APPENDIX E

ESSENTIAL FISH HABITAT (EFH) ASSESSMENT

Appendix E

Essential Fish Habitat Assessment
for the Broadwater LNG Project

Prepared by:
ENTRIX, Inc.
10 Corporate Circle, Suite 300
New Castle, DE 19720

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Acronyms and Abbreviatons

bcf .... billions cubic feet
bcfd .... billions cubic feet per day
CFR .... Code of Federal Regulations
CL&P .... Connecticut Light & Power
CO .... carbon monoxide
CO_2 .... carbon dioxide
COE .... U.S. Army Corps of Engineers
EEZ .... Economic Exclusion Zone
EFH .... Essential Fish Habitat
EIS .... Environmental Impact Statement
EPA .... Environmental Protection Agency
FERC .... Federal Energy Regulatory Commission
FMC .... Fishery Management Council
FSRU .... Floating Storage and Regasification Unit
DOT .... Department of Transportation
GBS .... gravity-based structures
HAPC .... Habitat Areas of Particular Concern
IGTS .... Iroquois Gas Transmission System
LNG .... liquefied natural gas
m^3 .... $meters^3$
MAFMC .... Mid-Atlantic Fishery Management Council
MSFCMA .... Magnuson-Stevens Fishery Conservation and Management Act
NEFMC .... New England Fishery Management Council
NEPA .... National Environmental Protection Act
NMFS .... National Marine Fisheries Service
NO_x .... nitrogen oxides
NOAA .... National Oceanic and Atmospheric Administration
NYSDEC .... New York State Department of Environmental Conservation
SPDES .... New York State Pollutant Discharge Elimination System
ORV .... Open rack vaporization
ppm .... part per million
psig .... pounds per square inch gauge
SCADA .... supervisory control and data acquisition
SCV .... submerged combustion vaporization
SPCC .... Spill Prevention, Containment, and Countermeasures
SRV .... shuttle regasification vessels
STV .... shell and tube vaporization
YMS .... yoke mooring system

1.0 INTRODUCTION

The purpose of this document is to present the findings of the Essential Fish Habitat (EFH) Assessment conducted for the proposed Broadwater Project as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) of 1976, as amended through 1998. This EFH Assessment is based on the regulations implemented in the United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) EFH Final Rule, 50 Code of Federal Regulations (CFR) Part 600 (NOAA 2002a). The objective of this EFH Assessment is to describe how the actions as part of the proposed Broadwater Project may affect EFH and EFH-managed species within the area influenced by the proposed Project. According to NOAA National Marine Fisheries Service (NMFS), EFH within Long Island Sound includes those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The area of influence of the proposed Project would primarily be in central Long Island Sound, with additional construction impacts extending along the proposed pipeline route. During operations, the area of influence would be the waters of central Long Island Sound.

This report was prepared to meet the requirements described by the NMFS to comply with the MSFCMA. The EFH Assessment includes a description of the proposed action; an analysis of the direct, indirect, and cumulative effects on EFH, EFH-managed species, and their major food sources; our evaluation of the effects of the proposed action on EFH and EFH-managed species; and proposed mitigation measures selected to minimize expected project effects if applicable.

2.0 PROJECT DESCRIPTION

Broadwater proposes to construct and operate a marine liquefied natural gas (LNG) floating storage and regasification unit (FSRU) and subsea pipeline for the importation, storage, regasification, and transportation of natural gas. The proposed Broadwater LNG FSRU would be located in Long Island Sound, in New York state waters, approximately nine miles from the coast of Long Island (Figure 2-1).

The proposed FSRU would be designed to receive, store, and regasify LNG at an average throughput of 1.0 billion cubic feet per day (bcfd). The proposed FSRU would be capable of a peak day throughput of 1.25 bcfd into the existing Iroquois Gas Transmission System (IGTS) pipeline via a proposed subsea pipeline.

LNG would be delivered to the proposed FSRU via LNG carriers with capacities ranging from 125,000 meters^3 (m^3) to 250,000 m^3. Broadwater anticipates that LNG carriers would deliver approximately two to three times per week (approximately 118 carriers per year). The proposed FSRU would be approximately 1,215 feet in length, 200 feet in width, and rise approximately 80 feet above the water line with some above-deck structures extending up to approximately 140 feet. The proposed FSRU would be capable of storing approximately 8 billion cubic feet (bcf) of LNG and vaporizing LNG using a closed-loop shell and tube vaporization (STV) system.

The proposed FSRU would be moored to the seafloor of Long Island Sound via four legs attached to a yoke mooring system (YMS). The YMS would allow the FSRU to pivot around the mooring tower base. The mooring tower base would feature an open design construction. The total area under the proposed YMS would be approximately 0.3 acre. The YMS would house the connection between the FSRU and the proposed new subsea pipeline.

Broadwater proposes to construct and install a 30-inch diameter 21.7-mile subsea natural gas pipeline that would transport LNG from the proposed FSRU to the existing IGTS pipeline (Figure 2-1).

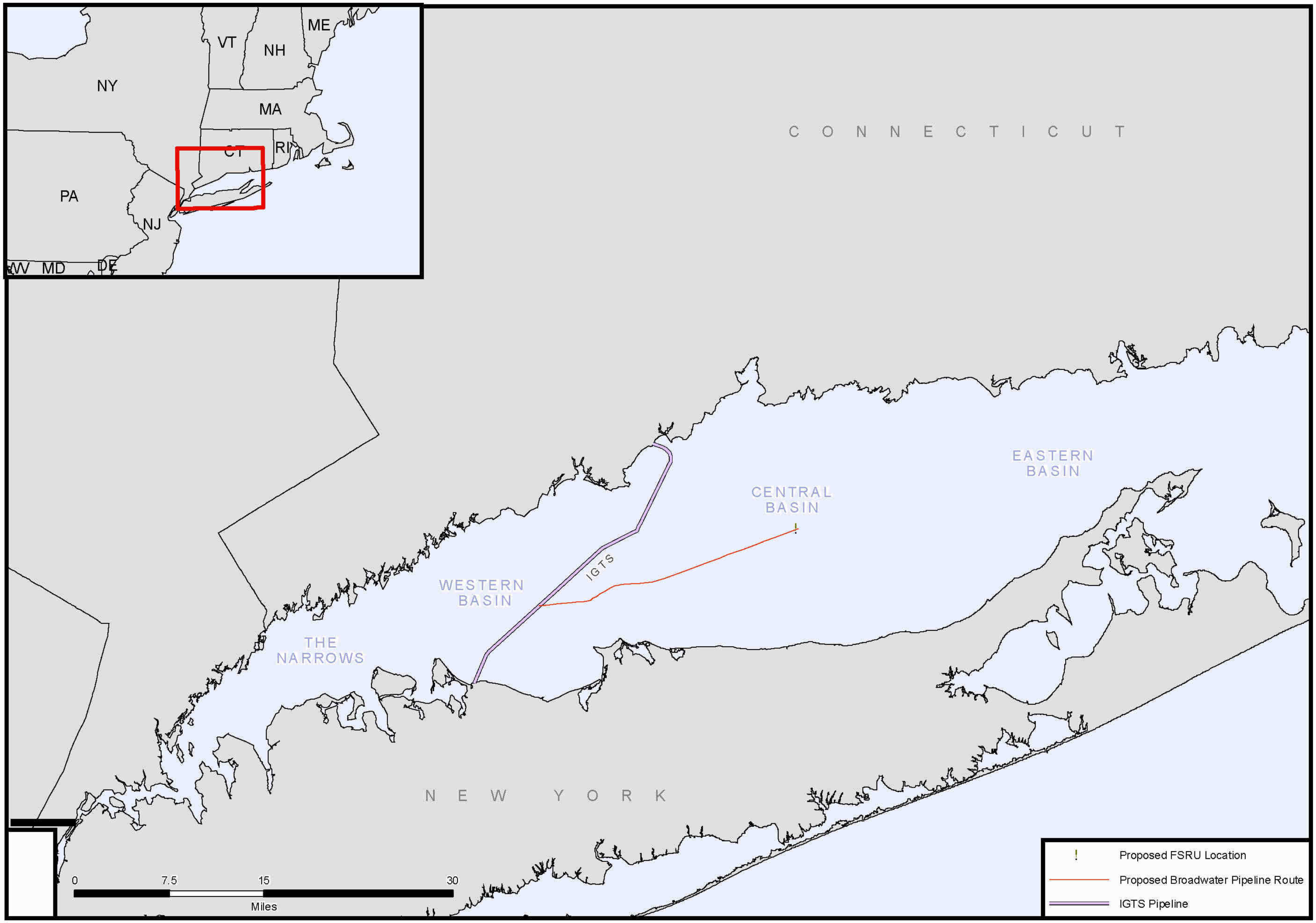

Figure 2-1
Broadwater LNG Project
Proposed FSRU Location and Pipeline Route

2.1 PROPOSED CONSTRUCTION METHODS

A brief discussion of the proposed construction methods for the proposed FSRU and pipeline are discussed below. A more detailed discussion of proposed construction methods can be found in Section 2.3 of the Environmental Impact Statement (EIS).

2.1.1 Proposed FSRU

The proposed FSRU would be constructed in a certified shipyard outside of the Project area. The proposed FSRU would then be towed into Long Island Sound to the YMS, which is described further below.

2.1.2 Proposed YMS

Prior to delivery of the FSRU, the YMS would be installed in the seafloor of the Sound. The four legs of the YMS would be driven into the seafloor, with a hydraulic hammer mounted on an anchored support barge, to depths of 165 feet to 230 feet, depending on existing geological conditions at the proposed site. The legs would be installed one by one, and installation would be conducted between mid-September to mid-November, 2010 allowing approximately 1 week for each leg. The proposed FSRU would be connected to a YMS installed at a water depth of approximately 95 feet. The proposed YMS would allow the proposed FSRU to pivot or "weathervane" around the YMS, enabling the vessel to orient in response to the prevailing wind, tide, and current conditions. The proposed YMS would consist of a four-legged mooring tower. About 0.3 acre of the seafloor would be between the four legs of the tower, and anchors from the support barge would impact less than 0.5 acre of seafloor. To maintain the stability of the mooring tower during lowering to the sea floor, a wooden frame (termed a "mud mat") constructed of untreated lumber would be installed between the legs of the tower and would remain in place for the life of the Project or until it degrades.

2.1.3 Proposed Pipeline

Broadwater would install the proposed subsea pipeline during the fall, winter, and early spring of 2009-2010, construction would commence on approximately October 12, 2009 and continue through the end of April. Broadwater anticipates that construction associated with sediment disturbance would be virtually completed prior to mid-March 2010 until YMS installation resumes construction utilities in mid-September 2010. As proposed by Broadwater, the direct impacts to sediment during pipeline installation would affect a total of 2,235.5 acres of sediment. Over 90 percent of this acreage would be affected by anchor cable sweep from construction and support vessels. Our recommendation that Broadwater use mid-line buoys on all anchor cables, or possibly a dynamically positioned lay barge, should virtually eliminate impacts to sediment associated with anchor cable sweep (URS Greiner 1998), thus reducing the extent of seafloor impacts by 90 percent (Section 3.1.2.2 of the EIS). From mid-March to the end of April 2010, construction activities would primarily consist of connecting the proposed pipeline to the IGTS pipeline and cleaning and testing of the proposed pipeline. The majority of the proposed pipeline (approximately 21.5 miles) would be installed via a subsea plow. Broadwater proposes to allow most of the trench (19 miles) to naturally backfill and has reported that natural backfilling would fill most of the trench within 1 year and virtually all of the trench within 3 years. Due to the differences among post-construction monitoring reports and concern about potential impacts of an open trench and exposed pipeline during natural backfilling, we have recommended that Broadwater mechanically backfill the trench with excavated spoil material immediately following pipeline installation (Section 3.1.2.2 of the EIS). Manual excavation by divers and/or the use of submersible pumps would be used to install the proposed pipeline at the IGTS tie-in, proposed FSRU tie-in, AT&T cable crossing, and the Cross Sound Cable crossing. A scaled-down subsea plowing has been proposed by Broadwater to address trenching through the coarser substrate along Stratford Shoal. In the event that the scaled-down plow approach is unsuccessful, Broadwater proposes a dredging alternative for Stratford Shoal. This alternative would require a dredged trench of 26 to 54 feet wide by 4,000 feet long to extend across the shoal. A second alternative proposed by Broadwater would involve placing the pipeline on the seafloor across Stratford Shoal and covering it with concrete mats. As described in the EIS (Section 3.1), we have recommended that Broadwater provide a contingency plan that outlines the specific alternative method, potential impacts, and mitigation measures that would be implemented to avoid and minimize potential impacts associated with pipeline installation across Stratford Shoal.

The proposed pipeline would be buried beneath the seafloor to a minimum depth of three feet where practicable. The proposed pipeline would be covered with armor in areas where it could not be buried. The entire subsea pipeline would also be coated with three inches of concrete.

2.2 PROPOSED OPERATIONS

Operation of the proposed Project would involve importation and transfer of LNG to the proposed FSRU from LNG carriers, regasification of LNG on the FSRU, and transfer of regasified LNG (natural gas) into the 21.7-mile subsea pipeline and ultimately into the existing IGTS pipeline system.

2.2.1 Proposed FSRU

Imported LNG would be obtained from liquefaction plants throughout the world and delivered by LNG carriers. Upon arrival at the FSRU, each LNG carrier would dock at the berthing area along the starboard side of the FSRU, attach to the FSRU's unloading arms, and transfer LNG to the FSRU's storage tanks. LNG would be transferred at a maximum rate of 5,000 m^3 per hour per arm.

From the storage tanks on the FSRU, LNG would be transferred by in-tank submersible pumps to a series of vaporizers, and then through the sendout lines and riser pipeline and into the subsea pipeline. As described in Section 2.4.1 of the EIS, LNG must be warmed from a liquid to a gaseous state (vaporized) before it can be transported as natural gas in the sendout pipeline. Broadwater has proposed to accomplish this using closed-loop shell-and-tube vaporization (STV) technology. Under this approach, LNG would be regasified by passing through a series of heated coils, which are heated using a glycol/water mixture contained in a closed loop system. The closed loop system is recommended by NOAA because this system requires no intake or discharge of seawater compared to an open loop system (NOAA 2005a) thereby, minimizing impacts to marine organisms from impingement/entrainment and heated discharge from open loop systems.

As the LNG is offloaded, ballast water would be taken on to compensate for the weight of the offloaded cargo. After completion of cargo transfer, the unloading arms and umbilicals would be detached, and the carrier would depart with tug assistance. The entire unloading process from ship arrival to departure would take approximately 35 hours (See Table 2.4-1 of the EIS).

LNG would be regasified using a system of 8 closed-loop STVs. The vaporizers would use a glycol/water solution as a medium to warm the LNG and convert it to natural gas. Three superheaters then would be used to heat the vaporized gas to sendout temperature. Boil-off gas from the storage tanks would be routed either to a recondenser or to boil-off gas compressors that would return natural gas vapor to the LNG carrier and recondenser or to the process heaters for use as fuel.

Seawater intakes for the proposed FSRU would be taken in through the FSRU's four seawater intakes - all of which would be on the bottom of the hull, approximately 40 feet below the water line. Two of these intakes would supply the sea chests which would provide water for ballast, desalinization, and the side-shell water curtain between the LNG carrier and proposed FSRU during LNG transfer. The sea chests would have two main intakes, one on the port side and one the starboard side and only one of these intakes would operate at a time. The sea chest intake systems would consist of a 35-inch pipe with a coarse grate, positioned flush with the hull. The openings in the grate would measure approximately 4 inches by 2 inches to allow ready water intake but to exclude larger-sized marine life and debris from the intakes. The pipe would lead to a 0.2-inch mesh screen. Between the coarse grate and the mesh screen, sodium hypochlorite would be continuously injected into the seawater, resulting in an initial sodium hypochlorite concentration in the seawater between 0.01 and 0.05 part per million (ppm).

In addition to the main seawater intakes, there would be two firewater pump intakes, one on the forward end and the other on the aft end. The intake portals would have coarse grates, with openings approximately 4 inches by 2 inches; a finer (0.2-inch) mesh screen would be incorporated into the crossover pipe.

All water intakes would be discharged directly into Long Island Sound. Routine discharge waters from the proposed FSRU would approximate ambient temperature, and most would be treated with sodium hypochlorite biocides. The chlorine concentrations would be monitored via a colorimetric assay. The residual chlorine concentration is not expected to affect water quality because dilution would occur rapidly due to the volume of water in Long Island Sound and mixing by the tides. All discharges would be in accordance with New York State Pollutant Discharge Elimination System (SPDES) Permits. Broadwater submitted their SPDES Permit application in on March 24, 2006 to New York State Department of Environmental Conservation (NYSDEC).

Broadwater anticipates that the maintenance program of the proposed FSRU would include visual inspections, operational checks and tests, routine onboard mechanical and electrical maintenance activities, lubrication schedules and regular steelwork examinations, and surveys above and below the water line. Underwater maintenance may include surface cleaning of the hull and other parts to remove localized accumulations of slime and weeds. The cleaning would be accomplished by divers and would consist of light brushings conducted no more than once per year. If mechanical repairs to underwater parts of the FSRU or YMS are necessary, the area to be repaired would be segregated from seawater by a cofferdam installed by divers.

2.2.2 Proposed Pipeline

The proposed pipeline facilities would be operated and maintained in accordance with 49 CFR 192. The pipeline would be operated at a maximum allowable operating pressure of about 1,400 pounds per square inch gauge (psig). This pressure would be compatible with the pressures in the IGTS pipeline. The average flow would be approximately 1.0 bcfd, with a maximum flow of 1.25 bcfd.

Operation of the proposed pipeline, including maintenance of gas quality and volumetric control, would be handled from the Broadwater FSRU command and control center. IGTS would also construct minor gas quality monitoring and control facilities at existing IGTS locations using blanket construction authorizations. This equipment would include gas chromatographs and other monitoring equipment and heating equipment. The Broadwater FSRU command and control facility and the IGTS control facilities - both of which are manned 24 hours per day - would monitor the pipeline facilities, using supervisory control and data acquisition (SCADA) systems. Operation and maintenance records would be maintained in accordance with the requirements of 49 CFR Part 192.

Regular pipeline maintenance would include maintenance and pigging at intervals specified in Broadwater's Project-specific pipeline maintenance plan that would be based on regulatory requirements of the U.S. Department of Transportation (DOT) and NYSDEC regulations for pipelines, and as conditions warrant. Pigging procedures would typically be completed in 10 to 14 days, depending on weather and the type of inspection required. Where necessary, concrete mats or other protective barriers covering the receiver flange at the IGTS pipeline tie-in would be temporarily removed prior to pigging and later replaced, using a dive support vessel.

The Broadwater pipeline would be equipped with an automatic and manual shutdown system that would be implemented if a pipeline leak, equipment failure, or system failure occurred.

2.2.3 LNG Carriers

LNG carriers must comply with all federal and international standards regarding LNG shipping and would be subject to all rules, regulations, and requirements of the Coast Guard. The proposed Project would be designed to accommodate LNG carriers with capacities ranging from 125,000 m^3 to 250,000 m^3. LNG carriers would be of double-hulled design (that is, each carrier would have a double bottom and double sides along the full length of the cargo area). LNG carriers would transport LNG to the proposed FSRU from various countries with natural gas liquefaction plants. Carriers would approach the Long Island Sound region from the Atlantic Ocean. After crossing the offshore boundary of the Economic Exclusion Zone (EEZ), the LNG carriers would continue towards and through either Rhode Island Sound east of Block Island to approach the Block Island pilot station (the northern or Block Island route), or Block Island Sound to the southwest of Block Island to approach the Montauk Channel pilot station (the southern or Montauk route). LNG carriers would berth along the starboard side of the FSRU, and only one LNG carrier would be allowed to berth at a time. Each LNG carrier would be secured to the FSRU using mooring lines equipped with quick-release hooks that would be permanently attached to the FSRU. Floating pneumatic fenders would be used to separate the hulls of the two vessels while berthed and to prevent contact. In addition, a side-shell water curtain would be directed overboard between the FSRU and the LNG carrier during off-loading. The side-shell water curtain would help the FSRU and the LNG carrier maintain hull integrity.

Carriers that transport LNG to the proposed Project would be fitted with an array of cargo monitoring and control systems that would automatically monitor and control cargo pressure, temperature of the cargo tanks and surrounding ballast tanks, emergency shutdown of cargo pumps and closing of critical valves, the level of cargo in the tanks, and gas and fire detection. These systems would be active while the carrier is at sea and during the remote-control phase of cargo operations at the FSRU.

2.2.4 Onshore Facilities

Onshore support facilities would be required for operation of the proposed FSRU and the pipeline. Permanent onshore support facilities would be established within an existing waterfront industrial site in either Greenport or Port Jefferson, New York. These facilities would include office space for 6 to 10 staff: a warehouse for storage and handling of spare parts, tools, and equipment; dock space for berthing four tugs; a workshop for tug maintenance; and a waterfront staging area capable of supporting container transfer cranes, large trucks, and a personnel transfer and boarding area. Apart from the installation of a perimeter security fence and guardpost, Broadwater does not anticipate modifying the existing onshore facilities.

3.0 ALTERNATIVES

In accordance with the National Environmental Protection Act (NEPA) and the Federal Energy Regulatory Commission (FERC) policy, a range of alternatives to the Broadwater LNG Project were evaluated. The purpose of this evaluation was to determine if there are reasonable alternatives that would be environmentally preferable to the Project as proposed. A more detailed discussion of alternatives can be found in Section 4.0 of the EIS.

Each alternative was considered until it was clear that the alternative was not reasonable or would result in environmental impacts that would be greater than those of the proposed Project as described in Section 3.0 of the EIS.

In addition, the proposed Project and alternatives to the proposed Project were compared with NOAA's *Recommended Best Practices for Liquefied Natural Gas Terminals* (NOAA 2005a). This document was developed by NOAA to provide guidance to NOAA staff to ensure consistent reviews of applications and environmental impact analyses for proposed LNG terminals. The document presents NOAA's recommendations regarding design, siting, construction, and operation of proposed LNG terminals so as to minimize impacts to marine and coastal resources.

3.1 ALTERNATIVE LNG TERMINAL DESIGNS

We identified three alternative types of LNG terminals that could be used to receive natural gas from international sources, and then store, regasify, and distribute natural gas via the existing natural gas pipeline infrastructure. Therefore, our assessment of general LNG terminal designs included:

- Onshore terminals
- Offshore gravity-based structures[1] (GBS); and
- Offshore terminals using shuttle regasification vessels (SRVs)[2].

3.1.1 Onshore LNG Terminal

To meet the Project objectives, federal LNG siting and safety criteria, and other federal requirements, an onshore LNG facility would require access to a deepwater port or other waterways where the water depth is approximately 50 feet or more, and a site with sufficient applicant-controlled land to accommodate a site-specific onshore exclusion zone. A minimum water depth of 50 feet would be required to safely accommodate transit, maneuvering and berthing of existing and future LNG carriers with drafts as deep as 40 feet.

We identified general areas in the Long Island Sound area where an onshore LNG terminal could be sited, all of which are on or near shorelines to provide marine berthing and transfer facilities for the LNG carriers. The onshore LNG storage facilities would need to be no more than about 2 miles from the berthing facility, based on the current technology for offshore, subsea cryogenic pipelines (Trammel 2006, Kitzel 2006). Rankin and Mick (2005) have recently suggested that longer subsea and onshore LNG pipelines may be feasible using a triple-walled pipe-in-pipe design. This technology is still being tested for LNG application and may be feasible, depending on advances in material availability and operational techniques that would maintain the required low temperature of the pipe when a carrier is not unloading LNG. At the present time, however, we do not consider it a feasible alternative.

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[1] Gravity-based structures are essentially concrete boxes that house LNG storage tanks and are placed on the seafloor.

[2] SRVs are marine vessels that transport LNG and have onboard vaporization equipment. Vaporized LNG is transferred from the SRV to a pipeline riser attached to an offshore buoy.

Existing developed ports in Long Island Sound where water depth exceeds 50 feet were initially examined. These sites included Northport and Port Jefferson in Long Island and Bridgeport, New Haven and New London in Connecticut. With the exception of New Haven, none of the deepwater ports evaluated appear to have sufficient land available for construction and operation of an onshore LNG terminal. Additionally, each of these ports experiences a high volume of commercial marine traffic, which would be adversely affected by construction, and operation of an onshore LNG terminal. Finally, residential neighborhoods occur within 0.5 miles of port areas at Northport, Port Jefferson and New Haven. Therefore, none of the existing deepwater port sites are considered suitable for development of an onshore LNG terminal.

No potential onshore LNG terminal sites exist adjacent to areas where water depth exceeds 50 feet. As a result, access for LNG carriers would require either shoreline modifications and nearshore dredging, or construction of a long dock or mooring jetty. A dock or mooring jetty would likely need to extend 1 mile or more into the Sound to provide sufficient water depth. Both the FWS (1991) and NYSDOS (2005) have designated much of the coastline of central Long Island Sound as significant natural areas due to the presence of shallow nearshore marine resources and coastal features. Dredging or pier or jetty construction could significantly impact these areas and would have an adverse impact on shellfish beds and other sensitive marine resources in excess of the impacts associated with the currently proposed Project.

Much of the shoreline of the region is relatively densely populated. Although LNG terminals have operated safely within populated areas, such as the Everett LNG facility in Boston, Massachusetts, increased distance between and LNG facility and populated areas enhances safety, reduces potential impacts of air emissions, and lessens visual impacts. Thus, the potential risks to human health and safety associated with an LNG terminal at most onshore locations in the region are greater than those of the proposed Project.

In addition, NOAA recommends all LNG terminals be sited as far offshore as possible, in areas of lower biological productivity, and away from sensitive habitats and migration routes of economically important fish species and their forage, marine mammals, or listed species (NOAA 2005a). Therefore, the proposed offshore location would address NOAA's recommendation (NOAA 2005a).

3.1.2 GBS Alternative

A GBS terminal could be constructed offshore, either in Long Island Sound or in the Atlantic Ocean. Under this alternative, LNG storage tanks would be contained in a concrete structure or structures placed directly on the seafloor and extending above the water surface. Vaporization equipment would be installed above the water likely using the concrete structures as a platform. LNG carriers would moor at the GBS and offload LNG into storage tanks in the GBS. The LNG would be regasified at the terminal and transported as natural gas through a sendout pipeline connected to an existing interstate natural gas distribution system.

GBSs would be constructed at a specialized onshore construction facility called a graving dock. Existing graving docks in the Project area, including facilities in Brooklyn, NY and Bayonne, NJ, are too small to accommodate construction of a GBS. Therefore, a new graving dock would need to be constructed for a Project-specific GBS. Environmental impacts associated with the construction of a graving dock would vary from site to site, although we anticipate that for most potential graving dock sites in the region, the impacts associated with construction of the GBS could be equal to or greater than those for the entire proposed Broadwater Project.

To accommodate LNG carriers, a GBS-based LNG terminal would need to be installed where water depth is at least 50 feet (Pepper and Shah 2004). Because the GBS must extend above the water, the maximum practicable water depth for a facility of this type would be approximately 100 feet. A GBS could be installed at the proposed site of the FSRU or at locations closer to shore with water depths of 100 feet or less. As the distance to the shoreline decreases, the visual impacts would increase. Broadwater estimated that a GBS capable of meeting the purpose of the Project would permanently impact approximately 16.9 acres of the seafloor, converting the substrate from softbottom sediments to concrete. As a result, a GBS (regardless of installation location) would result in a permanent seafloor conversion that would be greater than those of the proposed Project (about 16.9 acres for the GBS compared to about 0.1 acre for the FSRU's mooring system).

A GBS in the Atlantic Ocean would require a pipeline to the south shore of Long Island, with the impacts dependent on the distance to shore and the construction methods used through the nearshore area. However, construction through nearshore areas could affect sensitive marine species. In addition, a new onshore pipeline would be required to connect to the existing natural gas transmission system that transports gas to markets on Long Island and in New York City and Connecticut. A new compressor station would likely be required to maintain the appropriate pressure in the pipeline prior to connecting to the existing transmission system and would result in onshore air emissions and visual impacts that would not occur with the proposed Project. The adverse environmental impacts associated with a GBS, installation of the offshore and nearshore pipeline, installation of the onshore pipeline, and adding compression would be substantially greater than those of the proposed Project.

3.1.3 SRV Alternative

With this alternative, two or more permanently moored LNG unloading buoys would be constructed and attached to the seafloor using a 6- or 8-point mooring (anchoring) system. Each unloading buoy would contain a natural gas pipeline riser connected to a subsea pipeline that would extend to shore. The unloading buoy would be suspended within the water column below the sea surface.

SRV LNG terminals do not have the capacity to store LNG. To ensure that a continuous supply of gas would be provided to the region, use of an SRV LNG terminal would require two or three unloading buoys to allow for the departure/arrival of an SRV while another SRV is unloading.

An SRV with a draft of 45 to 52 feet would moor over the buoy, draw the buoy up through a port in the LNG vessel, vaporize LNG in its storage tanks, and transmit natural gas into the riser in the buoy. When unloading activities are complete, the unloading buoy would be disconnected from the LNG vessel and released. When not in use, the submerged unloading buoy and flexible riser are typically held suspended within the water column using a system of anchor chains. To accommodate the deep-draft SRVs and to prevent the subsea riser from contacting the bottom, the unloading buoys would need to be constructed where water depth is 120 feet or deeper. Only two areas within Long Island Sound have water deep enough (greater than or equal to 120 feet) to accommodate an SRV: an area approximately 4 miles north of the Port Jefferson area and an area west of and proximal to the Race. An SRV constructed at the former location would be much closer to coastal communities than the proposed Project and would result in additional air quality and visual impacts. An SRV constructed near the Race would likely result in greatly increased conflicts with commercial vessels.

If an SRV system were to be installed in the Atlantic Ocean, the adverse environmental impacts associated with the anchors and mooring lines, installation of the offshore and nearshore pipeline, and installation of the onshore pipeline would be substantially greater than those of the proposed Project. In addition, this alternative would not satisfy the Project purpose of providing adequate storage to better serve energy needs.

3.2 ALTERNATIVE LNG TERMINAL LOCATIONS

With the FSRU as the preferred type of LNG terminal, we evaluated alternative offshore locations for siting an FSRU. Our initial screening considered areas in the Atlantic Ocean south of Long Island, Block Island Sound, and throughout Long Island Sound as potential sites for the FSRU.

3.2.1 Block Island Sound and the Atlantic Ocean

With an FSRU in either Block Island Sound or the Atlantic Ocean, a sendout pipeline would extend from the offshore location through the nearshore area and onto Long Island or Connecticut. From that point, a pipeline would have to be installed to connect to the existing interstate natural gas transmission line that transports gas to New York City and Long Island. The impacts of pipeline construction would be dependent on the distance to shore and the construction methods used through the nearshore area. However, construction through nearshore areas could affect sensitive marine species, as much of the southern shoreline of Long Island is protected either as federal recreational land or listed as Significant Coastal Fish and Wildlife Habitat (NYSDOS 2006). These resources could include Jones Beach State Park, Hempstead Bay, Cupsogue Beach County Park, Shinnecocke County Park, Fire Island National Seashore, and Amagansett National Wildlife Refuge. As stated previously, nearshore areas should be avoided due to the higher concentration of fish eggs and larvae and sensitive nursery habitats (NOAA 2005a).

The environmental impacts associated with an FSRU site sited in either Block Island Sound or the Atlantic Ocean would be substantially greater than those of the proposed Project.

3.2.2 Central and Eastern Long Island Sound

Our evaluation of alternatives to the proposed Broadwater FSRU location within the central and eastern portions of the Sound included the assumption that the Project's sendout pipeline would be an offshore pipeline as proposed and would connect to the IGTS pipeline. This would avoid nearshore impacts and the need for an onshore pipeline to connect to the IGTS pipeline. With this as a basic assumption, a primary criterion in the evaluation was proximity to the IGTS pipeline to minimize the length of the sendout pipeline to the extent possible to minimize environmental impacts, including those to EFH and EFH-managed species.

Another critical criterion was a water depth of at least 50 feet to accommodate both the FSRU and the LNG carriers. The distance from shore was also considered in the evaluation since greater distances would decrease the visibility of the FSRU for viewers in the New York and Connecticut, and greater distances from shore would avoid impacts to sensitive marine resources due to construction of the sendout pipeline.

The FSRU location proposed by Broadwater is approximately 9 miles from the nearest shoreline. Because increased distance from the shoreline and the associated reduction in visual impacts and marine traffic conflicts was a key screening criterion for this analysis, we only considered alternative FSRU locations that were at least that approximate distance from the nearest shoreline. Rather than limit the distance to just 9 miles and farther, we considered that locations that are at least 7 miles from the nearest shoreline would greatly reduce visual impacts to shoreline residents while still meeting the 50-foot minimum water depth criteria. Figure 4.4-1 in the EIS illustrates the portion of Central and Eastern Long Island Sound that is at least 7 miles from the nearest shoreline. Locating the FSRU further to the east than the proposed location and more than 7 miles from the shoreline does not appear to offer any environmental advantages. However, it would require construction of a longer subsea pipeline which would result in greater seafloor impacts than the proposed Project. Therefore, we eliminated any alternative FSRU locations east of the proposed site from further consideration.

The length of the subsea pipeline could be shortened and benthic impacts reduced by locating the FSRU west of the proposed location within the area that is at least 7 miles from shore. However, the commercial vessel traffic analysis (described in Section 3.7.1 of the EIS) indicated that north-south vessel movement increases from a relatively low density at the proposed location to higher densities west of the site. We considered the potential long-term impact to marine transportation to be more important than the minor decrease in temporary to short-term bottom impacts (which are already minor with the proposed site) due to a somewhat shorter pipeline (up to several miles shorter). Therefore, we eliminated areas west of the proposed site and at least 7 miles from the shore from further consideration.

Similarly, there is a substantial increase in commercial vessel traffic south of the proposed location. In addition, visual impacts would increase with closer proximity to shore without achieving other environmental advantages. Consequently, we eliminated areas south of the proposed location from further consideration.

Although not as substantial a difference, the vessel traffic to the north of the site within the area at least 7 miles from shore is greater than in the vicinity of the proposed site. In addition, a commercial trawl lane has been established north of the proposed site, and although the safety and security zone around the proposed FSRU site would interfere with part of the lane, the conflict would be greater with a more northerly location. Therefore, we also eliminated areas north of the proposed location and at least 7 miles from the shoreline.

3.2.3 Western Long Island Sound

The western portion of the Sound is narrower than the central and eastern portions of the Sound. As a result there is a higher density of recreational use and fewer route options for commercial shipping than areas of the Sound to the east. There would be a greater potential for impacts to marine transportation and recreation in this area than elsewhere in the Sound. In addition, the water is typically more shallow in this area than in more easterly areas of the Sound, and many potential sites for the FSRU would likely require extensive dredging to provide the 50 feet of minimum water depth required for LNG carrier operation. In addition, since the western basin of Long Island Sound is narrower than the central basin, the FSRU and the berthed LNG carriers would be closer to the shoreline and densely populated areas.

In western Long Island Sound, the sendout pipeline from the FSRU to an interconnection with the IGTS Eastchester Extension pipeline would likely extend through more sensitive nearshore benthic environments, resulting in impacts greater than those of the proposed Project.

NOAA recommends avoiding shallow water areas due to increased concentrations of eggs and larvae (NOAA 2005a). NOAA's recommendation to site LNG terminals as far offshore as possible also minimizes the need for and impacts from additional dredging to support LNG carriers and support vessels. Recreational use areas should also be considered and avoided if possible (NOAA 2005a).

3.3 PIPELINE ROUTE ALTERNATIVES

Section 4.5.2 of the EIS evaluates five route alternatives between the FSRU location and the existing IGTS pipeline. We do not recommend any of these alternatives since they would not be environmentally superior to the proposed route. Four of these route alternatives would be located in the offshore waters of Long Island Sound, and one alternative would be located both onshore and offshore (Scott's Beach route alternative).

3.3.1 Pipeline Route Alternatives

There were a total of five pipeline route alternatives including three offshore route alternatives between the FSRU and an offshore interconnect with the existing IGTS pipeline, and two route alternatives that would connect the offshore FSRU with an onshore interconnect with the existing IGTS pipeline. The offshore route alternatives include a North Route, Middle Route, South Route, and Stratford Shoal Reroute. The proposed route (in central Long Island Sound) minimizes potential impacts to various resources by limiting the pipeline length while optimizing other screening criteria, such as human populations, marine transportation, or sensitive biological resources. It avoids the need for construction in areas of shallow bedrock, minimizes the number of utility crossings, and avoids or minimizes impacts to marine hazards and restricted areas. The proposed pipeline route addresses several of NOAA's suggestions such as avoiding wetlands and associated sensitive communities, eelgrass beds, and shellfish beds (2005a). The seafloor along the proposed pipeline route is made up of soft-bottom sediments and habitats with the exception of the hard-bottom substrate of Stratford Shoal. Each of these offshore alternative routes would impact more sensitive nearshore resources, have more utility crossings, disturb contaminated sediments, and/or result in a longer overall subsea pipeline or longer crossing of Stratford Shoal. Therefore, these 3 offshore alternative routes were not considered environmentally preferable to the proposed route.

The two alternative routes that would extend onshore include the Shoreham Route Alternative and the Scott's Beach Route Alternative. These route alternatives were developed in response to a request by NMFS to reduce the total length of pipeline construction within Long Island Sound. The Shoreham Route Alternative would include a 9.9-mile offshore pipeline that would proceed due south from the proposed FSRU location, then follow the proposed Islander East Pipeline Route to a landfall location near Shoreham. From there, an approximately 32-mile onshore pipeline would parallel the proposed Islander East Pipeline Route then travel westward to a tie-in with the IGTS Pipeline near Smithtown, New York. The Scott's Beach Route Alternative would include a 10.7-mile offshore pipeline that would extend southwesterly from the proposed FSRU to a landfall location at Scott's Beach near Miller Place, New York. From there, an approximately 23.3-mile onshore pipeline would be constructed primarily along existing roadways to tie-in with the IGTS Pipeline near Smithtown, New York.

Both the Shoreham Route and Scott's Beach Route Alternatives would result in the construction of a shorter pipeline within Long Island Sound relative to the proposed Project. However, both would require pipeline construction through sensitive nearshore, coastal, and onshore resources. These alternative routes would require extensive construction through residential and recreational areas and would have the potential to impact dozens of existing homes. These alternative routes would also cross approximately 8 to 9 miles of forested uplands, including portions of the Central Pine Barrens. Finally, an intermediate compressor station would be required if the pipeline were constructed along either the Shoreham Route or the Scott's Beach Route Alternatives.

Based on the potential for greater environmental impacts, we do not consider either the Shoreham Route or Scott's Beach Route Alternative environmentally preferable to the proposed route.

3.4 PIPELINE CONSTRUCTION ALTERNATIVES

In addition to pipeline route alternatives, we evaluated alternative pipeline construction methods to determine whether or not they could minimize the impacts of pipeline installation including the types of construction vessels used, and the methods used to physically install the pipeline in the seabed.

The proposed pipe lay approach would involve the use of a traditional lay barge that would be held in place and moved forward along the pipeline centerline using a system of anchors and anchoring cables. In Section 3.1.2.2 of the EIS, we recommended that Broadwater use mid-line buoys on all anchor cables (or a dynamically positioned lay barge if Broadwater considered it more feasible) to virtually eliminate the impacts of cable sweep. After lowering the pipeline to the seabed, the proposed pipeline installation approach would involve the use of the same lay barge to pull a subsea plow that would excavate a furrow beneath the pipeline. In Section 3.1.2.2 of the EIS, we have recommended that Broadwater actively backfill the proposed pipeline trench with excavated spoil material immediately following pipeline installation, and conduct post-construction monitoring to document success. NOAA suggests subsea plows be used for pipeline installation because they greatly reduce the collateral damage to the seafloor and recovery time (NOAA 2005a). In addition, the proposed pipeline would be installed from October to April, thus avoiding the more biologically sensitive spring and summer months of the year.

For pipe lay activities, we evaluated the use of a non-anchored, dynamically positioned lay barge as an alternative to an anchored lay barge. We also evaluated two alternative techniques for installing and covering the pipeline: post-lay jetting and pre-lay trenching.

3.4.1 Dynamically Positioned Lay Barge Alternative

With this alternative, the barge used to lay the pipeline on the bottom and to pull the subsea plow for pipeline installation would not require anchors and anchor lines to maintain position and move forward during pipe lay activities. Instead, station keeping and forward movement would be accomplished using thrusters.

If a dynamically positioned lay barge were used for installing the pipeline, impacts associated with anchor placement and anchor cable sweep during pipeline installation (approximately 16 acres and 2,020 acres, respectively) would not occur. However, thrusters on a dynamically positioned lay barge could disturb sediments beneath and adjacent to the barge in some locations, resulting in an increase in turbidity. By incorporating the recommendation for mid-line buoys into the Project, Broadwater would substantially reduce the impacts of anchor cable sweep (Section 3.1.2.2 of the EIS) and much of the potential environmental advantage to using a dynamically positioned lay barge for the Project would no longer apply. As part of our recommendation for the use of mid-line buoys, we have given Broadwater the option to use a dynamically positioned lay barge in the event that it would be more feasible than mid-line buoys on all anchor cables of a standard lay barge.

3.4.2 Alternative Pipeline Installation Methods

To meet federal pipeline integrity protection requirements, the pipeline must be buried to a minimum depth of 3 feet or covered with armored mats or rocks that provide an equivalent level of protection. Since covering the entire 21.7-mile subsea pipeline with armored mats or rocks would increase permanent sediment conversion from approximately 7 or 8 acres for the proposed Project to approximately 65 acres, these alternatives protection methods are not considered further. We evaluated two alternative methods for burying the pipeline with natural substrate: the use of a subsea jetting sled to bury the pipe and construction of a dredged trench.

3.4.2.1 Subsea Jetting Sled

With this alternative, a jet sled would be used to excavate the pipeline trench after the pipe is place on the sea floor. Similar to the proposed plow method of excavation, the subsea jet sled would be positioned around the pipeline on rollers and would be pulled forward by the lay barge (or alternatively, a dynamically positioned barge). High-pressure water jets on the jet sled would liquefy soils and sediments in front of the sled and force the sediments upward, creating a trench beneath the pipeline.

The width of the trench created by a jetting sled would vary depending upon the particle size and cohesiveness of the sediments. Because much of the proposed pipeline route traverses areas dominated by clays and other cohesive sediments, Broadwater estimated that a jetted trench would be approximately 40 feet wide; FERC estimated a similar jetted trench width in the Islander East FEIS. The trench width would likely increase in areas with less cohesive sandy and silty sediments. Unlike the proposed subsea plow, sediments displaced by a jet sled would not fall immediately adjacent to the trench but would be broadcast over a larger area. Under this alternative, we anticipate increased sediment deposition in a 100- to 300-foot-wide area beyond the trench, and the total area of seabottom impacts would increase to approximately 526 acres from about 197 acres for the proposed method. Because a jet sled would disperse sediment over a wider area than the proposed plowing method, we anticipate that turbidity and redeposition of sediment would be of greater magnitude and longer duration than would occur with the proposed pipeline installation approach. Therefore this alternative does not appear to environmentally superior to the proposed plow method of trenching.

3.4.2.2 Pre-Lay Dredge

With this alternative, the trench would be excavated using a barge-mounted excavator or clamshell dredge prior to lowering the pipe to the sea floor. Sediment removed from the trench would be placed on one or both sides of the trench, and after the trench is excavated, the pipeline would be laid directly into the trench.

Although the design width of a pre-lay trench would be 40 feet, slumping of sediments at a 2:1 slope would require that the pre-lay trench width be approximately 54 feet. We anticipate that sidecast dredged material would affect a 100- to 200-foot-wide area beyond the trench, and the total area of seabottom affected would be approximately 395 acres as compared to approximately 197 acres for the proposed method. In addition, we anticipate that movement of the excavated material vertically through the water column (in the excavator bucket or clamshell) coupled with the large volume of sidecast material left adjacent to the trench would result in greater turbidity and redeposition of sediment than would occur with the proposed pipeline installation approach. We do not consider this construction alternative environmentally preferable to the methods proposed for the Project.

3.5 ALTERNATIVE VAPORIZATION METHODS

LNG must be warmed from a liquid to a gaseous state (vaporized) before it can be transported as natural gas in the sendout pipeline. Broadwater has proposed to accomplish this using STV technology. Under this approach, LNG is regasified by passing through a series of heated coils, which are heated using a glycol/water mixture contained in a closed loop (Section 2.1.1.4 of the EIS). We evaluated three alternative vaporization technologies and their potential environmental impacts:

- Ambient-air-heated vaporization;
- Open rack vaporization; and
- Submerged combustion vaporization.

3.5.1 Ambient-Air-Heated Vaporization

Ambient-air-heated vaporizers use heat from the surrounding air to warm LNG as it is distributed through a series of heat exchanger tubes. Because heat would be derived solely from ambient air with no supplemental heating, no air emissions or water discharges would occur with this technology.

Because ambient air must be warm enough to vaporize LNG year round, this vaporization approach is only feasible for LNG terminals in warm climates, such as the Petronet LNG Terminal in Dahej, India (Yang and Huang 2004). LNG terminals in temperate climates would require supplemental heat from submerged combustion vaporization (SCVs) or STVs during cooler weather.

3.5.2 Open Rack Vaporization

Open rack vaporization (ORV) systems are widely used for LNG vaporization at LNG terminals in Japan, Korea, and portions of Europe (Yang and Huang 2004). In the Gulf of Mexico, the ORV system is in use at the Gulf Gateway Energy Bridge terminal and has been approved for use at the Port Pelican and Gulf Landing LNG terminal projects (Exponent 2005). ORV systems use seawater as the LNG warming medium, with the LNG pumped through a series of aluminum heat transfer tubes arranged in a rack. Seawater is drawn in through screened water intakes, treated with sodium hypochlorite to prevent marine growth, passed over the heat transfer rack to warm the LNG, and then discharged back to the water body. Discharged seawater is typically 13 to 22 °F cooler than the ambient seawater (Exponent 2005). A typical ORV system requires approximately 136 million gallons of seawater per day (Exponent 2005).

ORV systems are effective only when the ambient seawater temperature is at least 50 to 63°F. When seawater temperatures drop below this range, supplemental methods of LNG warming would need to be implemented. Typically, supplemental heating would be provided using submerged heaters similar to those used for submerged combustion vaporization systems or using an STV system. Both methods of supplemental heating would result in air emissions. Because the water temperature in Long Island Sound is often below 50°F, use of an ORV system for the Broadwater Project would also require a supplemental heating system.

The intake of seawater associated with ORV systems affects marine life through impingement and entrainment fish eggs and larvae (ichthyoplankton), shellfish eggs and larvae, and zooplankton that are unable to escape from the intake area. The discharge of cooled and chemically treated warming water would also affect marine life and water quality, although the effects would be localized. NMFS has opposed the use of ORV technology in new LNG terminal projects due to concerns about the magnitude of these impacts on fish and shellfish populations.

3.5.3 Submerged Combustion Vaporization

The SCV method is currently in use at LNG terminal facilities at Elba Island, Georgia, and Lake Charles, Louisiana, and was approved by FERC for use at the Cameron LNG project located near Hackberry, Louisiana. This type of system uses water heated by combustion exhaust to warm and vaporize LNG and includes a water bath containing stainless steel tubes (vaporization coils). LNG is warmed and vaporized by pumping it through tubes submerged in the heated water bath. As heat is transferred from the water bath to the LNG, the water bath cools and requires constant reheating. That is accomplished using a combustion chamber that is submerged in the water bath. Water in the water bath is periodically discharged and replaced with fresh water.

The submerged combustion units use vaporized LNG (natural gas) for fuel and produces carbon dioxide (CO_2) and water. The CO_2 is absorbed into the water bath, resulting in a low (acidic) pH that requires chemical treatment to neutralize the water bath prior to discharge. An SCV system with an average sendout rate of 1.0 bcfd of natural gas discharges approximately 173,000 gallons of treated freshwater per day.

Air emissions from SCVs include CO_2, carbon monoxide (CO), and nitrogen oxides (NO_x). Without emissions control systems being applied, NO_x and CO concentrations in the exhaust are typically 40 ppm and 80 ppm, respectively. With emission control systems, NO_x emissions are reduced by about 90 percent. Even with these controls, emissions would be greater than those compared to the proposed STV method, and, thus, this vaporization technology is not considered environmentally preferable to the proposed method.

3.5.4 Conclusions Regarding LNG Vaporization Technology Alternatives

Ambient-air-heated vaporization is not a feasible vaporization alternative for the Broadwater Project because air temperatures would be too cold during much of the year for this system to function properly. Similarly, water temperatures in Long Island Sound are often too low for an ORV system to be able to vaporize LNG. In addition, an ORV system would result in greater impacts to marine resources than the proposed STV system due to the large seawater intakes and discharges required for the system. SCV would result in higher levels of air emissions than those that associated with the proposed STV system and would also require the discharge of treated freshwater to Long Island Sound.

In summary, none of the alternative LNG vaporization methods considered in our evaluation would have fewer environmental impacts or would be otherwise environmentally preferable to the proposed STV system. We have therefore eliminated these vaporization alternatives from further consideration.

4.0 ESSENTIAL FISH HABITAT

The MSFCMA set forth a mandate for NMFS, regional Fishery Management Councils (FMC), and other federal agencies to identify and protect EFH for economically important marine and estuarine fisheries. NOAA (2002a) defines EFH as:

> "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; 'substrate' includes sediment, hardbottom, and structures underlying the waters, and associated biological communities; 'necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle."

EFH-designated species and life history stages in the proposed Project area were identified based on a list in the NOAA Guide to Essential Fish Habitat Designations in the Northeastern United States (NOAA 2005b). The guide identifies the managed species and their life stages that have EFH in selected 10-minute by 10-minute squares of latitude and longitude (referred to as "blocks"). These designations were completed by the New England Fishery Management Council (NEFMC), Mid-Atlantic Fishery Management Council (MAFMC), and the NMFS pursuant to the MSFCMA (Tables 4-1 and 4-2 and Figure 4-1).

TABLE 4-1
Ten-Minute Square Coordinate Designations Along the Proposed Broadwater Project in Long Island Sound

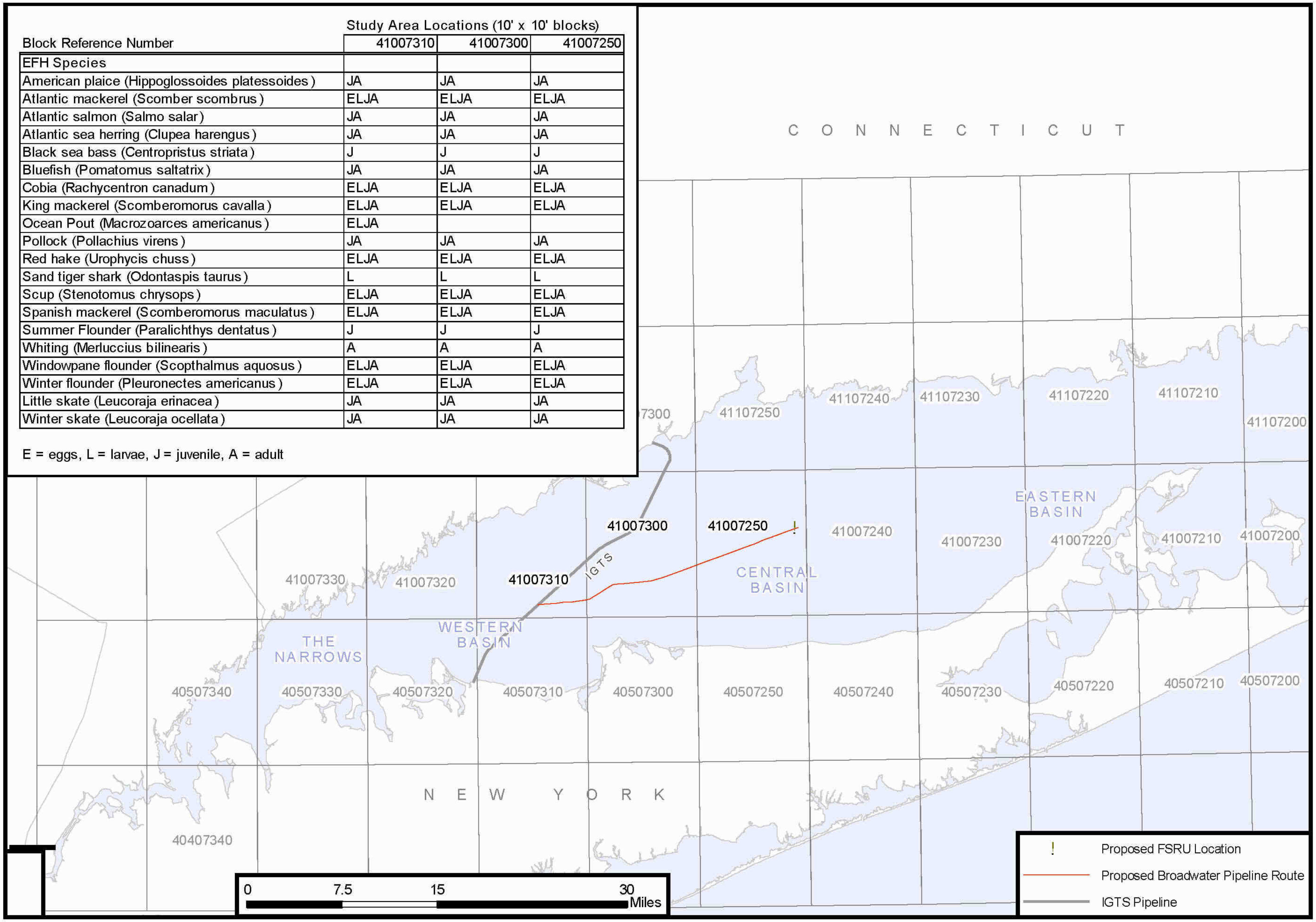
Block Number	North	East	South	West
41007250	41° 10.0' N	72° 50.0' W	41° 00.0' N	73° 00.0' W
41007300	41° 10.0' N	73° 00.0' W	41° 00.0' N	73° 10.0' W
41007310	41° 10.0' N	73° 10.0' W	41° 00.0' N	73° 20.0' W

Source: NOAA 2005b

TABLE 4-2
Species with Identified EFH within the Proposed Project Area

Species	Scientific Name	Egg	Larvae	Juvenile	Adult
Atlantic mackerel	*Scomber scombrus*	X	X	X	X
Atlantic salmon	*Salmo salar*			X	X
Atlantic herring	*Clupea harengus*			X	X
Black sea bass	*Centropristus striata*			X	
Bluefish	*Pomatomus saltatrix*			X	X
Cobia	*Rachycentron canadum*	X	X	X	X
King mackerel	*Scomberomorus cavalla*	X	X	X	X
Little skate	*Leucoraja erinacea*			X	X
Ocean pout	*Macrozoarces americanus*	X	X	X	X
Pollock	*Pollachius virens*			X	X
Red hake	*Urophycis chuss*	X	X	X	X
Sand tiger shark	*Odontaspis taurus*		X		
Scup	*Stenotomus chrysops*	X	X	X	X
Spanish mackerel	*Scomberomorus maculatus*	X	X	X	X
Summer flounder	*Paralicthys dentatus*			X	
Silver hake	*Merluccius bilinearis*				X
Windowpane flounder	*Scopthalmus aquosus*	X	X	X	X
Winter flounder	*Pleuronectes americanus*	X	X	X	X
Winter skate	*Leucoraja ocellata*			X	X

Source: NOAA 2005b



Block Reference Number	Study Area Locations (10' x 10' blocks) 41007310	41007300	41007250
EFH Species			
American plaice (Hippoglossoides platessoides)	JA	JA	JA
Atlantic mackerel (Scomber scombrus)	ELJA	ELJA	ELJA
Atlantic salmon (Salmo salar)	JA	JA	JA
Atlantic sea herring (Clupea harengus)	JA	JA	JA
Black sea bass (Centropristus striata)	J	J	J
Bluefish (Pomatomus saltatrix)	JA	JA	JA
Cobia (Rachycentron canadum)	ELJA	ELJA	ELJA
King mackerel (Scomberomorus cavalla)	ELJA	ELJA	ELJA
Ocean Pout (Macrozoarces americanus)	ELJA		
Pollock (Pollachius virens)	JA	JA	JA
Red hake (Urophycis chuss)	ELJA	ELJA	ELJA
Sand tiger shark (Odontaspis taurus)	L	L	L
Scup (Stenotomus chrysops)	ELJA	ELJA	ELJA
Spanish mackerel (Scomberomorus maculatus)	ELJA	ELJA	ELJA
Summer Flounder (Paralichthys dentatus)	J	J	J
Whiting (Merluccius bilinearis)	A	A	A
Windowpane flounder (Scopthalmus aquosus)	ELJA	ELJA	ELJA
Winter flounder (Pleuronectes americanus)	ELJA	ELJA	ELJA
Little skate (Leucoraja erinacea)	JA	JA	JA
Winter skate (Leucoraja ocellata)	JA	JA	JA

E = eggs, L = larvae, J = juvenile, A = adult

Source: NOAA 2005

Figure 4.1
Broadwater LNG Project
Essential Fish Habitats in the Vicinity of the Proposed Project

To provide additional focus for conservation efforts, the MSFCMA also requires that FMCs identify EFH - Habitat Areas of Particular Concern (HAPCs). For an EFH to be identified as a HAPC, they must meet the following criteria: (1) the importance of the ecological function provided by the habitat; (2) the extent to which the habitat is sensitive to human-induced environmental degradation; and (3) whether, and to what extent, development activities are, or will be, causing stress to the habitat type (NEFMC 1998). No HAPCs have been identified along the proposed pipeline route, at the proposed FSRU site, or along the proposed LNG carrier transit route.

4.1 LIFE HISTORY DESCRIPTIONS OF FEDERALLY MANAGED SPECIES

In reviewing the proposed Project location, designated EFH occurs in the proposed Project area for various lifestages of 19 species. Nine species have designated EFH for every lifestage; ocean pout, red hake, winter flounder, windowpane flounder, scup, Atlantic mackerel, king mackerel, Spanish mackerel, and cobia. None of these managed stocks are federally or state-listed endangered or threatened. Managed species are summarized in Table 4-2 and discussed below. Additional discussion on the duration and magnitude of potential impacts to EFH and EFH-managed species is provided in Section 6.0.

The managed species have also been grouped by habitat requirements to differentiate those that typically are found near the seafloor (demersal species), and those typically associated with the water column (pelagic species).

4.1.1 Demersal Species

4.1.1.1 Ocean Pout

EFH supporting all lifestages of ocean pout have been identified in the proposed Project area. The ocean pout is a bottom dwelling and cool-temperate species found on the Atlantic continental shelf from Labrador to Virginia. This species spawns in protected habitats, such as rock crevices and man-made artifacts, where it lays its eggs and guards them. Ocean pout spawn from late summer to early winter, peaking August through October. Eggs are typically present in the Sound from late fall through winter. Larvae ocean pout are typically present from late fall to spring. It is believed that larvae stay on or near the bottom. Juveniles are typically found in shallow coastal waters near rocks and other similar structures. Adults are demersal and do not make extensive migrations. Adult ocean pout feed on a variety of benthic invertebrates such as polychaetes, mollusks, crustaceans, and echinoderms (Steimle et al. 1999a).

Potential direct impacts to ocean pout EFH could affect all four lifestages. The proposed winter installation would minimize impacts to most other species however, it could affect eggs and larvae of the ocean pout. Ocean pout eggs are found on hard-bottom substrates from late fall to winter. Since this type of habitat is limited within the proposed Project area, any impacts as a result of construction would be expected within the 4,000-foot crossing of Stratford Shoal. Larval ocean pout prefer smooth-bottom habitats and are typically found along the bottom of the Sound from late fall to spring. Therefore, larval ocean pout may be impacted by construction of the proposed Project. However, any impacts are expected to be minor and temporary since the proposed Project area includes a small portion of the available habitat. Juvenile and adult ocean pout are bottom-dwelling fish that may be within the area of proposed pipeline construction. However, any impacts to juvenile and adult ocean pout during construction are expected to be minor and temporary since the proposed Project would affect a small portion of the available habitat within the Sound. Also, suitable habitat is readily available adjacent to the proposed pipeline route and FSRU. Potential indirect impacts to ocean pout EFH could affect juvenile and adult lifestages. Construction of the proposed Project could result in a short-term loss of the benthic forage organisms along the proposed pipeline corridor that juvenile and adult ocean pout feed upon. However, ocean pout are opportunistic feeders and can forage for additional prey items along areas of the proposed Project that are not under construction or undisturbed areas in the vicinity of the proposed Project. Approximately 215 acres of Long Island Sound would be under construction during the proposed Project. This accounts for approximately 0.03 percent of the available acreage in Long Island Sound (approximately 844,800 acres).

Operational impacts from the proposed Project are not anticipated since ocean pout are a demersal species.

4.1.1.2 Red Hake

EFH supporting all lifestages of red hake have been identified in the proposed Project area. Red hake is a demersal fish that occurs from North Carolina to Newfoundland. The highest population of red hake can be found from Georges Bank to New Jersey. This species makes seasonal migrations that are temperature dependent. They are commonly found in depths less than about 328 feet (100 m) during the warmer months and at greater depths during colder months. Spawning typically occurs from May through November. Red hake eggs are buoyant and float near the surface of the water. Larvae are common from May through December with peaks in September and October. However, red hake eggs and larvae are not present in Long Island Sound (Stone et al. 1994). Juvenile red hake are initially pelagic but become demersal as they mature. They feed on benthic and pelagic crustaceans such as shrimp, mysids, euphausiids, and amphipods. Adults are demersal and commonly found on soft sediments (Steimle et al. 1999c). Juveniles and adults are commonly found in Long Island Sound from March through November (Stone et al. 1994). They feed on crustaceans, demersal and pelagic fish, and squid (Steimle et al. 1999c).

Since juvenile and adult red hake would be demersal they could be impacted by construction of the proposed Project. However, since juveniles and adults would be highly mobile they are expected to leave the area of active construction, thereby avoiding impacts. These disturbances to red hake habitat are expected to be short term and minor. Construction of the proposed Project could result in a short-term loss of the benthic forage organisms that juvenile and adult red hake feed upon. However, red hake can forage for additional prey items along areas of the proposed Project that are not under construction or in the vicinity of the proposed Project. Approximately 215 acres of Long Island Sound would be directly impacted during construction of the proposed Project. Adult red hake predominately feed upon pelagic species, which would not be impacted by the proposed Project during construction.

Operational impacts from the proposed Project are not anticipated since red hake are a demersal species.

4.1.1.3 Winter Flounder

EFH supporting all lifestages of winter flounder have been identified in the proposed Project area. Winter flounder is an important commercial and recreational species. Winter flounder can be found along the Atlantic coast from Labrador to North Carolina and Georgia. This species spawns in nearshore areas from winter through spring, with peaks occurring during February and March. Winter flounder eggs are demersal and adhesive. Hatching generally occurs in two to three weeks. Larvae are initially planktonic but become bottom-oriented as they mature. Since the early lifestages are nondispersive, spawning and nursery grounds are essentially the same (Pearcy 1962). Winter flounder are omnivorous and opportunistic. They will consume a wide variety of prey (Pereira et al. 1999). Larvae are commonly found in Long Island Sound from February through June (Stone et al. 1994). Adults migrate inshore in the fall and early winter to spawn. Afterwards, adults tend to leave inshore spawning areas when temperatures begin to rise (Pereira et al. 1999). Adults and juvenile winter flounder can be found in Long Island Sound in all months of the year (Stone et al. 1994).

Potential direct impacts to winter flounder EFH could affect all lifestages. Siting the proposed Project in the central waters of Long Island Sound would aid in minimizing impacts to eggs and larvae since they inhabit inshore spawning and nursery areas. However, the proposed winter construction schedule could result in impacts to juvenile and adult winter flounder. Since juvenile and adult winter flounder are bottom-dwelling species they could be impacted during the proposed pipe-laying, pipe-lowering, and backfilling. However, since these lifestages are highly mobile, it is expected that they would avoid active construction areas, thereby minimizing any impacts. Indirect impacts on winter flounder EFH are expected to be temporary and minor. Construction of the proposed Project could result in a short-term loss of the benthic forage organisms that juvenile and adult winter flounder feed upon. However, winter flounder are opportunistic feeders and can forage for additional prey items along areas of the proposed Project that are not under construction or in the undisturbed areas vicinity of the proposed Project. Approximately 215 acres of Long Island Sound would be under construction during the proposed Project, which accounts for less than 0.1 percent of the benthic habitat of Long Island Sound.

Operational impacts from the proposed Project are not anticipated since winter flounder are a demersal species.

4.1.1.4 Summer Flounder

EFH supporting juvenile summer flounder have been identified in the proposed Project area. Summer flounder is a demersal fish that is an important commercial and recreational species. Summer flounder inhabit estuarine and shelf waters of the Atlantic Ocean from Nova Scotia to Florida. However, the highest population is found from Cape Cod, Massachusetts to Cape Hatteras, North Carolina. Juvenile summer flounder begin to move into estuarine areas in March and April. They are typically found in Long Island Sound from June through November but have been observed year-round. They feed primarily on mysid shrimp and small fish (Grimes et al. 1989).

Potential direct impacts to juvenile summer flounder EFH include temporary disturbance during construction of the proposed Project. Since juvenile summer flounder are bottom-dwelling species they could be impacted during the construction. However, since these lifestages are highly mobile, it is expected that they would avoid active construction areas, thereby minimizing any impacts. Indirect impacts on winter flounder EFH are expected to be short-term and minor. Construction of the proposed Project could result in a short-term loss of the benthic forage organisms that juvenile summer flounder feed upon. However, summer flounder can forage for additional prey items along areas of the proposed Project that are not under construction or in the undisturbed areas in the vicinity of the proposed Project.

Operational impacts from the proposed Project are not anticipated since summer flounder are a demersal species.

4.1.1.5 Windowpane Flounder

EFH supporting all lifestages of windowpane flounder have been identified in the proposed Project area. Windowpane flounder are found from the Gulf of Saint Lawrence to Florida. Populations of windowpane flounder are highest from Georges Bank to the Chesapeake Bay. They tend to inhabit waters less than about 360 feet (110 m) with sandy substrates (Chang et al. 1999). Adult windowpane flounder typically spawn from April through August in Long Island Sound (Stone et al. 1994). Eggs are buoyant and spherical, usually hatching in about eight days. Larvae are initially pelagic but become demersal as they mature (usually when they reach 10 mm total length) (Chang et al. 1999). They are commonly found in Long Island Sound from May through October (Stone et al. 1994). Larvae windowpane flounder inhabit the polyhaline (high salinity usually 30 ppt to 35 ppt) portion of estuaries in the spring but migrate to the continental shelf in the fall (Chang et al. 1999). Juvenile and adult windowpane flounder can be found in Long Island Sound during all months of the year (Stone et al. 1994).

EFH supporting all lifestages of windowpane flounder have been identified in the proposed Project area. Since windowpane eggs are present in Long Island Sound from April through August, they would not be present during proposed construction. Windowpane flounder eggs and larvae are pelagic and could be impacted by water intakes at the proposed FSRU. However, Broadwater proposes to withdraw water from approximately 20 to 40 feet below the surface of the water. The intakes for the LNG carriers would be approximately 20 feet deep (or more), and the intakes for the FSRU would be at a depth of approximately 40 feet. The FSRU intakes would have 0.2-inch mesh screen, and the water intake velocity would be limited to 0.5 ft/sec or less, thus reducing the potential for impingement and/or entrainment of plankton and ichthyoplankton. Since juvenile and adult windowpane flounder are bottom-dwelling species, they could be impacted during the construction. However, since these lifestages are highly mobile, it is expected that they would avoid active construction areas, thereby minimizing any impacts. Indirect impacts on windowpane flounder EFH are expected to be short-term and minor. Construction of the proposed Project could result in a short-term loss of the benthic forage organisms that juvenile and adult windowpane flounder feed upon. However, these lifestages can forage for additional prey items along areas of the proposed Project that are not under construction or in the undisturbed areas in the vicinity of the proposed Project.

Operational impacts from the proposed Project are not anticipated since windowpane flounder are a demersal species.

4.1.1.6 Little Skate

EFH supporting juvenile and adult little skate have been identified in the proposed Project area. Little skate are a demersal fish that occur from Nova Scotia to Cape Hatteras. The highest populations of little skate are found in the northern section of the Mid-Atlantic Bight and on Georges Bank. The little skate does not make extensive migrations but will make short seasonal migrations from nearshore to offshore (Packer et al. 2003a). Juvenile and adult little skate are highly abundant in Long Island Sound year round (Stone et al. 1994). Little skates feed primarily on invertebrates such as decapod crustaceans and amphipods. This species is generally found on sandy or gravelly bottoms, but may be also found on mud substrates (Packer et al. 2003a).

Potential direct impacts to little skate EFH could affect juveniles and adults during construction. Since little skates are bottom-dwelling organisms they could be impacted during installation of the proposed pipeline and FSRU. However, since these lifestages are highly mobile, they are expected to vacate areas of active construction, which would minimize impacts. Therefore, direct impacts would be minor and short-term. Construction of the proposed Project could result in a short-term loss of the benthic forage organisms that juvenile and adult little skate feed upon. However, these lifestages can forage for additional prey items along areas of the proposed Project that are not under construction or in the undisturbed areas in the vicinity of the proposed Project.

Operational impacts from the proposed Project are not anticipated since little skate are a demersal species.

4.1.1.7 Winter Skate

EFH supporting juvenile and adult winter skate have been identified in the proposed Project area. Winter skate are a demersal fish that occur from Newfoundland to Cape Hatteras. The highest populations of winter skate are found in the northern section of the Mid-Atlantic Bight and on Georges Bank. In both areas, the winter skate is usually second in abundance to little skate. Winter skate are generally found from the shoreline to depths of approximately 1000 feet. Like little skate, winter skate tend to inhabit sandy to gravelly substrates, but have been found over mud bottoms. Winter skate feed primarily on polychaetes, amphipods, decapods, isopods, bivalves, and fishes (Packer et al. 2003b). Juvenile and adult winter skate are highly abundant in Long Island Sound year round (Stone et al. 1994).

Potential direct impacts to winter skate EFH could affect juveniles and adults during construction. Since winter skates are bottom-dwelling organisms they could be impacted during installation of the proposed pipeline and FSRU. However, since these lifestages are highly mobile, they are expected to vacate areas of active construction, which would minimize impacts. Therefore, direct impacts would be minor and short-term. Construction of the proposed Project could result in a short-term loss of the benthic forage organisms that juvenile and adult winter skate feed upon. However, these lifestages can forage for additional prey items along areas of the proposed Project that are not under construction or in the undisturbed areas in the vicinity of the proposed Project.

Operational impacts from the proposed Project are not anticipated since winter skate are a demersal species.

4.1.1.8 Black Sea Bass

EFH supporting juvenile black sea bass have been identified in the proposed Project area. Black sea bass are a warm temperate species that tend to inhabit structured habitats such as reefs and shipwrecks. Black sea bass spawn on the continental shelf from the spring through the fall. Early juvenile black sea bass begin migrations to estuarine nurseries. Juveniles are visual predators that feed primarily on small benthic crustaceans such as isopods, amphipods, small crabs, sand shrimp, and copepods. They will also eat epibenthic estuarine and coastal organisms and small fish (Steimle et al. 1999b). Juvenile black sea bass are commonly found in Long Island Sound from April through November (Stone et al. 1994).

Potential direct impacts to black sea bass juveniles would be limited to habitat disturbances. Since black sea bass juveniles tend to inhabit structured habits, they would be more prevalent at Stratford Shoal area of the proposed Project route. Any impacts to habitat are expected to be temporary and minor. There may also be an indirect impact on prey species of the juvenile black sea bass that also inhabit structured areas. However, the structured areas of the proposed Project area are small, and the fish could readily find suitable habitat in the rest of Long Island Sound. In addition, the proposed FSRU mooring tower may provide additional structured habitat for the black sea bass population.

Operational impacts from the proposed Project are not anticipated since black sea bass are a demersal species.

4.1.1.9 Silver Hake

EFH supporting adult silver hake have been identified in the proposed Project area. Silver hake are a demersal fish that occur in the Atlantic Ocean from Newfoundland to Cape Fear, North Carolina. This species is most abundant from Nova Scotia to New Jersey. Adult silver hake spawn from May through October with peaks in August. Silver hake feed primarily on fish, crustaceans, and squid. This species makes seasonal migrations from the continental slope during the fall and winter to nearshore waters during the spring and summer. Silver hake have been found on most substrates (gravel to fine silt and clay) but are more common on silt and clay substrates. Silver hake occur in all areas of the Sound but are more abundant during the spring (Morse et al. 1999).

Potential direct impacts to silver hake EFH could affect adults during construction. Since adult silver hake are most abundant within the Sound during the spring they could be present during construction of the proposed Project. However, the area under construction is small relative to suitable silver hake habitat within the Sound. Adult hake are also highly mobile and would be expected to avoid active construction areas. Therefore, any direct impacts are expected to be temporary and minor. Construction of the proposed Project could result in a short-term loss of the benthic forage organisms that adult silver hake feed upon. However, hake can forage for additional prey items along areas of the proposed Project that are not under construction or in the undisturbed areas in the vicinity of the proposed Project.

Operational impacts from the proposed Project are not anticipated since silver hake are a demersal species.

4.1.1.10 Scup

EFH supporting all lifestages of scup have been identified in the proposed Project area. Scup are a temperate finfish that occurs from Massachusetts to South Carolina. Adult scup spawn on the inner continental shelf from May through August. Eggs are small, buoyant, and hatch in two to three days. They are commonly found in Long Island Sound from May through July (Stone et al. 1994). Scup larvae move into coastal waters during the warmer months to feed on small zooplankton. It is during this lifestage that scup settle to the seafloor and become demersal (Steimle et al. 1999d). Larvae are commonly found in Long Island Sound from May through August (Stone et al. 1994). Juvenile scup generally feed during the day on polychaetes, epibenthic amphipods, mollusks, and fish eggs and larvae (Steimle et al. 1999d). Juveniles are found in Long Island Sound from May through November (Stone et al. 1994). Adult scup are generally found in schools and on a range of substrates including sandy and structured (such as mussel beds or reefs) (Steimle et al. 1999d). Adults are present in Long Island Sound from May through November (Stone et al. 1994).

Potential direct impacts to scup EFH could affect all lifestages. Scup eggs and larvae can be found in the Sound from May through August. They could be impacted by the water intakes associated with the proposed FSRU. However, Broadwater proposes to withdraw water from 20 to 40 feet below the surface of the water, use 0.2-inch mesh screen, and limit water intake velocity to 0.5 ft/sec or less, thus reducing the potential for impingement and/or entrainment of plankton and ichthyoplankton. Juvenile and adult scup can be found in the Sound from May through November. They could be impacted during construction of the proposed Project. However, since construction is proposed in the winter and spring, any impacts associated with juvenile and adult scup would be minimized. In addition, since these lifestages are highly mobile, they are expected to avoid areas of active construction. Therefore, any direct impacts associated with the proposed Project are expected to be minor and temporary. Potential indirect impacts on scup EFH are expected to be limited to the short-term loss of the benthic forage organisms that juvenile and adult scup feed upon. However, these lifestages can forage for additional prey items along areas of the proposed Project that are not under construction or in the undisturbed areas in the vicinity of the proposed Project.

Operational impacts from the proposed Project are not anticipated since scup are a demersal species.

4.1.2 Pelagic Species

4.1.2.1 Atlantic Salmon

EFH supporting juvenile and adult Atlantic salmon have been identified in the proposed Project area. Atlantic salmon spend most of their life cycle in saltwater, but spawn in freshwater (anadromous). They occur from North Quebec to the Delaware River (Boschung et al. 1983). Adults spawn from mid October to mid November in gravel areas of freshwater streams (Oanie et al. 1984). Juveniles begin life in the freshwater streams where they were spawned. As they mature, they begin migrating to the ocean. Juvenile salmon feed primarily on mayfly larvae, stonefly larvae, chironomids, caddisflies, aquatic annelids, and mollusks (Oanie et al. 1984). Juvenile Atlantic salmon are rarely found in Long Island Sound from April through July (Stone et al. 1994). Adult Atlantic salmon spend their lives in the sea. They migrate to freshwater rivers to spawn. Adult Atlantic salmon primarily feed on herring, lance, alewives, capelin, smelt, and other fishes (Oanie et al. 1984). Adult Atlantic salmon are rarely found in Long Island Sound from February through November (Stone et al. 1994).

Since juvenile and adult Atlantic salmon are rarely found in Long Island Sound and they could readily avoid construction areas and impingement/entrainment, any impacts of the proposed Project would be negligible.

4.1.2.2 Atlantic Herring

EFH supporting juvenile and adult Atlantic herring have been identified in the proposed Project area. The Atlantic herring is a pelagic schooling fish that occurs from Labrador to Cape Hatteras. Spawning takes place in the area of the Gulf of Maine and Georges Bank during the summer and fall. Atlantic herring of all lifestages are opportunistic feeders. They will feed on any prey that is of an appropriate size for their jaws (Stevenson and Scott 2005). Juveniles are commonly found in Long Island Sound during all months of the year (Stone et al. 1994). Adult Atlantic herring make extensive seasonal migrations between summer spawning grounds (Gulf of Maine and Georges Bank) and wintering areas in south New England and the Mid-Atlantic Bight (Stevenson and Scott 2005). Adult Atlantic herring are present in Long Island Sound throughout the year (Stone et al. 1994).

Potential direct impacts to Atlantic herring EFH could affect juveniles and adults during construction and operation. However, these lifestages are pelagic and mobile and would be expected to avoid active construction areas. Given that Atlantic herring are opportunistic feeders, any indirect impacts associated with prey items would also be expected to be negligible since suitable prey species would be found in adjacent non-disturbed areas.

4.1.2.3 Bluefish

EFH supporting juvenile and adult bluefish have been identified in the proposed Project area. Bluefish are a pelagic finfish that occurs from Nova Scotia to Argentina. Spawning takes place on the Mid-Atlantic Bight from June through August. Juvenile and adult bluefish feed primarily on any prey items that are locally available (Fahay et al. 1999). Juvenile bluefish are abundant in Long Island Sound from August to October (Stone et al. 1994). Juvenile and adult bluefish inhabit a variety of habitats. Adult bluefish are present in Long Island Sound from August through November (Stone et al. 1994). Bluefish are warm water migrants. They migrate north in the spring and summer and migrate to southern New England and further south in the fall and winter (Fahay et al. 1999).

Juvenile bluefish are abundant in Long Island Sound from August to October while adults are abundant from August through November (Stone et al. 1994). Therefore, any direct impacts to these lifestages are expected to be minimal since they would not be present during construction (winter and spring). In addition, these lifestages are pelagic and mobile and would be expected to avoid active construction areas. Any indirect impacts associated with prey items would also be expected to be negligible since suitable prey species would be found in adjacent non-disturbed areas.

Operational impacts from the proposed Project are not expected to impact juvenile and adult bluefish. Operational impacts from water intakes would not be expected to affect these highly mobile and pelagic lifestages.

4.1.2.4 Atlantic Mackerel

EFH supporting all lifestages of Atlantic mackerel have been identified in the proposed Project area. Atlantic mackerel are a pelagic fish that occurs in the Atlantic Ocean from the Gulf of St. Lawrence to Cape Lookout, North Carolina. Adults spawn on the shoreward half of the continental shelf waters during the spring and summer (Studholme et al. 1999). Eggs are pelagic and present in Long Island Sound from April through June (Stone et al. 1994). Atlantic mackerel larvae feed primarily on zooplankton. Larvae can be found in Long Island Sound in May and June (Stone et al. 1994). Juveniles feed primarily on small crustaceans and pelagic mollusks. Adults feed on the same prey items as juveniles but also include larger prey items such as euphausiids, shrimp, and the larvae of many marine organisms (Studholme et al. 1999). Atlantic mackerel juveniles and adults are present in the Sound from April through November (Stone et al. 1994).

Since Atlantic mackerel eggs and larvae are present in the Sound during the summer they would not be expected to be impacted by construction of the proposed Project. However, they could be impinged/entrained by the water intakes at the proposed FSRU. Since Broadwater proposes to withdraw water from 20 to 40 feet below the surface of the water and use 0.2-inch mesh screen, potential impacts from impingement and/or entrainment would be reduced. Juvenile and adult Atlantic mackerel are present in the Sound from April through November. Since they would not be in the Sound during the primary construction period (winter to early spring) impacts would not be expected. Atlantic mackerel juveniles and adults are also pelagic and highly mobile and would be expected to avoid active construction areas. Therefore, any indirect impacts on the prey items of Atlantic mackerel would also not be expected.

4.1.2.5 Pollock

EFH supporting juvenile and adult pollock have been identified in the proposed Project area. Pollock occur in the Atlantic Ocean from the Gulf of St. Lawrence to New Jersey. The highest populations are observed in the Georges Bank area (Boschung et al. 1983). Adults spawn in three principal spawning locations: western Gulf of Maine, Great South Channel, and on the Scotian Shelf. Spawning tends to occur over rocky substrates from September to April. Juveniles have been found over a variety of substrates such as sand, mud, vegetation, and rock. They feed primarily on crustaceans (Cargnelli et al. 1999). Juvenile pollock are present in Long Island Sound from December through March (Stone et al. 1994). Adult pollock feed primarily on euphausiids, fish, and mollusks. Pollock adults have little preference for substrate (Cargnelli et al. 1999). They are present in Long Island Sound from December through March (Stone et al. 1994).

Since juvenile and adult pollock are present within the Sound from December through March, they would be present during the proposed construction period. However, these lifestages are pelagic and mobile and would be expected to avoid active construction areas. Any indirect impacts associated with prey items would also be expected to be negligible since suitable prey species could be found in adjacent non-disturbed areas.

Operational impacts from the proposed Project are not expected to impact juvenile and adult pollock. Operational impacts from water intakes would not be expected to affect these highly mobile and pelagic lifestages.

4.1.2.6 Sand Tiger Shark

EFH supporting the early lifestage of sand tiger shark (technically neonates) have been identified in the proposed Project area. Sand tiger sharks occur in the Atlantic Ocean from the Gulf of Maine to Argentina. EFH for neonate/early juveniles is designated as shallow coastal waters from Barnegat Inlet, New Jersey south to Cape Canaveral, Florida to the 25-meter isobath (NOAA 2005c). Little is known about the neonate stage. Sand tiger sharks were not collected during the 2002 Poletti ichthyoplankton survey or the 2005-2006 Broadwater ichthyoplankton surveys. In addition, neonate sand tiger sharks are a minimum of approximately 3 feet long (100 cm), and thus could readily escape construction areas and would not be susceptible to impingement or entrainment. Thus, the proposed Project would be expected to have a negligible (or no) impact on this species.

4.1.3 Coastal Migratory Pelagic Species

King mackerel, Spanish mackerel, and cobia are considered highly migratory species by NMFS. EFH has been designated for all lifestages of these species in the proposed Project area. The listed EFH includes: sandy shoals of capes and offshore bars, high-profile rocky bottoms, and barrier island ocean-side waters, from the surf to the shelf-break zone, including coastal inlets (NOAA 2005c).

4.1.3.1 King Mackerel

EFH supporting all lifestages of king mackerel have been identified in the proposed Project area. King mackerel are a pelagic fish that inhabit the Atlantic Ocean from the Gulf of Maine to Brazil (Boschung et al. 1983). This species is considered highly migratory by the NMFS. Adult king mackerel prefer warm waters that seldom fall below 68°F.

Since king mackerel are considered south Atlantic species for EFH purposes (NOAA 1998) and CTDEP trawl surveys indicate that they are uncommon in the Long Island Sound, impacts from the proposed Project are not expected.

4.1.3.2 Spanish Mackerel

EFH supporting all lifestages of Spanish mackerel have been identified in the proposed Project area. Spanish mackerel are a pelagic fish that inhabit the Atlantic Ocean from the Gulf of Maine to the Yucatan Peninsula (Boschung et al. 1983). This species is considered highly migratory by the NMFS. This species tends to feed on bait fishes such as anchovies (Boschung et al. 1983).

Since Spanish mackerel are considered south Atlantic species for EFH purposes (NOAA 1998) and CTDEP trawl surveys indicate that they are uncommon in the Long Island Sound, impacts from the proposed Project are not expected.

4.1.3.3 Cobia

EFH supporting all lifestages of cobia have been identified in the proposed Project area. Cobia are pelagic fish that inhabit the Atlantic Ocean from the Mid-Atlantic states to Argentina (Boschung et al. 1983). Cobia is a southern species that overwinters near Florida and migrates in the spring and summer to the Mid-Atlantic region to spawn. Adults are rarely found as far north as Massachusetts (Richards

1967). This species is considered highly migratory by the NMFS. Cobias have been known to frequent fishing holes where they will eat any bait (fish, squid, or crustacean) (Boschung et al. 1983).

Since Long Island Sound is at the northern end of this specie's range, only occasional visits by adult lifestages are expected. Therefore, no impacts from the proposed Project would be expected.

5.0 EFH IN THE PROPOSED PROJECT AREA

Impacts to habitats associated with the proposed Project would be limited to the seafloor sediment and water column since the proposed Project would be sited in the central waters of Long Island Sound. Therefore, there would be no impacts to other types of EFH such as eelgrass beds, live hard bottom habitats, or vegetated wetlands. There could be minimal impacts to seafloor sediment and the water column associated with vessel docking and maneuvering at the dock for the onshore facilities. However, any impacts would be minor and negligible.

5.1 SEAFLOOR SEDIMENT

Four types of bottom sedimentary environments have been identified in Long Island Sound. Fine-grained material covers about 50 percent of the area, primarily large portions of the central and western Sound (including the proposed Project area). Areas of sediment sorting cover approximately 22 percent, and course-grained materials approximately 16 percent of the area. Coarse-grained material is present mainly in the east-central portion of the Sound.

5.2 ESTUARINE WATER COLUMN

Estuarine waters occur throughout Long Island Sound, where fully saline seawater mixes with freshwater from inland sources. The estuarine water column can be viewed as a dynamic array of habitats distinguished by vertical and horizontal gradients of several parameters, including salinity, temperature, dissolved oxygen, nutrients, and turbidity. Nutrient levels are relatively high due to the input from freshwater and upland sources. Many marine species are directly or indirectly dependent on the estuarine water column. Many marine species utilize the estuarine water column as larvae where they thrive on blooms of plankton and relative lack of predators. Other marine species are indirectly dependent on estuaries because many of their prey items spend a portion of their lives in estuaries.

There is no inshore, nearshore, or shallow water estuarine habitat in the proposed Project area. The proposed FSRU would be located at a water depth of 95 feet and the minimum water depth along the proposed pipeline route is 55 feet.

6.0 ASSESSMENT OF IMPACTS

6.1 IMPACTS TO ESTUARINE ESSENTIAL FISH HABITAT

Broadwater has conducted various biological, habitat, and geophysical surveys to identify important marine resources in the proposed Project area. For those resources that could not be avoided, various project- and site-specific construction technologies and mitigation measures have been proposed by Broadwater in coordination with federal, state, and local resource agencies to limit impacts to EFH and EFH-managed species. We have also identified measures or recommendations in coordination with various resource agencies to further avoid or minimize potential impacts to managed resources in general and specifically EFH. These measures are described below and summarized in Section 8.0. The types of impacts would be comparable to those described for the habitat and fisheries of Long Island Sound as described in Sections 3.1, 3.2 and 3.3 of the EIS. Therefore, construction and operation of the proposed Project would result in both direct and indirect minor impacts to EFH.

The environmental consequences of constructing and operating the proposed pipeline Project would vary in duration and significance. Four levels of impact duration were considered: temporary, short-term, long-term, and permanent. Temporary impact generally occurs during active construction with the resource returning to pre-construction conditions almost immediately afterward. Short-term impact would continue for several months to approximately three years following construction. Impact was considered long-term if the resource would recover, but would require more than about three years to recover. A permanent impact would occur as a result of any activity that modifies a resource to the extent that it would not return to pre-construction conditions, such as with the placement of concrete mats at utility crossings. Specific impacts expected for EFH and managed species in the Project area are discussed in the following sections.

6.1.1 Direct Impacts

Direct impacts to EFH would occur from removal of habitat during excavation, disturbance or destruction of habitat from anchoring and pipeline installation, and conversion of seafloor substrate along some portion of the proposed pipeline by sediment (soft bottom substrate would be converted to hard structure at the placement of the YMS and concrete mats) (Table 6-1).

TABLE 6-1
Summary of Impacts by Construction Method and Habitat Type

Construction Feature	Total Bottom Direct Impacts (acres)
Pipeline lowering via plow	197.3
AT&T Cable Crossing	0.4
Cross Sound Cable Crossing	0.4
FSRU Tie-in	0.2
Check & Isolation Valve Spool	<0.1
IGTS Tie-in	0.3
YMS structure footprint	0.3
Anchor Footprint – Pipeline Installation	16.0
Anchor Footprint – YMS Installation	<0.5
Anchor Cable Sweep	2,020.0
Total Impacts	**2,235.5**
Total Impacts with "Mid-line Buoy" Recommendation	**215.5**

6.1.2 Trenching

Trenching of sediment to install the proposed pipeline and FSRU would directly impact EFH through disturbance and/or conversion of seafloor habitat. As a result of the proposed Project including our recommendations for reducing impacts, approximately 215.2 would be disturbed as result of construction of the proposed pipeline and FSRU. Broadwater proposes to allow most of the pipeline trench (19 miles) to naturally backfill and has reported that natural backfilling would fill most of the trench within 1 year and virtually all of the trench within 3 years. However, resource agencies have reported that existing post-construction monitoring surveys for other linear projects in Long Island Sound have found that the trenches did not naturally backfill as predicted. Therefore, to avoid and minimize potential impacts of an open trench and exposed pipeline during natural backfilling, we have recommended that Broadwater actively backfill the trench with excavated spoil material immediately following pipeline installation and conduct post-construction monitoring surveys to document success (Section 3.1.2.2 of the EIS). Therefore, the trench would be backfilled immediately following construction to avoid potential impacts of a persistent trench, such as a migration obstacle to biota and/or limited thermal impacts of an exposed pipeline during operation. It is anticipated the benthic community would recover within one to two years. Construction impacts to EFH would be the greatest during active construction and immediately following construction and the extent and magnitude of any impacts would gradually decrease during the remainder of the subsequent one to two years.

Construction of the proposed YMS would initially result in direct disturbance of approximately 0.8 acre of benthic habitat including about 0.5 acre associated with anchoring and 0.3 acre associated with the footprint of the YMS on the seafloor. This footprint would include the physical structure of the proposed YMS itself, including the YMS jackets or legs and a mud mat. The mud mat would be a latticework of wooden slats used to stabilize the legs during installation, and the mud mat would penetrate into the sediment upon YMS installation and be left there to decay.

Proposed general pipeline maintenance during operations would require minimal daylighting of buried facilities, with excavation by a submersible pump or by divers using hand-jetting or air-lifting equipment. It is expected that general maintenance of the pipeline would occur once every 5 to 7 years. These activities could result in localized disturbance of the seafloor habitat and redistribution of sediments. Direct impacts to the seafloor habitat would be very localized, and recovery could take from a few months to one to two years.

6.1.3 Anchoring

Impacts to the seafloor habitat of Long Island Sound during construction could occur as a result of anchors being laid directly on the bottom, or from anchor line sweep as waves and currents affect vessel positions.

Approximately 2,036.5 acres of seafloor would be impacted by anchoring and associated cable sweeps during construction of the pipeline, as proposed by Broadwater. Almost all of this acreage would be associated with cable sweep (2,020 acres). However, with implementation of our recommendation to use mid-line buoys and possibly a dynamically positioned lay barge (Section 3.1.2 of the EIS), anchoring impacts would total approximately 16.5 acres of seafloor. Impacts as a result of anchors would be expected to recover within a few months to one to two years.

Impacts from anchoring are expected during construction and would not occur during operation of the proposed pipeline and FSRU.

6.1.4 Hydrostatic Testing

Broadwater would hydrostatically test the proposed pipeline with approximately 3.9 million gallons of filtered seawater from Long Island Sound.

Impacts from hydrostatic testing could occur from toxic effects of chemical additives after discharge of the used test water. Prior to testing, water would be treated with biocides and oxygen inhibitors to prevent corrosion. Broadwater is proposing the use of biocides to protect the interior of the proposed pipeline from excessive corrosion during hydrostatic testing. Biocide would be added to the water during filling of the pipeline for hydrostatic testing, which would result in direct mortality of organisms entrained in the pipeline. After approximately 8 months, the hydrostatic test water with biocide would be pumped to holding tanks on a support vessel for treatment and neutralization prior to its discharge into Long Island Sound. Hydrostatic test water would be treated, and discharges would be conducted in accordance with SPDES requirements. Therefore, any impacts to EFH associated with the use of biocides would be highly localized and temporary. Additional discussion on potential impacts to EFH-managed species is provided in Section 6.2.1.3.

6.1.5 Cumulative Water Intakes

Broadwater has stated that the annual daily average intake volume for the FSRU would be 5.5 mgd (for ballasting, desalination, bilge and general services pumps, and the side-shell water curtain). This annual average intake volume includes fluctuation due to increased gas sendout and fire system testing. Some of the proposed intake water would be treated with a continuous dose of sodium hypochlorite. This would result in a residual sodium hypochlorite concentration in the seawater between 0.01 and 0.05 ppm. Any impacts to water quality and volume associated with water intakes are considered minor but long term because they would continue for the life of the proposed Project. Additional discussion on potential impacts to EFH-managed species is provided in Section 6.2.2.1.

6.1.6 Cumulative Water Discharge

The cumulative daily water discharges for the proposed FSRU would vary, based on the frequency of LNG carriers off-loading. The annual average daily discharge would be approximately 5.5 mgd, with a maximum daily discharge of 17.2 mgd. The maximum daily discharge volume would occur approximately 118 days per year and would result primarily from the need to discharge ballast water while LNG is being loaded onto the FSRU. Several other discharges from the proposed FSRU would be performed on a less frequent basis. The proposed FSRU would discharge approximately 0.7 million gallons once a month for testing of the firewater bypass system. Approximately once every 5 years, about 11.6 million gallons would be discharged for the inert gas scrubber overload. Although not anticipated to be necessary during the life of the Project, discharges could be associated with the central cooling water system and emergency bilge overboard. All of these processes, if they did occur, would discharge directly into Long Island Sound.

Routine discharge waters from the proposed FSRU would approximate ambient temperature, and most would be treated with sodium hypochlorite biocides. The chlorine concentrations would be monitored via a colorimetric assay. The initial residual chlorine concentration (between 0.01 and 0.05 ppm) would readily decrease due to rapid breakdown of the chlorine, and it is not expected to affect water quality. In addition, all discharges would be conducted in accordance with SPDES requirements. If the SPDES requirements establish a mixing zone, it is anticipated the chlorine concentrations would attenuate readily in the open waters of Long Island Sound due to the periodic nature of discharges (approximately twice per week), use of minimum effective concentrations of sodium hypochlorite in the discharge water, and the volume and hydrodynamic of the surrounding water in Long Island Sound.

The water quality of firewater discharges would be comparable to ambient conditions. Water temperatures of any water discharges associated with the inert gas scrubber (once every 5 years) and the central cooling water system (never anticipated) likely would be slightly above ambient temperatures. Although these exact processes are not currently specified, the associated discharges either would be required to satisfy New York's water quality standards for SA waters or would require special SPDES permit requirements to reduce potential impacts to water resources. For these reasons, any impacts to EFH associated with water discharges during operations are considered minor but long term because they would continue for the life of the proposed Project. Additional discussion on potential impacts to EFH-managed species is provided in Section 6.2.2.2.

6.1.7 Indirect Impacts

Construction of the proposed pipeline and FSRU would require plowing and/or dredging which could result in increased suspended solids and turbidity, the release of potential contaminants contained within the sediments, and a reduction in the dissolved oxygen concentrations in the area due to the release of oxygen demanding materials (decomposing organic materials contained within the sediments).

6.1.7.1 Turbidity and Sedimentation

Broadwater conducted sediment transport modeling to determine the extent of turbidity and sedimentation as a result of installation of the proposed pipeline using standard modeling methods (Section 3.2.3.1 of the EIS). Results of the sediment transport modeling showed that turbidity (measured as total suspended solids or TSS) in the upper and middle depth strata of Long Island Sound were predicted to be less than 10 mg/L and mostly less than 5 mg/L. The highest TSS concentrations would occur near the bottom during active plowing. Bottom depth strata TSS values typically ranged from 1 mg/L to 14 mg/L with the highest values at the location of active plowing. The highest TSS concentration recorded by the model was 80 mg/L. This concentration was modeled in the bottom depth strata, centered along the proposed pipeline route, approximately 0.2 miles wide, and was of short duration. The model results also indicated that any project-related TSS concentrations would be assimilated into Long Island Sound within about 12 hours of when the sediments were suspended during construction. Modeling to assess impacts from excavation activities associated with the specialized methods (e.g., IGTS and proposed FSRU tie-ins) were also examined. The model results showed no discernible increase in TSS values throughout the entire water column.

Broadwater has proposed to use various methods to monitor turbidity during trenching including periodic optical backscatter techniques, continuous acoustic doppler current profiling, and collecting TSS grab samples. The exact frequency, location, and concentrations of concern associated with this monitoring would be determined as part of the SPDES permitting process.

Based on the modeling results, construction and monitoring methods that are proposed, and the limited amount of sediment excavated in those areas, it is expected that increases in TSS concentrations would have minimal impacts and any increase in TSS concentrations would be readily assimilated into Long Island Sound.

As mentioned above, general pipeline maintenance would require minimal daylighting of buried pipeline facilities, with excavation by a submersible pump or by divers using hand-jetting or air-lifting equipment. Maintenance operations would not significantly affect the seafloor habitat due to the highly localized and infrequent maintenance activities (approximately every 5 to 7 years) and the temporary nature of impacts when they would occur.

6.1.7.2 Potential Sediment Contamination

The distribution of metal contaminants in surface sediments of Long Island Sound has been measured and mapped as part of a USGS study of the sediment quality of Long Island Sound (Mecray et al. 2000). Sediment samples were collected from 219 stations in the Sound and chemically analyzed. According to Paskevich and Poppe (2000), contaminants in the general vicinity of the pipeline route were generally within the background ranges and below federal benchmarks (effects range-low or ER-L) for most contaminants. Broadwater conducted site-specific sediment sampling along the proposed route and documented that contaminant concentrations were below ER-Ls for nearly all constituents with the exception of iron and magnesium. Therefore, any impact associated with contaminated sediments, if such sediments are present, would be insignificant and temporary.

6.1.7.3 Dissolved Oxygen

Low dissolved oxygen levels have been reported to occur in the bottom waters of some portions of Long Island Sound in late summer. Dissolved oxygen concentrations along the pipeline route could theoretically be reduced due to the release of oxygen demanding materials (decomposing organic materials contained within the sediments). However, pipeline construction would occur during the fall and winter, and any impacts would be expected to rapidly dissipate due to the tides and currents within Long Island Sound. Therefore, any impacts would be localized and short term.

6.1.8 Unexpected Impacts

Broadwater has proposed a pipeline route and construction methods intended to minimize the potential for unexpected impacts. However some potential sources of unexpected impacts include fuel spills and uncontrolled anchors or pipe segments.

6.1.8.1 LNG, Fuel and Other Hazardous Fluids

Impacts to the pelagic water column could occur as a result of accidental spills of LNG, petroleum lubricants and fuel during pipeline construction. These spills could originate from accidental spills from construction barges or support boats, loss of fuel during fuel transfers, or accidents resulting from collisions. Spills of toxic materials would result in a decrease in water quality. We have included a recommendation in Section 3.2.2.1 of the EIS that Broadwater provide an offshore-specific Spill Prevention, Containment, and Countermeasures (SPCC) Plan for construction activities. Since the LNG loading system would direct any LNG spills that may occur overboard, the majority of LNG from a spill would quickly disperse and vaporize on the sea surface. Additional information regarding spills can be found in Section 3.10 of the EIS.

6.1.8.2 Uncontrolled anchors or pipe segments

Other unexpected impacts may result from uncontrolled anchors or pipeline sections. However, construction and monitoring procedures have been developed to minimize the likelihood of these events and to contain them to minimize their extent if they do occur.

6.2 IMPACTS TO MANAGED SPECIES

Impacts from construction and operation of the proposed Project could occur to the managed species for which EFH has been designated. Life history characteristics for these species and potential impacts specific to each species and lifestage are provided in Section 4.1. Impacts that may occur to these species during construction and operation could include mortality; displacement due to loss of habitat; decreases in forage efficiency or reproductive success; impingement/entrainment associated with water intakes; or toxic effects from hazardous chemicals.

6.2.1 Construction Impacts

6.2.1.1 Habitat Loss

Habitat could be lost to demersal species because of physical disturbance of the surface sediment (e.g. trenching), or replacement of the surface substrate (such as importation of backfill for limited portions of the pipeline trench, concrete mats, or YMS legs). There are several EFH-managed demersal species that could utilize the proposed Project area such as ocean pout, red hake, winter flounder, summer flounder, windowpane flounder, little skate, winter skate, silver hake, black sea bass, and scup.

Construction of the proposed Project would be conducted in fall, winter, and early spring, thus avoiding the primary spring and summer spawning months for most species. Organisms that are not able to escape the area during construction could be removed or smothered along with their habitat, resulting in direct mortality of these organisms. The number of organisms impacted in this way would be minor, and would not result in population level impacts. In general, adult and juvenile lifestages of managed species would be able to escape the construction area. Mortality of mobile species and lifestages would not be expected, but these species would be temporarily displaced from their habitat. The amount of EFH that would be directly impacted would total 215.5 acres - less than 0.1 percent of the benthic habitat in Long Island Sound (approximately 844,800 acres). Of this total, approximately 7.9 acres of the seafloor would be converted from softbottom sediment to hard substrate due primarily to backfilling approximately 2 miles of the pipeline trench with imported rock (approximately 6.1 acres), use of concrete mats at the 2 utility crossings (total of 0.8 acre), and placement of the YMS on the seafloor (0.3 acre). Conversion of the habitat from soft to hard substrate could adversely impact some EFH-managed species or their prey (benthic community), but benefit other EFH-managed species such as pollock and scup, which use rocky substrates for spawning and habitat.

6.2.1.2 Turbidity and Sedimentation

Increased turbidity in the water column during construction could affect the ability of visual predators to forage efficiently (Newcombe and Jensen 1996). It is likely that these species would avoid the area until turbidity subsided. Those species that could not avoid the area might show a reduction in feeding rates or exhibit physiological effects, such as increased respiration, until turbidity levels subside. The extent of turbidity is very small and would be of short duration. Species would return to impacted areas shortly after turbidity levels decreased, and foraging ability would be expected to readily return to normal. Therefore, turbidity impacts to managed species would be temporary.

Increased turbidity levels or hazardous chemicals could impact spawning behavior and success. Potential impacts include increased egg or larval mortality, delayed hatching, or decreased growth rate. The proposed construction schedule would avoid most of the spring, summer, and/or fall spawning seasons of managed species. The primary exception would be winter flounder, which generally spawn from winter through spring.

Additional mortality associated with construction and operation of the pipeline would be negligible compared to natural mortality levels, and impacts to the reproductive success of managed species would not be evident at the population level.

As suspended sediments settle, benthic organisms could experience increased levels of sedimentation. Most EFH-managed species are highly mobile and would be able to escape the area or shed any sediment accumulation. Those species or lifestages that could not shed accumulated sediment could experience physiological stress, such as decreased feeding rates, decreased respiration rates, increased metabolic activity, or mortality. These effects would be limited to the area experiencing elevated sedimentation rates. Sedimentation would occur for a few days and most organisms along the proposed route would likely recover from sedimentation within a few days to weeks. Localized decreases in species composition and abundance would likely occur along the proposed route, but to a limited extent because only small portions of the habitat in the proposed Project area would be impacted. Modeling results indicate that sedimentation no greater than 0.2 inches would occur outside the 75-footwide corridor along the proposed route. Sediment deposition no greater than 0.04 inches would occur outside a distance of 300 to 660 feet from the pipeline route.

6.2.1.3 Hydrostatic Testing

Ichthyoplankton could suffer physical injury or mortality from hydrostatic testing of the proposed pipeline due to physical impingement/entrainment of finfish, or elevated chemical concentrations in the water column. To ensure the integrity of the proposed pipeline, hydrostatic testing would occur following installation and prior to initial operation. According to Broadwater, this testing would be performed in spring 2010. Testing involves filling the pipeline with seawater that is treated with biocide, using a suction head or submersible pump. The total volume of seawater required to fill the proposed 21.7-mile-long, 30-inch-diameter pipeline is approximately 3.9 million gallons. The proposed pipeline would be filled at a rate of approximately 4,000 gpm. Broadwater proposes to withdraw water from 20 to 40 feet below the surface of the water. The hydrostatic test would use 74-micron mesh screen (mesh opening 0.003 inches) to reduce the potential for impingement or entrainment of ichthyoplankton and plankton.

There would only be one occurrence of hydrotest water intake, and coupled with the mid-depth location of the intake and small screen size on the intake, the impacts of this testing on potential EFH-managed species would represent a negligible impact to the ichthyoplankton/plankton population of Long Island Sound.

Broadwater is proposing to use biocides to protect the interior of the proposed pipeline from excessive corrosion during hydrostatic testing. Biocide would be added to the water during filling of the pipeline for testing, which would result in direct mortality of organisms entrained in the pipeline. After approximately 8 months, the hydrostatic test water with biocide would be pumped to holding tanks on a support vessel for treatment and neutralization prior to its discharge into Long Island Sound. Hydrostatic test water would be treated, and discharges would be conducted in accordance with SPDES requirements. Therefore, any impacts associated with the use of biocides would be highly localized and temporary.

6.2.1.4 Noise

Finfish species and ichthyoplankton could be affected by acoustical disturbances associated with pile-driving used during installation of the proposed YMS. Although the effects of pile-driving on fisheries resources are not fully understood, intense sound pressure waves are known to alter fish behavior or injure/kill fish by rupturing swim bladders or causing internal hemorrhaging (NOAA 2003). Fish tolerance to sound waves depends on peak sound pressure, frequency, and species. In addition, the size and condition of the fish also play a role in tolerance since small fish are more prone to injury by intense sound waves than are larger fish of the same species. The presence of predators can also influence how a fish might be affected by pile-driving (e.g., fish stunned by pile-driving activities may be more susceptible to predators). According to Broadwater, either a vibratory hammer or a conventional pile-driver would be used to install the four legs of the YMS into the seafloor, however, the geologic investigations have not been completed to assess specific driving conditions. The legs would be installed one by one, and installation would require approximately 1 week for each leg. During installation, pile-driving would be limited to 12 hours per day and would not occur at night. According to Hastings (2002), sound pressure levels below 190 dB will not harm fish. NMFS has established a threshold of 180 dB for physical harm to fish for other projects (NOAA 2004a, 2004b). Broadwater has reported that preliminary noise estimates indicate that impulse noise levels may be as high as 180 dB at up to 1 mile or more from the activities. Therefore, we have recommended in Section 3.3 of the EIS that Broadwater coordinate with NMFS to identify noise thresholds and any appropriate measures that are protective of marine resources.

Juvenile and adult finfish are highly mobile and are expected to avoid the proposed YMS construction area. It is anticipated that impacts to finfish communities would largely be limited to younger, less mobile lifestages (eggs and larvae); and pile-driving activities are proposed to occur in

October, when egg and larval densities would be relatively low. With implementation of our recommendation, any impacts of noise to fisheries resources during construction of the YMS would be minor and temporary.

6.2.2 Operational Impacts

The primary operational impact to EFH-managed species during operation would be impingement and/or entrainment in the water intakes of the FSRU and LNG carriers. Additional impacts could be associated with water discharges and the use of anti-fouling paint.

6.2.2.1 Impingement/Entrainment

Nine EFH-managed species have early lifestages (eggs and/or larvae) that may be present in Long Island Sound, and most if not all of them could theoretically be located in the Project area. These species could be impinged and/or entrained by the water intakes associated with the proposed FSRU.

The best available information on potential ichthyoplankton abundance and diversity in the Project include the 2002 Poletti ichthyoplankton survey, site-specific sampling conducted by Broadwater, and species life history information, as described in Section 4.1.

The Poletti survey was conducted throughout various regions of Long Island Sound, and the results were presented based on region and habitat depth. For purposes of this assessment, we evaluated the results for regions within the central basin. The Poletti results were presented based on the overall water depth of the area: shallow (seafloor depths up to 20 feet), intermediate (seafloor depths 20 to 98-feet deep), and deep (seafloor depths over 98 feet deep). Although samples from each area were collected near the surface, mid-depth, and near the bottom, the samples from the different depths were composited to provide overall densities and diversity by area based on total seafloor depth. Bi-weekly surveys were conducted during the day between March and early August 2002 to cover the primary spawning period for most finfish species. There was little sampling conducted in the immediate vicinity of the Project area.

For this assessment, abundance and diversity information for the deep stratum from the Poletti survey were used to assess abundance and diversity as well as estimate impingement/entrainment values since the deep stratum would better represent the expected ichthyoplankton community at the FSRU than the intermediate stratum. While the FSRU location (approximately 95 feet deep) would technically be within the intermediate stratum, the intermediate stratum also includes sampling results from more shallow, nearshore habitats (as little as 20 feet deep), and the ichthyoplankton diversity and abundance in these more nearshore waters would be less representative of the fisheries community than would be expected in the deeper offshore waters at the proposed FSRU site. The EFH-managed lifestages of 4 species were collected during the entire Poletti surveys (Atlantic mackerel, scup, windowpane flounder, and winter flounder) in either the deep or intermediate stratum.

The 2002 Poletti ichthyoplankton survey was only collected during the day between March and August in the general area of the proposed Project, and samples were composited across water depths. To better evaluate the potential ichthyoplankton community that could be impacted by the proposed Project, Broadwater conducted depth-stratified surveys during day and night in the immediate vicinity of the proposed FSRU location. Six ichthyoplankton surveys were conducted between August 2005 and May 2006, and one lobster larvae survey was conducted in July 2006. These surveys documented the occurrence of EFH-managed lifestages for 4 species: Atlantic mackerel, black sea bass, windowpane flounder, and winter flounder.

Density estimates were determined during each sampling period for both surveys, and used to calculate annual standing crop in the central basin, and annual losses associated with impingement/entrainment by the proposed Project. It is recognized that this approach may overestimate the exact impingement/entrainment of some species, and underestimate that of other species, but it provides a useful approximation of total abundance. As described in Section 3.3.2 of the EIS and summarized below, this approach is likely to overestimate potential impacts to EFH-managed species, thereby providing conservative estimates of potential impacts.

Annual impingement/entrainment estimates were calculated by multiplying the average densities (by species) by the annual daily water intake rate for the proposed Project including the FSRU and LNG carriers (28.2 mgd). To develop annual estimates, this approach incorporated the results of the 2002 Poletti survey for the deep stratum between March and early August (averaged across water depths) and the 2005-06 Broadwater quarterly survey results for the mid-depth stratum between August and March. These annual impingement/entrainment losses for each EFH-managed species collected during the surveys are presented in Table 6-2.

TABLE 6-2
Annual Entrainment Estimates for EFH-Managed Species Collected during the 2002 Poletti and 2005-06 Broadwater Ichthyoplankton Surveys

Species	Eggs		Larvae	
	Number	Percentage	Number	Percentage
Atlantic Mackerel	22,716	0.6	495,294	9.3
Black sea bass*	0	0	176,190	3.3
Scup	1,963,833	55.2	2,212,906	41.4
Windowpane Flounder	1,568,083	44.1	868,988	16.3
Winter Flounder	5,081	0.1	1,586,763	29.7
TOTAL	**3,559,713**		**5,340,141**	

* = Entrainment estimates were only reported for March through August

The annual losses of EFH-managed species for the Broadwater Project during operations would total approximately 3.5 million EFH-managed eggs and 5.3 million eggs. Overall, the loss of EFH-managed species would compose approximately 3 percent of the ichthyoplankton losses for the overall finfish community (both eggs and larvae). Based on the average fish densities and water volume of the central basin, this loss would not be expected to have any significant impact on these species since it would constitute less than 0.1 percent of the total standing crop of the central basin of Long Island Sound.

As described in the species-specific life history descriptions in Section 4.1, the density of eggs and larvae for most EFH-managed species, would generally be at a minimum at mid-depth and therefore not generally be susceptible to impingement/entrainment by the proposed Project. For each of the EFH-managed species reported during the 2002 Poletti and 2005-06 Broadwater surveys, EFH-managed eggs are either buoyant (Atlantic mackerel, black sea bass, scup, and windowpane flounder) or demersal (winter flounder). Similarly EFH-managed larvae for the species documented to occur in the Project area tend to be demersal (scup, windowpane flounder, and winter flounder). Therefore, while EFH-managed species may be present in the general Project area, the vast majority of the eggs and larvae would not be expected to occur at mid-depth (where the water intakes would be), except during settlement to the bottom.

In addition to locating intakes at depths where minimum ichthyoplankton densities have been observed, other operational aspects of the proposed Project would also serve to further reduce potential impacts. Broadwater proposes to use 0.2-inch mesh screen on the water intakes, and limit water intake velocity to 0.5 foot per second or less to reduce the potential for impingement and/or entrainment of ichthyoplankton. These general measures are recommended by NOAA to reduce entrainment and impingement impacts associated with LNG terminal siting and design (NOAA 2005a).

Because the estimated impingement/entrainment represents such a small percentage of the general standing crop of EFH-managed species of central Long Island Sound, these impingement/entrainment losses are not expected to affect the general finfish population within Long Island Sound, nor specifically the EFH-managed species. Actual losses would be expected to be substantially lower than the estimated losses with implementation of the measures to minimize impacts (mid-depth intakes, fine mesh screens, and relatively low intake velocities),

6.2.2.2 Water Discharge

Managed species could come in contact with various chemicals from operation of the proposed FSRU. These include impacts associated with biocides. Water intakes at the proposed FSRU would withdraw water from Long Island Sound. Biocide (such as sodium hypochlorite) would also be added to some of these intakes. The residual chlorine concentration would range between 0.01 and 0.05 ppm. Broadwater would monitor sodium hypochlorite concentrations through sampling of overboard water prior to discharge into the Sound, and would only discharge in accordance with SPDES requirements. Chlorine concentrations would be determined using a colorimetric assay. This residual chlorine concentration is not expected to affect water quality because any discharge would be in accordance with SPDES requirements and dilution would occur rapidly due to the volume of water in Long Island Sound and mixing by the tides. Therefore, impacts associated with biocides would not be expected.

6.2.2.3 Anti-Fouling Paint

Broadwater would initially use anti-fouling paint on the proposed FSRU structure. Anti-fouling paint would be applied to the proposed FSRU hull at the shipyard. According to Broadwater, approximately 27.8 pounds per day of copper would be leached into the Sound (Section 3.2.3.1 of the EIS). Broadwater conservatively estimated the concentration of copper that would leach into the water column assuming Long Island Sound was a static system and the copper would remain in the water column beneath the footprint of the FSRU. The resulting concentration (1.0 μg of copper/liter of water) would be below the Environmental Protection Agency's (EPA) ambient water quality criteria for acute and chronic releases (3.1 and 1.9 μg/L, respectively). In addition, anti-fouling paint would only be applied to the proposed FSRU during construction. There would be no re-application of anti-fouling paint for the life of the proposed Project.

6.2.3 Impact Summary

Overall, impacts to EFH-managed species from construction of the pipeline would be generally minor and temporary. Areas with habitat conversion (soft bottom habitat to hard structure) would have more long-term to permanent impacts. Highly mobile organisms would be displaced, but would be expected to return shortly after construction ended. Less mobile species would be exposed to construction-related impacts, such as physiological stress, decreased reproductive or feeding success, or mortality. Many of these effects would be temporary or short-term from which organisms could recover. Displaced species would not be habitat limited, while impacts to benthic species would occur over a small portion of their range. Construction related impacts would not be evident at the population level.

Operational impacts such as impingement/entrainment and impacts from chemicals would be minor but long-term, extending for the life of the proposed Project.

7.0 CUMULATIVE IMPACTS ANALYSIS

The purpose of this cumulative impact analysis is to identify and describe cumulative impacts to EFH that could potentially result from implementation of the proposed Project. In general terms, cumulative impacts represent the incremental effects of the proposed action when added to other past, present, or reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a given period of time. The direct and indirect impacts of the proposed Project are discussed in other sections of this EFH assessment.

Inclusion of other projects within this cumulative impacts analysis is based on identifying common attributes between impacts from other projects and potential impacts from this proposed Project. For this EFH, actions meeting the following three criteria have been included in the cumulative impacts analysis:

- The project could impact a resource area or issue potentially impacted by the proposed Project;
- The impact of a project could occur within all, or part of, the region of impact for the proposed Project; and
- The impact of a project could occur within all, or part of, the time span for potential impact from the proposed Project.

Other actions considered in the cumulative analysis may vary from the proposed Project in nature, magnitude, and duration. These projects are included based on the likelihood of completion with only "reasonably foreseeable" future actions evaluated as part of the cumulative analysis. Therefore, based on the anticipated geographic and temporal impacts of the proposed Project and other actions, other actions that were not expected to affect similar resources during the duration of effects resulting from the proposed Project were excluded from further consideration. Anticipated cumulative impacts were based upon NEPA documentation, agency and public input, and best professional judgment.

We identified three types of past, present, and reasonably foreseeable future projects that could potentially result in a cumulative impact to EFH when considered with the proposed Project. For the purposes of this cumulative impact analysis, we considered the proposed Project area to be the offshore waters of Long Island Sound.

A total of 11 projects are either in place, are under construction, or are reasonably foreseeable future projects in the Project area. These projects consist of two existing and one proposed natural gas pipeline, five existing subsea telecommunication or electric transmission cables, two offshore oil transfer platforms, and two proposed offshore dredged material disposal sites.

7.1.1 Pipeline Projects

7.1.1.1 Islander East Pipeline Project

The Islander East Pipeline Company has proposed construction of a 24-inch-diameter gas transmission pipeline system from New Haven, Connecticut, to Shoreham, New York on Long Island (FERC 2002). The Islander East Pipeline project would include approximately 22.6 miles of subsea pipeline across Long Island Sound and 5 miles of additional lateral pipeline on Long Island. The Islander East Pipeline would be constructed approximately 6 miles east of the proposed Broadwater FSRU and subsea pipeline.

The Islander East Pipeline project is considered here with respect to the potential for cumulative impacts to the offshore habitats of Long Island Sound. The project has been approved by FERC, but has not yet been constructed pending appeal of a denial of water quality certification by the State of Connecticut. While it is not certain if or when this action will occur, it was considered further due to its similarity and proximity to the proposed Broadwater subsea pipeline. Table 7-1 presents a comparison of the two projects and the cumulative total impact.

TABLE 7-1
Cumulative Impacts of Broadwater LNG, Islander East Pipeline Projects

	Broadwater	Islander East	Cumulative Total
Offshore project length (miles)	21.7	22.6	44.3
Construction method			
Dredge (miles)	0.0	1.1	1.1
Plow (miles)	21.7	20.1	41.8
Horizontal directional drilling (miles)	0.0	1.4	1.4
Construction right-of-way width (feet)	50–300	80–150	130–450
Number of equipment passes (with anchors)	3	4	7
Offshore seafloor affected (acres)	215.5[a]	3,106	3,321.3

[a] Includes incorporation of our recommendations.

7.1.1.2 IGTS

IGTS is a 411-mile pipeline system running from Waddington, New York to Northport, New York. The portion of the IGTS that crosses Long Island Sound was constructed in 1991 and runs from Milford, Connecticut to Northport, Long Island. The proposed Broadwater pipeline would terminate at the IGTS pipeline in the middle of Long Island Sound. The IGTS pipeline was buried beneath the seafloor, using a combination of dredging, plowing, and excavation, depending on water depth; dredging was limited to shallow nearshore waters and therefore did not occur within the Project area.

The IGTS pipeline route was resurveyed in 1993 and 1999 to determine the extent to which topography differed from pre-construction conditions (TFOLIS 2003). Along much of the offshore pipeline route, natural sediment transport had refilled the construction trench; however shallow linear depressions were observed along portions of the pipeline centerline (TFOLIS 2003). The available survey results do not quantify the area of the benthic habitat that is continuing to recover. Post-construction surveys identified some more substantial impacts to nearshore oyster beds where dredging and drag beam operation occurred; however, these impacts did not occur within the Project area and are not considered further in this cumulative impact analysis.

7.1.1.3 IGTS Eastchester Extension

The IGTS Eastchester Extension, constructed in 2004, is a 32-mile, 24-inch natural gas pipeline running from Northport, Long Island to Bronx, New York. The Eastchester Extension pipeline was installed using a combination of horizontal directional drilling (in nearshore shallow water areas outside the Project area) and subsea plowing. Construction activities included attempts at mechanically backfilling the trench. Existing post-construction surveys indicate that the mechanical backfilling methods employed did not result in complete backfilling of the trench, but acreage estimates are not available. In addition, no quantitative information is available on the status of benthic recovery.

7.1.2 Telecommunication and Electric Transmission Cables

Five subsea telecommunication and electric transmission cable occur in the Project area. The most recently constructed cable, the Cross Sound Cable, was installed in 2004; the remaining cables have been in place for 5 years or more. Except as otherwise noted below, we are not aware of any long-term and ongoing environmental impacts associated with the construction of these cables. Regular operation of the cables does not result in any environmental impacts to the Project area.

7.1.2.1 1385 Cable Line

The 1385 cable line system, constructed in 1969 by Connecticut Light and Power (CL&P), traverses Long Island Sound approximately 11 miles from Norwalk, Connecticut to Northport, New York on Long Island. The cable is located more than 25 miles southwest of the proposed Broadwater Project. The cable system consists of seven 3-inch-diameter cables, each filled with a dielectric fluid (alkylbenzene). The 1385 cable system initially was installed using two construction methods. In shallow nearshore waters (outside the Project area), the cables were installed in a dredged trench that subsequently was backfilled with concrete, rock, or other fill. Within the Project area, the cables were laid directly on the seafloor and later were covered with fill material. These fill activities did not completely cover the cable; consequently, the 1385 cable is exposed in many places (TFOLIS 2003). Further, anecdotal information suggests that evidence of the cable trenches in nearshore waters (outside the Project area) were still apparent in 2002 (TFOLIS 2003).

Since 1970, third-party damage to exposed portions of the 1385 cable has resulted in release of alkylbenzene on 55 separate occasions (TFOLIS 2003). Although these releases have been small, localized, and temporary, CL&P has proposed replacing the 1385 cable system with a system of solid dielectric cables that do not contain alkylbenzene.

7.1.2.2 Cross Sound Cable

The Cross Sound Cable, constructed in 2002, traverses approximately 24 miles from New Haven, Connecticut to Brookhaven, New York on Long Island. The Cross Sound Cable was installed using horizontal directional drilling in shallow nearshore waters outside of the Project area. Within the Project area, the cable was installed using a remotely operated jet sled (TFOLIS 2003). The proposed pipeline would traverse the Cross Sound Cable at MP 3.0, and no impacts to the cable are anticipated.

Although some difficulties were encountered in burying the cable to permitted depth in nearshore waters, the cable was installed as permitted within the Project area. Six months after the Cross Sound Cable was installed, the construction corridor was surveyed for evidence of continuing impacts to bottom topography, sediment composition, and benthic marine communities. Within the Project area, there were some shallow depressions along the cable construction corridor. These depressions ranged from 2 to 8 feet wide and 0.5 to 2 feet deep. Sediment composition and marine benthic community composition and diversity did not appear to differ from pre-construction conditions within the Project area (OSI 2002).

7.1.2.3 AT&T Cable

The AT&T Cable traverses Long Island Sound approximately 22 miles from Connecticut to Long Island. The AT&T Cable was installed using horizontal directional drilling in shallow nearshore waters outside of the Project area. Within the Project area, the cable was installed using a jet plow (TFOLIS 2003). The proposed Broadwater pipeline would cross the AT&T cable at MP 6.4, and no impacts to the cable are anticipated.

No known information indicates that environmental impacts are continuing in association with construction of the AT&T Cable.

7.1.2.4 MCI Cable

The MCI Cable, constructed in 1996, traverses approximately 27 miles from Connecticut to Long Island, approximately 5 miles east of the proposed Broadwater Project. Like the AT&T Cable, the MCI Cable was installed using horizontal directional drilling in shallow nearshore waters outside of the Project area. Within the Project area, the cable was installed using a jet plow (TFOLIS 2003).

No known information indicates that environmental impacts are continuing in association with construction of the MCI Cable.

7.1.2.5 FLAG Atlantic 1 North Fiber Optic Cable

The FLAG Atlantic 1 North Fiber Optic Cable, constructed in 2001, is a trans-Atlantic cable connecting the north shore of Long Island to London, England along a corridor approximately 1 mile south of the proposed Broadwater Project. Like the AT&T and MCI Cables, the FLAG cable was installed using horizontal directional drilling in shallow nearshore waters outside of the Project area. Within the Project area, the cable was installed using a jet plow (TFOLIS 2003).

No known information indicates that environmental impacts are continuing in association with construction of the FLAG Atlantic 1 North Fiber Optic Cable.

7.1.3 Dredged Material Disposal Sites

The U.S. Army Corps of Engineers (COE) and EPA completed an EIS to evaluate potential sites in central and western Long Island Sound suitable for receiving spoil material from regional navigational dredging projects (EPA 2004). Two disposal sites were selected, the Western Long Island Sound site and the Central Long Island Sound site. The Western Long Island Sound site is located over 10 miles west of the western terminus of the proposed Broadwater Project. The Central Long Island Sound site, a formerly active EPA-designated dump site, is located in Connecticut waters approximately 3 miles northwest of the proposed Broadwater FSRU location.

Both proposed dumpsites either currently receive or did receive dredged disposal material from a variety of harbor and waterway maintenance dredging and deepening projects throughout the Long Island Sound area. The EIS identified appropriate mitigation measures to avoid and minimize potential impacts, and concluded that the effects of dredged material disposal on sediment and water quality at these two locations were minor and effectively limited to the dumpsite areas themselves.

7.1.4 Nearshore Oil Transfer Platforms

KeySpan operates a petroleum delivery platform on Long Island Sound approximately 1 mile offshore of Northport Harbor, New York. This platform, which has been in operation since 1967, consists of an unloading platform, two mooring platforms (each about 50 feet square), and mooring buoys. In 2005, 82 vessels (barges and tankers) made deliveries to this facility, with oil transported by pipeline to onshore facilities (KeySpan 2006).

ConocoPhillips operates a similar oil receiving platform approximately 1.5 miles offshore of Northport, New York. No specific information on the frequency of tanker operations at this facility has been made available at this date.

Although both the KeySpan and ConocoPhillips platforms are located in shallow, nearshore waters outside of the Project area, tanker activity at these locations has the potential to result in a cumulative impact on air quality and marine transportation within the Project area.

7.1.5 Potential Cumulative Impacts of the Proposed Action

Potential cumulative impacts to EFH and EFH-managed species are grouped by resource area. The potential impacts that are most likely to be cumulatively significant to EFH and EFH-managed species are related to water quality and benthic disturbance.

7.1.5.1 Water Quality

During construction, surface water quality would primarily be affected by turbidity caused by pipeline installation as part of the Broadwater Project. Turbidity modeling has demonstrated these impacts would dissipate within approximately 12 hours of construction activities. The primary impacts to water quality during operation of the Broadwater Project would be associated with water intakes and discharges. These intakes and discharges would comply with the recommended mitigation measures in this EIS and SPDES requirements but would continue throughout the life of the proposed Project.

The Islander East Pipeline Project has the potential to adversely affect water quality as a result of sediment resuspension and turbidity during pipeline installation; no impacts to water quality are expected during operation of the Islander East Pipeline. Operation of the proposed EPA dredged material disposal sites potentially affect water quality in the Project area; however, these impacts are expected to be localized (EPA 2004).

Elements of the proposed Broadwater Project, the Islander East Pipeline Project, and the dredged material disposal sites, with potential to affect water quality would be subject to review and approval under Section 404 of the CWA, as administered by COE; and any adverse impacts to water quality would require appropriate mitigation. Further, discharges to surface waters associated with operation of any of these projects would require review, approval, and mitigation (if necessary) under New York's SPDES program.

7.1.5.2 Water Temperature

Water temperature would be affected during the operation of the Project, but on a very limited basis, as described below. The pipeline would be coated with 3 inches of concrete except along the descent through the mooring tower. Natural gas is expected to enter the pipeline roughly between 100°F and 130°F at the top of the mooring tower and to fall to a temperature between 100°F and 120°F at the bottom of the mooring tower, at the sediment surface. The heat loss experienced in the pipeline from the surface to the seafloor would be transferred to the surrounding water column. Based on the volume of water flowing by the pipeline, any increases in temperature would be readily dissipated in the water column with no significant thermal plume expected. In the winter, the temperature differential between the pipeline and the surrounding water column could reach 80° to 90°F. The remainder of the pipeline would be coated with 3 inches of concrete and installed to a depth of 3 feet below the sediment surface, or otherwise protected with armor rock or concrete mats. The transmission of higher temperature gas through the pipeline could result in some minimal temperature transfer into the surrounding sediments, but the impact would be highly localized and not result in significant impacts on marine or benthic habitat. Increased sediment temperature associated with the heated gas flowing through the pipeline would be largely restricted to within the disturbed trench line.

Broadwater estimates that the discharged cooling water (about 43,333 gpm) from the steam-powered LNG carrier would be 3.6°F higher than ambient water temperatures. Based on the current available information, the discharge of cooling water from LNG carriers is not expected to exceed New York's water quality criteria for thermal discharges into estuaries.

Other sources of thermal impacts to Long Island Sound include KeySpan's power generation facilities at Northport, Port Jefferson, Ravenswood, as well as the nuclear power facility known as Millstone in Connecticut. The thermal impacts of the Broadwater Project on EFH when considered cumulatively with other projects are not significant.

7.1.5.3 Water Intake

As described in Section 6.2.2.1, impacts to EFH related to water quality and volume associated with water intakes are considered minor, but long term because they would continue for the life of the proposed Project. Similarly, impingement/entrainment of ichthyoplankton would affect a very small percentage of the standing crop of EFH-managed species of central Long Island Sound, and these losses are not expected to affect the finfish population within Long Island Sound.

Other sources of water intake impacts to Long Island Sound include KeySpan's power generation facilities at Northport facility (Suffolk County, New York) and the Ravenswood Generating Station (Queens County, New York). Daily seawater intake at these facilities is much greater than the proposed Project. For example, the Northport facility is designed to intake approximately 1,867 mgd of cooling water from the Sound (EPA 2004). The water intake impacts of the Broadwater Project would be approximately 1 percent of the volume used by one of these projects, and the Broadwater volume would be returned to the Sound. Thus, cumulative impacts associated with the proposed Project are not significant.

7.1.5.4 Benthic Disturbance

If the Islander East Pipeline were constructed during the same season as the proposed Project, it is possible that benthic and demersal EFH-managed species could be cumulatively affected by physical disturbance and increased levels of turbidity and sedimentation. These impacts largely would be limited to the immediate vicinity of the two projects, and the magnitude of the cumulative impacts would depend on whether construction phases of the two projects occurred concurrently. Benthic habitat disruption would result in mortality of sessile organisms, and mortality and displacement of some mobile invertebrates and fish. Further, seabottom disturbance associated with pipeline trenching and anchor placement could reduce the capacity of the affected area to provide epibenthic and infaunal recruits to a nearby disturbed site or provide adequate habitat to fish relocating from a nearby disturbed area. The overall effect could be greater loss of benthic prey species, EFH, and/or EFH-managed species for a longer period of time than if each project occurred separately. Further, operation of the dredged material disposal sites could affect benthic marine resources within the permitted disposal areas.

Recovery of the benthic communities disturbed by trenching and anchor placement would occur at varying rates dependent on a variety of environmental parameters and the severity of the impact. Previous construction of the Eastchester Expansion Project resulted in unsuccessful backfilling of the trench. Potential future construction of the Islander East Project and the Broadwater Project would incorporate active backfilling of the excavated trench using improved methods, and impacts to the benthic habitat are expected to be short term. Except for the 1385 Cable Project built in 1969, the available information on these completed pipeline and cable projects indicates that the benthic habitat in offshore areas recovers within 1 to 2 years. While each of these projects either has resulted in or could result in disturbance of benthic habitat, we do not believe that a significant cumulative impact to benthic habitat in Long Island Sound would result, based on the expansive softbottom habitat in Long Island Sound, the relatively small size of the individual project footprints (considerably less than 1%), and the geographic and potentially temporal separation of the projects.

7.1.6 Conclusions

We conclude that only the Islander East Pipeline Project has the potential to contribute any significant cumulative impacts to the proposed Project area. Both the proposed Broadwater Project and the Islander East Pipeline Project would be within the same general offshore area. While the actual schedule for construction of the Islander East project is not known, the proposed schedule is 2007. Therefore, construction of the two projects would not overlap unless Islander East was delayed for either 2 or 3 years. Additionally, the type of project, construction methods, and impacts would be similar for the two projects. Each of these projects would result in temporary and minor effects during construction, but each project would be designed to avoid or minimize impacts to water quality, EFH, and EFH-managed species. Mitigation generally leads to the avoidance or minimization of cumulative impacts.

We believe that impacts associated with the proposed Broadwater Project would be relatively minor, and we have included various recommendations in the EIS to further reduce the environmental impacts associated with the Project. We recognize that unanticipated accidents during construction or operation of either the Broadwater or Islander East Pipeline Projects could result in potential undefined impacts. However, a meaningful evaluation of those potential impacts is impossible, as quantification of potential impacts would be speculative at best. Accordingly, we consider project monitoring and mitigation programs to be critical in addressing unanticipated impacts, should they occur.

The environmental impacts associated with the proposed Broadwater Project and the Islander East Pipeline Project would be minimized by careful project routing, utilization of specialized construction techniques to cross sensitive resources, effective vessel scheduling and communication, and appropriate mitigation measures. Consequently, only a small cumulative effect is anticipated when the impacts of the proposed Project are added to past, present, or reasonably foreseeable future projects in the area.

8.0 AVOIDANCE, MINIMIZATION, AND MITIGATION OF IMPACTS

NMFS employs a three-tiered approach to protect resources under their jurisdiction from impact. Primary consideration is given to the total avoidance of impacts to EFH and managed species. When avoidance is not possible, NMFS stresses minimization of impacts to the extent practical. Finally, NMFS requires mitigation for any remaining, unavoidable impacts. We believe that Broadwater's proposed actions along with implementation of the recommendations identified in the EIS, especially those summarized in this document, has appropriately applied this three-step process to avoid and minimize impacts to EFH and managed species associated with the proposed Project, and to mitigate any expected, unavoidable impacts.

Various biological and geophysical surveys have been conducted in the proposed Project area to identify important marine resources in an attempt to avoid and minimize impacts to valuable resources. During the permitting process, Broadwater and FERC have periodically consulted with NMFS and other federal and state resource agencies. This coordination has resulted in various project- and site-specific construction methodologies and mitigation measures to avoid and minimize impacts from construction and operation of the proposed pipeline and FSRU. An overview of the proposed methods to avoid, minimize, and mitigate impacts to EFH from construction and operation of the proposed pipeline and FSRU is presented below.

8.1 GENERAL PROJECT SITING AND DESIGN

As discussed in the alternatives section of this document (Section 3.0), several types of LNG terminals were evaluated as alternatives to the FSRU technology including onshore terminals, nearshore terminals, and SRV terminals. Onshore and nearshore terminals would each result in increased impacts to onshore and nearshore resources including potential impacts to EFH and EFH-managed species relative to FSRU technology in the middle of Long Island Sound. SRV technology would also increase potential impacts to onshore, nearshore, and potentially offshore resources including EFH and EFH-managed species. In accordance with NOAA guidance (2005a), the proposed Project location and general design would avoid nearshore impacts associated with channel dredging, pipeline installation, and water intake and discharge. In addition, the use of an FSRU design would substantially reduce permanent seafloor conversion relative to a GBS design (0.1 acre and 16.9 acres respectively).

Different vaporization techniques were also evaluated including open-loop (ORV) and closed-loop (STV) technology. ORV technology would significantly increase the volume of operational water intakes and corresponding impingement/entrainment as well as significantly increase potential impacts due to thermal discharges. The STV technology was selected by Broadwater, in part, because it minimizes impingement/entrainment impacts by greatly reducing or eliminating the amount of water needed for regasification and other processes. In addition, NOAA (2005a) has determined that closed-loop regasification, such as STV, represents the best available technology to avoid and minimize impacts to sensitive fisheries habitats and resources.

The pipeline route was selected to avoid impacts to nearshore habitats and resources including avoidance of wetlands, shellfish beds, and eelgrass beds. Impacts to EFH and EFH-managed species have been limited by siting the proposed Project in the offshore waters of the Sound on softbottom habitat away from nearshore spawning and nursery areas, or heavily contaminated sediments. In addition, the proposed pipeline route avoids threatened and endangered species, areas of critical habitat, and live hard-bottom substrates. The proposed pipeline route would likely require no dredging (if dredging were subsequently determined to be necessary, an approved contingency plan would be required to minimize potential impacts), and the pipeline would tie in with the existing pipeline infrastructure so as to minimize new construction (as recommended in NOAA 2005a).

8.2 CONSTRUCTION

8.2.1 Trenching

Several trenching methods were evaluated including subsea plow, subsea jet sled, and pre-lay dredge (Section 3.0). Relative to the alternative methods, the proposed use of a subsea plow would reduce the extent and duration of turbidity and/or sedimentation. The subsea plow would also reduce the extent of the benthic EFH impacted by construction by approximately 50 percent relative to the pre-lay dredge (197 and 395 acres respectively).

The subsea plow has also been identified by NYSDEC as the preferred installation method. In addition, NOAA recommends the use of a subsea plow because it would greatly reduce collateral damage to the seafloor and habitat recovery time (NOAA 2005a). The slow speed, narrow spoil area, and limited turbidity and sedimentation of the subsea plow also aid in limiting impacts.

8.2.2 Other Measures

Other measures that Broadwater would employ during construction of the proposed Project to avoid and minimize impacts include the following:

- Construction activities in Long Island Sound would be limited to the fall through early spring period to avoid the peak spawning period of most fish species including most EFH-managed species;
- Water quality monitoring would be conducted during construction using optical backscatter techniques, acoustic doppler current profiling, and TSS grab sampling
- Backfilling of trenched areas with clean imported material in the vicinity of the FSRU, IGTS tie-in, and utility crossings as approved by COE; and
- Mid-line buoys would be used on all quarter anchor lines.

In addition, we have recommended that

- Broadwater use mid-line buoys on all anchor lines of all construction vessels including the lay barge (or use a dynamically positioned lay barge), which would virtually eliminate impacts from anchor cable sweep and reduce the impacts to benthic EFH by over 90 percent;
- Broadwater mechanically backfill the remaining trench immediately following pipeline installation and conduct post-construction monitoring instead or relying on natural backfilling in order to avoid the persistence of an open trench that could impede migration and movements, and minimize the recovery period of the benthic community;
- Broadwater coordinate with NMFS to identify noise thresholds that are protective of marine resources, especially marine mammals;
- Broadwater develop and implement a project-specific offshore SPCC Plan.

8.2.3 Project Operations

In addition to the operational measures identified above as part of the general siting and design discussion in Section 8.1, Broadwater has proposed to limit potential impacts to EFH and EFH-managed species by:

- Avoiding the application of anti-fouling paint during operations;
- Manually cleaning the FSRU hull and intake screens;
- Adhering to a project-specific SPCC Plan (as recommended by FERC);
- Implementation of emergency response designs, plans, and procedures developed in concert with FERC, the U.S. Coast Guard, and the U.S. Department of Homeland Security;

- Implementing best available technology to reduce impingement/entrainment associated with water intakes including a mid-depth position of the water intakes in the water column, limiting intake flow velocities to 0.5 foot per second, and utilizing preventative barriers with the smallest being a 0.2-inch mesh screen;
- Limiting sodium hypochlorite concentrations to the minimum effective concentration; and
- Monitoring water discharges in accordance with SPDES Permits.

9.0 CONCLUSIONS

The proposed Project siting, design, and construction and operation methods have been developed to avoid and minimize impacts to EFH and other important resources. Any unavoidable impacts would be mitigated through implementation of compensatory mitigation developed by Broadwater and the appropriate regulatory agencies. Compliance with all applicable environmental permits and recommendations would ensure that potential impacts are minimized or avoided.

9.1 SUMMARY OF IMPACTS

Essential fish habitat and the managed species that utilize these areas occur throughout the proposed Project area.

Impacts to managed species during construction would be minimal and largely temporary. Construction would initially impact approximately 215.5 acres of benthic habitat. It is expected that most juvenile and adult EFH-managed species would avoid active construction areas. Displacement of species would be minor, as species would rapidly re-colonize these areas following construction. For early lifestages of some EFH-managed species, there could be constraints on their ability to avoid construction impacts, but most EFH-managed species and lifestages are mobile and could seek shelter or shed the limited amount of expected sediment deposition.

Turbidity and sedimentation may result in fish egg and larval mortality, and decreased feeding in juvenile and adult fish. Results of the sediment transport modeling showed that the highest TSS concentrations would occur near the bottom during active plowing, with virtually no elevated TSS or sedimentation greater than 0.2 inches beyond the 75 foot construction corridor. The model results also indicated that any project-related TSS concentrations would be assimilated into Long Island Sound within about 12 hours of when the sediments were suspended during construction. Therefore, no impacts would occur to the large majority of EFH in Long Island Sound as a result of turbidity and sedimentation.

EFH-managed species could be affected by acoustical disturbances associated with pile-driving used during installation of the proposed YMS. Although the effects of pile-driving on fisheries resources are not fully understood, intense sound pressure waves are known to alter fish behavior or injure/kill fish by rupturing swim bladders or causing internal hemorrhaging (NOAA 2003). Fish tolerance to sound waves depends on peak sound pressure and frequency. According to Broadwater, either a vibratory hammer or a conventional pile-driver would be used to install the four legs of the YMS into the seafloor. According to Hastings (2002), sound pressure levels below 190 dB will not harm fish. NMFS has established a threshold of 180 dB for physical harm to fish for other projects (NOAA 2004a, 2004b). Broadwater has reported that preliminary noise estimates indicate that impulse noise levels may be as high as 180 dB at up to 1 mile or more from the activities. Broadwater has proposed to identify mitigation measures to reduce potential noise impacts pending the results of geotechnical surveys, and we have recommended that Broadwater coordinate with NMFS to identify appropriate measures to avoid and minimize potential impacts of underwater noise on biological resources including fish and marine mammals. Juvenile and adult finfish are highly mobile and are expected to avoid the proposed YMS construction area. It is anticipated that impacts to finfish communities would largely be limited to younger, less mobile lifestages (eggs and larvae); and pile-driving activities are proposed to occur in the fall, when egg and larval densities would be relatively low. With implementation of our recommendation, any impacts of noise to fisheries resources during construction of the YMS would be minor and temporary.

Installation of the YMS would result in the permanent conversion of less than 0.1 acre of softbottom habitat to hard structure. However, conversion of the habitat from soft to hard surface could benefit some EFH-managed species such as pollock and scup. Other construction-related impacts could include hydrostatic testing and the use of anti-fouling paint. However, these one-time events would be conducted in accordance with SPDES permit requirements and FERC requirements, and would not result any impacts would be highly localized, and any minor impacts would be temporary.

Impacts to benthic habitat would total less than 0.1 percent of the benthic habitat of Long Island Sound, and turbidity modeling results indicate turbidity would temporarily impact less than 1 percent of the acreage of Long Island Sound. Therefore, displaced species would not be habitat limited, and lethal impacts to young lifestages and non-mobile species would be localized and negligible on a population level.

During operations, it is conservatively estimated that approximately 3.5 million eggs and 5.3 million larvae of EFH-managed species would be impinged/entrained annually due to the proposed Project. These losses would compose less than 0.1 percent of the standing crop of the central basin of Long Island Sound based on average ichthyoplankton density and the volume of the central basin. Actual losses would be expected to be substantially less with implementation of the standard mitigation measures designed to minimize potential impacts to ichthyoplankton including mid-depth position of water intakes, reduced water velocity into water intakes, and fine mesh screens on water intakes. While these losses would continue for the life of the proposed Project, they would constitute a negligible impact to the EFH-managed populations within Long Island Sound.

Impacts could occur from fuel spills. However, it is not possible to quantify these impacts. Since, the LNG loading system would direct any LNG spills that may occur overboard, the majority of LNG from a spill would quickly disperse and vaporize on the sea surface. In addition, we have included a recommendation in Section 3.2.2.1 of the EIS that Broadwater provide an offshore-specific SPCC Plan for construction activities to minimize impacts. Additional information regarding spills can be found in Section 3.10 of the EIS.

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