equivalent Yield Estimates and Equivalent Yield Expressed as a Percentage of Average (1990-2004) Massachusetts Landings Associated with the Open-loop STV Alternative

Species	Age-1 Equivalents (Number)	Equivalent Yield (Pounds)	Equivalent Yield as a Percentage of Average Massachusetts Landings from 1990-2004
Atlantic Herring	798	81	0.000179%
Atlantic Cod	8	3	0.000009%
Haddock	2	2	0.000035%
Silver Hake	228	26	0.000534%
Pollock	367	918	0.015729%
Urophycis spp.	48	8	0.000205%
Sand Lance	16,389	0	N/A
Cunner	11,972	4	0.021458%
Yellowtail Flounder	994	451	0.004495%
Butterfish	451	17	0.025749%
Atlantic Mackerel	2125	113	0.001263%
Winter Flounder	17	10	0.000107%

Note: N/A – not applicable because there is no commercial harvest of sand lance.

Table 4-14

Total Landings for Immediate Project Vicinity for Open Loop Vaporization

Species[1]	Fishing Year[2]	Annual	NEG Equivalent Yield as a Percentage of NMFS landings for Area 21
Multispecies	2002	203,654	0.008%
Multispecies	2003	219,457	0.007%

1 - Species include fish regulated under Northeast Multispecies Fishery Management Plan: Cod, Haddock, Yellowtail flounder, American Paice, Witch flounder, Windowpane flounder, Redfish, White hake, and Pollack
2- Fishing year is from May to April (i.e. fishing year 2002 is May 2002 to April 2003)

Port Location Alternative

Along with the proposed NEG Port location, one alternative site is being considered. Section 2.2.2 describes characteristics of each location. Both sites are characterized by a low-energy, depositional environment with a relatively uniform sediment (primarily silt-clay with varying degrees of fine sand). The mooring anchors could be sited at both sites to avoid impacts on the hard-bottom areas from anchor installation or anchor line scouring.

The major difference in potential fish habitat impacts between the port sites is the amount of area that would be disturbed by the installation of the Pipeline Lateral, and the footprint of the proposed port. Location 1, the applicant's proposed site, would require a longer pipeline (16.1 miles) to connect with the HubLine than Location 2 (10.7 miles), which could result in greater short-term impacts to fish and benthic habitat depending on bottom conditions within the pipeline corridor. Location 2 would require a larger foot print (63 acres) than Location 1 (43 acres) which would result in a greater long-term impact. These differences are discussed in more detail in section 2.2.5.

Drilled and Grouted Pile Anchor Alternative

Drilled and grouted pile anchors are a possible alternative to the proposed suction anchors. This alternative would involve drilling through both sediment and rock to a depth where a pile anchor could be used for the proposed Port. The drilling process would create a washout area at the seafloor, and the material drilled from the hole would create a spoils area down current that would increase impact on fish habitat. Additionally, drilled piles are not removable, and at the time of Project abandonment would require abrasive jet cutting or explosive severing to achieve a seafloor clearance. Even so, the use of these anchors would cause minor short-term impacts.

Pipeline Route Alternatives

Four alternate pipeline routes were evaluated for this project (see section 2.2.5 for full description of alternate routes). Although Routes 1 and 4 are longer than Routes 2 and 3, they traverse only soft-bottom habitats. Both Routes 2 and 3 traverse areas of hard bottom (gravel and cobble). Given that soft-bottom habitats generally support fewer important commercial species and tend to recover more quickly after disturbance than hard-bottom habitats, the impacts on finfish resources would be less along the soft-bottom routes.

Construction within soft-bottom areas (Routes 1 and 4) would entail the simplest, most predictable and least sediment-disturbing construction methods. Given the presence of gravel, cobble and other hard substrate, and lack of thin surficial sediment layers within Routes 2 and 3, construction has a higher probability of requiring blasting, dredging or surface armoring. Additionally, more complex conditions present a higher potential for construction delays. As a result, routes 2 and 3 would be expected to cause increased impact on fish and benthic habitat.

Construction Schedule Alternatives

Based on the results of the month-by-month analysis of construction related effects, and the analysis of each species' and life stage's seasonal abundance in the Project area, it is not possible to select a single, continuous, seven-month construction window that optimizes protection of all species and life stages of concern concurrently. Allowing construction from November through May would minimize impacts to the greatest number of species of concern, and would be most protective of all Federally-protected species (marine mammals and sea turtles) as a group. Allowing construction from May through November would be most protective of the critically endangered North Atlantic right whale and fin and humpback whales, but would be less protective of sei whales, blue whales, sea turtles and some fish species.

The only finfish life stages that would be susceptible to entrainment impacts would be eggs and larvae. Eggs and larvae of the species included in Table 4-11 have the potential to occur in the Project area. Of these species only the yellowtail flounder is strictly demersal, so the habitat-related effects of the Project would have the most potential to impact this species. Thus, the Project schedule that would be most protective of finfish would avoid hydrostatic testing during seasonal peaks in ichthyoplankton abundance, as well as bottom-disturbing effects during peaks in juvenile and adult yellowtail flounder abundance.

A May through November construction period would occur during peak spawning periods for several species of commercially important fish, the soft substrates along pipeline Routes 1 and 4 are not preferred egg deposition habitat for these fish species. Furthermore, sediment suspension caused by pipeline trenching would be minimized by the use of a plow, which would restrict the area and duration of bottom-disturbing activities when compared to the effects of dredging or jetting. Additionally, bottom fishing and gillnetting would be prohibited in parts of the Project area for May and June, and the best weather of the year occurs in the summer months in Massachusetts Bay. As a result, the duration of construction is least likely to be delayed due to bad weather than in any other season.

Juvenile and adult yellowtail flounder are common in the Project area year-round, so time-of-year restrictions would not be a useful tool for managing impacts to this species. The January through July construction window would mean that hydrostatic testing would occur during spring when ichthyoplankton densities are increasing. This schedule would avoid periods of peak abundance for the eggs and larvae of lobsters and sea scallops, but would include the beginning of the spring peak of the eggs and larvae of yellowtail flounder, and the end of the winter peak of egg and larval stages of Atlantic herring.

4.2.3.5 Mitigation and Minimization – Finfish

The following measures have been proposed as potential measures for mitigating and/or minimizing impacts to Finfish.

- Impingement and entrainment would be reduced through reduced velocity and intake screens to the extent practicable.
- Water use at the proposed Port would be reduced by re-circulating ballast water in the regasification process.
- FERC staff is recommending that monitoring of egg and fish mortality be incorporated into a Monitoring and Mitigation Plan for the Project, developed through consultation with the appropriate regulatory agencies.

4.2.4 Non-Endangered or Threatened Marine Mammals

The impacts to non-endangered marine mammals and sea turtles found in the proposed Project area are discussed in this section. The impacts are considered separately for construction, operation, and decommissioning. Following the impacts analysis for the proposed Project, a summary of mitigation measures is included. Impacts to Threatened and Endangered marine species are discussed separately in section 4.3.

4.2.4.1 Evaluation Criteria

The following types of impacts have been considered: physical harassment, vessel strikes, alteration to habitat, acoustic harassment, alteration of prey species abundance and distribution, entanglement, ingestion of marine debris, fuel spills, impingement and entrainment, and bioaccumulation.

Physical Harassment

The term "harassment" is defined in the MMPA to include any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. Level A Harassment refers to the potential to injure, whereas Level B Harassment refers to the potential to disturb. The physical harassment addressed under this heading for all three phases of the Project (construction, operation, decommissioning) refers to Level B Harassment, excluding acoustic harassment. Aspects of acoustic harassment and Level A Harassment (vessel strikes and entanglement) are addressed separately under their respective headings. Projects resulting in Level A Harassment generally represent direct or indirect, major, adverse impacts to marine species, especially those that are threatened and endangered. Projects resulting in Level B Harassment may result in direct or indirect, minor to moderate, adverse impacts to marine species.

Vessel Strikes

Two ships operating in close proximity induce hydrodynamic forces on each other that can lead to collisions. These forces increase with ship speed and size. Some studies have indicated that whales, when exposed to the hydrodynamic forces of large ships, may be drawn into the path, thus colliding with the ship (Knowlton et al. 1995). Most ship strikes are fatal to marine mammals (Jensen and Silber, 2004), and vessel collisions are considered the greatest threat to the survival of baleen whales (Wiley et al. 1995). Vessel strikes, especially with threatened and endangered marine species, represent a direct, major, adverse impact resulting in Level A Harassment.

Of the 14 non-threatened or endangered species listed in Table 3-19, only the minke whale, harbor seal, and harp seal have been identified as being at risk for vessel collisions (Waring et al., 2004). Minke whales inhabit coastal waters during much of the year and are subject to collision with vessels.

Alteration to Habitat

Habitat areas for marine species include the water column within which they live, and for some species, it also includes the seafloor that supports a food source and behavioral activities. Direct alterations to the water column habitat can be caused by changes in water temperature, salinity, and suspended sediment. Alterations to the seafloor habitat can be caused by changes in sediment quality and composition as well as bathymetry. The installation of marine infrastructure can also result in permanent removal of habitat for marine mammals.

Marine mammals are warm-blooded and generally able to maintain a constant body temperature, allowing them to migrate over great distances through various water temperatures without adverse effects. As such, localized and short-term changes in water temperature, as might be caused by marine industry, are not known to significantly impact the activity of marine mammals. Changes in water column salinity are also not known to significantly impact the activities of marine mammals as they have a variety of mechanisms to control osmosis and the salt content of their cells.

Acoustic Harassment

NMFS has established guidelines for what constitutes harassment and acoustic takes on marine mammals under the MMPA and the ESA. Two levels of acoustic harassment have been defined in the MMPA: The current thresholds are 180 dB for Level A harassment, and 160 dB (impulse) and 120 dB (continuous) for Level B harassment. Whenever noise exceeds these thresholds, the potential for significant adverse impacts to marine mammals exists. On January 11, 2005 (FR Vol. 70, No. 7, p. 1871), the NMFS published a Notice of Intent to prepare an EIS to investigate the application of new criteria in guidelines to define what constitutes harassment as a result of exposure to anthropogenic noise in the marine environment. Therefore, the criteria listed above may change.

There are many natural sources of sound in the ocean including ocean currents, sea animals, and low-level seismic activity. Shipping noise is the primary human-related noise source in the marine environment. However, ambient underwater noise is most directly correlated to atmospheric wind and the resulting wave action that is strongly influenced by the physical characteristics of the area including water depth, ocean bottom topography, and proximity to shore. Existing ambient sound levels at the NEG Port site were estimated using standard acoustic engineering guidelines and published literature, accounting for Port site characteristics and shipping traffic. Existing underwater sound levels were calculated to range from 103 to 117 dB and are a function of wind speed and sea state, and include both natural and far field noise of ships operating in Massachusetts Bay. The lower value corresponds to calmer sea conditions. This ambient range was used as a reference point for evaluating the potential impact of the underwater noise associated with port and pipeline construction, operation, and decommissioning.

Alteration of Prey Species Abundance and Distribution

Alterations to the abundance of food source and/or distribution for marine mammals can have indirect, minor to major, adverse effects on the feeding and migration patterns for these species. Most marine mammals are thought to migrate in response to food source, and thus the movement of these mammals is related to prey species abundance and distribution (Reeves et al., 1998; Wilson and Ruff, 1999). For example, scientists have noticed a shift in preferred habitat for the humpback whale in the Stellwagen Bank area of Massachusetts Bay, which is believed to be due to changes in the distribution of available food (Hyot, 2005). Impacts to marine species prey from marine industry are generally related to impingement and/or entrainment at water intake structures. Ancillary impacts can result from changes in water quality (temperature, turbidity, etc.) and/or bottom sediments. As the diet of marine species ranges from the smallest zooplankton up through and including larger schooling fish, the impacts to many different species must be considered. The removal of large numbers of marine mammal prey species or changes in their distribution, when compared with the average annual mammal food consumption, would result in indirect, major adverse impact.

Entanglement

Marine mammals and sea turtles can be injured or killed from marine entanglements. Entangled animals may exhaust themselves and drown, lose their ability to catch food or avoid predators, incur wounds and infection, or engage in destructive behaviors (Laist et al., 1999). Most marine mammal and sea turtle entanglements occur due to interactions with fishing gear. Cetaceans and pinnipeds have been caught in association with set nets, lobster/crab trap lines, and long lines. Marine mammals and sea turtles may be attracted to fishing gear and become entangled when they try to take fish. Entanglement may also result from marine species failing to detect or recognize the presence and associated danger posed by nets (Northridge and Hofman, 1999). Entanglement in marine debris is another source of marine species mortality. Debris-related entanglements and consequent deaths have been attributed to debris ranging from fishing net fragments to plastic six-pack holders, gaskets, headlight rings, and polypropylene straps (Northridge and Hofman, 1999). Of the 14 non-threatened species listed in Table 3-19, repeated mortality of individuals from 12 species (excluding killer whales and Risso's dolphins) has been a result of entanglements (Waring et al., 2004). Entanglement that results in injury or death to a large number of marine species, especially threatened or endangered mammals and sea turtles, would result in a long-term, direct, major, adverse impact.

Ingestion of Marine Debris

Death associated with the ingestion of marine debris has been documented in 23% of all marine species (Laist, 1996). Animals that ingest marine debris may die due to digestive tract damage, reduced food intake, and diminished nutrient absorption (Laist et al., 1999). The most commonly encountered marine debris is plastic pellets, plastic bags, wrappers, bottles, cups, synthetic line, lumber, and cigarette butts. The principal at-sea sources of debris are offshore platforms and watercraft including cargo, commercial fishing, military, passenger, and recreational vessels (Laist et al., 1999). The cumulative effects of both accidental and purposeful discarding of material into the marine environment have devastating impacts on marine mammals and sea turtles at both the individual and population level. Injury or death to a large number of marine species as the result of marine debris ingestion would result in a long-term, direct, major, adverse impact.

Fuel Spill

Large scale oil spills, such as the 1989 Exxon Valdez spill in Prince William Sound, Alaska, and the 2002 Prestige spill off the coast of Spain, pose a number of risks to marine mammals and sea turtles. Adverse effects of fuel spills on marine species are caused by either the physical nature of the oil (physical contamination and smothering) or by its chemical components (toxic effects and bioaccumulation). Direct damage includes the oiling of fur in some species of seals, which destroys their insulating properties, injury to internal organs through ingesting oil, and pneumonia from inhaling it, especially in the case of whales and dolphins, who may inhale air through the oil slick at the surface of the water. Death to a large number of marine species caused by fuel spills would result in a long-term, direct, major, adverse impact, especially to threatened or endangered species.

Observations on the possible effects of fuel spills on marine mammals and sea turtles suggest that adverse impacts are greatest for pinnipeds, since they spend a portion of time hauled out on land, and must enter and leave the water through the surface where floating oil collects. Cetaceans have been observed in the presence of many past oil spills, but there has been little or no direct evidence to link a spill event to any cetacean mortality discovered either during or following a spill (Geraci and Aubin, 1990). Local observations made off Cape Cod following the June 20-21, 1979 oil slick produced by a collision of the freighter Regal Sword and the oil tanker Exxon Chester found humpback, fin, and North Atlantic right whales, as well as Atlantic white-sided dolphins, feeding in the midst of the slick (Goodale et al., 1979). Large numbers of fin and other whales were also observed in the area of an oil slick produced by the Argo Merchant off Nantucket Shoals in 1976 (Grose and Mattson, 1977). Despite direct contact of these marine mammals with the oil spills, no apparent adverse effects were recorded.

Impingement and Entrainment

Direct impacts to marine mammals and sea turtles from impingement and entrainment introduced by marine industry are of concern. Impingement occurs where marine organisms collide with water intake structures, while entrainment takes places when marine organisms are taken into the facility through the water intake pipe and killed. Most documented cases of impingement and/or entrainment of marine species have been in connection with power plant intakes, specifically for sea turtles and seals (USEPA, 2002). Death is most often the result for entrainment of sea turtles and seals. Impingement and entrainment for the larger marine mammals is generally not an issue. Death to a large number of marine species caused by impingement and entrainment would result in a long-term, direct, major, adverse impact, especially to threatened or endangered species.

Bioaccumulation

Bioaccumulation refers to the process by which the level of contaminants collecting within an organism increases as one moves higher up the food chain. Contaminants accumulate to hazardous levels when they are taken up and stored faster than they are broken down or excreted. For example, large fish species such as salmon or tuna have been shown to accumulate many of the toxins present in the smaller fish they prey upon. At the higher trophic levels where marine mammals reside, the levels of contaminants are of concern. Ongoing research has discovered various amounts of harmful chemicals in the tissues and organs of some marine mammal species. High bioaccumulation levels have been correlated with prey depletion, poor reproduction, low offspring survival rate, immune deficiencies, and even death (Reijnders, 2002). Studies of the harbor porpoise have demonstrated an association between blubber PCB concentrations and mortality due to infectious disease. For harbor seal populations, experiments have shown lower reproduction rates in seals exposed to PCBs (Reijnders, 2002). Finally, the levels of contaminants in killer whales have been found to vary with the age and sex of the individual. Female killer whales are thought to pass PCB contaminants to their newborn calves through their fat, thus reducing the level of PCB in the mother and placing the newborn at risk (Ross, 2001; Ross, et al. 2000). Death or debilitating injury to large numbers of marine species as a result of bioaccumulation would result in long-term, indirect, major, adverse impacts.

4.2.4.2 Impacts of Construction (Port and Pipeline)

NEG Port construction would occur about two miles to the west of the federally designated SBNMS (Figure 3-8). Pipeline construction would occur in two of the Massachusetts State Ocean Sanctuaries, the North Shore Ocean Sanctuary (NSOS) and the South Essex Ocean Sanctuary (SEOS), and within three miles of the western boundary of the SBNMS. For the purposes of examining impacts to marine species, construction activities associated with the NEG Port and Pipeline Lateral have not been separated into different sections because they would be similar for both activities. Rather, the different types of impacts associated with overall Project construction are discussed below.

Construction of the NEG Port would disturb approximately 33 acres of the seafloor for NEG Port construction, and alter approximately 1,000 acres of seafloor in the pipeline corridor. These activities would suspend bottom sediments from the seafloor and into the water column. The resulting sediment plumes would then be exposed to currents that have the potential to carry the suspended sediments short distances into the surrounding waters. The turbidity increase would be temporary during construction only, and would be limited to the lower portion of the water column. The suspended sediments would not be expected to rise in great amounts to the photic zone, and as such are not expected to adversely impact phytoplankton. Chemical assessments of sediments in the vicinity of the NEG Port and the Pipeline Lateral indicate metal, PCB, and PAH concentrations are below NOAA PELs. In general, pesticides were also below the NOAA PEL levels, except for several sample locations where 4,4 DDT, was reported above the NOAA PEL.

Project construction vessels are expected to make approximately 209 round trips between the construction sites and local ports. The speed of the major construction vessels (i.e., pipe lay barges and plow/backfill barges) would be low during the construction period (approximately one mile per day). All of the construction activities would create in-air and underwater noise that would have the potential for adverse impacts to marine mammals.

Physical Harassment

During construction, behavior modification of marine species is expected to be minor. Because the changes in the environment in the immediate vicinity of the NEG Port and Pipeline (e.g., topography of ocean floor, chemical changes in the water, night time lighting, and magnetic sensing; LTG Limited, n.d.) would be small, temporary, and intermittent, and would not adversely impact known behavior patterns including, but not limited to, migration, breathing, or sheltering. Short-term displacement from the Project area may occur as a result of these temporary construction-related changes during the May through November time frame, but the immediate Project area is small in relationship to the wider Massachusetts Bay habitat areas that marine mammals are known to frequent. General seasonal distributions of marine mammals provided within the Weinrich and Sardi (2005) and NARWC databases were used to evaluate impacts to mammal species. Physical harassment from construction activity is expected to be short-term, indirect and minor.

Vessel Strikes

Increased risk of marine mammal vessel strikes during NEG Project construction is a product of the increased number of vessels in the construction area. Offshore construction activities associated with the Project are scheduled to occur during the 7 month period between May and November. Approximately 209 round trips would occur as the result of construction over the 7-month period. The number of trips between the construction sites and local ports, as well as the approximate times at the station, are summarized in Table 4-15.

Table 4-15

Number of Vessels Trips and Time on Station During Construction

Vessel Type	Northeast Port Round Trips	Pipeline Lateral Round Trips	Approximate Days On Station: Northeast Port	Approximate Days On Station: Pipeline Lateral
Anchor handling vessel	8	14	15	105
Diving support vessel	5	10	105	150
Crew boat	12	100	NA	NA
Restoration vessel	4	NA	15	NA
Lay barge		1	Included in pipeline estimate	50
Plow vessel		2	Included in pipeline estimate	55
Tremie vessel		1	NA	30
Survey vessel		8	NA	105
Pipehaul barge tug		4	NA	50
Supply vessel		40	NA	NA
Total Round Trips	**29**	**180**	**135**	**545**

When the number of vessel roundtrips associated with Project construction is compared with the annual flux of traffic in Massachusetts Bay, the construction activity would cause a relative minor increase in vessel traffic. The number of ship transits for commercial vessels crossing Massachusetts Bay in 2003 was 4,561 (Table 4-16). These vessels are large enough to cause injury or death to marine mammals in the event of a strike. Small passenger vessels, sightseeing, and charter fishing boats with less than 18 feet (5 meters) of draft account for a significant amount of additional traffic in Massachusetts Bay, totaling 57,238 annual trips, or 28,619 round trips into and out of Boston Harbor alone (AcuTech, 2006). Although certainly possible, these smaller vessels are not as likely to result in mortality in the event of a marine mammal strike. On average, the 209 construction round trips account for only a 0.7% increase in small boat activity in Boston Harbor alone. This small increase in vessel activity during construction represents a minor increase in the risk of additional ship strikes to marine mammals.

Table 4-16
Commercial Vessel Traffic Entering and Leaving Massachusetts Bay Harbors in 2003

Port	Vessel Type	Approximate Maximum Length (ft)	Annual Number of Trips
Boston	Dry Cargo Barge	450	358
	Liquid Barge	450	536
	Self-Propelled, Dry	800	1,745
	Tanker	909	861
	Tow Boat	150	346
	Other	N/A	3
	Total No. of Annual Trips		**3,849**
Salem	Liquid Barge	450	24
	Self-Propelled, Dry	803	33
	Tanker	600	2
	Tow Boat	150	8
	Other	N/A	3
	Total No. of Annual Trips		**70**
Plymouth	Self-Propelled, Dry	873	32
	Tow Boat	< 100	2
	Total No. of Annual Trips		**34**
Gloucester	Self-Propelled, Dry	578	2
	Tanker	< 200	606
	Total No. of Annual Trips		**608**
Grand Total No. of Annual Trips			**4,561**

Note: N/A – No known limitations on vessel length.
Source: USACE, 2003.

The potential for vessel strikes during construction is also related to the speed of the construction vessels. During construction of the Pipeline Lateral, vessels would be controlled and positioned by the use of an anchor spread consisting of 8 to 10 anchors. Although the anchor spread allows the vessel to maintain station and provide controlled movements, the vessels are not considered maneuverable. The primary construction vessels would only travel between 0 and 4 knots, or 1 to 2 miles in a 24-hr period. The location and progress of these vessels would be very predictable and would be able to adhere to collision avoidance requirements. The NEG Port would use dynamically positioned vessels to install buoy and mooring anchors. Minimal movement of these vessels would occur during the buoy installation process and typically these vessels would travel at speeds of less than 10 knots.

The ancillary pipeline construction equipment, consisting of anchor handling tugs, pipe haul barges and tugs, dive support vessels and crew/supply boats are maneuverable and would be able to respond to collision avoidance requirements as necessary. All construction vessels greater than 300 gross tons would maintain a speed of 10 knots or less. Crew and supply boats less than 300 gross tons would move at speeds of up to 15 knots, and would follow the construction minimization measures provided in section 4.2.4.6.

The small increase in vessel activity during construction, slow speeds and maneuverability, construction minimization measures, and low numbers of non-threatened and endangered marine mammals impacted from ship strikes historically in the Massachusetts Bay area (see Section 4.2.4.1 – Vessel Strikes), would result in a short-term, direct, minor risk of marine mammal strikes during construction.

Alteration to Habitat

Impacts to sea floor habitat important to marine mammals and sea turtles would occur during construction of the NEG Port and the Pipeline Lateral. Since species of mammals feed on prey in the water column and/or from the sea floor, disturbance of the bottom during construction has the potential to impact feeding behavior. Approximately 33 acres of the seafloor would be disturbed for Port construction, and approximately 1,000 acres of seafloor around the Pipeline would be altered. These activities would suspend bottom sediments off the seafloor and into the water column; however, construction would not change the composition of the bottom sediments. The NEG proposed Pipeline Lateral route was selected to minimize crossing areas that would result in substantial or permanent alteration of seafloor habitat, such as extensive areas of hard substrata and bedrock. The use of plowing and backfill plowing would cause changes to the seafloor topography in the vicinity of the Pipeline Lateral; however, permanent changes to the seafloor are not expected.

Water column habitat changes due to increased turbidity during construction would be within the lower portion of the water column nearest the seafloor. Based on data collected during construction of the HubLine, turbidity levels are expected to be low and generally approximate average reference site readings. The primary use of plowing to trench the pipeline would occur in water depths of more than 100 feet (30 meters). The suction anchors would to be installed in greater water depths of 270 to 290 feet (82 to 88 meters). Sediments suspended at these depths would not reach the water column surface. These zones of increased turbidity would be localized to the site of construction, and would disperse quickly upon completion of construction. Therefore, alterations to habitat from bottom changes or increased turbidity during pipeline or NEG Port construction would pose short-term, minor, indirect adverse effects on marine mammals and sea turtles.

Acoustic Harassment

For offshore construction, NEG Port construction equipment would consist of crane barges, anchor-handling tug vessels, supply vessels, survey equipment and diving/crew boats. Underwater noise during the construction phase would be produced by a wide variety of sources. Dynamically positioned vessels would likely be used only for the installation of the PLEM and anchor lines. These vessels would intermittently produce a low level of engine noise because they are dynamically positioned and not anchored during construction. In general, sound generated by the thrusters of dynamically positioned vessels would be the dominant source of underwater sound during construction activities; more so than sound generated by tugs and barges. The thrusters are operated intermittently as needed to get vessels into position during anchoring and construction. Other pipeline construction vessels would involve tugs, barges, plow vessels, and lay vessels. The barges, which would be the largest vessels used during pipeline construction, do not have engines and are towed by tugs. The tugs used during pipeline construction for barge handling would increase the amount of underwater noise while pulling the barges. The frequency and source level of noise would increase as the tug pulls heavier barges (those that are loaded vs. unloaded) (Richardson et al. 1995). In addition, the machines (cranes, winches, and stingers), construction activities (welding and sand blasting), and living activities (lights and cooking) on the vessels and on the barges would require generators, which create their own level of noise, a small fraction of which is transferred into the water column.

Each construction noise source has its own corresponding source level and frequency range. Vessel noises, caused by the turning of the screws, engine noises, and noises of on board operating machinery, generally fall in the frequency range of 5 to 2,000 Hz, with highest intensities below 100 Hz (Scrimger and Heitmeyer, 1991). Pipeline Lateral construction activities, such as post-lay jetting, have been recorded in the past to create broadband sounds; the strongest was below 10 Hz and reaching frequencies as high as 500 Hz (Richardson et al. 1995). Broadband source levels for the NEG Port construction vessels are expected to range from approximately 160 to 180 dB re 1 μPA at 1 meter. Operation of the thrusters used to dynamically position the larger vessels could increase sound source levels by an additional 5 to 10 dB. No pile driving or blasting (the loudest of marine construction activities) is proposed for construction of Project facilities.

Figure 4-2 shows the net acoustic impact of five construction vessels operating simultaneously with source levels ranging from 160 dBL re 1 μPA at 1 meter (vessel movements) to 180 dBL re 1 μPA at 1 meter (thrusters used for dynamic positioning). The contour plots present the worst-case instantaneous received sound level, the dominant source being the thrusters. Thrusters are operated intermittently and only for relatively short durations of time. The resultant area within the critical 120 dB isopleths ranges from 40 to 42 square kilometers, and the area within the 160 dB isopleths is less than 1 square kilometer. Though not continuous by definition, the short-term sounds generated by construction of the Pipeline Lateral would result in exceedances of the 120 dB criteria established for continuous sound during worst-case cumulative construction operations. Noise levels within the nearby SBNMS during construction would be below the 120 dB criteria. Exceedances of the 160 dB impulse criteria would be much more localized and would not extend beyond the immediate area where construction activities are occurring.

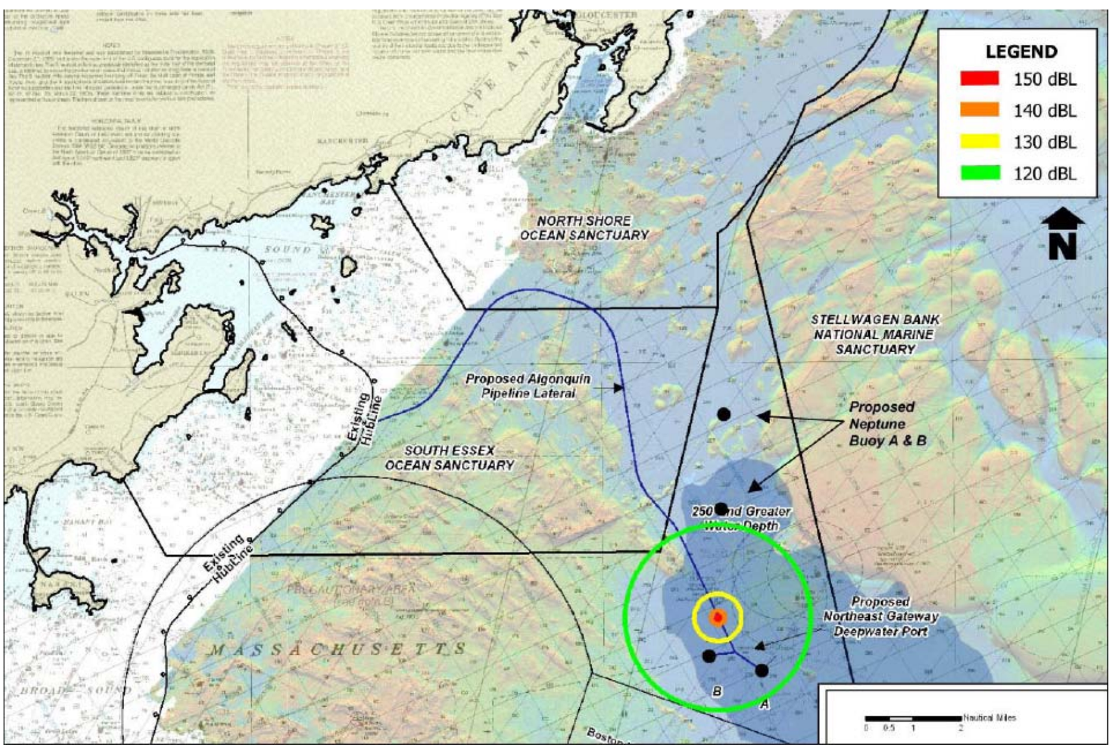

Figure 4-2. Acoustic Impact of Construction Noise

Research indicates that most marine species habituate rapidly to low-level underwater sounds and are able to distinguish the sounds they generate for communication from noise generated by human activities (Richardson et. al., 1995). Given their mobility, most marine animals would take evasive action and avoid areas with high levels of noise (Richardson et al., 1995. Overall, the intensity of construction sounds would be well below the intensity associated with injury to the hearing of cetaceans, but may at times be above harassment levels as established by the MMPA, and thus might result in minor to moderate, short-term, direct, adverse impacts on whale behavior in the area. As such, the applicants are consulting with NOAA for an incidental harassment authorization.

To demonstrate and document that whales are not exposed to sound levels that exceed permitting thresholds, MARAD will require the applicant, as a condition of the DWPA license, if granted, to install and operate an array of near-real-time acoustic detection buoys to detect and localize vocally active marine mammals relative to construction-related sound sources. Further details regarding this system, will be approved by MARAD and NOAA as part of a detailed monitoring and mitigation plan being developed by MARAD. The final monitoring and mitigation plan will be filed with FERC prior to the start of any pipeline construction activities.

Alteration of Prey Species Abundance and Distribution

Once the NEG Port and Pipeline Lateral have been installed, there would be a need for hydrostatic testing of the flowlines. To evaluate the impacts of zooplankton losses through entrainment during hydrostatic testing, the relationship between zooplankton lost and consumption rates of zooplankton by a typical blue whale was investigated. The mean biomass of zooplankton consumed by typical blue whale on a daily basis are estimated to be 1120 kg per individual (Croll and Kudela, 2004). Measured weights of copepods consumed by baleen whales range from 3.7×10^{-9} to 3.0×10^{-8} kg (Schnetzer and Caron, 2005; Haberman and Künnap, 2002). Assuming that the largest number of copepod individuals entrained have the greatest mass, an estimated maximum mass of 31.75 kg of copepods would be lost during hydrostatic testing. This suggests that impacts from construction (hydrostatic testing) would remove approximately 3% by weight of a single blue whales prey consumption for one day. This entrainment of copepods would have a short-term, indirect, minor adverse impact on the abundance and distribution of prey species for whales.

Entanglement

Entanglement in gear is a possible threat to marine mammals and sea turtles. Most marine species entanglements have occurred with set nets, lobster trap lines, and long lines, which are typically 3 inches (7.6 cm) or less in diameter. The Pipeline Lateral construction (PLP and BFP) activities mimic bottom trawl fishery activities. During construction, the plow would be dragged across the sea floor by a towing cable and control umbilical that travel from the plow to the towing vessel. The cross-section and configuration of this steel cable (3 to 4 inches; 7 to 10 centimeters) would make it easier to detect by seals, sea turtles and whales than lines from bottom trawls. In addition, the plow and back-fill plow cable is typically less than 100 to 300 tons of pulling force, and in this taut condition is unlikely to result in entanglement. Similarly, the 8 to 12 steel anchor cables used on the pipelay, plow, and back-fill plow barges are typically 2 to 3 inches (5 to 7 centimeters) in diameter and are also typically under great tension while deployed Therefore, since the cables used during construction would be close in size to the largest commercial fishing lines, and because the cables would be taut most of the time, risks from entanglement of marine mammals and sea turtles are expected to be short-term, direct, and minor.

The risk of entanglement from fishing gear other than trawls should not increase as a result of Project construction. Fishing activities may be displaced from the Project site to other areas during construction, but the number of overall fishing vessels would not increase; thus, risk of entanglement would remain the same. There is concern that fishing activities would increase in the SBNMS (where certain species of marine mammals are concentrated (Weinrich and Sardi, 2005) due to displacement, but there has been no quantitative data to support this concern.

Ingestion of Marine Debris

Ingestion of marine debris such as plastic pellets, plastic bags, wrappers, bottles, cups, synthetic line, lumber, and cigarette butts has been a documented cause of mortality in marine species (Laist, 1996). During the proposed 7-month construction period, crew-operated vessels would be required to install the NEG Port and Pipeline Lateral. While these vessels are on site there is the potential for debris to enter the environment. Potential adverse effects would be minimized by avoiding the discharge of garbage and other debris by the crews on all vessels within the NEG Project area. Additionally, training of construction crews would include a requirement explaining that the discharge of trash and debris overboard is harmful to the marine species and the environment, and is illegal under the Act to Prevent Pollution from Ships and the Ocean Duping Act, depending on the type of material. Discharge of debris would therefore be prohibited and violations would be subject to enforcement actions. The combination of crew training, existing regulations, and the temporary nature and timing of construction (7 months) would result in a short-term, direct, minor increase in the risk of ingestion of marine debris by marine mammals.

Fuel Spill

During construction of the NEG Project, the relatively small size of construction vessels precludes the possibility of large scale fuel spills that could cause adverse effects to marine mammals. On the type of vessels used for construction, fuel spills resulting from refueling or hydraulic fluid leaks would be relatively small. The small size of these potential spills minimizes the risk of exposure to marine mammals and sea turtles. In the unlikely event of a fuel spill, short-term, direct, minor adverse impacts to marine mammals could occur. Cetaceans that might come into contact with a small fuel spill at the Project site would not be likely to show adverse effects, as past observations have shown no apparent adverse effects or behavioral changes caused by contact with fuel spills (Grose and Mattson, 1977; Goodale et al., 1979). To further minimize the potential for mammal interaction with fuel spills, the applicants have committed to follow a SPCC plan during construction.

Bioaccumulation

There is potential for bioaccumulation of contaminants in marine mammals during construction of the Project, both from the suspension of contaminated bottom sediments and from release of biocide used during hydrostatic testing of the pipeline. Chemical analyses on sediments collected during the spring of 2005 from the buoy and pipeline locations indicate some low level sediment contamination. Comparison of contaminant concentrations in the bottom sediments with NOAA's SQuiRT values (Buchman, 1999) provides an indication that some of the surface sediments in the Project area are toxic to marine organisms. Per NOAA guidelines, sediments with one or more constituents at or above the PEL are likely to be toxic to some organisms. In the vicinity of the buoy sites, all metals and PCBs were below PELs; however, one sample tested above the PEL for pesticides. The laboratory Method Detection Limits (MDL) for several PAH constituents were above the PEL, so it is not known if the PEL was actually exceeded. Sediments collected from the Pipeline Lateral route were below the NOAA PELs, except for one sample that exceeded the pesticide PEL, and another that exceeded PELs for Nickel and Cadmium.

The only possible route of uptake of contaminants by marine mammals is through food consumption, as contaminants are not absorbed through the skin of marine mammals, and they do not drink large quantities of seawater. Contaminants that may be mobilized by construction activities may accumulate in the food chain leading to the marine mammals; however, the level of bioaccumulation within marine mammals would be very low. The already low levels contaminants found in the sediments would be further diluted during resuspension caused by construction. In addition, monitoring during plowing for placement of the HubLine pipeline showed only short-term, localized increases in suspended sediment. The short duration of sediment resuspension events would further reduce the potential for bioaccumulation of contaminants in marine mammals. As such, impacts to marine mammals caused by bioaccumulation of bottom contaminants during construction would be short-term, indirect, and minor.

Chemical contamination of the water column from biocides used during backfilling and hydrostatic testing of the Pipeline Lateral would be unlikely to lead to bioaccumulation in marine mammals. The biocide Tetrakis (hydroxymethyl) phosphonium sulfonate (THPS) would be used to inhibit microbially-induced corrosion in the pipeline. THPS demonstrates low toxicity in aquatic organisms and rapidly breaks down in the environment through hydrolysis, oxidation, photodegradation, and biodegradation (WHO, 2000). Discharge of the biocide into the water column would occur during two discrete time periods at either MP 0.0 or MP 16.0 as the pipeline was emptied. The biocide would be neutralized with hydrogen peroxide and then aerated prior to release to Massachusetts Bay. This method was permitted and successfully performed during the HubLine pipeline hydrostatic testing and dewatering process. During that project, on site laboratory testing was used to determine the concentrations of biocide at the discharge point, so that the appropriate amounts of hydrogen peroxide required to neutralize the biocide could be determined. All THPS levels in the discharged water met NPDES permit requirements. Since these same procedures are proposed for the NEG Project, bioaccumulation in marine mammals from the biocide would result in a short-term, indirect, and minor risk.

4.2.4.3 Consequences of Operation (Port and Pipeline)

Physical Harassment

Changes in marine mammal behavior can be attributed to a variety of factors, many of which are largely unknown. There is a potential for marine mammal behavior modification during operation, primarily from acoustic harassment caused by the EBRVs (see discussion below). Other causes for marine mammal behavior modification during operation are likely to be long-term, indirect and minor, because other than the presence of the LNG vessels, there would be no changes in the environment in the immediate vicinity of the Port and Pipeline known to alter the behavior patterns of marine mammals.

Vessel Strikes

NEG Project operation is expected to result in approximately one EBRV trip inbound and outbound per week, or a maximum of approximately 65 EBRV round trips per year. EBRV approaches to the NEG Port would generally be by way of the TSS for the Port of Boston, but use of the TSS may vary depending on weather conditions, loading port, and other variables under consideration by the Master of the EBRV. The EBRV would approach the Port and moor under its own power with no tug assist. Support vessels from Boston Harbor or Gloucester, Massachusetts would visit the NEG Port at a rate of one to two per week. Based on information presented in Table 4-16 for the number of commercial vessels calling on Boston for 2003, proposed EBRV arrivals would result in an approximate 3.4 percent increase in large vessel traffic through the SBNMS in the TSS heading into and out of the Port of Boston This rise increases the risk of whale strikes. However, current research does not provide predictive estimates of vessel strikes based on number of vessel trips and density of marine mammals. What is understood is that any increase in vessel traffic increases the risk of whale strikes. What is not known is how this increase relates to the probability of whale strikes.

Existing large vessel traffic entering and exiting the Port of Boston must follow the TSS, which essentially bisects the SBNMS, an area that is highly used by marine mammals. As such, existing vessel traffic poses a threat to marine mammals from ship strikes. A recent analysis by NOAA/NOS identified high and low risk areas for whale/vessel collisions within the SBNMS. As a result of this analysis, NOS is evaluating a strategy to address the problem, which involves rotating the TSS to the north. The USCG, in coordination with NOAA, has proposed an amendment to the TSS that would shift the TSS crossing in SBNMS to an area that is less heavily visited by whales. Table 4-17 presents the number of whale sightings by species, from commercial whale-watch vessels within the current and proposed TSS.

Table 4-17

Whale Sightings by Species

Species	# of Whale sightings within the existing TSS	# of Whale Sightings in proposed TSS Re-alignment	% Sightings - Reduction
Humpback	39,760	26,500	33
Right	449	235	48
Minke	8,312	4,546	45
Fin	8,558	5,216	39
Total	57,019	36,497	36

Source: NOAA.

Vessel speed has been shown to be directly related to marine mammal collisions, and Laist et al. (2001) has documented that most vessel collisions occur at speeds over 14 knots. NEG EBRVs would maintain a speed of 12 knots or less while in the TSS until reaching the vicinity of the buoys (Table 4-18). Vessel speed would gradually be reduced to 3 knots at 1.86 miles out from the NEG Port and to less than 1 knot at a distance of 1,640 feet from the NEG Port. A 10 knot speed restriction would be applicable during the following time periods: Cape Cod Bay: January 1 - May 15, Off Race Point: March 1 - April 30, Great South Channel: April 1 - July 31. NEG would continue to consult with NOAA regarding vessel speeds.

Table 4-18

EBRV Vessel Speeds in Vicinity of NEG Project

Location	Speed (knots)
Great South Channel Critical Habitat Area to 1.86 miles from NEG Port Site(s) with exceptions below	12
Cape Cod Bay (Jan. 1 – May 15)	10
Off Race Point (Mar. 1 – Apr. 30)	10
Great South Channel (Apr. 1 – Jul. 31)	10
Distance of 1.86 miles from NEG Port Site(s)	3
Distance of 1,640 feet from NEG Port Site(s)	1
NEG Port Site(s)	0

While maintaining the speeds detailed above, if an EBRV was required to make an unexpected navigational adjustment to avoid an obstruction in its path, it would take nearly 30 seconds before an appreciable course alteration occurred. In that time the vessel would have traveled at least two and one-half vessel lengths along the original centerline path (approximately 2,250 feet) before the bow of the vessel began to change direction. However, it would not be until another one and one-half vessel lengths, or nearly 1,250 feet, that the ship's course would change off of the centerline path. It would be the decision of the Vessel Master whether a diversion of course would put the vessel in jeopardy of collision with other vessels transiting the TSS. Although reliance on EBRV maneuverability to successfully avoid vessel-whale collisions is not the best mitigation for mammal strikes, reductions in vessel speed would serve to reduce the risk of marine mammal strikes caused by EBRVs approaching and departing the Port. Overall, the reduced vessel speeds proposed for operation present a long-term, direct, minor impact to non-endangered marine mammals.

Other vessel activity associated with operations includes support vessels. Prior to arrival of an EBRV at the NEG Port, inspection of the STL messenger line and marker buoys would be conducted by either an offshore supply vessel (OSV), or by helicopter. There would be no pilot or tug requirements associated with the routine operation of the NEG Port. The OSVs would make roughly 65 round trips to the NEG Port site each year. These vessels are between 110 ft and 160 ft long, with horsepowers between 2,500 and 3,200. When compared with the existing traffic estimates in and around the Port of Boston for commercial, small passenger vessels, sightseeing, and charter fishing boats, the OSVs required for NEG Port operation represent a 0.3% increase in small vessel marine traffic. Given this small percentage increase caused by the OSV traffic, there is little to no increase in the risk of marine mammal strikes from support vessels. Risk of increased ship strikes from OSV traffic would be long-term, direct, and minor.

Over the past several months, the USCG and MARAD have had numerous interagency discussions involving NOAA, other cooperating agencies and Excelerate to discuss appropriate mitigations in response to the potential added risk of ship strikes within the Boston TSS as a result of the proposed Project. Based on the analysis provided in this EIS and consultations with NOAA/SBNMS, MARAD will require, as a condition of any DWPA license issued for this project, that the applicant install and operate an array of near-real-time acoustic detection buoys in the Boston TSS, the number, duration and specific location for which will be approved in advance by MARAD and NOAA as part of a detailed monitoring and mitigation plan prepared by MARAD. As agreed to by NOAA, alternative system technology may be presented by the applicant for consideration by NOAA, so long as it meets the criteria as listed by NOAA in its comments to the USCG dated July 3, 2006.

Alteration to Habitat

Alterations to marine mammal habitat during NEG Port operations could result from disturbance of the seafloor by the anchor chains and by the physical presence of the anchor chains in the water column. Since species of mammals feed on prey in the water column and/or from the sea floor, disturbance by anchor chains has the potential to impact feeding behavior. While the EBRV is on buoy, constant natural gas offloading would occur along with normal vessel operations. Should both STL buoys be occupied with an EBRV during a severe 100-year storm, a maximum of 43 acres of seafloor habitat would be disturbed by the anchor chain sweep. The seafloor in the vicinity of the NEG Port is composed of fine-grained sediment in water depths of 270 to 290 feet (82 to 88 meters). Seafloor disturbance from anchor chain movement would result in increased turbidity levels in the vicinity of the buoys. As much of this increased turbidity would be near the seafloor, below the photic zone, adverse impacts to prey species for marine mammals are expected to be short-term, indirect, and minor.

The physical presence of anchor chains in the water column may impair marine mammal navigation; however, this is not likely to be an issue with the smaller species of whales and marine mammals, because they would be able to navigate around the chains. Impacts to larger threatened and endangered whales are discussed further in section 4.3.

Acoustic Harassment

A special study was undertaken at an existing LNG facility to identify sound levels that could be produced by proposed Project operations. Sound level measurements were obtained of the underwater and in-air sound generated by an EBRV during LNG regasification and offloading operations in the Gulf of Mexico under open-loop conditions. These measurements were completed during the first regasification and offloading operation of the *Excelsior* EBRV, which operates in open-loop mode. Measurements were performed over the 5-day period in 2005. The results of the survey were used to develop the source data for modeling the potential sound effects of the proposed NEG Port.

Sound pressure measurements were made with hydrophones when measuring underwater sound and microphones when measuring sound in air. The survey concentrated on far-field measurements to characterize EBRV operational sound as a function of operating conditions and directivity relative to the ship's deck. Sound generated by the EBRV is transmitted into the air directly from mechanical equipment located on or near the deck of the ship and into the water primarily by energy transmitted through the ships hull. Underwater sound may also be generated by the natural gas piping, flexible riser, PLEM and Pipeline Lateral on the seafloor.

With knowledge of the distance from the measurement equipment to the sound source and the site-specific sound propagation characteristics, the underwater source data were adjusted to a reference distance of 200 meters at a depth of 20 feet (6 meters) and are summarized in Table 4-19. The data presented in Table 4-14 were derived from measurements that included both Gulf of Mexico background and EBRV (operating in open-loop mode) generated sounds. The background or ambient noise levels in the Gulf include multiple industrial sources in close proximity to Gulf Gateway, as well as the numerous vessels passing by the facility. EBRV-generated sounds were attributable to normal vessel operations, as well as equipment and processes related to the open-loop mode for regasification. As such, the sound pressure measurements from Gulf Gateway were adjusted for extraneous noise sources so that the effective sound environment at the NEG Port site, and the contribution from an EBRV running in closed-loop regasification mode at the site could be calculated.

The data presented in the first row of Table 4-19 (Broadband – Open Loop) include background or ambient noise and incidental noise recorded from the measuring tools or hydrodynamic noise caused by movement of the observation vessel. Analyses indicate that actual noise levels from the EBRV operating in the open-loop regasification mode would be approximately 6-10 dB lower than those levels presented for frequencies in the 12.5 to 50 Hz range where the background or ambient noise levels and the other incidental noises were prevalent. This adjustment lowers the broadband sound levels by 3 to 7 dBA. The adjusted measurements provided in row two of Table 4-19 (Broadband – Open Loop Adjusted for Gulf Masking and Self Noise Effects) represent the reduction in noise levels attributed to background or ambient noise and the incidental noise recorded from the measuring tools or hydrodynamic noise caused by the movement of the observation vessel.

Given that the closed-loop mode eliminates discharge of the heating water, current data suggests a reduction in the overall broadband sound levels by a minimum of 7 dB for the closed-loop system. The third row of Table 4-19 (Broadband – Adjusted for Closed Loop Operations) incorporates both the low frequency correction and the adjustment from open- to closed-loop vaporization as a maximum broadband dBL level.

The data shown in Table 4-19 reflect adjusted sound levels measured on all four sides of an EBRV operating in closed-loop mode at a distance of 200 meters. Similar spectrum shapes and overall broadband levels are shown, with the lowest levels measured off the stern and port at 108 dB, and the highest levels measured off the bow at 112 dB. Sound levels off the starboard were similar to the port and stern at 109 dB.

Table 4-19

Summary of Maximum Recorded Sound Pressure Levels at Gulf Gateway and Sound Levels for EBRV Regasification at the NEG Site Corrected for Gulf Masking, Self Noise Effects, and Closed-Loop Operations (L_P)

Sound Pressure Level (dB re 1 µPa)	Starboard	Port	Stern	Bow
Broadband dB – Open-Loop	122	121	118	123
Broadband dB – Open-Loop Adjusted for Gulf Masking and Self Noise Effects	116	115	115	119
Broadband dB – Adjusted for Closed-Loop Operations	109	108	108	112
Octave Band (dB)				
12.5 Hz	109	110	104	110
16Hz	105	103	99	100
20Hz	102	100	96	97
25Hz	98	94	93	96
31.5Hz	100	92	95	95
40Hz	97	93	93	98
50Hz	97	94	93	94
63Hz	99	96	90	96
80Hz	103	102	95	101
100Hz	100	101	97	99
125Hz	102	105	102	101
160Hz	98	99	95	97
200Hz	100	100	96	98
250Hz	101	101	95	99
315Hz	101	101	95	98
400Hz	103	99	96	99
500Hz	104	99	98	101
630Hz	100	97	102	99
800Hz	101	97	103	99
1KHz	101	95	99	101
1.25KHz	99	94	97	101
1.6KHz	97	91	95	99
2KHz	95	91	95	98
2.5KHz	94	92	95	99
3.15KHz	95	92	95	99
4KHz	94	94	99	104
5KHz	94	93	100	106
6.3KHz	94	93	100	107
8KHz	95	94	101	108
10KHz	97	94	102	109
12.5KHz	99	96	104	109
16 KHz	102	98	106	110
20 KHz	102	98	106	109

Using the source data shown in Table 4-19, underwater sound levels were calculated at three distances (100, 500, and 1000 m) from the four sides of the EBRV (port, stern, starboard, and bow), adding in the minimum existing baseline sound (103 dB) at the NEG Port site. The results of the calculation, as well as comparisons to the estimated baseline levels in the vicinity of the Project site, are shown in Figures 4-3 through 4-5. Figure 4-3 shows that at 100 meters from the NEG EBRV, sounds at all but the highest frequencies would be within the existing baseline sound levels. Only sound energy at approximately 3.5 kHz and higher would be outside the existing ambient range. However, all sound energy at this 100 meter distance would fall below the MMPA Level B harassment threshold of 120 dB for continuous noise. At 500 meters and one kilometer (Figures 4-4 and 4-5) all sound energy would be within the existing ambient range and below the MMPA Level B harassment threshold. Cumulative operational sound levels assuming that both NEG buoy sites were occupied show no overlap in underwater noise levels, indicating no additive underwater noise impacts even under heavily used conditions (Figure 4-6). Cumulative operational sound levels remain below the 120 dBL mammal harassment criteria for a continuous sound source at all three distances.

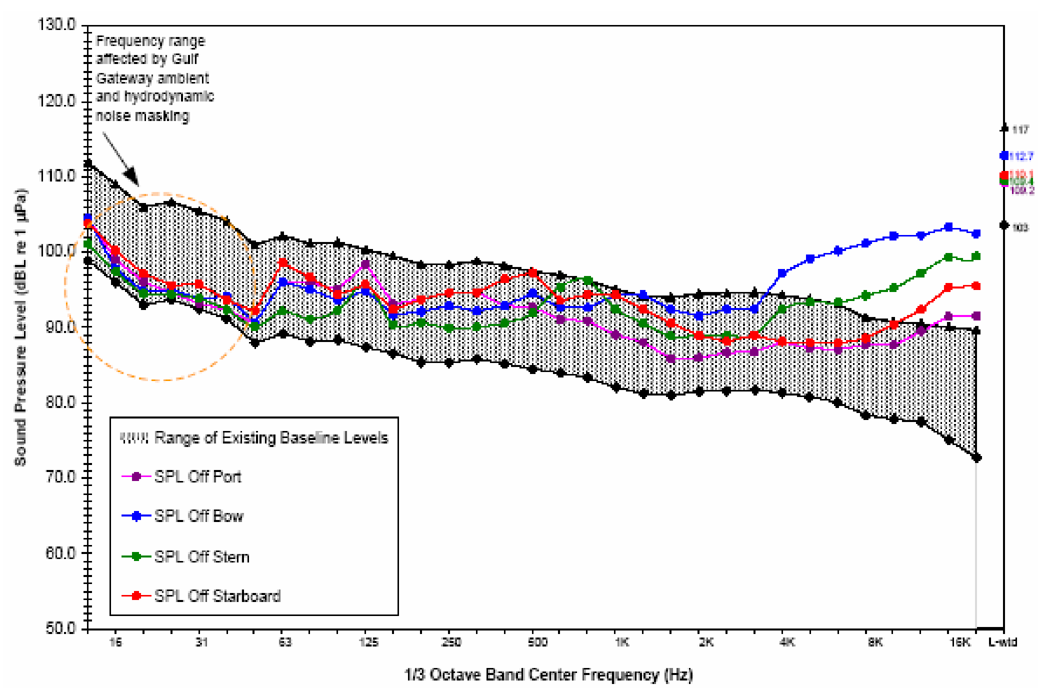

Figure 4-3. Comparison of the Predicted Frequency Spectrum of Underwater Sound Pressure Levels at 100 Meters from the EBRV Compared to Estimated Existing Underwater Ambient Levels.

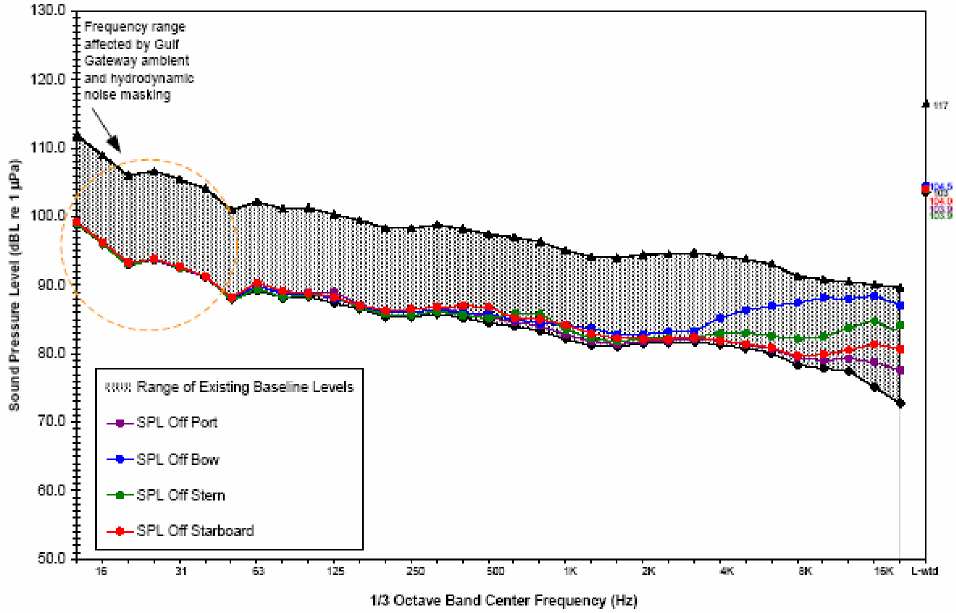

Figure 4-4. Comparison of the Predicted Frequency Spectrum of Underwater Sound Pressure Levels at 500 Meters from the EBRV Compared to Estimated Existing Underwater Ambient Levels.

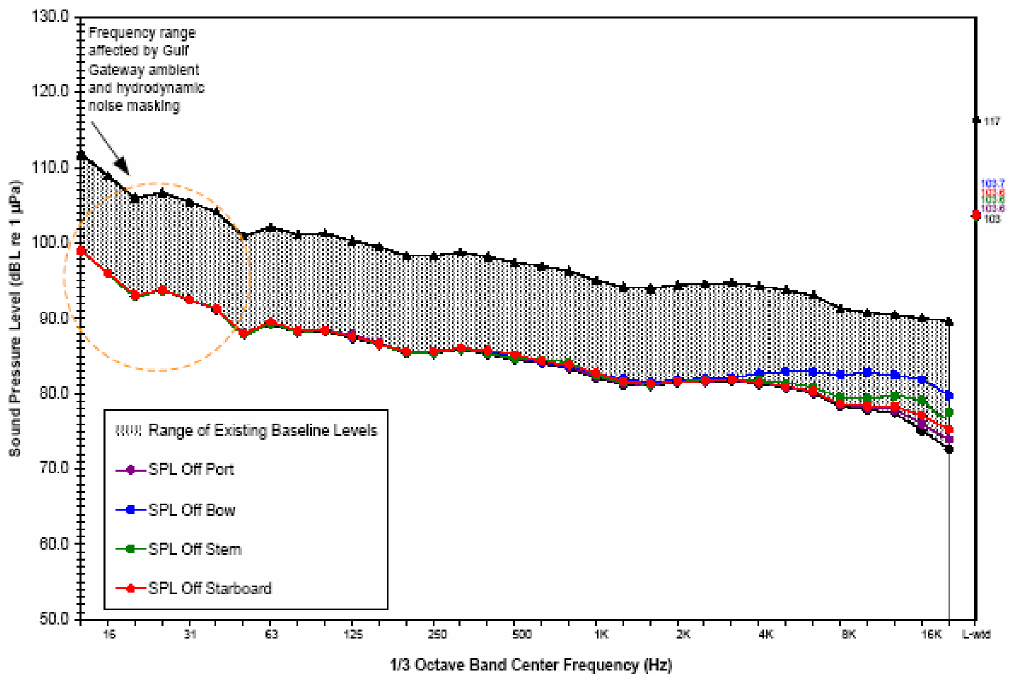

Figure 4-5. Comparison of the Predicted Frequency Spectrum of Underwater Sound Pressure Levels at 1 Kilometer from the EBRV Compared to Estimated Existing Underwater Ambient Levels.

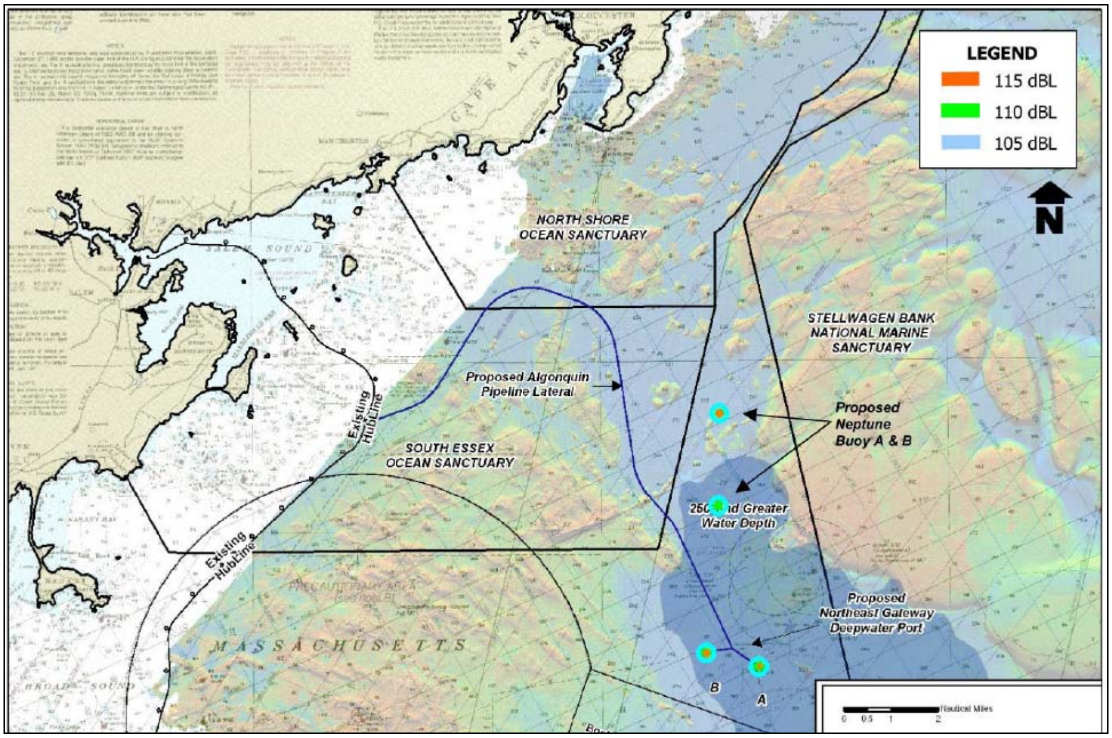

Figure 4-6. Maximum Cumulative Underwater Sound Levels During Regasification.

Acoustic screening level analyses were completed to determine the potential noise that would be emitted by NEG EBRVs in transit as they approach and position at the buoys. The distribution of maximum instantaneous received sound levels that would occur during transit is shown in Figure 4-7. These data show underwater sound levels between 120 and 140 dBL within a zone approximately 0.5 nautical miles (0.9 km) around the buoy sites. Upon arrival at the buoy, the EBRVs would require the use of thrusters for dynamic positioning during docking procedure. Thruster and sound levels produced by the NEG EBRVs would be similar to other large vessels that currently operate in Massachusetts Bay. Thrusters dominate operational noise conditions, effectively masking concurrent sound sources. For the NEG EBRVs a maximum source term was calculated of approximately 160 – 170 dBL from normal thruster operations during coupling/decoupling operations and EBRV maneuvering at the Port. Typically, the docking procedure would be completed over a 10- to 30-minute period, with the thrusters activated as necessary in short bursts and not in continuous use. EBRV thruster operations were modeled based on recent field surveys. Sounds associated with two EBRVs at 100 meters would fall below the MMPA Level B harassment threshold. Given the proximity of the NEG buoys to each other, NEG would prohibit two vessels from simultaneously maneuvering on or off the buoys. At 500 meters and 1 kilometer (Figures 4-3 and 4-4) all sound energy is within the existing ambient range and below the MMPA Level B harassment threshold, even when considering the unloading of two EBRVs.

As described above, the noise levels associated with EBRV(s) offloading at the NEG site are below the MMPA Level B harassment thresholds of 160 dB and 120 dB, and therefore should not cause a disruption in whale behavior. Acoustic impacts on marine mammals from regasification are therefore expected to be long-term, direct, and minor. Noise levels associated with EBRVs transiting to the site, as well as positioning at the buoys, would produce intermittent (impulse), direct, moderate adverse impacts on marine mammals.

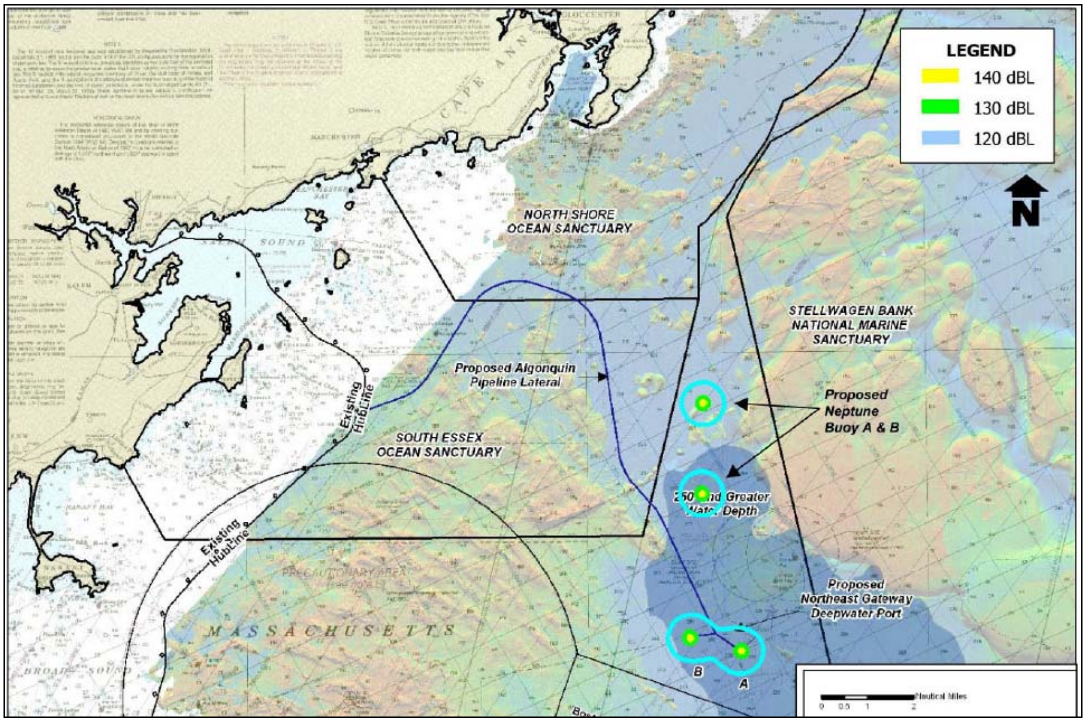

Figure 4-7. Distribution of Maximum Instantaneous Received Sound Levels During EBRV Transit Operations.

Alteration of Prey Species Abundance and Distribution

During a typical 8-day regasification event, the intake of seawater would entrain large numbers of zooplankton, which serve as an important food source for baleen whales in the Project area. Using the same type of analysis described in Section 4.2.4.2, impacts from operations are estimated impacts during operations would remove 7 percent by weight of a single blue whale's prey consumption per day. When spread across the entire whale population in the Project area, this entrainment of copepods would have a long-term, indirect, minor impact on these species as they search for prey.

A few of the MMPA protected marine mammals consume several species of fish as their desired prey species. In regards to the abundance of possible prey in the area, only pelagic fish would be subject to impingement, and in very small numbers. The through-screen velocity of 0.82 feet per second represents the highest through-screen velocity that fish would experience. Atlantic mackerel and Atlantic herring are two of the common pelagic fishes that might be expected to be exposed to impingement. However, Atlantic mackerel are very strong swimmers and it is not expected that impingement of Atlantic mackerel would pose a significant threat. A total of 1,810 Atlantic herring have been impinged at Seabrook Station since 1994, with an annual mean impingement of 181 fish per year. However, it is expected that Atlantic herring would also be able to escape the through screen velocity of 0.82 feet/second. The intakes at Seabrook Station have a much larger estimated opening of 2,000 square feet (186 square meters) compared to the estimated openings of 88.3 square feet (8.2 square meters) for the EBRVs, and impingement of pelagic fishes would be expected to be much lower than 181 Atlantic herring per year. A few of the fish species could be subject to impingement, but not in substantial enough numbers to cause a significant adverse impact to marine mammals.

Entanglement

When the EBRV arrives onsite, it would use a grapnel hook to recover the line from the sea surface buoy. The grapnel hook is attached to a traction winch located on the bow of the EBRV, adjacent to and above the STL turret compartment. Once retrieved, the buoy would be winched into the turret compartment and locked into place. A flexible riser and the connected flowline would be raised along with the mooring chains and wire rope. The design of the STL buoy system includes anchor lines and recovery lines throughout the water column. Marine mammals would be unlikely to become entangled in these lines because of the large size of the lines (the anchor chain would be 18 inches [46 centimeters] in diameter, the anchor cable would be 6 inches [15 centimeters], and the retrieval line would be 4 inches [10 centimeters] in diameter). For comparison purposes, typical diameters of set nets, lobster trap lines, and long lines, which have been known to cause entanglement problems, are 3 inches (7.6 cm) or less. It is possible that risk of entanglement in buoy mooring lines would increase if a mammal is startled by increased sound levels during offloading of the EBRV and/or positioning. This could cause the mammal to attempt to flee the area and become entangled. This impact could be minimized by ramping-up activities that increase sound. Overall, however, risk of increased entanglement due to operations is expected to be long-term, direct, and minor.

The risk of entanglement from fishing gear should not increase as a result of proposed Project operation. Fishing activities may be displaced from the NEG Port site to other areas, but the number of overall fishing vessels would not increase; thus, risk of entanglement would remain the same.

Ingestion of Marine Debris

During each 8-day regasification cycle, crew members would be required to operate the EBRV. While these vessels are on the buoys, there is the potential for debris to enter the environment, potentially harming the marine mammals. Adverse effects would be minimized by avoiding the discharge of garbage and other debris by the crews on all vessels within the NEG Project area. Additionally, training of construction crews would include a requirement explaining that the discharge of trash and debris overboard is harmful to the marine mammals, and therefore is prohibited. Therefore, marine debris could cause a short-term, direct, and minor increase in the risk of ingestion of marine debris by marine mammals.

Fuel Spill

The potential for fuel spills from the EBRVs is low. The EBRV cargo tanks are double containment tanks and, based on LNG carrier operator history and EBRV design, a failure of one of the containment tanks is highly improbable. All vents on the EBRV's fuel tanks are fitted with spill containment systems to prevent the discharge of fuel while the vessel is at the NEG Port performing regasification and offloading. Refueling of the EBRVs would occur at specialized fueling or bunkering docks, and would not occur at sea, or while on the STL buoy. In the unlikely event of a spill, Standard Operating Procedures would be followed to prevent and/or mitigate any LNG leaks. In addition, each EBRV would maintain a Shipboard Oil Pollution Emergency Plan (SOPEP) as required by international convention. The SOPEP complies with MARPOL 73/78 Consolidated Edition 2002 Annex I Regulation 26 requiring every oil tanker of 150 tons gross and above, and every ship of 400 tons gross and above to carry an SOPEP approved by the Administration.

In the unlikely event that natural gas was released during regasification and offloading, the gas would vaporize and disperse quickly. During the lifetime of the Project the potential for adverse impacts due to fuel spills would be long-term, direct, and minor. If this occurred, it is possible that some gas could temporarily pool on the water surface. The low potential for such a release, coupled with the volatile nature of the gas reduces the possibility of harmful effects to marine mammals. Cetaceans that might come into contact with a small fuel spill at the Project site are not expected to experience adverse effects, as past observations have shown no apparent adverse effects or behavioral changes caused by contact with fuel spills (Grose and Mattson, 1977; Goodale et al., 1979).

Impingement and Entrainment

Once moored to the buoy, the EBRV would operate under normal capacity water intake as the vessel prepared for the start-up of the regasification operations. During the first four hours of the regasification process, the EBRV would use 11.58 million gallons of seawater. When the vessel converts to the closed-loop heat recovery and exchange mode (after four hours), all main and auxiliary sea water would be diverted through the heat exchangers and all seawater intakes would be secured, except for the minimal sea water supply to the onboard desalination plants. Total water intake for ballast, firewater, and other operational requirements for the duration of the regasification process would be approximately 2.77 million gallons per day. As the vessel approaches the end of the regasification sequence, the vessel main and auxiliary cooling system would resume its normal water intake amount for approximately four hours, using approximately 11.58 million gallons of seawater. All seawater used in support of the EBRV ship operations would be drawn through four sea chests: starboard high, starboard low, port high, and port low. Each sea chest grid would be equipped with metal gratings having 21 mm slots between the grating bars. Water intake velocities under normal water use capacity (first and last four hours) would be approximately 0.82 ft/sec, and would be reduced to 0.5 ft/sec while the EBRV is operating in the closed-loop heat recovery and exchange mode. Entrainment of non-threatened and endangered marine mammals during EBRV operations would not be an issue, as these mammals are too large to be impacted by this activity.

Bioaccumulation

There is potential for bioaccumulation of contaminants in marine mammals during operation of the NEG Port, as the movement of STL buoy anchor chains is expected to cause resuspension of sediments from the seafloor. The maximum seafloor area disturbed by the anchor chains, under a 100-year storm event, would be about 43 acres. Within this area the sediments are generally clean; however, one sample was found to exceed NOAA’s PEL level for pesticides. According to NOAA, sediments with one or more constituents at or above the PELs are likely to be toxic to some organisms.

The only possible route of uptake of contaminants by marine mammals is through food consumption, as contaminants are not absorbed through the skin of marine mammals, and they do not drink large quantities of seawater. Contaminants that may be mobilized by anchor chain sweep may accumulate in the food chain leading to the marine mammals; however, the level of bioaccumulation within marine mammals is expected to be very low. The already low levels of contaminants found in the sediments would be further diluted during resuspension caused by operations. As such, impacts to marine mammals caused by bioaccumulation of bottom contaminants during operations would be long-term, indirect, and minor.

4.2.4.4 Impacts of Decommissioning

Decommissioning the NEG Port and Pipeline Lateral would involve removal of various components of the Project. All components in the water column would be retrieved, including the STL buoys, flexible risers, and wire rope mooring segments. Additionally, all of the suction pile anchors would be recovered by reverse pumping, and PLEMs would be removed. Any portions of the flowlines that were not buried would also be removed during decommissioning.

Impacts to marine mammals caused by physical harassment, vessel strikes, alteration to habitat, acoustic harassment, entanglement, ingestion of marine debris, and fuel spills would be similar to those encountered during construction (section 4.2.4.2). Other impacts from alteration of prey species abundance and distribution, bioaccumulation, and impingement and entrainment would be less than construction, as seawater intake and use of biocides would not be required.

4.2.4.5 Impacts of Alternatives

Drilled and Grouted Pile Anchor Alternative

The main impact of drilled and pile anchors on marine mammals would involve a turbidity plume that would result from the drilling of the anchors. This plume would be substantially larger than one created from installation of the suction pile anchors, but would still be isolated to deepwater and not reach water column surface, and, therefore, should not affect marine mammals.

Port Location Alternative

For the purposes of marine mammals, these two locations pose similar risks to marine mammals.

Vaporization Alternatives

An STV system can operate in two modes, open-loop and closed-loop. Open-loop mode would withdraw approximately 76 million gallons of water per day (MGD) during warm months and an average of 4.97 MGD during cold months. This option would result in an order of magnitude more water withdrawn and discharged over the proposed closed-loop vaporization system, and would therefore remove substantially more marine mammal prey species (zooplankton).

Pipeline Alternative

Construction within soft-bottom areas (Routes 1 and 4) would entail the simplest, most predictable and least sediment-disturbing construction methods. Given the presence of gravel, cobble and other hard substrate, and lack of thin surficial sediment layers within Routes 2 and 3, construction on these routes would have a higher probability of requiring blasting, dredging or surface armoring. Additionally, more complex conditions present a higher potential for construction delays, which would in turn extend the construction time and increase the risk of vessel strikes during construction. In addition, Routes 2 and 3 would be expected to cause increased impact on marine species habitat and behavior.

Construction Schedule Alternatives

Based on the results of the month-by-month analysis of construction related effects, and the analysis of each species' and life stage's seasonal abundance in the Project area, it is not possible to select a single, continuous, seven-month construction window that optimizes protection of all species and life stages of concern concurrently. Allowing construction from November through May would minimize impacts to the greatest number of species of concern, and would be most protective of all Federally-protected species (marine mammals and sea turtles) as a group. Allowing construction from May through November would be most protective of the critically endangered North Atlantic right whale and fin and humpback whales, but would be less protective of sei whales, blue whales, sea turtles and some fish species.

Right whale occurrences in Massachusetts Bay tend to peak between February and April, so the potential for vessel strikes or entanglement would increase during the November through May and January to July schedules. Similarly, humpback whales and finback whales arrive in Massachusetts Bay in March and April, respectively, and would be more vulnerable to vessel strikes and entanglement during this time. In late spring, humpback whales typically move offshore towards SBNMS, so the potential for impacts on this species would likely decrease during the later spring and summer.

4.2.4.6 Mitigation and Minimization – Marine Mammals

Construction Mitigation and Minimization

The following mitigation measures are designed to minimize potential impacts to marine species caused by physical harassment, vessel strikes, ingestion of marine debris, fuel spills, and impingement and entrainment.

- To determine whether and/or when marine mammals are being exposed to levels of sound considered in permitting, MARAD will require the applicant, as a condition of the DWPA license, if granted, to install and operate an array of near-real time acoustic detection buoys to detect and localize vocally active marine mammals relative to construction-related sound sources. The applicant will be required to operate the system throughout the construction period. Further details regarding this system will be approved by MARAD and NOAA as part of a detailed monitoring and mitigation plan being developed by MARAD. The final monitoring and mitigation plan will be filed with FERC prior to the start of any pipeline construction activities.
- The applicants have proposed a Marine Mammal/Sea Turtle Visual Monitoring Plan (Plan) to minimize the potential for impacts to marine mammals and sea turtles from construction of the NEG Project. This Plan would use human visual observers as the primary detection device during the construction phase of the Project. The Project would employ qualified marine mammal/sea turtle observers on each pipeline lay barge, bury barge and diving support vessel for visual shipboard surveys during construction activities that have direct field experience on a marine mammal/sea turtle vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico. The observers would be responsible for visually locating marine mammals and sea turtles at the ocean's surface and to the extent possible, identifying the species. All observers would meet the experience requirements established by NMFS.
- The vessel superintendent or on-deck supervisor would be notified immediately if any marine mammals or sea turtles are visually detected within 0.5-miles of the construction vessel and the vessel's crew would be put on a heightened state of alert. The marine mammal or sea turtle would be monitored constantly to determine if it is moving toward the construction area. The observer would be required to report all right whale sightings to the NMFS.
- Construction vessel(s) in the vicinity of a sighting would be directed to cease any movement and/or stop noise emitting activities that exceed 120 decibels (dB) in the event that a right whale comes within 500 yards of any operating construction vessel. For other whales and sea turtles this distance would be 100 yards. Vessels transiting the construction area, such as pipe haul barge tugs, would also be required to maintain these separation distances.

- Construction would resume after the marine mammal/sea turtle is positively confirmed to be outside the established zones (either 500 yards or 100 yards depending upon species).
- During construction weekly status reports would be provided to the NMFS utilizing standardized reporting forms.
- Since the NEG Project area is within the Mandatory Ship Reporting Area (MSRA), all construction and support vessels would report their activities to the mandatory reporting section of the USCG to remain apprised of North Atlantic right whale movements within the area.
- All construction vessels greater than 300 gross tons would maintain a speed of 10 knots or less. Crew and supply boats, which move at up to 15 knots, when smaller than 300 gross tons would not be restricted to 10 knots; however, the crew members would be required to monitor the area for marine mammals and report any sightings to the other construction vessels operating in the area.
- Mesh grates would be used during flooding and hydrostatic testing of the pipeline and flowlines to minimize the risk of impingement and entrainment of marine mammals and sea turtles.
- Construction operations that involved excessively noisy equipment would "ramp-up" sound sources, allowing whales a chance to leave the area before the sounds reached maximum levels.
- NEG and Algonquin would require contractors to maintain individual SPCC Plans during construction.
- Although not anticipated, if blasting is determined to be required as a result of ongoing geophysical and geotechnical surveys, Algonquin would prepare a Blasting Mitigation Plan in consultation with the NOAA.
- In accordance with MMS NTL 2003-G11, Marine Trash and Debris Placards would be placed in prominent places on all fixed and floating production facilities that have sleeping or food preparation capabilities and on mobile vessels. These notices would be referenced, and their contents explained, during any initial orientation given on the facility for visitors or occupants. Placards would be sturdy enough to withstand the local environment and would be replaced when damage or wear compromised readability.
- FERC staff is recommending that a Monitoring and Mitigation Plan for the Project is developed through consultation with the appropriate regulatory agencies and includes installation and operation of an array of autonomous recording units to monitor and evaluate underwater sound output from the NEG Project.

Operational Mitigation and Minimization

The following mitigation measures have been designed to minimize impacts to marine mammals caused by Project operation.

- MARAD will require, as a condition of any DWPA license issued for this Project, that the applicant install and operate an array of near-real-time acoustic detection buoys in the Boston TSS, the number, duration and specific location for which will be approved in advance by MARAD and NOAA as part of a detailed monitoring and mitigation plan prepared by MARAD. As agreed to by NOAA, alternative system technology may be presented by the applicant for consideration by NOAA, so long as it meets the criteria as listed by NOAA in its comments to the USCG dated July 3, 2006 (see Appendix D)

- All individuals onboard the EBRVs responsible for the navigation and lookout duties would receive training, a component of which would be training on marine mammal sighting/reporting and vessel strike avoidance measures, as required by IMO standards. These individuals would use a New England reference guide that includes and helps identify the species of whales, species of sea turtles and the species of seals that might be encountered in the NEG Project area.
- Crew training of EBRV personnel would stress individual responsibility for marine mammal awareness and reporting.
- If a marine mammal or sea turtle is sighted by a crew member, an immediate notification would be made to the Person-in-Charge on board the EBRV and the NEG Port Manager, who would ensure that the required reporting procedures were followed.
- The NEG Project area is within the MSRA, so all EBRVs transiting to and from the MSRA would report their activities to the mandatory reporting section of the USCG to remain apprised of North Atlantic right whale movements within the area. All vessels entering and exiting the MSRA would report their activities to WHALESNORTH and the USCG through approved channels.
- EBRVs traversing the Great South Channel Critical Habitat Area would enter the existing TSS as soon as practicable. NEG proposes that the EBRVs would maintain a speed of 12 knots or less while in the TSS until reaching the vicinity of the buoys. Vessel speed would gradually be reduced to 3 knots at 1.86 miles out from the NEG Port and to less than 1 knot at a distance of 1,640 feet from the NEG Port. A 10 knot speed restriction would be applicable during the following time periods: Cape Cod Bay: January 1 - May 15, Off Race Point: March 1 - April 30, Great South Channel: April 1 - July 31. MARAD and Coast Guard will address the issue of vessel speed through a combination of voluntary commitments from the applicant and licensing conditions that are developed in coordination and consultation with NOAA. These actions would include appropriate speed reductions and increased vigilance when indicated.
- During Project construction and operation, NEG would use large diameter lines that would be visible to marine mammals and sea turtles.
- In the unlikely event that a marine mammal became entangled, the environmental coordinator would immediately notify NMFS so that a rescue effort could be initiated.

4.2.5 Avian Resources

Nearshore birds, offshore seabirds or migrating terrestrial species are not expected to be affected by construction, operation, or decommissioning of the NEG Project. Based on a review of available literature and data on the existing species that may use the Project area, and the offshore and deepwater location of the Project, nesting, roosting or breeding grounds would not be affected.

The NEG Project would not cause substantial prey reduction or habitat displacement for any of the species discussed in section 3.2.5. Due to the large area in which these birds can choose to feed and the typical avoidance behavior of these species toward any disturbance source, such as the large ships traversing the TSS, any adverse impact to feeding would be short-term or transitory. Operational noise and lighting levels resulting from construction vessels or the EBRV and offloading activities are not anticipated to alter the migration patterns of avian species within the area. While in transit or docking with the buoy system, the EBRVs would not be expected to disturb avian species given their ability to avoid the ships, and the minimal activity in comparison to that of the adjacent Boston Harbor traffic lanes. The proposed NEG Port and Pipeline Lateral would not contain condensates or other liquids, thus the possibility of a release of liquid petroleum products during operations is negligible.

Ocean-going ships churn water and can create temporary, localized upwelling situations that can increase the presence of surficial prey and serve as an attractant to birds. Also, construction vessels and the EBRVs would provide an ongoing lighted environment that could attract flying insects. Because of this, some contact would probably occur between these ships and foraging/feeding seabirds, however, mortality in these situations would be minor and would not have an overall impact on the avian populations.

4.2.5.1 Nearshore Birds

Nearshore birds include shorebirds, wading birds, and waterfowl. The Project would not be located within waters shallow enough to impact nesting or roosting areas of these species. Nearshore birds would be expected to limit use of the Project area to feeding or migration.

The NEG Project may cause limited, localized prey reduction for nearshore bird species, which could cause the birds to search for food in other locations, and could, in turn, cause them to have reduced contact with the Project area. Some species, such as ducks, may be able to tolerate high levels of human disturbance without exhibiting avoidance behavior, while others would actively avoid the area during construction and operation.

4.2.5.2 Coastal and Offshore Seabirds

Coastal and offshore seabirds spend most of their lives on the open oceanic waters and come to land for breeding only. Foraging habitat for marine birds can be widespread and diffuse. Impacts to these species would be of concern if their prey were at risk. Detailed evaluation of fisheries impacts indicate prey reductions would not occur to the extent that seabirds could not obtain food.

Coastal and offshore birds would exhibit avoidance behavior so as to limit their contact with construction vessels and the EBRV during construction and operation. Given the relative size of the disturbance area in comparison to the open water areas, these birds should have little difficulty circumventing the Project area.

4.2.5.3 Impacts of Alternatives

Anchor Alternatives

Neither of the anchor system alternatives being considered for the proposed Port would impact birds.

Port Location Alternatives

From an avian resource perspective, there is no difference between the alternate Port locations.

Vaporization Alternatives

Neither STV system alternative would have any impact on avian resources.

Pipeline Route Alternative

From an avian perspective, there is no difference between the alternate Pipeline routes.

Construction Schedule Alternatives

From all available perspectives there is no difference between the alternative construction schedules.

4.2.6 Upland Resources

This section describes the proposed consequences of construction, operation and decommissioning of the land based components of the NEG Project. During construction, onshore load-out yards for offshore construction materials would be used for construction, staging and materials storage, and modifications would be made to two existing onshore aboveground meter stations located in the City of Salem and the Town of Weymouth. A regional operations center would be established in rental space to support the operation of the NEG Port.

4.2.6.1 NEG Port

Impacts of Construction

NEG proposes to use existing shorefront port facilities (yet to be identified) as staging areas and load-out yards during NEG Port construction. Assuming that existing port facilities that required no modification would be leased, onshore staging and load-out activities would have no impact on upland resources.

Impacts of Operation

A proposed site for the Regional Operation Center has not yet been identified. NEG proposes to lease existing office and warehouse space for this function, and does not expect any modifications to the selected site. Assuming that space is leased in an existing structure, use of the Regional Operation Center would have no impact on upland resources.

Impacts of Decommissioning

Since NEG is not proposing to construct any new onshore facilities for Port operation, there would be no land based facilities to remove during decommissioning. As a result, decommissioning would have no effect on upland resources.

4.2.6.2 NEG Pipeline

Impacts of Construction

Load-out Yards

Four existing load-out yards are under consideration as staging areas for Pipeline Lateral construction. The four proposed load-out yards consist of commercial piers and would be used to transfer materials, equipment and personnel from the shorebase to the offshore construction vessels working on the Pipeline. No temporary or permanent disturbances to existing land uses would occur at the onshore load-out yards as a result Project construction activities. All of the onshore load-out yards were previously approved for use during the construction of Algonquin’s HubLine (FERC Docket Nos. CP-01-5-000 and CPO1-5-001). Sites under consideration for load-out yards include:

- The Americold Wharf – This facility, located in Gloucester, MA, is a cold storage facility that handles frozen fish products for local, regional, and national companies. The site consists of paved parking, storage areas, and a pier consisting of a concrete and asphalt deck with wood pilings. This pier is capable of berthing a variety of sea vessels.
- Pier 11 – This facility is located in the Charlestown section of the City of Boston. The site consists of a large storage facilities and open paved areas. The pier is comprised of a concrete and asphalt deck with wooded pilings.
- The Quincy Ship Yard – Located in the City of Quincy, MA, this facility is presently used as a large commercial port. The yard consists of storage facilities and a large concrete pier.
- Quonset Davisville Port – The yard and existing pier at the Davisville Industrial Park is located in the Town of North Kingstown, RI, and encompasses 54 acres. The land is flat open space with large areas of broken pavement. The pier to be used for the construction of the Pipeline Lateral consists of a concrete an asphalt deck and wooded pilings and is one of three within the Quonset Davisville Port and Commerce Park.

Meter Stations

Proposed modifications to existing meter stations would cause some temporary disturbance and permanent impacts to land within the existing station properties. Each metering facility contains typical natural gas infrastructure including buildings, metering equipment, valves, fencing, and other aboveground equipment. All of the proposed permanent impacts would occur within existing meter station fencing, within existing pipeline ROW or within existing paved parking areas. No new permanent ROW would be required to complete the meter station modifications.

The Salem Meter Station is located in the City of Salem on the east side of Kernwood Street adjacent to McCabe Park on a level, crushed stone substrate that is surrounded by security fencing. Wetlands subject to local, state, and federal jurisdiction are present on the site.

The Weymouth Meter Station is located in the Town of Weymouth, MA adjacent to the Route 3A Bridge on the east side of the Weymouth Fore River. This existing station sits on a level, crushed stone substrate and is surrounded by security fencing on industrial property also occupied by the Massachusetts Water Resource Authority (MWRA) and the Excelon Electrical Generating station. A field review confirmed the National Wetland Inventory Mapping that no federal jurisdictional wetlands would be affected by the modifications to this Metering Station.

At the Salem Meter Station, approximately 0.003 acres of land within the existing station footprint would be permanently altered for the construction of the new 10 ft by 15 ft enclosure and the new foundation for the building addition. In addition, approximately 1.83 acres of land would be temporarily used during construction for material fabrication, or as parking/laydown for equipment and vehicles.

Construction of the new 16 ft by 21 ft concrete building and the new foundations for the heater and scrubber at the Weymouth Meter Station would permanently alter approximately 0.008 acres of land within the existing station footprint. In addition, approximately 1.2 acres of land would be temporarily used during construction, for material fabrication or as parking/laydown for equipment and vehicles.

No streams or other surface waterbodies would be affected by the proposed modifications to meter stations, therefore, no impacts to inland fishery resources would occur. No federal wetlands would be directly affected by the proposed modification work at the stations. Algonquin would be required to submit an application pursuant to the local and state wetland provisions for modifications at the Salem Meter Station prior to commencement of any construction activities.

The areas within each Meter Station site are not vegetated and the proposed work would be confined to the existing aboveground facilities within existing station fence lines. The availability and value of the habitat for wildlife at these site-specific locations is low. Due to the location and nature of the proposed work, the Project would have a minor short-term impact on existing wildlife resources.

Work at the Salem and Weymouth Meter Stations would be performed in compliance with applicable federal regulations and guidelines, and the specific requirements of the necessary permits. Work would be performed in compliance with applicable federal and state regulations and in compliance with Algonquin's Erosion and Sediment Control Plan (ESCP). A copy of the ESCP is provided in Appendix I.

Given the proposed location for new metering equipment within existing meter station properties, and assuming that Algonquin would make the modifications in compliance with federal, state and local requirements, the Project would have, at most, a minor long-term impact on upland resources.

Impacts of Operation

The Salem and Weymouth Meter Stations would be operated and maintained by Algonquin in accordance with standard industry practices and in the same manner as the company currently operates and maintains their major interstate facilities in the Northeast. Operation would not require further land modification and, as a result, would not have any further impact on upland resources.

Impacts of Decommissioning

Since no upland facilities would be removed or changed by Project decommissioning, there would be no impacts to upland resources from this action.

4.2.6.3 Impacts of Alternatives

None of the alternatives being considered would occur on land or would affect resources on land. As a result, there is no significant difference between any of the alternatives from the perspective of upland resources.

4.2.6.4 Mitigation and Minimization

Nearshore birds, offshore seabirds or migrating terrestrial species are not expected to be affected by construction, operation, or decommissioning of the NEG Project, therefore no mitigation measures are proposed.

4.3 THREATENED AND ENDANGERED MARINE MAMMALS AND TURTLES

The impacts to threatened and endangered marine mammals and turtles found in the proposed Project area are discussed in this section. The impacts are considered separately for the construction, operation, and decommissioning phase of the Project. Following the impacts analysis for the proposed Project, a summary of mitigation and minimization measures is included. Impacts to non-threatened and endangered species are discussed separately in section 4.2.4.

This threatened and endangered species section of the FEIS has been prepared to serve as the Biological Assessment (BA) as required under Section 7 of the ESA. Informal consultation for this project has already been initiated (Appendix D).

4.3.1 Evaluation Criteria

The following types of physical harassment have been considered: vessel strikes, alteration to habitat, acoustic harassment, alteration of prey species abundance and distribution, entanglement, ingestion of marine debris, fuel spills, impingement and entrainment, and bioaccumulation. Background information for alterations to habitat, prey species abundance and distribution, entanglement, fuel spills, and bioaccumulation is the same as presented for non-threatened or endangered species in sections 4.2.4.1.

Vessel Strikes

Since 1985 there have been 26 known ship strikes of threatened and/or endangered whales in the Massachusetts Bay area (Jensen and Silber, 2004): 1 blue whale, 8 fin whales, 10 humpback whales, 6 right whales, and 1 sei whale (Table 4-20). The larger number of fin whale and humpback whale strikes was due to their high densities in the Massachusetts Bay area. An additional 12 minke whales, a non-threatened species, have also been struck by ships within the Massachusetts Bay area.

About 90 percent of non-natural North Atlantic right whale deaths have been attributed to ship strikes (NOAA, n.d.; WWF, 2005a). The right whales apparently have a limited ability to detect or maneuver around on-coming ships. North Atlantic right whales spend most of their time at the surface, resting, mating, and nursing, which increases their vulnerability to collisions. Based on observations of right whale strandings between 1970 and 1990, Kraus (1990) estimated that one-third of the mortalities of right whales in inshore waters were caused by ship/whale collisions and entanglement in fishing gear. Approximately 7 percent of photo-documented living right whales, and 20 percent of stranded right whales have shown evidence of wounds from ship propellers, indicating a high apparent rate of injury resulting from encounters with ships. Other than the information presented in Table 4-20 similar information regarding vessel strike issues for species other than North Atlantic right whales is not available.

Table 4-20

Identified Ship Strikes of Threatened and/or Endangered Whales in the NEG Project Area

Date	Species	Sex	Length (m)	Location of strike or recovery	Type of Impact	Vessel Type	Vessel Size (m)	Speed (knots)
3/3/1998	Blue			Approaching Narragansett Bay, RI	Mortality	Bulbous bow tanker	148	
5/12/1997	Fin		12 est	Boston Harbor, MA	Mortality		173	
8/4/1997	Fin	F		Eastham, MA	Mortality	Bulbous bow tanker		
8/1/1995	Fin		17	48 km SE of Cape Cod, MA	Mortality			
8/1993	Fin			Boston Harbor, MA	Mortality			
1/15/1998	Fin		15	Marshfield, MA	Mortality			
8/18/1987	Fin			Boston, MA	Unknown			
7/13/1985	Fin			Stellwagen Bank NMS, MA	Injury	Whale-watch vessel	28	26
8/1984	Fin			Stellwagen Bank NMS, MA	Mortality			
10/4/2001	Humpback			Approx. 5 nm NW of Stellwagen	Injured	Whale-watch vessel		11.7
10/1/2001	Humpback	F	11.4	Duxbury Beach, MA	Mortality	Injury indicative of a ship strike		
7/29/2000	Humpback			Stellwagen Bank NMS, MA	Unknown			
5/14/2000	Humpback			Stellwagen Bank NMS, MA	Unknown			
8/2/1998	Humpback			Stellwagen Bank NMS, MA	Unknown	Whale-watch catamaran	36	18.3
6/7/1998	Humpbacks (2)			Boston Harbor, MA	Unknown			
7/20/1997	Humpback			Cape Cod Bay, MA	Unknown	USCG	82.3	20
7/19/1994	Humpback			Stellwagen Bank NMS, MA	Unknown			
6/21/1991	Humpback			Stellwagen Bank NMS, MA	Injury	Whale-watch vessel	14	
6/8/1990	Humpback			Stellwagen Bank NMS, MA	Unknown			
3/25/1996	Right	M		Wellfleet, MA	Mortality, stranded			
3/9/1996	Right	M		MA	Mortality			
8/7/1986	Right	F		Massachusetts Bay, MA	Mortality			
5/25/1980	Right	M		Great South Channel, MA	Injury			
4/15/1976	Right	M		MA	Mortality			
4/20/1999	Right	F		Cape Cod, MA	Mortality			
11/17/1994	Sei		15 est	Charlestown Harbor, Boston, MA	Mortality	Cruise ship		

Source: NFSC, 2005; Jensen and Silber, 2004; Waring et al, 2004

Vessel collisions, especially propeller strikes, have also been identified as a threat to sea turtles. The juvenile Kemp's ridley turtles that enter the NEG Project area are small (20 to 30 cm long) and difficult to observe from a boat. The leatherback and loggerhead turtles, which are naturally larger species, may be somewhat easier to detect in the water, but are still very difficult to spot from a ship (Shoop and Kenney, 1992).

Ingestion of Marine Debris

Background for this impact is the same as for non-threatened and endangered species (section 4.2.4.1); however, ingestion of marine debris is more of a threat for listed sea turtles than any other species of concern because sea turtles mistake marine debris for prey (e.g., leatherback and green sea turtles) (Bjorndal et al., 1994; National Marine Fisheries Service and U.S. Fish and Wildlife Service, 1992). Ingested items include, but are not limited to plastic, monofilament line, fish hooks, rubber, aluminum foil, and tar. Injury or death to a large number of threatened and endangered marine mammals or sea turtles as a result of marine debris ingestion would result in a long-term, direct, major, adverse impact.

Impingement and Entrainment

Background for this impact is the same as for non-threatened and endangered species (section 4.2.4.1); however, impingement and entrainment is more of a threat for listed sea turtles (juveniles) and seals than any other species of concern (USEPA, 2002). Depending on screen mesh sizing, juvenile sea turtles can be entrained in water intake structures, resulting in mortality. Larger adult sea turtles and seals are sometimes injured or killed as a result of impingement around power plant intake structures. Death to a large number of threatened or endangered marine species caused by impingement and entrainment would result in a long-term, direct, major, adverse impact.

4.3.2 Impacts of Construction (NEG Port and Pipeline)

4.3.2.1 Physical Harassment

Changes in species behavior can be attributed to a variety of factors, many of which are largely unknown. There is a potential for species behavior modification during construction, primarily from vessel collisions, entanglement, ingestion of debris, and acoustic harassment (see discussions below). Behavior modification from other causes is likely to be minor because the changes in the environment in the immediate vicinity of the Port and Pipeline would be small, temporary, and intermittent, and would not impact known behavior patterns including, but not limited to, migration, breathing, or sheltering (e.g., topography of ocean floor, chemical changes in the water, night time lighting, and magnetic sensing; LTG Limited n.d.). Short-term displacement from the Project area as a result of these temporary construction-related changes may occur, but the immediate Project area is small in relationship to the entire Massachusetts Bay in which marine mammals are known to frequent. General seasonal distributions of threatened and endangered marine mammals provided within the Weinrich and Sardi (2005) and NARWC databases were used to develop a construction window that would minimize impacts to mammal species. Physical harassment from factors not including vessel collisions, entanglement, ingestion of debris, and acoustic harassment should be short-term, indirect and minor.

Vessel Strikes

Increased risk of threatened and/or endangered species vessel strikes during the Project construction is a product of the increased number of vessels in the construction area. Offshore construction activities associated with the Project are scheduled to occur over a 7 month period. Construction vessels would make approximately 209 round trips to and from the Project area over the 7-month construction period. The number of trips between the construction sites and local ports, as well as the approximate times at the station, are summarized in Table 4-11. The impacts would be the same as discussed for non-threatened and endangered marine mammals in section 4.2.4.

The small increase in vessel activity during construction, slow speeds of construction vessels, construction minimization measures, and low numbers of non-threatened and endangered marine mammals impacted from ship strikes historically in the Massachusetts Bay area, would result in a short-term, direct, minor impact to marine mammals during construction. Mitigation measures described in section 4.2.4.6 could further reduce the risk of ship strikes to marine mammals.

Alteration to Habitat, Acoustic Harassment, Entanglement and Bioaccumulation

Alteration to habitat, acoustic harassment, entanglement and bioaccumulation impacts for threatened and endangered marine mammals and sea turtles, as a result of NEG Port and Pipeline Lateral construction, are the same as discussed for non-threatened and endangered marine species (section 4.2.4).

Alteration of Prey Species Abundance and Distribution

The largest change of altering prey species abundance during NEG Port and Pipeline Lateral construction would be during hydrostatic testing, which has the potential to entrain zooplankton that serve as an important food source for baleen whales in the Project area. Mean abundances of zooplankton at MWRA's nearfield stations, which are subject to natural variations, indicate minimum and maximum abundances from 13.64×10^3 to 96.53×10^3 organisms per m^3 (Libby et. al., 2000, 2001, 2002a, b, c, 2003, 2004a,b, 2005). The total entrainment of zooplankton during hydrostatic testing would, therefore, range from 163.7×10^6 to $1,058.4 \times 10^6$ individuals.

To evaluate the impacts of zooplankton losses through entrainment during hydrostatic testing, the relationship between zooplankton lost and consumption rates of zooplankton by typical blue and North Atlantic right whales was investigated. The mean biomass of zooplankton consumed by typical North Atlantic right whales on a daily basis is estimated to be 501 kg per individual (Croll and Kudela, 2004). Measured weights of copepods consumed by baleen whales range from 3.7×10^{-9} to 3.0×10^{-8} kg (Schnetzer and Caron, 2005; Haberman and Künnap, 2002). Assuming that the largest number of copepod individuals entrained at the MWRA site have the greatest mass, it is possible to estimate a maximum mass of 31.75 kg of copepods would be lost during hydrostatic testing. This suggests that impacts from construction (hydrostatic testing) would remove approximately 6.2% by weight of a single right whale's prey consumption for one day. When spread across the entire threatened and endangered baleen whale population in the Project area, entrainment of copepods during Project construction would have a short-term, indirect, minor impact on the abundance and distribution of prey species.

Ingestion of Marine Debris

Ingestion of marine debris such as plastic pellets, plastic bags, wrappers, bottles, cups, synthetic line, lumber, and cigarette butts represents the greatest risk to threatened and endangered sea turtles, as these species are known to identify marine debris as prey. During the proposed 7-month construction period, crew-operated vessels would be required to install the NEG Port and Pipeline Lateral. While these vessels are on site there is the potential for debris to enter the environment. Potential adverse effects would be minimized by avoiding the discharge of garbage and other debris by the crews on all vessels within the NEG Project area. Additionally, training of construction crews would include a requirement explaining that the discharge of trash and debris overboard is harmful to the marine species and the environment, and is illegal under the Act to Prevent Pollution from Ships and the Ocean Duping Act, depending on the type of material. Discharge of debris would therefore be prohibited and violations would be subject to enforcement actions. The combination of crew training, existing regulations, and the temporary nature and timing of construction (7 months) would result in a short-term, direct, minor increase in the risk of ingestion of marine debris by marine mammals.

Impingement and Entrainment

The greatest risk of impingement and/or entrainment of threatened and endangered marine species during construction of the NEG Port and Pipeline Lateral would be to sea turtles. Most other threatened and endangered species would be too large to be impacted by impingement or entrainment at the Project site. The primary water intake activities would occur during hydrostatic testing of the pipeline and flowlines. This activity has the greatest potential to impact green, Kemp's ridley, and loggerhead turtles because these species are smaller than the pipelines, and because they are known to dive or forage along the seafloor. However, the actual area of impact coupled with the short duration of hydrostatic testing would result in a short-term, direct, minor adverse impact of impingement to these smaller species

4.3.3 Impacts of Operation

Details regarding operations at the proposed NEG Port facility that have the potential to impact threatened and endangered marine mammals and sea turtles are discussed in section 4.2.4.3. Specific impacts from operations on threatened and endangered marine species are discussed below.

Physical Harassment

There is a potential for species behavior modification during operation, primarily from acoustic harassment caused by the EBRVs, which could emit underwater sound levels above the designated MMPA harassment threshold for continuous noise (see discussion below). Other causes for species behavior modification during operation are likely to be long-term, indirect and minor, because other than the presence of the LNG vessels, there would be no changes in the environment in the immediate vicinity of the Port and Pipeline known to alter the behavior patterns of species including, but not limited to, migration, breathing, feeding, or sheltering. (e.g., topography of ocean floor, chemical changes in the water, and magnetic sensing; LTG Limited n.d.).

Vessel Strikes

Increased risk of species vessel strikes during Project operation is possible due to the increased number of vessels transiting to and from the NEG Port. The risk would be greatest for threatened and endangered baleen whales due to their greater populations in the Project area. During NEG Port operation, approximately one EBRV trip inbound and outbound would occur per week, or approximately 65 EBRV round trips per year. Approaches to the NEG Port by EBRVs would be by way of the TSS for the Port of Boston. The EBRV would approach the NEG Port and would moor under its own power with no tug assist. Based on information presented in Table 4-12 for the number of commercial vessels transiting to and from the Port of Boston in 2003, the proposed EBRV arrivals would result in a 3.4 percent increase in commercial traffic through the SBNMS in the TSS.

The North Atlantic right whale is the only critically endangered species for which recent population modeling exercises by NOAA indicate that the loss of a single individual could have a negative effect on the survival of the species. As a result, NOAA has set a Potential Biological Removal (PBR) value of zero for North Atlantic right whales. This means that the death of even one individual is above the acceptable limit. Current research does not provide predictive estimates of vessel strikes based on number of vessel trips and density of marine mammals. While it is known that an increase in vessel traffic increases the risk of collision, the probability of that risk cannot be quantified. What is understood is that any increase in vessel traffic increases the risk of whale strikes. What is not known is how this increase relates to cause or probability of whale strikes.

In recognition of the potential added risk of ship strikes within the Boston TSS, MARAD will require, as a condition of any DWPA license issued for this Project, that the applicant install and operate an array of near-real-time acoustic detection buoys in the Boston TSS, the number, duration and specific location for which will be approved in advance by MARAD and NOAA as part of a detailed monitoring and mitigation plan prepared by MARAD. As agreed to by NOAA, alternative system technology may be presented by the applicant for consideration by NOAA, so long as it meets the criteria as listed by NOAA in its comments to the USCG dated July 3, 2006 (see Appendix D).

Alteration to Habitat, Acoustic Harassment, Entanglement and Bioaccumulation

Alteration to habitat, acoustic harassment, entanglement and bioaccumulation impacts for threatened and endangered marine mammals and sea turtles, as a result of NEG Port operations is the same as discussed for non-threatened and endangered marine species (section 4.2.4.3).

Alteration of Prey Species Abundance and Distribution

During a typical 8-day regasification event, the intake of seawater would entrain zooplankton that serve as an important food source for threatened and endangered baleen whales in the Project area. The mean biomass of zooplankton consumed by typical right whales on a daily basis are estimated to be 501 kg per individual (Croll and Kudela, 2004). Measured weights of copepods consumed by baleen whales range from 3.7×10^{-9} to 3.0×10^{-8} kg (Schnetzer and Caron, 2005; Haberman and Künnap, 2002). Assuming that the largest number of copepod individuals entrained at the MWRA site have the greatest mass, it is possible to estimate a maximum mass of 435.9 kg of copepods lost during an 8-day regasification cycle (average loss of 54.5 kg per day). This suggests that impacts during operations would remove only 11% by weight of a single right whales prey consumption per day. When spread across the entire baleen whale population in the Project area, this entrainment of copepods during operations would have a long-term, direct and minor adverse impact on the abundance and distribution of prey.

Ingestion of Marine Debris

During each 8-day regasification cycle, there is the potential for debris to enter the environment. This activity has the greatest potential to harm sea turtles, which commonly mistake marine debris as prey. Adverse effects would be minimized by avoiding the discharge of garbage and other debris by the crews on all vessels within the NEG Project area. In addition, training of construction crews would include a requirement explaining that the discharge of trash and debris overboard is harmful to the marine mammals and the environment, and is illegal under the Act to Prevent Pollution from Ships and the Ocean Dumping Act, depending on the type of material. Discharge of debris would therefore be prohibited, and violations would be subject to enforcement actions. With these minimization measures the impacts from ingestion of marine debris during construction would be long-term, direct, and minor.

Impingement and Entrainment

Water use during NEG Port operations would take place through four sea chests in the following locations: starboard high, starboard low, port high, and port low. Each sea chest grid would be equipped with metal gratings having 21 mm slots between the grating bars. Water intake velocities under normal water use capacity (first and last four hours) would be approximately 0.82 ft/sec, and would be reduced to 0.5 ft/sec while the EBRV operates in the closed-loop heat recovery and exchange mode. Entrainment of threatened and endangered marine mammals during EBRV operations would not be an issue, as these mammals are too large to be impacted by this activity. Risk of impingement of some of the smaller sea turtles may increase as a result of the EBRV operations; however, velocities of 0.5 ft/sec which would occur during most of the time are generally accepted by NOAA as causing minimal impacts. The greater velocities of 0.82 ft/sec can result in impingement, but the limited time over which this would occur (approx. 8 hours every 8 days), coupled with the low numbers of sea turtles in the Project area indicate that the Project would have long-term, direct, minor adverse impacts.

4.3.4 Impacts of Decommissioning

Potential impacts to threatened and endangered marine mammals and sea turtles as a result of decommissioning activities are the same as for non-threatened and endangered species (section 4.2.4.4).

4.3.5 Impacts of Alternatives

Drilled and Grouted Pile Anchor Alternative

The main impact of this alternative on threatened and endangered species would involve a turbidity plume that would result from the drilling of the anchors. This plume would be substantially larger than one created from installation of the suction pile anchors, but would still be isolated to deepwater and not reach water column surface, and, therefore, should not affect threatened and endangered species.

Port Location Alternative

Along with the applicant’s proposed location, an alternative Port location, referred to as Port Location 2, was also evaluated. From the perspective of marine mammals, Port Location 2 would have essentially the same impact as Location 1.

Vaporization Alternatives

As an alternative to the closed-loop Heat Recovery System proposed for this Project, it could be technically feasible to use open-loop regasification. Open-loop mode requires significant amounts of seawater, but would only operate during relatively warm-water months. From April through December, the open-loop shell-and-tube vaporizer would have a cooling and ballast water intake of 76 mgd for each EBRV. From January through March, a single EBRV would have seawater intake of 4.97 mgd. The impact from the average daily seawater intake associated with this alternative would be approximately 15 times higher than operations during April through December

From a marine mammal perspective, the open-loop-mode is not preferable to the closed-loop system proposed by the applicant, because it involves over 10 times as much water withdrawal and discharge and would remove substantially more prey species (zooplankton).

Pipeline Alternative

Four alternate pipeline routes were evaluated for this Project (see section 2.2.5 for full description of alternate routes). Construction within soft-bottom areas (Routes 1 and 4) would entail the simplest, most predictable and least sediment-disturbing construction methods. Given the presence of gravel, cobble and other hard substrate, and lack of thin surficial sediment layers within Routes 2 and 3, construction has a higher probability of requiring blasting, dredging or surface armoring. Additionally, more complex conditions present a higher potential for construction delays, which would in turn extend the construction time and increase the risk of vessel strikes during construction. In addition, Routes 2 and 3 would be expected to cause increased impact on marine species habitat and behavior.

Construction Schedule Alternatives

Based on the results of the month-by-month analysis of construction related effects, and the analysis of each species' and life stage's seasonal abundance in the Project area, it is not possible to select a single, continuous, seven-month construction window that optimizes protection of all species and life stages of concern concurrently. Allowing construction from November through May would minimize impacts to the greatest number of species of concern, and would be most protective of all Federally-protected species (marine mammals and sea turtles) as a group. Allowing construction from May through November would be most protective of the critically endangered North Atlantic right whale and fin and humpback whales, but would be less protective of sei whales, blue whales, sea turtles and some fish species.

Right whale occurrences in Massachusetts Bay tend to peak between February and April, so the potential for vessel strikes or entanglement would increase during the November through May and January to July schedules. Similarly, humpback whales and finback whales arrive in Massachusetts Bay in March and April, respectively, and would be more vulnerable to vessel strikes and entanglement during this time. In late spring, humpback whales typically move offshore towards SBNMS, so the potential for impacts on this species would likely decrease during the later spring and summer.

4.3.6 Mitigation Measures and Minimization

Mitigation and minimization measures to protect threatened and endangered species during construction and operation of the NEG Project are the same as for non-threatened and endangered species (see section 4.2.4.5). In addition, **FERC staff** recommends that Algonquin not begin construction activities **unt**il:

a. FERC staff receives comments from the NMFS regarding the proposed action;
b. the staff completes formal consultation with the NMFS, if required; and
c. Algonquin has received written notification from the Director of the Office of Energy Projects (OEP) that construction or use of mitigation may begin.

4.4 ESSENTIAL FISH HABITAT

4.4.1 Introduction

None of the finfish species likely to be present in the NEG Project area is listed under the ESA, but several are protected under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). As such, it is necessary to describe existing Essential Fish Habitat (EFH) in the Project area and to assess potential impacts on EFH and EFH-managed species in the area.

The proposed Project crosses four of the 10-minute by 10-minute quadrats that have been designated EFH for various species (Table 4-21). Within the area, EFH has been designated for 28 species of finfish, two species of squid, and three shellfish. Each quadrant was assigned an arbitrary reference number (1-4) for this discussion. Quadrats 1 (northwest) and 2 (northeast) and 3 (southwest) encompass the Pipeline Lateral, while quadrat 4 (southwest) includes the Port area and part of the Pipeline Lateral. The detailed EFH assessment presented in Appendix F provides a species-specific account of EFH species found in the Project area, and likely extent of impact. A summary of the findings discussed in the Appendix is presented here.

Table 4-21

Locations of Essential Fish Habitat Quadrats, and Components of the Project that are Proposed for each Quadrat

Reference Number	Quadrat Name	Project Component (Mileposts)[A]	Latitude/Longitude Coordinates of Boundaries				Total Area (acres)	Area within Trenching Affected Zone
			North	East	South	West		
1	Northwest	Pipeline Lateral (2.67-7.29)	42°40.0'N	70°40.0'W	42°30.0'N	70°50.0'W	3,404	29.1
2	Northeast	Pipeline Lateral (7.29-8.51)	42°40.0'N	70°30.0'W	42°30.0'N	70°40.0'W	828	51.2
3	Southwest	Pipeline Lateral (0.0-2.67)	42°30.0'N	70°40.0'W	42°20.0'N	70°50.0'W	2,673	11.1
4	Southeast	Pipeline Lateral and Port (8.51-16.42)	42°30.0'N	70°30.0'W	42°20.0'N	70°40.0'W	6,397[C]	81.4[C] 43.0[D]

[A] Milepost 0.0 is the junction with the HubLine
[B] Pipeline Lateral Tenching Affected Zone is defined as the direct disturbance width for plowed areas of 75 feet and jetted area of 400 feet
[C] Area of NEG Pipeline Lateral trenching
[D] Area of sediment disturbance for NEG Port construction

4.4.2 EFH Assessment Methods

The primary sources of information for the habitat requirements of the EFH species were the EFH source documents produced by NMFS. The EFH documents provide descriptions of the habitat for locations where fish have been found in some degree of abundance. However, the occurrence of fish in a particular habitat is not an indication that it is essential or even preferred habitat. It is only an indication that the fish were found in a particular habitat when sampling occurred. Therefore, not all areas that have been designated as EFH support the specific habitat features required by each regulated species for spawning, breeding, feeding, or growth to maturity.

Based on the habitat descriptions found in the EFH source documents, 11 of the species for which the Project area has been declared EFH prefer soft substrate (see Table 4-22). Because the proposed Project site is located primarily on soft substrate, Project-related effects on these species may be more significant than on pelagic species. All EFH species are discussed in detail in the EFH Assessment (Appendix F), and estimated impact area is given for each, based on life history and habitat requirements.

Table 4-22

Summary of Species and Lifestages with Designated Essential Fish Habitat in the NEG Project Area

Species	EFH Quadrat			
	Eggs	Larvae	Juveniles	Adults
American plaice (*Hippoglossoides platessoides*)	1,3,4[a]	1,3,4	1,2,3,4	1,2,3,4
Atlantic bluefin tuna (*Thunnus thynnus*)			1,2,3,4	1,2,3,4
Atlantic cod (*Gadus morhua*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Atlantic halibut (*Hippoglossus hippoglossus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Atlantic herring (*Clupea harengus*)		1,2,3,4	1,2,3,4	1,2,3,4
Atlantic mackerel (*Scomber scombrus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Black sea bass (*Centropristis striata*)	[b]			1,2
Bluefish (*Pomatomus saltatrix*)			1,3	1,3
Butterfish (*Peprilus triacanthus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Goosefish (*Lophius americanus*)	2,3,4	2,3,4	2,4	2,4
Haddock (*Melanogrammus aeglefinus*)	1,3,4	1,3	1,2,3,4	
Little skate (*Leucoraja erinacea*)			1,2,3	1,2,3
Longfin inshore squid (*Loligo pealei*)[d]	N/A	N/A	1,2,3,4	1,2,3,4
Northern shortfin squid (*Illex illecebrosus*)[d]	N/A	N/A	1,2,3,4	1,2,3,4
Ocean pout (*Macrozoarces americanus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Ocean quahog (*Artica islandica*)[d]	N/A	N/A	2	2
Pollock (*Pollachius virens*)	1,3	1,3	1,3	1,3
Red hake (*Urophycis chuss*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Redfish (*Sebastes fasciatus and S. mentella*)	N/A[c]	1,2,3,4	1,2,3,4	1,2,3,4
Scup (*Stenotomus chrysops*)			1,2,3	1,2,3
Sea scallop (*Placopecten magellanicus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Silver hake (*Merluccius bilinearis*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Smooth skate (*Malacoraja senta*)			4	
Spiny dogfish (*Squalus acanthias*)	N/A[c]	N/A	3	3
Summer flounder (*Paralichthys dentatus*)				1,2
Surf clam (*Spisula solidissima*)[d]	N/A	N/A	1,2,3	1,2,3
Thorny skate (*Amblyraja radiate*)			1,2,3,4	4
White hake (*Urophycis tenuis*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Windowpane (*Scopthalmus aquosus*)	1,3,4	1,3,4	1,3	1,3
Winter flounder (*Pseudopleuronectes americanus*)	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Winter skate (*Leucoraja ocellata*)			1,2,3	2
Witch flounder (*Glyptocephalus cynoglossus*)	3,4	2,3,4	2,4	3,4
Yellowtail flounder (*Limanda ferruginea*)	1,3,4	1,2,3,4	1,2,3,4	1,2,3,4

[a] The proposed facilities cross four of the designated EFH 10-minute-by-10-minute squares of latitude and longitude. The numbers presented in this table for each species and life stage represent the Project-assigned square number where the species and specific life stage have designated EFH.

[b] Empty spaces denote that EFH has not been designated within the square for the given species and life stage.

[c] N/A indicates no data available, or the life stage is not present in the species/reproductive cycle.

[d] Juveniles and adults correspond to pre-recruits and recruits, respectively.

4.4.3 Impacts of Construction and Operation

The potential to impact EFH would derive primarily from disruption of substrate during construction of the NEG Port and Pipeline. Secondary impacts on habitat, such as creation of a turbidity plume, accidental contaminant spills, or alteration of food availability could occur, but would involve temporary and minor impacts on the value of habitat for managed species in the vicinity of the Project. Displacement of fishing activity from the NEG Port area could cause a minor increase in fishing pressure and resultant impacts on EFH areas in the region.

In addition to assessment of habitat area affected by construction, an estimate of ichthyoplankton entrainment was made to assess the magnitude of hydrostatic and ballast water withdrawals on planktonic life stages. This analysis included equivalent adult (AE) estimates to evaluate equivalent losses of age-1 fish. This analysis is described in Appendix E, Ichthyoplankton Entrainment Assessment and Methodology.

4.4.3.1 NEG Port

Potential impacts due to the Port on EFH include construction and operational impacts. An estimated 33 acres (13.4 hectares) of soft substrate would be disrupted due to installation of Port components (flow lines, mooring wire rope and chain, anchors, and PLEMs). Approximately 43 acres would be disrupted during operation due to substrate scour by the mooring wire rope and chains. Additional operational impacts include withdrawal of approximately 40 million gallons of seawater during each regasification period (up to 65 per year) and entrainment of early stages (egg and larvae) of EFH species. Use of seawater for daily ship operations and ballast would have similar effects on the ichthyoplankton fauna in the Project area. Ichthyoplankton residing in water withdrawn for either purpose would be entrained in the ship's intake system. Estimated losses of ichthyoplankton, and adult equivalent loss estimates are given in Tables 4-7, 4-8 and 4-9. Losses due to the operation of the EBRVs would occur as long as the port was in operation. Loss of ichthyoplankton is of concern in that these early life stages serve many ecological purposes, including supply of high-quality plankton to food webs. The life strategy of fish includes high mortality of eggs and larvae, and anthropogenically-induced mortality of eggs, over and above the high natural mortality rates can be important. In this case, however, the seawater use is relatively low, and the number of entrained ichthyoplankton is correspondingly low. Equivalent-adult modeling showed losses of just tens to hundreds of age-one individuals for most species. As a result, entrainment impacts would be minor, long-term, direct and adverse. Entrainment effects are discussed in section 4.2.2.1 analyzed in detail in Appendix E.

Accidental spills and the unintentional release of substances such as diesel fuel, lubricants, and hydraulic fluid could cause short-term, minor adverse impacts. The NEG Port would be constructed and operated with an approved SPCC Plan which would serve to minimize potential impacts from spills.

Displacement of fishing activity from the NEG Port area could cause minor, long-term adverse impacts on EFH outside the Project area, particularly if active gears were dragged along the seafloor. Effects on benthic communities are discussed in section 4.2.1.3. It cannot be determined exactly how much fishing activity would be displaced from the NEG Port exclusion and safety zones into other areas, nor which EFH areas are likely to be targeted. The potential for displaced fishing activity and gear to adversely affect EFH outside the Project area would be expected to be low. NOAA landings data indicate that the level of fishing activity occurring in the Project area is relatively low compared to overall fishing activity in Massachusetts or New England. As a result any fishing activity displaced from the NEG Port area would only create a minor increase in fishing effort in other areas. (See section 4.8 for a discussion of commercial fishing activity in the Project area).

4.4.3.2 NEG Pipeline Lateral

Short-term, minor, direct and indirect impacts would occur from construction and operation of the Pipeline Lateral. Impacts would occur almost exclusively during the seven-month construction period. Operation of the Pipeline would not affect EFH species unless periodic maintenance is required in isolated sections of the pipeline. Construction impacts include disturbance of the seafloor and benthic habitats within the four EFH quadrats along the pipeline corridor. The disturbance would be caused by pipe lay, trenching, backfilling, and anchoring for barge move-ahead. Construction of connections with the flowlines and the existing

HubLine would also affect soft substrate. Direct impacts to benthic EFH species would occur via disturbance of the seafloor, burial in sidecast sediment, and increased turbidity.

Soft substrate habitat constitutes the greatest area that would be affected by NEG Pipeline Lateral construction and is expected to recover to preconstruction conditions quickly relative to hard-substrate areas. MDMF personnel indicate that recovery of soft sediments varies with depth, and that disturbances at greater depth have been observed to last longer than anticipated (MDMF, 2006). Complete recovery of the benthic ecosystem would be dependent on the reestablishment of the habitat forming organisms such as polychaete worms, bivalves, and other invertebrates that constitute the primary forage base for demersal fish.

In the small areas (about 8 percent of the Pipeline Lateral disturbance zone) where hard substrate is impacted by anchor cable sweep, recolonizing organisms would include bryozoans, hydroids, serpulids, sponges, and tunicates. Since the physical nature of the hard substrate would not be greatly altered, the community that recovers should be similar to the pre-existing one.

The estimate of the quantity of fish habitat affected by pipeline construction is dependent on several factors including their lifestyle, degree of dependence of the species or lifestage on the substrate, and the amount of a particular habitat present along the pipeline route. Organisms with a completely pelagic lifestyle such as Atlantic mackerel are not dependent on the benthic habitat and it is not expected that modification of the substrate would significantly affect these species. There may be some temporary impacts to species' use of specific areas due to suspended sediments in the water column during certain construction activities, however, pelagic juvenile and adult lifestages should largely avoid these areas. Other species with a primarily pelagic lifestyle include bluefish, spiny dogfish, longfin inshore squid, and northern shortfin squid. Atlantic herring are pelagic fish with demersal adhesive eggs that could be affected by modifications of the substrate. However, the pipeline route does not contain any areas that have been designated EFH for the Atlantic herring egg lifestage. Pollock are intermediate in their lifestyle between pelagic and demersal modes. Although they are probably ubiquitous along the pipeline route, only their spawning habitat appears to be directly dependent on hard substrates. Butterfish are also primarily pelagic with juveniles found over sand and muddy substrate, and adults found over sandy silt and muddy substrate (Cross et al, 1999). The strength of association between the substrate and the occurrence of this pelagic fish is not known, but probably is not strong because the majority of the food items for butterfish are also pelagic.

Entrainment of ichthyoplankton during pipeline flooding and hydrostatic testing would be a potential impact on the ichthyoplankton community, however, losses due to these one-time hydrostatic tests would be minor. Entrainment analysis (Appendix E) showed that hydrostatic testing of the pipeline and flowlines would cause a one-time loss of 195 fish eggs and 98 fish larvae. This loss of early stages would result in the loss of less than one, age-1 fish of each species.

Organisms that are demersal or benthic would be affected to a greater degree than other organisms. Demersal fishes with EFH in the Project area include all of the flounders and hakes. These organisms have the largest estimates of affected habitat because they are directly dependent on the substrate for completion of their life cycles. Juvenile Atlantic cod are demersal fish that are strongly dependent on cobble habitat during the juvenile lifestage. However, all of the cobble habitat that occurs along the Pipeline Lateral corridor is in the anchoring area and would not be impacted directly by pipeline laying, trenching, or burial.

A third group of organisms affected by pipeline construction are those restricted in distribution by either space or time. Although large amounts of substrate may be suitable for Atlantic halibut and redfish, the preferred depths for these fish are generally deeper than those found in the Project area. Therefore, the estimates of affected habitat were restricted to the shallowest depths where these fishes have been known to occur. However, these estimates are still probably overestimated because the depth restrictions were based on minimum depths rather than preferred depths.

Habitat exists along the pipeline route for fish that occur seasonally in the Gulf of Maine, such as scup or black sea bass. Even though relatively large amounts of this habitat may be affected, it is unlikely that modification of this habitat would have any effect on standing stock because they are not numerous enough in the region to exploit this entire habitat.

Construction equipment and methods have been selected to minimize the area of seafloor impacted along the trench, and substantially restore the seafloor to preconstruction sediments and contours to allow natural restoration and recolonization processes to occur, thereby minimizing any permanent habitat loss.

4.4.3.3 Impacts of Alternatives

Drilled and Grouted Pile Anchor Alternative

From an EFH perspective, Suction Anchors would create less disruption during construction than Drilled and Grouted Pile Anchors and would allow for restoration of habitat following decommissioning.

Port Location Alternative

Two alternate sites are being considered for the NEG Port location. Section 2.2.2.1.3 describes characteristics of each location. Both sites are characterized by a low-energy, depositional environment with a relatively uniform sediment (primarily silt-clay with varying degrees of fine sand). Both sites are designated EFH for the same species (for details see Appendix F), so there is no known difference in EFH or habitat quality between the two sites.

Two major differences in potential EFH impacts between the port sites are the amount of area that would be disturbed by the proposed pipeline installation, and the footprint of the proposed port. Location 1, the applicant proposed site, would require a longer pipeline (16.1 miles) to connect with the HubLine than Location 2 (10.7 miles), which could result in greater EFH impacts depending on bottom conditions within the pipeline corridor. Location 2, however, would require a larger Port footprint (63 acres) than Location 1 (43 acres). These differences are discussed in more detail in section 2.2.5.

Vaporization Alternatives

As an alternative to the closed-loop Heat Recovery System proposed for this Project, it would be technically feasible to use open-loop regasification. Open-loop mode requires significant amounts of seawater (roughly 76 mgd), but would only operate from May through December. EFH-species with larval stages present during May through December would be most affected by a change to open-loop vaporization. Entrainment of early stage EFH species in seawater intakes would cause minor, direct, long-term, adverse impact. Because open-loop vaporization requires about 15 times the amount of water used in closed-loop operation, entrainment would be, on average, 15 times higher under open-loop than closed-loop vaporization.

Pipeline Alternative

Four alternate pipeline routes were evaluated for this Project (see section 2.2.5 for full description of alternate routes). Although Routes 1 and 4 are longer than Routes 2 and 3, they traverse only soft-bottom habitats. Both Routes 2 and 3 traverse areas of hard bottom (gravel and cobble). Given that soft-bottom habitats generally recover more quickly after disturbance than hard-bottom habitats, the impacts on EFH would be lower along the soft-bottom routes.

Construction within soft-bottom areas (Routes 1 and 4) would entail the simplest, most predictable and least sediment-disturbing construction methods. Given the presence of gravel, cobble and other hard substrate, and lack of thin surficial sediment layers within Routes 2 and 3, construction has a higher probability of requiring blasting, dredging or surface armoring. Additionally, more complex conditions would present a higher potential for construction delays.

Construction Schedule Alternatives

Based on the results of the month-by-month analysis of construction related effects, and the analysis of each species' and life stage's seasonal abundance in the Project area, it is not possible to select a single, continuous, seven-month construction window that optimizes protection of all species and life stages of concern concurrently. Allowing construction from November through May would minimize impacts to the greatest number of species of concern, and would be most protective of all Federally-protected species (marine mammals and sea turtles) as a group.

The only finfish life stages that would be susceptible to entrainment impacts would be eggs and larvae, and the eggs and larvae of all finfish species included in Table 4-11 have the potential to occur in the Project area. Of these species only the yellowtail flounder is strictly demersal, so the habitat-related effects of the Project would have the most potential to impact this species. Thus, the Project schedule that would be most protective of finfish would avoid hydrostatic testing during seasonal peaks in ichthyoplankton abundance, as well as bottom-disturbing effects during peaks in juvenile and adult yellowtail flounder abundance.

A May through November construction period would occur during peak spawning periods for several species of commercially important fish, the soft substrates along pipeline Routes 1 and 4 are not preferred egg deposition habitat for these fish species. Furthermore, sediment suspension caused by pipeline trenching would be minimized by the use of a plow, which would restrict the area and duration of bottom-disturbing activities when compared to the effects of dredging or jetting. Additionally, bottom fishing and gillnetting would be prohibited in parts of the Project area for May and June, and the best weather of the year occurs in the summer months in Massachusetts Bay. As a result, the duration of construction is least likely to be delayed due to bad weather than in any other season.

Juvenile and adult yellowtail flounder are common in the Project area year-round, so time-of-year restrictions would not be a useful tool for managing impacts to this species. The January through July construction window would mean that hydrostatic testing would occur during spring when ichthyoplankton densities are increasing. This schedule would avoid periods of peak abundance for the eggs and larvae of lobsters and sea scallops, but would include the beginning of the spring peak of the eggs and larvae of yellowtail flounder, and the end of the winter peak of egg and larval stages of Atlantic herring.

4.4.3.4 EFH Species Response to Project Activities - Summary

The response of EFH species to Project construction and operation would vary depending on life history. Demersal fishes that are closely associated with soft bottom such as the flounders and skates would be more directly affected by disruption of sediment during Port and Pipeline Lateral construction. Impacts would include mortality due to direct contact with construction equipment, or burial by sidecast or retrieved spoil. The temporary loss of soft-substrate habitat may affect these species via reduction in available benthic prey, but only if food is limiting their production and growth. The pelagic fishes, including Atlantic herring, Atlantic mackerel, and butterfish may be able to avoid construction activities and the associated increases in turbidity.

These fish have behavioral mechanisms for avoidance of areas of increased suspended sediments or direct contact with the construction equipment (Newcombe and Jensen, 1996). The estimated areas of habitat for each species that would be disturbed by the Port and Pipeline area are given for each species in Appendix F.

Accidental spills and unintentional release of substances such as diesel fuel, lubricants, and hydraulic fluid could cause minor, short-term adverse impacts on EFH species. The Project would be constructed with an approved SPCC Plan which would serve to minimize potential impacts from spills.

In summary, impacts to EFH would include disruption of substrate, entrainment of larval stages in seawater and hydrostatic test water, and minor changes in water quality. Impacts would differ depending on life history of each species, and would probably be greater on demersal species with a preference for soft substrate than on other species. Overall impacts would be minor.

4.5 GEOLOGICAL RESOURCES

4.5.1 Evaluation Criteria

Construction and operation of the NEG Project could both affect and be affected by geological resources. The NEG Project would be considered to have major adverse consequences to geological resources under the following conditions:

- the Project would preclude or disrupt the development of mineral resources;
- Project construction or operation would result in damage or loss of vertebrate or invertebrate fossils that are considered important by paleontologists;
- construction or operational activities permanently damage or disturb unique geological features;
- construction or operational activities increase erosion or affected seafloor stability; or
- the Project posed or triggered geologic hazards.
- Geological conditions could impact Project operations if earthquake-induced ground motion, liquefaction, slope instability, subsidence, lateral spreading of sediment, surface faulting, or other geologic hazards would cause damage to the proposed NEG Port or Pipeline Lateral, disrupt operation, create a threat to public safety, or cause injury to workers.

This section discusses both potential impacts to geological resources that might result from NEG Project construction and operation (4.5.2 and 4.5.3), as well as the geological conditions that could adversely impact Project operations (4.5.4).

4.5.2 Regional Geology

The consequences of construction and operation of the NEG Project on regional geology are considered to be nonexistent for this project. The potential impact of regional geology on the construction and operation of the NEG Port and/or Pipeline would be limited to the potential for earthquakes, resultant ground motion, and potential for liquefaction or fault movement as described in more detail in section 4.5.4.

4.5.3 Local Geology

4.5.3.1 NEG Port

Impacts of Construction

The seafloor at the proposed Port site is composed of soft sediments (gravel and smaller grain size material). As a result, construction activities are unlikely to require blasting, bucket dredging, or other more disruptive techniques (NEG 2005a). Information provided through seabed surveys indicates that there would be sufficient sediment thickness at the various anchor locations to support the use of suction anchors. Additional survey, including coring, would be required to confirm this at the specific anchor locations, and to provide soil compositional information to allow for detailed anchor design.

The final port anchor size and position would be decided based on established mooring line design loads, specific soil properties at the anchor location(s), and a detailed geotechnical soil survey (considering both static and dynamic loading). The final design should consider geologic hazards and mitigation measures, if necessary. Geologic hazards are discussed further below in section 4.5.5.

Installation of suction pile anchors would cause disturbance of sediments at and in the immediate vicinity of each anchor location. It is estimated that a 20-foot (6-meter) diameter suction anchor could disturb a diameter of 25 feet (8 meters), corresponding to an area of approximately 490 square feet (45 square meters) for each anchor, and total area less than 0.1 acre (less than 0.05 hectare) for each anchor array (comprised of eight anchors). This impact would be long-term, direct, and minor.

Depending on the type of foundation required, the PLEM would either be lowered to the seafloor and oriented (gravity-base foundation), or lowered and embedded (suction-pile foundation). Seafloor disturbance by the PLEM is not expected to exceed its dimensions, approximately 40 feet by 40 feet (12 meters by 12 meters). Preliminary engineering parameters for geotechnical evaluation of foundation designs were estimated based on general material types, index soil tests correlations and limited shear strength tests on vibracore samples that are considered, by definition, to be disturbed samples. Based upon these preliminary data, the proposed suction anchor, PLEM, and Pipeline Lateral designs are compatible with the preliminary geotechnical conditions revealed by the limited subsurface explorations and would result in direct, long-term, and minor adverse impacts.

Final design of the proposed anchoring system, PLEM foundation for static and dynamic conditions would require more detailed and comprehensive geotechnical data. Accordingly, the scope of the next phases of subsurface exploration and testing should include service and extreme loadings (seismic, wave actions), depth of submarine erosion or scour expected, and existing and planned submarine slope angles to provide a basis for selection of types of geotechnical explorations, in-situ and laboratory tests, and exploration depths.

Impacts of Operation

NEG Port operation is expected to have only minor impacts to geological resources. The mooring ground chain is attached to the side of the suction anchor cylinder, and embeds along with the cylinder. These mooring chains would create some sediment disturbance from anchor sweep during normal port operation.

The total erosion area created by the eight anchor chains would be about 43 acres under a 100-year storm event. The volume of sediments eroded from this area was calculated assuming that the chain would essentially excavate to a depth of 0.11 feet, which is one-quarter of the link width of the 134 mm anchor chain. The estimated average volume of the eroded area for one anchor is 11,643 ft^3.

Potential consequences to port operation from geologic hazards are discussed in more detail in section 4.5.5.

Impacts of Decommissioning

Port decommissioning would not affect areas that were previously undisturbed by construction and operation. Port facilities would be removed, but would not affect geological conditions in the Project area. As a result, NEG Project decommissioning would have no effect on geological resources.

Impacts of Alternatives

Drilled and Grouted Pile Anchor Alternative

Rather than being impacted by the action, the geology of the area affects the feasibility of the various anchoring systems under consideration and are of concern from a constructability perspective. Bottom conditions in the Port area are suitable for Suction Anchors, which have been proposed by the applicant. An alternative, Drilled and Grouted Pile Anchors, is also being considered. While suitable bottom conditions exist for this alternative, Drilled and Grouted Pile Anchors would require an offshore drilling vessel to drill through both sediment and rock to enable a tubular pile to be lowered into the drilled hole and cement pumped into the annular space between the hole and the pile. No drilling would be required for embedding of Suction Piles.

Port Location Alternative

Two port locations were carried through for analysis. An alternative location being considered, Port Location 2, is generally level with soft soils (clays) over bedrock or glacial till. Except for those areas where hard ground is at or close to the seafloor, the soils are of sufficient composition and depth to provide suitable conditions for use of suction piles. The areas of shallow sediment and outcroppings are sparsely distributed throughout the site. Aside from the anchoring systems, neither location would affect or be affected by geologic resources.

Vaporization Alternatives

Two alternatives exist in the water intake system of the EBRV ships based on the selected STV system, which can operate in two modes, open-loop and closed-loop. Neither option would affect or be affected by geologic resources.

4.5.3.2 NEG Pipeline Lateral

Impacts of Construction

Preconstruction surveys identified a proposed route for the NEG Pipeline Lateral that would avoid bedrock or coarse glacial till areas that would require blasting. Algonquin proposes to install the pipeline using plowing equipment (over 96 percent of the route) and jetting equipment for short, discrete sections. No blasting or conventional bucket dredging is proposed or anticipated along the route. This route appears to minimize impacts by maximizing the length of pipeline that can be installed by plowing.

Temporary displacement of material from the trench would occur during plowing and jetting operations. The return of the sidecasted sediment to the open trench containing the newly laid pipeline would be completed through one pass of a backfill plow. The sea floor in the trench area may remain somewhat irregular after backfilling, with minor topographic relief above and below the original grade. Algonquin proposes to backfill the majority of the pipeline with one pass of the backfill plow. The backfill plow operates in a similar manner to the plow, but has reversed mold boards, that are used to pull the spoil back into the trench. Limitations in the ability of existing offshore pipeline construction equipment to exactly match contours, particularly in water over 200 feet deep, limit the ability to match pre-construction contours. In areas where only plowing and backfill plowing would be used, the post-construction contours would generally match pre-existing conditions more closely than areas that would be dredged, jetted, or blasted. Other areas of sea floor would be disturbed as anchors are placed. In these locations, some mixing of sediment layers may also occur and some irregularity in contours could remain after construction. Anchor cable sweep along the sea floor surface would be unlikely to measurably mix sediment layers or create sea floor contour changes.

In the limited areas along the pipeline route where jetting is proposed, the Pipeline trench would be backfilled with sand (placed by tremie tube), concrete mats (at the Hibernia and unknown cable crossings), or diver-placed sand bags, depending on the operational requirements of the site. Whatever material is used, it would be placed over the pipeline using a tremie tube or by divers, and no imported backfill material would be dumped from surface vessels.

The primary construction barges would use mid-line buoys on all anchor cables to minimize scouring of the sea floor and the release of sediments resulting from cable sweep that would occur during movement of the construction vessels.

Based on the proposed construction methods, the affected area would be minimized by use of plow techniques, tremie tube backfill techniques, and mid-line buoys for barge anchoring and impacts to geological resources would be minor.

Impacts of Operation

Operation of the NEG Pipeline would not have any major impact on geologic resources and sediments along the route. Operational activities that could occur infrequently include limited excavation to access the pipeline for repairs or cathodic protection maintenance. In this rare instance, Algonquin would coordinate with the applicable Federal, state and local resource agencies to ensure that the work was performed in accordance with appropriate requirements and restrictions.

Impacts of Decommissioning

It is anticipated that Project decommissioning would not affect areas that were previously undisturbed by Project construction and operation. The pipeline would be abandoned in place and would not change or impact the geology of the pipeline corridor or Massachusetts Bay.

Impacts of Alternatives

Pipeline Alternative

In addition to Route 4, the Applicant's proposed route, three alternative pipeline routes were analyzed. Route 3 (see Figure 2-14) is shorter, but would traverse more complex substrate. Route 4 contains no hard bottom whereas the Route 3 corridor contains up to 5 percent hard bottom that would require blasting to achieve desired depth. Construction in hard bottom areas would also take longer than construction in the soft bottom and would therefore lengthen the time required for overall pipeline construction.

Surficial sediments along Route 1 are predominantly fine marine silts and clay grading to fine sands inshore. The depth to bedrock or tills is generally greater than 20 ft (6.1 m) and conditions are similar to those on Route 1.

Route 2 would traverse a restricted corridor that passes between morphological highs, where bedrock and glacial tills outcrop. The predominant sediments within the upper 6 ft are very soft clays within the eastern section of the route and fine sands to the west (adjacent to the HubLine). Approximately 3.1 mi (5.0 km), or 34 % of the route, primarily near the western end, pass through areas where surficial sediments are less than 5 ft (1.5 m) thick. Within these areas, reworked glacial deposits would be encountered. This unit is likely to comprise poorly sorted sand gravels and cobbles in a silt/clay matrix. Boulders, stiff clay, and dense sands also might be encountered. Phase I geophysical and geotechnical survey results confirmed that this route is trenchable, however, there is a risk that, as with previous projects in Massachusetts Bay, trenching to a depth of 1.5 m (5 ft) or greater, and backfilling problems could be encountered, which could lead to schedule delays and extensive remedial works.

4.5.4 Mineral Resources (NEG Port and Pipeline)

Review of the most current USGS topographic maps and NOAA Nautical Charts indicate that no mines, quarries, prospects, or sand and gravel operations are located within 0.25 nautical mile (approximately 1,500 linear feet or .46 kilometers) of the proposed NEG Project area.

Sand and mixed aggregate are known to occur in significant quantities, and could potentially be mined, in the inshore waters off Boston Harbor between Hull and Plymouth, and on Stellwagen Bank. Since the proposed Project would not be located in either of these areas, it should have no effect on the potential future exploitation of those resources.

4.5.5 Geologic Hazards (NEG Port and Pipeline)

4.5.5.1 Earthquakes

Seismic activity in the Project region has been documented since early colonial settlement in the 1600's. The largest earthquakes in the region include events in 1727 and 1755 located just offshore of northeastern Massachusetts. Although seismicity of the New England region is considered to be low to moderate, the occurrence of the 1755 earthquake demonstrates that damaging earthquakes can occur, but with an assessed low annual probability of occurrence. Critical structures, including power plants, dams, bridges, and LNG or gas storage and receiving terminals located in New England, typically have incorporated seismic designs able to resist ground motions associated with local occurrence of an earthquake similar in magnitude to the 1755 Cape Ann event. The NEG Project area is located about 30 miles southwest of the epicenter of the 1755 earthquake. Similarly, the Project area is located about 30 miles south of the epicenter of the 1727 Newbury, MA earthquake. The 1727 earthquake, magnitude near 5 and MMI of VII, produced liquefaction effects in Essex County in northeastern Massachusetts

Possible impacts from earthquakes including stresses imposed by strong vibrations and secondary effects including slope failures and liquefaction should be analyzed and results integrated into an effective earthquake resistant design for the NEG Port and Pipeline Lateral. No current seismic hazard study exists for the Project at this moment (a seismic hazard study investigates the historical seismicity and geological data and based on a probabilistic approach comes up with the annual probabilities of exceedance for different levels of shaking). Even though it may be anticipated that seismic loading does not govern this design, NEG would consult with the facility design contractor to determine whether or not it would be prudent to perform a site-specific seismic hazard study.

According to the seismic zone maps, the peak ground acceleration (PGA) on the bedrock, offshore Boston, for an earthquake with a return period of 1,000 years is about 0.06g. Assuming a sediment amplification factor of 2.5, the seabed PGA would be about 0.15g. For typical design earthquake events of operating basis earthquake (OBE) = 500 years and safe shutdown earthquake (SSE) = 3,000 years, the corresponding seabed PGAs could be in the order of 0.11g and 0.23g

The effects of seismic events on the operation of the pipeline were included in the facility design analysis to comply with ASME B31.8 code, *Gas Transmission and Distribution Piping Systems* which governs the design and installation of Natural Gas Pipelines. Calculating the stress in a buried pipeline due to earthquake loading considered the transitory strains caused by differential ground displacement arising from ground shaking and permanent ground displacement (PGD). The Pipeline Lateral would be completely buried with no vertical members; therefore, ground shaking would cause insignificant stresses on it.

4.5.5.2 Faulting

Eastern Massachusetts is cut by metamorphic and post-metamorphic fault zones and systems that are projected into the offshore environment. A working hypothesis that has emerged over the past several decades of siting studies conducted for critical facilities in New England is that the contemporary seismicity occurs on deep-seated or buried faults that produce no discernable surface expression. No clear evidence exists that any of the numerous faults mapped in the region is an “active fault” in the present stress environment. The consequences of faulting on the Project are considered to be addressed by analysis of possible earthquakes in the region as described above.

4.5.6 Mitigation and Minimization

The following measures have been proposed as potential measures for mitigating and/or minimizing impacts to geologic resources.

- Construct the Pipeline Lateral through soft bottom. Due to the soft, more easily plowed sediments, avoidance of gravel, cobble, and other hard substrates and lack of thin surficial sediment layers, construction time and potential water quality impacts caused by construction and support vessel water discharges would be reduced.
- Although not anticipated, if blasting was determined to be required as a result of ongoing geophysical and geotechnical surveys, Algonquin would prepare a Blasting Mitigation Plan in consultation with the NOAA for submittal to, and approval by, the FERC.

4.6 CULTURAL RESOURCES

4.6.1 Evaluation Criteria

Impacts on cultural resources are considered to be major if Project construction or operation would cause an irreversible adverse effect on the characteristics that contribute to the eligibility of a property for the NRHP. Adverse effects may include, but are not limited to:

- physical destruction of or damage to all or part of the resource;
- a change in character of the property’s use or of physical features within a property’s setting that contribute to its historic significance; and
- introduction of visual, atmospheric, or audible elements that diminish the integrity of the property’s significant historic features.

4.6.2 Impacts of Construction (NEG Port and Pipeline Lateral)

Sub-bottom profiling and examination of vibracores identified no distinct paleosols, indicating that intact ancient land forms are not present in the Project area. As a result, construction and operation of the NEG Project is unlikely to affect cultural resources.

The applicants have prepared an unanticipated discoveries plan (Appendix I) for the proposed Project that identifies the steps that would be taken if previously undiscovered resources were uncovered by construction activities, including:

- work stoppage and further evaluation of the resource by a qualified marine archaeologist;
- visual ROV inspection, if the site is potentially eligible for the NRHP;
- agency notification; and
- development of avoidance measures, if appropriate. Given the extent of surveys that have been conducted, however, there is a low probability that undiscovered resources exist within the Project area.

Given that no know resources are located within the area to be affected by Project construction and the fact that a Plan exists that would protect resources, if discovered, it is anticipated that construction of the NEG Project, as proposed, would have no effect on cultural resources.

4.6.3 Impacts of Operation (NEG Port and Pipeline Lateral)

Operation of the NEG Project would have no impact on cultural resources since no new areas of seafloor would be impacted by operational activities.

4.6.4 Impacts of Decommissioning (NEG Port and Pipeline Lateral)

Decommissioning of the NEG Project would have no impact on cultural resources since it would not affect previously undisturbed land on- or off-shore.

4.6.5 Impacts of Alternatives

Anchor Alternatives

Neither of the anchor system alternatives being considered for the proposed Port would affect cultural resources since no cultural resources are present at the NEG Port site. As a result, there is no preference between anchor options.

Port Location Alternatives

Surveys of the proposed NEG Port site (Buoys A and B) found no cultural resources. Surveys of Location 2 identified and mapped a number of seafloor drumlins considered likely to contain submerged prehistoric cultural resources, as well as three submerged historic cultural resources, i.e., shipwrecks, in Federal waters. The footprint of the Location 2 could be modified to avoid all of the shipwrecks and drumlins identified by the survey.

Vaporization Alternatives

Neither STV system alternative would have any impact on cultural resources. Consequently, there is no preference between vaporization alternatives from a cultural resources perspective.

Pipeline Route Alternative

Based on surveys of Pipeline Route 4, the Applicant's proposed route, no cultural resources are present or would be affected by construction or operation of the Project. It is unknown whether or not cultural resources are present within the Route 3 corridor and surveys would be required to make that determination.

Surveys of the Route 1 identified a number of seafloor drumlins, hills formed by glacial action, which are considered likely to contain submerged prehistoric cultural resources. In addition, three submerged historic cultural resources (i.e., shipwrecks) and two other targets that have a high probability of being shipwrecks were identified along this route. All of these high-probability targets, shipwrecks, and drumlins could be avoided during construction.

Survey of the Route 2 identified a number of seafloor drumlins considered likely to contain submerged prehistoric cultural resources. In addition, two submerged historic cultural resources (i.e., shipwrecks) and two other targets that have a high probability of being shipwrecks were identified along this route. All of these high-probability targets, shipwrecks, and drumlins should be avoided during construction. Dynamically Positioned vessels could be used during the construction of the route to avoid both high-probability targets and shipwrecks. Considering both the present Route 1 construction plan and methodology, and the locations of drumlins, avoidance of drumlins along Route 1 would be impossible unless changes to this route are initiated. If the Route 1 is chosen and areas containing drumlins cannot be avoided, further consultation with the appropriate regulatory authorities (MMS, MHC/SHPO and BUAR) would be required. Additional investigations may be necessary prior to construction to mitigate adverse direct, indirect, or cumulative effects to submerged cultural resources. Use of the Route 1 could result in a determination of "Historic properties affected" (36 CFR 800.4), and in a determination that the Project could have a long-term, minor, direct and adverse impact on historic properties (36 CFR 800.5).

4.6.6 Mitigation and Minimization

The following measures have been proposed as potential measures for mitigating and/or minimizing impacts to cultural resources

- A plan has been developed by the applicants for management any unanticipated cultural resources that could be encountered during construction. The plan includes steps for stopping work, notifying authorities, and identification of the remains and Plan would become a part of any license issued by MARAD. A copy of the Plan is provided in Appendix J.

4.7 OCEAN USE, LAND USE, RECREATION AND VISUAL RESOURCES

This section discusses the impact of the NEG Port and Pipeline Lateral on ocean uses, land use, recreation, and visual resources.

4.7.1 Evaluation Criteria

Impacts on ocean use and recreation would be considered major if the Project would permanently prevent access to an established or planned recreation site or cause substantial impairment of recreational fishing, boating, or diving sites. Impacts on visual resources would be considered major if the Project would have a substantial adverse effect on a scenic vista, substantially degrade existing visual character, or be a new source of substantial light or glare that would adversely affect day or nighttime views in the area.

An adverse impact on land use would be considered major and require additional mitigation if Project construction or operation would physically divide an established community, conflict with existing land use plans, policies, or regulations, displace a business or permanent residence from its established location, or conflict with any approved residential or commercial development plans.

4.7.2 Ocean Use

4.7.2.1 NEG Port

Impacts of Construction

Marine Sanctuaries

The NEG Port is located outside of the boundaries of all nearby marine sanctuaries. Located between Boston Harbor and SBNMS, the proposed NEG Port site is located about two miles from the closest boundary of SBNMS. During construction, vessels destined for SBNMS would be forced to choose navigation routes that avoid the NEG Port anchor spread corridor. The total number of ships that would access SBNMS via the NEG Port area during construction, and their typical course of travel is not known. Changes in navigation are likely to be similar in nature to current steps taken to avoid deep-draft vessel traffic while crossing the TSS. Aside from potentially lengthening the trip to get to the SBNMS, NEG Port construction activities would have a minor affect the use of SBNMS or any other marine sanctuary.

MBDS

The proposed NEG Port site is located about 650 feet from the boundary of the MBDS at its closest point. NEG Port construction would temporarily close the Port site to access by non-Project related vessels. During construction, barges containing dredge material bound for MBDS would be forced to detour around the NEG Port anchor spread corridor. The required maneuvering is likely to be similar in nature to current steps taken to avoid deep-draft vessel traffic while crossing the TSS and would not adversely affect the use of the MBDS.

Commercial Fishing

A variety of fishing activities, including bottom trawling, gillnetting, and lobstering currently occur in the area proposed for the NEG Port (see section 3.8). Areas closed for Port construction would be permanently closed for the duration of the facility's operating life. Direct impacts on ocean use would include the loss of areas for commercial fishing and lobstering. Indirect effects of construction would include navigational changes for commercial fishermen necessary to avoid the anchor spread area. Biological and economic impacts to fishery resources and the fishing industry are discussed in sections 4.2 and 4.8, respectively.

Conclusions

Construction of the NEG Port would have a direct, short-term, minor adverse impact on ocean sanctuaries and the MBDS by requiring vessels to detour around restricted areas. It would also have a minor impact on commercial fishing by restricting access to productive fishing grounds.

Impacts of Operation

NEG Port operation would eliminate access by non-Port related vessels to the Safety Zone, approximately 830 acres surrounding the NEG buoys, and restrict access to approximately 720 additional acres for the NAA, within Block 125. Non-Port associated vessel traffic would be prohibited from entering the Safety Zone surrounding each buoy. While the Safety Zone would theoretically only be in effect while a vessel was using the Port, at least one EBRV would be on station at the Port at all times for the license term (25 years). As much as 10 percent of the time, two EBRVs would be simultaneously moored at both of the Port buoys. Thus, this analysis assumes a Safety Zone comprising less than one percent of Block 125 for both buoys that would be restricted from access for the duration of the Project license. Figure 4-8 shows the location of the proposed Project relative to Block 125.

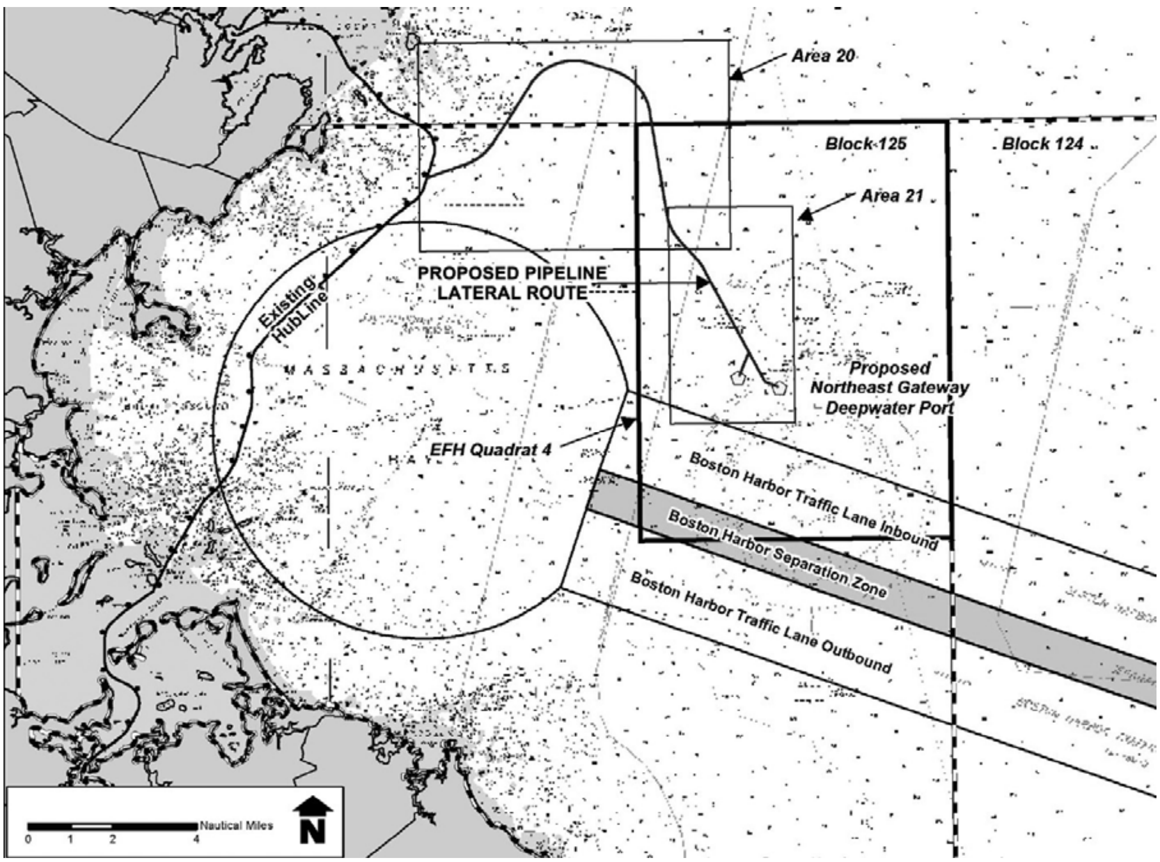

Figure 4-8 Location of the Proposed NEG Project in Relation to Block 125

Operation of the NEG Port would not directly affect SBNMS, South Essex Ocean Sanctuary or North Shore Ocean Sanctuary. It is likely that the presence of the Port and its associated Safety Zone would necessitate course changes and longer travel times for some ships wishing to enter SBNMS. It is possible that the NAA would affect traffic to and from the MBDS by forcing navigational changes. However, such changes are anticipated to be similar to the maneuvers that these barges currently perform to avoid other vessels when crossing the TSS.

While in transit, each EBRV would be protected by the Safety and Security Zone (within the COTP Boston zone) restricting access within 2 miles ahead, 1 mile astern, and 500 yards on either side (figure 2-3 shows the boundaries of the COTP zone). This would occur approximately twice per week as EBRVs entered or departed the NEG Port. Since the EBRVs would use the Boston Harbor TSS lanes to access the Port, the Safety and Security zones would have a minimal impact on marine sanctuaries and marine travel, and no direct effect on the MBDS. Between the TSS and the NEG Port, the Safety and Security Zone around each moving EBRV could affect ships heading to and from the MBDS by causing them to have to change course slightly. Although this could increase the transit time of the MBDS vessels, it would not affect the overall accessibility or use of that area and would be of short-term duration.

The presence of mobile security zones would affect fishing vessels, as well. For cases where an EBRV is within approximately 2 miles of the NEG Port (traveling at no more than 1 knot), this would effectively result in a continuous NAA covering 1,785 acres that would restrict lobstering and fishing activity near the EBRV and expand the navigational restrictions already imposed on fishing vessels

Conclusions

Operation of the proposed Project would have a direct, long-term, minor adverse impact on the use of ocean sanctuaries and the MBDS by requiring vessels traveling to and from those resources to detour around the restricted area. The permanent Safety Zone around the proposed Port would remove 830 acres of ocean from active use for the duration of the Project license. Avoidance of the Safety Zone and NAA could impose a navigational burden on the commercial fishing fleet bound from Gloucester and other North Shore ports. It is recognized that small deviations in course can have an impact on these vessels' ability to maximize their fishing activities; navigating around the NAA would potentially reduce the time that vessels are able to devote to fishing. However, as section 4.8.2.1 shows, the economic losses to the Commercial Fishing industry from the NEG Port would be minor.

Impacts of Decommissioning

Decommissioning of the NEG Port would have a positive impact on commercial fishing activities, and other ocean uses when compared to conditions during operation. Upon completion of facilities removal and decommissioning, the Safety Zone and NAA would no longer be in effect and vessel passage into and through the Port site would be restored to pre-construction conditions.

4.7.2.2 NEG Pipeline

Impacts of Construction

Marine Sanctuaries

The pipeline route proposed by NEG is located entirely outside of SBNMS, but would cross approximately 9.7 statute miles (8.4 nautical miles) of the South Essex Ocean Sanctuary and approximately 2.8 statute miles (2.4 nautical miles) of the North Shore Ocean Sanctuary. Lay barges and other ships to be used for construction would require a 6,000-foot wide corridor for their anchor spreads, and limited portions of the pipeline corridor may be prohibited for non-construction vessels for a portion of the seven-month pipeline construction process. During construction, vessel prohibitions in the NEG Pipeline area would temporarily prevent use of portions of an 11 square mile area (nearly 20 percent) in the SEOS and some 3 square miles (more than one percent) in the NSOS.

The indirect effects of the closures would include slightly altered navigation patterns for ships wishing to travel to or within the NSOS and SEOS, as well as ships wishing to access and egress the SBNMS, since the NEG Pipeline Lateral crosses travel routes between Boston Harbor and the three sanctuaries. Access restrictions associated with Pipeline construction would be of short-term duration, lasting only for the portion of the construction period that a given section of the Pipeline was under construction. Full access in and over the Pipeline corridor would be restored upon completion of construction activities.

MBDS

During construction, barges bound for the MBDS would be required to detour around construction vessels and the anchor spread corridor. The required maneuvering would be similar in nature to current steps taken to avoid deep-draft vessel traffic while crossing the TSS. This impact would be of short-term duration, however, lasting only for the pipeline construction period. Following completion of pipeline construction, normal access would be allowed over the pipeline corridor.

Other Ocean Uses

Halfway Rock, a long-term ocean monitoring research station, is located approximately 1.5 miles to the northwest of the point where the NEG Pipeline would interconnect with the HubLine (MP 0.0). Research vessels may need to alter their navigational courses to access Halfway Rock or other research stations during construction. However, such navigation would not involve excessive effort on the part of such vessels. Construction is not anticipated to generate any turbidity plumes capable of affecting the monitoring stations and the proposed anchor and anchor cables would not impact the stations.

Hibernia Cable Crossing

The proposed Pipeline Lateral route would cross a cable owned by Hibernia Atlantic at about MP 15.3. Hibernia Atlantic claims that the NEG Pipeline Lateral crossing of the cable would violate MDEP License No. 8458 and has proposed an agreement to Algonquin to address "the problems with not only the pipeline crossing of the cable, but also the long term maintenance and repairs of the Pipeline and the Hibernia cable where the Pipeline and cable would be 500 meters or less apart." Hibernia would like to establish a Special Maintenance Zone (SMZ) for cable maintenance and repair and has requested the FERC to add conditions to the Algonquin's certificate. Hibernia Atlantic proposes measures for the SMZ with regard to repairing and maintaining the cable; giving Algonquin notice of repair or maintenance operations and allowing Algonquin to have an observer aboard the cable Repair Vessel; holding Algonquin accountable for the cost of any damages related to Algonquin's activities; indemnifying the cable Repair Vessel for any damages to the pipeline that Algonquin experiences; and reimbursing Hibernia Atlantic for the cost of providing an observer aboard the ship during Pipeline installation and maintenance

In a letter to the FERC (July 20, 2006), Algonquin contends that the NEG Pipeline Lateral crossing of the cable would not violate MDEP License No. 8458 and that for the last four years Hibernia Atlantic (360 Networks) has not asserted a violation of MDEP License No. 8458 with respect to its 360 Network/HubLine cable crossing. Algonquin claims that the 360 Networks/HubLine cable crossing is in all material respects the same as the proposed NEG Pipeline/Hibernia Atlantic crossing and Algonquin has proposed a counter agreement similar to the agreement between HubLine and 360 Networks to remedy Hibernia Atlantic's concerns. Algonquin objected to Hibernia Atlantic's initial request and stated that it would agree to several of the requests without the inclusion of numbered paragraphs 1, 4, and 5 and the last sentence of paragraph 7 from Hibernia Atlantic's filing. FERC staff believes that Algonquin and Hibernia

Atlantic can reach a mutually acceptable agreement, as was reached with HubLine and 360 Networks, without the need for limiting conditions in the certificate. Therefore, **FERC staff recommends that:**

- Algonquin should continue consultations with the operators of the Hibernia cable to attempt to reach an agreement regarding the proposed pipeline crossing of the cable and the long term maintenance and repairs of the pipeline and the Hibernia cable**.**

Conclusions

Construction of the NEG Pipeline would have a direct, short-term, minor adverse impact on the MBDS, and other ocean uses. Construction would have a direct, short-term, minor adverse impact on ocean sanctuaries by temporarily closing approximately 14 square miles of the South Essex and North Shore Ocean Sanctuaries. Construction would also adversely impact commercial fishing by temporarily restricting access to productive fishing grounds. These impacts would be short-term and minor.

Impacts of Operation

During operation, there would be no restrictions to the waters above the Pipeline Lateral. Activities interrupted or displaced by construction would return to pre-construction conditions. As a result, NEG Pipeline operation would have no effect on ocean uses.

Impacts of Decommissioning

Decommissioning of the Pipeline would have a minor impact on ocean uses. During decommissioning, temporary access could be denied to small sections of water above the ends of the pipeline while it is cleaned and capped. However, since the overall pipeline would be abandoned in place, it would have no effect on activities in the waters above it.

4.7.3 Land Use

4.7.3.1 NEG Port

Impacts of Construction

NEG proposes to use existing port facilities as load-out yards and staging areas for NEG Port construction. However, the location of these sites, as well as the distribution and intensity of ground traffic associated with them is not yet known. Assuming that existing waterfront facilities currently catering to water based industrial activities are leased, NEG Port construction would have minimal to no impact on land use.

Impacts of Operation

NEG proposes to lease existing office or warehouse space within a designated port area, for a Regional Operations Center. By leasing existing facilities, the establishment of the Operations Center would not alter or affect existing land uses.

Impacts of Decommissioning

NEG Port decommissioning would have no effect on onshore resources. Since NEG plans to rent facilities onshore for an Operations Center, decommissioning of the Port would only require closing out the lease. Since no on-shore facilities would be removed or affected, no land use changes would be anticipated.

4.7.3.2 NEG Pipeline

Impacts of Construction

Load-out Yards

During construction of the NEG Pipeline, Algonquin would use four existing ports as load-out yards (see section 3.7.2.2). All four of the facilities have existing commercial piers, and would be used to transfer materials, equipment, and personnel from the shore base to the offshore construction vessels working on the Pipeline. All of the onshore load-out yards were used by Algonquin during construction of the HubLine Pipeline (FERC Docket Nos. CP01-5-000 and CP01-5-001), and are capable of supporting NEG Pipeline construction activities. The predominant land use surrounding proposed load-out yards is industrial or marine commercial. Because these are existing facilities that would not require any modifications for the proposed use, no temporary disturbances to existing land uses would occur at or adjacent to the onshore load-out yards as a result of NEG Pipeline construction.

During construction, it is anticipated that the load-out yards would receive an increased amount of noise and increased vehicular traffic as land-based construction supplies, workers, and other materials are transferred to ships. Most NEG Pipeline construction materials would be shipped via rail, barge, or ship to and from the proposed storage/pipe yard in Quonset Point, Rhode Island, which is the same facility that was used for the HubLine project. This increased transportation activity would cease upon completion of NEG Pipeline construction. Because the proposed load-out yards are existing industrial waterfront facilities that are capable of handling the proposed construction activities, increased activity at proposed load-out yards would have minimal to no impact on land uses.

Meter Stations

Construction of the NEG Pipeline would involve modifications to the existing Salem and Weymouth Meter Stations. The proposed modifications are listed in Table 4-23. All modifications to these facilities would take place entirely within the existing fenced-in portions of the meter station properties and would cause both temporary disturbance and permanent changes to the existing land use within the meter station property.

Table 4-23

Proposed Aboveground Modifications to Existing Meter Stations

Facility	Proposed Modification
Salem Meter Station	Install new 10 x 15 foot fiberglass meter building
	Add 8-foot section to existing 10-foot tall concrete building
	Remove and reverse ultrasonic meter and add one new ultrasonic meter run
	Install chromatograph
Weymouth Meter Station	Install new 16 x 21 x 10 foot tall concrete meter building
	Install gas heater
	Install chromatograph
	Remove existing ultrasonic meter and building
	Install ultrasonic meters and install scrubber
	Install pressure control valve.

As noted in section 3.7, land use around the Weymouth Meter Station is primarily industrial, while the Salem Meter Station is surrounded by recreational uses, including a public boat ramp to the north, a city park to the east, and a private golf course to the south and west. No residences are located within 50 feet of either station. Activities associated with construction and facility modification are anticipated to create louder than normal noise levels and some additional traffic to and from the stations. Potential noise impacts are addressed in section 4.11.

Construction activities at the meter stations would take approximately two months. Following completion of facility modifications, traffic access to and from the meter stations would resume to pre-construction levels. Because construction at the meter stations would be brief, would be in character with existing meter facilities, and would occur entirely within the boundary of the station sites, modifications to these facilities would have minimal impact on land use.

NEG Project activities at the load-out yards would not physically affect nearby properties. Properties to be used for Project construction staging are currently used for industrial and port activities and would not require alteration for this project. In addition, use of these properties for Project construction activities would not conflict with any existing land use plans, policies, or regulations. As a result, modifications at the meter stations would have a direct, minor long-term impact on land use.

Impacts of Operation

The two meter stations associated with the Pipeline Lateral currently exist and operate without attendance. During NEG Port operation the meter stations would remain unattended, aside from routine maintenance activities. Because the physical and functional alterations would take place on land that is already dedicated and used for industrial activities, construction would not conflict with existing land use plans, policies, or regulations. As a result, Pipeline operation is anticipated to have a minor long-term impact on land use.

Impacts of Decommissioning

Decommissioning of the Pipeline Lateral would have no effect on onshore resources. Meter stations associated with the Pipeline Lateral would probably continue to operate. As a result, no land use changes would be anticipated.

4.7.4 Recreation

4.7.4.1 NEG Port

Impacts of Construction and Operation

Onshore Recreational Resources

Construction and operation of the NEG Port would have no effect on onshore recreational resources.

Recreational Fishing

As noted in section 3.7, recreational fisheries in the NEG Port area target bluefish, Atlantic cod, Atlantic mackerel, striped bass, and winter flounder among other species. Some loss of recreational fishing area in the immediate vicinity of the construction vessels would occur. However, it is anticipated that recreational fishing would continue without disruption in other areas of Massachusetts Bay, thereby minimizing any potential adverse effect on recreational fishing from Project construction. Adverse impacts to recreational fishing from NEG Port construction and operation would be long-term and minor.

Recreational Boating

As noted in section 3.7, recreational boating is very popular in Massachusetts Bay, with numerous marinas located along the coast. Project construction and operation would have a permanent impact on boating. Upon commencement of construction, the area in which construction vessels are located would be off limits to boaters. Upon completion of construction, the NAA around the Port would be off-limits to recreational boating for the duration of the Project license. However, the vast majority of recreational boating in this area occurs close to shore, and longer-distance recreational boat trips can be planned to avoid the NEG Port construction area.

Diving

Recreational diving is not a popular activity in the immediate vicinity of the NEG Port and, therefore would not be affected by Port construction.

Whale Watching

Construction and operation of the NEG Port would permanently reduce some of the area accessed by whale watching vessels. Construction would affect some navigation routes that whale watch vessels take in transit to and from SBNMS and during their active pursuit of whales. During operation, whale watch vessels would be required to detour around the NAA. However, neither Port construction nor operation would prevent whale watching tours from occurring or affect or deny access to SBNMS, where the bulk of whale watching occurs.

Conclusion

Construction and operation of the NEG Port would create the need for some recreational boaters and whale watching cruises to alter their navigation patterns, and would result in some loss of recreational ocean use. These impacts would be limited to the Port area and would be of small scale compared to the usable portion of Massachusetts Bay. Consequently, Port and operation would have a long-term minor adverse impact on recreational uses.

4.7.4.2 NEG Pipeline

Impacts of Construction

Recreational Fishing

Bluefish, Atlantic cod, Atlantic mackerel, striped bass, and winter flounder are the primary targets of recreational fishing in and around the NEG Pipeline corridor. During construction, some temporary loss of recreational fishing area in the immediate vicinity of the construction vessels would occur. Due to the linear nature of the Pipeline Lateral, the installation activity and associated construction vessels, tugboats and tenders would move along the route, staying in one place only temporarily. The large expanse of available fishing area in Massachusetts Bay ensures that recreational fishing opportunities would continue without disruption in areas outside of the construction corridor.

Recreational Boating

As noted in section 3.7, Massachusetts Bay is actively used for recreational boating and the Massachusetts shoreline has numerous marinas where a variety of recreational boats are moored. Day trips or through passage to popular destinations in the Boston area, and further north at Cape Ann, the Isles of Shoals (New Hampshire and Maine), coastal New Hampshire and Maine, and further south to Cape Cod and the islands are common, and travel frequently traverses the proposed Pipeline corridor.

Some temporary loss of boating access would occur in the immediate vicinity of the construction vessels, and some long-distance boaters may be forced to alter their navigational courses. However, the vast majority of recreational boating in this area occurs nearer to shore and course alterations would be minor. As a result, impacts to recreational boating from NEG Pipeline construction would be short-term and minor.

Diving

Limited recreational diving occurs in the vicinity of the proposed pipeline. Diving in Massachusetts Bay primarily occurs between May and October at underwater rocky ledges and rock outcropping. The most popular offshore recreational diving locations are far enough from the pipeline corridor to avoid any potential impacts.

Two popular dive spots, Saturday Night Ledge, located about 0.5 mile north of MP 6.0, of the Pipeline's interconnect with HubLine, and Newcomb Ledge, approximately 0.5 mile west of the pipeline at MP 3.0 (Henry, 2005), could be affected by the anchor spread during pipeline construction, which would prohibit use of these areas. Jetting, also proposed near Saturday Night Ledge, may also result in some short-term turbidity impacts. Sediment disturbance caused by the pipeline construction in these areas would be similar to that caused by a typical winter storm, but on a much more localized level. Any Project associated impacts to diving areas would be of short-term duration lasting only through completion of Pipeline construction. Additionally, other popular diving locations that are located in close proximity to the North Shore would not be affected by the Project.

Whale Watching

As noted in section 3.7, whale watching operations in the region are mainly focused on Stellwagen Bank and Jeffrey's Ledge, to the north of SBNMS. Although some whale sightings have been recorded in the vicinity of the proposed NEG Pipeline Lateral route, especially from approximately MP 6.0 to the proposed NEG Port site (see section 3.3), the bulk of sightings in the past few years have occurred farther to the east, in SBNMS.

Construction of the Pipeline Lateral would cause the temporary loss of some whale watching opportunities outside of SBNMS. Construction may also affect the navigation routes that whale watch vessels take in transit to and from SBNMS whale watch areas and during their active pursuit of whales (especially if such pursuits approach the NEG pipeline corridor). However, construction would not prevent any whale watching tours from occurring, nor would it affect access to SBNMS, where the bulk of whale sightings typically occur.

Conclusion

Construction of the NEG Pipeline would alter navigation for some recreational boaters and whale watching cruises, and therefore result in some loss of ocean use, however, these limitations would be of limited scale compared to the usable portion of Massachusetts Bay, and would be of limited duration. Overall, construction of the NEG pipeline would have direct, short-term, minor adverse impacts on recreational boaters.

Impacts of Operation

During operation, the Pipeline Lateral would have no impact on recreational resources. Once installed, the Pipeline would not require any precautionary zones and activities that occurred in the pipeline vicinity prior to construction could be resumed.

Impacts of Decommissioning

NEG Project decommissioning would have an overall beneficial impact on recreation resources. Upon decommissioning, Port facilities, including the buoys, flowlines, anchors and

PLEM would be removed along with the restrictions of the NAA. The pipeline would be capped and abandoned in place. Following removal or closure of Project facilities, access to the area for recreation would be restored. During removal activities, boating access would continue to be restricted within the NAA. Following removal of NEG Port facilities, restrictions would be removed and access would be restored to pre-development conditions.

4.7.5 Visual Resources

4.7.5.1 NEG Port

Impacts of Construction

Construction vessels would be visible from the shore and by boaters for the duration of NEG Port construction. During the construction period, a variety of vessels would be seen in the vicinity of the Port. At approximately 13 miles from the nearest shore point, however, ships near the Port would be barely visible from shore. Construction vessels would also be visible from boats on the water at much shorter distances, however, commercial vessels are common in Massachusetts Bay and the vessels associated with Project construction would be visually similar to other commercial vessels. As a result, NEG Port construction would have a direct, short-term, minor adverse impact to onshore or offshore viewers.

Impacts of Operation

Gloucester/Eastern Point (Gloucester), Singing Beach (Manchester-by-the-Sea), and Marblehead Lighthouse (Marblehead), the three closest onshore points to the proposed NEG Port, are all at least 13 miles away. From these locations, only a portion of the EBRV would be visible under ideal weather conditions and would appear as an extremely small feature on the horizon. Given the amount of vessel traffic in Massachusetts Bay, it is unlikely that the EBRVs would be a focal point on the horizon unless viewers were specifically looking to identify them. Under non-ideal weather conditions (cloudy skies, fog, or during precipitation), the EBRVs would be less visible, or not visible at all.

During operations, the proposed NEG Port would be lit throughout the night, with most lights directed at the Port and EBRV. This would be a new light source in Massachusetts Bay. The lights would likely be visible to onshore viewers during clear conditions as a glow on the horizon. During overcast or hazy conditions, onshore viewers might see some reflected glare from the Port's lights.

In clear conditions, EBRVs would also be visible from vessels on the water at a distance of at least 2.2 miles. During the day, EBRVs would be visible from the MBDS (650 feet from the proposed NEG Port at its closest point), and may be visible from the eastern boundary of SBNMS (2 miles from the proposed NEG Port at its closest point) in clear conditions. At night, EBRV lights, as well as reflected glare, would be visible from vessels on the water at greater distances. Given the distance from shore, even under ideal weather conditions, visual impacts from facility operations would be long-term but minor.

Impacts of Decommissioning

Decommissioning of the NEG Port would have a positive impact on visual resources when compared to conditions during operation of the proposed action. Upon completion of decommissioning activities and facilities removal, the EBRVs would no longer be part of views, and views of the Port site would resort back to pre-construction conditions.

4.7.5.2 NEG Pipeline

Impacts of Construction

Vessels required for NEG Pipeline construction would be visible by viewers onshore and by boaters in the Project vicinity. Construction vessels would be similar in size to other commercial vessels seen in and around Massachusetts Bay. As a result, they would not substantially change views from the shore and would have only limited impact on viewers from the water. Additionally, construction vessels would not be located in a single spot for an extended period. Given the abundance of commercial vessel traffic in Massachusetts coastal waters, the presence of construction vessels required for Pipeline Lateral construction would have a minor short-term impact on views.

Impacts of Operation

During operation, the Pipeline Lateral would not be visible to users on the land or the ocean, and would have no impact on recreational resources or visual resources. Once installed, the waters over the Pipeline Lateral would not be restricted and activities that occurred in the pipeline vicinity prior to construction could be resumed. As a result, during operation, the Pipeline Lateral would have no impact on visual resources.

Impacts of Decommissioning

Decommissioning of the Pipeline Lateral would have no impact on visual resources, since it would remain buried. The meter stations associated with this Project would continue to be used and would not be removed.

4.7.6 Impacts of Alternatives

Anchor Alternatives

Neither of the anchor system alternatives being considered for the proposed port would affect ocean use, land use, recreation or visual resources.

Port Location Alternatives

From an ocean use, land use, recreation or visual perspective, there is no difference between the alternate port locations.

Vaporization Alternatives

Neither STV system alternative would have any impact on ocean use, land use, recreation or visual resources.

Pipeline Route Alternative

There would be no difference in impacts to ocean use, land use or visual resources from construction of any of the four pipeline route alternatives.

4.8 SOCIOECONOMICS

The socioeconomic impacts of the offshore LNG facilities proposal are considered for the Project Region as defined in section 2.2.

4.8.1 Evaluation Criteria

This section considers potential direct and indirect impacts on socioeconomic conditions that could occur as the result of Project construction, operation or decommissioning, including positive or negative impacts on the local and regional economy, potential changes to employment, social conditions and infrastructure. Also considered are Environmental Justice concerns related to disproportionate impacts from the Project on low-income or minority populations.

Socioeconomic impacts would be considered major if Project construction, operation or decommissioning would:

- cause a substantial permanent population increase;
- have a disproportionately high, long-term adverse impact on employment and employment opportunities within the region;
- increase the short- or long-term demand for public services in excess of existing and projected capacities; or
- Result in any racial, ethnic, or socioeconomic group bearing a disproportionate share of adverse Project effects.

4.8.2 Economics

4.8.2.1 Employment and Dependents

One of the most significant economic impacts associated with an LNG project is the employment it generates. Employment can be generated through a number of avenues, direct employment, indirect employment (contractors, suppliers), and induced employment (increased demand for transport, shops and public services).

Since the Project is being completed in two phases, construction and operation, there would be both short- and long-term employment opportunities.

The spending of direct and indirect employees generates multiplier employment in the local economy. This results from spending on:

- Housing;
- Food;
- Clothing;
- Leisure activities, such as tourism;
- Personal services;
- Business services, such as banking;
- Transportation;
- Utilities; and
- Public services, such as education and healthcare.

While most spending would be by employees, the public sector could provide some services on their behalf (education, for example).

4.8.2.2 NEG Port

Impacts of Construction

NEG Port construction would require two 28-day shifts of workers onboard construction barges. Approximately 40 people per shift would be hired from the local union halls, for a total of 80 local workers employed for NEG Port construction. While on shift, the majority of construction workers would be living offshore on a barge, so minimal induced employment would occur during that time. Table 4-24 identifies the estimated direct employment associated with NEG Port construction.

Table 4-24
Estimated Direct NEG Port Employment

Project Phase	Net Loss - No. of Employees Associated with Fishing and Lobster Industry	No. of Employees associated with LNG facility
Port Construction (Temporary)		204
Local employees	0.2 jobs or about 10.8 labor weeks*	80
Non-local employees	0.2 jobs or about 10.8 labor weeks	124
Port Operation (Permanent)		83
Local employees	5.2 jobs or about 270 labor weeks	5
Non-local employees	5.2 jobs or about 270 labor weeks	78

*A labor week is 40 hours

Source: Jin, 2005a

In addition to the workers hired specifically for NEG Port construction, some limited short-term indirect employment would also be associated with the Project, including tugboat crews, onshore employees of the load out yard, and various ship workers.

Impacts of Operation

NEG Port operation would provide direct employment to about 83 people. Between 30 and 34 non-local employees would be on-board each of the EBRVs. In addition to the workers on the EBRVs, NEG would hire five Persons-In-Charge, with two on board each EBRV when two EBRVs were at the Port, as well as one superintendent to oversee operations. Four NEG Port employees would also be hired to work in the Regional Operations Center, most likely non-local workers. NEG Port operations would also require a support vessel with a crew of five local workers. However, at this time NEG is unsure if it would own and operate, or contract the support vessel.

If the support vessel was owned and operated by NEG, the Project could create 5 additional full time positions, all to be filled by local workers. NEG would also hire locally contracted helicopter services, although this would not require any further full time jobs. Maintenance and repair services of the Port facilities would be purchased from local vendors.

Based on technical experience, during NEG Port operation induced employment would have a multiplier of two (with a high margin of error attached to these estimates) times the total number of direct and indirect jobs. Port operations would create about 83 direct positions (or 78 direct and 5 indirect jobs if the support vessel was not owned by NEG). However, 64 of these employees would live and work on-board the EBRV ships, so they would contribute little to induced employment. Based on the on-shore employment of 19 persons, it is estimated that NEG Port operation would create induced employment of approximately 38 people.

The families of workers that are employed directly or indirectly for NEG Port operation would also receive tangible economic benefits from the Project. With an average annual regional household size of 2.51, approximately 213 local dependents would directly benefit from Port operation.

Commercial Fishing

During NEG Port operation, adherence to the safety zone would prevent fishing vessels and their gear from approaching the anchor cables, and would minimize the losses of gear in these zones. The safety zone would close a relatively small portion of Block 125 from commercial fishing. However, a sizeable portion of that block is already restricted due to the presence of the Boston Harbor TSS lanes and precautionary zone, SBNMS, and other sanctuaries. More than 1,000 commercial vessels conducted fishing and lobstering activities in and around the NEG Port site in the 2002 and 2003 fishing years. The relatively low percentage of multispecies and lobster catch within the NEG Port and Pipeline area indicates that while the Project area at large provides very productive fishing grounds that produce landings roughly proportional to landings of those species reported in Massachusetts, restricting access to portions of the Project area during construction and to the safety zones during operation would have a relatively minor overall impact on total landings in Massachusetts.

The tracks of fishing vessels at speeds of 5 knots or below in the Massachusetts Bay area from 2003 to 2005 are plotted in Figure 4-9 from NMFS's Vessel Monitoring System (VMS). As the figure shows, the density of travel is highest in the areas located north, heading into and out of Gloucester harbor, and east of the NEG Port site, in Stellwagen Bank. Based on information provided by the figure, the NEG Port site is located in an area of much lower fishing activity than other areas of Massachusetts Bay. Although some fishing activity is documented in the area proposed for buoy placement, fishing activity is not as dense in that location as it is immediately to the west. Although VMS data does not reflect all fishing activity in the area, it does provide further support for the other information gathered regarding commercial fishing activity in Massachusetts Bay.

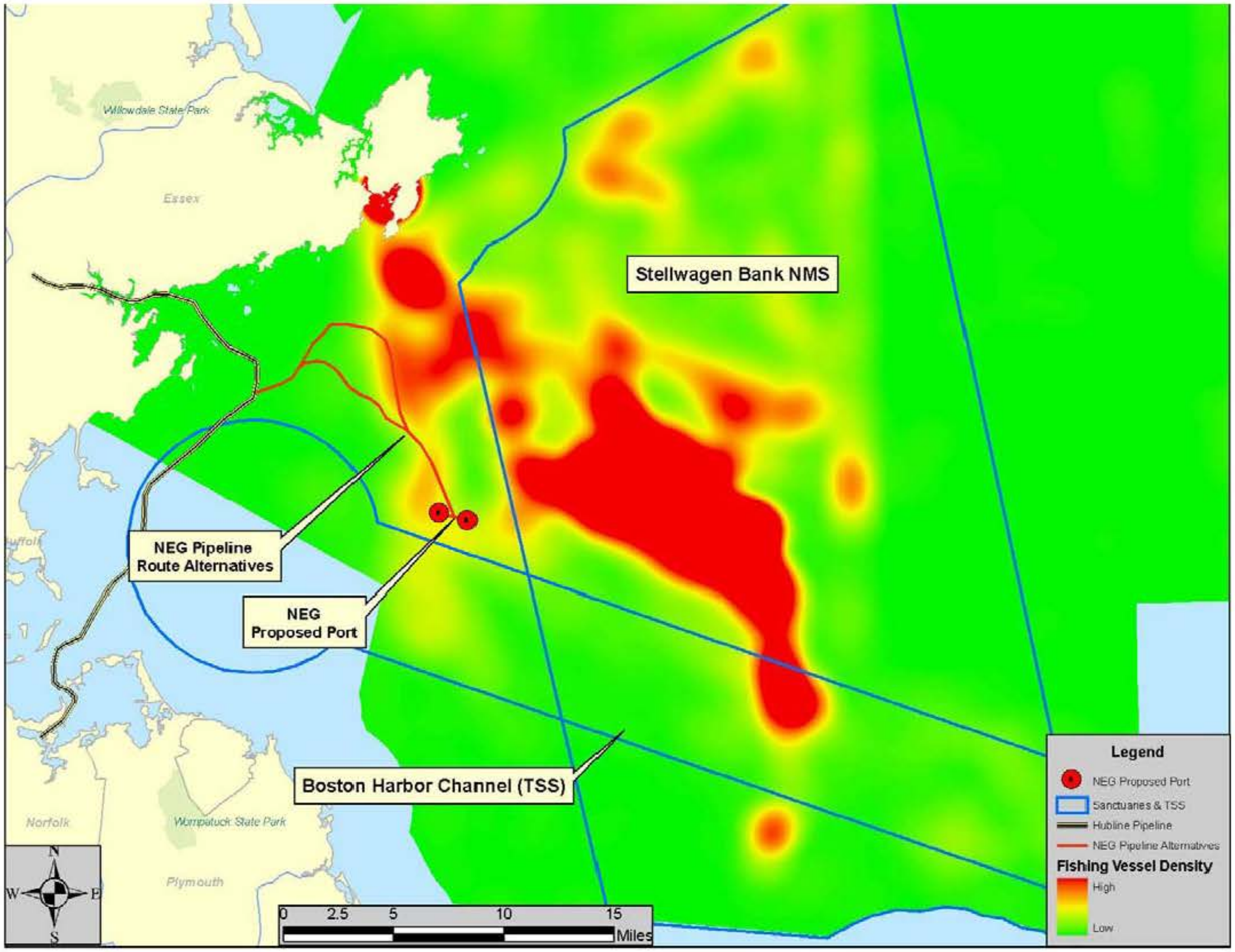

Figure 4-9 Plot of VMS Tracking Data

The proposed NEG Port would be located in MDMF Area 19. The Pipeline Lateral would be located primarily in statistical Area 3, with the northern portion of the pipeline route slightly in Area 2, and the eastern end located in Area 19 (see Figure 4-10). The MDMF data indicates that roughly 10 percent to 12 percent of lobster landed in Massachusetts from state and federally permitted vessels (according to dealer data) comes from state-permitted vessels operating in Area 19. Notably, Area 19 is roughly 100 square nautical miles while the NEG Safety Zone would prohibit access to about 830 acres, or less than 1 percent of Area 19.

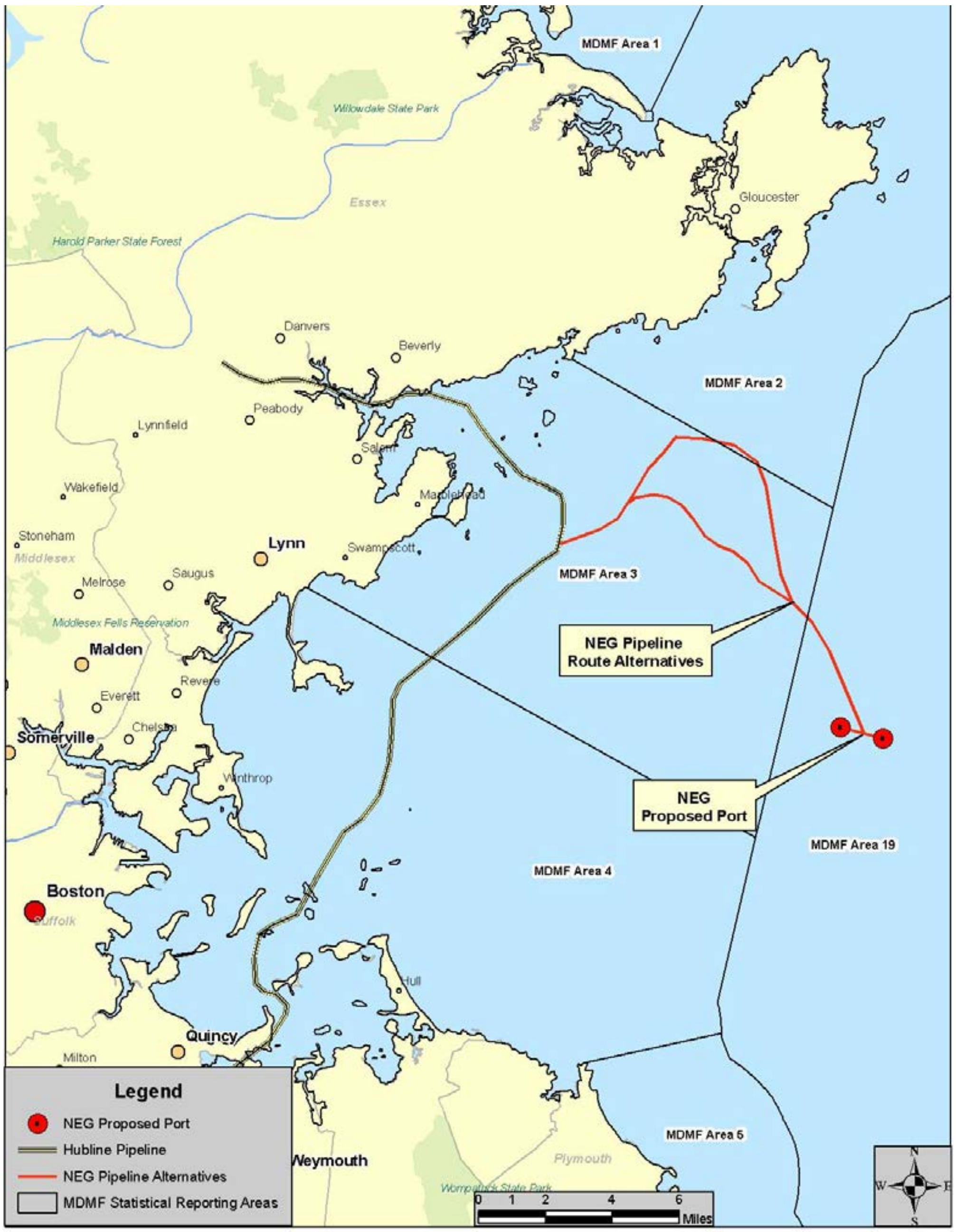

Figure 4-10 Boundaries of MDMF Reporting Areas Relative to the NEG Project

While the proposed Safety Zone surrounding each buoy would impose navigational restrictions on commercial fishing vessels by limiting access to about 830 acres of Massachusetts Bay, the restriction would have a minor impact on the commercial fishing industry. Fishing and lobstering activities would be allowed in the NAA and ATBA (for vessels with pre-approved simultaneous operations management systems) as long as the activities did not interfere with Port operations or EBRV maneuvering. A large portion of the commercial fishing fleet in Massachusetts Bay is based in Gloucester, and many of the preferred fishing grounds for this fleet are located to the south of the proposed Port site (Gloucester Fishermen Association, 2005). Commercial fishing vessels would be required to alter some preferred navigational routes from Gloucester to these fishing grounds in order to avoid crossing through the Safety Zone around each buoy. Given the highly regulated fishing environment in Massachusetts Bay—which includes seasonal and permanent closures, and strict time limits for vessels to conduct fishing activities, minor detours to avoid the Safety Zone could cost individual fishing vessels valuable time, and could therefore have a detrimental impact on a fishing vessel owner’s already limited ability to maximize the use of the ocean.

A 2005 study of the economic effects of the NEG Port on the Massachusetts fishing industry (Jin, 2005a) estimates that there would be a gross loss of about $2.4 million and a net loss of $1.9 million to the fishing industry over 25-years of Project operation (Jin, 2005a; see Appendix J). The difference in these two values (about $486,500) is accounted for through the: variable costs such as fuel and labor, and extrapolates to about $19,500 annually. Based on previous technical experience, a regional multiplier of 2 has been assumed. This means that there would be a per annum loss of about $9,700 to the regional economy. Using the past four years of average weekly fishing wages in Essex, Suffolk, Norfolk and Plymouth counties of $899 per week, this equates to a total of about 10.8 weeks of labor lost annually (or 5.2 jobs total) as the result of the closure of the waters near the NEG Port over a 25-year life. Overall this would be less than one job lost per annum, which is considered a minor adverse impact.

Impacts of Decommissioning

Activities associated with NEG Port decommissioning would provide benefits in the form of employment opportunities to a limited number of local workers. Decommissioning could be accomplished over a period of two to four weeks and would require an increased number of vessels traveling to and from the NEG Port to support the decommissioning work. While specific numbers are not available at this time, decommissioning would provide a minor beneficial direct economic impact to the area in the form of short-term increased employment.

Upon completion of Port decommissioning, the NAA would be lifted and the Port site would again become accessible to marine vessels. The restoration of this area to regional fishing fleets would provide a minor benefit to commercial fishing operations by restoring access to waters previously occupied by the Port. It would also enable more direct, faster access to fishing grounds, thus increasing the profitability of area commercial fishing operations.

4.8.2.3 NEG Pipeline Lateral

Impacts of Construction

Pipeline construction would consist of two 28-day shifts. NEG plans on hiring 134 workers (or 36 percent of construction labor) of the construction labor force from the local labor pool during the 7 month construction period. In addition, Pipeline construction would require 4 full-time workers to oversee operations. Table 4-25 outlines the estimated direct employment associated with the Pipeline Lateral.

Table 4-25
Estimated Direct NEG Pipeline Employment

Project Phase	Net Loss - No. of Employees Associated with Fishing and Lobster Industry	No. of Employees associated with LNG facility
Pipeline Construction (Temporary)	5.2	475
Local employees	2.6	134
Non-local employees	2.6	341
Pipeline Operation (Permanent)	0	4
Local employees	0	4
Non-local employees	0	0

*A labor week is 40 hours

Source: Jin, 2005a

Commercial Fishing

A variety of fishing activities, including bottom trawling, gillnetting, and lobstering currently occur in the vicinity of the proposed NEG Pipeline route. Direct impacts include the temporary loss of areas for commercial fishing and lobstering. Construction-related closures would prohibit or impede fishing activity in portions of Massachusetts Bay where construction is occurring. At any given time during pipeline construction, construction vessels and their anchor spreads would occupy approximately 1.3 square miles of ocean. Algonquin would mark the construction area and implement a communication plan, similar to the one developed and used for HubLine construction, to provide advance notification of specific construction routes, activities and timelines, in order to minimize and prevent the loss of fishing gear. Following completion of pipeline construction, normal fishing activities would resume over and around the pipeline corridor. The biological impacts associated with pipeline construction are presented in section 4.2.

Indirect effects of construction include navigational changes necessary to avoid the anchor spread. Depending on the location of construction vessels, circumnavigation of the anchor spread could add several miles to the projected course of a commercial fishing vessel bound for areas of Blocks 125 and 133. Most of these vessels travel at no more than 8 knots (Gloucester Fishermen Association, 2005). Given the heavily regulated nature of fishing in Massachusetts Bay, even adding a few hours to travel time could have an adverse effect on the amount of time that these vessels can dedicate to fishing. While the amount of ocean to be closed for pipeline construction is a relatively small portion of Blocks 125 and 133, navigational areas and seasonal and permanent fishing closures already limit activity.

A report on the net economic effect of NEG Port (Jin, 2005) estimates that there would be a maximum gross loss between $438,300 and $473,000, and a net loss between $350,700 and $378,500 to the fishing industry during the 7-month construction period. The difference in these values is attributed to the variable cost of fishing (labor and fuel). Using the upper gross bound and the lower net bound, provides the full range of potential economic loss. Based on available data, it is not possible to break down variable costs into constituents. As a result, the estimated loss employment is extremely conservative, based on an assumption that labor costs equals variable costs. Using the average weekly fishing wage over the past 4 years across Essex, Suffolk, Norfolk and Plymouth counties of $899, the loss in fishing industry income from the closure of the waters during the 7-month period would correlate to 136 weeks of lost employment, or approximately 5.2 jobs lost during the construction period.

Construction of the Pipeline Lateral would require support from tugboat crews and ship workers as well as onshore workers at the pipe load-out facilities; however it is anticipated that this would not result in further employment. During Pipeline construction, the additional spending of disposable incomes of all workers at local businesses could result in services purchasing more inventories from suppliers as well as inducing the demand for more employees in local businesses to meet the increased demand for services.

Families of workers that are employed directly or indirectly by the proposed NEG Port would also receive tangible economic benefits from the Project. With an average annual regional household size of 2.51, 10 local dependents would directly benefit from NEG Port construction. Overall, however, these beneficial impacts would be minor.

Impacts of Operation

During operation, there would be no access restrictions to waters over the pipeline corridor. As a result, NEG pipeline operation would, at most, have a minor impact on the local fishing economy.

Since it is anticipated that there would be only four permanent jobs during operations, the long term induced employment effects of Port operation would be minor. In addition, given the low number of employees associated with Pipeline operation, any induced employment or beneficial impacts to dependents would be minor.

Impacts of Decommissioning

Activities associated with Pipeline Lateral decommissioning would provide very minor benefits in the form of employment opportunities to a limited number of local workers for cleaning and capping the Pipeline Lateral. Since the pipeline would be abandoned in place, the work would be of short duration and have a minimal impact on the regional economy.

4.8.2.4 Mitigation

As mitigation for lost jobs in the fishing industry, preference should be given to displaced fisherman when recruiting for permanent positions for Port or Pipeline operations, especially any nautically-focused jobs (i.e., support vessel, EBRV vessel crews, pipeline maintenance/ operations).

At locations where the Pipeline Lateral would cross existing utilities, the Pipeline would be laid on the seafloor and protected with concrete armoring, which could be a potential obstacle for ground fishing gear.

In order to minimize disruption to fishing and damage to fishing gear, **FERC staff recommends that**:

- Algonquin prepare as-built construction plans for the Pipeline Lateral that include the details of where the pipeline would be laid on the ocean floor and protected with concrete mats. To minimize the potential for the Pipeline to become an obstacle for ground fishing gear, these plans should be made available to the USCG and other jurisdictional agencies for dissemination to the commercial fishing industry.

4.8.2.5 Value of Procurement

Money spent by the NEG and Algonquin for the procurement of goods and services (purchasing and outsourcing) within the local economy can be considerable. The on-flow effect of this spending can boost local production and promote the development of new industries. Examples of areas that can benefit from this procurement include:

- Utilities;
- Construction;
- Manufacturing;
- Food supply;
- Road, rail, public and air transportation; and
- Banking and insurance.

NEG Port

Impacts of Construction

Construction of the NEG Port would cost approximately $140 million. However, NEG states that relatively small amounts of this would be spent in the regional economy (NEG, 2005a). While procurement would have minimal regional impact, it would have a positive impact nationally.

Impacts of Operation

NEG Port operations would result in an annual operating cost of approximately $3,319,000 (NEG, 2005a). Of this total cost, an estimated 38 percent would be spent in the regional economy, sourcing services and consumables. Over 25 years of Port operation, this would amount to approximately $1,267,500 annually.

Impacts of Decommissioning

Procurement for NEG Port decommissioning would probably come in the form of contracts for the vessels and services required to remove the anchors, buoys and PLEM. The specific requirements are not available at this time, but given the short duration of this activity (two to four weeks), it is anticipated that Port decommissioning would have a minor beneficial impact relative to the value of procurement.

NEG Pipeline

Impacts of Construction

Algonquin projects that construction of the Pipeline Lateral would cost approximately $180 million; however, the amount of materials purchased locally would be negligible (NEG, 2005a). While procurement would have minimal regional impact, it would have a positive impact nationally.

Impacts of Operation

Assuming that operating and maintenance costs would be approximately 7 percent of construction costs, the operating budget for the NEG Pipeline would be approximately $12.6 million per annum over 25 years.

Impacts of Decommissioning

Activities associated with Pipeline Lateral decommissioning would provide very minor benefits in the form of employment opportunities to a limited number of local workers for cleaning, and capping the Pipeline Lateral. Since the pipeline would be abandoned in place, the work would be of short duration and have a negligible impact on the regional economy.

4.8.2.6 Contribution to Government Revenues

Tax revenue would be paid by the Company. The value of the Company's tax contribution has not been identified at this time.

NEG Port

Impacts of Construction

NEG Port construction would contribute to government revenues in the form of both direct and indirect taxes.

NEG estimates that approximately $11.5 million would be paid in wages during port construction, $4.8 million of which would be paid to local workers. In 2005, the Massachusetts state income tax was 5.3 percent (MA DOR, Guide to Taxes). Assuming direct and indirect taxes of 10 percent of the wage cost, tax revenue for Massachusetts from NEG Port construction would amount to approximately $480,000.

All Project related workers would be required to pay federal income taxes. Assuming that these indirect taxes (income tax and sales tax) would amount to approximately 35% of the total wage cost, the total federal income taxes paid by Project employees during Port construction would be approximately $4.03 million. Table 4-26 lists federal income tax rates for single filers.

Table 4-26
2006 Federal Income Tax Rates for Single Filers

Taxable Income Exceeding	Not Exceeding	Tax on Lower Amount	Rate on Excess
$0	$7,550	$0.00	10%
$7,550	$30,650	$755.00	15%
$30,650	$74,200	$4,220.00	25%
$74,200	$154,800	$15,107.50	28%
$154,800	$336,550	$37,675.50	33%
$336,550	No Limit	$97,653.00	35%

Source: IRS, 2006

Impacts of Operation

NEG would employ four local employees that would pay Massachusetts state taxes. These four incomes would equal approximately $354,900 annually and, assuming they would contribute approximately 10 percent of this in indirect taxes, would contribute approximately $35,490 to state tax revenues annually. In addition, all workers would pay Federal income taxes. Assuming Federal taxes would be 35 percent of their total wage cost, federal government tax revenues would be approximately $124,215 annually. Although beneficial, these impacts would be minor.

With consumables from operations presumably being bought in the local economy, the $60,000 annual spend on consumables (NEG, 2005a) would contribute approximately $3,000 in sales tax.

Assuming a loss in commercial fishing revenues during NEG Port construction and operation, there would be a loss in regional, state and federal tax revenues, attributable to fishing, although this amount would be minor (Jin, 2005).

Impacts of Decommissioning

Decommissioning of the NEG Port would require the removal of Port facilities including the buoys, anchors, flowlines and the PLEM. NEG estimates that decommissioning would take approximately two to four weeks, during which time individuals employed by NEG on decommissioning would receive taxable earnings for their work. Although the number of individuals to be employed for this activity is unknown, given the short duration of decommissioning activities, any government tax revenues would be minor and short-term.

NEG Pipeline

Impacts of Construction

Algonquin estimates that wages paid for pipeline construction would be about $29 million, approximately $9 million of which would be paid to local workers (Algonquin, 2005). Since all local workers would pay Massachusetts state income taxes, and assuming direct and indirect local taxes would equal approximately 10 percent of the wage costs, the Commonwealth of Massachusetts would gain approximately $900,000 in tax revenues.

Pipeline construction workers would also pay Federal income taxes, which, assuming taxes would be 35 percent of the total wage cost, would provide tax revenue to the federal government of approximately $10.2 million.

Assuming that restrictions to fishing grounds in the immediate vicinity of the pipeline corridor during construction would cause a loss in fishing revenues during construction, the net loss of state and federal income tax revenues from not-fishing would be between approximately $350,700 and $378,500 over the 7-month construction period (NEG, 2005a). Overall the impacts from taxes would be beneficial but minor.

Impacts of Operation

Given the low number of employees required for pipeline operation (four), revenues to the federal and state from income taxes paid by Pipeline employees would be minor.

The potential for economic benefits to the State from increasing LNG supplies, which may result in a relative decrease in energy prices, has not been assessed.

Impacts of Decommissioning

Decommissioning of the Pipeline Lateral would require the cleanout and capping of the pipeline and subsequent abandonment in place. Although the number of individuals to be employed for this activity is unknown, given the short duration of decommissioning activities, any tax benefits to be derived from this activity would be minor and short-term.

4.8.3 Housing and Public Services

4.8.3.1 NEG Port

Impacts of Construction

During their 28-day rotations, construction workers would live aboard the construction barges and would not require temporary or permanent housing. Workers hired from local union halls would already reside in the region and not require new housing. Therefore, the Project would have no impact on housing in the Project area.

Approximately 56 non-local workers (58 percent of the 96-person workforce) would be in the Project area during one 28-day rotation. As a result of these workers and port construction, demand for public services could experience a temporary increase. Any increase in demand would be small relative to the existing facilities and services in the region that include over 22 hospitals, numerous fire departments with fireboats, and stand-by emergency assistance from the USCG. These facilities should be sufficient to respond to any Port-related increase in demand for public services. As a result any impacts to housing or public services would be minor.

Impacts of Operation

Project area residents would fill some of the new positions created for NEG Port operation. In 2000 there were approximately 20,500 vacant housing units within the Project region, more than sufficient to accommodate this small increase in permanent employees (section 3.8 provides information on population and housing in the Project region).

Current public facilities and services in the region include over 22 hospitals, 17 police departments, 17 fire departments, and stand-by emergency assistance from the USCG. Since operations would occur 13 miles offshore and the EBRVs would have a variety of fire prevention, detection, and extinguishment systems on board in case of an on-vessel emergency, limited impacts on Project region public services would occur. If the Project required services within the harbors in the Project region, local firehouses and police would provide service. Based on the small scale of the on-shore Project operations and the public services available, NEG Port operation would have a minor impact on public services.

Impacts of Decommissioning

NEG Port decommissioning would have minor impacts on housing and public services. No individuals would be expected to move into Massachusetts as the result of employment for decommissioning due to the short duration of the decommissioning activities (two to four weeks). At most, some individuals may require short-term hotel rooms, however, workers are expected to be housed on the vessels conducting decommissioning activities. As a result, decommissioning would not create any new demands for housing or public services in the Project region and would have a minor effect on these resources.

4.8.3.2 NEG Pipeline

Impacts of Construction

Algonquin would hire a total of 475 workers for construction of the Pipeline Lateral, which would last for 7 months. This workforce would operate on a 28-day rotation with a maximum workforce of 300 persons per rotation. Approximately 340 non-local workers (64 percent) would be brought in to the area to supply the highly specialized skill sets required for pipeline construction: the balance of workers would be hired from local union halls. In 2004, the population of the Project area was approximately 1.1 million. Based on this large population, the temporary influx of approximately 340 workers would have a minimal impact on the local population.

While on shift, workers would live offshore on the construction vessels. It is anticipated that workers would return to their homes during their 28-day off shift periods. As a result, no additional demands for housing would occur. The Project area would experience no long-term effects as the non-local, temporary workers would leave after completion of construction.

Algonquin also proposes to use layout and staging areas including construction worker parking areas; barge loading/unloading; and other associate facilities at Charlestown, Gloucester, and, Quincy, Massachusetts and North Kingstown, Rhode Island. These shore-based facilities are existing commercial or industrial docks, and their use for NEG Pipeline construction would not affect public services or housing.

Impacts of Operation

Pipeline operation would have no adverse effect on the communities in the region. Only four employees would be required for operation, which is a negligible amount considering the population of the Project area.

4.8.4 Environmental Justice

NEG Port and Pipeline Lateral

NEG Port and Pipeline Lateral construction and operation would take place offshore and would have a minor adverse impact on populations in the Project region, including minority and low-income populations. Local fishermen out of Essex County communities, particularly the City of Gloucester, constitute an economic/cultural community that may include a large minority or low-income membership (see section 3.8.3.1.3 for a discussion of the fishing industry). Although Project construction and operation would remove some productive fishing areas from use, only approximately 3 jobs would be lost during Project construction and 5 during operation (see sections 4.8.2.2 and 4.8.2.3). As noted in section 3.8, a total of 262 individuals were employed in the fishing industry in Essex County in 2000. The loss of 3 jobs during construction or approximately 5 jobs during operation, which represents about 1 percent of all commercial fishing employees, would be minor from an Environmental Justice perspective when compared to the total number of individuals employed in the fishing industry in Essex County.

4.8.5 Summary

NEG Port

Overall, NEG Port construction would provide economic benefits to the Massachusetts economy by providing employment opportunities and additional tax revenues to the state. Of the total jobs created, local employees would fill about 80 temporary construction and 43 permanent positions. Taxes paid to Massachusetts by NEG Port employees would amount to about $480,000 during Port construction and $35,940 annually during Port operations. In addition the total value of procurement from regional Massachusetts sources for Port construction and operation could amount to approximately $31,687,500.

Port operation would have an adverse impact on the fishing industry, which, based on estimates of net and gross losses, would lose approximately 10.8 weeks of labor annually, or 270 labor weeks over 25 years. Although this is substantial to those workers employed in the Massachusetts fishing industry, it is a minor amount when viewed in the context of overall economic benefits provided by the Project. Assuming a reduction in fishing revenues during Port construction and operation, there would be a loss in regional, state and federal tax revenues of approximately $78,000.

NEG Pipeline

Pipeline construction and operation would create 134 temporary and 4 permanent jobs for local workers. Indirect taxes paid during pipeline construction would contribute approximately $900,000 in Massachusetts state tax revenues. In contrast, by restricting access to the pipeline corridor during construction, there would be approximately 2.6 jobs lost in the fishing industry during the 7-month construction period.

4.8.6 Impacts of Alternatives

Anchor Alternatives

From a socioeconomic perspective there is no significant difference between the two anchor system alternatives being considered.

Port Location Alternatives

From socioeconomic perspective, there is no significant difference between the alternate Port locations.

Vaporization Alternatives

Neither STV system alternative would have any impact on population, employment, the economy or public services.

Pipeline Route Alternative

From a socioeconomic perspective, there is no significant difference between the alternate Pipeline routes.

4.8.7 Mitigation and Minimization

The following measures have been proposed as potential measures for mitigating and/or minimizing socioeconomic impacts.

- As mitigation for some of the jobs that could be lost due to NEG Project construction and operation, preference should be given to displaced fisherman when recruiting for temporary and permanent positions for Port or Pipeline construction and operations, especially any nautically-focused jobs (i.e., support vessel, EBRV vessel crews, pipeline operations).
- In consultation with the Secretary of EOEA, NEG is developing a compensatory mitigation program for commercial fishermen and lobstermen impacted by the Project and is engaged in discussions to structure the program (see appendix A).
- The Project would temporarily impact recreational fishermen, boaters, whale-watch vessels, and charter boats during construction of both the Port and Pipeline, and would have minor permanent impacts to these recreational interests during Port operation. To mitigate the loss of useable ocean surface area, the Project has initiated discussions with the Secretary of EOEA regarding compensatory mitigation for public benefits related to improving the quality of or access to coastal resources. To the extent possible, such compensatory mitigation would be proximate to the areas affected by the Project (see appendix A).

4.9 TRANSPORTATION

This section discusses the impact of construction, operation and decommissioning of the proposed NEG Project on Transportation. Direct, indirect, and cumulative impacts are discussed for each category.

Changes to the Boston Harbor Inbound TSS lane have been proposed and a PARS is underway. However, since the proposed changes are still being evaluated and are not final, this analysis evaluates the proposed action with the existing TSS configuration.

4.9.1 Evaluation Criteria

Direct or indirect impacts on transportation include those that would have some effect, positive or negative, on existing or reasonably foreseeable transportation patterns.

Adverse impacts on transportation are considered major if construction or operation is likely to: prohibit navigation within all or a portion of a designated navigation channel; prevent or substantially reduce access to existing port facilities; substantially increase the distance or time that vessels must travel to reach their destination; substantially increase the safety risks to vessels in Massachusetts Bay; or cause substantial increases in onshore vehicular traffic or substantial worsening of onshore traffic congestion.

4.9.2 Ship Traffic Lane Relocation

Changes have been proposed to modify the alignment of the Boston Harbor TSS and to establish limitations on certain vessels operating in the vicinity off Race Point and the Great South Channel (Subcommittee on Safety, 2006). The proposed TSS revision is shown in Figure 3-32. The modified TSS alignment would not directly affect the NEG Port site, nor would it force EBRVs to substantially alter their navigation between the TSS and the NEG Port site (compared to the existing TSS configuration).

4.9.3 Onshore Transportation

4.9.3.1 Impacts of Construction (NEG Port and Pipeline Lateral)

During construction of the NEG Port and Pipeline Lateral, existing waterfront port facilities would be used as load out yards (see section 3.7). Supplies and construction material would arrive at these ports, via rail, boat and truck, and would be transferred to construction vessels bound for the Project area. The amount of construction-related land-based traffic, the distribution of land-based trips to each of the four load-out yards, and the type of vehicles used to carry supplies into the ports is not known. Because the proposed load-out yards are existing industrial waterfront facilities that are capable of handling the proposed construction activities, increased activity at proposed load-out yards should have minimal to no impact on transportation.

At its peak, NEG Port construction would employ about 96 workers, while a peak workforce of approximately 300 workers would be required for the pipeline. Since the location of on-shore Port facilities has not yet been finalized, it isn’t known. Because all construction would be done in shifts, it is unlikely that 400 total workers would require parking at a single time. However, NEG Port and Pipeline construction would create demand for a large number of parking spaces. However, it is likely that, as industrial facilities, the proposed load-out yards would adequate enough on-site parking to accommodate this demand. Accordingly, construction of the NEG Port and Pipeline would have a short-term minor adverse impact on onshore transportation.

4.9.3.2 Impacts of Operation (NEG Port)

NEG Port operation would involve two onshore sites, a Regional Operations Center and an existing port that would serve as the base for OSV operations. The location of the Regional

Operations Center and OSV port has not yet been determined, but NEG proposes to lease property within existing facilities. Under normal operating conditions, these facilities would generate no more than a few onshore vehicle trips per day. Accordingly, operation of the NEG Port would have a minor adverse impact on onshore transportation resources.

4.9.3.3 Impacts of Operation (Pipeline Lateral)

Operation of the NEG Pipeline would involve two onshore sites, meter stations in Weymouth and Salem, Massachusetts, since the facilities are un-manned, under normal operating conditions. Accordingly, operation of the Pipeline Lateral would have a minor impact on onshore transportation resources.

4.9.4 Offshore Transportation

4.9.4.1 NEG Port

Impacts of Construction

The NEG Port, is entirely outside of the Boston Harbor TSS lanes (about 1.4 miles north of the inbound TSS lane) and precautionary area. It is also located outside of designated anchorage and lightering areas and well seaward of all designated mooring areas associated with North Shore communities. Depending on course, vessels heading for these ports might have to detour around construction activities, but such detours would not generally be considered substantial.

Construction activities associated with the NEG Port would involve various vessels with specialized construction capabilities on station and making trips between the NEG Port and local ports during the construction period. The types of vessels and the number of trips between the construction sites and local ports and approximate time on station are summarized in Table 4-27. The likely number of trips from each local port is not known, nor is the specific course that these vessels would take.

Table 4-27
Number of Vessels Trips and Time on Station During Deepwater Port Construction

Vessel Type	Round Trips	Approximate Days On Station
Anchor handling vessel	8	15
Diving support vessel	5	105
Crew boat	12	N/A
Restoration vessel	4	15
Total Round Trips	**29**	**135**

Source: NEG, 2005a

Offshore construction activities associated with the NEG Port are located away from onshore ports. The total number of service vessel trips associated with the NEG Port equates to less than one round trip per week during the 7-month construction period. This number is minor, given the type and number of vessels that already travel through Massachusetts Bay.

Construction of the NEG Port would have short-term, direct, minor adverse impacts on vessel navigation in Massachusetts Bay.

Impacts of Operation

Vessel Navigation

The NEG Port area would be protected by concentric Safety Zones (0.54 nautical mile [nm] radius from each buoy), no anchor areas (1.1 nm radius from each buoy) and an Area To Be Avoided (ATBA) (1.4 nm radius from each buoy). Barges containing dredge material from ports south of Boston Harbor would have to maneuver to avoid the NAA around each buoy during operation of the Port. Vessels approaching the MBDS would be in the EBRV Watch Zone and tracked. Unidentified vessels would be contacted by the EBRV Master.

The potential for adverse transportation impacts associated with NEG Port operation revolves primarily around the potential for navigational conflicts with EBRVs approaching, using, or departing the Port's buoys. Approximately 65 EBRV would access the terminal each year, with at least one EBRV moored at the Port at any given time, and two EBRVs moored approximately 10 percent of the time. EBRVs would generally approach the Port by way of the Boston Harbor TSS, although this course may vary depending on weather conditions and other variables. No tug assist would be required for either EBRV or mooring.

Non-port vessel traffic would be prohibited from the Safety Zone and discouraged from entering the no anchor area or the ATBA. The ATBA would be located outside of designated navigational channels such as the Boston Harbor TSS lanes and precautionary area. With the exception of commercial fishing vessels (as described in section 4.7.1), this closure would have a minor adverse impact on vessels in the area.

While in transit, each EBRV would be surrounded by a moving security zone (2 miles in front, 1 mile behind and 500 yards on either side of each EBRV) as they entered and left the Port. Mobile security zones around the EBRVs would also be in effect when they were in transit in the TSS lanes. This would affect navigation of non-NEG Port related vessels bound to or from Boston Harbor, forcing them to not only observe standard safety buffers, but to coordinate with USCG for any additional buffer that EBRV operations might require. While noticeable, these requirements would not likely be considered substantial for TSS traffic, since many of the vessels that transit the TSS are quite large and accustomed to maintaining ample separation from other vessels.

When approaching the Port, EBRVs would maintain a speed of no more than 3 knots beginning at 3 kilometers from the designated buoy, with a further reduction to < 1 knot maneuvering speed beginning 500 meters from the Port. The reverse would apply when departing the Port. Thus, during docking or departing operations the size of the ATBA would increase from 1.4 nm to 3 nm to the southeast (depending on weather conditions). This would further increase the navigational changes that other vessels would make to avoid the NEG Port area. However, impacts on non-NEG Port related vessels would be minor, given the large areas of Massachusetts Bay available for navigation.

Conflicts with Port-Related Vessels

Prior to the arrival of an EBRV, an inspection of the NEG Port buoy and related equipment would be conducted by either an offshore supply vessel (OSV) or by helicopter. Planned maintenance would include the weekly inspection of surface components of the Port by either a shore-based OSV, transporting personnel to attend to specific needs of the Port, or by a helicopter. An OSV would make one trip per week from a base of operations located on the mainland. The addition of one service vessel trip per week to the mix of vessels in the TSS lanes would not affect other vessel transportation.

Impacts of Decommissioning

Decommissioning of the NEG Port would have a minor positive impact on transportation, due to the removal of the ATBA and elimination of more than 100 vessel round trips (including EBRVs and OSVs) from Massachusetts Bay. As a result, NEG Port decommissioning would have a minor beneficial impact on transportation.

4.9.4.2 NEG Pipeline

Vessel Navigation

The NEG Pipeline corridor, including the anticipated anchor spread of construction vessels, is entirely outside of the Boston Harbor TSS lanes and precautionary area. The proposed pipeline corridor is also outside of designated anchorage and lightering areas and seaward of all designated mooring areas associated with Salem, Beverly, Gloucester, and other nearby harbors along the North Shore. Vessels heading for these ports would have to detour around construction activities, but the detours would be temporary, lasting only for the approximately 7-month duration of Pipeline construction.

Construction activities associated with the NEG Pipeline Lateral would involve various vessels with specialized construction capabilities on station and making trips between the NEG Port and local ports during the construction period. The types of vessels and the number of trips between the construction sites and local ports and approximate time on station are summarized in Table 4-28. The likely number of trips from each local port is not known, nor is the specific course that these vessels would take.

Table 4-28

Vessels Trips and Time on Station During NEG Pipeline Construction

Vessel Type	Round Trips	Approximate Days On Station
Anchor handling vessel	14	105
Diving support vessel	10	150
Crew boat	100	N/A
Restoration vessel	N/A	N/A
Lay barge	1	50
Plow vessel	2	55
Tremie vessel	1	30
Survey vessel	8	105
Pipehaul barge tug	4	50
Supply vessel	40	N/A
Total Round Trips	**180**	**545**

Source: NEG, 2005a

Pipeline construction is proposed to occur between the months of May and November 2007. Service vessels would make approximately 180 round trips (between proposed load-out yards and the pipeline construction area) during the 7-month NEG Pipeline construction period—

an average of less than one round trip per day. This number is minor when compared to the 4,561 annual large commercial vessel transits in the Boston Harbor TSS lanes (see section 3.7) in northern Massachusetts Bay annually. Approximately, 140 of the 180 construction vessel round trips would be accomplished by either the crew boat or supply vessel, which would be relatively small vessels. The larger and less maneuverable vessels, such as the Lay Barge, would make few round trips, creating fewer opportunities for navigation conflicts or delays. Vessels that are "on station" would remain within or near the anchor spread corridor. By avoiding the anchor spread corridor, non-construction vessels would avoid conflicts with any on-station construction vessels. The added traffic directly associated with NEG pipeline construction should be minor compared to the overall mix of traffic in Massachusetts Bay.

Impacts of Operation

Once installed, there would be no on-water activity associated with normal operations of the NEG Pipeline Lateral. Operation of the Pipeline Lateral would at most, have a minor impact on transportation.

Impacts of Decommissioning

It is assumed that upon decommissioning, the NEG pipeline would be abandoned in place. Minor short-term activity would occur at each end of the Pipeline Lateral that may require some vessels to change course. As a result, decommissioning would have a minor adverse, short-term impact on transportation.

4.9.5 Impacts of Alternatives

Anchor Alternatives

Neither of the anchor system alternatives being considered for the proposed Port would impact transportation. Consequently there is no preference between anchor alternatives.

Port Location Alternatives

From a transportation perspective, there is no difference between the alternate Port locations.

Vaporization Alternatives

Neither STV system alternative would have any impact on transportation. Consequently there is no preference from a transportation perspective.

Pipeline Route Alternative

From a transportation perspective, there is no difference between the alternate Pipeline routes.

4.9.6 Mitigation and Monitoring

There are no proposed mitigation or monitoring actions that are specific to transportation impacts.

4.10 AIR QUALITY

The NEG Port is proposed to be located in federal waters. The majority of the proposed Pipeline Lateral would be located within Massachusetts territorial waters with a small portion extending into federal waters. Generally, the CAA does not require EPA to make air quality designations for areas that are outside of state boundaries. As such, the portions of Massachusetts Bay that are beyond the territorial waters of the Commonwealth of Massachusetts, including the proposed location of the NEG Port, have not been designated.

The DWPA designates deepwater ports as new sources for the purposes of implementing the CAA. EPA Region 1 would develop and issue all CAA permits required for construction and operation of the NEG Port.

4.10.1 Evaluation Criteria

Potential impacts to local and regional air quality are determined by:

1. increases in regulated pollutant emissions relative to existing conditions;
2. increases in ambient air pollutant concentrations; and
3. Project's compliance with applicable air emission standards.

Air quality impacts would be major if construction or operation of the Project would be likely to cause or substantially contribute to a violation of any NAAQS, expose sensitive receptors to substantially increased air pollutant concentrations, or violate an applicable permit requirement.

4.10.2 NEG Port

4.10.2.1 Impacts of Construction

Marine vessels required for NEG Port construction would include a 12,000-hp buoy delivery vessel, a 12,000-hp anchor handling vessel (AHV), a 10,000-hp diving support vessel (DSV), a 4,800-hp restoration vessel, a 1,200-hp crew boat, and 4,200 hp and 4,800 hp buoy tugs. These vessels would generate PM_{10}, SO_2, NOx, VOCs, CO, Pb and hazardous air pollutant (HAP) emissions over a period of seven months in 2007 as summarized in Table 4-29. NOx, CO, and VOC emissions were calculated based on emission factors provided by MDEP. Emissions of other pollutants were based on EPA's AP-42 emission factors. Total fuel consumption for all vessels were estimated by the construction management contractors, based on previous experience and fuel usage information obtained from marine companies and boat crews used on past projects.

TABLE 4-29

Estimated Emissions from Vessels Involved in Port Construction[a]

	Total Activity			NOx		CO		VOC		SO_2		$PM_{10}/PM_{2.5}$		Pb		Total HAPs	
Source	**Metric tons/day**	**gals[e]**	**days**	**lb/hr**	**tpy**	**lb/hr**	**tpy**	**lb/hr**	**tpy**	**lb/hr**	**tpy**	**lb/hr**	**tpy**	**lb/hr**	**tpy**	**lb/hr**	**tpy**
Buoy Delivery Vessel, 12,000 hp (all modes of operation)[b]	45.4	38,016	3	143	5.13	58.08	2.09	26.40	0.95	40.13	1.44	7.92	0.29	0.0008	0.00003	0.39	0.01
Buoy Tug #1, 4,200 hp (all modes of operation)[b]	15.9	133,200	30	50.0	18.0	20.35	7.33	9.25	3.33	14.06	5.06	2.78	1.00	0.0003	0.0001	0.14	0.05
Buoy Tug #2, 4,800 hp (all modes of operation)[b]	18.1	151,920	30	57.0	20.5	23.21	8.36	10.55	3.80	16.04	5.77	3.17	1.14	0.0003	0.0001	0.16	0.06
Diving Support Vessel 10,000 hp																	
Infra-field transit (approx. 6 knots)[c]	3.8	64,428	60	12.1	8.70	4.92	3.54	2.24	1.61	3.40	2.45	0.67	0.48	0.00007	0.00005	0.03	0.02
Station-keep/dynamic positioning (DP)[c]	2.6	17,181	24	8.1	2.32	3.28	0.94	1.49	0.43	2.27	0.65	0.45	0.13	0.00004	0.00001	0.02	0.01
Transit (approx. 12 knots)[c]	10.3	11,454	4	32.2	1.55	13.12	0.63	5.97	0.29	9.07	0.44	1.79	0.09	0.0018	0.00001	0.09	0.004
Anchor Handling Vessel 12,000 hp																	
Infra-field transit (approx. 6 knots)[c]	4.60	33,503	26	14.5	4.52	5.91	1.84	2.68	0.84	4.08	1.27	0.81	0.25	0.00008	0.00003	0.04	0.01
Transit (approx. 12 knots)[d]	14.1	31,412	8	44.2	4.24	18.00	1.73	8.18	0.79	12.43	1.19	2.45	0.24	0.00025	0.00002	0.12	0.01
Crew Boat, 1,200 hp (Transit, approx. 12 knots)[c]	1.2	9,621	28	3.87	1.30	1.64	0.55	0.72	0.24	1.09	0.37	0.21	0.07	0.00002	0.00001	0.01	0.004
Restoration Vessel, 4,800 hp (Station keep/dynamic positioning, DP)[c]	1.2	4,811	14	3.87	0.65	1.46	0.28	0.72	0.12	1.09	0.18	0.21	0.04	0.00002	0.000004	0.01	0.002
Total		**495,546**	**227**	**368**	**66.9**	**150**	**27.3**	**68.2**	**12.4**	**104**	**18.8**	**20.5**	**3.72**	**0.002**	**0.0004**	**1.00**	**0.18**

a. Emissions were based on emission factors for NOx (270 lb/1,000 gal), CO (110 lb/1,000 gal), and VOC (50 lb/1,000 gal) for marine diesels provided by MDEP (Kenneth Santlal); the emission factors for SO2 (76 lb/1,000 gal), PM (15 lb/1,000 gal), and Total HAPs (0.735 lb/1,000 gal) are from Ap-42, Section 3.4 (for large stationary diesel engines). Emission factor for Pb (0.0015 lb/1,000 gal) is assumed to be the same as that for boilers firing residual oil (Ap-42 Section 1.3).

b. Actual fuel consumption (tones/day) estimated by JP Kenny, Inc. based on operational experience.

c. Daily fuel usage (tones/day) based on daily fuel usage data obtained from a 15,600 hp Maersk MSV (offshore support vessel) – 16 metric tons/day for transit at 12 knots, 6 metric tons/day for intra-field (6 knots), 4 metric tons/day for station-deep/DP – scaled down proportional to vessel horsepower.

d. Daily fuel usage (tons/day) based on hourly fuel usage obtained from a 12,000 hp CalDive Witch Queen in transit (12 knots) - multiplied by 24 hours/day.

e. Total fuel consumption in gallons from each source was calculated based on: the actual fuel consumption or usage (tons/day)*(2,200 lb/ton)/(7.88 lb/gal)*(# of days each vessel was used).

Indirect emissions would occur from truck and vehicle traffic associated with the buoy construction (onshore activities). Activities associated with building the small enclosures at Salem and Weymouth are negligible in comparison. Table 4-30 shows emission estimates for NOx, VOC, and CO. The table provides an associated estimate of total vehicle miles traveled (VMT) by the heavy-duty diesel vehicles (HDDVs) and light-duty gasoline vehicles (conservatively assumed to be trucks, LDGTs), based on a conservative assumption of 80 miles per vehicle roundtrip. Emissions per VMT (including exhaust and evaporative emissions) were based on NEG's estimates that were generated from running EPA's MOBILE6.2 emissions model (version 6.2.03) and input data obtained from MDEP. Emissions from construction vehicles would be short-term and would cease after the construction is complete.

Table 4-30

Estimated Indirect Emissions from Onshore Vehicles Used During Port Construction

Activity/Source	HDDV	LDGT	Total
Buoy Construction (trips)			
Construction-related equipment	14		14
1 Crew bus trip/ 2 weeks for 16 weeks	8		8
1 Truck/week of consumables for 16 weeks	16		16
10 Light-duty vehicle (LDV) trips/day for 80 days		800	800
Demobilization	4		4
Total Trips	42	800	842
Conservative assumption of Average Miles/trip	80	80	160
Total Vehicle Miles Traveled (VMT)	3,360	64,000	67,360
Emission Factors - MOBILE6.2 (grams/VMT)			
NOx	9.88	0.70	10.58
CO	2.43	6.75	9.18
VOC	0.47	0.51	0.98
Emission Estimates (tons)			
NOx	0.04	0.05	0.1
CO	0.01	0.48	0.49
VOC	0.002	0.04	0.04

Since virtually all construction emissions for the NEG Port are sea-based, fugitive dust emissions normally associated with land-based construction activities would not occur. Air quality impacts from port construction have been evaluated as part of USCG/MARAD's General Conformity Determination (the draft conformity document was submitted to EPA Region 1 in September, 2006). Further details of the conformity analysis are provided in section 4.10.4.

Since Massachusetts is designated a non-attainment for ozone, a conservative modeling analysis was conducted to evaluate potential impacts to air quality due to NOx (an ozone precursor) emissions that occur during NEG Port construction. The results of this analysis indicate that the construction activity associated with the Project would not cause or contribute to concentrations in excess of the NAAQS.

4.10.2.2 Impacts of Operation

Emissions generated from the NEG Port operations were evaluated based on data provided by NEG in their non-major permit application that was submitted to EPA Region 1 in February, 2006. The air permit application details NEG's proposals for its vessels and boiler design, emission estimates, control requirements and operational restrictions. EPA is currently reviewing this application and will make its determination as to the adequacy of NEG's proposals upon completion of its review. EPA would develop a permit that details the applicable monitoring, recordkeeping and reporting requirements sufficient to ensure the requirements of the permit are enforceable. EPA would issue the draft permit and supporting documentation for public review prior to issuance of the final permit.

The NEG Port operations would result in emissions from stationary and mobile sources, which are discussed below.

Stationary Sources

Emissions generated by NEG Port operation would include stationary source emissions resulting from the regasification of LNG on the EBRVs and navigational emissions (i.e., emissions from the EBRVs and service vessels while maneuvering within 1,640 feet of the buoy). The worst-case impact of the stationary source emissions on air quality was determined using dispersion modeling practices consistent with stationary source regulations.

During regasification, emissions from the EBRVs would be generated from two marine boilers, each rated at 224 million British Thermal units per hour MMBtu/hr, burning natural gas and operating continuously (8,760 hours per year); and one auxiliary diesel generator, 3,650 kilowatts (kW), which would be limited to a total of two weeks per year of possible hours of operation or 336 hours per year. The auxiliary generator is only needed for regasification when a steam generation is off-line. Second generation EBRVs would be equipped with an additional 100 MMBtu/hr (auxiliary) boiler, fired only with boil-off gas or regasified LNG that would enable the vessels to regasify LNG at a higher discharge rate, when such rates are required. NEG's proposed operations would include overlapping deliveries with two EBRVs at the Port up to 10 percent of the time, or for approximately 876 hours per year.

Proposed NEG Port operations would generate emissions of NOx, CO, VOCs, SO_2, $PM_{10}/PM_{2.5}$, and HAPs. Table 4-31 compares the nonattainment new source review (NNSR) and the prevention of significant deterioration (PSD) major source thresholds to the potential to emit (PTE) for the Port. Based on emission estimates shown in the table, stationary emissions are unlikely to exceed major source NSR/PSD thresholds. As part of the development of the applicable CAA preconstruction permit, EPA would evaluate the applicant's proposed air pollution controls and associated compliance monitoring mechanisms to determine whether NEG is appropriately subject to major or minor NSR. It would also review the information about stationary emissions at the Port and develop all applicable CAA permits, which would be available for public review and comment prior to final issuance.

Table 4-31

Comparison of Potential Emissions from Moored EBRVs to NSR/PSD Permit Thresholds (All values expressed in tons per year)

Pollutant	PTE from moored EBRVs	NSR Major Source Threshold[a]	PSD Major Source Threshold[b]
NOx	49	50	100
CO	99	NA (attainment area)	100
VOC	16.1	50	NA (nonattainment area)
SO_2	4.9	NA (attainment area)	100
PM_{10}	20.6	NA (attainment area)	100
$PM_{2.5}$	20.6	NA (attainment area)	100

a Emissions shown for NOx and CO are not potential emissions. Project would limit emissions of NOX and CO to 49 TPY and 99 TPY, respectively by restricting the number of hours per year the boilers would operate at full load (depending on which pollutant is the limiting factor).

b From 310 CMR 7.00, Appendix A

c From 40 CFR 52.21(b)(1)(i); these thresholds apply to fossil-fuel boilers (or combinations thereof) totaling more than 250 MMBtu/hr heat input.

It is anticipated that all NOx and CO emissions from vessels moored at the Port during regasification operations would be limited to 49.0 tpy and 99.0 tpy, respectively, by restricting the number of hours per year the boilers would operate at full load (depending on which of the two pollutants is the limiting factor). Table 4-32 conservatively assumes that emissions of the remaining pollutants (i.e., VOC, SO_2, PM, Pb, and total HAPs) are based on a 100 percent load, 24 hours per day, and 365 days per year; but in actuality, it is anticipated that these emissions would also be restricted to the same annual hours of operation that NOx and CO emissions would be limited to. After EPA and other cooperating agencies complete the “ongoing” permit development process, a final decision would be made on the kinds of operational restrictions the facility should be subject to.

Port operations would include a second EBRV arriving and beginning to regasify LNG before the first EBRV departs. To calculate the potential emissions associated with overlapping deliveries, it was assumed that two EBRVs could be operating simultaneously up to 10 percent of the time, or 876 hours per year. The 876 hours (i.e., 10 percent of the potential 8,760 annual hours) of operations per year from the second EBRV is conservative; in actuality, annual emissions from the second EBRV would be restricted to 10 percent of the same annual hours of operation that NOx and CO emissions would be limited to. As noted before, the operational restriction is subject to EPA’s approval, upon completion of the permit development process.

During regasification operations, EBRV boilers would combust only natural gas, which has negligible sulfur content thereby minimizing emissions of SO_2 and particulates. The EBRV auxiliary generator operation would be limited to a maximum of 336 hours annually and EBRV maneuvering time to and from the buoy would be minimized. NOx emissions from the first generation EBRV auxiliary generators would be controlled to the level specified by MARPOL Annex VI requirements and the second generation EBRV auxiliary generators would be dual fuel fired (approximately 99% of gas and 1% of 0.5% sulfur oil). The diesel fuel combusted in the EBRV generator would be limited in sulfur content to a maximum of 0.5 percent thereby minimizing emissions of SO_2 and particulates. All combustion equipment on the EBRV would be maintained and tuned in accordance with manufacturer’s operation and maintenance recommendations and best management practices.

The applicant has proposed the use of selective catalytic reduction (SCR) as a control measure for NOx emissions on the main and auxiliary boilers of any EBRV (first or second generation) that would be moored at the port. The SCR control technology would be installed with a vendor guaranteed NOx emissions specification of 0.018 lb/MMBtu (15 ppmvd at 15% oxygen, dry basis), which is a 90 percent reduction in NOx emissions when compared to a NOx emission factor of 0.186 lbs/MMBtu from a typical uncontrolled natural gas external combustion engine (see section 1.4 of EPA's AP-42 document). The CO emission factors for the main and auxiliary boilers are based on a conservative 60 ppmvd at 3% oxygen (dry basis). All other emission factors for the main and auxiliary boilers were taken from section 1.4 of EPA's AP-42 document. Total PM emissions from the main and auxiliary boilers were calculated based on total filterable and condensable PM emission factors taken from section 1.4 of EPA's AP-42 document.

Table 4-32

Total NEG Port Potential to Emit Criteria Pollutants

Pollutant	Single buoy with regasification 8760 hr/yr			2nd buoy (10% of 1st buoy) tons/yr	Total Potential[c] tons/yr
	Main boilers (2) tons/year	Aux. boiler[a] tons/year	Aux. generator[b] tons/year		
NOx	35	7.9	16.4	5.9	49
CO	85.8	19.3	4.5	11	99
VOC	10.5	2.4	1.7	1.5	16.1
SO_2[b]	0.9	0.3	3.3	0.4	4.9
$PM_{10}/PM_{2.5}$	14.9	3.3	0.6	1.9	20.6
Pb	9.6E-04	2.2E-04	8.3E-03	9.4E-04	1.0E-02
Total HAP	3.5	0.8	2.3E-02	0.4	4.8

a Conservatively assumes that 2nd generation EBRVs are used essentially entirely

b Conservatively assumes that all 336 hrs of aux. generator operation are from a 1st generation EBRV
c NEG proposes to limit emissions of NOx and CO to 49 TPY and 99 TPY, respectively by restricting the number of hours per year the boilers would operate at full load (depending on which pollutant is the limiting factor). Enforceability of limits is still under review by EPA.

The NOx emission factors for generators on the first generation EBRVs were calculated using the EPA limit (12.1 g/kwh) for marine engines; the remaining emission factors are stationary engine emission factors from section 3.4 of EPA's AP-42 document. Total PM emissions from the auxiliary generators were calculated based on total filterable and condensable PM emission factors taken from section 3.4 of EPA's AP-42 document.

The potential to emit SO_2 from the auxiliary diesel generators assumes the use of 0.5 percent sulfur content diesel oil. Second generation EBRVs would have dual-fuel auxiliary generators that would result in lower emissions because they would burn predominantly natural gas, which is a cleaner fuel.

Because it would be located over 10 nautical miles from shore, no sensitive receptors exist near the proposed NEG Port site. Table 4-33 summarizes the significance criteria (NAAQS and SILs) applicable to the proposed NEG Project.

Table 4-33
Applicable NAAQS and Modeling Significance Impact Levels

Pollutant	Averaging Period	NAAQS (µg/m^3)	Significance Impact Level (µg/m^3)
SO_2	Annual[a]	80 (0.03 ppm)	1
	24-Hour[b]	365 (0.1 ppm)	5
	3-Hour[b]	1,300 (0.5 ppm)	25
PM_{10}	Annual[a]	50	1
	24-Hour[b]	150	5
CO	8-Hour[b]	10,000 (9 ppm)	500
	1-Hour[b]	40,000 (35 ppm)	2,000
NO_2	Annual[a]	100 (0.05 ppm)	1
$PM_{2.5}$	Annual[a]	15	NA
	24-Hour[b]	65	NA

a. arithmetic mean not to exceed standard

b. standard not to be exceeded more than once per year. Background concentration represents the highest second high concentration measured in the Project area

Air quality dispersion modeling was performed using the Offshore and Coastal Dispersion (OCD) model to calculate the impact of vessel emissions during regasification operations relative to the NAAQS, PSD, and SIL. The OCD model accounts for over-water transport and dispersion and shoreline effects, and sea breeze and fumigation. A summary of the OCD modeling results is presented in Table 4-34. The modeling results indicate that the proposed NEG Port would not exceed NAAQS, SIL or PSD thresholds and that the maximum predicted Project impact concentrations for CO, PM_{10}/$PM_{2.5}$ and NO_2 are less than corresponding SILs. The worst case impact occurs at a distance of 500 meters from the Project. Emissions from mobile sources, including emissions from the EBRV in transit, offshore service vessels, crew boat and testing of the emergency lifeboats, were not input into the model as their impact was judged to be insignificant based on their relative emissions.

Table 4-34
Results of OCD Modeling

Pollutant	Avg. Period	Significant Impact Levels ($\mu g/m^3$)	Max. Project Impact ($\mu g/m^3$)		Multisource Modeling Impact - Max. Conc[c]. ($\mu g/m^3$)	Max. Back ground Conc. ($\mu g/m^3$)	Max. Total Impact ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
			500 m Receptors	100 & 300 m Receptors				
PM_{10}[a]	24-Hour	5	4.9	4.3	(a)	69	73.9	150
	Annual	1	0.4	0.4	(a)	30	30.4	50
$PM_{2.5}$[b]	24-Hour	NA	4.9	4.3	(b)	54	58.9	65
	Annual	NA	0.4	0.4	(b)	13.4	13.8	15
NO_2	Annual	1	0.56	0.47	2.2	23	25.2	100
CO[a]	1-Hour	2,000	160	154	(a)	3,200	3360	40,000
	8-Hour	500	67	104	(a)	1,889	1,956	10,000

[a] Multisource modeling is not required for NO_2, PM_{10}, and CO impacts because the facility was below PSD modeling significance levels. However, multi-source modeling was conducted for NO_2
[b] No SIL has been established for $PM_{2.5}$. Project impact concentrations plus ambient background are less than NAAQS demonstrating compliance.
[c] Includes proposed Project impact

Results of modeling conducted by the applicant was reviewed to verify proper application of the model, correct representation in the model input files of source parameters and emission rates, and correct representation of model results in the summaries presented in the application (and displayed in Table 4-34). Additionally, meteorological input files provided by the applicant were reviewed to ensure that these input parameters were within expected ranges. Model runs were duplicated in order to assist in this review. Based on this review, a number of conservative assumptions by the applicant were noted but these tended to result in an overstatement of Project impacts and do not affect the conclusions.

The Chatham station was selected because it is the best available upper air station that closely approximates over-water conditions, because the station is located on the shoreline of Stage Harbor with Chatham Harbor surrounding it on approximately three sides. The mixing heights were calculated with standard EPA processors that use the Holzworth method to calculate twice-daily mixing heights, which were then interpolated to create hourly values. Since the over-water boundary layer is considerably different from the boundary layer over land, mixing heights calculated by the Holzworth method may not be representative of overwater conditions. In particular, afternoon mixing heights over water do not attain the depths achieved over land since strong convective activity due to heating of the ground surface does not occur over water. A sensitivity study designed to explore this issue was conducted. The meteorological files for all five years were modified to limit the mixing height during any hour to no more than 500 meters (the default for OCD). Receptor locations were added at distances of 100 and 300 meters from each source location, every 10 degrees for a total of 72 new receptors, and the model re-run for these receptors. The runs included all five years of meteorology and five source operational scenarios, for PM, CO and NOx emissions. The results of this modeling continue to show that maximum impacts would all be less than the SILs established for these pollutants. The concentration results for distances at 100m and 300m are less than that for the 500m due to the taller stacks with exhaust temperatures high enough to cause plume rise high enough that smaller concentrations are predicted at shorter distances than farther away. No further air quality analysis is therefore required.

OCD was run again with the modified files, and maximum concentrations were compared to maximum concentrations predicted using the unmodified files. For all pollutants and all years, maximum concentrations did not change due to the change in mixing heights. This is a reflection of the fact that all of the point sources modeled in this analysis have relatively short stacks and are subject to downwash. This causes maximum impacts to occur very close to the stack, a situation where the value of the mixing height has less of an effect on concentration than at points further downwind where plumes are more dispersed. Therefore the Chatham mixing heights are appropriate for use in this analysis.

Final impacts of operation emissions to air quality will be determined by EPA and other cooperating agencies after conducting modeling analyses associated with its “ongoing’ pre-construction permit development process to evaluate NAAQS compliance and ensure its consistency with Massachusetts SIP requirements.

EPA will also determine the applicable federal and state air pollution control requirements during the development of the preconstruction permit.

Mobile Sources

While underway (to and from) and maneuvering within the safety zone, EBRV boilers would be running on residual oil instead of gas. The only support vessel assistance required would be one trip by a diesel-powered OSV. While EBRVs would not be entering state territorial waters, each EBRV would be expected to be maneuvering for a few hours within the Safety Zone for each berthing, and Massachusetts inventories emissions of NOx, CO, and VOC within 25 miles from the ports. Total fuel usage for the boilers is estimated to be 500 gal/hr and would be equivalent to that required for an hour an a half of operation at approximately 50 percent (or 75 MMBTu/hr) of normal load (normal load per boiler is 150 MMBtu/hr). During maneuvering/mooring within the Safety Zone, total fuel usage per boiler is estimated to be 200 gal/hr for three hours of operation at approximately 20 percent (30 MMBtu/hr) of normal load. Emission factors for oil firing are those used by MDEP in developing its commercial marine vessels (CMV) emission inventory (i.e., NOx = 55.8 lb/10^3gal, VOC = 0.7 lb/10^3gal and CO = 3.5 lb/10^3gal). Emission estimates of EBRVs moving to/from Safety Zone are based on the emission factors and on the approximate fuel usage per boiler. Emission estimates of OSVs (conservatively rated at 3,500 hp) are based on the diesel engine’s fuel usage of 240 gal/day and 65 moorings per year. OSV emission factors for NOx (270 lb/10^3gal), VOC (50 lb/10^3gal), and CO (110 lb/10^3gal) are from MDEP emission factors for diesel-powered CMV 18 feet or longer, underway.

Aside from emissions from navigational activities (EBRV boilers and OSV diesel engines) mentioned above, the only other emissions sources subject to conformity onboard each EBRV (both first generation and second generation) would consist of**:**

- A small incinerator used for routine disposal of trash and sludge, rated for 730,000 kcal/hr (2.9 MMBtu/hr), that would run for approximately 60 minutes each day;
- A lifeboat (two 29 hp engines) and rescue boat (one 144 hp engine), each of which would be fueled with marine fuel oil and would have its engines tested once per week for approximately 30 minutes;
- An inert gas generator that would only be used within 25 miles of shore for training, maintenance or emergency operations for approximately one (1) hour per month, and then only if such training and maintenance has not been done at sea; and

- Breathing losses from ten storage tanks for marine fuel oil and waste oil (total capacity 8,344 m^3 (2.2 million gallons).

Incinerator emissions are based on an average heating value of 2,020 kcal/ kg for food waste, rubbish, and sewage sludge, and on emission factors from section 2.1 of EPA's AP-42 document. Engine testing emissions from the lifeboat and rescue boat are based on a total weekly energy output of approximately 1,000 kWh and on the same emission factors used for the auxiliary generators on the first generation EBRVs. Inert gas generator emissions are based on a generation rate of 8,844 scfm at 20º C (converted from 14,000 nominal cubic meters (Nm^3/hr) at 0º C to scfm at 20º C) and on vendor guaranteed NOx and CO emission factors of 65 ppmv (4.12 lb/hr) and 100 ppmv (3.85 lb/hr), respectively. There is no specification for VOCs, but it is expected that VOC emissions would be less than CO emissions. Breathing losses (VOC emissions) from the ten storage tanks are very minor, primarily because the volatility of the oil is so low. Emissions calculated using EPA guidance are less than 5 lbs/yr.

Table 4-35 summarizes all emissions from navigational / maneuvering activities and other minor sources onboard each EBRV. The inclusion of these navigational emissions in the conformity analysis is considered to be conservative, since all support vessel emissions are assumed to be occurring in the safety zone, whereas in actuality some of the support vessel emissions would occur in federal waters between the state territorial boundary and the safety zone.

Table 4-35

Estimated Emissions from Navigational Activities and Other Sources Onboard the EBRVs

	Navigational Activities[a]			Other Sources			
Pollutant	EBRV travel to/ from safety zone tons/year	EBRV maneuvering in safety zone tons/year	OSV emissions tons/year	Incinerator emissions tons/year	Engine testing emissions tons/year	Inert gas generator emissions tons/year	Fuel oil evaporation tons/year
NOx	2.7	1.8	2.1	0.2	0.69	0.02	0
CO	0.2	0.1	0.9	1.5	0.19	0.02	0
VOC	3.90E-02	1.60E-02	0.4	1.1	0.07	<0.02	<0.0025
SO_2	26.8	17.9	0.6	0.2	negligible	negligible	0
$PM_{10}/PM_{2.5}$	2.2	1.5	0.1	1.1	negligible	negligible	0
Pb	7.40E-05	4.90E-05	1.20E-05	negligible	negligible	negligible	0
Total HAP	negligible[b]	negligible[b]	5.70E-03	negligible	negligible	negligible	negligible

[a] Based on 65 moorings per year. Fuel sulfur content is assumed to be 4.5% by weight (MARPOL maximum) for EBRV travel/maneuvering and 0.5% weight for the OSV (conservative; US EPA standard for marine navigation vessels would be 500 ppm = 0.05% in 2007).

[b] Emission factors for Total HAP were not calculated; the composite emission factors are not readily available, and it is clear from the magnitude of the VOC and PM emissions that these could not be large.

Because only stationary source pollutants are regulated under NSR, the emissions from the navigational and other sources (e.g., incinerator, engine testing etc) presented in Table 4-35 are not subject to NSR/PSD. The impacts of these navigational and other source emissions within state territorial waters and within a 500-meter Safety Zone around the buoys have been evaluated for purposes of determining conformity with the Massachusetts SIP in section 4.10-4.

Emissions from navigational activities and other sources were not included in the modeling analysis because these emissions are relatively minor when compared to EBRV emissions generated during regasification (i.e., NOx emissions of 7.5 tpy from navigational and other sources vs. 49 tpy from the EBRV regasification used in the modeling). As the modeled NO_2 emissions from regasification are well below the SIL for NO_2 (1µg/m^3), the addition of these minor operational sources to the modeling is not expected to result in total NO_2 levels over the SIL. Furthermore, if the inclusion of the navigational and other sources in the model did cause an exceedance of the SIL and required multi-source modeling of NO_2 (Table 4-34) indicates that the total ambient concentration of NO_2 from the multi-source modeling is significantly below the NAAQS. Based on the information above, impacts to air emissions during NEG Port operation is expected to be minor.

4.10.2.3 Impacts of Decommissioning

NEG Port decommissioning would result in comparable emissions to those described for the construction process.

4.10.2.4 Impacts of Alternatives

Foundation Alternative

Other anchoring alternatives offer no benefit to air quality.

Alternate Port Location

Location 2 would offer no benefit to air quality. Both port locations are far enough out to sea that the concentrations over land are expected to be minor for either location.

Vaporization Alternative

The open-loop STV alternative would offer direct long-term minor beneficial effect to air quality because, unlike the proposed closed-loop STV system, it does not require burning natural gas (at a rate of 0.56 MMscf/hr per NEG's continuous regasification rate of 800 MMscfd; based on 0.07 MMscf/hr per 100 MMscfd rate) to generate heat needed for vaporizing the LNG. This vaporization alternative generates no emissions during LNG vaporization because it uses considerable volumes of warm seawater as a heat source to vaporize the LNG. Since the impacts modeled for the higher emissions associated with the proposed closed-loop option were not above significance limits, the emissions from the open-loop alternative would be either. No major improvement in air quality would be expected from using the open-loop vaporizer alternative.

Construction Schedule Alternative

From an Air Quality perspective, there is no difference between the alternative construction schedules.

4.10.3 NEG Pipeline Lateral

4.10.3.1 Impacts of Construction

Emissions from construction activities would be temporary in nature. NEG Pipeline construction would involve a DSV, crew/supply vessel, tugs and barges, and a support vessel over the course of approximately seven months construction period (see section 2.1.2.2 for a detailed description of pipeline construction) that would result in emissions to the air from these diesel engines. Table 4-36 summarizes maximum short-term emissions (in pounds per hour) and total construction phase emissions (in tons per year) for the pipeline construction and support operations. NOx, CO, and VOC emissions were calculated based on emission factors provided by

MDEP. Emissions of other pollutants were based on EPA's AP-42 emission factors. Total fuel consumption for all vessels was estimated by the construction management contractors, based on previous experience and fuel usage information obtained from marine companies and boat crews used on past projects. The maximum short-term emissions listed are conservative since they are based on the sum of maximum hourly emissions for each engine. It is unlikely that all construction and support equipment would be operating simultaneously at any time.

TABLE 4-36
Estimated Emissions from Vessels Involved in Pipeline Lateral Construction

Operations/ Source	Total horse power (Hp)	Actual Hourly Fuel Use (gal/hr)	Actual Yearly Fuel Use (gals/yr)	NOx		CO		VOC		SO_2		$PM_{10}/PM_{2.5}$		Pb		Total HAPs	
				lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
Diving Support Vessels (73% of days are in state waters)	12,400	180	505,920	48.6	68.3	19.8	27.8	9.0	12.6	13.7	19.2	2.7	3.8	0.0003	0.0004	0.13	0.19
Pipelay and Pipe Burial Vessels (78% of days are in state waters)	46,185	958	993,840	258.6	134.2	105.4	54.7	47.9	24.8	72.8	37.8	14.4	7.5	0.0014	0.0007	0.70	0.37
Survey Vessels (78% of days are in state waters)	1,638	110	277,200	29.7	37.4	12.1	15.2	5.5	6.9	8.4	10.5	1.7	2.1	0.0002	0.0002	0.08	0.10
Tremie Vessels (50% in state waters - one pipeline end is in state waters and one is in federal waters)	9,185	330	166,980	89.0	22.5	36.3	9.2	16.5	4.2	25.1	6.3	4.9	1.3	0.0005	0.0001	0.24	0.06
Total (federal & state waters)	***69,408***	***1,577***	***1,943,940***	***425.9***	***262.4***	***173.5***	***106.9***	***78.9***	***48.6***	***119.9***	***73.9***	***23.7***	***14.6***	***0.0024***	***0.0015***	***1.16***	***0.71***
Total in state waters	**69,408**	**1,577**	**1,444,223**	**304.9**	**195.0**	**124.2**	**79.4**	**56.5**	**36.1**	**85.8**	**54.9**	**16.9**	**10.8**	**0.0017**	**0.0011**	**0.83**	**0.53**

Indirect emissions would occur from onshore truck and vehicle traffic associated with the pipeline construction. Table 4-37 shows emission estimates for NOx, VOC, and CO. The table provides an associated estimate of total vehicle miles traveled (VMT) by the heavy-duty diesel vehicles (HDDVs) and light-duty gasoline vehicles (conservatively assumed to be trucks, LDGTs), based on a conservative assumption of 80 miles per vehicle roundtrip. Emissions from construction vehicles would be short-term and would cease after the construction is complete.

Table 4-37

Estimated Indirect Emissions from Onshore Vehicles Used During Pipeline Construction

Activity/Source	HDDV	LDGT	Total
Pipeline/ Flowline Construction (trips)			
Sand hauling	650		650
2 Crew bus trips/ week for 39 weeks	78		78
1 Truck/week of consumables for 39 weeks	39		39
10 Light-duty vehicle (LDV) trips/day for 210 days		2,100	2,100
Demobilization	4		4
Total Trips	771	2,100	2,871
Conservative assumption of Average Miles/trip	80	80	160
Total Vehicle Miles Traveled (VMT)	61,680	168,000	229,680
Emission Factors - MOBILE6.2 (grams/VMT)			
NOx	9.88	0.70	10.58
CO	2.43	6.75	9.18
VOC	0.47	0.51	0.98
Emission Estimates (tons)			
NOx	0.67	0.13	**0.80**
CO	0.17	1.25	**1.42**
VOC	0.03	0.09	**0.13**

NEG Pipeline construction would be spread over approximately seven months in 2007. Pipeline construction would be sea-based and would take place far from any residences or businesses. As a result, fugitive dust emissions normally associated with construction activities would not occur. It is anticipated that the impact of the construction emissions at any individual location would be minor given the mobile nature of pipeline construction and the expected short duration of activity at most locations. Impacts to air quality from pipeline construction are further discussed in section 4.10.4 for conformity determination purposes and consistency with Massachusetts' SIP.

A conservative modeling analysis was conducted to evaluate potential impacts to air quality due to NOx emissions that occur during NEG Port and Pipeline Lateral construction. The construction activity associated with the Project would occur over water and hence the OCD dispersion model, as described in section 4.10.2.2, was used for this analysis with the same meteorological inputs as the operational phase modeling. The construction activity includes the construction of the port and lateral pipeline. The pipeline sources were modeled as a series of point sources (a total of 12 points) located along the path of the pipeline, while the port sources were modeled as two point sources. All the sources were modeled using conservative stack parameters, (as shown in Table 4-38) namely, a stack height of 10 meters, diameter 1.0 meter, temperature 300 degrees Kelvin (K), and exit velocity 5.0 meters/second. The total emissions from the pipeline construction activity (262.4 tons) were distributed among the twelve point sources, while the port emissions (66.9 tons) were distributed evenly between the two buoy locations. The receptor grid for this modeling included two sets of receptors: a rectangular grid at a spacing of 2 kilometers (km) and a polar grid around each modeled source. The polar receptor grid included three rings at distances of 1.0 km, 1.5 km, and 2.0 km around each point source. Only receptors which were at distances of greater than 500 meters from all point sources were included in the modeling analysis. The location of the sources and the receptors is shown in Figure 4-11.

Table 4-38
Summary of Inputs Used for OCD Modeling

(a) Stack Parameters		
Stack Height	10	m
Stack Diameter	1	m
Exit Velocity	5	m/s
Temperature	300	K
(b) Emissions		
Number of Point Sources along Pipeline	12	
Emission Rate for Pipeline Construction Sources	262.4	tpy
Emissions per Pipeline Point source	21.867	tpy
	0.629	**g/s**
Number of Point Sources at Port (Buoy)	2	
Emission Rate for Port Construction Sources	66.9	tpy
Emissions per Buoy	33.45	tpy
	0.962	**g/s**

The maximum annual NO_2 impacts from construction sources over all years modeled and all receptors is 4.53 micrograms per cubic meter ($\mu g/m^3$). This result is greater than the Massachusetts SIL for NO_2 (1 $\mu g/m^3$). A cumulative modeling analysis was conducted that evaluated impacts due to NO_x sources within 57 km of the Project site. Based on that cumulative modeling analysis, the maximum NO_2 cumulative impact was 2.22 $\mu g/m^3$, while the background monitored concentration was 22.6 $\mu g/m^3$. The combined impact of the construction emissions (4.53 $\mu g/m^3$), the background concentration (22.6 $\mu g/m^3$), and the maximum impact of other modeled sources (2.22 $\mu g/m^3$) is 29.35 $\mu g/m^3$, which is significantly below the NAAQS for NO_2 (100 $\mu g/m^3$). Hence, the construction activity associated with the Project would not cause or contribute to concentrations in excess of the NAAQS.

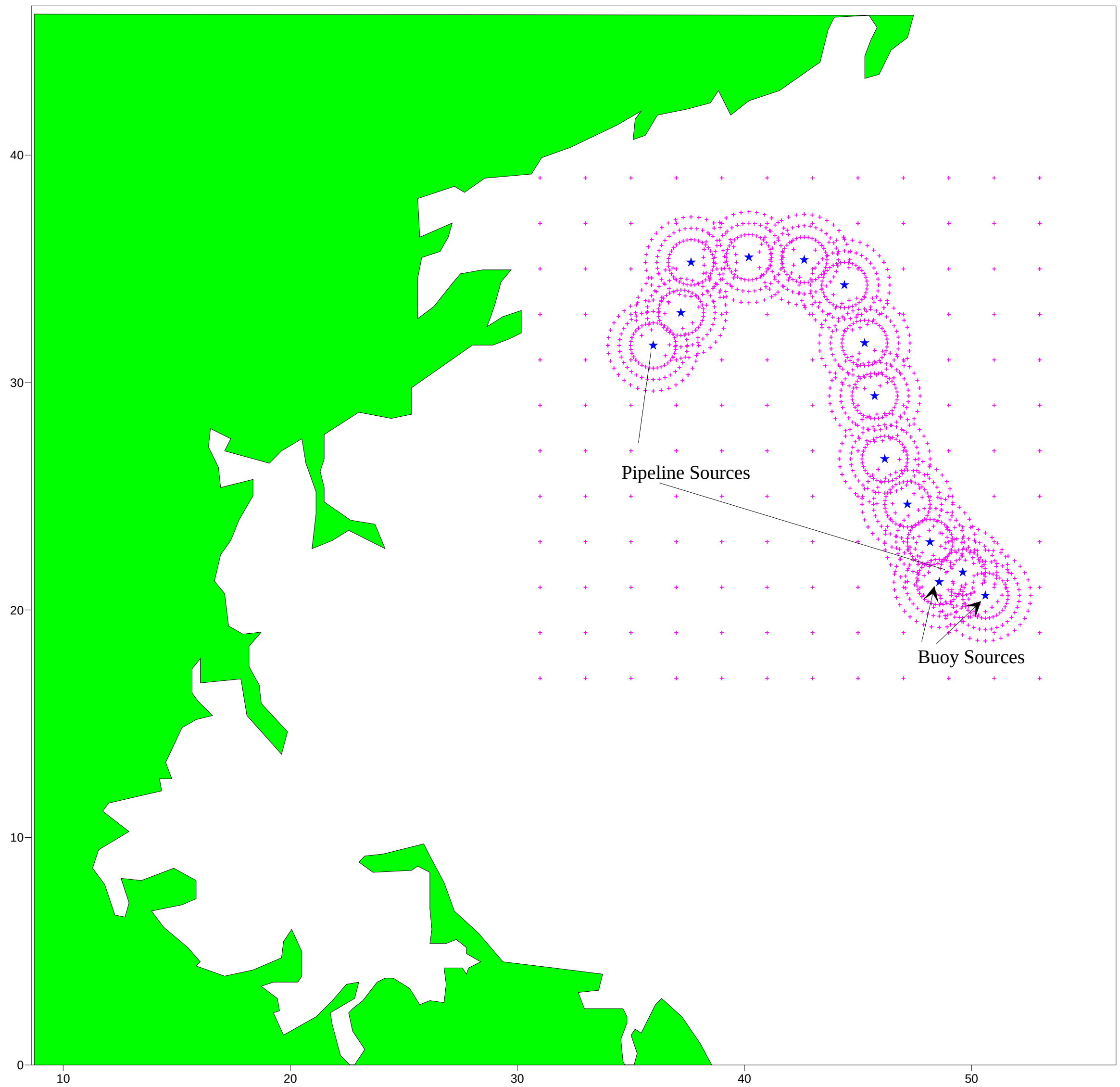

Figure 4-11. Location of Point Sources and Receptors Used for OCD Modeling

4.10.3.2 Impacts of Operation

The only air emissions that would be associated with Pipeline Lateral operation would result from operation of new natural gas-fired heater, with a maximum energy input capacity of about 5 MMBtu/hr that would be installed at the Weymouth Meter Station. Operation of the Pipeline Lateral itself would not produce air emissions. The heater would supplement the existing heating capacity provided by a 9.5 MMBtu/hr natural gas-fired heater.

Emissions estimates of criteria pollutants and total HAPs for the existing and proposed heaters are provided in Table 4-39. Based on emission estimates shown in the table, the addition of a new heater at Weymouth Meter Station would not cause the existing station source to exceed any major source NSR/PSD thresholds (i.e., 50 tpy of NOx or VOCs, or 100 tpy of any PSD pollutant). Therefore, impacts to air quality from NEG pipeline operation are expected to be minor. The new heater at the Weymouth station, would require a minor source permit from MDEP.

Table 4-39

Potential Emissions from Natural Gas-Fired Heaters

Description	Emission Estimates (lb/hr)						Total Emission Estimates (tons/yr)					
	NO_x	CO	VOC	SO_2	PM_{10}	HAP	NO_x	CO	VOC	SO_2	PM_{10}	HAP
Existing Heater												
Weymouth Meter Station	0.93	0.78	0.05	0.006	0.071	0.020	4.1	3.4	0.22	0.020	0.31	0.07
Proposed Heater												
Weymouth Meter Station	0.49	0.41	0.03	0.003	0.040	0.009	2.1	1.8	0.12	0.013	0.16	0.04
Total Emissions	1.43	1.19	0.08	0.009	0.110	0.029	6.2	5.2	0.34	0.033	0.47	0.11

[a] Emission factors used to generate these emissions were taken from EPA's AP-42 publication (Section 1.4), assuming 1,020 Btu/cf natural gas.

[b] Annual emissions for the proposed and existing heaters are potential emissions for 5 MMBtu/hr and 9.5 MMBtu/hr respectively, of heat input capacity operating at 100% load for 365 days/year.

4.10.3.3 Decommissioning Impacts

At decommissioning, the offshore pipeline would be capped and abandoned in-place. Minimal to no air emissions would be anticipated to be generated by abandonment activities.

4.10.3.4 Impacts of Alternatives

Alternate Pipeline Routes

Pipeline route alternatives 1 and 2 offers no beneficial effect to air quality over the proposed route. Pipeline route 3 would have a direct, short-term, minor adverse effect to air quality. This alternative is shorter, but would traverse more complex substrate. Route 4 contains no hard bottom whereas the Route 3 corridor contains up to 5 percent hard bottom that would require blasting to achieve desired depth. Because of the bottom conditions along route 3, additional marine construction equipment for blasting and dredging would be required for construction, which would cause more air emissions. The more difficult construction along Route 3 would also increase the duration of the construction period, which would ultimately result in increased air emissions over a longer time period. From an air quality perspective, the alternate route 3 would produce impacts of greater magnitude than route 4.

4.10.4 Conformity

A conformity determination must be conducted by a federal agency (in this case USCG) if a federal action is likely to generate direct and indirect emissions that would exceed the conformity threshold levels of the pollutant(s) for which an air basin is designated nonattainment or is currently a maintenance area (40 CFR 93). According to the conformity regulations, emissions from sources subject to major NSR or PSD permits or requirements are exempt and are deemed to have conformed. Massachusetts does not have its own EPA-approved general conformity regulations; therefore it refers to EPA's federal general conformity regulations under 40 CFR 93.

Eastern Massachusetts) is currently designated a "moderate nonattainment area" for 8-hour ozone standard and some communities in the Boston area are maintenance areas for CO.

The whole of Massachusetts is also located in the ozone transport region (OTR). The Project region is in attainment for all other criteria pollutants. The NEG Project area is at sea and is not a maintenance area for CO; therefore, CO emissions at sea are exempt from conformity determination. Therefore, a conformity determination is required only if NOx or VOC (ozone precursors) emissions exceeds federal conformity applicability thresholds. The conformity applicability threshold for the NEG Project area is 100 tpy of NOx and 50 tpy of VOC emissions. For conformity applicability purposes, it is anticipated that neither the proposed onshore gas heater at Weymouth nor the EBRV boilers would be subject to major source permitting, and as a result, should be included in the conformity analysis. The inclusion of emissions from these "anticipated, non-major sources" to the conformity applicability are not yet final and solely dependent on the outcome of EPA and MDEP's ongoing permit development process. Table 4-40 summarizes total NOx and VOC emissions, which are expected to be subject to conformity.

Table 4-40
Total NOx and VOC Emissions Subject to Conformity

	2007					2008 and Beyond		
	Construction		Operation		Total Emissions in 2007 (tpy)	Operation		Conformity Applicability Thresholds (tpy)
Pollutant	Activity	Emis-sions (tpy)	Activity	Emis-sions (tpy)		Activity	Emis-sions (tpy)	
NOx	Port	66.9	Port regasification	4.08	71	Port regasification	49	
	Pipeline	195	Navigational Activities	0.55	196	Navigational Activities	6.61	
	Port onshore vehicles	0.1	Other sources onboard the EBRVs	0.08	0.18	Other sources onboard the EBRVs	0.91	
	Pipeline onshore vehicles	0.8	Proposed Onshore Gas Heater	0.18	0.98	Proposed Onshore Gas Heater	2.1	
	Total	**262.8**	**Total**	**4.9**	**268**	**Total**	**59**	**100**
VOC	Port	12.4	Port regasification	1.34	13.7	Port regasification	16.1	
	Pipeline	36.1	Navigational Activities	0.04	36.1	Navigational Activities	0.45	
	Port onshore vehicles	0.04	Other sources onboard the EBRVs	0.1	0.14	Other sources onboard the EBRVs	1.2	
	Pipeline onshore vehicles	0.13	Proposed Onshore Gas Heater	0.01	0.14	Proposed Onshore Gas Heater	0.12	
	Total	**48.7**	**Total**	**1.49**	**50.2**	**Total**	**18**	**50**

As shown in Table 4-40, total NOx and VOC emissions would exceed the conformity applicability thresholds during the 2007 calendar year. In 2008 and beyond, both NOx and VOC emissions during operations would be below the conformity applicability thresholds. The emissions from the construction and operational activities in 2007 require that a conformity determination be made for NOx and VOCs. The USCG is working with EPA to develop a General Conformity Determination document. At this time NEG has made the necessary commitments to demonstrate conformance with the SIP for eastern Massachusetts. Specifically, the Project appears to comply with the control measures and regulations in the SIP, and NEG has committed to fully offset its NOx and VOC construction emissions through the purchase of certified emission reduction credits (ERCs) in accordance with 40 CFR 52.858(2) and 40 CFR 93.158(a)(2).

4.10.5 Mitigation and Minimization – Air Quality

The following measures have been proposed as potential measures for mitigating and/or minimizing impacts to air quality.

- NEG would obtain a CAA pre-construction permit prior to commencement of NEG Port construction.
- NEG would apply for a Title V operating permit within 1 year of commencement of operation
- Construction of the Project would result in emissions from fuel combustion from marine vessels employed during the construction phase. Emissions would be minimized through the operation and maintenance of the marine engines in accordance with recommended manufacturer operation and maintenance procedures.
- Fuel combustion sources would result in emissions of NOx and CO, and, to a lesser extent, emissions of VOCs, SO_2, and particulate matter. During the vaporization process, the boilers would be fired by natural gas only. The SCR would be equipped with low NOx burners (SCV) to minimize emissions of NOx, CO, and VOCs. Potential annual emissions would be limited by a fuel use restriction.
- Vessel emissions of NOx are above the General Conformity thresholds applicable to the Project area. NEG would obtain emission reduction credits as mitigation.
- The power generation engines would supply electrical power for the vaporization process. Potential emissions would be based on use of natural gas (>99%) with a small amount (<1%) of diesel pilot fuel and an SCR and oxidation catalyst to control NOx and CO/VOC emissions.

FERC staff recommends that:

- **Prior to construction**, NEG should provide to the Coast Guard staff for review and approval a full air quality analysis identifying all mitigation requirements required to demonstrate conformity and submit detailed information documenting how the Project would demonstrate conformance with the applicable SIP in accordance with Title 40 CFR Part 51.858. The documentation should address each regulatory criteria listed in Part 51.858; provide a detailed explanation as to whether or not the Project would meet each requirement; and for each criteria being satisfied, provide all supporting information on how the Project would comply. Should any element of the Project change substantially, NEG should resubmit the aforementioned information so that Coast Guard staff may determine the Conformity of the revised action.
- **Prior to construction**, Algonquin file documentation with the Secretary of the Commission that confirms Coast Guard staff's review and approval of the Project's air quality analysis and identifies all mitigation requirements required to demonstrate conformity with Title 40 CFR Part 51.858.

4. 11 NOISE

This section discusses potential impacts from noise sources that are above the water. Underwater sound and its impacts are discussed in sections 4.2 and 4.3.

At any location, both the magnitude and frequency of environmental noise could vary considerably throughout the construction or operation period of the proposed NEG Project based in part by changes in sound energy generated by the source, weather conditions as well as other conditions affecting the transmission and attenuation of sound.

4.11.1 Evaluation Criteria

There are no federal, state, or local noise control regulations specifying above or below water decibel limitations that apply to the Project. However, there are guidelines and policies that can be used as a guide in evaluating the potential for impact.

U.S. Environmental Protection Agency

The EPA identifies 55 dBA L_{dn} as the suggested noise level required to minimize adverse effects on outdoor activity interference (EPA, 1974).

Massachusetts State Regulation

Noise in Massachusetts is regulated by the MDEP under 310 CMR 7.10, which prohibits unnecessary emissions of sound. A noise source is considered to be in violation of the State's noise code if the source:

- increases the broadband sound pressure level by more than 10 dBA above ambient; or
- produces a "pure tone" condition – when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.

MDEP policy defines ambient as the A-weighted L_{90} during equipment hours. The criteria apply at both the property line and the nearest inhabited residence. The policy does not apply to construction activities and does not apply to portions of the Project outside of the Massachusetts territorial limit.

4.11.2 NEG Port

4.11.2.1 Impacts of Construction

As indicated in section 4.10.2, construction of the NEG Port would involve a diesel-powered AHV, DSV, and restoration vessel, as well as weekly trips by a crew boat, over the course of approximately seven months. Broadband source levels for the four types of NEG Port construction vessels are expected to range from approximately 150 to 190 dB re 1 μPA at 1 meter. Operation of the thrusters used to dynamically position the larger vessels could increase sound source levels by an additional 5 to 10 dB.

Construction equipment would be operated on an as-needed basis during the construction period and would include the use of engine mufflers and acoustical enclosures as necessary to help reduce sound during construction. Based on the information above, impacts to noise quality from the NEG Port construction are expected to be minor and short-term.

4.11.2.2 Impacts of Operation

NEG developed sound source data for Port operation based on measurements that were taken during the first regasification and offloading operation for the Excelsior EBRV at the Gulf Gateway site in the Gulf of Mexico. Operational in-air sound power levels ranged from 112 dBA off the stern to 118 dBA off the starboard as shown in Table 4-41.

Table 4-41
Summary of In-Air EBRV Sound Power Levels (L_w)

Sound Power Levels (Lw) (dB re 10^{-12} watts)	Starboard	Port	Stern	Bow
Broadband dB(A)	118	115	112	113
Broadband dB(L)	123	125	125	123
Octave Band (dB)				
31.5 Hz	119	122	120	119
63 Hz	116	119	122	116
125 Hz	110	115	115	115
250 Hz	110	113	109	110
500 Hz	111	113	110	110
1000 Hz	114	110	107	108
2000 Hz	112	107	101	105
4000 Hz	108	100	96	98
8000 Hz	96	91	87	88
16000 Hz	77	80	73	78

The in-air acoustic model run by NEG assumed one EBRV docked and performing normal regasification and offloading operations. If two EBRVs were offloading during the same time period, the acoustic results would increase by a maximum of 3 dB, which represents a doubling of the net acoustic energy. The total broadband sound level onshore, assuming two EBRVs are offloading, would range from -5 to 4 dBA, depending on receptor location and the orientation of the EBRV. Based on the modeling analysis for the worst case with two EBRVs offloading simultaneously, sound energy at all frequencies would be below the threshold of human hearing and well below existing baseline levels. As a result, Port operation would not anticipate creating any audible sound onshore.

4.11.2.3 Impacts of Decommissioning

Noise generated during decommissioning of the NEG Port would not be audible to onshore or nearby receptors. Its impact would be comparable to the noise created during facility construction.

4.11.2.4 Impacts of Alternatives

Alternate Port

Location 2 offers no beneficial effect to noise quality. Since the same activities would occur at either Port site regardless of location, there would be no difference in noise impacts between the two Port locations.

Alternative Anchor Systems

From a noise perspective, any impacts associated with anchor noise would be limited to the construction phase of the Project and, consequently short-term in duration. Although there may be slight differences in construction equipment between the two anchor systems and the noise generated by that equipment, the difference is not considered major. The drilled and grouted pile anchor alternative would produce a direct short-term minor adverse effect to noise receptors.

Vaporization Alternative

No large scale decrease in in-air sound levels is expected between the two STV technologies, as this is not the dominant sound source.

4.11.3 NEG Pipeline Lateral

4.11.3.1 Impacts of Construction

Pipeline construction would occur from 4-10 miles off the Massachusetts coastline, except for the minor modifications at the existing aboveground metering facilities in Weymouth and Salem. Offshore construction equipment would include a lay barge, plow barge, anchor handling tug vessels, supply vessels, crew transport vessels, survey equipment, and diving boats and crews (section 2.1.2.2 provides a more detailed description of pipeline construction activities). The proposed temporary construction activities would not significantly increase the ambient noise levels of Massachusetts Bay since vessels commonly transit the area where Pipeline construction would occur.

The onshore aboveground activities associated with pipeline construction are also not anticipated to adversely affect sensitive receptors in the vicinity of Project facilities. The proposed modifications to the two meter stations are minor and would occur at existing facilities. Areas used for the offloading of construction materials for marine construction activities would be located in existing industrial and/ or commercial sites. While certain noise created during modification of the meter stations may exceed ambient levels, the incidents would be of short-term duration and would have no long term effects on the surrounding area. Noises created at offloading locations are not expected to exceed that of normal ambient area sounds because the offloading locations would be located in existing industrial and/or commercial areas. Construction equipment would be operated on an as-needed basis during this period and maintained to the manufacturer’s specifications in order to minimize noise impacts. The use of engine mufflers and acoustical enclosures would be employed as necessary to help reduce sound during construction. Based on the information above, impacts to noise quality from the NEG Pipeline construction are expected to be minor and short-term.

4.11.3.2 Impacts of Operation

The Pipeline Lateral would be buried beneath the sea floor in deepwater areas of Massachusetts Bay and would not generate any noise that would affect onshore receptors. There would be no noise increase at the Salem Meter Station, where the scope of work involves the installation of a reverse flow meter similar to the existing facilities.

Algonquin proposes to install a new heater at the Weymouth Meter Station that would be much smaller than the existing heater. The existing 9.5 MMBtu heater, with a noise-reduction burner, produces approximately 81 dBA at 3 feet (based upon information submitted by the vendor), which correlates to about 61 dBA at the Weymouth site fence. The new unit would have about one-half the Btu output of the existing unit, which the vendor indicates would require only one burner instead of the two burners in the existing unit. As a result, the noise produced by the new unit would be approximately 10 dBA lower. The new unit would also be slightly smaller and therefore farther from the Weymouth site fence, thus contributing to the noise attenuation. The combined noise level from the two sources would be about 1 to 2 dBA higher at the Weymouth site fence than the current noise level. Given that the existing meter station is located in an industrial area that is bordered by a heavily traveled highway (State Route 3A); the slight increase in noise from the new heater is expected to be minor.

4.11.3.3 Impacts of Decommissioning

At decommissioning, the offshore pipeline would be abandoned in-place and minor noise would be generated from abandonment activities, but the impact would be short-term.

4.11.3.4 Impacts of Alternatives

Alternate Pipeline Routes

Routes 1, 2 and 3 would have similar construction and operation impacts as the proposed route (route 4). There would be no beneficial effect from these alternatives to noise receptors.

4.12 FERC CONCLUSIONS AND RECOMMENDATIONS

Mitigation to which Algonquin has already committed and mitigation that would be required by permits and authorizations that Algonquin must obtain are discussed in the preceding resource sections. If the Commission authorizes the Pipeline Lateral portion of the NEG Project, the FERC staff recommends that the following measures be included as specific conditions in the Commission’s Order. The FERC staff believes that these measures would further mitigate the environmental impacts associated with the construction and operation of the proposed Project. Mitigation measures 1 though 9 are standard conditions recommended by the FERC staff for all pipeline projects.

1. Algonquin should follow the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests) and as identified in the EIS, unless modified by the Order. Algonquin must:
    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary of the Commission (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 Office of Energy Projects (OEP) before using that modification.
2. The Director of OEP has delegated authority to take whatever steps are necessary to ensure the protection of all environmental resources during construction and operation of the Project. This authority should allow:
    a. the modification of conditions of the Order; and
    b. the design and implementation of any additional measures deemed necessary (including stop work authority) to assure continued compliance with the intent of the environmental conditions as well as the avoidance or mitigation of adverse environmental impact resulting from Project construction and operation.
3. **Prior to any construction**, Algonquin should file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel,

environmental inspectors, and contractor personnel will be informed of the environmental inspector'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 should be as shown in the EIS and as supplemented by filed alignment sheets. **As soon as they are available, and before the start of construction,** Algonquin shall file with the Secretary any revised detailed survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these alignment maps/sheets.

   Algonquin’s exercise of eminent domain authority granted under Natural Gas Act (NGA) section 7(h) in any condemnation proceedings related to the Order must be consistent with these authorized facilities and locations. Algonquin’s right of eminent domain granted under NGA section 7(h) does not authorize it to increase the size of its natural gas pipeline to accommodate future needs or to acquire a right-of-way for a pipeline to transport a commodity other than natural gas.

5. Algonquin should file with the Secretary detailed alignment maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage yards, 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, and documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

   This requirement does not apply to extra workspace allowed by the *Upland Erosion Control, Revegetation, and Maintenance Plan,* minor field realignments per landowner needs and requirements which do not affect other landowners or sensitive environmental areas such as wetlands.

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   c. implementation of cultural resources mitigation measures;

   d. implementation of endangered, threatened, or special concern species mitigation measures;

   e. recommendations by state regulatory authorities; and

   f. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

6. **Within 60 days of the acceptance of this certificate and before construction** begins, Algonquin shall file an initial Implementation Plan with the Secretary for review and written approval by the Director of OEP describing how Algonquin will implement the mitigation measures required by the Order. Algonquin must file revisions to the plan as schedules change. The plan shall identify:

g. how Algonquin will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;

h. the number of environmental inspectors assigned per spread, and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;

i. company personnel, including environmental inspectors and contractors, who will receive copies of the appropriate material;

j. the training and instructions Algonquin will give to all personnel involved with construction and restoration (initial and refresher training as the Project progresses and personnel change), with the opportunity for OEP staff to participate in the training session(s);

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

l. the procedures (including use of contract penalties) Algonquin will follow if noncompliance occurs; and

m. 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 mitigation training of onsite personnel;

(3) the start of construction; and

(4) the start and completion of restoration.

7. Algonquin shall employ at least one environmental inspector per construction spread. The environmental inspector shall be:

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

o. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 5 above) and any other authorizing document;

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

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

r. 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

s. responsible for maintaining status reports.

8. Algonquin shall file updated status reports prepared by the environmental inspector with the Secretary and MMS on a **biweekly** basis **until all construction and restoration activities are complete.** On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

t. the current construction status of the Project, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally sensitive areas;

u. a listing of all problems encountered and each instance of noncompliance observed by the environmental inspector(s) 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);

v. corrective actions implemented in response to all instances of noncompliance, and their cost;

w. the effectiveness of all corrective actions implemented;

x. 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

y. copies of any correspondence received by Algonquin from other federal, state or local permitting agencies concerning instances of noncompliance, and Algonquin's response.

9. Algonquin must receive written authorization from the Director of OEP **before commencing service** from the Project. Such authorization will only be granted following a determination that rehabilitation and restoration of the right-of-way and other areas affected by the Project are proceeding satisfactorily.

10. **Within 30 days of placing the certificated facilities in service**, Algonquin shall file an affirmative statement with the Secretary, certified by a senior company official:

z. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

aa. identifying which of the certificate conditions Algonquin 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.

11. Algonquin should not begin construction activities **until:**

a. FERC staff receives comments from NMFS regarding the proposed action;

b. the Staff completes formal consultation with the NMFS, if required; and

c. Algonquin has received written notification from the Director of the Office of Energy Projects (OEP) that construction or use of mitigation may begin.

12. **Prior to construction**, NEG should provide to the USCG staff for review and approval a full air quality analysis identifying all mitigation requirements required to demonstrate conformity and submit detailed information documenting how the Project would demonstrate conformance with applicable SIP in accordance with Title 40 CFR Part 51.858. The documentation should address each regulatory criteria listed in Part 51.858; provide a detailed explanation as to whether or not the Project would meet each requirement; and for each criteria being satisfied, provide all supporting information on how the Project would comply.

13. **Prior to construction**, Algonquin should file documentation with the Secretary of the Commission that confirms USCG staff's review and approval of the Project's air quality analysis and identifies all mitigation requirements required to demonstrate conformity with Title 40 CFR Part 51.858.

14. Algonquin should not begin construction of the Project until it files with the Secretary of the Commission a copy of the determination of consistency with the Coastal Zone Management Plan issued by the Massachusetts Office of Coastal Zone Management.

15. Algonquin should prepare as-built construction plans for the Pipeline Lateral that include the details of where the pipeline would be laid on the ocean floor and protected with concrete mats. To minimize the potential for the pipeline to become an obstacle for ground fishing gear, these plans should be made available to the USCG and other jurisdictional agencies for dissemination to the commercial fishing industry.

16. Algonquin should file with the Secretary of the Commission, **prior to construction**, a detailed Monitoring and Mitigation Plan regarding impacts associated with construction of the Pipeline Lateral, including documentation of all consultation with jurisdictional resource management agencies. The Monitoring and Mitigation Plan should include:

    a) appropriate pipeline depth and cover criteria;
    b) any measure to minimize impacts to migrating lobsters from pipeline trenching and backfilling;
    c) mitigation and monitoring of egg and fish mortality;
    d) water quality monitoring; and
    e) installation and operation of an array of autonomous recording units to monitor and evaluate underwater sound output from the NEG Project.

17. Algonquin should continue consultations with the operators of the Hibernia cable to attempt to reach an agreement regarding the proposed pipeline crossing of the cable and the long term maintenance and repairs of the pipeline and the Hibernia cable**.**

5.0 SAFETY

The transportation, storage, and processing of LNG and the transportation of natural gas via pipeline require strict controls to minimize public safety risks and interruptions of natural gas supplies. The purpose of this section is to address the risks to public safety and property as it pertains to the operation of the proposed NEG Project. This section is limited to the design, engineering, and operational components of the proposed NEG Port and associated NEG Pipeline Lateral infrastructure, collectively referred to as the NEG Project, as they relate to safety.

Should a license be approved, NEG would be required to meet any conditions within the Record of Decision and License itself. Additionally, the USCG would review and approve all design, engineering, and operational specifications prior to construction and/or operation of the proposed NEG Port and Pipeline Lateral.

The evaluation of safety concerns regarding the NEG Project has been completed by reviewing studies and reports determining and quantifying the hazards of LNG. In addition, an Independent Risk Assessment (IRA) was contracted by the USCG to review the potential risks to the public from the NEG Project and the proposed nearby Neptune LNG Project, both collectively and individually, based on a large scale release of LNG. The IRA, performed by AcuTech Consulting Group (AcuTech), assessed potential risks associated with both projects in order to evaluate cumulative public safety and property risks in the event that both projects are approved and constructed. This report in its entirety is included in Appendix L of this EIS.

Section 5.1 discusses physical properties of LNG and the risks of these hazards to public safety and property based on past and current studies, and NEG Project safety controls. Section 5.2 evaluates potential effects of the NEG Project on public safety. The criteria used to perform the evaluation are discussed in Section 5.2.1. LNG industry standard guidelines and potential impacts to public safety and property are presented in Sections 5.2.2 and 5.2.3, respectively.

Section 5.3 discusses the results of the IRA. The IRA assessed the risk of four (4) potential alternatives associated with the NEG Project and the Neptune Project. Analyses of the potential effects and consequences of intentional acts, ship collisions, equipment failure, or accidents resulting from extreme weather and sea conditions are incorporated into the IRA.

Marine Safety for the DWP portion of the NEG Project is evaluated and discussed in Section 5.4, including the establishment of safety zones.

The evaluation of potential public safety impacts associated with natural gas transportation by pipeline draws on decades of operational history for thousands of miles of transmission pipelines. Historical data and analysis of natural gas pipeline incidents in the United States are used to assess the safety risks associated with the offshore NEG Pipeline Lateral, which is discussed in Section 5.5.

5.1 LNG HAZARDS

5.1.1 Physical Properties

Depending on the source, imported LNG is about 95 to 97 percent methane (natural gas) in liquid form, and the remainder consists of ethane, propane, and other natural gas liquids. When natural gas is cooled to -260ºF (-162ºC) it decreases in volume and becomes a clear and odorless liquid. LNG is transported and stored at near ambient (atmospheric) pressure. As the liquid vaporizes and expands to form a gas within an LNG storage tank, a pressure slightly above atmospheric pressure is maintained. This elevated pressure precludes air from entering the storage container.

LNG has several physical properties of note:

- LNG is colorless, odorless, and non-toxic, but the vaporized gases can serve as an asphyxiant to humans by displacing air.
- When initially vaporized, LNG vapor or a vapor/air mixture will generally be colder and denser than the ambient air and will remain heavier than air until it warms.
- Methane gas at ambient temperatures is lighter than air.
- Methane gas occupies 625 times more volume than LNG (methane liquid).

When mixed with air, the lower and upper flammability limits of methane are 5.5 to 14 percent natural gas by volume, at 77ºF (25ºC). Beyond these limits, LNG will not burn or combust. LNG is considered a flammable gas, but has the highest auto-ignition temperature when compared to other fuels (e.g., LPG, gasoline, and diesel).

When LNG is spilled onto water, a physical phenomenon called a Rapid Phase Transition (RPT), which is the result of the LNG absorbing large quantities of heat from the sea, can occur as the methane rapidly transitions from its liquid phase to its gaseous phase.

Regardless of the cause, the formation of a methane/air mixture and its movement depends on the quantity and rate of the spill, whether it is on land or water, atmospheric stability, wind direction and velocity, and the temperature of the atmosphere and water.

There are five (5) major hazards associated with LNG that could have significant impacts over wide areas, including:

- Thermal Radiation (Flux) Hazards;
- LNG pool fires that could occur on the surface of water or impervious surfaces;
- Flammable vapor clouds that could form if the spill is not immediately ignited;
- Cryogenic Hazards; and
- RPT from rapid mixing of LNG and water.

Each of these potential hazards associated with LNG are discussed in further detail in the sections below.

5.1.2 Thermal Radiation (Flux) Hazards

Thermal radiation (flux) hazards may result from ignition of an LNG pool or ignition of a flammable LNG vapor cloud. Hazards to humans include burns ranging from first degree to third degree burns, and may result in moderate to severe injury or possible death. The degree of thermal radiation hazard is dependent on a number of factors including distance from the thermal radiation source, exposure time, and shielding via personal protective equipment and/or structures. Other thermal (fire) related hazards to humans include smoke inhalation and asphyxiation due to lack of oxygen.

Hazards to vessels and equipment are also possible due to thermal radiation. Literature reviewed indicates that thermal flux levels of 37.5 kilowatts per square meter (kW/m^2) can cause damage to steel tanks and process equipment. Section 5.3 (DWP Risk Assessment) provides additional details regarding thermal radiation hazards and impact distances associated with pool fires and flammable vapor clouds.

5.1.3 Flammable Vapor Clouds

When exposed to the atmosphere, LNG absorbs heat from the ambient air, forming a heavy, cold cloud that may be visible due to condensed moisture within the air. Because heat rises, the cold air and LNG gas mixture is not buoyant. During the early stages of an LNG release, when vaporized methane gas is beginning to mix with air, most of the plume growth would be entrained into the cloud so that its dispersion is governed solely by ambient turbulence (EPA, 1988). In the LNG cloud, the amount of gas mixing with air would not be uniform, and pockets of the flammable gas/air mixture might exist in regions of the cloud that are generally outside the flammability limits of methane (USCG and MARAD, 2003a). If this flammable plume encounters an ignition source, a fire would flash back to the source of the spill, causing potentially serious burns to individuals within the flammable concentration zone. Due to the high probability that an ignition source will be present, sustained development and dispersion of a flammable vapor cloud is less likely to occur.

Thermal radiation (e.g. the heat that is felt when standing in front of a fire) is the primary mechanism of heat transfer from the burning methane to an individual or structure (USCG and MARAD, 2003a). When LNG initially vaporizes from its liquid state to its gaseous state, the methane concentration is high, resulting in insufficient oxygen levels to support combustion. When the concentration of methane decreases to 14 percent of the vapor/air mixture (14 percent methane, 86 percent air) it will burn (Sandia National Laboratories [Sandia], 2004). This is the upper flammability limit. As the vapor continues to mix with more of the surrounding air, its concentration continues to decrease. When the mixture is diluted to concentrations below 5.5 percent methane (5.5 percent methane, 94.5 percent air) it becomes too lean to burn; this is known as the lower flammability limit (LFL). When an unconfined cloud containing a natural gas/air mixture burns in the open, the flame generally spreads from the ignition source back over the surface of the LNG vapor cloud.

5.1.4 Pool Fire

When LNG burns under unconfined conditions, the flame speed is too slow to generate an explosion. Instead, the flame will burn back to the LNG source and continue burning until extinguished or the source of methane is exhausted. The primary concern in this situation is the radiant heat generated from the fire. For LNG to cause an explosion the vapor cloud must be confined, resulting in pressurization (LNG is not normally pressurized). A literature search of LNG incidents revealed no recorded, unconfined, vapor cloud explosions involving methane. Large-scale field tests involving releases of methane into the open air or onto water did not result in an explosion when ignited. Any methane that does not burn after being diluted below its LFL will dissipate into the atmosphere.

Any large release of LNG from the terminal could result in a pool of LNG that could ignite and burn. LNG pools could form prior to ignition and are likely to result in the highest risk in terms of a damage radius.

5.1.5 Atmospheric and Cryogenic Hazards

Potential hazards in addition to those described above include asphyxiation by concentrated vapors and exposure to low temperature LNG. Even though LNG vapor is not toxic, a vapor cloud could displace enough air to make the atmosphere unsafe for humans to breathe. This represents a hazard to the personnel in close proximity to an LNG release (i.e., DWP facility personnel), especially if the vapor is confined, allowing the concentration to increase in the area. The low temperature of LNG is also sufficient to cause rapid frostbite, severe tissue damage, or death, should sufficient body surface be directly exposed. Each of these hazards could develop quickly following a spill. Furthermore, as a cryogenic liquid, LNG quickly cools the materials it comes into contact with and causes extreme thermal stress in materials not specifically designed for ultra-cold conditions. These thermal stresses can cause brittleness and possible fracture of common construction materials, including steel, which is used for carrier structures (FERC, 2003). This could cause failure of onboard equipment that could present hazards to Northeast Gateway personnel.

5.1.6 Rapid Phase Transition

RPT occurs when a very cold liquefied gas strikes a warmer surface, such as water. In some cases, the rapid, uncontrolled expansion of LNG as it changes phase from a liquid to gas could result in an explosion given the physical energy released during this transition (Lees, 1996). Studies show that the hazard zones extending from an RPT would not be as large as either vapor cloud or pool fire hazard zones.

5.2 EVALUATION OF PUBLIC SAFETY

During the initial public scoping meetings for both the NEG Project and Neptune Project, the USCG received various comments from the public, federal and state agencies requesting that a hazard study be completed to identify the risks and consequences associated with both DWP projects. Based on these comments, the USCG determined that a project specific IRA, looking at both the NEG Project and the Neptune Project individually and collectively, would be required in order to satisfy the public and agency concerns and thus meet the requirement of the National Environmental Policy Act. This combined IRA was completed by AcuTech for the USCG. Further details of the IRA can be found in Section 5.3 of this DEIS.

5.2.1 Criteria

The safety review criteria used to complete the IRA was provided by the USCG with guidance from Sandia. In completing the IRA, AcuTech identified credible accidental and intentional scenario hazards, incorporated site specific conditions, reviewed direct impacts to the public, and identified the bounding case (largest credible impact). The IRA reported resulting pool fire thermal radiation hazard distances, and vapor dispersion hazard distances to the LFL for an unignited vapor cloud, based on modeling performed for selected accidental and intentional release scenarios. This section summarizes the process and considerations that went into modeling and development of the IRA. The complete IRA is provided as Appendix L.

5.2.1.1 Credible

The evaluation of public safety must include an objective analysis of the potential impact of the NEG Project to public safety and property. The IRA study reviewed a wide range of potential scenarios involving both accidental and intentional hazards. Input in determining the potential hazards was obtained by a number of qualified federal, state, and local experts during a Hazards Identification Study (HAZID) conducted on February 14-15, 2006. Participants included the USCG, Sandia National Laboratories (Sandia), Joint Terrorism Task Force (JTTF), Boston Harbor Pilots, Eastern Point Pilots, MA State Police, MA Department of Environmental Protection, and AcuTech. The risk analysis process is shown in Figure 2.1 of the AcuTech IRA.

The HAZID process identified 11 potential accidental release cases that were grouped into four categories; Marine Related, Process Related, Weather Related, and Aircraft Related. In addition, intentional release scenarios were also reviewed and analyzed. From the identified hazards, a subset of potential hazards was identified and chosen to bracket the credible range of potential accidental and intentional LNG release scenarios on which to base the public safety evaluation. Further details regarding the identified hazards on which the IRA was based are provided in Section 5.3 of this EIS.

The IRA consisted of a systems level risk assessment that considered operations related to the transfer, storage, and regasification of LNG for both the NEG and Neptune Projects. The IRA did not, however, evaluate risks associated with natural gas releases for onshore components, which is outside the scope of this DWP DEIS. The IRA also did not evaluate risks associated with the Pipeline Lateral portions of the projects. Information regarding offshore pipeline safety is, however, provided in Section 5.5 of this EIS.

5.2.1.2 Site Specific

Site specific input data used in completing the risk assessment included a description of the LNG DWP projects, design information on the DWP locations; sizes of the LNG regasification vessels (LNGRVs); operating conditions of the offloading, storage and regasification process; meteorological data; and marine traffic data for the project areas. Additional vessel traffic data, from a number of sources, was also reviewed as part of the IRA for vessels transiting Massachusetts Bay.

5.2.1.3 Direct Impact to Public

The purpose of the public safety evaluation and IRA is to review the NEG and Neptune Projects' potential safety and security impacts to the public and property in the subject DWP area. An assessment of potential direct impacts to humans and property was performed from a potential large scale release of LNG from the NEG and Neptune Projects, both individually and collectively. Public and property impacts are addressed in the DWP areas only, and are limited to direct impacts only. Indirect impacts to public and property (e.g. economic impacts resulting from an LNG releases) are not included as part of the public safety evaluation.

5.2.1.4 Bounding Case (Largest Credible Impact)

The public safety evaluation and IRA process represents a deterministic assessment of the most significant credible loss scenarios representing maximum expected impacts from accidental and intentional events. The assessment did not seek to estimate the cumulative frequency and impact of expected losses over the life of the DWP facilities. What resulted from the evaluation were a representative set of scenarios, and the identification of the most significant potential and credible impacts (bounding cases) that could be used to assess the public risks associated with construction of the DWP projects.

5.2.2 Sandia National Laboratory Guidelines

In 2004, the DOE commissioned Sandia to develop a risk-based analysis approach to assess and quantify potential hazards and consequences of an LNG spill from an LNG carrier. Sandia utilized previously completed studies and conducted its own studies to determine the hazards of an LNG spill. Sandia also developed risk management strategies to minimize the likelihood of an incident. The 2004 Sandia report is typically used as an industry standard and benchmark on which to base site and project specific risk assessment studies.

The IRA followed the baseline guidance for accidental and intentional breach models of LNG carrier inner hulls provided in the 2004 Sandia report (SAND2004-6258).

AcuTech worked directly with Sandia and the USCG to apply site specific conditions and parameters for the NEG and Neptune Projects IRA process. With regard to accidental vessel collisions, Sandia data used lower speeds typically found within an inner harbor in assessing collision scenarios. Due to the NEG and Neptune project's offshore location, Sandia collision data was extrapolated to account for higher potential vessel speeds that may potentially occur in the offshore DWP area.

With regard to potential intentional threats, Sandia guidance suggests that the threat, breach, spill and hazard analyses should be conducted on a site-specific basis. AcuTech, in conjunction with Sandia and USCG, utilized site-specific conditions and scenarios to assess the threat and consequence of intentional LNG incidents.

5.2.3 Impacts to Public Safety and Property

The potential impacts to public safety and property from DWPs, LNG carriers, and process equipment are described below. Impacts from marine shipping and pipelines are described in section 5.4 and 5.5, respectively.

5.2.3.1 Deepwater Port

At present, only one LNG import facility located entirely offshore has been built, the Gulf Gateway Energy Bridge Project, which commenced operations in March 2005. A review of available information indicates that there are no recorded incidents regarding impacts to public safety and property for DWP facilities. Guidance documents for building offshore LNG storage and regasification terminals have recently been produced by the Classification Societies (American Bureau of Shipping, Bureau Veritas, Det Norske Veritas and Lloyds Register). A review of available information is therefore limited to land-based LNG facilities, and indicates that there have been only seven documented incidents with one or more fatalities connected directly to operations at land-based LNG facilities: Skikda, Algeria, 2004; Bontang, Indonesia 1983; Maryland, United States, 1979; Arzew, Algeria, 1977; Texas, United States, 1973; Raunheim, Germany, 1966; and Ohio, United States, 1944.

5.2.3.2 LNG Carriers

LNG carriers are constructed with spill and accident prevention measures incorporated into equipment design, operations, and safety training (FERC, 2001). The transportation of LNG by ship has proven to be an extremely safe method since the first LNG maritime shipment in 1959. Commercial maritime shipments of LNG began shortly thereafter, in 1964. In 1980, the USCG determined that the level of risk associated with LNG maritime transportation is acceptable. More than 80,000 LNG carrier voyages have taken place, covering more than 100 million miles (161 million km) while loaded, with no major accidents, safety problems, recorded fatalities to vessel crew or the general public, or recorded fires on deck or within cargo areas. Out of the greater than 80,000 shipments of LNG since 1964, 8 marine incidents worldwide have resulted in LNG spills. These spills have resulted in some damage to the carrier, but no LNG fires have occurred (Sandia, 2004). The most significant damage resulting from LNG leakage involved a deck or plating fracture from cryogenic embrittlement (CH-IV International, 2002). An additional 11 incidents involved a vessel collision, a vessel running aground, or vessel fracture due to high seas deflection stresses. However, none of these 11 incidents resulted in a spill of LNG (CH-IV International, 2002).

Currently, the world's LNG fleet is comprised of about 150 active vessels. The LNG capacities of these ships ranged from 674,500 to 4,860,300 ft^3 (19,100 to 137,628 m^3). All of these LNG carriers operate under a foreign flag with foreign crews and must (when entering US waters) have a Certificate of Compliance issued by the USCG, in conjunction with a thorough examination, to verify compliance with international safety standards and applicable domestic regulations. These ships are required to have an operations plan written in English and at least one officer fluent in English aboard at all times that is knowledgeable of the cargo systems (USCG and MARAD, 2003a).

In December 2002, at the urging of the USCG, the United Nation's International Maritime Organization (IMO) Maritime Safety Committee developed amendments to the 1974 International Convention for Safety of Life at Sea (SOLAS) intended to enhance maritime security. The new International Ship and Port Facility Security (ISPS) Code was also adopted to provide a standardized, consistent framework for evaluating risk, enabling governments to offset changes in threat with changes in vulnerability for ship and port facilities. The implementation schedule of both the SOLAS amendments and the ISPS Code is July 1, 2004.

On a national front, the U.S. Congress enacted the Maritime Transportation Security Act (MTSA) in November 2002, which was designed to protect U.S. ports and waterways from a terrorist attack by requiring area maritime security committees and security plans for facilities and vessels that may be involved in a transportation security incident. In response to the terrorists attacks on September 11, 2001, the USCG reaffirmed its Maritime Homeland Security mission and its lead role, in coordination with other Federal, State and local agencies, owners and operators of vessels and marine facilities, and other entities with interests in the U.S. Marine Transportation System, to detect, deter, disrupt and respond to attacks by terrorist organizations against U.S. territory, population, vessels, facilities and critical maritime infrastructure.

Accordingly, the USCG developed maritime security rules that require owners and operators of certain facilities in U.S. ports, and certain vessels operating in US waters, to conduct a Facility/Vessel Security Assessment (FSA), name a Facility/Vessel Security Officer (FSO), and develop and implement a Facility/Vessel Security Plan (FSP). The NEG and Neptune DWP facilities and LNG regasification vessels (LNGRV) will be required to develop the required assessments and plans in accordance with the MTSA.

5.2.3.3 Process Equipment Hazards

In addition to the accidental marine collision and intentional attack scenarios, several other types of events are possible aboard these vessels that can cause result in significant LNG spills. There is the potential for process-related releases due to the significant top-side processing equipment on the LNGRV for the regasification of LNG and the distribution of natural gas from the buoys to the sub sea piping. These scenarios involve accidental equipment failures, human errors, or external events that can result in a release of LNG or natural gas leading to fires, explosions, or other serious shipboard events.

LNGRVs are designed to carry cryogenic gases and follow more stringent IMO regulations that govern their construction and operation including fire and gas detection systems, emergency shut-downs, and fire and vapor supressions systems. The result of these regulations is that the safety features required significantly reduce the likelihood of an accidental LNG release at the proposed DWP projects. Additionally these safety features would also mitigate any release of LNG, regardless of cause.

The process related scenarios identified in the HAZID were not analyzed in the IRA. These types of releases were determined to have smaller potential release sizes (e.g., potential hole size, inventory available for release, and duration of release) and a lower potential to escalate (due to the safety and emergency shutdown systems) as compared to other accidental and intentional cases for which a detailed examination of the consequences was performed. The lower likelihood for catastrophic accidental events is based on the regulations covering LNG carriers, the safety record of the LNG industry (both onshore and transportation), and the associated safety features onboard an LNGRV. Therefore, while process releases are credible scenarios, they do not represent the bounding consequence case for accidental or intentional events. If a license is granted, further work will be conducted in hazard identification and risk management of process-related scenarios in post licensing activities of design and operations reviews and approvals.

5.3 DWP RISK ASSESSMENT

5.3.1 Purpose and Objectives

In response to applications filed with the USCG and MARAD for the NEG and Neptune projects, the USCG contracted an IRA to review the potential risks to the public from the two projects, both collectively and individually, based on a large scale release of LNG.

The purpose of the IRA is to develop a stand alone technical report on the potential risks to the public from the proposed Project(s) based on a large scale release(s) of LNG. The primary objective of the IRA is to assess impacts to humans and property not associated with the DWP from an event(s) that compromises LNG containment. The secondary objective of the IRA is to qualitatively analyze the process safety hazards that may cascade beyond the identified maximum credible breach scenarios. The IRA assessed potential risks associated with both projects in order to review cumulative public safety and property risks in the event that both projects are approved and constructed.

The conclusions of this risk assessment are presented based on four potential alternatives:

Alternative A: Neither LNG DWP Applications Accepted

Alternative B: Northeast Gateway DWP Accepted

Alternative C: Neptune DWP Accepted

Alternative D: Both Northeast Gateway and Neptune DWP's Accepted

Prevention and mitigation strategies for both accidental and intentional release scenarios will be developed in a coordinated effort between the USCG and the Applicant in the Port Operations Manual and Facility Security Plan. Process design and operational reviews and approvals are also included. Though on-going, much of this activity is completed in the post licensing phase of the application.

5.3.2 Technical Approach

The risk analysis process involved six steps:

- DWP Area Characterization – the DWP applications were reviewed as well as additional data was gathered and analyzed about the port environment;
- HAZID – input was received from various stakeholders to identify accidental and intentional scenarios;
- Scenario Development – the HAZID scenarios were further analyzed to determine credible scenarios;

- Vessel Collision and Frequency Analysis – the type of vessel and frequency of collision was analyzed.
- Consequence Analysis – the impacts of the bounding cases were analyzed using Computational Fluid Dynamics modeling;
- Results and Conclusions – the analysis results were assessed and presented.

The conclusions of this risk assessment are presented as the hazard zones for thermal radiation and vapor cloud dispersion for the accidental and intentional release scenarios evaluated. The hazard zones have been presented as graphical overlays on the nautical chart for the proposed DWP project locations. Note that the results of this risk assessment is presented without passing judgment on the merits of any applicant's proposed DWP. While the IRA evaluated the potential impacts to the public or surrounding infrastructure, it did not attempt to predict the number of potential fatalities or injuries from these events. Also, the IRA was done without considering any mitigation measures that could be implemented to reduce the risk of accidental or intentional release of LNG from these proposed projects.

5.3.3 DWP Potential Impact

The HAZID process established a minimum baseline of scenarios, including:

- Marine collision and/or allision resulting in LNG containment penetration;
- Major accidental LNG spills or cargo piping ruptures;
- Spill in confined spaces; and
- Major cascading events leading to compromise of LNG cargo containment.

The HAZID process identified 11 potential accidental release cases, which were then classed into four (4) categories. The major categories included Marine Related, Process Related, Weather Related, and Aircraft Related scenarios. Each of these categories is briefly summarized here.

Although no reported marine accidents resulting in a breach of containment have been identified in past studies, marine collision scenarios were still included for further consideration. Groundings, however, were ruled out as not being likely in the DWP area. A review of IMO and International Gas Code (IGC) safety and safeguard requirements indicated that process related scenarios were not credible bounding cases and therefore not further considered. Review of potential sea-state and weather conditions, mooring and connection operating conditions for the DWP facility, mitigation and procedural safeguards, and recent test case data for Excelerate Energy's DWP facility off Louisiana during the 2005 hurricane season indicated that weather related events would also not be a credible bounding case. Weather related hazards were therefore not further considered. Finally, aircraft related incidents were determined to be remote and therefore not considered for further analysis.

The HAZID team also reviewed a number of intentional release scenarios. AcuTech worked closely with USCG and Sandia personnel to identify site specific, credible incidents that would bound the likely potential consequences of an LNG release. From this process, two (2) intentional release scenarios were selected. Due to the sensitive nature of this information, details of the analysis are not provided. The IRA did conclude, however, that the intentional release scenarios were not considered likely to occur, due to multiple countermeasures that include MTSA requirements, USCG operational requirements, and DWP applicant operational procedures and programs.

5.3.3.1 Release Scenarios

The release scenarios derived from the IRA Process include:

- Scenario 1 – Intentional event leading to a 24 m^2 breach in a single compartment of LNGRV.
- Scenario 2 – Intentional event leading to a 12 m^2 breach in two compartments of the LNGRV.
- Scenario 3 – Accidental collision leading to a 22.5 m^2 breach in a single compartment of LNGRV.

Several developmental notes regarding the selection and modeling of the release scenarios were noted. All of the accidental scenarios were bound by the collision case (Scenario 3). In comparing the above three release scenarios, the risk analysis screening indicated that the modeling results were essentially similar for Scenario 1 and Scenario 3. Scenario 3 was therefore not individually modeled in the risk assessment, and its results were assumed similar to those of Scenario 1. In addition, the risk analysis screening indicated that despite slightly different tank dimensions for the NEG and Neptune LNGRVs, resulting hazard distances were similar. As a result, the risk analysis modeling for the three release scenarios was performed using a single set of LNGRV parameters.

Summaries of the Pool Fire and Vapor Dispersion hazard distances for above release scenarios is discussed below.

5.3.3.1.1 Pool Fire

Thermal radiation hazard distances from a pool fire were estimated for three different heat flux levels:

- 37.5 kW/m^2: Damage to the process equipment and storage tanks, based on average 10 minute exposure duration (Barry, 2002).
- 25 kW/ m^2: Minimum energy for ignition of wood without direct flame exposure, based on average 10 minute exposure duration (Barry, 2002).
- 5 kW/ m^2: Onset of second degree burns based on an average 40 second exposure duration (FEMA, 2006), and a permissible level for emergency operations lasting several minutes with appropriate clothing based on an average 10 minute exposure duration (Barry, 2002).

The pool fire thermal hazard distance analysis was performed by comparing three different models; the standard solid flame, the two-zone solid flame, and the LNGFIRE3 models. The maximum credible pool fire thermal radiation hazard distances predicted by the different models occurred with Intentional Scenario 2. The pool fire distances to endpoint for this scenario were 3,540 m, 1,740 m, and 1,440 m for the 5, 25 and 37.5 kW/ m^2 Radiative Heat Flux levels, respectively. Summary results for each of the three scenarios can be found in Table 5-1.

5.3.3.1.2 Vapor Dispersion

The vapor cloud dispersion hazard distance was determined as the maximum downwind distance to the LFL. The flammable vapor cloud dispersion simulations were performed using Fluent, a commercial Computational Fluid Dynamics code. Fluent was validated for this study by comparison with experimental LNG vapor dispersion data from the Burro tests (Appendix A to IRA).

The maximum credible flammable vapor cloud distance to the LFL predicted by the IRA analysis also occurred with Intentional Scenario 2, resulting in a distance of 6,060 m. Summary results for each of the three scenarios can also be found in Table 5-1.

Table 5-1

Summary Risk Analysis Consequences (see Table 8.3 of the IRA)

Result	**Intentional (Scenario 1)**	**Intentional (Scenario 2)**	**Marine Collision Scenario 3)**
Breach Size, m^2	24	12	22.5
Number of Tanks	1	2	1
Release Quantity, m^3	28,575	57,150	28,575
Pool Spread Distance			
Maximum Pool Radius, m	380	470	380
Pool Fire Maximum Distance to Endpoint (meters)			
Radiative Heat Flux > 5 kW/m^2	2,890	3,540	2,890
Radiative Heat Flux > 25kW/m^2	1,460	1,740	1,460
Radiative Heat Flux > 37.5kW/m^2	1,220	1,440	1,220
Flammable Vapor Cloud Dispersion (No Ignition)			
Distance to LFL, m	5,070	6,060	5,070
Time for Maximum Distance, min	25	30	25
Cloud Peak Elevation, m	48	49	48

5.3.4 Prevention and Mitigation Strategies

Prevention and mitigation strategies for both accidental and intention release scenarios will be developed in a coordinated effort between the USCG and NEG in the Port Operations Manual and Facility Security Plan. Process design and operational reviews and approvals are also included. Though on-going, much of this activity is completed in the post licensing phase of the application.

5.4 MARINE SAFETY

In completing the AcuTech IRA, the assumption was made that all vessels would maintain at least a 1.5 nautical miles (nm) separation with moored LNGRVs while entering/leaving the Precautionary Area at the junction of the Traffic Separation Scheme (TSS) In-bound and Out-bound lanes for Boston Harbor. Also note that the Applicant proposed Area to Be Avoided (ATBA) is a 1.4 nm diameter area around the DWP facility.

Historical vessel traffic data and travel routes were reviewed and consolidated into eight (8) approach lanes for Boston, which were used to assess the potential for vessel collisions and impacts to marine safety in the event of an LNG release. Establishment of safety zones and other limited access areas (LAAs), compliance with USCG maritime safety and DWP requirements, facility development of Operations Manuals and Security Plans, and USCG oversight are all mitigation measures established to ensure adequate marine safety.

Several agency and public comments have discussed the potential impact of the proposed shift to the Boston Harbor TSS on the proposed DWP facilities. The IRA study determined that the proposed modification to the TSS would not substantially affect the results of the IRA study.

5.4.1 Marine Safety Standards

Should a license be approved, NEG would be required to submit a Facility Security Plan as part of its Port Operations Manual for Coast Guard approval. In accordance with Title 33 CFR Section 150.15(v), the deepwater port operator must ensure that the Facility Security Plan "address(es) or [is] comparable to the key security elements provided in Title 33 CFR Part 106 (for Outer Contenental Shelf [OCS] facilities)." The purpose of the Facility Security Plan would be to provide NEG personnel with security responsibilities and a systematic approach to securing NEG assets, which would include providing integrated security and safety protocols that would protect not only NEG personnel, but also personnel aboard the moored EBRV from man-made threats such as terrorism.

Safety and security criteria were used in the evaluation of the proposed NEG STL Buoys location and would be critical components of its design and operating procedures. To receive approval from the USCG, the offshore location of the proposed NEG Project must be conducive to safety by minimizing any potential risks while simultaneously allowing for adequate security.

The NEG Project is well removed from any populated area. The facility's proximity to the shipping lanes to promote easy EBRV LNG carrier access is balanced against the need to ensure minimal risk of collision from passing ships. NEG is located 1.2 miles north of the Boston Harbor Traffic Lane (inbound) and immediately south of the Massachusetts Bay Disposal Site – an existing disposal site for dredged materials. The proposed NEG STL buoy locations have no offshore structures nearby. The nearest structure is an offshore navigation aid that is in excess of 8 miles (12.8 km) away. The proposed Neptune DWP would be located approximately 6 miles away. The location of the NEG Project would eliminate the need for EBRV LNG carriers associated with the proposed facility to transit into and out of congested ports and waterways to discharge LNG cargo, thereby reducing the chance of a collision, grounding, or other marine casualty.

If approved, NEG's proposed STL buoy site would employ various physical and operational security features. The security of the facility would take into account the placement of operational equipment to minimize access or exposure. The NEG site would have no specific physical facilities located on shore, and all offshore components would be located below the surface of the water. The NEG STL buoy system is designed, when not in use, to be neutrally buoyant and remain at about 80 feet below the surface of the water. No physical barriers are necessary. Port personnel, EBRV LNG carrier crew members, and visitors to the proposed deepwater port facility would be carefully checked and verified through the vessel's normal access control. Additionally, NEG EBRVs would employ comprehensive security protocols designed to maintain full surveillance of the moored vessel and the surrounding approaches in the water.

5.4.2 Navigational Safety Measures

The navigational safety measures LAA discussed below would be incorporated into port operations with final dimensions and mandatory or recommendatory restrictions yet to be assessed for safety and security. It is likely, however, that the proposed dimensions would be a starting point for this assessment.

5.4.2.1 Safety Zone

Each STL buoy location would have three marine traffic management zones. The first zone proposed would be a 0.54 nm diameter (500 meter radius) Safety Zone around each of the buoys whether an EBRV is moored or not. This Safety Zone may actually increase to approximately 800 meters in the presence of a 300 meter EBRV as it “weathervanes” or rotates around the buoy. Only EBRV’s, support vessels, and law enforcement vessels would be permitted to enter this USCG enforceable safety zone.

In addition to the proposed Safety Zone around the port itself, the Coast Guard has established a mandatory safety and security zone around an underway LNG carrier specific to the Massachusetts Bay area (33 CFR 165.110 Safety and Security Zone; Liquefied Natural Gas Carrier Transits and Anchorage Operations, Boston, Massachusetts). This includes 2 miles ahead, 1 mile astern and 500 yards on either side.

5.4.2.2 No Anchoring Area (NAA)

The second zone would be a 1.1 nm diameter (1000 meter radius) No Anchoring Area requested by NEG of the USCG and the IMO. No vessels would be allowed to anchor in this area to prevent damage to the STL buoy and mooring system or damage to their equipment from entanglement. These restrictions would likely also apply to bottom trawling. A NAA may be either mandatory or recommendatory. Transiting the NAA may or may not be allowed.

Both the NEG and Neptune project applicants have indicated that they do not intend to use designated anchorage areas in the event that LNGRVs must delay their arrivals to the DWP facilities. Incoming LNGRVs would instead vary their speed and course in order to arrive at the DWP facilities when conditions are clear.

5.4.2.3 Area To Be Avoided (ATBA)

The third zone is a 1.4 nm diameter (1250 meter radius) ATBA also requested of the USCG and the IMO. This ATBA would help ensure that other vessels do not interfere with the deepwater port operations including the maneuvering of EBRVs and their support vessels. EBRV traffic would be coordinated by the NEG Traffic Supervisor. The ATBA would appear on subsequent editions of nautical charts of this area. ATBA is meant to discourage vessel traffic and is normally recommendatory.

5.4.2.4 Precautionary Areas

A precautionary area is intended to allow vessel traffic, but may have restrictions on vessel speed or direction. Vessel restrictions and prohibited vessel activity in the vicinity of the DWP is addressed via the implementation of the three limited access areas outlined above. At this time there are no proposed precautionary areas in the footprint of the NEG project. There are, however, restrictions associated with the Boston Harbor Traffic Lane (inbound), which is 1.2 miles south of the DWP, and the Massachusetts Bay Disposal Site, which is immediately north of the DWP.

5.4.2.5 LNG Carrier Support

NEG proposes a shore-based facility for providing staging areas and carrier support services for the DWP. Additional operational information and DWP facility support vessel information, procedures, and protocols would be required to be addressed in the Operations

Manual for the DWP facility. For purposes of completing the IRA, LNG Carrier Support vessel traffic, also referred to as LNG DWP Operations Support Vessel (OSV) traffic, was estimated to consist of 120 OSV trips per DWP facility per year. This is based on an estimated 60 LNGRV arrivals/departures per year for each DWP facility. OSVs would be required to transport personnel and materials at the LNGRV arrival, and return at the conclusion of the offloading process. If both NEG and Neptune DWP projects are approved and constructed, a total of 240 OSV trips are estimated each year.

5.5 OFFSHORE PIPELINE SAFETY

The Pipeline Lateral is not located within any designated commercial shipping lanes and there are no NOAA navigational buoys in the Pipeline Lateral area (NOAA chart Nos. 13274 and, 13275). The seaward end of the pipeline where it terminates at the NEG Port (MP16.4) is 1.2 miles north of the main shipping lane to Boston Harbor (NOAA Map No. 13274 and 13275).

The Pipeline Lateral is more than 1 mile north of the Precautionary Area at its closest point (from where the Pipeline Lateral interconnects with the HubLine). The Precautionary Area is a designated, offshore staging area for vessels entering and departing Boston Harbor. Ships routinely anchor in this area awaiting entry into the Harbor or awaiting good sailing weather for departure.

There are no designated anchorage areas in the Pipeline Lateral area as noted on NOAA Navigation Chart Nos. 13274 and 13275. The Pipeline Lateral is located seaward of all designated mooring areas associated with Salem, Beverly, Gloucester and other nearby harbors along the north shore (Gifford, 2005; McPherson, 2005; Caulkett, 2005).

Lightering is described as at-sea ship-to-ship transfer of petroleum products, materials or other matter (NOAA, 1998). It is performed in order to transfer petroleum products to smaller, shallower draft vessels that are able to enter harbors that are not able to accommodate larger commercial vessels. There are no designated lightering areas in the vicinity of the proposed Pipeline Lateral.

Potential public risks associated with the construction and operation of the proposed pipeline would be minimized by use of safe work practices and the applicable requirements of NEG's Port Operations Manual. It is anticipated that the pipeline would pose a minimal risk to public safety.

5.5.1 Offshore Pipeline Safety Standards

The proposed Pipeline Lateral would be designed, constructed, operated, and maintained in accordance with the USDOT Minimum Federal Safety Standards in 49 CFR Part 192. The regulations are intended to ensure adequate protection for the public from natural gas pipeline failures. Part 192 specifies material selection and qualification, minimum design requirements, and protection from internal, external, and atmospheric corrosion. Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation.

The pipeline would be buried to meet the regulatory standards of cover as determined by ongoing agency consultations. In order to assure subsea stability, an appropriate amount of concrete weight coating would be applied to the pipeline.

The pipeline would be protected by a corrosion protection system that includes a thin film external coating and sacrificial anodes. The design life of the pipeline is at least 50 years. The Pipeline Lateral would be hydrostatically tested upon completion of construction and prior to being placed into operation. The hydrostatic test would be performed in accordance with applicable codes and specifications, using industry standard test pressures and procedures specific to the type and location of the Pipeline Lateral.

Pipeline design pressures, hydrostatic test pressures, maximum allowable operating pressure, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. The standard for the Pipeline Lateral would be developed in accordance with the applicable codes and made a part of the operating procedures for the pipeline.

Part 192 prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under Section 192.615, each pipeline operator must also establish an emergency plan that provides written procedures to minimize the hazards from a gas pipeline emergency. Key elements of the plan include procedures for:

1. Receiving, identifying, and classifying emergency events (e.g., gas leakage, fires, explosions, and natural disasters);
2. Establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response;
3. Making personnel, equipment, tools, and materials available at the scene of an emergency;
4. Protecting people first and then property, and making safe from actual or potential hazards; and
5. Emergency shutdown of system and safety restoring service.

NEG has stated that its Port Operations Manual would include the following provisions:

- Employees would be trained/qualified to operate and maintain the pipeline system in accordance with all applicable and appropriate regulations and guidance. Operating procedures would address routine and emergency tasks.
- Periodic in-house refresher training classes would be required for operation and maintenance personnel to maintain skill levels and review safety and emergency procedures.
- Testing and inspection of pressure limiting devices and emergency shutdown systems would be performed at regular intervals according to the guidelines outlined in NEG's Emergency Action Plan, which incorporates all applicable regulations, codes, and standards.

Inspections of the offshore Pipeline Lateral would be conducted at specified time intervals in accordance with DOT regulations.

If a license is approved, appropriate conditions would be included to ensure that design, construction, and operating requirements are incorporated into the proposed NEG Port and Pipeline Lateral, and that appropriate construction and operations training is developed and implemented.

5.5.2 Offshore Pipeline Incident Data

Tables 5-2 and 5-3 provide information on gas transmission pipeline incidents as reported by the Pipeline and Hazardous Materials Safety Administration (PHMSA) and MMS. The data presented in Table 5-3 are specific to the Gulf of Mexico.

Table 5-2

Transmission Pipeline Incident Summary by Cause[a]

Cause	1997	1998	1999	2000	2001
Construction/Material Defect	12	19	8	7	12
External Corrosion	5	8	3	14	7
Internal Corrosion	16	14	10	16	9
Other Corrosion	0	0	0	1	0
Third Party Damage	28	37	18	20	36
Other	12	21	14	22	22
Total	73	99	54	80	86

[a] Historical totals may change as the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) receives supplemental information regarding incidents.

Source: PHMSA, 2003

Table 5-3

Gulf of Mexico Gas Pipeline Incident Summary by Cause

Cause	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[a]
Construction/Material Defect	2	1	2	4	4	2	2	0	3	1	0
External Corrosion[b]	4	12	15	15	10	8	16	17	13	8	0
Internal Corrosion	4	19	5	4	11	6	4	8	3	7	4
Other Corrosion	0	0	0	0	0	0	1	0	0	1	0
Third party Damage	5	6	6	3	6	2	3	5	4	1	0
Other	13	7	16	15	6	19	11	13	13	34	5
Total	28	45	44	41	37	37	37	43	36	52	9

[a] Data through May 14, 2003

[b] External corrosion generally not considered a problem given the installation of a sacrificial anode system. These incidents arise mainly with older pipelines that do not have the preventative system installed.

Source: Minerals Management Service, 2003

As shown in Table 5-3, damage from third-parties appears to be the greatest single threat to pipeline safety. Further discussions regarding Offshore Third Party Hazards can be found in Section 5.5.3 of this EIS.

All operators of transmission and gathering systems are mandated by 49 CER Part 191 to notify USDOT of any reportable incident and to submit a written report. Data presented in Table 5-4 is for incidents that involve property damage valued at more than $50,000, injury, death, release of gas, or incidents that are otherwise considered significant by the operator. Table 5-4 summarizes pipeline incidents and accidents by category from 1986 to 2000. The category accounting for the highest percentage of pipeline incidents is caused by damage from external forces (40 percent). External forces include third-party damage from construction equipment, earth movements (e.g., landslides), weather damage, or purposeful damage (e.g., deliberate damage made to the pipeline). The most likely cause of potential damage to the Pipeline Lateral facilities would be external forces. Older pipelines have a higher frequency of external force incidents, partly because their location may be less well known or less well marked than newer lines. In addition, the older pipelines comprise a disproportionate number of smaller diameter pipelines, which are more easily affected by external forces.

Table 5-4

Office of Pipeline Safety – 1986 through 2000 Incident Summary (by case)

Year	Number of Locations	Construction / Material Failure	Corrosion	Damage by External Forces	Other	Fatalities/ Injuries
1986	83	15	12	32	24	6/20
1987	70	5	22	26	17	0/15
1988	89	9	19	39	22	2/11
1989	102	11	31	39	21	22/28
1990	89	22	16	39	12	0/17
1991	71	4	16	41	10	0/12
1992	74	9	12	32	21	3/15
1993	96	15	15	36	30	1/18
1994	80	9	33	23	15	0/19
1995	64	13	9	27	15	2/10
1996	73	7	13	37	16	1/5
1997	67	8	21	28	10	1/5
1998	98	119	22	36	21	1/11
1999	54	8	14	18	14	2/8
2000	80	7	31	20	22	15/18
Totals	1,190	161 (13%)	286 (24%)	473 (40%)	270 (23%)	56-215

Source: U.S. Department of Transportation. Office of Pipeline Safety internet site http://ops.dot.gov

The category accounting for the next most frequent cause of pipeline incidents is corrosion (24 percent). The frequency of corrosion-related incidents is largely dependant on pipeline age. While pipelines installed since 1950 exhibit a fairly constant frequency of corrosion incidents, pipelines installed before that time have a significantly higher rate. Older pipelines have a higher frequency of corrosion incidents because corrosion is a time-dependent process. The corrosion potential for new pipe is further reduced by use of more advanced coatings and cathodic protection. Prior to 1971, pipelines were not required to use cathodic protection and protective coatings.

Table 5-4 identifies an average annual reportable incident frequency of 0.27 failures per 1,000 miles per year for all natural gas transmission and gathering lines. The population of pipelines included in the data set varies widely in terms of age, pipe diameter, and level of corrosion control. Each of these variables influences the incident frequency that may be expected for a specific segment of pipeline.

5.5.3 Offshore Third Party Hazards

During offshore operations, there is a remote possibility that activities in the coastal waters around the NEG Port and Pipeline Lateral could impact the pipeline and result in a loss of natural gas. The proposed DWP facility connection would be designed with emergency shutdown valves at the interconnects that would stop flow in the pipeline in the event of an emergency. In the event of a collision and fire, DWP facility personnel would commence emergency shutdown and evacuation procedures. Any fire that occurs would be confined to the general vicinity of the release and would be of limited duration. The fire would have limited impact on the environment and, due to the lack of surrounding man-made features, would have a minimal impact on other facilities.

Anchor hooking of a pipeline could possibly puncture the pipeline, leading to a natural gas leak. However, any significant damage would be unlikely from this type of event, because natural gas would bubble to the surface and dissipate. Because of the shut-off valve activation in the case of a pressure drop, the resultant leak and possible fire would be of short duration and have limited impact on the environment.

An anchor or net snagging the risers or delivery interconnect could result in significant damage to the DWP infrastructure or the third-party vessel. Implementation of the Safety Zone, NAA, and ATBA, and the requirements of NEG's Port Operations Manual would minimize the risk to both the proposed DWP facility and any third-party vessel.

6.0 CUMULATIVE IMPACTS

The CEQ defines cumulative impacts as the "impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions."[1] Although the impact of each individual project may be minor, the additive impacts from multiple projects could be major.

This section discusses cumulative impacts that could occur in concert with NEG Project development. The time frame in this evaluation is 25 years, which corresponds to the term of the Deepwater Port Act license that may be issued. The spatial extent of the other projects considered includes both onshore and offshore facilities that could be developed and simultaneously contribute to impacts anticipated by NEG Project development.

This analysis generally looks at two separate scales of spatial analysis – regional context and local setting. The regional context includes Massachusetts Bay and the Gulf of Maine and takes into consideration the additive effects of the NEG Project with Federal and state programs, as well as existing vessel traffic. The local setting focuses on the immediate NEG Project area and includes the nearby Neptune Project, as well as other relevant projects, to provide a more detailed evaluation of the additive effects of these projects. In some cases, such as marine mammals, the spatial scale is expanded to fully capture potential cumulative effects.

In determining which actions to include in this cumulative impact analysis, three factors were considered: the temporal context, the spatial context, and the "reasonably foreseeable" nature of a project. In order to be included in this analysis, an action must occur in the regional or local setting defined above, be expected to occur within the next 25 years, and be reasonably expected to occur. Projects for which applications for a permit or license have been filed, as well as ongoing actions, are considered reasonably foreseeable. Given the highly speculative nature of many proposals prior to filing, and the lack of any substantive information regarding each project, projects that have not submitted license or permit applications are not included in this analysis.

6.1 PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

Past, present, and reasonably foreseeable future actions considered in this analysis were identified through consultation with various resource agencies, the public, and published media reports. These actions include other existing and proposed energy projects similar to the NEG Project, dredging projects, dredged material disposal sites, wastewater treatment plant outfalls, and various Federal and state fishery management and endangered species protection programs. A general description of these actions is provided below organized into past and present actions and reasonably foreseeable future actions.

6.1.1 Past and Present Actions

The environmental effects of past and present actions are reflected in the existing environmental conditions of the Project area. The following are the major actions affecting the Project area.

[1] Title 40 CFR Section 1508.7

Everett LNG Terminal

The Everett LNG terminal is an existing LNG import terminal located in Everett, Massachusetts. The terminal received its first shipment of LNG in November 1971. The 35-acre site includes a marine terminal for cargo unloading, two double-walled above-ground LNG storage tanks, and associated equipment. The operations at Everett have the potential to contribute to cumulative effects on marine mammals and vessel traffic.

Massachusetts Bay Disposal Site

The Massachusetts Bay Disposal Site (MBDS), which is located approximately 1 mile from the proposed NEG Port site and encompasses approximately 5,300 acres, is an USEPA-designated ocean disposal site regulated under the Ocean Dumping Act. The MBDS is used for the disposal of suitable dredged sediments from Boston Harbor and other coastal Massachusetts community dredging projects. The quantities of dredged material disposed at the MBDS from these various projects vary annually. Between 1982 and 2004, dredged material disposal has ranged from less than 100,000 to greater than 2.5 million cubic yards per year, averaging approximately 500,000 cubic yards per year (www.nae.usace.army.mil/environm/damos/mbdsmap_2.htm). The Boston Harbor Navigation Improvement Project – Phase II and the Outer Harbor Maintenance Dredging Project have contributed approximately 3.5 million cubic yards of dredged material to MBDS between 1998 and 2005. The MBDS is still actively used for dredged material disposal and is expected to be adequate to meet the dredged material disposal needs of Boston Harbor through 2026.

Massachusetts Water Resources Authority (MWRA) Outfall

The MWRA outfall is located about 8 miles (7 nautical miles) southwest of the proposed NEG Port site within Massachusetts Bay. The MWRA outfall discharges treated effluent from the primary and secondary treatment plant on Deer Island. The effluent enters the deep waters of the bay through 55 riser pipes along the last 1.25 miles (2.01 kilometers) of the tunnel. On average approximately 350 million gallons per day (mgd) are discharged, however, during extreme wet periods in spring, up to 1.3 billion gallons per day can be released into Massachusetts Bay. There are at least 12 other smaller wastewater treatment plants that discharge treated effluent into Massachusetts Bay.

HubLine Natural Gas Pipeline, Algonquin Gas Transmission, LLC.

The HubLine natural gas pipeline was constructed by Algonquin Gas Transmission Company in Massachusetts Bay in 2002 and 2003. This 29.4-mile-long, 24- to 30-inch-diameter pipeline runs from Salem/Beverly to Weymouth and is generally buried with a minimum depth of 3 feet. Horizontal directional drilling, conventional dredging, jetting, plowing, and blasting were all part of the construction process and collectively affected the marine environment and living resources. Depending upon the type of equipment used, the area of disturbed sediments along the pipeline pathway caused by trenching and back-filling varied to as wide as approximately 70 feet.

Commercial and Recreational Vessel Traffic

A wide variety of commercial and recreational vessels use Massachusetts Bay. The Massachusetts Port Authority (Massport) is an independent agency that develops, promotes, and manages the seaport and transportation infrastructure of the Commonwealth of Massachusetts, including the Port of Boston. The Boston Harbor is home to the Conley terminal for cargo shipments and the Moran terminal for automobile imports. These two terminals handle more than 1.3 million tons of general cargo, 1.5 million tons of non-fuels bulk cargo, and 12.8 million tons of bulk fuel cargos yearly. The Black Falcon Cruise terminal, in the Boston Marine Industrial Park, served more than 210,000 cruise passengers in 2005.

Cargo and cruise ship use the Boston Harbor Traffic Separation Scheme (TSS) for travel into and out of the Boston Port. Table 6-1 provides estimates of the number of one-way trips per year on Massachusetts Bay. These vessels cumulatively affect marine transportation, but also can affect water quality by using seawater (either directly or indirectly) to cool their engines.

Table 6-1
Commercial and Recreational Vessels in Massachusetts Bay

Vessel Type	No. of One-Way Trips per Year[1]
Large Commercial Vessels (e.g., Container, Cruise, Bulk, and Tanker)	2,280
Medium commercial Vessels (e.g., Tugs)	~7,000 (includes harbor escort tug)
Small Commercial Vessels (e.g., Whale Watching, Fishing “Party” Boats)	~260,000
Other (e.g., Government, Military)	Unknown
Large Commercial Fishing Vessels	~10,000
Very Small Commercial Fishing Vessels/Recreational Vessels (40-225 horsepower engine)	~2.65 Million

Notes: Types of equipment carried on each type of vessel was based on actual representative vessels, however there are many configurations and sizes of vessels.
[1]Intec Engineering, 2005.
Government/Military vessel operations are not publicly tracked.

Resource Management Programs

The Federal and state resource agencies responsible for Massachusetts Bay and the Gulf of Maine have implemented various fishery management and endangered species protection programs. A few major programs are briefly described below.

Area Fishing Restrictions

Historically, the marine fishery resource of Massachusetts Bay has played an important role in the development of culture and commerce in the communities bordering the bay. The commercial fisheries and annual catch have diminished over the last several decades due to overfishing by both foreign and domestic fleets (GTFMGI, 2004). Federal Fishery Management Zones (FFMZs) are marine protected areas where fishing for some or all species is prohibited, or “closed,” to protect critical habitats, rebuild fish stocks, ensure against overfishing, or enhance fishery yield. Closures may or may not be permanent, depending on how fish stocks respond. During closed periods, no fishing vessel or person on a fishing vessel may enter, transit, or fish in these areas. Also, with certain exceptions, no fishing gear capable of catching northeast multispecies may be on board a vessel in these areas during the closure periods (NMFS, 2004a). Through active management by the New England Fisheries Management Council (NEFMC), and for some species, in consultation/joint management with the Mid-Atlantic Fisheries Management Council and/or the Atlantic States Marine Fisheries Commission (ASMFC), this fishing area still provides resources that support a small vessel commercial fishery. Presently a reduced, but still extensive, and active domestic finfish fishery continues within the Massachusetts Bay and surrounding waters from adjacent coastal communities. Approximately 450 commercial finfish vessels fish in and around the Stellwagen Bank area. Present day management efforts include minimum mesh size, fish size limit, and closure areas within the Massachusetts Bay area.

The NEFMC is one of eight regional councils created through the MSA to manage living marine resources in the Federal waters of the Exclusive Economic Zone (EEZ). The NEFMC creates Fishery Management Plans (FMPs) for those species that are being depleted through overfishing, by catch, or loss of EFH. The NEFMC generally updates FMPs for each species every 2 to 3 years. As described in section 3.8.3, there are a number of restrictions including time at sea limitations and periodic area closures. At this time no new area closures are expected for the next 2 to 3 year period (Kellogg, 2006; NEFMC, 2006).

MDMF is the state agency responsible for managing commercial and recreational fisheries off the coast of Massachusetts. MDMF manages several programs and projects in the Massachusetts state waters to protect the diverse marine resources. MDMF and NEFMC work together along with the ASMFC to develop and implement FMPs. MDMF also manages mitigation and restoration projects. New projects include the Boston Harbor Artificial Reef Program to enhance habitat for lobsters and finfish in the area adjacent to the HubLine.

Whale Protection Projects

Massachusetts Bay supports an abundance of marine animals, especially large whales. The Stellwagen Bank area, in particular, provides feeding areas for migratory large whales including the endangered North Atlantic right whale and the humpback whale. As described in section 3.2.4 and 3.3, there are several species of whales that are threatened or endangered, primarily due to historic overfishing by both domestic and foreign whaling operations.

The Commonwealth right whale Conservation Program was developed in 1996 to address the threats to North Atlantic right whales in Massachusetts state waters. It is managed by MDMF in support of the Large Whale Take Reduction Plan.

On June 1, 2004, NMFS published an Advanced Notice of Proposed Rulemaking (ANPR) and is currently writing an EIS to analyze the potential impacts of implementing the operational measures of NOAA’s right whale Ship Strike Reduction Strategy (Strategy). The Strategy for the Gulf of Maine could include the possible movement of the Traffic Separation Scheme (TSS) and seasonal speed restrictions (69 FR 30857). The existing volume of vessel traffic coupled with future increases in the number of vessels could contribute to higher impacts on all whales in Massachusetts Bay.

6.1.2 Reasonably Foreseeable Future Actions

Major reasonably foreseeable future projects that have the potential to cumulatively affect the resources of the Project area are discussed below.

Proposed Energy Projects in Massachusetts Bay

Since the amendment of the DWPA in 2002 to encompass deepwater ports for natural gas, the USCG has received two LNG Deepwater Port license applications for Massachusetts Bay. In addition to the NEG Project, the USCG and MARAD have received a license application for the Neptune Project, which would be located approximately 5 miles from the proposed NEG Port. In addition, AES Battery Rock LLC announced in September 2005 its intention to build an LNG terminal on Outer Brewster Island near Boston, which would be subject to FERC jurisdiction.

Neptune LNG Deepwater Port

Neptune LNG LLC (Neptune), a subsidiary of Tractabel-Suez, proposes to construct and operate a deepwater port for LNG approximately 22 miles (35 km) east of Boston, Massachusetts, in federal waters less than 5 miles from the proposed NEG Port site. The proposed port, utilizing two submerged unloading buoys, would moor specially designed ships equipped to store, transport, and vaporize LNG. The two buoys would interconnect via a riser, PLEM, and pipeline with the existing HubLine. The average output would be 400 MMcfd and the ships would moor for 4 to 8 days, depending on vessel size, vaporizer throughput, and market demand. The Neptune application for a Deepwater Port License was determined to be complete and noticed in the Federal Register on October 7, 2005. The DEIS was issued by the USCG on June 2, 2006. Neptune estimates project startup for commercial operation in mid-2009.

AES Battery Rock LNG Terminal

AES Battery Rock LLC has announced its intention to construct an LNG import terminal on Outer Brewster Island in Massachusetts Bay. The project would be approximately 14 miles (23 km) from the Northeast Gateway port site. The AES project would provide 800 MMcfd of natural gas. No application has yet been submitted to FERC, and no pre-filing information has been provided. Specific project information will not be available for assessment or public review until a complete application is available on the FERC Docket, at which time the FERC will actively evaluate potential impacts for the proposal. No additional information is currently available. The Massachusetts Legislative committee voted against this project on March 15, 2006, but sent it to a study committee for further review.

Navigational Dredging Projects

The ACOE is planning two dredging projects that would dispose of dredged materials at the MBDS near the Project area. These projects include dredging the Mystic River and Marine Ship Channel as part of the Inner Harbor Maintenance Dredging Project. This dredging project is expected to begin in 2006, will take two years, and will dispose of approximately 1.9 million cubic yards of dredged material at MBDS. The ACOE is also planning the Deep Draft Navigation Improvement Project between 2010 and 2013, which will focus on the inbound shipping channels around Spectacle Island, and include the Main Ship Channel, the upper section of the reserved Channel, a portion of the Charles River Channel, and possibly a portion of the Chelsea River near the Chelsea River Bridge (Keegan, 2006). This project would dispose between 6 and 7 million cubic yards at MBDS.

6.1.3 Summary of Past, Present, and Reasonably Foreseeable Future Actions

Table 6-2 provides a list of the past, present, and reasonably foreseeable future actions within Massachusetts Bay that have the potential, in combination with the NEG Project, to cumulatively affect environmental resources. For each action, the resource areas that are potentially cumulatively affected are listed.

Table 6-2

Past, Present, and Reasonably Foreseeable Future Actions Considered in the Cumulative Impact Assessment for Massachusetts Bay

Action	Permitting Status / Timeframe	Distance from NEG Port	Potential Cumulative Resource Areas
Proposed NEG LNG Deepwater Port Massachusetts Bay	Application submitted to MARAD/USCG June 2005	N/A	Water quality, biological resources, threatened and endangered species, essential fish habitat, geological resources, ocean use, visual resources, socioeconomics, transportation, air quality, noise, and safety
Proposed Neptune LNG Deepwater Port Massachusetts Bay	Application submitted to MARAD/USCG February 2005	5 miles	Water quality, biological resources, threatened and endangered species, essential fish habitat, geological resources, ocean use, visual resources, socioeconomics, transportation, air quality, noise, and safety
AES Battery Rock LNG Terminal, Outer Brewster Island, Massachusetts Bay	No application filed with FERC.	14 miles	Marine mammals, threatened and endangered species, socioeconomics, transportation, and air quality
Massachusetts Bay Disposal Site (MBDS)	In use	1 mile	Water quality, marine mammals, threatened and endangered species, and geology
HubLine Natural Gas Pipeline	In operation	10 miles	Biological resources (primarily benthic)
Everett LNG Terminal Boston, MA	In operation	25 miles	Marine mammals, threatened and endangered species, and transportation
MWRA Wastewater Effluent Outfall	In use	10 miles	Water quality
Commercial and Industrial Vessel traffic in Massachusetts Bay and Gulf of Maine	Ongoing	Includes Project area	Water quality, biological resources, transportation, marine mammals, threatened and endangered species, and air quality
Commercial and Recreational Fishing Area Restrictions in Federal waters.	Rolling fishing limitations in the immediate vicinity to help meet FMPs	Includes Project area	Biological resources and socioeconomics
Speed Reduction Zones in Massachusetts Bay	Unknown	Unknown	Marine mammals, threatened and endangered species, and transportation
right whale Protection	NMFS is currently preparing an EIS	Includes Project area	Marine mammals and threatened and endangered species
Traffic Separation Scheme Shift, Massachusetts Bay	Anticipated shift in ship traffic	Adjacent to project area	Marine mammals and threatened and endangered species

Other Energy Projects

Numerous other LNG import terminals as well as other energy facilities are proposed for the northeastern United States and the Canadian Maritime Provinces. Because the habitat for northern right whales extends from north of the Canadian border to Florida, all existing and proposed LNG terminals on the east coast of the United States could impact the right whale as a result of their LNG shipments. Any lethal right whale strike would be considered a population level impact since there are so few remaining right whales. Therefore, all existing and proposed LNG terminals in the eastern United States are included in this cumulative impact analysis strictly because of the potential cumulative effects on right whales and other marine mammals (see Table 6-3).

Table 6-3

Regional LNG Projects Considered

Project	Description	Distance from NEG Port	Permitting Status	Potential Cumulative Resource Areas
Weaver's Cove LNG Terminal, MA	Onshore, 0.4 -0.8 bcfd	55 mi	FERC certificate issued in 2005.	Marine mammals
Broadwater Energy LNG Terminal, Long Island, NY	Offshore 1.25 bcfd [a]	150 mi	Application under review with FERC	Marine mammals
Safe Harbor Energy LNG Terminal, NY	2.0 bcfd	150 mi	Unknown	Marine mammals
Quoddy LNG Terminal, ME	Onshore, 0.5 bcfd [b]	251 miles	Pre-application process with FERC	Marine mammals
Downeast LNG Terminal, ME	Onshore, 0.5 bcfd [c]	254 miles	Pre-application process with FERC	Marine mammals
Crown Landing LNG Terminal, NJ	Onshore, 1.2 bcfd [d]	306 miles	Final EIS issued in May 2006	Marine mammals
Somerset LNG Terminal, ME	Onshore, 0.65 bcfd [e]	Unknown	Unknown	Marine mammals
BP Consulting LNG Terminal , ME	Onshore [f]	Unknown	No application filed with FERC	Marine mammals
Freedom Energy Center/ Philadelphia Gas Works, PA	Onshore 0.6 bcfd	290 mi	No application filed with FERC	Marine mammals
AES Sparrows Point LNG Terminal; MD	Onshore 1.5 bcfd	380 mi	Pre-application process with FERC	Marine mammals
Cove Point LNG Terminal, MD	Onshore, 1.8 bcfd	410 mi	Currently operating	Marine mammals
Elba Island, GA	Onshore, 2.0 bcfd	915 mi	Currently operating	Marine mammals
Rabaska, Canada [g]	0.5 bcfd	335 miles	Begin operations in late 2009	Marine mammals
Gros Cacouna Energy, Canada [h]	0.5 bcfd	360 miles	Begin operations in late 2009	Marine mammals
Canaport LNG, New Brunswick [i]	0.5 to 1.0 bcfd	320 miles	Begin operations in 2008	Marine mammals
Bear Head LNG, Nova Scotia [j]	0.75 to 1.0 bcfd	500 miles	Construction activities slowed	Marine mammals
Goldboro LNG, Nova Scotia [k]	1 to 2 bcfd	490 miles	Begin operations after 2011	Marine mammals

Sources:

[a] *Federal Register* 70(160): 48698–48701, August 19, 2005; [b] Quoddy 2005a, b; [c] Downeast 2005a, b; [d] Crown Landing 2005; [e] NGA 2005; [f] Rabaska 2005; [g] Cacouna undated(a), undated(b); [h] Ocean Resources 2005, Irving Oil 2005; [i] Anadarko 2005a, b, c; [j] Nova Scotia 2005a, b, c; [k] CNW Group 2005

6.1.4 Single Natural Gas Interconnection Pipeline

Given the close proximity between the proposed NEG and Neptune Project pipeline laterals, the possibility has been raised of constructing a single pipeline to connect both projects to the HubLine natural gas pipeline. This option is being examined under cumulative impacts because it involves both projects. It is not considered an alternative to NEG's proposed pipeline, because it would only occur if both projects were permitted. A single offshore pipeline with two or more facilities supplying gas into it is an arrangement that exists at other projects. This discussion of a single combined pipeline considers a number of factors including the needs of all parties involved, engineering and construction requirements, environmental impact, cost, timing, permitting, jurisdictional, business and additional considerations.

6.1.4.1 Engineering Feasibility

Currently, the Neptune and NEG projects each propose separate 24-inch-diameter pipelines, 13.1 and 16.1 miles long, respectively, which would each require an approximately 65-foot-wide plowing corridor. The engineering feasibility was evaluated for two alternatives: a 7.6 mile 30-inch combined pipeline and a 12.7 mile 36-inch combined pipeline.

7.6 Mile 30-inch Combined Pipeline

The first alternative, shown in Figure 6-1, would replace the two proposed, parallel, 24-inch diameter laterals with a single, 30-inch diameter lateral from the HubLine pipeline to approximately MP 7.6 on the NEG Pipeline Lateral route. Based on the maximum proposed flow rates of 800,000 Mcfd for NEG and 750,000 Mcfd for Neptune, Algonquin estimates that a 30-inch diameter pipe would be required to accommodate the volumes and pressures contemplated by both ports for a 7.6 mile combined pipe. The remaining connections to the respective buoy locations would be accomplished with 24-inch diameter pipelines (i.e., 5.9 miles of 24-inch pipe for Neptune and 8.5 miles of 24-inch pipe for NEG) and flowlines identical to the proposals for each Project. Suez estimates a slightly different tie-in point that would result in a 6.5-mile pipe for the Neptune Project.

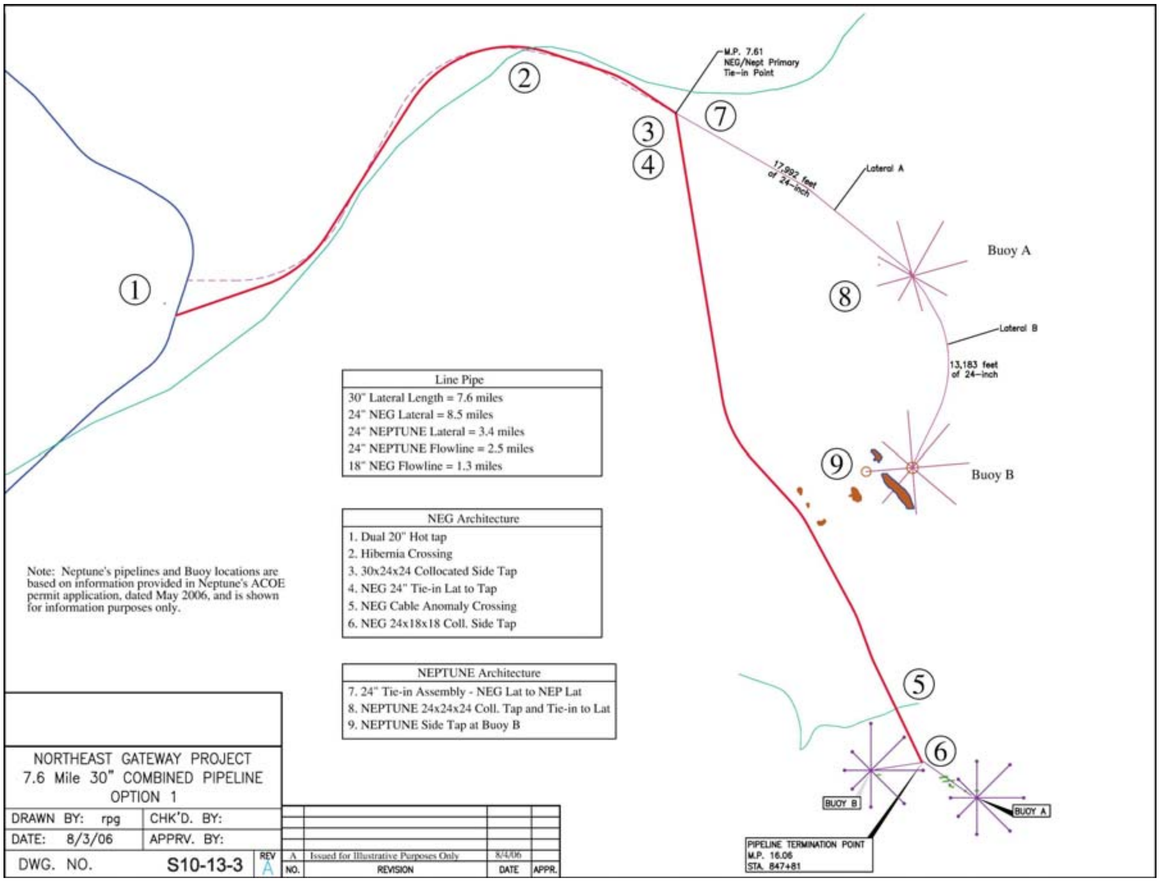

Figure 6-1. Single Pipeline Option 1 – 7.6 mile 30-inch Line

12.7 Mile 36-inch Combined Pipeline

The second option, shown in Figure 6-2, would replace the two proposed, parallel, 24-inch diameter laterals with a single, 36-inch diameter pipeline from HubLine to approximately MP 12.7 on the NEG Pipeline Lateral route, which is the closest point on that route to the proposed locations for the Neptune buoys. Based on the maximum proposed flow rates stated above and the extension of the length of the combined pipeline to MP 12.7 along the route of the pipeline lateral, a 36-inch diameter pipe would be necessary to accommodate the delivery quantities and ensure adequate pressure from the operation of both ports. From MP 12.7, two 24-inch diameter pipes would diverge to each respective ports. NEG's 24-inch pipe would extend approximately 3.4 miles to its proposed termination point and Neptune's 24-inch pipe would run in a northeasterly direction for approximately 1.6 miles to Neptune's southern buoy and then another 2.5 miles to its northern buoy.

Under either option, the flowlines (i.e., the segments of pipeline from the termination of the pipeline laterals to the subsea manifolds for the ports) for both the NEG Project and the Neptune Project would be essentially the same as in the existing proposals.

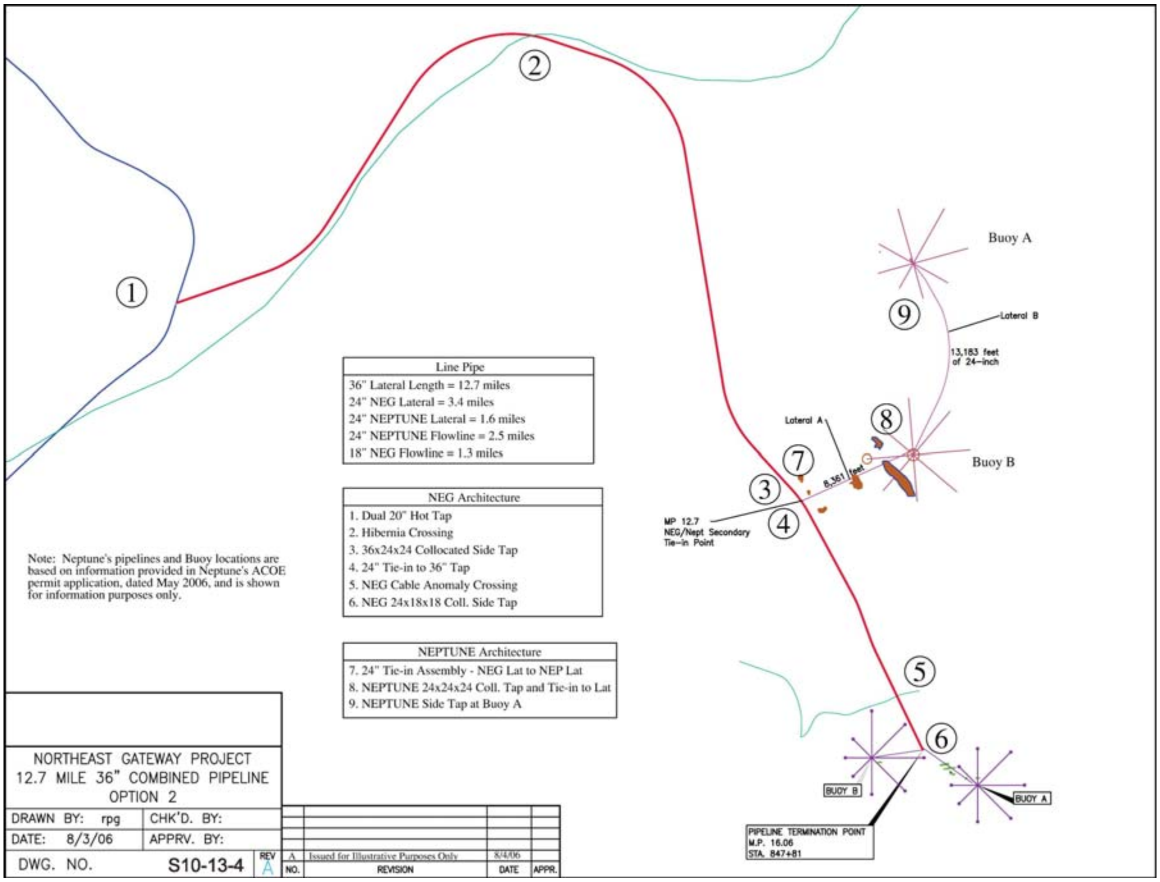

Figure 6-2. Single Pipeline Option 2 – 12.7 mile 36-inch Line

Additional Facilities

Under each of the combined pipeline options, at least two 20-inch taps into HubLine would be needed to connect via a manifold to the combined pipeline. Also, either at MP 7.6 or MP 12.7 where the 24-inch lines would diverge to the two ports under the two different scenarios, each alternative would require an additional assembly of side taps, valves and pigging connections for each separate pipeline as it interconnects with the combined pipeline. These facilities would be similar to the interconnection assemblies that are currently proposed, and would be required, at the ends of NEG's and Neptune's 24-inch laterals, respectively.

6.1.4.2 Construction Requirements

Installation of 30- or 36-inch pipe would require two passes of the burial plow to achieve the target burial depth. The deeper trench would lengthen the transition zones resulting from the initiation and cessation of the plowing process by approximately 50 percent over the proposed scenario in order to accommodate a second plow pass and the need for adequate soil support for the plow when starting the second pass. It would also require additional jetting to achieve proper burial depth and cover.

Installation of 30- or 36-inch diameter pipe would extend the construction duration by approximately 3 months as a result of the increased time needed to lay the larger diameter pipeline, to complete the second plow pass, to install a second hot tap and the additional tie-in assemblies necessitated by the second hot tap, to connect the 24-inch pipelines to the 30-inch or 36-inch pipeline, and to complete the additional hydrostatic testing, dewatering and drying steps resulting from the increased design complexity of the combined pipeline system.

Schedule Impacts

As discussed in section 1.1, a number of studies forecast a need for additional natural gas supplies as early as the winter of 2006/2007, in New England. The purpose and need of the NEG Project is to meet that demand in 2007, while the Neptune project looks to fill this demand in 2009. Any delays to schedule associated with the single pipeline would impact the NEG proposed in-service date. Delays could also have implications on contractors and the availability of materials. The queue at the pipe mills capable of rolling large diameter pipe is extremely tight due to world-wide demand, which was exacerbated by last year's hurricane damage in the Gulf of Mexico, and pipe mills indicate that the deadline for ordering the larger diameter pipe for a spring 2007 commencement date for construction is fast approaching. Given these constraints, it is unlikely that the larger 30- or 36-inch pipe would be available in time to meet an in-service date of late-2007.

The equipment necessary to construct a 30-inch or 36-inch diameter pipeline in many cases is different than that required for installation of 24-inch pipe, and its availability more limited. Because of the heightened activity in off-shore construction due to the 2005 hurricanes and the increase in oil and gas work internationally, offshore pipeline contractors and their equipment are in short supply, with the majority of the contractors booked well into 2008. Absent an agreement between NEG and Suez to construct a single pipeline, and by regulators to approve a combined pipeline, it is highly unlikely that contractors would be available to start work in time to flow gas by late 2007.

6.1.4.3 Environmental Impacts

Comparative Mileage

Table 6-4 compares the length of the 30- and 36-inch combined pipelines. Were both projects constructed using the 7.6 Mile 30-inch combined pipeline, the total mileage of 30-inch and 24-inch pipelines for the two projects would total approximately 22.0 miles.[2]

Were both projects constructed using 36-inch combined pipeline, the combined mileage of 36-inch pipeline and 24-inch pipeline for the two projects would total approximately 20.2 miles.

Table 6-4
Length, in Miles, of as-Filed and Optional Routes

Option	NEG	Neptune	Total	Variance to As-Filed
As-Filed	16.1	13.3	29.4	
30" to MP 7.6	16.1	5.9	22.0	-7.4
36" to MP 12.7	16.1	4.1	20.2	-9.2

[2] A slight discrepancy in the mileage figures results due to the fact that Neptune's pipeline does not start and finish at the same exact tie-in point on HubLine as proposed by the NEG Project in its filing.

Sea Floor Impacts

At least two 20-inch taps would be required into the HubLine under a combined pipe scenario, and the associated manifold would require a greater amount of sea floor disturbance due to the increased jetting required in that specific area. The facilities required for the interconnections to the 24-inch pipelines at MP 7.6 or MP 12.7 would require additional jetting not previously contemplated, and the length of the Hibernia cable crossing would have to be extended to accommodate the more rigid, larger diameter pipeline. This would increase the length of surface lay, lengthen the plow transitions and require more jetting along the crossing. As a result, while the linear pipeline reduction results in a route length savings for the two alternatives of 25 percent and 31 percent, respectively, the estimate of the corresponding sea floor impact acreage savings results is slightly less at approximately 20 and 23 percent, respectively, as noted in Table 6-5.

Table 6-5

Acres of Sea Floor Affected

Option	NEG	Neptune	Total	Variance (acres)	Variance (percent)
Projects as Filed	1000	793	1793		
30-inch To MP 7.6	1086	352	1438	-355	-20%
36-inch To MP 12.7	1147	235	1382	-411	-23%

Only preliminary surveying has been performed of the alternate 24-inch pipeline corridor between the 36-inch pipeline lateral at MP 12.7 and the Neptune flowlines. ROV surveys, vibracores, and other detailed assessments could be required for Suez prior to laying pipe in this area. Should the combined routes contain some hard bottom and/or rock areas, construction methods would require additional plowing, jetting or the use of rock or mat cover. The extra time required for construction of the larger pipelines would also increase the potential for construction overlapping with a critical time period for an important marine species (see construction timing discussion in section 2.2.6).

6.1.4.4 Jurisdiction and Operational Feasibility

Cost

While construction of a single pipeline would likely reduce Suez's pipeline capital costs by 50 to 65 percent[3] depending on which single pipeline alternative was developed, construction of either of the combined pipeline options would be more costly for NEG than the total cost of building its pipeline lateral separately. The equipment required to build the 30-inch or 36-inch pipeline would be over-equipped for the installation of the remaining 24-inch pipeline sections and carry a larger cost per mile, but the separate costs to mobilize separate vessels from the Gulf of Mexico or international locations just to build a portion of the pipelines would not justify the use of separate vessels for the two differently sized pipelines. As a result, the cost of constructing the remaining portion of the 24-inch diameter pipeline with the larger vessels would increase

[3] Cost estimate based on amount saved due to reduced pipeline length. This estimate does not account for any contribution from Suez to the cost of the single pipeline.

significantly on a per-mile basis, resulting in an overall increase in construction cost to the first developer, which would be passed on to natural gas consumers.

After factoring in an estimate for the reduced cost of the Neptune Project resulting from the reduction in the length in its 24-inch diameter pipeline, estimated total costs to install the two projects would increase 12 percent and 20 percent for the 30-inch and 36-inch combined pipeline alternatives, respectively.[4]

Jurisdictional/Permitting Issues

At this time, a combined pipeline route has not been evaluated in either the NEPA or MEPA processes and would likely require the filing of a Notice of Project Change. In addition, no entity has submitted an application to either the FERC or MARAD for a combined pipeline. Applications for the other permits, such as a waterways license and water quality certificate from the MDEP and Orders of Conditions from local municipalities, would also be necessary to construct a combined pipeline. The time to prepare, file and process those applications would likely place construction start-up in 2008, at the earliest.

Since there is no certainty that both projects will be built, there is a risk that the additional environmental impacts that would result from construction of a single combined pipeline would occur if one of the projects decided not to move forward with its development. Finally, should a larger single pipe be installed and one of the projects not be constructed, the available capacity presented by the presence of the larger pipe could be a lure to other LNG developers to pursue the undeveloped site.

6.2 POTENTIAL CUMULATIVE IMPACTS BY RESOURCE AREA

This section evaluates resource-specific impacts related to past, present and reasonably foreseeable future actions identified in section 6.1. Only those actions that may cumulatively affect a resource area in combination with the construction or operation of the NEG Project are considered.

6.2.1 Water Quality

6.2.1.1 Regional Context

Various historic and current activities have degraded Massachusetts Bay water quality over time. Discharge from an increasing number of power plants, vessel operations, as well as increased dredging activity have all created a trend of increased impact to the water quality of Massachusetts Bay. Currently, water quality impacts in the Project area are driven by activity at the MBDS, outfall at the MWRA and multiple discharges from waste water treatment plants.

6.2.1.2 Local Setting

The water quality of Massachusetts Bay reflects the effects of changes in land use, wastewater and industrial discharges, vessel operations, and dredging activity, among other

[4] This calculation assumes that Algonquin could resell the 24-inch diameter pipe it already purchased that is currently in storage if the 30-inch or 36-inch pipe were used, and did not include an escalator to account for the differences in the base year used for each applicant's Exhibit K (Algonquin's is 2007 costs; Neptune's is 2009).

factors. Water quality in the Project area is primarily affected by ongoing dredged material disposal at the MBDS, wastewater discharges from MWRA, and vessel operations. Reasonably foreseeable future actions with the potential to affect water quality in Massachusetts Bay include the NEG and Neptune deepwater port projects and the onshore Battery Rock LNG terminal. The effects of these past, present, and future actions on water quality is evaluated below by key water quality parameters.

Turbidity

Turbidity levels would be affected by construction of the proposed projects and by activity at the MDBS. Dredge material disposal in the MBDS is ongoing in the immediate vicinity of the proposed NEG Project. Disposal volumes ranging from around 900,000 cubic yards (688,099 cubic meters) in 2000 to less than 100,000 cubic yards (76,455 cubic meters) in 2003 were dumped near indicator buoys within an area that encompasses 5,312 acres (2,150 hectares). Disposal activity at the MBDS causes short-term turbidity in the water column and changes in the seafloor where material is dumped. Dumping has been occurring over the last several decades and presently consists of materials removed during dredging of the Boston Harbor and other nearby harbors when dredged materials are found to be uncontaminated and suitable for open ocean disposal. Should the proposed widening of Boston Harbor occur, disposal volumes could increase.

The incremental impact associated from the proposed projects in addition to the existing MDBS activity would be minor. The total volume of bottom material that would be disturbed by NEG construction activities and potentially suspended into the water column would be small. The Neptune project has the potential to disturb a larger volume of bottom material, if that project is built where it is presently proposed. Neptune's proposed location is in an area of geologic deposition, where the installation of sea anchors, pipelines/flowlines and other structures during construction and the scouring of anchor chains and risers during terminal operations would stir up sediments and increase turbidity. The spatial extent would be limited due to the short time period that material stays in the water column and rapid dilution in an open ocean setting for both projects. In addition, the transport of plumes vertically into near surface waters, where the majority of plankton growth occurs, would be highly unlikely.

Sediment samples collected at the proposed pipeline construction anchor locations fall within MDEP chemical Class 1. Sediment contaminant concentrations within the Project area are expected to be low and the rapid dilution of the plume and the limited area it occupies would reduce the likelihood of transport and keep these effects to a minimum. Resuspension of toxic materials during construction and/or operation of the Pipeline Lateral or Deepwater Port is not anticipated. Impacts to the water column, resulting from the presence of the sediment plume are temporary and localized due to the nature of the plowing and backfill plowing activities. The spatial extent is also limited due to the short time period that material stays in the water column and rapid dilution in an open ocean setting. Because the plow and backfill plow would move along the length of the pipeline at rates potentially up to several miles a day, there would be little potential for generation of a dense, concentrated plume. Impacts to the water column resulting from the presence of the sediment plume would be temporary and localized for each of the proposed projects, and taken together, would result in a minor cumulative impact. No change in water column turbidity is anticipated during routine operation of either Port, and this would result in a minor long-term adverse effect.

The addition of up to two new natural gas pipelines associated with the Neptune and NEG deepwater ports would add approximately 25.4 miles of new offshore pipeline in Massachusetts Bay in addition to the existing HubLine. Current construction schedules for the Neptune and NEG projects do not coincide – NEG construction is scheduled for 2007 while

Neptune construction is scheduled for 2009, thus there are no expected cumulative impacts on water quality from pipeline construction. If a single pipeline was constructed to connect both ports, the total impacts on water quality would be reduced because the area disturbed would be reduced by between 20 and 23 percent.

Pipeline installation activities would only produce short-term, minor, direct, adverse impacts on marine water quality.

Water Intake and Discharges

Water quality impacts from vessel water intakes are discussed below. Water intake effects on Plankton are discussed in section 6.2.2.3.

Dissolved Oxygen

Based on results from HubLine construction, no reduction in DO concentration would be expected during construction of either the NEG or the Neptune Port or Pipeline Lateral projects. Waste discharged during operation of either port would be minimal and would result in a direct, long-term, minor adverse effect on DO levels in either port area as the waste material is assimilated. Taken together, the two ports would have a minor impact on DO during either project construction or operation.

Nutrients

Anthropogenic sources of nutrients near the Project area primarily include the MWRA outfall, which discharges treated effluent from the secondary treatment plant on Deer Island. On average approximately 350 MGD are discharged at a site 9.5 miles east of Boston; however, during extreme wet periods in spring, up to 1.3 billion gallons per day can be released into Massachusetts Bay. At least twelve other waste treatment plants release treated wastewater into Massachusetts Bay. Any release of nutrients from bottom sediments during construction of either project would be much smaller than the contribution of nutrients to Massachusetts Bay from the MWRA outfall (e.g., 27.5 tons of ammonia per day) (Wu, 2003), which has not resulted in substantial increases in phytoplankton biomass, whether measured as phytoplankton abundance or chlorophyll-a (Libby et al., 2004). Furthermore, modelers have found that MWRA treatment plant effluent is only a minor component of the total nitrogen loading (approximately 3 percent) into Massachusetts Bay, while the Gulf of Maine contributes 92 percent of the total nitrogen (HydroQual, 2000). The incremental increase in nutrient levels from both proposed projects would not result in a cumulatively major impact.

The amount of waste discharged during operations for either project from treated blackwater, graywater, or food waste is minor and not expected to affect nutrient levels in the area due to either port or to the two ports taken together.

Fecal Coliform

Assuming full compliance with Annex IV of MARPOL by both projects, construction and operation of the NEG and Neptune projects would not result in the introduction of fecal coliforms or pathogenic organisms into the water column. Therefore, no cumulative impact on fecal coliform levels would occur.

Temperature

The proposed NEG and Neptune projects would involve additional water intake and discharge from Massachusetts Bay. To provide an assessment of potential cumulative water quality impacts on temperature from the additional vessel traffic to be added to Massachusetts Bay from these projects, the engine horsepower, engine cooling water rates and the annual number of hours commercial (e.g., tanker, natural gas, cargo cruise, fishing, and tug/barge) and private vessels operate in Massachusetts Bay and Cape Cod Bay has been estimated.

All vessels powered by engines must cool the engines. Most engine designs circulate seawater through engine coolers in a once-through process. Although advanced cooling systems do not circulate cooling water directly, but use intermediate loops to restrict direct contact of seawater, all engine cooling systems put heat into the seawater (either directly or indirectly) to cool the engines. The overall impact of this thermal pollution is not known.

Table 6-6 summarizes engine horsepower, and engine cooling water rates for the representative range of marine diesel engines that are present in vessels transiting Massachusetts Bay and Cape Cod Bay. Table 6-7 provides typical overboard discharges for vessels in Massachusetts Bay.

Table 6-6
Typical Cooling Water (Raw Water) Overboard Discharge by Brake Horsepower

Engine HP	Representative Marine Diesel Engine	Raw Water Discharge (GPM)
300	Caterpillar C7	78
500	Cat C9	63
800	Cat 3412C	35
1,000	Cat 3412E	173
1,200	Cat 3512	192
1,500	Cat 3512	192
2,000	Cat 3512C	192
2,130	Cat 3516B	192
2,500	Cat 3516C	192
Other	Cat 3508	192
21,000	MAK 16M43C	1,145

Source: Cleveland 2006; Deissler 2006

Table 6-7

Typical Overboard Discharge for Vessels in Massachusetts Bay

Vessel Type	Assumed Equipment in Operation	Typical Overboard Discharge Rate (GPM)	Number of one-way Trips per Year	Typical Time Spent in Mass. Bay or Cape Cod Bay (hours)	Total Annual Time in Mass. Bay or Cape Cod Bay (hours)	Typical Annual Discharge (Gallons)
Large Commercial Vessels (e.g., Container, Cruise, Bulk, and Tanker)	1 Main Diesel Engine (10,000-80,000 HP) Typical~21,000 HP/ 2X Diesel Generators (2,000 HP each)	1,145/384	3,131	16	50,096	4.6 Billion
Medium Commercial Vessels (e.g., Tugs)	2X Main Diesel Engine (2500 HP each)/ 2X Generators (500 HP each)	384	~7,000 (includes harbor escort tug estimate)	6	42,000	968 Million
Small Commercial Vessels (e.g., Whale Watching, Fishing “Party” Boats)	1 Main Diesel Engine (800 HP)	35	~260,000	4	1,040,000	2.18 Billion
Other (e.g., Government, Military)	2X Main Diesel Engine (3,200 HP each) / 2X Generators (500 HP each)	384/ 63	Unknown	Unknown	Conservative Estimate: 5,000	134 Million
Large Commercial Fishing Vessels	1 Main diesel Engine (2,100 HP) / 1 Generator (300 HP)	192/ 78	~10,000	8	80,000	1.3 Billion
Small Commercial Fishing Vessels / Recreational Vessels 40-225 HP Engine	1 X 40-225 HP Engine (Could be outboard or inboard)	~10	~2.65 Million	3	~7.95 Million	4.77 Billion

Assumptions:

- Caterpillar Engine data was used for estimation purposes. Not all vessels will use these engines.
- Types of equipment carried on each type of vessel was based on actual representative vessels, however there are many configurations and sizes of vessels.
- Hours spent in Massachusetts/Cape Cod Bay are estimated based on typical transit times in/out of the bays, and other non-tracked factors such as anchoring and conducting commercial fishing within the bays.
- Government/Military vessel operations are not publicly tracked. Data on engines and generators is based on equipment carried on mid size USCG Cutters, however types and sizes of craft vary widely.

The estimated total annual discharge from vessels in Massachusetts Bay is calculated as approximately 13.95 billion gallons. For comparison purposes, the NEG deepwater port will discharge 3.08 million gpd, or approximately 1.1 billion gallons per year total. Neptune would have no cooling water discharge. Discharges from these projects, therefore, represent an 8 percent increase to the estimated annual total discharges of 13.95 billion gallons from all estimated annual vessel traffic in Massachusetts Bay. It is not known, however, what the temperature affects of this discharge would be in relation to all thermal effects in Massachusetts

Bay. It is only currently know what the temperature effects are of discharges from the EBRV vessels.

Since the Neptune project does not have any cooling water discharges, the cumulative affects to the project area would come solely from the NEG Project. Temperature modeling for the NEG Project found that the maximum surface temperature elevation estimated by CORMIX was 1.1ºF (0.61ºC (summer conditions) with an estimated surface temperature elevation of 0.18 ºF (0.10ºC) at a distance of 1,640 feet (500 meters) downdrift from the discharge port. Modeling results indicate that the discharge would be relatively small and would mix quickly to near ambient temperatures. Potential cooling water discharge impacts from Neptune would be minor and highly localized relative to discharges from the MWRA sewage outfall (350 to 400 mmgpd, also with elevated temperature). In addition, the Neptune project and the NEG Project are proposed for installation at sufficient distance (5 miles) from one another such that there would be no interaction between the slight warming of water near the discharge points of the vessels with other vessel discharges. Therefore, the proposed projects would produce a direct, long-term, minor adverse impact on temperature due to either construction or operation.

These discharges would comply with all applicable regulations, including Clean Water Act 316(b) as regulated under NPDES. Specifics of this regulation can be found in the Applicant's NPDES permit application.

Construction of the ports, individually or combined, would have a direct, short-term, minor adverse effect on water quality through the alteration of the water column temperature. Although construction vessels for either project would use a small amount of seawater to cool diesel electric motors used, the discharge would be minimal.

Other Contaminants

Port construction and operation activities could release contaminants from the sediments; however, surveys of the area indicate that contaminated sediments are rare at the proposed NEG Port site. Continuous dumping of dredged sediments at MBDS causes longer-term impacts on water and sediment quality than those that would be associated with temporary port construction activities. Release of contaminants during the construction/operation of the proposed Neptune Project would also be minor. Since the sediment redistribution from construction activities would be temporary, and the offshore disposal area is outside the project area and in an area of deposition, there would be minor cumulative impacts regarding contaminated sediment redistribution.

Construction of the NEG Pipeline Lateral and flowlines would include hydrostatic testing with seawater, which would then be discharged into Massachusetts Bay. NEG has noted that it could be necessary to inject a biocide during the filling operations to inhibit microbially induced corrosion. Assuming that Neptune followed the same hydrostatic testing approach as the NEG Project, these releases would cumulatively produce direct, short-term, minor adverse impacts on water quality in Massachusetts Bay. This discharge would comply with all applicable regulations, including Clean Water Act 316(b) as regulated under NPDES. Specifics of this regulation can be found in the Applicant's NPDES permit application.

Data collected by the applicants indicate that sediment contaminant concentrations within either Project area would be low. The rapid dilution of the plume created from anchor chain sweep during Port operation and the limited area impacted by that activity would keep contamination effects to a minimum, and would result in a cumulatively direct, long-term, minor adverse impact.

Potential Spills and Releases

Compliance with MARPOL Annex I and IV and other applicable regulations would minimize the risk of any accidental discharge during both construction and operation of either port. Thus, the risk of accidental discharge would be small for both projects.

Summary

As discussed above, cumulative water quality impacts associated with the construction or operation of the NEG Project when considered together with the Neptune Project, MBDS, and MWRA outfall would be minor.

6.2.2 Biological Resources

The goal of the biological resources cumulative effects analysis is to determine if the proposed NEG Project, in combination with past impacts and the impacts of ongoing or proposed future activities, would lead to detrimental impacts to marine resources or ecosystems. Cumulative impacts are discussed in the sections below for the following marine resources: marine fish, benthic communities plankton, marine mammals, sea turtles, and seabirds.

6.2.2.1 Marine Fish

Regional context

Historically, the marine fishery resource of Massachusetts Bay has played an important role in the economics of coastal communities. The commercial fisheries and their harvest have diminished from the 20th century due to overfishing by both foreign and domestic fleets. Nonetheless, under active management of the NEFMC, and consultation/joint management with the Mid-Atlantic Fisheries Management Council and/or Atlantic Marine Fisheries Commission, this fishing area still provides resources that support a small vessel commercial fishery. In addition, there is a well-established lobster fishery**.**

Presently a reduced, but still extensive and active, domestic finfish fishery continues within the Massachusetts Bay and surrounding waters from adjacent coastal communities. One of the working groups of the Stellwagen Bank National Marine Sanctuary reviewing preliminary information collected by NOAA Fisheries estimated that up to 450 finfish vessels operate in and around Stellwagen Bank. Present day management efforts include establishing a minimum mesh size, fish size limit, and closure areas within the Massachusetts Bay area.

Fish stocks in the region have been in decline for decades due to cumulative effects of heavy fishing pressure, nearshore water quality degradation from point and non-point pollution sources, pipeline projects, cooling water intake structures, and anthropogenic habitat modification (e.g., from dredging, offshore spoil/waste disposal). Since 1996, federal regulations have been in place that established the NOAA Fisheries Gulf of Maine Rolling Closures which involve closures of specified fishing areas during set periods of the year, and restrict fishermen to a limited number of allowable fishing days per year to protect and restore fish populations. Permanent closures near the study area include the Western Gulf of Maine Closure Area, which is permanently closed to multispecies fishing. Seasonal closures surround these permanent closures at various times throughout the year and could include portions of the study area. Seasonal closures were implemented by the NEFMC to protect stocks of Gulf of Maine groundfish from overfishing and to allow the populations of these species to regenerate to a healthy level. Figure 6-3 shows existing fishing closure areas and Table 68 describes seasonal fishing closures as they relate to the Project.

Under the Gulf of Maine Seasonal Rolling Closure Areas, seasonal closures occur from April 1 to June 30 and October 1 to November 30 every year. The southeastern portion of SBNMS is located in one of the year-round fishing closure areas. A letter of authorization is required for charter and party vessels to fish in these areas. The NEG Pipeline Lateral is also located in the federal Gulf of Maine/Georges Bank Inshore Restricted Roller Gear Area. In this area, the maximum diameter of any part of the trawl footrope, including discs, rollers, or rockhoppers, may not exceed 12 inches (30.5 centimeters). Sea urchin dragging is exempted from mobile gear restrictions because the dragging gear does not dig into the substrate, and is therefore different from a dredge. Another closure area is the Massachusetts Bay Cod Conservation Zone, which limits fishing activity on a seasonal basis at an area immediately west of the proposed action. Based on fishing mortality rates, both the Gulf of Maine and Georges Bank cod stocks are currently considered over fished (NMFS 2005). The Gulf of Maine (GOM) stock is particularly stressed at present, and the MDMF notes that the depleted state of GOM cod is one of the most pressing challenges facing federal and state fishery managers. Accordingly, MDMF enforces seasonal closures on the most productive grounds in Massachusetts Bay (the area north of latitude 42º 20’and south of latitude 42º 30’ designated as a “Cod Conservation Zone”). From December through the end of February 2006, cod harvest is prohibited by any person, with any type of fishing gear. This seasonal closure is expected to be in effect at least through 2007.

During the lobstering season of Oct.1 to Jan. 31, there are no restrictions on lobstering in the vicinity of the proposed action. These closures demonstrate the trends that have created the current setting of a fish stock severely stressed and in decline.

Table 6-8

Seasonal (Rolling) Fishing Closures

Type of Species	Dates of Closure	Location of Closure	Exemptions
Multispecies (groundfish)[a]	April 1 to May 31	Blocks 124-125 and 132-133	Closed to all fishing vessels except those vessels with federal NE multispecies permits (and fishing only in State waters); charter, party, or recreation vessels; vessels fishing with spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, mid-water and shrimp trawls, surf clam/quahog dredge gear, sea scallop dredge gear, and pelagic hook, line, longline, and gillnets.
Multispecies (groundfish)	June 1 to June 30	Blocks 124-125 and 132-133	Same as above
Multispecies (groundfish)	Oct 1 to Nov 30	Blocks 124-125	Same as above

[a] Multispecies include Atlantic cod; witch, yellowtail, winter, and windowpane flounder, American plaice, haddock, Pollock, redfish, white hake, Atlantic halibut, and ocean pout.

Source: NOAA, 2004b.

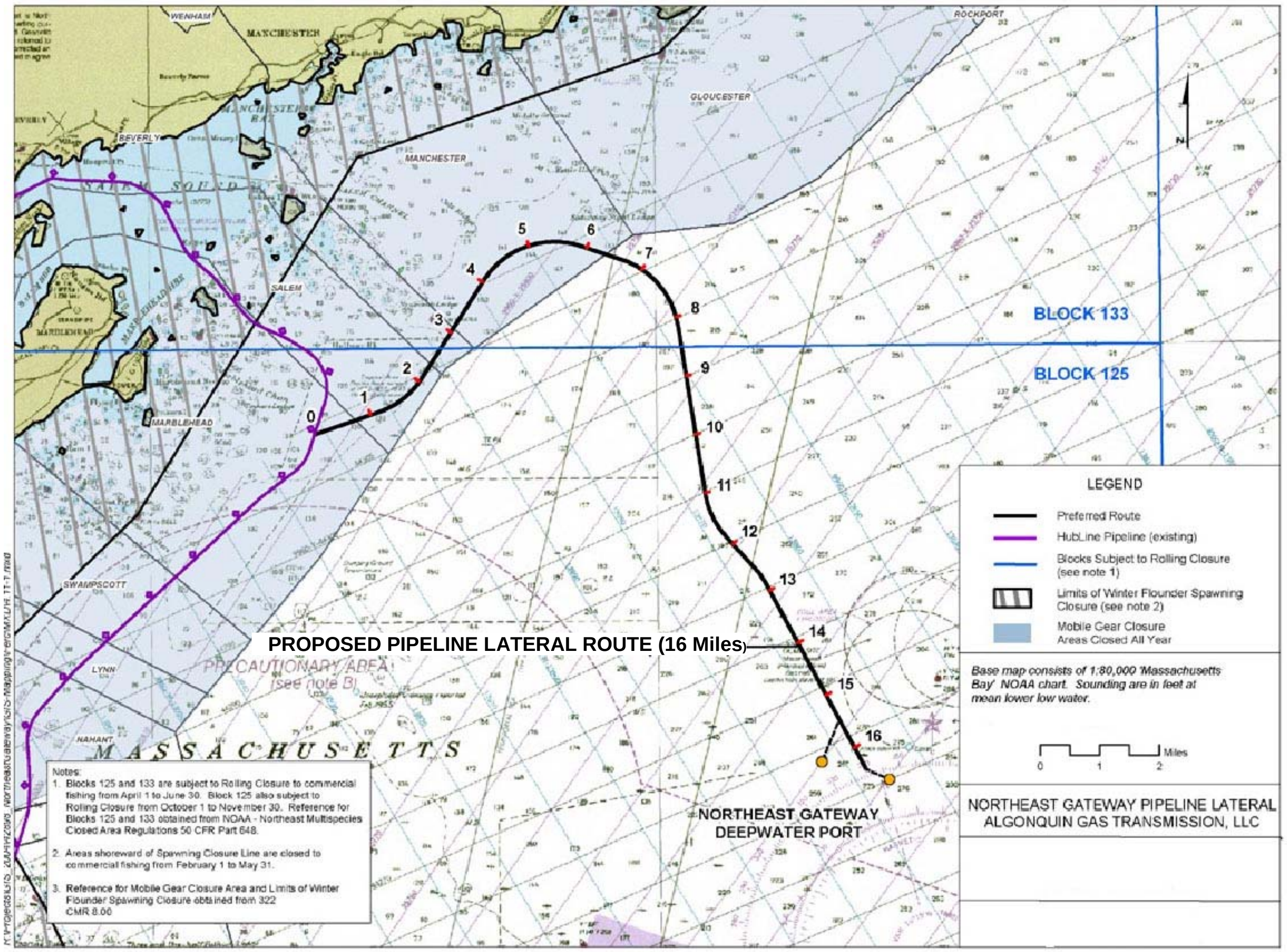

Figure 6-3. Fishing Closure Areas

Local Setting

Specific activities that may affect marine fish in the project vicinity include continued use of the MBDS and the potential development of the Neptune LNG DWP in the vicinity of the NEG Port. The impacts of the NEG Project on finfish would be limited to minor impacts due to temporary disturbance of habitat, particularly for demersal fish. During operation, the NEG Port would have a minor potential for entrainment of fish eggs and larvae; and an even smaller potential for impingement of adult fish on the water intake grates covering the EBRV seachests. The Neptune DWP Project would result in similar, short-term minor adverse impacts to fish from changes to the benthic community (from construction), and a greater potential for impacts due to operation of both facilities (primarily from impingement and entrainment of juvenile fish and ichthyoplankton in the engine cooling water flow-through system). The potential cumulative impact of these activities, however, would be minor as will be discussed in more detail below.

The effects on benthic communities from the two projects would occur approximately two years apart. Natural population recruitment of soft bottom populations could replace the lost benthic communities in the interval between construction of the two facilities and associated pipelines. Table 4-4 lists several projects where benthic communities have recovered to pre-disturbance levels with recovery times ranging from 6 months to 5 years. Together, both project ports would temporarily impact roughly 1,800 acres (construction) and permanently impact 106 acres (operation) of benthic habitat. This impact would be offset by the fishing restrictions around the project from safety zones. These zones would prohibit benthic disturbance from bottom-trawling activities of roughly 2,000 acres.

The area excluded from commercial fishing by the ATBA might slightly improve finfish populations by creating a small sanctuary for finfish. The impact of the small area of fishing exclusion when added to the fishery closures is not cumulatively substantial for finfish populations. The individually small (several square miles), combined exclusion zones of the two ports could act as a positive, albeit small, contribution to the effect of the NOAA Rolling Closure areas in increasing fish populations.

6.2.2.2 Benthic Communities

While the proposed NEG Pipeline Lateral route has no bedrock along the trenching centerline, there would be several miles of bedrock and high-boulder content seabed for the Neptune Project. Although this seabed disturbance would lead to mortality of benthic organisms in this total area, NEG Pipeline Lateral construction would precede pipeline installation of Neptune by two years. Given the rapid regeneration time documented for soft-bottom communities (see Table 4-4), the benthic community disturbed by installation of the NEG Pipeline Lateral could recover by natural population recruitment within the interval between construction of the two facilities and associated pipelines. With the known exception of the two cable crossings, where the pipeline would be above the surface and armored, the soft-bottom habitat now present along the NEG Pipeline corridor would recover. Given that the vast majority of the NEG pipeline corridor area could be restored to soft bottom habitat, the impact of the small amount of armoring needed for the Hibernia cable crossing (0.06 acres) would be a direct, permanent minor loss of soft bottom habitat.

Construction of the Port would also have a small temporary impact on benthic habitats. Though construction timing of the two DWP projects is different, the benthic communities would be recovering from construction impacts in the same timeframe, and the impacts could be considered additive. However, even when considered together, the impacts of construction from both projects would have a minor adverse impact on benthic communities, and not prevent their eventual recovery after construction is complete.

Cumulatively, operation of both the Neptune and NEG Ports would result in the combined long-term disturbance of approximately 106 acres of soft-bottom habitat within Massachusetts Bay, due, primarily, to recurring bottom scouring caused by the sweep or motion of mooring lines of the four combined unloading/mooring buoy systems (63 acres due to Neptune and 43 acres due to NEG). This scour would probably prevent recolonization of benthic communities during the 25-year license of the two projects. Impacts to shellfish from anchors and cable sweep in areas of soft sediment would be similar to those described above for benthos. Rocky areas within the anchor corridor would provide some protection for crabs and lobsters in these areas from contact with cables. Therefore, when considered together with the potential Neptune impacts, the cumulative adverse impacts from the two Projects on benthic resources would be minor.

The ongoing operation of the MBDS does impact benthic resources by covering existing macrofauna and shellfish with disposed material and by providing new substrate for colonization, which tends to keep the MBDS area in early successional stages of a benthic ecosystem. The addition of the 43 acres (17 hectares) of ongoing disturbance from anchor chain and cable sweep during NEG Port operation, when considered in combination with MBDS operations, constitutes a cumulatively minor impact when compared to the hundreds of thousands of relatively undisturbed acres of deep water benthic habitat available in Massachusetts Bay. Therefore, when considered together with the ongoing MBDS impacts, the cumulative impacts on benthic resources are considered minor.

6.2.2.3 Plankton

In general, the NEG Project and any of the proposed or ongoing projects in the region produce a direct, long-term, minor adverse impact on plankton populations (including phytoplankton, zooplankton, and ichthyoplankton).

Because the ongoing operation of the MBDS creates periodic short-term increases in water column turbidity, a short-term adverse impact on plankton may occur, but it would be minor and limited in both spatial and temporal extent. When combined with the impact of turbidity changes from either construction or operation of the NEG Project, the cumulative impact to plankton populations in the Project area would be minor.

The use of seawater for cooling and for ballast water could be additive across the two projects, though they are separated by over 5 miles (8 kilometers). One vessel on buoy is assumed to withdraw 4.97 mgd for NEG and 2.39 mgd for Neptune, with a maximum of 11.58 mgd for NEG and 6.97 for Neptune. Assuming that there could be up to two vessels at each of the two ports in a worst-case scenario then the potential total intake for the two projects taken together is an average of 14.72 mgd or a maximum of 37.1 mgd. If these vessels were operating under an open-loop system the greatest amount of water they would withdraw would be 304 mgd (76 mgd for four vessels). The possibility of all four vessels being on buoy and withdrawing water at the same time are extremely low.

Closed-Loop Analysis

NEG conducted analysis for impingement and entrainment of ichthyoplankton communities from both hydrostatic testing during construction and water intake for regasification. Losses due to one-time hydrostatic tests can be considered minor. A one-time total of 194 fish eggs and 98 fish larvae might be entrained and lost. For each species these numbers would result in the loss of less than one age 1 fish. When combined with Neptune's Ichthyoplankton

Assessment, which also projected losses of less than one fish for most species (except for Hake and Sandlance, which had losses of 125 and 15.6 fish respectively), these losses represent a direct, short-term, minor adverse impact on fish populations.

Losses due to the operation of the EBRVs would be larger than losses from hydrostatic testing and would occur as long as the port is in operation. Although the losses of ichthyoplankton for some of the species in Table 4-8 appear to be very large, the extremely high natural mortality rate for ichthyoplankton means that very few of these organisms would survive to maturity. Adult equivalent-adult modeling showed losses of just tens to hundreds of age-one individuals for most species (Table 6-9). When taken in combination with the Neptune project, these projects would result in direct, long-term, minor adverse impact to the ichthyoplankton and finfish communities.

Table 6-9

Entrainment Calculations for Closed-Loop System

Average (1990-2004) Age-1 Equivalent for Assessed Species Assuming Closed-loop vaporization

Species	**Northeast Gateway**	**Neptune**	Total
Atlantic Herring	235	238	473
Atlantic Cod	3	3	6
Haddock	1	1	1
Silver Hake	65	65	130
Pollock	388	121	509
Hakes	15	15	30
Cunner	3,909	4,940	8,849
Sand Lance	43,431	39,700	83,131
Atlantic Mackerel	75	76	152
Butterfish	273	145	418
Winter Flounder	5	1	6
Yellowtail	311	311	622
Lobster	63	53	116

During a typical 8-day regasification event, the intake of seawater from both projects would entrain large numbers of zooplankton, which serve as an important food source for baleen whales in the project area. Using the same type of analysis described in Section 4.2.4.2, impacts from operations are estimated to remove 14% by weight of a single blue whale's prey consumption for one day. When spread across the entire minke whale population in the project area, this entrainment of copepods would have a long-term, indirect, minor impact on these species as they search for prey.

Open-Loop Analysis

Although the NEG Project does not propose to use open-loop vaporization, it is technically possible for that option to be used. If this option were used, minor, direct, long-term, adverse impacts on phytoplankton, zooplankton (holoplankton) (e.g., copepods), and meroplankton (planktonic fish and invertebrates) would occur from seawater intake of both NEG and Neptune projects. The design of the seawater intake is described in section 2.1.1.2. Planktonic species would be entrained in the seawater intake. From April through December, the open-loop shell-and-tube vaporizer would have a cooling and ballast water intake of 76 mgd for each EBRV. From January through March, a single EBRV would only have seawater intake of 4.97 mgd for cooling/ballast water. The impact from the average daily seawater intake associated with this alternative would be approximately 15 times higher than the Project from April through December. The average seawater intake from January through March would be the same as the Project. Therefore, the plankton that are most abundant from April through December would be the most heavily impacted. The age-1 equivalent and equivalent yield estimates for the species assessed under this alternative are presented in Table 6-10. Table 6-10 also presents equivalent yield as a percentage of average Massachusetts landings from 1990-2004. A detailed description of this assessment is presented in Appendix E.

These values show that even under open-loop vaporization, both projects would still only produce a minor adverse impact to plankton and age-1 equivalent communities.

Table 6-10

Annual Entrainment Estimates for both NEG and Neptune Projects

Annual Age-1 Equivalent and Equivalent Yield Estimates and Equivalent Yield Expressed as a Percentage of Average (1990-2004) Massachusetts Landings Associated with the Open-loop Shell-And-Tube Vaporization Alternative[1]

Species	Age-1 Equivalents (Number)	Equivalent Yield (Pounds)	Total Massachusetts Landings (Pounds)	Equivalent Yield as a Percentage of Average Massachusetts Landings from 1990-2004
Atlantic Herring	8,718	962	45,341,890	0.00212%
Atlantic Cod	87	33	32,774,549	0.00010%
Haddock	27	34	5,750,278	0.00059%
Silver Hake	2,438	201	4,864,613	0.00413%
Pollock	1,497	4,108	5,836,217	0.07039%
Urophycis spp.	566	91	3,911,211	0.00233%
Sand Lance	177,389	0	0	N/A[2]
Cunner	178,972	77	18,641	0.00000%
Yellowtail Flounder	40	22	10,034,420	0.00024%
Butterfish	5,361	192	66,022	0.29081%
Atlantic Mackerel	4,715	238	8,944,209	0.00254%
Winter Flounder	11,594	5,761	9,377,968	0.05741%
Lobster	2,009	99	14,851,329	0.00067%

[1] Estimates for Both Neptune and Northeast Gateway projects combined
[2] N/A - no commercial or recreational fishery for this species

Source: NMFS, 2006

6.2.2.4 Marine Mammals

Regional context

Historically, marine mammal populations have been in decline in Massachusetts Bay, and this decline has resulted in the protection of numerous species. Marine mammals known to traverse or occasionally visit the waters of Massachusetts Bay include both threatened or endangered species, as well as those species that are not threatened or endangered. This section discusses only those marine mammals that are not listed as threatened or endangered under the ESA, but are protected under the Marine Mammal Protection Act of 1972 as amended in 1994 (MMPA). A more complete description of threatened and endangered mammals is given in section 6.4.2.7.

The proposed locations of both the NEG and Neptune projects in Massachusetts Bay are within areas known to be visited by marine mammals. Both the federal government and the Commonwealth of Massachusetts have designated protected areas with the Bay to serve the interests of marine mammals and their habitats. The locations of these protected areas with respect to the proposed NEG Port and Pipeline Lateral are shown in Figure 6-2. As shown, the NEG Port is located outside the boundaries of all protected areas, while the Pipeline Lateral is proposed within portions of the South Essex and North Shore Ocean Sanctuaries. Table 6-11 provides a summary of the federal and state protected areas within the vicinity of the Project.

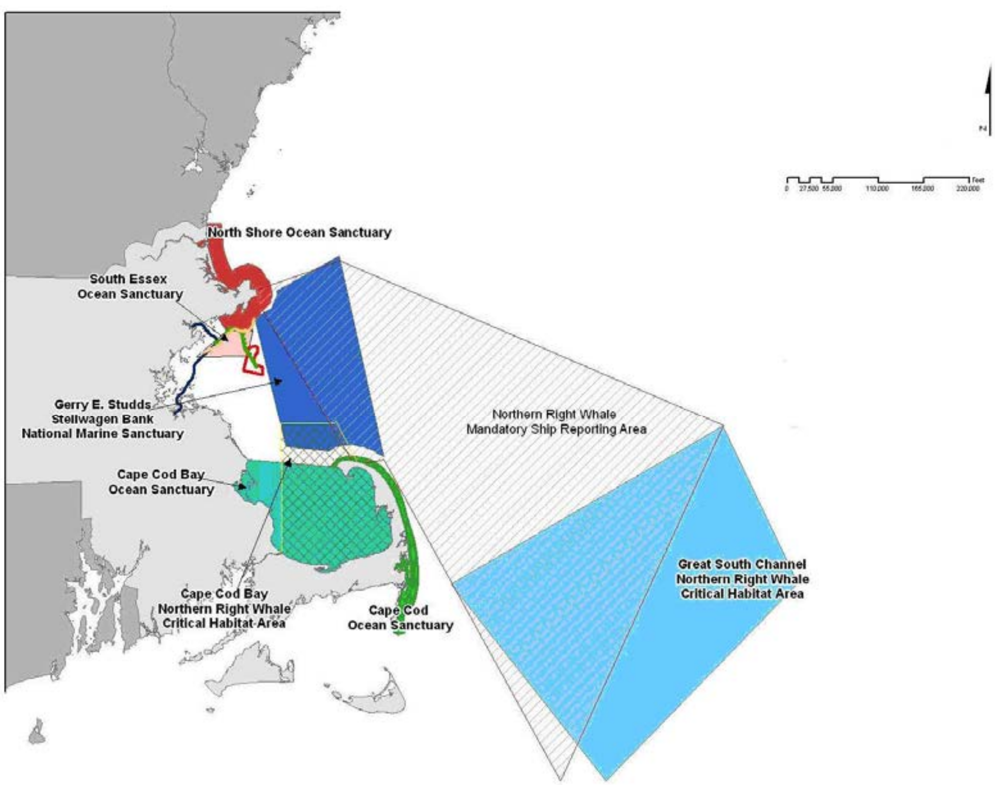

Figure 6-4 Location of the NEG Port and Pipeline, Marine Protected Areas, Sanctuaries, and Northern Right Whale Reporting Area

Table 6-11

Federal and State Marine Mammal Protected Areas in Project Region

Managing Agency	Site Name	Size (Sq. M)	Location
NOAA, NMSP	Gerry E. Studds Stellwagen Bank National Marine Sanctuary	842	Mouth Of Mass. Bay Between Cape Cod And Cape Ann On Stellwagen Bank; Just East Of Project area
NOAA, NMFS	Great South Channel Northern right whale Critical Habitat Area	3,321	East Of Cape Cod And Nantucket And West Of Georges Bank; Approx. 71 Miles South Of Project area
NOAA, NMFS	Cape Cod Bay Northern right whale Critical Habitat Area	643	North End Of Cape Cod Bay; Approx. 21 Miles South Of NEG Port
MASS. DCR	North Shore Ocean Sanctuary	175	Northern Mass. Coast From NH Border To Manchester-By-The-Sea; Pipeline Lateral Within Southern End Of Sanctuary
MASS. DCR	South Essex Ocean Sanctuary	56	Mass. Coast From Manchester-By-The Sea South Through Swampscott; Pipeline Lateral Within Sanctuary
MASS. DCR	Cape Cod Bay Ocean Sanctuary	616	Entire Cape Cod Bay; Approx. 21 Miles South Of Project area
MASS. DCR	Cape Cod Bay Ocean Sanctuary	189	East Of Cape Cod Along Entire Outer Cape Cod Peninsula; Approx. 27 Miles South Of Project area

Local Setting

For the purposes of this analysis, the local setting can be expanded to consider Massachusetts Bay since whales are not limited to the immediate project area. Whale species found within Massachusetts Bay vary with season in conjunction with the presence of forage finfish species as well as zooplankton (in the case of the right whale). Jensen and Gregory (2003) highlighted that after finbacks, humpback whales are the second most frequent whale impacted by ship strikes. The existing high volume of vessel traffic coupled with future increases in both number of vessels and speed will most likely contribute to higher impacts to all whales in Massachusetts Bay. Specifically, with development of advanced high-speed vessels, including component and propulsion systems, the potential for whale-ship strike impacts can be expected to increase.

In whale watch vessels alone, there has been a noted speed increase over the last 10 years. During the late 1990s vessels generally traveled at a speed of approximately 13 knots. As the whale watching industry matures, slower vessels are being replaced with faster and larger vessels to accommodate the increasing demand to carry larger numbers of passengers to whale areas and to make two trips per day. In fact, one vessel from Boston can now conduct three whale-watching trips per day due to its increase traveling speed and the longer daylight hours during the summer. Average speed of existing vessels is 18 knots (Gerry E. Studds Stellwagen Bank National Marine Sanctuary Marine Mammal Vessel Strike Action Plan [no date]).

The direct, long-term, minor impact of the proposed and current projects on plankton populations (see 6.4.2.3), when combined with the minor impact of the Neptune Project, would result in an indirect, long-term minor adverse effect on either baleen or toothed whales by impacting the plankton food source. The three main categories of potential impacts from the proposed projects are: vessel strikes, entanglement, and noise.

Cumulative Impacts due to Vessel Strikes

Out of the projects noted in section 6.2, those most relevant to a discussion of vessel traffic and potential strikes are the proposed LNG terminals and the MBDS. Two proposed LNG terminals were considered for cumulative impacts. The NEG Port and Neptune Project would both occur in Massachusetts Bay. Although proposed for a location on the Massachusetts coast, Weaver's Cove is not located on Massachusetts Bay and would not affect resources in that water body. Therefore, Weaver's Cove would not contribute to cumulative impacts in the Massachusetts Bay vicinity, but would contribute cumulative impacts to marine mammal species that have regional distribution in the waters south of Massachusetts Bay.

Collisions between marine mammals and ships, although expected to be rare, could increase with an increase in shipping and cause serious injury or mortality. In 2003, there were 4,561 large commercial vessel (>300 tons) transits entering or leaving Massachusetts Bay Harbors (Boston, Gloucester, Salem, and Plymouth; Acutech, 2006). This number does not include the number of recreational, fishing, or barge vessel trips that occurred in the area (57,238 calls for Boston Harbor alone; Boston Harbor Pilots Association, 2005). During routine operations at the NEG Port, approximately 130 additional LNG vessel transits would occur in Massachusetts Bay each year. The three proposed LNG facilities affecting Massachusetts Bay would result in approximately 350 additional LNG vessel trips each year (which includes the NEG Project), representing an increase of roughly 7.7 percent. Compared to the overall amount of existing commercial, recreational, fishing, and military vessel traffic in the area, this increase is moderate.

A general rise in vessel activity could increase the occurrence of collisions between marine mammals and vessels, potentially resulting in increased injury or death. Habitat for several marine mammal species extends from the Northeastern United States and Canada to the Southeastern United States. Therefore, all of the proposed and operating LNG projects listed in Table 6-2 could impact whales or other marine mammals. There is currently a degree of uncertainty regarding the relationship between vessel traffic and whale strikes. What is known is that any increase in vessel traffic increases the risk for a whale strike. What is unknown is how this risk translates into probability. It is unknown whether an increased risk means an increased impact to the resource. This is also described in section 6.4.2.7, Threatened Species, as it refers to the North Atlantic right whale.

Another consideration for vessel traffic is the MBDS, a 2.0-nautical mile-diameter circular area situated on the eastern side of the proposed NEG Port and west of the western boundary of SBNMS. The MBDS receives material from such ports as Boston, Hingham, Salem, and Gloucester. Since 2000, use of the site has varied significantly from year to year from the disposal of as little as several thousand cubic yards of dredged material to nearly 2.5 million cubic yards. There is a small additional chance of a vessel collision to marine mammals when the Massachusetts Bay LNG project impacts are added to the ongoing MBDS use, both during construction and during operation. However, this increased potential is small because the tugs towing the barges to and from the MBDS are not large enough and do not move quickly enough to present a hazard to whales. Also, a marine mammal observer is on board the scows transmitting to the MDBS from Feb. 1 to May 31 to avoid potential ship strikes with marine mammals, particularly right whales.

Although the increase in vessel traffic that would occur during installation, decommissioning and routine operation of the NEG Port would be small, the Project would contribute to an increase in the overall level of vessel traffic in Massachusetts Bay. When considered with potential increases due to other proposed projects, the increase in overall vessel traffic would be large.

Cumulative Impacts due to Entanglement

There is a small chance that a marine mammal could become entangled in the anchor lines during construction or operation of either Project. However, it is assumed that the lines for both projects would be large diameter and under tension, thus reducing the potential for entanglement. An indirect entanglement potential could result from fishing operations being displaced to SBNMS. The increased fishing activity in an area with greater populations of marine mammals could result in a greater entanglement potential. When assessed cumulatively, the entanglement potential if such a shift did occur would be incrementally greater, but would still be expected to be minor.

Cumulative Impacts due to Habitat Disturbance

While habitat disturbance would be roughly doubled if both the Neptune and NEG projects were constructed, with an estimated cumulative 85 acres for port construction and 99 acres for port operation, the overall disturbance amount is minor when compared to the deep water habitat available in Massachusetts Bay.

Cumulative Underwater Acoustic Impacts

We assume that construction noise would be about the same for both projects, but would occur during different years and would therefore not be additive. Noise of operation, once both ports were functioning, would occur at the same time but would be separated by 5 miles (8 kilometers).

The individual impacts from each individual project, would result in sound levels below the MMPA Level B harassment threshold for continuous noise (120dB) during operations within a 100 meter zone around the buoys (NMFS, 2005j).Figure 6-5 presents the net acoustic impact of four vessels on buoy (two each at the Northeast Gateway and Neptune Ports) during regasification and offloading operations. The cumulative sound contours have been plotted to extend to the lower range of estimated background level within the Project study area (i.e., in areas where no contours are shown, the operational sound levels will be at or below existing ambient sound levels). As shown in the plots, there is no overlap in underwater noise levels at the Northeast Gateway or Neptune buoys, which supports the conclusion that there will be no additive underwater noise impacts even under this worst-case operational scenario. Cumulative operational sound levels sound levels would also remain below the 120 dBL marine mammal harassment criterion for a continuous sound source.

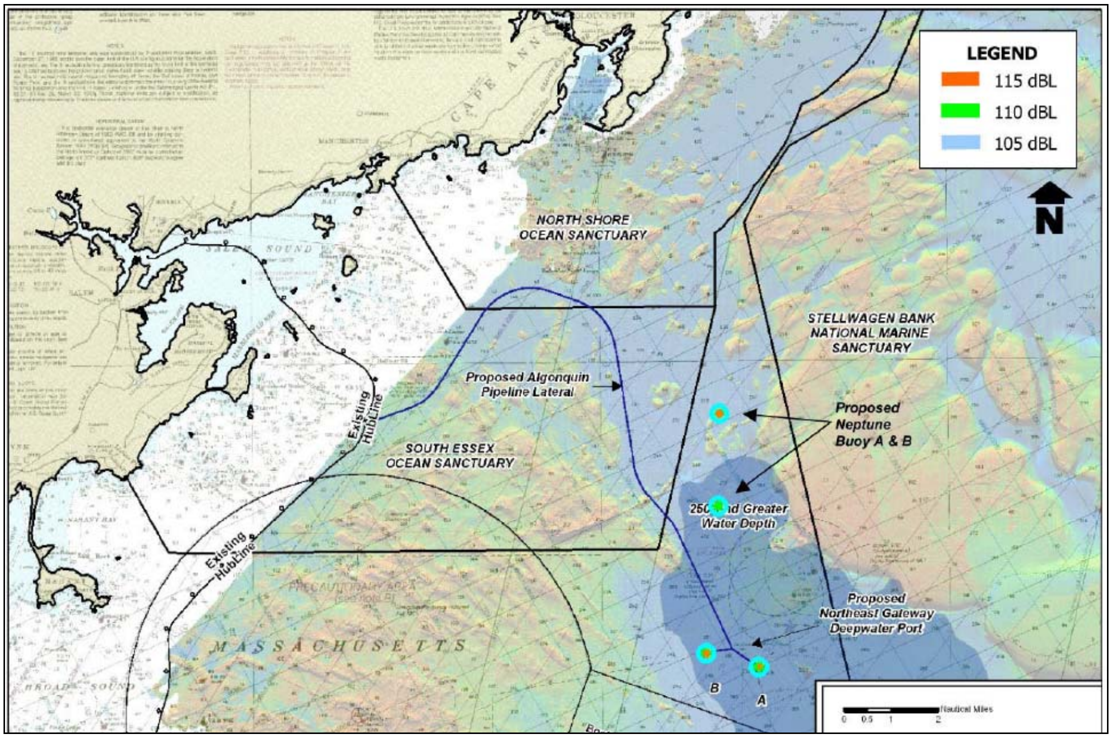

Figure 6-5 Maximum Cumulative Underwater Sound Levels During Regasification

In addition to on-buoy operations, an acoustic screening analysis was completed for all EBRVs and Neptune vessels during transit and during docking and positioning procedures. Thruster and transit sound levels used in this modeling analysis are typical for similar vessels that currently operate in Massachusetts Bay. During transit, the dominant source of underwater sound is caused by propeller cavitations. Discrete tonal contributions are also generated and are dependant on the propeller blade passage frequency. At reduced speeds, the sound source level was estimated to reach a maximum broadband level of 170 to 180 dBL re 1 μPA at 1 meter. Figure 6-6 presents cumulative sound contour levels down to 120 dBL as all four vessels transit to or from the Deepwater Port buoys.

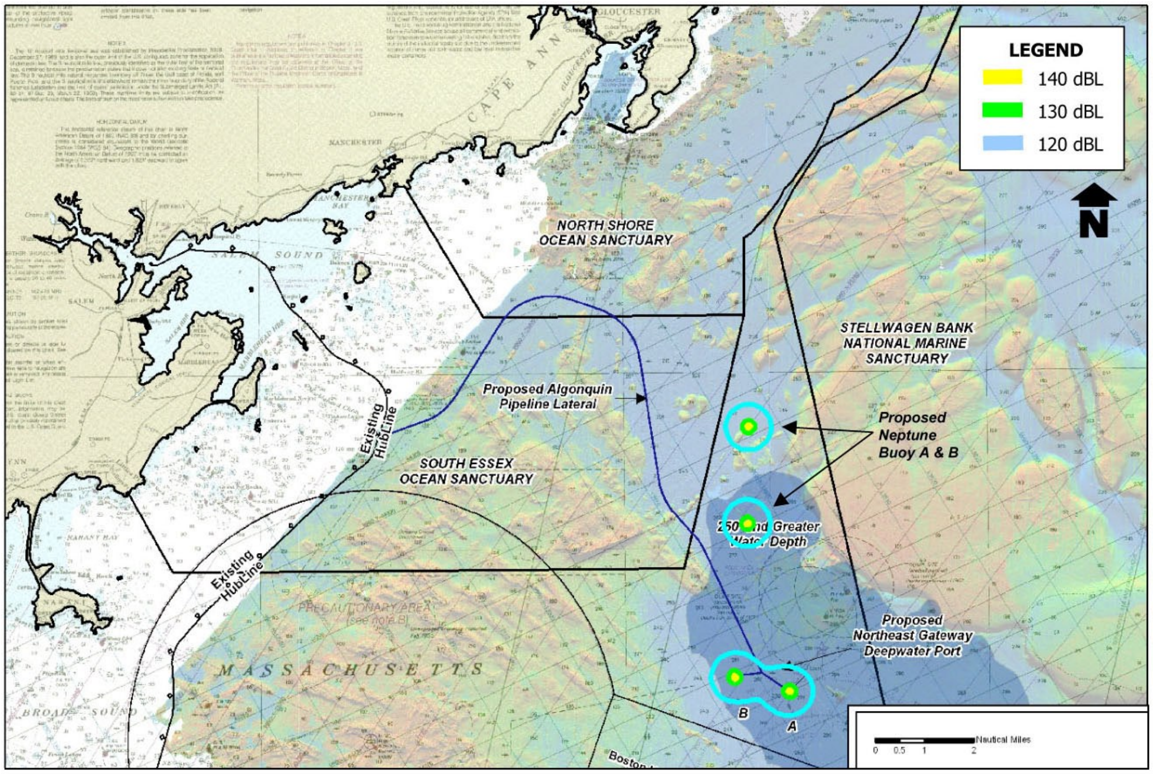

Figure 6-6 Maximum Cumulative Underwater Sound Levels During Transit

Upon arrival at the buoy, the EBRV and Neptune LNG carriers would require the use of thrusters for dynamic positioning during docking procedure. Typically, the docking procedure is completed over a 10- to 30-minute period, with the thrusters activated as necessary for short periods of time second bursts, not a continuous sound source. EBRV thruster operations were modeled based on recent field surveys. Thrusters dominate operational noise conditions, effectively masking concurrent sound sources. Based on these measurements, a maximum source term was calculated of approximately 160-170 dBL from normal thruster operations during coupling/decoupling operations and the EBRV maneuvering at the Deepwater Port. NEG operations procedures prevent the possibility of two EBRVs to be maneuvering with thrusters operating during final positioning. This condition, coupled with a maximum source term of approximately 160 -170 dBL and the distance between the Northeast Gateway and Neptune buoys, means there is little potential for cumulative impacts. Additionally, the sound distributions would be intermittent, as the duration of thruster use in positioning is on the order of 10 to 30 minutes during docking. Sounds associated with two EBRVs at 100 meters would fall below the MMPA Level B harassment threshold. At 500 meters and 1 kilometer (Figures 4-3 and 4-4 from section 4) all sound energy is within the existing ambient range and below the MMPA Level B harassment threshold, even when considering the unloading of two EBRVs.

As described above, the noise levels associated with EBRV(s) offloading at the NEG site are below the MMPA Level B harassment thresholds of 160 dBL and 120 dBL, and therefore should not cause a disruption in whale behavior. Acoustic impacts on marine mammals from regasification are therefore expected to be long-term, direct, and minor. Noise levels associated with EBRVs transiting to the site, as well as positioning at the buoys, would produce intermittent (impulse), direct, moderate adverse impacts on marine mammals.

6.2.2.5 Sea Turtles

The same projects/areas/activities/features that were considered in the analysis of cumulative impacts for marine mammals were considered for an analysis of cumulative impacts to sea turtles. However, the relatively low occurrence of sea turtles in the project area limits the potential for significant cumulative effects on sea turtles. Therefore, the contribution to cumulative impacts would be minor.

6.2.2.6 Seabirds

Since potential impacts to seabirds from the both projects are individually minor and none of the seabird species in the project vicinity are listed as threatened or endangered under the ESA, the project would have minor cumulative impacts to the seabird population.

6.2.3 Threatened and Endangered Species

Regional Context

Both endangered whales and sea turtles are found in the Project area. Of the threatened and endangered species in Massachusetts Bay, the species of most critical importance is the North Atlantic right whale. The 2003 United States Atlantic and Gulf of Mexico Marine Mammal Stock Assessments reported only 291 North Atlantic right whales in existence, which is less than what was reported in the Northern right whale Recovery Plan written in 1991 (NMFS, 1991b; Waring et al., 2004). The distribution and relative abundance of right whales in Cape Cod Bay remained relatively stable between 1975, when intensive observations programs began, and 1986. right whales are most abundant each spring in the eastern part of Cape Cod Bay. Fishing gear entanglement and vessel collisions have been labeled the greatest threat to North Atlantic right whales (NMFS, 2005f). Most ship strikes are fatal to the North Atlantic right whales (Jensen et al., 2003). In the Massachusetts Bay area, between 1976 and 2001, there were six right whale strikes recorded; five of which resulted in mortality (Jensen and Silber, 2004; Waring et al., 2004).

Local Setting

One major concern for right whales associated with the NEG and Neptune projects is the increase in vessel traffic numbers and the potential for whale strikes. The proposed projects in Massachusetts Bay would contribute a moderate increase (7.7 %) in the traffic of large (>300 tons) vessels, and this rise increases the risk of whale strikes. NOAA has currently set a Potential Biological Removal (PBR) value of zero for North Atlantic right whales, meaning that the death of a single whale could jeopardize the survival of the entire population. Therefore, even one individual mortality of right whales due to vessel strikes is above the acceptable PBR. However, current research does not provide an estimate of collisions based on number of vessel trips and density of marine mammals. What is understood is that any increase in vessel traffic increases the risk of whale strikes. What is unknown is how this increase relates to causation or probability of whale strikes. In their North Atlantic right whale Recovery Plan, NOAA (2006) indicates that ship speed is an important factor in the frequency of occurrence of ship strikes in large whale species, including right whales, and that strikes occurring at reduced speeds (below 10 knots) rarely caused serious injuries. Several new potential mitigation measures have been discussed with agencies that may even be able to reduce the risk of vessel strikes despite an increase in traffic. Mitigation measures (similar to those described in section 4.2.2.2) have been proposed and will be required. These measures are designed to reduce the potential for major adverse interactions between vessels and marine mammals.

It is not known whether this total cumulative increase in vessel traffic would actually lead to an increase in the number of whale strikes, but the probability of a strike would increase. A small proportional increase in the number of whales struck for most species would likely not impact the overall population; however, if the number of right whale strikes increased due to the cumulative increase in traffic, the population as a whole would be impacted. Even one right whale mortality would be considered a direct, long-term and major adverse impact to the population as a whole.

6.2.4 Geological Resources

This section focuses on the cumulative effect on geologic resources from the NEG Project when considered together with the impacts from the proposed Neptune Project and from the ongoing operation of the MBDS. The only impacts to geological resources posed by NEG would be seafloor disturbance. The seabed in this region has been extensively disturbed by fishing and in more limited areas dredged material disposal. Because both the NEG and Neptune projects have minor impact on the geology of the seafloor, either through construction or operation, their additional impact, when considered together with the ongoing change in bottom sediments and configuration caused by ocean dumping of clean materials in the use of the MBDS, is cumulatively minor.

6.2.5 Cultural Resources

Based on offshore cultural surveys, including magnetic and acoustic surveys, the NEG Project avoids all known cultural resource sites and would have no effect on cultural resources listed on, or eligible for listing on, the National Register of Historic Places. Similarly, the Neptune Project would also avoid cultural resources during construction, operation, and decommissioning activities along the proposed pipeline route and terminal area. Neither project would contribute to any cumulative effects on cultural resources.

6.2.6 Ocean Use, Land Use, Recreation, and Visual Resources

Ocean use, recreation, and visual resources are potentially cumulatively affected by the proposed NEG and Neptune projects. These potential cumulative effects are evaluated below. Land use would not be cumulatively affected because the NEG and Neptune projects would not result in any adverse affects on land use.

Ocean Use

The construction of the NEG and Neptune projects would result in some temporary use restrictions within ocean sanctuaries, however, these areas would be relatively small. As such, construction would have minor adverse impacts on the use of marine sanctuaries. Operation of both projects would only impose minor navigational limits on vessels bound for these areas.

Recreational Resources

Recreational use of the deep water area in which the NEG and Neptune projects are located is limited. Recreational fishing, boating, sailing, and diving are principally confined to shallower areas near the coastline. A minor, short term, adverse impact on recreational boating and fishing would occur during offshore pipeline construction activities. The projects would affect whale-watching trips that occasionally occur in the Project area, but this affect would be intermittent and minor.

Visual Resources

The continual presence of up to four vessels at the NEG and Neptune projects would cause minor, long-term cumulative impacts on visual resources. The impacts would be minor because the ports are sufficiently distant from shore and few recreational boaters venture this far from shore. The size of the EBRVs would be similar to other commercial vessels seen in and around Massachusetts Bay, including more than 1,000 large vessels that call on the Port of Boston each year. While the EBRVs would usually not be visible from shore, they would be visible from SBNMS and from other areas frequented by both commercial fishing and whale watching. If the Neptune Project is also constructed, there would be two ships within 5 miles (8 kilometers) of one another potentially visible, and up to four ships at a time if both projects have overlapping ship visits. Taken together, the visual impact of the two projects from Stellwagen would be higher than for the NEG alone.

6.2.7 Socioeconomics

Socioeconomic resources are potentially cumulatively affected by three actions – the NEG Port, the Neptune Port, and current and future recreational and commercial fishery management. This discussion is divided into three main sections: regional economy, recreational fisheries, and commercial fisheries.

Regional Economy

The regional economy would be slightly and favorably impacted by the additional supply of natural gas from the NEG and Neptune Projects as well as by wage and tax income to local communities and states from each of the projects. Thus the construction and operation of NEG and Neptune Projects would contribute to wages, tax income, natural gas supply diversity and reliability. Cumulatively, the projects would contribute to the economic well-being of the New England area.

Recreational Fishing

Recreational fishing is primarily conducted nearer to shore than the 13-mile (21-kilometer) distance to the NEG Port, or the 8-mile distance to Neptune Port. The projects would have no material impact on recreational fisheries, and therefore no cumulative impact when considered together with other projects in the area.

Commercial Fishing

The commercial finfish and lobster fishing industries in the region are currently experiencing economic decline from the cumulative effects of government fishing regulations due to overfishing, overcapitalization, reduced fish stocks, stagnant fish prices, rising coastal property values, other commercial port activity, and increasing international competition. Since 1996, federal regulations have been in place that established the NOAA Fisheries Gulf of Maine Rolling Closures which involve closures of specified fishing areas during set periods of the year, and restrict fishermen to a limited number of allowable fishing days per year to protect and restore fish populations. Permanent closures near the study area for multi-species fishing include the Western Gulf of Maine Closure Area. Seasonal closures, which surround the permanent closure at various times throughout the year, could include portions of the study area. Seasonal closures were implemented by the NEFMC to protect stocks of Gulf of Maine groundfish from overfishing, and to allow the populations of these species to regenerate to a healthy level.

The cumulative effects of these current conditions and ongoing activities were evaluated in combination with the proposed NEG and Neptune projects and other proposed projects, which would lead to loss of access to fishing grounds if they were approved and constructed. The proposed Battery Rock LNG terminal could also lead to periodic loss of fishing ground access mainly due to LNG carrier traffic, since an exclusion area for the proposed facility would likely be established near the shore of Outer Brewster Island.

The days-at-sea restrictions and NOAA Gulf of Maine Rolling Closures have substantially limited the areas and the number of days per year that fishermen can fish, which limits their ability to generate revenue and make fishing a profitable venture. The rolling closures affect areas that are several orders of magnitude larger than the combined area comprised by the Neptune and NEG projects' exclusion zones. Another closure area is the Massachusetts Bay Cod Conservation Zone, which limits fishing activity on a seasonal basis at an area immediately west of the proposed action.

Some commercial fishermen have expressed concern about the cumulative impact of the ATBA fishing closure when taken together with the existing fishing closures (see Figure 6-3). Block 125, in which the ATBA is located, has been, in recent years, closed to groundfish fishing (trawling) from April 1 through June 30 and From October 1 to November 30. The presence or absence of the ATBA during those months is irrelevant, as the entire block is closed to fishing. However, from July 1 through October 1, trawlers have access to Block 125. They also have access during the winter months from December 1 through March 30, but are less likely to fish during those months. During the summer period, and assuming that the ATBA has the effect of excluding fishing, there would be a less than one percent reduction of Block 125 available for fishing. When considered together with the existing fishing closures, the NEG Project would have a cumulatively minor impact on commercial trawling fishing. Another meaningful comparison is between the No Anchor Area (NAA) and a comparable trawlable area of similar habitat within the range of the inshore one-day trip for a commercial fishing vessel. There is an estimated 400 square miles of mud bottom trawlable habitat that has the potential to be used by the mobile gear fishery within 30 miles of Gloucester sea buoy located near the mouth of Gloucester Harbor. The NAA around the NEG Port is 830 acres or less than 1 percent of the trawlable area within 30 miles of the Gloucester sea buoy. If this were doubled to include the Neptune Project, it would result in less than a 2 percent reduction of trawlable area. Assuming that these 400 square miles are not saturated with fishing effort, there is ample opportunity for mobile fishing effort to be moved elsewhere. These small percentages represent minor cumulative impacts on commercial fishing due to restricted zones around the NEG and Neptune ports.

During construction of both the NEG Port and the Pipeline Lateral, a communication plan would be in place that would provide notice to fishermen and other mariners of the existence of construction equipment, cables, and anchors in the vicinity. It is conceivable that some lobster or other fishing gear would be damaged during the course of construction. Both Algonquin and NEG have committed to the establishment of a gear compensation plan. For the purposes of cumulative impact evaluation, it is assumed that Neptune would also establish a communication plan and a gear compensation plan similar to those of NEG.

Direct impacts on commercial fishing include the temporary loss of areas for commercial fishing and lobstering during construction (approximately a 1.3 square mile area at any given time). Construction would cross through MDMF Statistical Reporting Areas 2 and 3, two of the most lobster-rich areas in Massachusetts Bay. Construction activities would likely cause interruptions in lobstering activity for the duration of construction, and would inhibit lobstering and fishing along limited portions of the entire length and width of the pipeline lateral's construction corridor. During operation, the ATBA would prevent all fishing and lobstering in a

4.2 square mile portion of Massachusetts Bay. The waters in and around the ATBA are productive lobstering grounds, and are the site of fishing and lobstering activities for as many as 800 vessel trips per year.

Construction-related navigational changes (to avoid prohibited areas) would likely add time and distance to commercial fishing expeditions, a substantial factor for fishermen who are subject to restrictive time limits at sea (Gloucester Fishermen Association, 2005). These impacts would also be present (although more predictable) during operation when fishermen would have to navigate around the ATBA.

Any delay in construction activity could cause summertime closures. Currently, the summer months (July and August) are the only productive times of year when fishermen are not subject to seasonal closures of fishing grounds. Thus, any substantial construction delay would directly conflict with the year's most important commercial fishing activities. Because construction and operational activity for the NEG Project would result in temporary loss of use of a portion of Massachusetts Bay known for its abundance of lobsters, and because of the real concern that construction activities might overlap, and therefore restrict ocean use during the summer fishing season, construction activities would have a direct, short-term, major adverse impact on commercial fishing activity in the Project area.

In terms of the local fishing economy, based on estimates of net and gross losses, there would be approximately 10.8 weeks of labor lost annually, or 270 labor weeks over 25 years for the NEG Project, which is a materially minor amount, resulting from the Port construction and operations (see section 4.8 for detailed analysis and methodology). With similar economic impacts from Neptune's project, cumulative effects would be long-term and minor.

While the fishing industry has been in decline in the Massachusetts Bay region, the impacts associated with both Neptune and NEG projects would not meaningfully contribute to this decline. The cumulative impacts associated with these projects would result in minor adverse cumulative socioeconomic impacts to the commercial fishing industry.

6.2.8 Transportation

About one barge per day is hauled to the MBDS from Boston Harbor. Barges containing dredge material departing Boston Harbor or ports to the north of Boston Harbor would be unencumbered in their route from the harbor to the dredge disposal site. Barges containing dredge material from ports south of Boston Harbor would have to maneuver to avoid the ATBA around each buoy. These barges currently must cross the TSS and maneuver to avoid deep draft vessel traffic using the TSS. Vessels approaching the MBDS would also be in the EBRV Watch Zone and tracked. Any unidentified vessel would be contacted by the EBRV Master. The operation of the NEG Project would have a small adverse impact on the operation of the MBDS, but the impact is minor, and manageable with small routing changes.

If the Neptune, NEG, and AES Battery rock projects are constructed, there may be a tripling of the number of LNG vessels arriving to dock, regasify, and discharge natural gas into the New England pipeline system compared to the operation of the NEG Project alone. These projects would result in an additional 350 LNG vessels transiting Massachusetts Bay annually. This may increase the number of large vessels in proximity to the Boston TSS and other shipping lanes. In the context of the existing 2,280 large ship calls per year into Massachusetts Bay ports, the three projects taken together would generate an approximate 7 percent increase in shipping traffic for large commercial vessels. However, that traffic would not continue into the Harbor itself and would stop approximately 13 miles (21 kilometers) offshore. Other harbors in the area, including New York, experience several thousand large ship calls per year without serious incidents. Existing navigational regulations are sufficient to reduce the impact of this additional traffic to moderate. Therefore there are no cumulatively major impacts from both NEG and Neptune Projects from increased marine traffic.

Cumulative Impacts to Marine Traffic

SBNMS has proposed a northward shift of the TSS. The NEG Port location is outside of the proposed TSS boundaries and would likely have moderate impacts to marine transportation. While the Neptune project considered alone would have moderate impacts on marine traffic, establishment of Safety and Precautionary Zones from both the development of NEG and Neptune projects would restrict vessel movement to and from the TSS. With implementation of traffic mitigation measures, a moderate cumulative impact would be expected.

Cumulative Impacts to Restricted Areas

Development of permanent facilities such as the offshore dumpsites, NEG LNG, Battery Rock, and Neptune prevent future development from occurring in these areas. Additionally, because projects like Neptune and NEG have safety and security concerns, exclusion zones are created thereby limiting commercial and recreational activities occurring in these areas. As stated previously, the creation of an Area to be Avoided (ATBA) would have a minor impact on recreational and commercial activities, because all non-project related vessels would be able to maneuver around the terminal, and could continue normal operations/activities, with only a slight delay or adjustment in their planned vessel route. Development of both Neptune and NEG Ports (approximately five miles apart) would result in at least two vessels present with applicable exclusion zones, and at a maximum, four vessels present with applicable exclusion zones.

Non-Neptune and NEG-related vessels would be able to transit the area, however they vessels would be required to maneuver around both exclusion zones, resulting in an even longer delay or route adjustment than if only one project was developed. Because their normal operations (commercial and coastwise shipping, recreational vessels, recreational fishing, and whale-watching) would be able to continue, this analysis considers this a moderate cumulative impact.

Cumulative effects resulting from construction and installation of the pipeline and mooring and buoy system are expected to be minor because construction would be temporary and commercial and recreational activities outside the clearance zone would not be precluded.

6.2.9 Air Quality

The NEPA cumulative air impacts assessment, which encompass assessment of regional and localized air quality (including emissions from the construction and operation of the proposed NEG Project), and an evaluation of cumulative impacts of all major NOx sources in the region out to 50 km beyond the SIA (57.5 km), and all reasonably foreseeable air emissions in the vicinity of the proposed NEG Port (e.g., emissions from other vessel traffic, direct and indirect emissions from the proposed Neptune project). The air impact assessment is usually achieved through a combination of emissions and regulatory evaluations and air quality modeling.

Regional emissions control strategies included in the SIPs are already based on projected future-year emission inventories that include construction emissions (not associated with any specific project) and incorporate estimates of growth in emissions-producing activities over time. The comparison to regional air quality requirements addresses the contribution of the proposed source in combination with all other emission sources in the air quality control region. It appears that the project can meet those requirements.

Table 6-12 shows model predicted concentrations for NEG Project are below the Significant Impact Levels (SILs) for all pollutants and averaging periods. For the air impact assessment dispersion modeling was conducted to show that the source would not contribute to localized high concentrations of air pollution at the local or regional level. Table 6-13 shows the results of the modeling runs for the Neptune project, which is a reasonably foreseeable source. Since maximum ambient impacts for all pollutants are shown to be below the modeling SILs, no additional modeling was required. By definition, the proposed emissions would not cause or contribute to an exceedance of the NAAQS for any pollutant.

Although the project emissions do not exceed the SIL, cumulative modeling of the worst case annual emissions (during construction) was conducted with other regional NOx emission sources was conducted. The MDEP and the New Hampshire Department of Environmental Services (NH DES) were asked to provide an inventory of major NOx sources in the region out to 50 km beyond the SIA. There were no major sources in New Hampshire within this distance. Therefore, the MDEP inventory was used and the nearby Neptune Project was added to the inventory list. The proposed AES Battery Rock LNG Terminal was not included because no information was available regarding potential air emissions. The major NOx sources considered for cumulative impacts are provided in Table 6.6.8-2-142 along with stack parameters for the individual facility stacks. The results from the multisource impact modeling are presented in Table 6-15.4-3. The worst case impact occurs at 500 meters from the facility. The maximum predicted impact for all sources is 2.22 micrograms per cubic meter ($\mu g/m^3$) and the background monitored NO_2 concentration was 22.6 $\mu g/m^3$. As discussed in section 4.10.3.1 of this document, a conservative modeling analysis was conducted to evaluate potential impacts to air quality due to NOx construction emissions. The maximum annual NO_2 impacts over all years modeled and all receptors, due to NOx emissions from the construction sources, is 4.53 micrograms per cubic meter ($\mu g/m^3$). Therefore, the combined impact of the construction emissions (4.53 $\mu g/m^3$), the background concentration (22.6 $\mu g/m^3$), and the maximum impact of other modeled OCD impact sources (2.22 $\mu g/m^3$) is 29.35 $\mu g/m^3$, which is significantly below the NAAQS for NO_2 (100 $\mu g/m^3$). The maximum predicted impact for all sources is 2.22 micrograms per cubic meter ($\mu g/m^3$). The monitored NO_2 concentration was 22.6 $\mu g/m^3$ and therefore the combined impact considering the background monitoring and modeled OCD impact sources is 24.8 $\mu g/m^3$, which is well below the 100 $\mu g/m^3$ standard.

A conformity determination, discussed in section 4.10.4 is one element of the broader NEPA air impact assessment that ensures that total direct and indirect emissions resulting from a federal action (like the NEG Project) will not interfere with a state implementation plan (SIP) for reaching attainment of the NAAQS. According to the conformity regulations, emissions from sources subject to major NSR or PSD are exempt and are deemed to have conformed. Because eastern Massachusetts is in a moderate nonattainment area for 8-hour ozone, NOx and VOC (ozone precursors) emissions (direct and indirect) were evaluated to determine if the conformity thresholds (100 tpy for NOx and 50 tpy for VOC) would be exceeded.

As shown in section 4.10.4 of this document, total NOx and VOC emissions would exceed the conformity applicability thresholds during the 2007 calendar year. Both NOx and VOC emissions during operations in 2008 and beyond would be below the conformity applicability thresholds. The emissions from the construction and operational activities in 2007 require that a conformity determination be made for NOx and VOCs. The USCG developed and issued a General Conformity Determination document to EPA in September 2006. The conformity document indicates that the NEG Project has demonstrated conformance with the SIP for Eastern Massachusetts by complying with the control measures and regulations in the SIP, and by committing to fully offsetting its NOx construction emissions through the purchase of discrete emission reduction credits (ERCs) and/or NSR offsets (rate based ERCs) in accordance with 40 CFR 52.858(2) and 40 CFR 93.158(a)(2).

Table 6-12

Air Model Results - NEG

Year	Operating Scenario Case	Receptor	Deg	Dist. From Loc B Km	Dist. From Loc A Km	East Coord	North Coord	Averaging Period	Maximum Concentration (Micrograms/M**3)	Significant Impact Level (Micrograms/M**3)
Highest Predicted CO Impacts										
2000	3	5	50	0.5	1.55	48.96	21.55	1- HOUR	160	2000
2001	3	30	300	0.5	2.33	48.15	21.48	8- HOUR	67	500
Highest Predicted PM10/ PM2.5 Impacts										
2000	3	9	90	0.5	1.41	49.08	21.23	24 HOUR	4.89	5
2001	3	21	210	0.5	2.12	48.33	20.80	ANNUAL	0.39	1
Highest Predicted NO_2 Impacts										
2001	3	21	210	0.5	2.12	48.33	20.80		0.56	1

Table 6-13

Air Model Results - Neptune

Pollutant	Averaging Period	2000	2001	2002	2003	2004	Overall Max. Con. (μg/m³)	De minimis (μg/m³)	Exceeds Significant Impact Levels?
CO	1-Hr	15.88	12.08	15.28	13.22	14.28	15.88	2000	No
CO	8-Hr	3.50	4.23	4.44	3.23	4.02	4.44	500	No
NO_2	Annual	0.06	0.08	0.07	0.05	0.05	0.08	1	No
PM_{10}	Annual	0.02	0.04	0.03	0.02	0.02	0.04	1	No
PM_{10}	24-Hr	1.41	1.15	1.67	1.07	1.11	1.67	5	No
SO^2	Annual	0.00	0.00	0.00	0.00	0.00	0.00	1	No
SO^2	3-Hr	0.22	0.21	0.22	0.23	0.20	0.23	25	No
SO^2	24-Hr	0.06	0.04	0.06	0.04	0.05	0.06	5	No

Table 6-14

Cumulative Impacts Modeling – Highest NO_2 Multisource Modeling Impact Result

Year	Operating Scenario Case	Receptor	Deg	Dist. From Loc B Km	Dist. From Loc A Km	East Coord	North Coord	Average Annual Concentration (Micrograms/ M**3)
2001	3	585	270R	32.73	34.87	15.85	21.37	2.22

It should be noted that the natural gas to be supplied by the proposed project is a cleaner burning fuel with respect to all air pollutants than the most likely alternative energy sources (i.e., coal and oil). In this regard, long term benefits to regional air quality would be expected from the operation of the proposed project.

Table 6-15

Cumulative Impacts Modeling – Emissions Sources within 50 km Radius of Proposed NEG Project

Facility Name	Stack Id	Model Id	Utm-E M	Utm-N M	Distance From Project Site (Kilometers)	NOx G/S	Stack Height M	T K	Dia. M	V M/S	Elv. M
Neptune LNG Project	1	Srvblr1	368,026	4,704,876	8.0	2.079	45	678.3	1.50	32.6	0
Neptune LNG Project	2	Powert1	368,026	4,704,876	8.0	0.601	45	672.2	1.00	22.7	0
Neptune LNG Project	3	Srvblr2	367,917	4,701,174	8.0	Na	45	678.3	1.50	32.6	0
Neptune LNG Project	4	Power2	367,917	4,701,174	8.0	Na	45	672.2	1.00	22.7	0
Bay State Paper Co	1	Bay1	326,100	4,680,800	45.2	3.28	46.94	588.72	2.44	0.3	12
Boston Generating Mystic I Llc	1	Bgm1	329,700	4,695,000	39.3	0.66	102.11	438.72	3.35	25.91	0
Boston Generating Mystic I Llc	2	Bgm2	329,700	4,695,000	39.3	0.43	102.11	438.72	3.23	25.91	0
Boston Generating Mystic I Llc	3	Bgm3	329,700	4,695,000	39.3	0.26	102.11	438.72	3.2	25.91	0
Boston Generating Mystic I Llc	4	Bgm4	329,700	4,695,000	39.3	26.64	152.4	633.16	3.66	25.91	0
Boston Generating Mystic I Llc	5	Bgm5	329,700	4,695,000	39.3	0.03	9.14	810.94	3.66	3.05	0
Boston Generating Mystic I Llc	11	Bgm11	329,700	4,695,000	39.3	2.85	92.96	368.16	6.25	21.95	0
Boston Generating Mystic I Llc	12	Bgm12	329,700	4,695,000	39.3	1.55	92.96	368.16	6.25	21.95	0
Boston Generating Mystic I Llc	15	Bgm15	329,700	4,695,000	39.3	2.33	92.96	368.16	6.25	21.95	0
Boston Generating Mystic I Llc	16	Bgm16	329,700	4,695,000	39.3	2.91	92.96	368.16	6.22	21.95	0
Braintree Electric	3	Brain3	337,600	4,677,500	35.9	2.82	39.62	444.27	5.18	14.94	16
Braintree Electric	4	Brain4	337,600	4,677,500	35.9	0.03	12.19	449.83	0.61	3.35	16
Braintree Electric	5	Brain5	337,600	4,677,500	35.9	0.09	12.19	699.83	0.55	6.1	16
Covanta Haverhill Incorporated	1	Covan1	326,000	4,736,700	60.1	13.09	87.78	413.72	2.38	18.9	17
Covanta Haverhill Incorporated	2	Covan2	326,000	4,736,700	60.1	13.41	87.78	413.72	2.38	18.59	17
Covanta Haverhill Incorporated	8	Covan8	326,000	4,736,700	60.1	0.03	2.74	683.16	0.15	530.35	17
Dominion Energy Salem Harbor Llc	1	Dom1	345,900	4,709,700	27.5	18.78	132.89	436.49	2.74	26.21	0
Dominion Energy Salem Harbor Llc	2	Dom2	345,900	4,709,700	27.5	21.83	132.89	431.49	2.74	26.21	0
Dominion Energy Salem Harbor Llc	3	Dom3	345,900	4,709,700	27.5	41.28	132.89	422.6	3.84	24.99	0
Dominion Energy Salem Harbor Llc	4	Dom4	345,900	4,709,700	27.5	14.47	152.4	433.16	5.67	22.86	0

Table 6-15

Cumulative Impacts Modeling – Emissions Sources within 50 km Radius of Proposed NEG Project

Facility Name	Stack Id	Model Id	Utm-E M	Utm-N M	Distance From Project Site (Kilometers)	NOx G/S	Stack Height M	T K	Dia. M	V M/S	Elv. M
Eastman Gelatine Corp	1	East1	340,700	4,709,200	31.8	1.01	49.38	505.38	2.13	5.18	15
Eastman Gelatine Corp	2	East2	340,700	4,709,200	31.8	0.6	41.76	499.83	1.52	6.1	15
Eastman Gelatine Corp	3	East3	340,700	4,709,200	31.8	1.35	41.76	488.72	1.52	6.1	15
Eastman Gelatine Corp	4	East4	340,700	4,709,200	31.8	0.03	11.28	377.6	0.4	14.94	15
Eastman Gelatine Corp	5	East5	340,700	4,709,200	31.8	0.03	11.28	377.6	0.4	13.41	15
Exelon Fore River Development Llc	1	Exel1	337,800	4,678,300	35.3	0.14	6.4	599.27	1.07	23.47	0
Exelon Fore River Development Llc	3	Exel3	337,800	4,678,300	35.3	3.57	77.72	428.16	6.25	25.91	0
Exelon Fore River Development Llc	4	Exel4	337,800	4,678,300	35.3	2.36	77.72	428.16	6.25	25.91	0
Exelon New Boston Llc	1	Exelnew1	332,300	4,689,200	37.2	2.88	97.54	394.27	2.44	3.05	13
Exelon New Boston Llc	3	Exelnew3	332,300	4,689,200	37.2	0.06	76.2	574.83	5.49	3.05	13
Exelon New Boston Llc	4	Exelnew4	332,300	4,689,200	37.2	0.03	36.58	810.94	3.05	18.29	13
General Electric Aircraft Engines	1	Ge1	337,700	4,701,700	32.1	0.6	33.53	477.6	1.83	11.28	0
General Electric Aircraft Engines	2	Ge2	337,700	4,701,700	32.1	2.53	41.15	477.6	1.83	11.28	0
General Electric Aircraft Engines	3	Ge3	337,700	4,701,700	32.1	4.57	41.76	477.6	2.44	10.06	0
General Electric Aircraft Engines	4	Ge4	337,700	4,701,700	32.1	1.73	36.58	477.6	2.44	36.27	0
General Electric Aircraft Engines	5	Ge5	337,700	4,701,700	32.1	5.84	10.7	811	0.914	15.2	0
General Electric Aircraft Engines	6	Ge6	337,700	4,701,700	32.1	0.43	53.34	400	1.52	17.98	0
General Electric Aircraft Engines	14	Ge14	337,700	4,701,700	32.1	0.03	9.75	294.27	0.15	0.3	0
General Electric Aircraft Engines	18	Ge18	337,700	4,701,700	32.1	0.03	10.67	477.6	0.15	4.57	0
Gillette Company The	1	Gill1	330,800	4,690,000	38.5	7.02	48.77	433.16	1.95	9.14	2
Harvard University	1	Harv1	325,800	4,692,100	43.3	1.64	45.72	469.27	3.66	10.36	3
Harvard University	2	Harv2	325,800	4,692,100	43.3	3.08	48.77	435.94	3.05	12.5	3
Haverhill Paperboard	1	Haver1	331,000	4,736,800	56.7	5.75	50.9	487.05	1.1	26.82	7
Kraft Foods	2	Kraft2	326,100	4,704,700	44.1	3.02	45.72	491.49	1.31	18.29	25
Kraft Foods	3	Kraft3	326,100	4,704,700	44.1	1.29	45.72	435.94	1.83	9.14	25
Medical Area Total Energy	1	Mate1	326,300	4,689,100	43.1	37.43	96.01	472.05	2.44	21.34	14
Mirant - Kendall Llc	1	Mirant1	325,700	4,692,200	43.4	3.68	53.34	428	3.05	12.50	1

Table 6-15

Cumulative Impacts Modeling – Emissions Sources within 50 km Radius of Proposed NEG Project

Facility Name	Stack Id	Model Id	Utm-E M	Utm-N M	Distance From Project Site (Kilometers)	NOx G/S	Stack Height M	T K	Dia. M	V M/S	Elv. M
Mirant - Kendall Llc	2	Mirant2	325,700	4,692,200	43.4	2.22	53.34	461	2.74	9.45	1
Mirant - Kendall Llc	3	Mirant3	325,700	4,692,200	43.4	0.35	53.34	614.27	1.68	15.24	1
Mirant - Kendall Llc	4	Mirant4	325,700	4,692,200	43.4	0.14	10.06	838.72	3.96	39.62	1
Mirant - Kendall Llc	5	Mirant5	325,700	4,692,200	43.4	0.03	9.45	838.72	4.45	9.14	1
Mirant - Kendall Llc	10	Mirant10	325,700	4,692,200	43.4	0.16	76.2	394.27	5.11	23.4	1
Mit	1	Mit	327,600	4,691,800	41.5	5.12	53.95	483.16	1.83	27.43	1
Semass Partnership	1	Semass1	351,300	4,629,300	67.8	40.94	105.16	416.49	2.29	25.91	0
Semass Partnership	24	Semass24	351,300	4,629,300	67.8	0.03	3.35	533.16	0.12	19.81	0
Semass Partnership	25	Semass25	351,300	4,629,300	67.8	0.06	3.96	533.16	0.09	140.21	0
Semass Partnership	26	Semass26	351,300	4,629,300	67.8	0.03	2.44	533.16	0.09	31.7	0
Taunton Municipal Light - Cleary Flood	1	Taunt1	325,200	4,636,700	72.8	0.12	23.47	522.05	0.91	6.1	0
Taunton Municipal Light - Cleary Flood	2	Taunt2	325,200	4,636,700	72.8	4.57	57	477.6	3.05	18.29	0
Taunton Municipal Light - Cleary Flood	3	Taunt3	325,200	4,636,700	72.8	0.49	57	422.05	2.07	14.33	0
Trigen Boston Energy	1	Trigen1	330,400	4,690,400	38.9	7.74	80.77	405.38	3.51	5.49	1
Trigen Boston Energy	2	Trigen2	330,400	4,690,400	38.9	6.79	80.77	477.6	3.96	7.62	1
Us Hanscom 66th Sptg	1	Ushans1	312,400	4,703,200	57.3	1.73	45.72	544.27	2.13	3.96	0
Us Hanscom 66th Sptg	2	Ushans2	312,400	4,703,200	57.3	1.75	45.72	544.27	2.13	3.96	0
Us Hanscom 66th Sptg	3	Ushans3	312,400	4,703,200	57.3	0.17	1.52	449.83	0.3	0.61	0
Wheelabrator North Andover Incorporated	1	Wheel1	326,300	4,732,400	57.0	20.94	70.1	418.16	2.13	22.86	26
Wheelabrator Saugus Jv	1	Wheelsag	337,100	4,701,100	32.6	19.3	87.17	416.49	2.16	24.38	0
Suez Tractebel Lng Import Terminal	1	Suez1	330,500	4,695,300	38.5	0.35	9.0	422	0.61	17.7	0
Suez Tractebel Lng Import Terminal	2	Suez2	330,500	4,695,300	38.5	0.32	16.5	386	1.01	10.1	0
Suez Tractebel Lng Import Terminal	3	Suez3	330,500	4,695,300	38.5	0.43	25.0	355	1.22	20.4	0

6.2.10 In-Air Noise

A temporary increase in atmospheric noise levels would occur during onshore and offshore construction activities. As proposed, the construction periods for the NEG and Neptune projects would not overlap and therefore no cumulative construction-related noise effects would occur. Construction noise would have minor short-term adverse effects on fish, marine mammals, and seabirds, but no significant cumulative effects because of the relative short duration of construction.

The NEG Port would be sufficiently distant from shore (over 10 miles) that noise generated from port operations would not affect any noise-sensitive areas and would have no adverse effects onshore. Based on the proposed locations of the two projects approximately 5 nautical miles apart, in-air sound would not be additive during operation. Therefore, when considered together with the potential Neptune noise impacts, there would be no cumulative noise impacts from the NEG Project.

6.2.11 Safety

Section 5.0 discusses the potential cumulative effects of the NEG and Neptune Projects on safety.

6.3 ONSHORE EFFECTS

Onshore effects of the NEG Project would be limited to load-out yards and staging areas during construction and a Regional Operations Center and meter stations during operations. NEG proposes to use existing waterfront port facilities as load-out yards and staging areas during Port construction, and existing office/warehouse space for the Regional Operations Center, which would have no adverse effects. Construction at the meter stations would occur entirely within existing fenced areas and would have no adverse effects. Since the onshore components of the NEG Project would have no adverse effects, there would be no cumulative impacts.

6.4 OVERVIEW OF CUMULATIVE IMPACTS ANALYSIS

Massachusetts Bay supports commercial maritime transportation, commercial fishing activities, and whale watching, as well as providing ocean disposal sites for municipal wastewater and dredged material. These historical and ongoing activities have cumulatively affected Massachusetts Bay

Table 616 summarizes the potential cumulative impacts on resources from past, present, and future activities along with the Proposed Action.

Table 6-16
Summary of Cumulative Impacts

Resource	Past Actions	Current Actions	Proposed Action and Alternatives	Reasonably Foreseeable Future Actions	Cumulative Impacts
Water Resources	Dredge disposal, onshore cooling water discharges, wastewater effluent discharge, and industrial and radioactive waste disposal have all impacted Massachusetts Bay water quality	Dredging and dredge disposal, vessel operations, effluent discharge, onshore cooling water, and waste disposal all impact Massachusetts Bay water quality.	Roughly 3 mgd water discharge from operations, and temporary turbidity impacts during construction from both projects may impact water quality.	Dredge disposal, vessel operations, effluent discharge, onshore cooling water, and waste disposal can all impact Massachusetts Bay water quality.	Current and future activities could impact coastal and marine water quality (DO, TSS, pH, etc). LNG DWP would result in small incremental increase in impacts on water quality.
Biological Resources	Degraded historic habitat of sensitive and common wildlife species. Degraded water quality impacted sensitive species. Stresses to Massachusetts Bay fisheries including overfishing of certain species.	Dredging and dredge disposal, vessel operations, onshore cooling water, effluent discharges, noise, and fishing activities continue to impact threatened and endangered species (especially the right whale) as well as other biological resources.	Increase in vessel traffic increases chances for vessel strikes to endangered whales as well as harassment from noise; temporary impacts on habitat from construction; water intake and vessel operations; habitat impacts from anchor sweep could all impact biological resources.	Vessel traffic, dredging and dredge disposal, vessel operations, onshore cooling water, and discharges, and fishing activities could continue to impact biological resources.	Current and future activities could impact coastal and marine waters. LNG DWP could have small incremental increase of impacts on biological resources.
Geologic	Installation of pipelines on the seafloor, dredging, and dredged material disposal have affected surficial geology of Massachusetts Bay in localized areas.	Installation of pipelines on the seafloor, dredging, and dredged material disposal have affected surfical geology of Massachusetts Bay in localized areas.	Installation of pipelines and port anchors on seafloor would have minor affect on surficial geology in localized areas	Installation of pipelines and DWP anchors on the seafloor, dredging and dredged material disposal would have minor affect on surficial geology in localized areas.	Current and future activities would have minor affect on surficial geology in localized areas.
Cultural	Possible destruction of unknown artifacts	Possible destruction of unknown artifacts	Possible destruction of unknown artifacts	Possible destruction of unknown artifacts	Possible destruction of unknown artifacts
Ocean Use, Recreation, and Visual	Little effect on ocean use, recreation, or visual resources from past actions.	Little effect on ocean use, recreation, or visual resources from current actions.	NEG Project would limit access to small areas during construction and near port during operation, but few recreational boaters venture this far from shore. Project would have minor long-term adverse affect on aesthetics	Neptune Project would limit access to small areas during construction and near port during operation, but few recreational boaters venture this far from shore. Project would have minor long-term adverse affect on aesthetics.	The NEG and Neptune projects would cumulatively have a minor long-term adverse affect on visual resources, especially for whale watchers and other visitors to SBNMS.
Socioeconomics	Construction, real estate, fishing, seafood sales, transportation, tourism, recreation, technology and education have all contributed to the socioeconomic resources of coastal Massachusetts.	Construction, real estate, fishing, seafood sales, transportation tourism, recreation, technology and education have all contributed to the socioeconomic resources of coastal Massachusetts.	The proposed activity would adversely affect the commercial fishing industry, but these impacts would be long term and minor.	All current contributors to socioeconomic resources would continue to support the regional economy	Minor stimulation of local economies from construction activities with minor long-term adverse impacts to the fishing industry.

Table 6-16
Summary of Cumulative Impacts

Resource	Past Actions	Current Actions	Proposed Action and Alternatives	Reasonably Foreseeable Future Actions	Cumulative Impacts
Transportation	Cargo vessels, fishing ships, dredge vessels, tugs, recreational and tourism ships have all used Massachusetts Bay.	Cargo vessels, fishing ships, dredge vessels, tugs, recreational and tourism ships have all used Massachusetts Bay.	The proposed actions would affect transportation around each projects safety zone and around LNG vessels during transit.	Current vessels would continue to use Massachusetts Bay for marine transportation.	Vessel movement would be restricted around project ports and LNG vessels under way, and these limitations would constitute a minor cumulative impact for transportation.
Air Quality	Emissions from regional activities, cargo and other vessels degraded offshore air quality. Power plants, factories, vehicles, and other major emissions sources degraded onshore regional air quality.	Emissions from regional activities, cargo and other vessels degraded offshore air quality. Power plants, factories, vehicles, and other major emissions sources degraded onshore regional air quality to produce non-attainment areas.	Proposed action would result in increased emissions, of which NOx is the pollutant of greatest concern. NOx emissions for operation estimated at 49.9 tpy and over 300 tpy for construction.	Emissions from Regional activities are expected to maintain present levels or decrease.	Current activities would be the predominant source of emissions. Proposed activities would add eligible cumulative impacts.
In-Air Noise	Natural causes (e.g. wind and waves) generate most noise. Ships and dredging activities were dominant human generated noise sources.	Natural causes (e.g. wind and waves) generate most noise. Ships and dredging activities were dominant human generated noise sources.	NEG Project would generate noise during construction and operation, but Project is sufficiently distant from shore that it would not affect any noise sensitive areas.	Neptune Project would generate noise during construction and operation, but Project is sufficiently distant from shore that it would not affect any noise sensitive areas.	The NEG Project would not adversely impact noise levels because other noise sources are either temporary or too distant to be cumulatively affected.

7.0 COASTAL ZONE CONSISTENCY

According to the Massachusetts Coastal Zone Management Program (MCZM Program), the coastal zone of Massachusetts includes the lands and waters within an area defined by the seaward limit of the state's territorial waters, which is generally 3 miles (5 kilometers) from the shore, extending from the Massachusetts/New Hampshire border south to the Massachusetts/Rhode Island border, and landward to 100 feet (30 meters) of specified major roads, rail lines, or other visible rights-of-way.

Mileposts 0 through 12.5 of the proposed NEG pipeline are located within the territorial waters of Massachusetts, and are, therefore, within the MCZM area. In addition, the geographic scope of MCZM's jurisdiction includes the coastal zone, and activities in adjacent marine waters, adjacent state waters, or in Massachusetts coastal watersheds if activities can reasonably be expected to affect the resources or land or water uses of the Massachusetts coastal zone. As such, the entirety of the proposed Project is subject to review under the federal Coastal Zone Management Act (CZM) for federal consistency with the policies of the MCZM Program. In June 2005, Excelerate Energy LLC and Algonquin Gas Transmission submitted a MCZM Consistency Certification for the NEG Project and the NEG Pipeline Lateral, respectively, to the MCZM Office for concurrence. At this time the Massachusetts Office of Coastal Zone Management has not issued a decision regarding consistency.

RECOMMENDATIONS

FERC staff recommends that:

Algonquin not begin construction of the Project until it files with the Secretary of FERC a copy of the determination of consistency with the Coastal Zone Management Plan issued by the Massachusetts Office of Coastal Zone Management.

8.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Should the NEG Project be licensed and constructed, there would be some irreversible or irretrievable commitments of resources. Irreversible or irretrievable commitments are those that cannot be reversed, except perhaps in the extreme long-term. A commitment of resources involves the use or destruction of nonrenewable resources, as well as the effects that loss would have on future generations. If a species becomes extinct as a result of a Proposed Action, for example, that loss is permanent. If wetland is filled to build a parking lot, that habitat is irretrievable as long as the parking lot remains. Construction and operation of the NEG Port involves the irreversible and irretrievable commitment of material resources, energy, and biological resources.

Material resources used for the proposed Port include building materials for new structures, pipelines, and other facilities. Construction of the proposed Port would also require use of fossil fuels, a nonrenewable natural resource.

Construction and operation of the proposed NEG Port would result in an irreversible or irretrievable loss of some biological resources, including the irretrievable loss of approximately 43 acres of soft bottom habitat in the anchor chain and cable sweep area. The use of seawater for the STV vaporizer alternatives and for hydrostatic testing of the flowlines and NEG Pipeline Lateral would also cause the irreversible loss of fish eggs and larvae.

Approximately 11 weeks of labor would be irretrievably lost annually to the fishing industry in Massachusetts due to the enforcement of the security area around the Port. The creation of the security areas around the LNG carriers during transit and while at berth would also result in the irretrievable loss of transportation routes and recreation.

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