4.0 ALTERNATIVES

In accordance with NEPA and FERC policy, we have evaluated a range of alternatives to the Broadwater LNG Project, as well as alternatives for design and construction of the Project. The purpose of this evaluation was to determine whether or not there are reasonable alternatives that would be result in less environmental impact than the Project as proposed. The proposed action before FERC is to consider issuing to Broadwater a Section 3 authorization for an LNG import facility and a Section 7 Certificate for a new natural gas pipeline.

The Commission has three possible courses of action in processing an application for a project such as that proposed by Broadwater. The Commission may (1) authorize the proposal with or without conditions, (2) deny the proposal, or (3) postpone action pending further study. Alternatives for the FERC action that are addressed in this section include the No-action or Postponed-action Alternatives, alternative energy sources, system alternatives, alternative LNG terminal concepts and sites, onshore facility alternatives, alternative pipeline routes, pipeline installation alternatives, and alternative LNG vaporization methods. We identified potential alternatives based on public comments and input from federal, state, and local regulatory agencies.

Alternatives were evaluated against the stated purpose and need of the Project, as described in Section 1.1. The purpose of the Project is to establish an LNG marine terminal capable of receiving imported LNG from LNG carriers, and storing and regasifying the LNG at an average sendout rate of 1.0 bcfd. The terminal would provide a new source of reliable, long-term, and competitively priced natural gas to the Long Island, New York City, and Connecticut markets by connecting to the existing natural gas pipeline system.

We established several key criteria to evaluate the potential alternatives identified. Each alternative was evaluated in consideration of whether or not it would:

- Be technically and economically feasible and practical;
- Offer significant environmental advantage over the proposed Project or its components; and
- Meet the objectives of the proposed Project, as described above.

With respect to the first criterion, it is important to recognize that not all conceivable alternatives are technically and economically feasible and practical. For example, some alternatives may not be feasible because the technology may not be available at the time or it may not be possible to implement the alternative due to costs, technological difficulties, or logistics. It is also important to consider the environmental advantages and disadvantages of the proposed action and to focus the analysis on alternatives that may reduce impacts. Further, because the total proposed Project would consist of individual components (such as the LNG terminal and the subsea pipeline), all of these components must be present and must function together for the alternative to be considered feasible.

Information used to evaluate alternatives to the proposed Project included published studies, comments and suggestions from regulatory agencies, analyses prepared for similar projects, comments from the public, and data and analyses provided by Broadwater in its application.

Each alternative was considered until it was clear that the alternative was not reasonable or that the alternative would result in environmental impacts that would be greater than those of the proposed Project - as described in Section 3.0 - and that could not be readily mitigated. This assessment included consideration of using existing or proposed LNG projects and siting the Project in a different area.

The evaluation of alternatives is presented in the following sections:

- No-action or Postponed-action Alternatives (Section 4.1)
- Alternative Energy Sources (Section 4.2)
- System Alternatives (Section 4.3)
- Alternative LNG Terminal Designs and Locations (Section 4.4)
- Pipeline Route Alternatives (Section 4.5)
- Pipeline Construction Alternatives (Section 4.6)
- Alternative Vaporization Methods (Section 4.7)
- Alternative Onshore Facilities Locations (Section 4.8)

Section 4.9 presents a summary of conclusions for the alternatives evaluated.

A regional siting plan recently has been advocated as a more desirable approach to siting LNG facilities. If a regional siting study is completed during our assessment of the proposed Broadwater LNG Project, we will take the conclusions into consideration. However, we do not believe that a regional siting study needs to be concluded prior to conducting the site-specific review of the Project. Rather, FERC's responsibility is to review applications as they are filed. Section 313(c) of the Energy Policy Act of 1992 (EPAct) also directs FERC to establish a schedule for the regulatory review that ensures an "expeditious completion" of the proceeding. Our NEPA scoping process has provided input from the public and regionally-based federal, state, and local agencies. This input has been fully considered in the following alternatives. Ultimately, FERC will continue to seek better ways to balance national, regional, state, and local concerns in siting LNG import facilities.

In addition, the Coast Guard has evaluated alternatives associated with its action. The proposed action before the Coast Guard is to consider whether or not to issue Broadwater a Letter of Recommendation that finds the waterways suitable for LNG marine traffic. Alternatives considered by the Coast Guard consisted of the following:

- Issuing a Letter of Recommendation finding that the waterway is suitable without the implementation of additional measures;
- Issuing a Letter of Recommendation finding that the waterway is unsuitable (No-action Alternative); and
- Issuing a Letter of Recommendation finding that to make the waterway suitable, additional measures are necessary to responsibly manage risks to navigation safety or maritime security associated with LNG marine traffic.

Issuing a Letter of Recommendation finding the waterways to be suitable for the Project would allow construction of the Project if Broadwater receives FERC authorization and other required permits and approvals. This would result in meeting the energy needs of the target market for the Project. A determination that the waterways are suitable could be rendered with or without additional measures. Based on the findings of the WSR, the Coast Guard determined that additional measures would be required to make the waterways suitable for the Project. Therefore, the alternative of issuing a Letter of Recommendation finding the waterways suitable for LNG marine traffic without additional measures is not considered reasonable and was not addressed further.

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A reasonable alternative for the Coast Guard would be to issue a Letter of Recommendation that finds the waterways unsuitable for LNG marine traffic. With this alternative, the waterways would continue to be used as it is currently and the environmental impacts associated with issuance of a Letter of Recommendation with specific conditions would be avoided. However, the purpose and need of the Project would not be met and the region's increasing energy demands would not be met.

4.1 NO-ACTION OR POSTPONED-ACTION ALTERNATIVES

As previously described in Section 1.1, projected natural gas demands in the region are expected to exceed the currently available supply. Broadwater believes that an additional supply of natural gas is necessary to satisfy the increasing demand for natural gas in the region and that the additional supply provided by the Project would help meet the region's growing energy demands, enhance reliability, and provide a needed diversification of supply.

If the Commission denies the proposal, the short- and long-term environmental impacts identified in this EIS would not occur. If the Commission postpones action on the application, the environmental impacts would be delayed; or – if the applicant decided not to pursue the Project, the impacts would not occur at all. If the Commission selects the No-action Alternative, Broadwater would not be able to provide a new source of natural gas to the region and the objectives of the Project would not be met.

Although it would be purely speculative and beyond the scope of this analysis to attempt to predict what actions might be taken by policymakers or end users in response to the No-action or Postponed-action Alternative, it is likely that potential end users would (1) make other arrangements to obtain natural gas, such as non-LNG derived natural gas or LNG-derived gas from another project; (2) use alternative fossil-fuel energy sources (such as fuel oil or coal) and other traditional long-term fuel source alternatives (such as nuclear power or hydroelectric power); and/or (3) use renewable energy sources, such as wind power. It is also possible that energy conservation practices could be used to offset the demand for natural gas in markets that would be supplied by the proposed Project.

Each of these alternative approaches to meeting the energy needs of the region would result in some level of environmental impacts. Considered individually, specific energy alternatives or conservation measures would not provide the projected energy needs of the regional markets. As part of our analysis, we also have evaluated whether or not these alternatives could provide the needed energy when considered together. Issues associated with the use of alternative sources of energy and conservation are addressed in Section 4.2, and issues associated with the use of existing or proposed natural gas facilities to meet the objectives of the proposed Project are addressed in Section 4.3.

4.2 ALTERNATIVE ENERGY SOURCES

The following four alternative means of accomplishing the purpose of the Project were evaluated and are addressed below: use of other non-renewable fuels (Section 4.2.1), renewable energy sources (Section 4.2.2), energy conservation (Section 4.2.3), and renewable energy combined with energy conservation (Section 4.2.4).

4.2.1 Other Non-renewable Fuels

Based on our assessment of natural gas demand and supply in the target market (presented in Section 1.1), the area likely would experience a shortage of natural gas for power generation if the Broadwater Project, or a similar new-source project, is not implemented. These shortages could in turn lead to an increased reliance on fuel oil and other non-renewable fuel supply sources for power generating facilities. EIA (2005) reported that, between 2002 and 2025, petroleum product consumption is likely to increase at a rate similar to that of natural gas; therefore, fuel oil likely would not provide a readily available or cost-effective alternative to natural gas. Further, natural gas is the cleanest burning of the fossil fuels, and reliance on coal or oil to fuel power generation for the region may result in an increased output of air pollutants such as NO_x, SO_2, mercury, and greenhouse gases (EIA 2005). Increased emissions of these pollutants would decrease air quality in the region. In addition, like natural gas, secondary impacts are associated with production (coal mining and oil exploration and drilling), transportation (oil tankers, rail cars, and pipelines), and processing of other fossil fuels.

Another traditional non-renewable fuel source alternative to natural gas for electric generation is nuclear power. The Shoreham Nuclear Power Plant was constructed in 1983 to help to meet the growing energy demands of Long Island. As a result of overwhelming public opposition and safety concerns, however, the Shoreham facility was decommissioned in 1985 without generating any electricity (New York State Office of State Comptroller 1996). Regulatory requirements and public concerns make it unlikely that another nuclear power plant would be sited on Long Island in the foreseeable future. Consequently, the use of nuclear power, while not impossible, does not appear to be a practical alternative.

Millstone Nuclear Station was constructed by Northeast Utilities in 1970 on a 500-acre former quarry site in Waterford, Connecticut. Northeast Utilities sold the facility to Dominion Generation in 2001. The Millstone Nuclear Station currently meets approximately 50 percent of Connecticut's electricity demand (EIA 2004). However, regulatory requirements and public concerns suggest that approval of another nuclear power plant in Connecticut is also unlikely. If a nuclear plant were constructed in Connecticut, meeting the energy needs of Long Island and New York City also would require a cross-Sound electrical cable with associated environmental impacts.

4.2.2 Renewable Energy Sources

Nationwide, renewable energy sources have included wind, solar, tidal, and hydroelectric power; geothermal sources; and energy or fuel from municipal solid wastes, wood, and other biomass. Although new geothermal and traditional hydroelectric power projects are unlikely to be permitted and constructed in the region, other forms of renewable energy sources are likely to play an increasing role in meeting energy demands within the region in the coming years. Regional entities, including the States of New York and Connecticut, as well as some municipalities within the region, have adopted goals and incentives for increased energy conservation and the use of renewable energy sources. These programs include New York State's Renewable Power Procurement Policy and Renewables Portfolio Standard, and LIPA's Solar Pioneer Program (DSIRE 2006); and Connecticut's Renewables Portfolio Standard and Clean Energy Options (CSC 2004).

Several renewable energy projects have been proposed for the region. Verdant Power's proposed Roosevelt Island Tidal Energy Project, which was scheduled to begin construction in June 2006 but is currently delayed, would generate approximately 10 MW of electricity for New York City customers from a field of 390 turbines to be constructed in the East Channel of the East River in New York City (Verdant Power 2005).

In August and September 2006, three applications for preliminary permits to construct and operate underwater turbines to generate tidal energy from the currents in eastern Long Island Sound were submitted to FERC. Orient Point Tidal Energy, Inc., a Verdant Power subsidiary, is proposing the Orient Point Tidal Energy Project in Plum Gut. This project would have the potential of providing up to 124 MW of electric power. Natural Currents Energy Services, LLC is proposing the Long Island Tidal Energy Project in the same general area as the Orient Point project. The Long Island Tidal Energy Project would have the capacity to generate 250 MW if fully developed. Fisher Island Tidal Energy, Inc.

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(also a subsidiary of Verdant Power) is proposing the Fisher Island Tidal Energy Project in the Race, which is also in the same general area as the previous two projects. The Fisher Island project would have the capacity to provide from 93 to 450 MW of power.

These projects would consist of a series of "free-flow" hydro turbines located at least 30 feet below the surface of the water and would generate power from tidal currents. Cables from the undersea portions of the projects could extend into New York, Connecticut, or Rhode Island. Studies are either planned or in progress to evaluate the effects of the projects on marine resources, particularly fish. It is not clear whether or not all the projects could be approved, constructed, and operated, or if the full capacity of each project could be reached. If all projects were implemented at full capacity, they would provide the region with up to about 824 MW of additional power.

Two wind energy projects have been proposed in the Long Island area: one that would be located 2.5 miles east of Orient Point was proposed by Winergy Power LLC, and another would be located off Jones Beach on the South Shore of Long Island. The application for the latter project was jointly filed with the COE by LIPA and FPL Energy; the proposal seeks authorization to install a 140-MW offshore wind energy park (LIPA 2005b). The project is currently under review by the COE. Winergy Power LLC proposed installing a pilot wind farm that would consist of three 445-foot wind turbines.

The upstate New York area has various wind energy projects in operation. Two new projects are currently under construction in that area and will be capable of adding up to 130 MW of power to the grid when in operation. In addition, there are 10 proposals for new wind energy projects in the same general area that are under various stages of review. If all of the projects are implemented as proposed, about 1,280 MW would be added to the grid at the maximum generating capacity. There is also one 50-MW project in the planning and siting stage in Connecticut (near Sterling). Once the power from these projects is added to the electrical transmission system, it would be available to consumers throughout the general area. This may include consumers in New York City, Long Island, and Connecticut, dependent on the limitations of the transmission system and its operators.

In addition, Tidewalker Associates has proposed to construct the Cutler Tidal Power Project on Cutler Naval Base in Cutler, Maine. This project, which was filed with the FERC Division of Hydropower in April 2006, would involve damming Little Machias Bay and using tidal flow to generate approximately 13.5 MW of electricity. In their application, Tidewalker Associates assert that the project could be expanded in the future to include an LNG terminal that would be constructed on the site of an existing diesel-fired power plant (see Section 4.3.2). In June 2006, Tidewalker Associates proposed a second tidal energy facility (Half Moon Cove Project) that would be located in Perry, Maine. The Half Moon Cove Project, which would require construction of a 1,210-foot-long dam and a power facility, would generate approximately 13.5 MW of power. No LNG terminal is proposed for the Half Moon Cove Project.

Proposed renewable energy projects in New York State, along with existing efforts such as Connecticut's landfill gas generation and fuel cell programs (CSC 2004), would account for only a portion of the energy demand of the region that would be met if the proposed Project is implemented. In addition, although federal, state, and local initiatives promoting renewable energy likely will contribute to an increase in the availability and cost effectiveness of these technologies in the coming years, studies such as NYSERDA's Energy Efficiency and Renewable Energy Resource Development Potential in New York State (NYSERDA 1999) and the Connecticut Clean Energy Fund (CSC 2004) predict that renewable energy sources would offset only a small part of the projected energy demand for the region for the foreseeable future. As a result, use of renewable energy sources would not offset the need for the proposed Project.

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4.2.3 Energy Conservation

Energy conservation measures likely will play an increasingly prominent role in offsetting some of the projected energy demand for the region. Regional entities, including the States of New York and Connecticut and some local municipalities, have adopted goals and incentives for increased energy conservation and the use of renewable energy sources (such as New York State Executive Order 111, New York State Public Service Commission's Renewable Portfolio Standard Program, Connecticut's Renewable Portfolio Standard Program, and Connecticut's Project 100 Initiative 9). NYSERDA (2005) found that programmed energy conservation and increased energy efficiency measures already in place could offset as much as 5 to 6 percent of the projected energy demand of the New York City and Long Island areas by 2022. Similarly, a study commissioned by the Connecticut Energy Conservation Management Board (CSC 2004) found that conservation programs could reduce Connecticut's energy demands by as much as 13 percent by 2012; however, because this estimate does not consider factors such as costs of program implementation and market acceptability, actual reductions in energy demand likely would be much lower.

Although energy conservation measures will be important elements in addressing future energy demands for the region, energy conservation will reduce the energy demands of the region by only a small fraction of the projected energy demand for the region within the foreseeable future. Thus, energy conservation would not replace the need for the Project (see Section 1.1.5.4).

4.2.4 Renewable Energy Combined with Energy Conservation

As noted above, use of either renewable energy sources or energy conservation would individually reduce energy demands in the region by only a small amount. Even when combined, it is clear that they would not meet the projected increase in energy demand for the region. As discussed in Section 1.1.5, the gains achieved collectively through better management, increased efficiency, and renewable energy use could only moderate, not reverse, the projected increases in gas consumption for the region.

4.2.5 Conclusions Regarding Alternative Energy Sources

The alternative energy source alternatives considered in our evaluation could reduce some environmental impacts associated with the proposed Project but could not individually or cumulatively meet the projected future energy needs of the New York City, Connecticut, and Long Island markets. The use of other non-renewable energy sources such as coal or oil would result in greater impacts to air quality, and regulatory requirements and public opposition make the use of nuclear energy in the Project area unlikely. Renewable energy sources, including wind, tidal, and solar power – as well as existing and proposed energy conservation measures, will continue to play an increasingly important role in power generation for the New York City, Connecticut, and Long Island markets; however, these sources represent only a small fraction of the projected energy demands for these markets for the foreseeable future, whether considered alone or in combination. Therefore, we have eliminated the use of alternative sources of energy from further consideration.

4.3 SYSTEM ALTERNATIVES

System alternatives would make use of other existing or proposed LNG or natural gas facilities to meet the stated purpose of the proposed Project. A system alternative would make it unnecessary to construct all or part of the proposed Project, although some modifications or additions to the existing or proposed facilities may be necessary. These modifications or additions would result in environmental impacts that could be less than, similar to, or greater than those associated with the Broadwater Project.

The purpose of identifying and evaluating system alternatives is to determine whether or not potential environmental impacts associated with construction and operation of the proposed facilities could be avoided or reduced while still meeting the Project objectives identified in Section 1.1. We considered two basic types of system alternatives in our analysis:

- Expansion of existing or planned natural gas pipeline systems (Section 4.3.1); and
- Expansion of existing LNG terminals or construction of new LNG terminals to serve the region (Section 4.3.2).

4.3.1 Pipeline System Alternatives

As an alternative to constructing a new LNG import terminal, we considered the feasibility of using or expanding existing pipeline systems (Section 4.3.1.1) and proposed new pipeline systems (Section 4.3.1.2) to meet the projected natural gas needs of the region. Section 4.3.1.3 presents a summary of our analyses regarding the potential use of existing or proposed pipeline systems to meet the purpose and need of the proposed Project.

4.3.1.1 Existing Pipelines

Existing pipelines that currently serve, or could potentially be expanded to serve, the region include the Algonquin Pipeline System (Algonquin), the Texas Eastern Pipeline System (Texas Eastern), the Transcontinental Gas pipeline (Transco), the Columbia Gas Transmission System (Columbia), the Tennessee Pipeline System (Tennessee), and the Iroquois Gas Transmission System (IGTS) pipeline. Key characteristics of each of these systems are presented in Table 4.3-1, and the locations of the pipelines within the region are illustrated in Figure 1.1-1.

Algonquin Pipeline System

Algonquin, a subsidiary of Duke Energy, is an existing open-access interstate pipeline company that transports 1.6 bcfd of natural gas from eastern Pennsylvania to Boston, Massachusetts. It serves the New England market and has interconnections with the Texas Eastern and Maritimes & Northeast Pipeline Systems in northern New Jersey and Beverly, Massachusetts, respectively. If the proposed Islander East Pipeline Project (see Section 4.3.1.2) is constructed as proposed from New Haven, Connecticut across Long Island Sound to Wading River, New York, Algonquin would increase its capacity by approximately 0.3 bcfd. Natural gas transported by Algonquin is derived from reserves in the Gulf Coast region and western Canada, as well as regasified LNG from the Everett LNG terminal in Everett, Massachusetts (see Section 4.3.2.1). If the Weaver's Cove LNG terminal is constructed (see Section 4.3.2.2), it also would supply regasified LNG to Algonquin.

To supply an additional 1.0 bcfd of natural gas to the region, the Algonquin system would require significant modification and expansion. In addition, because Algonquin's operating pressure is only 750 psi, the existing 24-inch pipeline would need to be replaced with larger diameter pipe along much of the route or supplemented with additional pipeline installed adjacent to the existing pipeline, a technique termed "looping." This would require installation of either new (replacement) pipe or looping, backfilling and revegetation along much of the existing route, and maintenance of the ROW for the life of the project. The distance of the existing route along which the construction would occur would be substantially greater than the 22-mile-long proposed subsea pipeline; assuming that a 100-foot-wide construction corridor would be required, each mile of new or looped pipeline construction would disturb at least 12.1 acres of existing land uses that could include forested and non-forested wetlands, wildlife habitat, waterbodies, residences, and recreational land. Additional compression also would be required, either in the form of new compressor stations or increased compression at existing stations. These system

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upgrades would result in environmental impacts that would be greater than those anticipated from implementation of the proposed Project. Further, the objective for providing imported natural gas storage and additional storage facilities could not be met without major modifications and the associated environmental impacts.

TABLE 4.3-1
Existing Pipelines Serving the Region

Pipeline	Pipeline Diameter (inches)	Average Operating Pressure (psi)	Pipeline Capacity (bcfd)	Gas Source	Limitations/Constraints
Algonquin Pipeline System	26/30	750	1.6	Gulf Coast region, western Canada, LNG (Everett)	Larger diameter pipeline and additional compression required.
Texas Eastern Pipeline System	20/24/36	1,100	5.9	Gulf Coast region	Larger diameter pipeline and additional compression required.
Transcontinental Gas Pipeline System	30/36/42	800	8.1	Gulf Coast region, western Pennsylvania and New Jersey storage, LNG (Cove Point)	Larger diameter pipeline and additional compression required.
Columbia Gas Transmission System	10/12	650	3.0	Gulf Coast region, LNG (Cove Point)	Function in region being replaced by Millennium pipeline; see Table 4.3-2.
Tennessee Pipeline System	24/30	800	7.0	Gulf Coast region, western Canada, Appalachia, LNG (Everett)	Larger diameter pipeline and additional compression required. Additional mainline pipeline needed to supply Long Island.
Iroquois Gas Transmission System	24/30	1,440	1.0	Gulf Coast region, western Canada	Larger diameter pipeline and additional compression required.

Texas Eastern Pipeline System

Texas Eastern, also a subsidiary of Duke Energy, connects Texas and the Gulf Coast region with northern New Jersey. The system has a natural gas transport capacity of 5.9 bcfd and a storage capacity of 75.1 bcf of natural gas; it serves markets from Texas to New Jersey. Texas Eastern has an interconnection with the Algonquin pipeline in northern New Jersey.

Texas Eastern currently supplies a large amount of natural gas to the New York City market and offers access to natural gas storage areas in the region. The ability of Texas Eastern to supply additional natural gas to the region is constrained by the fact that the New York City area represents the northern limit of the existing pipeline. Additional natural gas sufficient to meet regional market needs could not be delivered to the region through the Texas Eastern pipeline without increases in pipeline diameter (replacement pipe), looping, new or additional compression, and other system upgrades as described above for the Algonquin system. These system upgrades would result in environmental impacts from construction and operation that would be greater than the impacts that would result from implementation of the proposed Project. Further, the objective for providing imported natural gas storage and additional storage facilities could not be met without major modifications and the associated environmental impacts.

Transcontinental Gas Pipeline System

The Transcontinental Gas Pipeline System (Transco) is part of the Williams Companies and connects Texas and the Gulf Coast region with the mid-Atlantic region. The system has a transport capacity of 8.1 bcfd and a storage capacity of 216 bcf; it serves markets from Texas to New York City. It is the largest provider of natural gas to the New York City market. Gas supplies transported through the system are from the Gulf Coast region, a natural gas storage facility in western Pennsylvania, and the Cove Point LNG terminal in Cove Point, Maryland. Transco also is connected to a 2.0-bcf LNG storage facility in Carlstadt, New Jersey. Transco's proposed Leidy-to-Long Island Expansion Project (see Section 4.3.1.2) would increase throughput from the storage facility in western Pennsylvania by 0.1 bcfd. In addition, Transco's planned Sentinel Expansion Project would provide up to 0.3 bcfd of additional gas transportation capacity through Transco's pipeline facilities in Maryland, Pennsylvania, New Jersey, and New York.

Because the New York City, Long Island, and Connecticut region is near the terminus of the Transco system, Transco is constrained in its ability to supply additional natural gas to the region without major upgrades in the system along much of the existing route. These system upgrades and the associated environmental effects would be similar to those described for Algonquin and would be greater than those of the proposed Project. Further, the objective for providing imported natural gas storage and additional storage facilities could not be met without major modifications and the associated environmental impacts.

Columbia Gas Transmission System

Columbia, a subsidiary of NiSource, Inc., transports natural gas in the Midwest and mid-Atlantic regions. In total, Columbia has a natural gas transport capacity of 3 bcfd and a storage capacity of 600 bcf. An additional 0.1 bcf of storage is planned as part of Columbia's Eastern Market Expansion Project. Within New York State, much of the Columbia system would be upgraded and replaced by the Millennium Pipeline Project (see Section 4.3.1.2). There are two sources of gas for the Columbia system: the Gulf Coast region (through the Columbia Gulf Transmission System) and regasified LNG from the Cove Point LNG terminal in Maryland. Consideration of Columbia as a system alternative is addressed under the MarketAccess Project in Section 4.3.1.3.

Tennessee Pipeline System

Tennessee, a unit of the El Paso Corporation, extends from the Mexican border to Canada, including facilities in the mid-Atlantic and New England regions. It provides gas to New York City and other major cities, including Boston and Chicago. Tennessee currently has a natural gas transport capacity of 7.0 bcfd. It recently announced expansion plans that could increase the transport capacity by an additional 0.2 bcfd (see Section 4.3.1.2). Gas for the system comes from supplies in the Gulf of Mexico, Appalachia, and Canada, and from the Everett LNG terminal in Everett, Massachusetts.

Like Algonquin, the existing Tennessee system operates at a low pressure. Construction of larger diameter replacement pipe or looping and additional compression would be required to meet the purpose of the Project. A substantial amount of additional mainline pipe also would need to be installed to provide access to the Long Island market. These upgrades would be similar to those described for Algonquin and would result in environmental impacts that would be greater than those anticipated for the Broadwater Project. Further, the objective for providing imported natural gas storage and additional storage facilities could not be met without major modifications and the associated environmental impacts.

Iroquois Gas Transmission System

IGTS is owned by a group of affiliates of five U.S. energy companies and affiliates of TransCanada, the parent company of one of the owners of Broadwater. The system extends from a connection with the TransCanada Pipeline System in Waddington, New York to Devon, Connecticut, where it crosses Long Island Sound to Northport, New York and then extends into the Bronx. IGTS has a natural gas transport capacity of 1.0 bcfd and serves markets in Connecticut and New York State. IGTS also has interconnections with the Dominion, Tennessee, and Algonquin systems. Gas transported by IGTS is supplied from the Gulf Coast region through a connection with Texas Eastern and from western Canadian reserves through its connection with the TransCanada Pipeline System. If the MarketAccess Project is constructed (see Section 4.3.1.2), IGTS also would transport approximately 0.1 bcfd of natural gas from storage facilities in western Pennsylvania. IGTS also has proposed the Brookhaven Lateral, a project currently in the FERC pre-filing review process. If constructed, the Brookhaven Lateral could provide an additional 0.05 bcfd of natural gas to the Long Island market through a new 21-mile-long, 24-inch-diameter pipeline from Smithtown to a proposed 350-MW power plant in Brookhaven. The Brookhaven lateral is scheduled to be in service in April 2009.

IGTS is constrained in its ability to supply the additional gas required to meet the projected increase in demand for natural gas in New York City and on Long Island. Long Island and New York City are near the terminus of the IGTS system, and delivery of that volume of gas would require substantial pipeline system upgrades if additional gas is to be provided upstream of Long Island Sound. Further, because natural gas transported by the IGTS pipeline is supplied through interconnections with other interstate pipelines, such as Algonquin and Texas Eastern, increased delivery to the Long Island and New York City area likely would require capacity upgrades of the other systems and could require additional compression along the upstream supply pipelines, resulting in additional environmental impacts.

Although the upgrades likely would be smaller than those required for Algonquin and the other systems described above, the upgrades would include increasing the pipeline capacity across Long Island Sound. This would require construction in both the nearshore and offshore environments. As a result, the environmental impacts of implementation of the upgrades would exceed the anticipated environmental impacts of the Broadwater Project. Further, the objective for providing imported natural gas storage and additional storage facilities could not be met without major modifications and the associated environmental impacts.

4.3.1.2 Proposed Pipeline Projects

Eight new pipeline projects have been proposed within or near the region: the Millennium Pipeline Project, the MarketAccess Project, the Islander East Pipeline Project (Algonquin), two small Tennessee Pipeline projects (the Northeast ConneXion New England Project and the Atlantic Supply Expansion Project), the Leidy to Long Island Pipeline Project (Transco), the Sentinel Expansion Project, and the Dominion Hub Project. The Leidy to Long Island Pipeline Project was issued a certificate from FERC on May 18, 2006. Key characteristics for each of these systems are listed in Table 4.3-2, and locations of the proposed pipelines are illustrated in Figure 4.3-1. We have assessed the use of these projects as system alternatives, as described below.

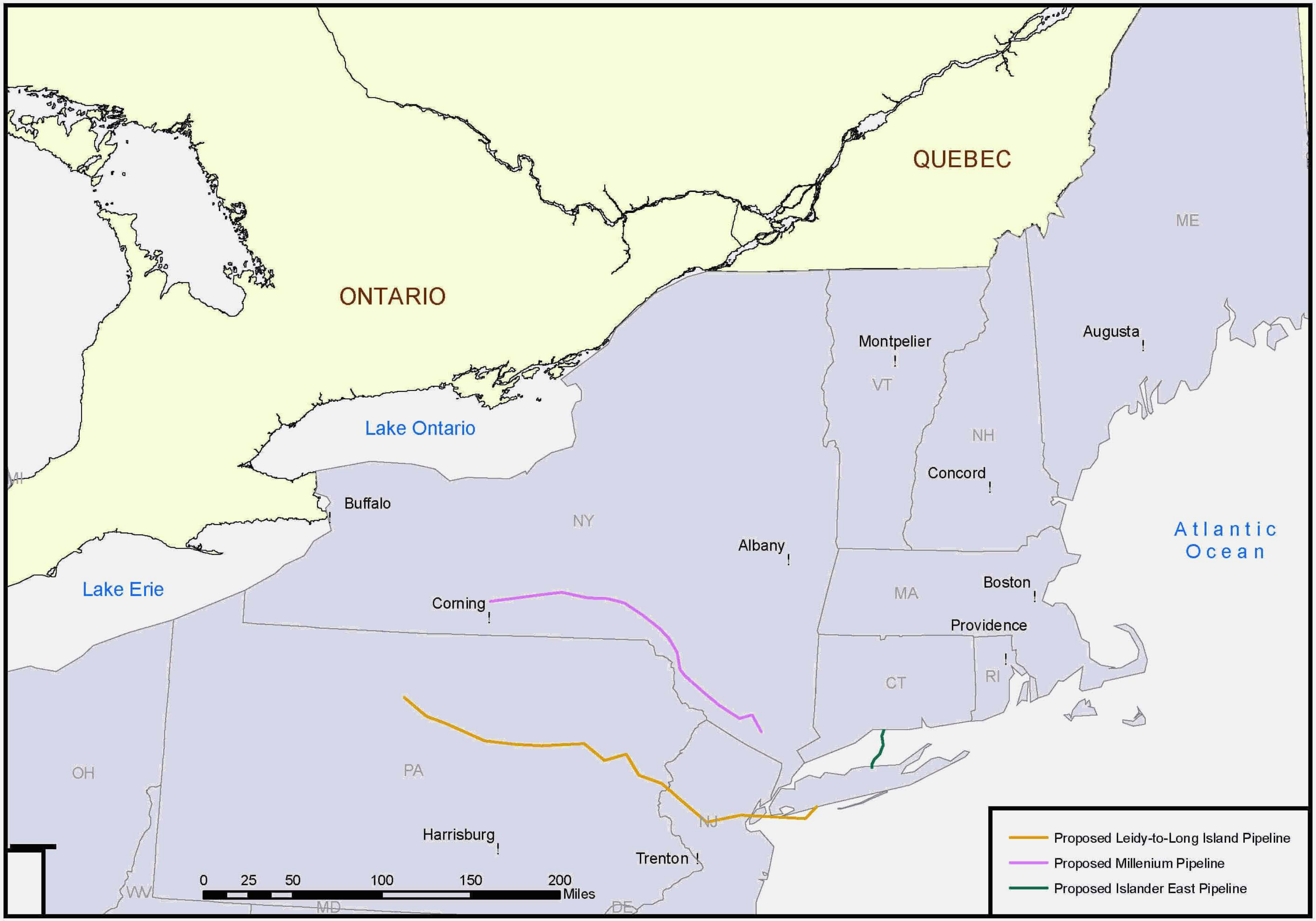

Figure 4.3-1
Broadwater LNG Project
Other Proposed Natural Gas Transmission Pipelines

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TABLE 4.3-2 Proposed Pipeline Projects in or near the Region				
Project	**Pipeline Diameter (inches)**	**Pipeline Length (miles)**	**Pipeline Capacity (bcfd)**	**Limitations**
Millennium Pipeline Project	36	186	0.5	Not connected to the region as currently approved (Phase I) but could supply 0.1 bcfd of gas to the region if MarketAccess is approved.
MarketAccess Project [a]	0[a]	0[a]	0[a]	Would provide 0.1 bcfd of gas to the region.
Islander East Pipeline Project	24	50	0.3	Insufficient capacity to transport the projected natural gas demands for the New York City, Long Island, and CT market without pipeline expansion and additional compression.
Tennessee Pipeline projects [b]	N/A	N/A	0.4	Insufficient capacity to transport required volumes of gas to the region.
Leidy to Long Island Pipeline Project	26	0[c]	0.1	Insufficient capacity to transport required volumes of gas to the region.
Sentinel Expansion Project	N/A	N/A	0.2 to 0.3	Insufficient capacity to transport required volumes of gas to the region.
Dominion Hub Project	N/A	N/A	0.3	Insufficient capacity to transport required volumes of gas to the region.

N/A = Information not available.

[a] The MarketAccess Project is not a new pipeline but rather a proposal to provide 0.1 bcfd from the proposed but not yet constructed Millennium (Phase I) Pipeline to the region via interconnections with existing Algonquin, IGTS, and Con Edison pipeline facilities. It is considered a portion of the Northeast – 07 Project, along with the Millennium Pipeline Project.

[b] Includes Northeast ConneXion New England and Atlantic Supply Expansion Projects.

[d] FERC approval granted on May 18, 2006.

Millennium Pipeline Project

The planned Millennium Pipeline Project, approved by FERC in September 2002, would have extended approximately 374 miles from Lake Erie to the Westchester/Bronx County line in Mount Vernon, New York. An interconnection with the TransCanada Pipeline System (via the proposed Empire Connector Pipeline Project) would transport gas obtained from reserves in western Canada. Initially, the project was planned to be constructed in two phases. Phase I would consist of 186 miles of pipeline from Corning, New York to Ramapo, New York that would replace and upgrade the existing Columbia pipeline in that area. Phase I of the Millennium Pipeline is now proposed as part of a larger pipeline improvement project called Northeast-07, which also includes the Columbia A-5 Replacement Project, the Ramapo Expansion Project, the Empire Connector Project, and the MarketAccess Project. Millennium Phase I would terminate in Ramapo, New York, would transport approximately 0.5 bcfd of natural gas, and would serve markets in New York State that are substantially north of the target market area for the proposed Broadwater Project.

A second phase was planned that would have connected the Phase I pipeline to the New York City metropolitan market. Phase I of the project has been certificated, and all permits have been issued.

However, the application for Phase II was denied by NYSDOS; and the decision was upheld in the U.S. District Court for the District of Columbia on April 3, 2006. Based on this ruling, we find it unlikely that Phase II of the Millennium pipeline would be constructed. Additional transportation capacity would be needed to supply gas from the Millennium pipeline to the target region of the Broadwater Project. This would essentially require a doubling the of Millennium pipeline Phase I project, which could result in more than 4,500 acres of land use impacts such as those listed above for the Algonquin system.

If the proposed MarketAccess Project is constructed (see below), it would provide approximately 0.1 bcfd of natural gas from the Millennium pipeline to the New York City area via a program of compressor station upgrades and interconnections with existing interstate pipelines.

MarketAccess Project

In a partnership with Algonquin, Con Edison, and Millennium, IGTS is proposing to construct the MarketAccess Project in the Town of Brookfield in Fairfield County, Connecticut and the Town of Dover in Duchess County, New York. The MarketAccess Project would require construction of a new compressor station and natural gas cooling facilities in Brookfield, and installation of cooling facilities at an existing IGTS compressor station in Dover. If approved and constructed, the MarketAccess Project would supply approximately 0.1 bcfd of natural gas to the New York City area from the Millennium and Algonquin pipelines. All of this gas would be delivered to Con Edison at its Hunt's Point Facility.

The MarketAccess Project is not a pipeline expansion project but a portion of the Northeast-07 Project that is designed to link several pipeline facility upgrades together to provide 0.1 bcfd of natural gas to electric generation facilities in the New York City market. Modification of the MarketAccess Project to supply additional volumes of natural gas to supply the Long Island and Connecticut markets could not be accomplished without looping much of the proposed Millennium and/or Algonquin pipeline routes, resulting in environmental impacts far in excess of those of the proposed Project. In addition, this project would not meet the Broadwater Project objectives of providing a source of imported natural gas and additional natural gas storage facilities.

Islander East Pipeline Project

The Islander East Pipeline Project, which would be owned by subsidiaries of Duke Energy and KeySpan, was conditionally approved by FERC in August 2002 and is waiting for issuance of permits and final FERC approval to begin construction. The project would transport western Canadian gas obtained from Algonquin. Islander East would include approximately 50.4 miles of new 24-inch-diameter pipeline extending from North Haven, Connecticut across Long Island Sound to Wading River, New York. The project would include increasing the pressure in approximately 27 miles of 10- and 16-inch-diameter pipeline in the existing Algonquin system from 750 to 814 psig through use of a new 12,028-horsepower compressor station. Construction of Islander East would add approximately 0.3 bcfd of natural gas capacity to the Algonquin system (see Section 4.3.1.1) and would extend the Algonquin service area to Long Island. Natural gas from this system is fully subscribed and would be purchased by KeySpan Energy Long Island, KeySpan Energy New York, and American National Power (Duke Energy 2006).

Construction of the Islander East Pipeline has been delayed for several years because the State of Connecticut has denied issuance of a water quality certificate for the project. On October 5, 2006, the U.S. Second Circuit Court of Appeals ruled that the State of Connecticut did not sufficiently support its decision to deny a water quality certificate to the Islander East Pipeline Company, LLC, and that reconsideration of the application must be completed within 75 days of the date of the ruling, that is, by December 19, 2006.

Because the Long Island market is at the terminus of Islander East, providing additional gas to Long Island and New York City through Islander East would require increasing the capacity of both Islander East (replacement pipe or looping across both nearshore and offshore portions of Long Island Sound) and the Algonquin system, as well as increased compression. As described for Algonquin, construction and operation of those upgrades would result in environmental impacts in excess of those associated with the proposed Project. In addition, this project would not meet the Broadwater Project objectives of providing a source of imported natural gas and additional natural gas storage facilities.

Tennessee Pipeline Projects

Two expansion projects are proposed for Tennessee pipeline facilities in the mid-Atlantic region. The Northeast ConneXion New England Project, approved by FERC in May 2006, would add up to 0.1 bcfd of natural gas capacity to the existing Tennessee pipeline by adding compression at existing compressor stations in Pennsylvania, New York, and Massachusetts. The Atlantic Supply Expansion Project, announced in May 2005, would include system upgrades to transport up to 0.3 bcfd of gas from an existing interconnection with the Maritimes & Northeast pipeline in Dracut, Massachusetts. No further information was available regarding this project at the time that this EIS was prepared. Construction of upgrades to the Tennessee system that would be required to allow it to serve as a system alternative are described in Section 4.2. As noted in that section, implementation of system upgrades would result in impacts that would be greater than those of the proposed Project. In addition, this project would not meet the Broadwater Project objectives of providing a source of imported natural gas and additional natural gas storage facilities.

Leidy to Long Island Pipeline Project

The Leidy to Long Island Expansion Project, filed with FERC by Transco in December 2005 and approved by FERC in May 2006, would add approximately 0.1 bcfd of natural gas capacity to the existing Transco pipeline between Leidy, Pennsylvania and Long Island - all of which would be available to the Long Island market area. The project also would increase access to natural gas storage fields in Leidy. Use of the Leidy to Long Island Expansion Project to access imported gas and gas from additional storage facilities would require substantial upgrades to the expansion project and to the Transco Pipeline System, and would result in environmental impacts that would be greater than those of the proposed Project. In addition, this project would not meet the Broadwater Project objectives of providing a source of imported natural gas and additional natural gas storage facilities.

Sentinel Expansion Project

The Sentinel Expansion Project, announced by Transco in October 2005, would add between 0.2 and 0.3 bcfd of natural gas capacity to the existing Transco pipeline between western Pennsylvania and Maryland (Northeast Gas Association 2005). At the time that this EIS was prepared, no further details were available for this project. However, it is likely that transport of additional gas provided by the Sentinel Expansion Project would involve the same amount of system upgrades described above for the Transco system, along with the associated impacts. In addition, this project would not meet the Broadwater Project objectives of providing a source of imported natural gas and additional natural gas storage facilities.

Dominion Hub Project

The Dominion Hub Project, announced by Dominion in May 2006, would add 0.3 bcfd of natural gas capacity to the existing Dominion Pipeline System, which includes a connection with the IGTS Pipeline (Dominion 2006). At the time that this EIS was prepared, no further details were available for

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this project. However, it is likely that transport of additional gas provided by the Dominion Hub Project would involve the same amount of system upgrades described above for the Transco System, along with the associated impacts. In addition, this project would not meet the Broadwater Project objectives of providing a source of imported natural gas and additional natural gas storage facilities.

4.3.1.3 Conclusions Regarding Pipeline System Alternatives

A number of proposals are being considered to provide natural gas to specific markets in the region. All of these provide relatively small volumes of gas in response to immediate or short-term needs of those markets. None of the existing or proposed pipeline system alternatives considered in our evaluation would provide natural gas from foreign sources or from additional natural gas storage facilities. In addition, the New York City, Connecticut, and Long Island markets are located at or near the terminus of each of the pipeline system alternatives; consequently, increasing the capacity of the pipelines in the market area would require substantial upgrades to each of the potential pipeline system alternatives. Construction of the upgrades would require ROW excavation along substantially longer distances than for the proposed Project, potentially affecting sensitive resources; and operation would require additional compression to transport the volume of gas required. Upgrading any of the pipeline system alternatives to provide the required gas flow to meet the objectives of the proposed Project likely would require hundreds of miles of new or looped pipeline; and construction of the upgrades would affect thousands of acres of existing land uses – including forested areas, wetlands, wildlife habitat, and residential land. Consequently, the environmental impacts associated with construction and operation of these facilities would be greater than those associated with the proposed Project. We therefore have eliminated pipeline system alternatives from further consideration.

4.3.2 LNG Terminal System Alternatives

As an alternative to the Project, we considered the feasibility of relying on existing or proposed LNG terminals to meet the Project objectives. Existing, approved, proposed, or planned LNG terminals considered as potential system alternatives to the Project are depicted in Figure 4.3-2; each of these terminals is or would be located in the mid-Atlantic and northeast Atlantic coastal regions of the United States or in the southeastern coastal region of Canada (FERC 2005b, Northeast Gas Association 2006). Our analysis did not consider existing or proposed LNG terminals in other parts of North America, such as the Southeast and Gulf Coast regions, because use of those facilities would require substantial new infrastructure development to transport gas to the Long Island, New York City, and Connecticut region. Further, we did not consider the proposed KeySpan LNG Terminal Project in Providence, Rhode Island because FERC has declined to authorize this project. We understand that KeySpan is appealing FERC's decision. Table 4.3-3 lists the LNG terminals considered and their relevant characteristics.

With the exception of the planned Safe Harbor Energy Project, all of the LNG terminals identified as potential LNG terminal system alternatives are located far from the markets proposed to be served by the Project (from 113 to 648 miles). Although each LNG system alternative considered could provide a foreign source of gas to the regional markets, none except the planned Safe Harbor Energy Project could meet the purpose of the Broadwater Project without significant expansion of the LNG terminals. Meeting the purpose of the Project also would require substantial upgrades to the existing natural gas transmission systems between the LNG terminals considered and the IGTS pipeline (assuming that the IGTS pipeline is the most appropriate system to transport the gas to the Long Island and New York City area) or, in the case of the Safe Harbor Energy Project, new pipeline through areas that do not currently have a gas transmission pipeline. The new or upgraded pipeline would be substantially longer than the proposed subsea pipeline, and as described in Section 4.3.1, each mile of new pipeline would affect 12.1 acres of existing land uses.

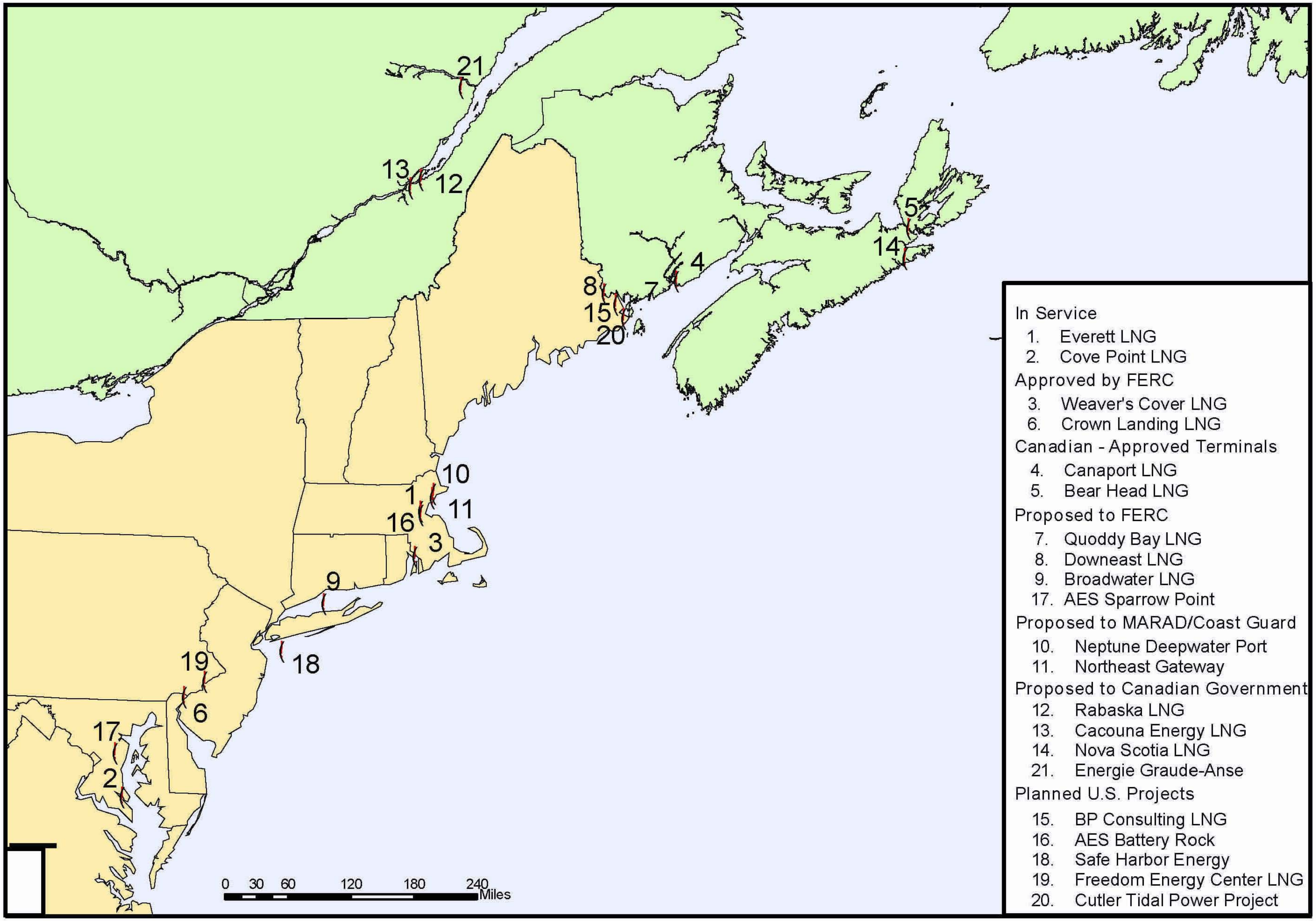

Figure 4.3-2
Broadwater LNG Project
LNG Terminals Considered as Alternatives

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TABLE 4.3-3
Existing, Authorized, Proposed, and Planned LNG Terminals Considered as Alternatives

Project	Location and Approximate Distance from IGTS[a]	Daily Sendout Capacity (bcfd)	Target Market	Facility Type	Status
In-Service Projects					
Everett LNG	Boston, Massachusetts (131 miles)	0.7	New England	Onshore	Operating
Cove Point LNG	Cove Point, Maryland (255 miles)	1.0[b]	Mid-Atlantic	Onshore	Operating[b]
FERC-Approved Projects					
Weaver's Cove LNG	Fall River, Massachusetts (113 miles)	0.8	New England (southeastern Massachusetts and Rhode Island)	Onshore	Approved by FERC; other permits pending
Crown Landing LNG	New Jersey (Delaware River) (148 miles)	1.4	Mid-Atlantic	Onshore (Delaware River)	Approved by FERC Coastal Zone Permit denied by Delaware; currently being considered by U.S. Supreme Court
Canadian-Approved Projects					
Canaport LNG	St. John, New Brunswick (465 miles)	1.0	New England and eastern Canada	Onshore	Approved by Canadian government; construction underway
Bear Head LNG	Point Tupper, Nova Scotia (670 miles)	1.5	New England and eastern Canada	Onshore	Approved by Canadian government; construction started but currently on hold pending LNG source considerations
Proposed Projects					
Northeast Gateway Energy Bridge	Offshore Gloucester, Massachusetts (162 miles)	0.8	New England	Offshore, shuttle regasification vessel (SRV)[c]	Proposed to U.S. Coast Guard (Coast Guard)

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TABLE 4.3-3 (continued) Existing, Authorized, Proposed, and Planned LNG Terminals Considered as Alternatives					
Project	**Location and Approximate Distance from IGTS**	**Daily Sendout Capacity (bcfd)**	**Target Market**	**Facility Type**	**Status**
Proposed Projects (continued)					
Neptune Deepwater Port	Offshore Gloucester, Massachusetts (160 miles)	0.4	New England	Offshore, SRV	Proposed to Coast Guard
AES Sparrow Point	Dundalk, Maryland (216 miles)	1.5	Mid-Atlantic	Onshore	FERC pre-filing[d]
Downeast LNG	Robbinston, Maine (416 miles)	0.5	New England	Onshore	FERC pre-filing
Quoddy Bay LNG	Perry, Maine (411 miles)	2.0	New England	Onshore	FERC pre-filing
Planned U.S. Projects					
BP Consulting LNG	Calais, Maine (418 miles)	1.0	New England	Onshore	Announced
AES Battery Rock	Boston, Massachusetts (143 miles)	0.8	New England	Onshore	Announced
Safe Harbor Energy	Offshore Long Island, New York (47 miles)	2	New York City, New Jersey, and Northeast	Offshore	Announced
Freedom Energy Center LNG	Philadelphia, Pennsylvania (126 miles)	N/A	Mid-Atlantic	Onshore	Announced
Cutler Tidal Power Project	Little Machias Bay, Cutler, Maine	0.5[e]	New England	Onshore	Announced
Planned Canadian Projects					
Rabaska	Quebec City, Quebec (419 miles)	0.5	Eastern Canada	Onshore	Under Canadian government review
Cacouna Energy	Gros Cacouna, Quebec (422 miles)	0.5	Eastern Canada	Onshore	Under Canadian government review

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TABLE 4.3-3 (continued) Existing, Authorized, Proposed, and Planned LNG Terminals Considered as Alternatives					
Project	**Location and Approximate Distance from IGTS**	**Daily Sendout Capacity (bcfd)**	**Target Market**	**Facility Type**	**Status**
Planned Canadian Projects					
Nova Scotia	Goldboro, Nova Scotia (648 miles)	1.0 (additional 1.0 with expansion)	Eastern Canada	Onshore	Under Canadian government review
Energie Grande-Anse	Saguenay, Quebec (517 miles)	1.0	Eastern Canada	Onshore	Announced

DEIS = Draft environmental impact statement.

N/A = Information not available.

[a] Approximate straight-line distance to the IGTS pipeline at Milford, Connecticut, except for the Safe Harbor Energy Project. The distance listed for that project is to the IGTS pipeline near Northport, Long Island.

[b] A proposal to add 0.8 bcfd of sendout capacity to the Cove Point LNG facility was approved by FERC in June 2006.

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

[d] Includes LNG terminal and Mid-Atlantic Express pipeline.

[e] Project as currently proposed does not include an LNG terminal. Tidewalker Associates has indicated that an LNG terminal could be added at a later date

Use of any of the LNG terminals as a system alternative would include impacts associated with expanding the LNG terminals (potentially adding new berths, tanks, and vaporization equipment); installing replacement pipe, looping, or new pipeline; and adding new compressor stations or upgrading existing compressor stations. These impacts would be substantially greater than those that would result from implementation of the proposed Project.

A recent study by Synapse Energy Economics, Inc. (Hausman et al. 2006) suggested that natural gas demands of the regional markets could be met by the Bear Head and Canaport LNG terminals, both of which are under construction in Canada (see Figure 4.3-2 and Table 4.3-3). Natural gas produced by the facilities reportedly would be transported by the Maritimes & Northeast pipeline. To accommodate the additional volume of natural gas, Maritimes & Northeast has proposed the Phase IV Expansion Project, currently undergoing a review by FERC. The Phase IV expansion originally was proposed to include 146 miles of looped 36-inch-diameter pipeline along the existing route and 6 new compressor stations in Maine and Massachusetts, terminating in Dracut, Massachusetts. In May 2006, in response to an announcement that construction of the Bear Head LNG terminal had been discontinued indefinitely, the Phase IV proposal was modified to eliminate a new compressor station and all but 1.7 miles of new pipeline in Maine. The modified Maritimes & Northeast Phase IV pipeline would transport approximately 0.4 bcfd of natural gas from the Canaport LNG terminal (Maritimes & Northeast Pipeline 2006).

Gas from Canaport not consumed in Canada and New England potentially could be transported to other markets in the northeastern United States through existing interconnections between the Maritimes & Northeast pipeline and the Tennessee and Algonquin pipelines in Dracut and Beverly, Massachusetts, respectively. Tennessee has announced plans to expand its facilities downstream of the Dracut interconnection to accommodate 0.2 bcfd of additional natural gas from the Maritimes & Northeast pipeline (see Section 4.3.1.2), but no specific information regarding project upgrades or associated impacts has been made available. To provide natural gas to the New York City/Long Island market area through the Algonquin and Tennessee systems would require upgrades along the pipeline routes and may require new or updated compressor stations, as described in Section 4.3.1. Construction and operation of these upgrades would result in impacts to resources along the existing Tennessee and Algonquin pipeline routes.

The Canaport LNG terminal and Maritimes & Northeast pipeline Phase IV expansion, as proposed, would not be able to supply the needed volume of gas to the regional markets. Even if the Bear Head LNG terminal were to become operational, substantial upgrades to the downstream interstate pipeline systems and, potentially, the LNG terminals themselves would be required to meet regional market needs. Impacts associated with these upgrades would be greater than those associated with the Broadwater Project. Expansion of the Maritimes & Northeast pipeline to accommodate natural gas from both the Bear Head and Canaport LNG facilities would include construction of 146 miles of new looped pipeline and would affect nearly 2,000 acres of land in Maine, including 322 acres of wetlands and 148 perennial waterbody crossings. Further expansion of the Maritimes & Northeast, Algonquin, and/or Tennessee Pipeline Systems to serve the Broadwater Project market needs could exceed these impacts.

On January 26, 2006, the Atlantic Sea Island Group announced plans to develop the Safe Harbor Energy Project to serve the same market as the proposed Broadwater Project (Safe Harbor Energy 2006). This project would consist of a new man-made island, located about 13.5 miles offshore and south of Long Island. The island would have an above-water area of 53 to 65 acres and would cover approximately 120 acres of sea floor. An LNG terminal would be constructed on the island, and the facility would have a sendout capacity of 2.0 bcfd. The terminal would provide berthing facilities for two LNG carriers and would provide an LNG storage capacity of 720,000 m^3. Although not mentioned in the initial announcements, it is apparent that a new onshore pipeline also 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. The pipeline could be routed onto Long Island and connect to the IGTS pipeline, or could be routed to New Jersey and connect to the Transco system. In September 2006, the Atlantic Sea Island Group submitted an application to the Coast Guard for a Deepwater Port License for the project. The Coast Guard is reviewing the application and will prepare an EIS for the project.

This project would meet Broadwater's objectives of providing a foreign source of natural gas and natural gas storage facilities. However, construction of the island would result in a permanent impact to a large area of the seafloor in the Atlantic Ocean. In addition, the island appears to be in the commercial vessel traffic lanes offshore of Long Island and could affect commercial shipping. If a pipeline to Long Island is installed, construction-related impacts also would occur along the pipeline route from the new island through the nearshore area and on Long Island. The adverse environmental impacts associated with construction of the island, installation of the offshore and nearshore pipeline, and installation of the onshore pipeline would be substantially greater than those of the proposed Project.

If a pipeline to New Jersey is installed, there would also be impacts to nearshore and onshore environments. In addition, the Transco system would need to be substantially upgraded to provide the necessary volumes of gas to the New York City, Long Island, and Connecticut markets, as described in Section 4.3.1.1.

4.3.2.1 Conclusions Regarding LNG Terminal System Alternatives

None of the existing, proposed, or planned LNG terminal system alternatives considered in our evaluation would be able to meet the energy demands of the New York City, Connecticut, and Long

Island markets without extensive construction of new pipeline facilities along distances substantially greater than the proposed 21.7-mile-long subsea pipeline. Construction would result in environmental impacts that would substantially exceed those of the proposed Project. With the exception of the planned Safe Harbor Energy Project, all of the LNG terminals identified as potential LNG terminal system alternatives are located far from the markets proposed to be served by the Project (from 113 to 648 miles) and would require expansion of existing LNG storage and receiving facilities as well as construction of new pipelines, compressor stations, and other aboveground features. The Safe Harbor Energy Project would be located close to the markets targeted by the proposed Project. However, construction of the Safe Harbor Energy Project would result in a permanent impact to a large area of the seafloor in the Atlantic Ocean, could affect established commercial shipping lanes offshore Long Island, and would require construction of a pipeline through sensitive nearshore and onshore environments. The adverse environmental impacts associated with construction of the Safe Harbor Energy Project would be substantially greater than those of the proposed Project.

In summary, the environmental impacts associated with the pipeline and LNG terminal upgrades that would be needed to use the existing, proposed, or planned LNG terminals identified as potential system alternatives to the Broadwater Project would be greater than those associated with the Broadwater Project. Therefore, we have eliminated LNG terminal system alternatives from further consideration.

4.4 ALTERNATIVE LNG TERMINAL DESIGNS AND LOCATIONS

We evaluated alternative LNG terminal designs and alternative locations for an LNG terminal as a means of achieving the purpose of the Project. Each of the terminal designs would meet the objective of providing imported natural gas and, except for the terminals that would use shuttle regasification vessels (SRVs)[1] or floating recovery units (FRUs)[2], they would provide storage facilities for natural gas. Our analysis was based on the assumption that, irrespective of the design type, the LNG terminal would need to be within or near the targeted region if it is to meet the purpose of the Project without requiring substantial upgrades to the existing infrastructure. Such upgrades would result in greater environmental impacts associated with construction and operation than those associated with the proposed Project.

4.4.1 Alternative LNG Terminal Designs

We identified three alternative types of LNG terminals that could meet the purpose of the Project:

- Onshore terminals (Section 4.4.1.1);
- Offshore gravity-based structures[3] (GBSs) (Section 4.4.1.2);
- Offshore terminals that would use SRVs (Section 4.4.1.3); and
- Offshore terminals that use FRUs (Section 4.4.1.4).

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

[2] FRUs are floating vaporization units connected to a subsea sendout pipeline. An FRU attaches to a moored LNG carrier, transfers LNG from the carrier, vaporizes it, and sends the vaporized LNG into the sendout pipeline through a flexible riser.

[3] GBSs are essentially concrete boxes that house LNG storage tanks and are placed on the seafloor.

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Types of LNG terminal designs are compared in Table 4.4-1.

TABLE 4.4-1
Comparison of LNG Terminal Designs

Feature	FSRU (Proposed)	Onshore Terminal	Gravity-Based Structure (GBS)	Shuttle Regasification Vessel (SRV)	Floating Recovery Unity (FRU)
Nearshore dredging or jetty construction required?	No	Yes	No	No	No
Impacts to nearshore resources?	No	Yes	Possible[a]	Possible[b]	Possible[b]
Water depth restrictions (feet)	> 50	> 50 (in channel)	50 to 100	> 120	350 to 500[c]
Permanent seafloor impacts (acres)	0.1[i]	None	16.9[d]	Variable[e]	Variable[e]
Water surface use area (acres)[f]	135.4[g]	None	9.9	3.4 [h]	3.4 [h]
Provides LNG storage?	Yes	Yes	Yes	No	No

a Construction of a graving dock could affect coastal or nearshore resources.

b Depending on the site of the off-loading buoys, construction of a pipeline through nearshore and coastal areas could be required.

c TORP (2006).

d Includes scour protection area.

e Impacts would be associated with anchors and anchor lines, and would vary depending on water depth.

f For comparison, the water surface use area estimates do not include the area of the safety and security zone.

g Calculated as a full turn of the FSRU around the mooring tower.

h Assumes an arrangement of three unloading buoys, arranged symmetrically, with a 2-mile-wide vessel-exclusion zone around each buoy.

I Extent of sediment conversion

4.4.1.1 Onshore LNG Terminal Alternative

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, and a site with sufficient applicant-controlled land to accommodate a site-specific onshore exclusion zone. We examined areas with water depth of 50 feet or more 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) recently suggested that longer subsea and onshore LNG pipelines may be feasible using a triple-walled pipe-in-pipe design developed by InTerPipe. 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 that a feasible alternative.

We began by evaluating the potential for siting an LNG terminal at an existing developed port in Long Island Sound where water depth exceeds 50 feet and can accommodate the draft of LNG carriers. Port sites evaluated included Northport and Port Jefferson in Long Island and Bridgeport, New Haven, and New London in Connecticut. Except for New Haven, none of the deepwater ports evaluated appear to have sufficient land available for construction and operation of an onshore LNG terminal. Further, as discussed in Section 3.7.1 and shown in Table 3.7.1-1, each of these ports experiences a high volume of commercial marine traffic, and construction and operation of an onshore LNG terminal at any of these ports could adversely affect marine traffic. Finally, residential neighborhoods occur proximal (within 0.5 mile) of port areas at Northport, Port Jefferson, and New Haven. Therefore, none of the existing deepwater port sites offer land availability and the desired distance from the public for development of an onshore LNG terminal.

No potential onshore LNG terminal sites exist adjacent to areas where water depth exceeds 50 feet. Consequently, access for LNG carriers would require either nearshore dredging or construction of a long dock or mooring jetty. A dock or mooring jetty likely would need to extend 1 mile or more into the Sound to provide sufficient water depth. Both 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 affect these areas and could adversely affect shellfish beds and other sensitive marine resources.

In addition, 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 an LNG facility and populated areas enhances safety and reduces visual impacts. Thus, in general, 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.

We also evaluated two specific sites: Block Island, as suggested by public comments; and the site of the former Shoreham Nuclear Power Plant in Wading River, New York. An onshore LNG terminal at Block Island would require construction of an approximately 87-mile-long subsea pipeline to ship natural gas from the terminal to an interconnection with the IGTS pipeline, or a 14-mile-long subsea pipeline to the nearest shoreline and a new onshore pipeline to the IGTS pipeline. Based solely on pipeline length, impacts to marine resources associated with construction of a pipeline from Block Island could be four times greater than those associated with the proposed Broadwater pipeline. Further, because water depths within about 1 mile or more of Block Island are less than 50 feet, operation of an onshore LNG facility on Block Island would require substantial nearshore dredging and associated impacts to nearshore marine resources. The overall environmental impacts associated with pipeline construction and dredging would be substantially greater than those of the proposed Project.

The site of the Shoreham Nuclear Power Plant could provide a sufficient exclusion zone for LNG storage and regasification facilities. In addition, because the site already contains buildings and structures typical of heavy industry, use of the site also would minimize visual impacts.

As with other onshore locations in Long Island, nearshore water depths adjacent to the Shoreham site are shallower than the 50 feet required to accommodate LNG carriers. As a result, construction of an onshore LNG facility at the Shoreham site would require extensive nearshore dredging or construction of an approximately 1.2-mile-long pier. Use of this site also would require construction of about 25 miles of onshore pipeline to transport the natural gas to the existing IGTS pipeline near Commack, New York. Pipeline construction would affect more than 300 acres of land, including extensive residential communities and the Central Pine Barrens, a habitat type listed for protection under New York State Environmental Conservation Law Article 57 (CPBC 2004).

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Finally, because an LNG terminal at the Shoreham site would be much closer to residential areas, air emissions and noise impacts associated with construction and operation of the terminal would be greater than those anticipated for the Broadwater Project. Overall, the environmental impacts associated with an LNG terminal and regasification facility at the Shoreham site would be substantially greater than those of the proposed Project.

As suggested by public comments, we examined the possibility of constructing an LNG receiving terminal on either the KeySpan or the ConocoPhillips petrochemical platforms (see Section 3.5.2.2) that would be connected to an onshore LNG storage and regasification facility via a cryogenic pipeline. The KeySpan facility, constructed in 1967, consists of two 50-foot by 50-foot platforms located approximately 1 mile off the coast of Northport, New York. The ConocoPhilips facility is located approximately 1.8 miles offshore of Riverhead, New York. The 100-foot by 45-foot platform, constructed in 1974, includes breasting and mooring dolphins creating two berths.

Neither the KeySpan nor the ConocoPhillips platforms would be suitable to support LNG transfer operations because neither was designed for LNG transfer operations. The KeySpan and ConocoPhillips platforms would be much too small to accommodate transfer of LNG from LNG carriers and would need to be extensively expanded to meet this purpose. Further, as discussed earlier in this section, sufficient vacant land is not available onshore of either of the platform locations to accommodate an onshore LNG storage and regasification facility. For these reasons, construction of an LNG receiving terminal on an existing oil receiving platform in Long Island Sound was not considered further.

In summary, an LNG terminal at the Shoreham site or at any other onshore site in the region would result in greater impacts than the proposed Project; therefore, the Onshore LNG Terminal Alternative was not considered further.

4.4.1.2 Offshore 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 likely would be installed above the water, 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. An LNG terminal using a GBS design in either Long Island Sound or the Atlantic Ocean would provide a foreign source of gas to add diversity to the natural gas market in the region and therefore could meet the purpose of the Broadwater Project.

GBSs would be constructed at a specialized onshore construction facility called a graving dock. Graving docks generally are established adjacent to a channel of sufficient depth to float the GBS once the construction is complete. In most cases, sheet piling or a similar type of barrier is installed to block water from the channel, and an area is excavated to accommodate the concrete forms required to construct the structure. In some cases, more than one graving dock is constructed to allow concurrent construction of all structures associated with the terminal. After the GBS is constructed in the graving dock, the barrier would be removed and the GBS floated and towed from the graving dock. At the terminal location, the GBS would be allowed to sink to the seabottom.

Existing graving docks in the project area, including facilities at Bayonne, New Jersey (Port of New York/New Jersey 2006) are too small to accommodate construction of a GBS. Therefore, a new graving dock would need to be created for a project-specific GBS. Environmental impacts associated with construction of a graving dock would vary from site to site, although we anticipate that, for most potential sites for graving docks in the region, the impacts associated with construction of a GBS could be equal to or greater than those for the entire 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. As water depth increases beyond 100 feet, factors such as structure size and geotechnical constraints generally limit the practicability of a GBS-based terminal (Pepper and Shah 2004). A GBS could be installed at the proposed site of the FSRU or at locations closer to shore. As the distance to the shoreline decreases, the visual impacts would increase and safety concerns would increase. In addition, commercial and recreational vessel traffic is generally higher in areas with adequate depth, but located closer to Long Island than at the proposed FSRU location.

Broadwater estimated that a GBS capable of meeting the purpose of the Project would permanently affect approximately 16.9 acres of seabottom. As a result, wherever a GBS may be installed, the permanent impacts to the seafloor would be greater than those of the proposed Project (about 17 acres for the GBS compared to about 0.1 acre for the FSRU's mooring system), particularly at the lower limits of the depth requirements due to the presence of sensitive marine resources closer to shore. If a GBS were constructed at the proposed site for the FSRU, environmental impacts associated with offshore pipeline installation in the Sound likely would be similar to those of the proposed Project. If a GBS were installed closer to shore, installation of the offshore pipeline would affect fewer acres of seabottom than the proposed Project, but construction would affect the higher quality marine resources of the nearshore environment.

A GBS terminal 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. A GBS terminal installed off the southern shore of Long Island due south of the Town of Huntington would be between 2.7 and 7.4 miles offshore; sites located farther than 7.4 miles offshore in this area could conflict with established shipping lanes. In addition to the offshore pipeline, an 18.6-mile-long onshore pipeline also would be required for the interconnection with the existing IGTS pipeline; construction of this onshore pipeline would affect an additional 225 acres of existing land uses and would require construction in sensitive nearshore environments, as described above. In addition to the greater seabottom impacts associated with the GBS footprint, visual impacts would be greater than for the proposed Project and would affect a larger number of people due to the closer proximity of the terminal to the shoreline and the onshore construction requirements.

A GBS terminal installed off of the southern shore of Long Island due south of the proposed location of the FSRU would be between 0.8 and 5.1 miles from shore. A 47.9-mile-long onshore pipeline would be required to connect with the existing IGTS pipeline near Huntington; construction of this onshore pipeline would affect an additional 580 acres of existing land uses and would require construction in sensitive nearshore environments, as described above. In addition to the greater seabottom impacts associated with the GBS footprint, visual impacts would be greater than for the proposed Project and would affect a larger number of people due to the closer proximity of the terminal to the shoreline. Installation of the onshore pipeline would result in significant impacts to coastal environmental resources and to recreational and residential areas. A new compressor station also may be required to maintain the appropriate pressure in the pipeline prior to connecting to the existing transmission system, which would result in air emissions and visual impacts that would not occur with the proposed Project.

A GBS terminal in the Atlantic Ocean would be subject to more extreme weather conditions than sites within Long Island Sound and could experience occasional interruptions of service, decreasing the reliability of natural gas deliveries from the LNG terminal (see Section 4.4.2). Interruptions in the Atlantic are likely to be more frequent than in Long Island Sound due to the more protected nature of the Sound.

Overall, the adverse environmental impacts associated with installation of a GBS terminal in either the Atlantic Ocean or Long Island Sound; construction of the offshore, nearshore, and onshore pipelines; and adding compression would be substantially greater than those of the proposed Project. Consequently, we have not further considered the GBS terminal design as an alternative to the proposed Project.

4.4.1.3 Offshore SRV Alternative

Under the Offshore SRV Alternative, two or more permanently moored LNG unloading buoys would be constructed and attached to the seafloor, using a six- or eight-point mooring (anchoring) system. Each unloading buoy would contain a natural gas pipeline riser connected to a subsea pipeline that would extend to shore. When not in use, the unloading buoy would be suspended within the water column below the sea surface.

An SRV would moor over the buoy, draw the buoy up through a "moon 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. To supply the volume of gas proposed by Broadwater, an SRV terminal would need to receive regasified LNG from an average of two 140,000-m^3 SRVs per day, every day of the week. An SRV terminal could operate under somewhat rougher sea states than an FSRU, allowing SRV connection in seas greater than 16 feet (Advanced Production and Loading [APL] 2006).

Typical SRV terminals do not have the capacity to store LNG. The lack of storage severely limits this technology for providing base load natural gas supply to the region. 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. During severe weather, particularly in the Atlantic Ocean (see Section 4.4.2), the potential for periodic interruptions of service when the SRVs are unable to berth and unload natural gas into the riser significantly reduces the reliability of this alternative. Calypso LNG LLC has announced the development of a deepwater port project near Fort Lauderdale, Florida that would include both an SRV terminal and a semi-permanently moored FSRU-like vessel. Such a system would provide onsite storage capacity.

To accommodate the deep-draft SRVs (drafts of 45 to 52 feet) and to prevent the subsea riser from contacting the bottom, the unloading buoys for other SRV terminals typically are constructed where water depth is at least 130 feet and typically much deeper. Water depths in only two areas in Long Island Sound would accommodate an SRV terminal: an area approximately 4 miles north of Port Jefferson, and an area west of the Race. An SRV terminal installed at the former location would result in conflicts with the Bridgeport–Port Jefferson ferry and would be much closer to coastal communities than the Broadwater Project, with the resultant increase in visual impacts and potential safety concerns. However, the visual impacts would occur only when SRVs are at berth or in the vicinity of the terminal. An SRV terminal installed near the Race likely would result in greatly increased conflicts with commercial vessels and recreational boating and fishing, and also would be closer to the shoreline than the proposed FSRU location. In addition, the pipeline connection from the terminal to the IGTS pipeline would be substantially longer than the proposed subsea pipeline, and construction of the pipeline would result in environmental impacts that would be greater than those of the proposed Project. At both SRV terminal locations, there would be greater carrier traffic as compared to the proposed Project, with the resultant increase in potential impacts to marine transportation.

Bottom impacts associated with each buoy and its mooring lines would depend on water depth. For example, each of the two unloading buoys associated with the proposed Neptune Deepwater Port Project (see Table 4.3-3), which is proposed for construction in 260 feet of water, would be anchored to the seafloor using eight 4,000-foot-long mooring lines. Anchor installation and movement of mooring lines would affect approximately 56 acres of seafloor for the life of the project, although it is not possible to quantify the area of the seabottom that would be affected. Further, raising and lowering the submerged unloading buoy and flexible riser during operation of an SRV terminal would result in some level of chronic seafloor disturbance and could contribute to increased turbidity in the vicinity of the riser, although these impacts also are difficult to quantify.

Mooring buoys would need to be separated from each other by a minimum of 2 miles to provide adequate buffer zones for simultaneous movements of transiting and off-loading SRVs. This arrangement of buoys would result in the permanent exclusion of vessels (including commercial fishing vessels, other commercial vessels, and recreational vessels) from an area as large as 5.3 square miles, and an additional exclusion area within the safety and security zone would be established by the Coast Guard during unloading of each vessel.

Overall, the use of an SRV terminal in Long Island Sound would result in substantially greater impacts on marine transportation, recreational boating and fishing, benthic resources, and visual resources; it also would cause greater safety concerns because the terminal would be closer to the shoreline than the proposed Project. Therefore, we did not further consider an SRV terminal in Long Island Sound.

If an SRV system were installed in the Atlantic Ocean, the subsea pipeline would extend to the south shore of Long Island, and an onshore pipeline would be constructed to connect to the existing gas transmission system. An SRV sited due south of Huntington in about 130 feet of water would require an offshore pipeline at least 23.2 miles long, as well as an 18.6-mile-long onshore pipeline to interconnect with the existing IGTS pipeline near Huntington; construction of this onshore pipeline would affect approximately 225 acres of existing land uses. An SRV sited due south of the proposed FSRU location in 130 feet of water would require an offshore pipeline at least 13.1 miles long, as well as a 47.9-mile-long onshore pipeline to connect with the existing IGTS pipeline near Huntington; construction of this onshore pipeline would affect approximately 580 acres of existing land uses. In both cases, onshore pipeline installation would require construction in sensitive nearshore habitats such as Jones Beach State Park, Hempstead Bay, Cupsogue Beach County Park, Shinnecocke County Park, Fire Island National Seashore, Amagansett National Wildlife Refuge, South Oyster Bay, Mastic Beach, and Narrow Bay. Horizontal directional drilling (HDD) or other trenchless pipeline construction methods could be used to reduce impacts to these resources during pipeline installation. However, physical limitations on the maximum HDD length, coupled with the geographic extent of natural and recreational resources along the southern shoreline of Long Island, likely would require some trenching in these areas.

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. The impacts on marine transportation may be less than those of the proposed Project, although the terminal's proximity to established vessel traffic lanes could result in conflicts with commercial shipping. The impacts to visual resources and the safety concerns of an SRV terminal in the Atlantic Ocean likely would be similar to those of the proposed Project if the terminal is located at least 9 miles from the shoreline. Although the visual impacts would occur only when vessels are at berth, berthing would occur on every day that weather conditions permitted.

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In summary, the inability of the SRV to provide storage, coupled with the greater environmental impacts associated with an SRV terminal installed in Long Island Sound or in the Atlantic Ocean compared to those associated with the proposed Project (see Table 4.4-1), makes this terminal design inferior to the proposed Project. Therefore, we have not considered the SRV terminal design further as an alternative to the proposed Project.

4.4.1.4 Offshore FRU Alternative

An FRU represents a variation on the SRV-based LNG terminal concept. Under this approach, LNG off-loading and vaporization equipment would be housed on a floating L-shaped structure equipped with positioning thrusters. LNG carriers arriving at the terminal would be moored to an anchored mooring buoy. Mooring pilings also would be installed near the mooring buoy to provide additional support to the FRU in the event of a significant storm or hurricane. The FRU would then connect to the LNG carrier using a suction cup-like attachment system. As with an SRV-based system, LNG would be off-loaded, vaporized, and sent via a flexible riser connected to a subsea pipeline.

TORP Terminal LP recently filed an application with the Coast Guard for its proposed Bienville Offshore Energy (Bienville) Project, which would be the first offshore LNG terminal to use FRU technology. As proposed, the Bienville terminal would consist of two FRUs and mooring buoys, as well as a support platform housing a control room, metering, and support facilities.

Like an SRV-based LNG system, the FRU would require deep water to accommodate the deep-draft SRVs (drafts of 45 to 52 feet) and to prevent the subsea riser from contacting the bottom. In its application for the Bienville project, TORP reports that optimal water depth for an FRU system is 350 to 500 feet of water. The FRU could not be installed in Long Island Sound without extensive dredging; construction of an FRU in the Atlantic Ocean would result in offshore and onshore impacts similar to those described for an SRV in that area. Finally, like an SRV, an FRU would be unable to provide LNG storage.

In summary, the inability of the FRU to provide storage, coupled with the greater environmental impacts associated with an FRU terminal installed in Long Island Sound or in the Atlantic Ocean compared to those associated with the proposed Project (see Table 4.4-1), makes this terminal design environmentally inferior to the proposed Project. Therefore, we have not considered the FRU terminal design further as an alternative to the proposed Project.

4.4.1.5 Conclusions Regarding Alternative LNG Terminal Designs

Each of the alternative types of terminals considered in our evaluation would result in greater environmental impacts than those that would result from using the proposed FSRU design (see comparisons in Table 4.4-1).

An onshore terminal would be closer to populated areas than the proposed Project, resulting in a shorter distance between the berthing facility and the shoreline and potentially greater visual impacts, depending on the location. Construction of the berthing facility, the associated dock or jetty, and the onshore terminal would result in impacts to environmentally sensitive coastal and nearshore marine features that would not occur with the proposed Project. Some potential sites would be distant from the market to be served and would result in greater environmental impacts than those of the proposed Project due to the need for construction of a longer pipeline that would extend through nearshore areas with more sensitive biological resources. In addition, additional compression may be needed for some onshore terminal sites that would not be necessary for the proposed Project.

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A GBS terminal would result in much greater permanent impacts to seabottom resources in Long Island Sound or the Atlantic Ocean than the proposed Project. A GBS also would require construction of a large-scale graving dock facility, with the magnitude of associated impacts dependent on the location of the facility; no such impacts would be associated with the proposed Project.

An LNG terminal using either SRV or FRU technology would result in greater seabottom impacts and periodic exclusion of vessels from a larger area than would the proposed Project. An SRV- or FRU-based terminal also would require either an offshore pipeline to the IGTS pipeline that is longer than the proposed subsea pipeline or a pipeline through the nearshore area, an onshore pipeline, and additional compression. Either of these options would result in greater environmental impacts than those of the proposed Project. Therefore, we have eliminated alternative LNG designs from further consideration.

4.4.2 Alternative LNG Terminal Locations

With the FSRU as the preferred type of LNG terminal, we evaluated alternative locations for siting an FSRU. Our assessment considered areas in Block Island Sound and the Atlantic Ocean south of Long Island (Section 4.4.2.1) and areas within Long Island Sound (Section 4.4.2.2) as potential sites for the FSRU.

4.4.2.1 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 need 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. The total length of pipeline required to connect to the IGTS pipeline from either of these locations would be substantially longer (approximately 50 to 75 miles) than the proposed subsea pipeline and would result in greater impacts than those of the proposed pipeline.

Siting an FSRU in either the Atlantic Ocean or in Block Island Sound would present greater technical difficulties during operation due to the more frequent severe weather conditions and sea states in those areas. Because LNG carriers must berth alongside the FSRU to unload LNG, severe weather conditions would result in conditions that would preclude the possibility of berthing. In both Block Island Sound and the Atlantic Ocean, those conditions occur more frequently than in Long Island Sound and could result in interruptions in service if the conditions lasted for an extended period of time. A review of NOAA buoy data indicated that average hourly wave heights near Montauk Point and in the Atlantic Ocean south of Long Island exceed the 2-meter operational threshold for LNG transfer approximately 18 percent of the time. Between September and April, wave heights in these areas exceed 2 meters more than 22 percent of the time. By contrast, average hourly wave heights in Central Long Island Sound never exceeded the 2-meter threshold in 2004 or 2005 (NOAA 2006d). Further, an FSRU sited in the Atlantic Ocean south of Long Island could conflict with established commercial shipping lanes. Finally, the sendout pipeline from an FSRU sited south of Long Island would need to be constructed through nearshore recreational areas and sensitive shallow-water and coastal ecosystems, 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 by NYSDOS (NYSDOS 2006). These resources could include Jones Beach State Park, Hempstead Bay, Cupsogue Beach County Park, Shinnecocke County Park, Fire Island National Seashore, Amagansett National Wildlife Refuge, South Oyster Bay, Mastic Beach, and Narrow Bay. As described in Section 4.4.1.3, pipeline construction in these areas could result in hundreds of acres of impacts to these resources.

In summary, the environmental impacts associated with an FSRU sited in either Block Island Sound or the Atlantic Ocean would be greater than those of the proposed Project due to the need to construct a substantially longer pipeline to connect the terminal to the existing pipeline transmission system. In addition, operational difficulties would be greater for an FSRU in either body of water as compared to the proposed location.

4.4.2.2 Long Island Sound

Our evaluation of alternative sites within Long Island Sound considered the following basic siting criteria:

- Based on engineering recommendations from IGTS (see Section 4.5.1), a sendout pipeline from an FSRU in Long Island Sound should be connected to the IGTS pipeline in the vicinity of the proposed tie-in to optimize gas delivery and to avoid the need for IGTS system upgrades and the associated environmental impacts;
- To minimize impacts to marine biological resources, a connecting pipeline between the FSRU and the IGTS pipeline should not be substantially longer than the proposed pipeline length, unless there are clear environmental advantages; and
- As the distance between the shoreline and potential FSRU sites increases, the potential impacts to sensitive marine biological resources decrease, the magnitude of visual impacts decreases, and safety concerns decrease.

We examined possible FSRU locations throughout Long Island Sound that would be meet these screening criteria. For the purposes of this evaluation, we subdivided the Sound into two general regions: (1) western Long Island Sound and (2) central and eastern Long Island Sound. For the purposes of our analysis, we considered the limits of western Long Island Sound to be the Narrows to 3 miles east of the Bridgeport–Port Jefferson ferry route. Central and eastern Long Island Sound was bounded to the west by a line 3 miles east of the Bridgeport–Port Jefferson ferry route and to the east by the Race.

Western Long Island Sound

For alternative sites in Long Island Sound, we identified western Long Island Sound as a region that presents multiple conflicts with the proposed Project. This region extends from the Narrows eastward to a line 3 miles east of the Bridgeport–Port Jefferson ferry route. To minimize potential conflicts with current and proposed ferry operations in Long Island Sound, avoid the more congested waters of western Long Island Sound, and avoid placing the FSRU closer to shore than proposed, we applied a 3-mile offset buffer from the ferry route. This area of the Sound is narrower than the central and eastern portions of the Sound, the density of recreational use is higher, and fewer route options exist for commercial shipping than areas of the Sound to the east. The potential for impacts to marine transportation and recreation would be greater in this area than elsewhere in the Sound. In addition, the water is typically shallower in this area than in more easterly areas of the Sound, and many potential sites for the FSRU likely would require dredging to provide the 50-foot minimum water depth required for LNG carrier operation.

Because the distance between the New York and Connecticut shorelines is shorter in western Long Island Sound than elsewhere in the Sound, the FSRU and the berthed LNG carriers would be closer to the shorelines. That situation, combined with a greater population density, would result in a greater potential for adverse visual impacts.

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In western Long Island Sound, the sendout pipeline from the FSRU to an interconnection with the IGTS Eastchester Extension pipeline likely would extend through more sensitive nearshore benthic environments, with the result that the impacts of pipeline installation would be greater than those for the proposed Project. Although this area is closer to New York City, providing gas to other areas of Long Island and to Connecticut likely would require upgrades to the existing transmission system, such as looping or additional compression.

In summary, none of the potential FSRU sites within western Long Island Sound would reduce environmental impacts compared to the proposed site.

Central and Eastern Long Island Sound

Our evaluation of alternative sites within the central and eastern portions of the Sound included the assumption that the Project's sendout pipeline would be an offshore pipeline that 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 basic assumption, a primary criterion in the evaluation was proximity to the IGTS pipeline in order to minimize the length of the sendout pipeline and potential impacts to the benthic environment.

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 also was considered in the evaluation because distances less than those proposed would increase the visibility of the FSRU for viewers in New York and Connecticut. In addition, greater distances from the nearshore environment would further minimize impacts to benthic resources due to construction.

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 approximately this 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 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 and would result in greater seabottom 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) 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 impact to marine transportation to be more important than the minor decrease in 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.

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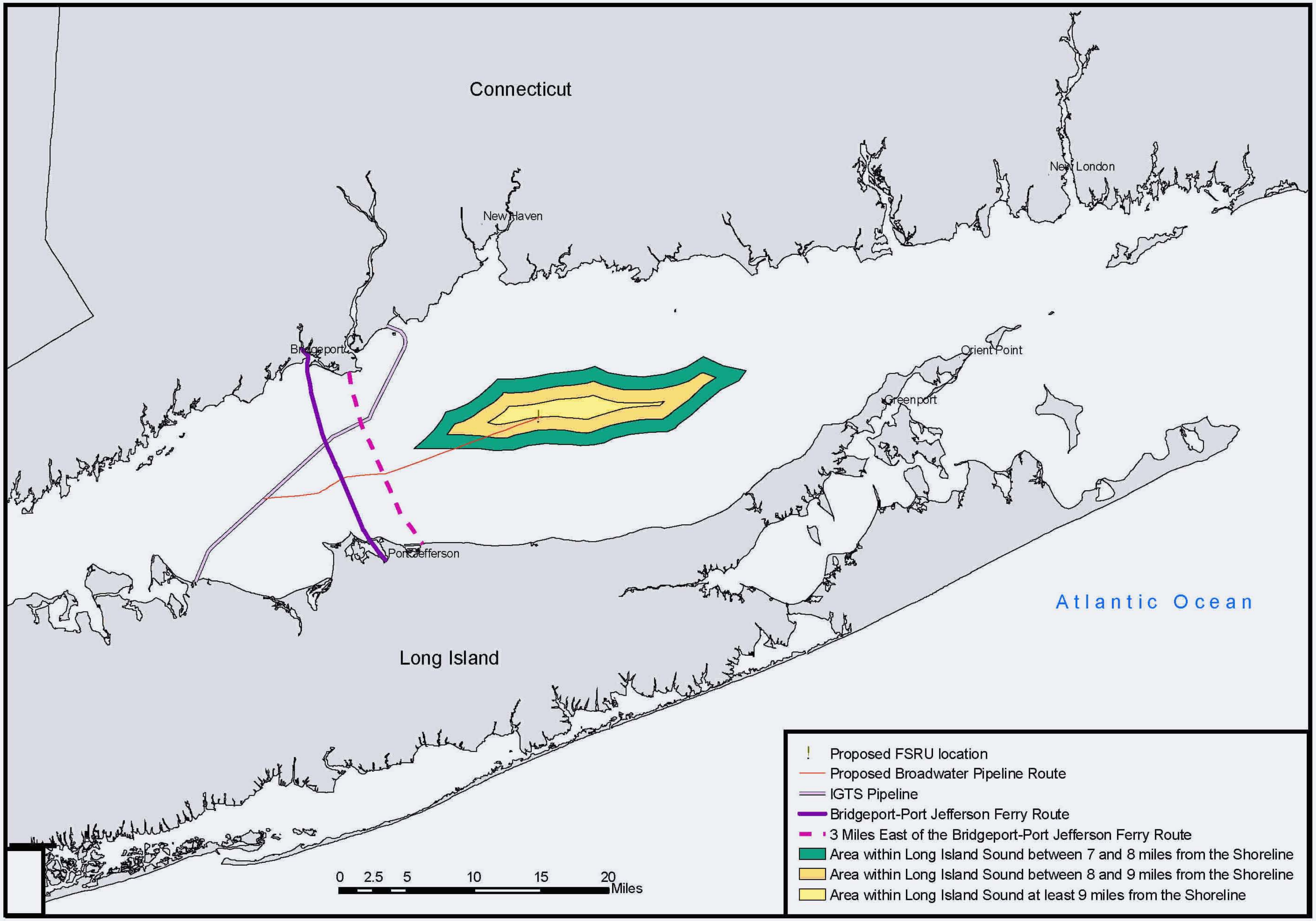

Figure 4.4-1
Broadwater LNG Project
Alternative FSRU Locations in the Central Basin

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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.

4.4.2.3 Conclusions Regarding Alternative LNG Terminal Locations

None of the alternative FSRU sites considered in our evaluation would result in fewer environmental impacts than those of the proposed Project. The environmental impacts associated with an FSRU sited in Block Island Sound or in the Atlantic Ocean would be substantially greater than those of the proposed Project due to the need to construct a substantially longer pipeline to connect the terminal to the existing natural gas transmission system. In addition, operational difficulties would be greater for an FSRU in either body of water as compared to the proposed location due to the more frequent occurrence of severe wind and sea conditions. To avoid conflicts with the Bridgeport-Port Jefferson ferry, we eliminated all areas of Long Island Sound that are west of a line drawn 3 miles east of the ferry route. In addition, an FSRU sited in western Long Island Sound would result in greater potential for visual impacts and could result in more nearshore construction impacts to sensitive marine habitats than the proposed Project.

An FSRU located east of the proposed site would require a longer pipeline to connect to the IGTS pipeline and would increase the environmental impacts without gaining other environmental advantages. In addition, the FSRU would be closer to shore and the visual impacts would be greater. Sites to the west would be closer to the IGTS pipeline than the proposed Project and would reduce the length of the required pipeline and associated benthic impacts; but they would increase visual impacts due to closer proximity to shore and would result in greater interference with commercial vessel traffic. Location of the FSRU north or south of the proposed site also would increase interference with commercial vessel traffic.

In summary, none of the alternative areas considered for the FSRU in Long Island Sound would reduce overall environmental impacts relative to the proposed site of the FSRU. Therefore, we have eliminated alternative sites for an FSRU from further consideration.

4.5 PIPELINE ROUTE ALTERNATIVES

Route alternatives were identified and evaluated to determine whether or not alternative alignments could avoid or reduce the impacts identified in Section 3.0. Because we did not identify any alternative sites for the FSRU that would have fewer environmental impacts than the proposed location, we identified route alternatives with an eastern terminus at the FSRU. As described below, the western terminus of each alternative is at the IGTS pipeline, although we considered more than one point of interconnection with the pipeline.

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4.5.1 Potential IGTS Pipeline Tie-in Locations

In selecting the optimal tie-in location with the IGTS pipeline, several key factors must be considered. The tie-in must allow sufficient gas flow to meet the purpose of the Project and must meet the operational requirements of the existing transmission system. The location also should minimize the length of the alignment and thus minimize the associated environmental impacts of the subsea pipeline.

In a letter to FERC dated June 15, 2005 (filed in the Broadwater Docket), IGTS indicated that a majority of the increased natural gas demands on the IGTS system would be from markets in Long Island and New York City. To maximize operational efficiency, therefore, the interconnection site with the IGTS pipeline should be closer to Long Island than Connecticut. IGTS further stated that a Broadwater sendout pipeline interconnected with IGTS at a location farther north than IGTS MP 17 would result in reduced volumes of gas deliveries to the New York City and Long Island markets or would require construction of additional facilities (loops or compressor stations) on the IGTS system. Because the IGTS pipeline extends in a roughly northeast-southwest direction, a tie-in point closer to the Long Island shoreline than the one proposed would require a longer subsea pipeline.

Broadwater conducted a hydraulic modeling analysis of natural gas delivery rates to the New York City and Long Island markets. They determined that a sendout pipe from the FSRU to an interconnection with the IGTS pipeline located farther north than MP 17 would reduce the delivery rate of gas to New York City by 18 percent and to Long Island by nearly 30 percent. Overcoming these shortfalls in delivery volumes would require construction of approximately 20 miles of offshore pipeline loop to the IGTS pipeline and a new compressor station near Northport.

Based on these constraints, Broadwater identified a 6.5-mile portion of the IGTS pipeline between MP 17 and MP 23.5 where an interconnection would meet its objectives and the needs of the IGTS system. Broadwater then selected IGTS MP 18.2 as the optimal interconnect location based on geophysical and other environmental constraints, including minimization of pipeline length, availability of suitable soil conditions to maximize pipeline and tie-in cover, and minimization of scour potential.

Although it would not optimize natural gas deliveries to markets on Long Island and in New York City, Broadwater also considered connecting to the IGTS pipeline at MP 7.0. Connecting at this point would result in a shorter pipeline as compared to the proposed subsea pipeline.

4.5.2 Pipeline Route Alternatives

We evaluated five route alternatives that would connect the FSRU with the IGTS pipeline at IGTS MP 18.2: the North Route, the Middle Route, the Stratford Shoal Reroute, the South Route, the Scott's Beach Route, and the Shoreham Route Alternatives. Key characteristics of these route alternatives are presented in Table 4.5-1, and the routes are depicted in Figure 4.5-1.

Pipeline route alternatives were compared using the following criteria:

- •• Pipeline length ••Shorter routes generally were considered to cause less impact on the environment;
- •• Presence of shallow bedrock ••The presence of exposed or shallowly buried bedrock along a route could indicate the need for blasting and its associated environmental impacts;
- •• Number of utility crossings ••Minimizing the number of utility crossings would minimize the potential for impacts to the utilities;

TABLE 4.5-1
Comparison of Pipeline Route Alternatives

Parameter	North Route	Proposed Route	Middle Route	Stratford Shoal Reroute	South Route	Scott's Beach Route	Shoreham Route
Physical Characteristics							
Offshore length (miles)	12.4	21.7	21.5	22.3	23.5	10.7	9.9
Onshore length (miles)	0	0	0	0	0	23.3	32.0
Nearest distance to shore (miles)	2.7	3.7	4.5	2.3	1.2	0	0
Additional compression or IGTS pipeline looping required?	Yes	No	No	No	No	Yes	Yes
Shallow bedrock likely?	No	No	Yes	No	No	No	No
Marine Hazards or Obstructions and Presence of Contaminated Sediments							
Number of submarine cable crossings	2	2	2	4	4	2	2
Active or inactive dump sites crossed?	No	No	No	Yes	No	No	No
Number of lightering areas within 1 mile of route	0	1	0	1	1	0	0
Potential for contaminated sediments	High	Low	Low	Low	Low	Moderate	Moderate
Habitat Characteristics							
Presence of high-quality coastal or marine habitat?	Yes	No	No	No	No	Yes	Yes
Presence of high-quality onshore upland or wetland habitat?	No	No	No	No	No	Yes	Yes

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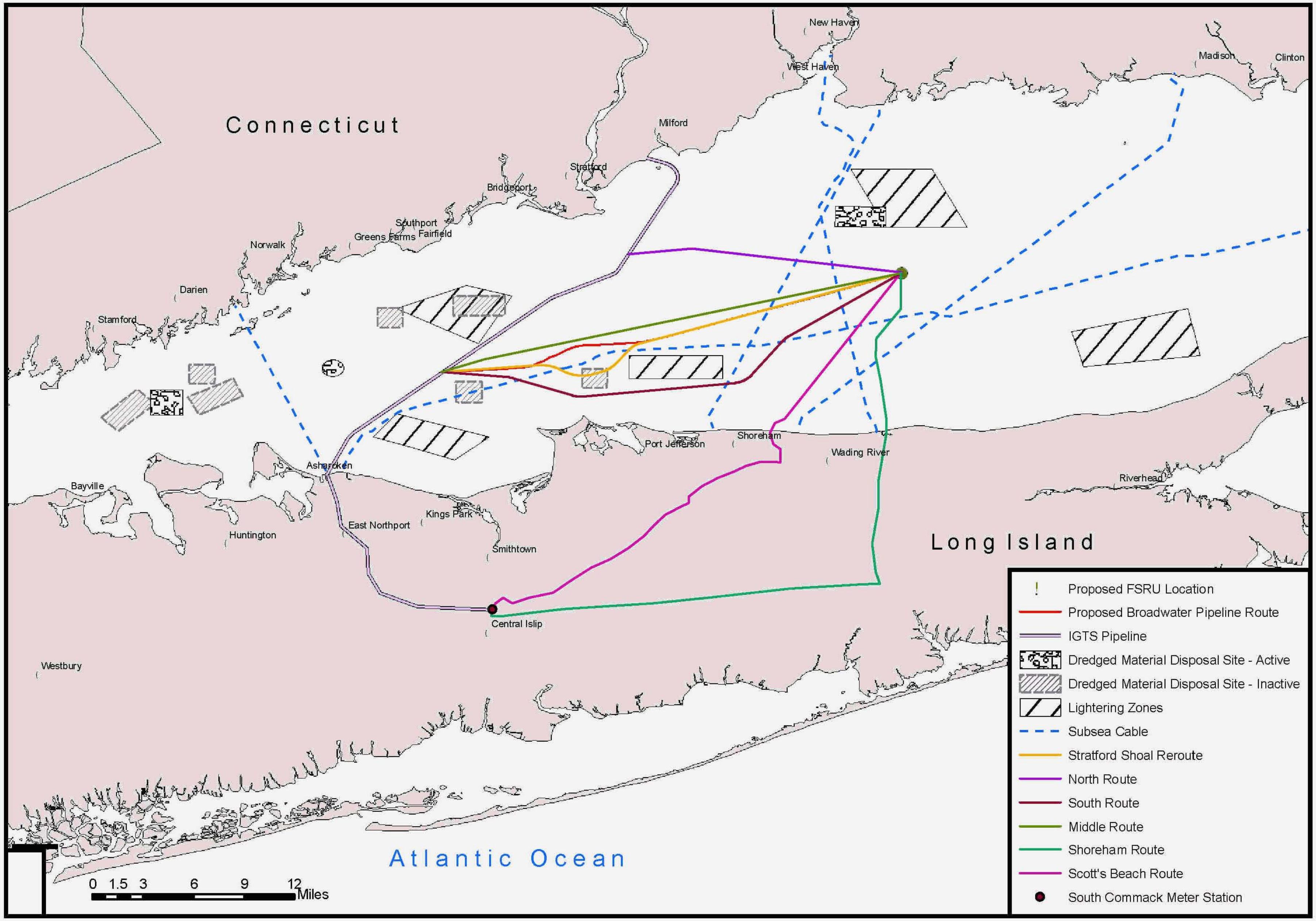

Figure 4.5-1
Broadwater LNG Project
Pipeline Route Alternatives

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- Hazards, obstructions, and restricted use areas • •Areas such as lightering zones and active and inactive dump sites could create hazards or obstacles to pipeline construction and should be avoided to the extent possible;
- Need for IGTS system upgrades • •Minimizing the need for system upgrades would minimize the potential for environmental impacts associated with implementation of the upgrades;
- Potential for encountering contaminated sediments – Minimizing the potential for resuspension of sediments during pipeline construction within areas of known sediment contamination would in turn minimize potential impacts on marine organisms;
- Offshore locations – Construction farther offshore would minimize the potential for impacts to higher quality marine benthic and coastal resources that are typically present in nearshore areas; and
- Need for onshore pipeline construction – Avoiding construction of an onshore pipeline would avoid potential impacts to residences, public places, sensitive environmental resources and aesthetics.

4.5.2.1 North Route Alternative

The North Route Alternative, which is the shortest alternative considered, would extend from the FSRU to IGTS MP 7.0 (see Figure 4.5-1). This route would be approximately 9.3 miles shorter than the proposed route and, like the proposed route, would cross two subsea utilities.

In its letter to FERC dated June 15, 2005, IGTS indicated that, if the Broadwater pipeline connected to the IGTS pipeline at a location north of IGTS MP 18.2, IGTS system upgrades would need to be constructed if the proposed volumes of gas were to be delivered to target markets in New York City and Long Island. These system upgrades could include looping the IGTS pipeline and/or adding compression at existing compressor stations or a new compressor station. These upgrades and their associated impacts would not occur with the proposed route or with the other alternatives considered.

The North Route Alternative would traverse areas reported by USGS (1998) to have a higher density and diversity of marine benthic communities than those found in the more central parts of Long Island Sound. Consequently, although this route is shorter than the proposed route, construction-related sedimentation and turbidity impacts to marine benthic communities from trenching and pipe burial likely could be greater than for the proposed route and other route alternatives considered in this analysis.

The North Route Alternative also would traverse areas of known sediment contamination. USGS (2000) data indicate that sediments along much of the North Route Alternative show much higher levels of chromium, copper, lead, mercury, nickel, and zinc than do sediments along the proposed pipeline route. Pipeline installation could result in entrainment of these contaminated sediments into the water column and could result in impacts on marine organisms.

The North Route Alternative is the shortest of the route alternatives assessed and would avoid the need to install a pipeline through the hard ground of the Stratford Shoal. However, installing a pipeline along this route would result in impacts to higher quality marine benthic resources than the proposed route, and there is a greater potential to release contaminated sediments during construction along this route. In addition, the North Route Alternative requires capacity and/or compression upgrades to the IGTS pipeline, which would result in greater benthic impacts associated with pipeline looping and/or air emissions than use of the proposed route. Since the North Route Alternative would not reduce environmental impacts relative to the proposed route, it was not considered further.

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4.5.2.2 Middle Route Alternative

The Middle Route Alternative is essentially a straight-line route between the FSRU and the proposed tie-in location at IGTS MP 18.2 (see Figure 4.5-1), and is approximately 0.2 mile shorter than the proposed route. However, this route would traverse a portion of the Stratford Shoal where bedrock may be present at or near the seabed surface (USGS 2000, 2005b). The likely presence of bedrock along this route increases the likelihood that blasting could be necessary to achieve the depth of cover required by pipeline safety regulations.

While the Middle Route Alternative is similar to the proposed pipeline route in length and general location, impacts associated with pipeline construction—particularly if blasting were required—would be greater than for the proposed route. Since the Middle Route Alternative would not reduce environmental impacts relative to the proposed route, it was not considered further.

4.5.2.3 Stratford Shoal Reroute Alternative

The Stratford Shoal Reroute Alternative follows the same alignment as the proposed pipeline route for most of its length (see Figure 4.5-1). In the vicinity of the Stratford Shoal, this alternative deviates approximately 2.5 miles south of the proposed route to traverse an area south of Stratford Shoal, where sandy and silty sediments are present (USGS 2000, 2005b).

While the Stratford Shoal Reroute Alternative would avoid the need to install a pipeline through the hard ground of the Stratford Shoal, a pipeline constructed along this route would be 0.8 mile longer than the proposed pipeline. This alternative would require that the pipeline be installed through a historical dredge disposal site offshore of Port Jefferson. Broadwater's investigations of the historical dump indicated that contamination problems are not likely.

While impacts under this alternative route would be similar to the proposed Project Route, the Stratford Shoal Reroute Alternative would require two crossings of the FLAG Atlantic-1 North fiber optic cable. The subsea crossings of the FLAG Atlantic-1 North Cable are a concern because the cable provides the primary physical connection for phone and data transmission service between the United States and Europe, and the crossings represent a potential risk to the cables. Considering the additional length and the cable crossings, the Stratford Shoal Reroute Alternative would not reduce environmental impacts relative to the proposed route.

4.5.2.4 South Route Alternative

Like the Stratford Shoal Reroute, the South Route Alternative was developed to avoid the need to install the pipeline through the harder substrate of the Stratford Shoal. Along much of its length, this alternative would be between 3 and 4 miles south of the proposed route and would avoid the former dredge disposal site as well as a large lightering area (see Figure 4.5-1).

The South Route Alternative would be approximately 1.2 miles longer than the proposed route and would require two crossings of the FLAG Atlantic-1 North fiber optic cable. Although this route alternative would avoid the potential impacts associated with installing a pipeline through the hard ground of the Stratford Shoal, the added length in comparison to the proposed route would result in increased impacts. As described for the Stratford Shoal Reroute Alternative, the two crossings of the FLAG Atlantic-1 North cable represent potential impacts to operation of the phone and data lines that would not be associated with the proposed route. As a result, we concluded the South Route Alternative would not reduce environmental impacts relative to the proposed route.

4.5.2.5 Shoreham Route and Scott's Beach Route Alternatives

Two additional route alternatives (the Shoreham Route and Scott's Beach Route Alternatives) were developed at the request of NMFS to reduce the total length of pipeline construction within Long Island Sound. The Shoreham Route Alternative would include a 9.9-mile-long 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-long onshore pipeline would be traverse southward parallel to the proposed Islander East pipeline route then travel westward to a tie-in with the IGTS pipeline at IGTS's South Commack Meter Station near Smithtown, New York (see Figure 4.5-1). The Scott's Beach Route Alternative would include a 10.7-mile-long offshore pipeline that would extend southwesterly from the proposed FSRU location to a landfall location at Scott's Beach near Miller Place, New York. From there, an approximately 23.3-mile-long onshore pipeline would be constructed primarily along existing roadways to tie-in with the IGTS pipeline at IGTS's South Commack Meter Station near Smithtown, New York (see Figure 4.5-1).

Both the Shoreham Route and Scott's Beach Route Alternatives would result in construction of a shorter pipeline within Long Island Sound than the proposed Project. However, both would require pipeline construction through sensitive nearshore and coastal resources. Further, with the Shoreham Route Alternative, the onshore pipeline would require extensive construction through residential and recreational areas, with the potential to affect dozens of existing homes. The Shoreham Route Alternative also would involve pipeline construction through approximately 8 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.

We understand that IGTS is considering construction of a 24-inch-diameter Brookhaven Lateral that would connect an as yet undeveloped power plant in the central portion of Long Island to the South Commack Meter Station. At present, no specific route has been proposed for this lateral, and it is not certain that the lateral would be approved or constructed.

Based on the potential for greater environmental impacts, both the Shoreham Route and the Scott's Beach Route Alternatives were removed from further consideration.

4.5.2.6 Conclusions Regarding Pipeline Route Alternatives

Our assessment indicates that the proposed pipeline route would have fewer environmental impacts than the alternative routes we considered. The proposed route provides the following advantages over the other alternative routes:

- Minimizes pipeline length while achieving other screening criteria;
- Avoids the need for construction in areas of shallow bedrock;
- Minimizes the number of utility crossings;
- Avoids or minimizes impacts to marine hazards and restricted areas;
- Avoids the need to construct in areas with extensive contaminated sediments;
- Minimizes impacts to sensitive marine habitats; and
- Eliminates the need to construct an onshore pipeline.

The North Route, Shoreham Route, and Scott's Beach Route Alternatives would result in shorter offshore pipelines than the proposed route while minimizing impacts to shallow bedrock, utilities, and marine hazards. A pipeline constructed along the North Route Alternative would require upgrades to the IGTS system that would result in additional benthic impacts, would require sediment disturbance in areas of known contamination, and would affect higher quality marine resources as compared to the impacts of the proposed route. It also would result in more air quality impacts than the proposed Project due to the need for additional compression. A pipeline constructed along the Shoreham Route or Scott's Beach Route Alternative would traverse higher quality nearshore marine resources and would require construction of an onshore pipeline through residential and recreational areas, and additional compression. Therefore, we concluded that all of the pipeline route alternatives evaluated would result in greater environmental impact than the proposed route.

4.6 PIPELINE CONSTRUCTION ALTERNATIVES

Because our alternatives analysis indicated that the proposed route would result in less environmental impact than the alternative routes considered, we evaluated alternative installation methods along the proposed pipeline route to determine whether or not they could minimize the impacts of pipeline installation.

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, we recommended that Broadwater use mid-line buoys on all anchor cables to eliminate or minimize the impacts of cable sweep. Where deployed and maintained correctly, the use of mid-line buoys on all anchor lines has been demonstrated to virtually eliminate bottom impacts associated with anchor cable sweep (URS Greiner 1998). After lowering the pipeline to the seabed, the proposed pipeline installation approach would involve the use of the same anchored lay barge to pull a subsea plow that would excavate a trench beneath the pipeline. Additional information on the proposed methods for pipe installation is presented in Section 2.3.2.

For pipe lay activities, we evaluated the use of a non-anchored, dynamically positioned lay barge as an alternative to an anchored lay barge (Section 4.6.1). We also evaluated two alternative techniques for installing and covering the pipeline in Section 4.6.2: post-lay jetting and pre-lay trenching.

4.6.1 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, thus avoiding the impacts associated with anchor placement and anchor line contact with the seafloor.

If a dynamically positioned lay barge was used for the Project, impacts associated with anchor placement and anchor cable sweep (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 at some locations where water depth is shallow, resulting in an increase in turbidity. If Broadwater incorporates the recommendation for mid-line buoys for all anchors into the Project, the impacts of anchor cable sweep would be substantially reduced (see Section 3.1.2.2) and much of the potential environmental advantage to using a dynamically positioned lay barge for the Project would no longer apply.

4.6.2 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. We evaluated two alternative methods for achieving pipeline burial and cover: the use of a subsea jetting sled to bury the pipe after it is laid on the seafloor (Section 4.6.2.1), and construction of a dredged trench prior to pipe lay (Section 4.6.2.2). Table 4.6-1 lists the key characteristics of the alternative pipeline installation methods. NYSDEC has expressed a preference for use of the subsea plow method.

TABLE 4.6-1
Comparison of Alternative Pipeline Installation Methods

Criterion	Subsea Plow (Proposed)	Subsea Jetting Sled	Pre-lay Dredge
Anticipated trench width (feet)	25	40[a]	54[b]
Anticipated total construction width (feet)[c]	75	100 to 300[d]	100 to 200[e]
Anticipated impact area (acres)[c, f]	197.3	526.1	394.5
Anticipated level of turbidity	Low	High	Moderate

a Source: FERC 2002b.

b Assumes a 40-foot-wide box cut with a 2:1 side slope.

c Does not include anchor or anchor cable impact area. We anticipate that these would be similar for all installation alternatives.

d Source: TFOLIS 2003.

e Assumes that spoil material would be sidecast except along 1 mile through the Stratford Shoal, where excavated material would be brought to a barge for disposal.

f The impact area was calculated as the average width of the construction area multiplied by 21.7 miles of pipeline.

4.6.2.1 Subsea Jetting Sled Alternative

Under this alternative, a jet sled would be used to excavate the pipeline trench after the pipe is placed on the sea floor. As for 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, by 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 on 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 (2002) estimated a similar jetted trench width in its final EIS for the Islander East Pipeline Project. The trench width likely would 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 that sediments would affect a 100- to 300-foot-wide area beyond the trench (with the width dependent on the sediment characteristics, current velocity, and other variables), and the total area of seabottom impacts would increase to approximately 526 acres from about 197 acres for the proposed

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method. Because a jet sled would disperse sediment over a wider area than the proposed plowing method, we anticipate that the increase in turbidity and redeposition of sediment would be of greater magnitude and longer duration than for the proposed pipeline installation approach. Therefore, we determined that the proposed plow method would have less environmental impact than the Subsea Jetting Sled Alternative.

4.6.2.2 Pre-lay Dredge Alternative

Under this alternative, the trench would be excavated prior to lowering the pipe to the sea floor, using a barge-mounted excavator or clamshell dredge. Sediment removed from the trench would be placed on one or both sides of the trench; 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 a greater increase in turbidity and redeposition of sediment than would occur with the proposed pipeline installation approach. Therefore, the Pre-lay Dredge Alternative e was not considered further since it would result in greater environmental impacts than the proposed construction methods.

4.6.2.3 Conclusions Regarding Pipeline Construction Alternatives

Our evaluation of construction alternatives for the proposed Project was confined to alternative means for laying the pipeline on the sea floor and burying it. We determined that the use of a conventional anchored lay barge would result in similar impacts to those that would occur with use of a dynamically positioned lay barge, provided that the former employed mid-line buoys on all anchor lines to eliminate anchor cable sweep as we recommend. We also determined that neither the use of a jetting sled or pre-lay dredging would result in fewer impacts than the proposed method of subsea plowing.

4.7 ALTERNATIVE VAPORIZATION METHODS

As described in Section 2.4.1, 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 shell-and-tube vaporization (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 (see Section 2.1.1.4). We evaluated three alternative vaporization technologies and their potential environmental impacts in the following sections:

- Ambient-air-heated vaporization (Section 4.7.1);
- Open rack vaporization (ORV) (Section 4.7.2); and
- Submerged combustion vaporization (SCV) (Section 4.7.3).

Section 4.8.4 provides a summary of our evaluation of alternative vaporization methods, and Table 4.7-1 lists the key characteristics of each of the methods we assessed.

TABLE 4.7-1 Comparison of Alternative Vaporization Methods[a]				
Characteristic	Ambient-air-heated Vaporization	Open Rack Vaporization	Submerged Combustion Vaporization	Shell-and-tube Vaporization (Proposed)
System capable of year-round operation in Long Island Sound?	No	No	Yes	Yes
Average daily seawater requirement (gallons per day)	0	134 million	0	0
Freshwater production (gallons per day)	N/A	0	173,000	0
NO_x emissions (ppm)	N/A[b]	N/A[b]	4[c]	2.5[c]
CO emissions (ppm)	N/A[b]	N/A[b]	10[c]	5[c]

N/A = Not applicable.

ppm = Parts per million.

[a] Sources: Yang and Huang 2004, Coast Guard 2006.

[b] Assumes that no supplemental heat source is used.

[c] Based on system operating with selective catalytic reduction units for emissions reduction.

4.7.1 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 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 SCVs or STVs during cooler weather.

4.7.2 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 waterbody. 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 greater than 50°F (Black and Veatch 2006). Warmer water temperatures are better and may reduce the volume of water required. When seawater temperatures drop below 50 °F, supplemental methods of LNG warming would need to be implemented. Typically, supplemental heating would be provided using submerged heaters similar to those used for SCV systems (see Section 4.7.3) or using an STV system. Both methods of supplemental heating would result in air emissions (see Table 4.7-1). Because the water temperature in

Long Island Sound is often below 50°F, use of an ORV system for the Broadwater Project also would require a supplemental heating system.

The intake of seawater associated with ORV systems affects marine life through impingement and entrainment of small fish, shellfish eggs and larvae, some shellfish adults, and other components of the ichthyoplankton that are unable to escape from the intake area. The discharge of cooled water also would 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.

4.7.3 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 freshwater.

The submerged combustion units use vaporized LNG (natural gas) for fuel and 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 NO_x (see Table 4.7-1). 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, but these emissions would still be greater than the emissions associated with the proposed STV system.

4.7.4 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 associated with the proposed STV system and would require the discharge of treated freshwater to Long Island Sound.

In summary, none of the alternative LNG vaporization methods considered in our evaluation would reduce environmental impacts relative to the proposed STV system. We therefore have eliminated these vaporization alternatives from further consideration.

4.8 ALTERNATIVE ONSHORE FACILITIES LOCATIONS

To support the operation of the FSRU and pipeline, Broadwater has indicated that it will require waterfront access for tugs and other vessels serving construction and operation of the Project, along with access to nearby office space and warehouse space. Broadwater proposes to lease existing facilities in

Greenport or Port Jefferson, Long Island, or perhaps lease both sites (see Figures 2.4-2 and 2.4-3). At both sites evaluated, the existing facilities have been used for similar purposes. In addition, Broadwater is not proposing any modification to either site except for installation of a perimeter fence and a security checkpoint/guard station. Use of these sites would not result in significant impacts, and neither site appears to offer an environmental advantage over the other.

4.9 ALTERNATIVE POWER SOURCES FOR BERTHED LNG CARRIERS

While berthed at the FSRU, LNG carriers would need to generate 10 MW or more of electrical power for LNG transfer operations, maintenance of the hazard detection and emergency shutdown systems, and other vessel functions. Berthed LNG carriers generate this electrical power onboard. Per a request by EPA, we evaluated whether the FSRU could supply electrical power to a berthed LNG carrier. Under this alternative, berthed LNG carriers would receive electrical power from the FSRU via a flexible cable connection system, which would be attached to the carrier following berthing and detached just prior to unberthing.

Because berthed LNG carriers generate electricity using fuel oil rather than regasified LNG (see Section 3.9.1.2), the use of FSRU-generated power could reduce air emissions, particularly SO_x, associated with the Project. The use of FSRU-generated power would also eliminate the need for LNG carriers to take in and discharge engine cooling water. However, the current fleet of LNG carriers is not designed to receive externally generated electrical power while berthed at an LNG terminal and would need to be redesigned and retrofitted in order to do so. Further, the LNG carriers require an uninterrupted power supply for continuous operation of their hazard detection and emergency shutdown systems; power for these systems would not be available during attachment and detachment of the FSRU power cables. Finally, the connection, management, and disconnection of the large cables that would be needed to transfer electrical power from the FSRU to a berthed LNG carrier would increase the residence time of the carrier at the FSRU and could impair the quick departure of an LNG carrier in the event of an emergency. For these reasons, we do not consider the use of FSRU-derived electrical power a feasible alternative for powering berthed LNG carriers.

4.10 SUMMARY OF CONCLUSIONS FOR ALTERNATIVES CONSIDERED

Our assessment of alternatives addressed the No-action and Postponed-action Alternatives, alternative energy sources, system alternatives, alternative LNG terminal concepts and sites, onshore facility alternatives, alternative pipeline routes, pipeline installation alternatives, and alternative LNG vaporization methods. We determined that, with the No-action and Postponed-action Alternatives, the projected energy needs for the New York City, Long Island, and Connecticut markets would not be met. We assessed the use of alternative energy sources (nonrenewable fuel, renewable energy sources, and conservation) to meet the area's energy needs but found that nonrenewable sources would either result in greater impacts (oil and coal) or would be impracticable for the area (nuclear) and that renewable energy sources, as well as existing and proposed energy conservation measures, meet only a small fraction of the projected energy demands for these markets for the foreseeable future, whether considered alone or in combination.

Our assessment also indicated that none of the existing or proposed pipeline systems or the existing, proposed, or planned LNG terminals could meet all of the objectives of the Project without major system upgrades that would result in substantially greater environmental impacts than those of the proposed Project.

In assessing alternative LNG terminal designs and locations, we considered the following criteria:

- Construction within or adjacent to water at least 50 feet deep to allow LNG carriers to transfer cargo without nearshore dredging or dock construction, which would result in impacts to nearshore natural resources and recreational use;
- Interconnection with the IGTS pipeline system to minimize pipeline length and associated environmental impacts;
- Location as far from shorelines as feasible in Connecticut and Long Island to minimize safety concerns and visual impacts;
- Location to minimize interference with commercial marine traffic; and
- Length of the sendout pipeline to minimize the associated construction-related impacts to the seafloor.

Each of the alternative types of terminals considered in our evaluation would result in greater environmental impacts than those that would result from using the proposed FSRU design. An onshore LNG facility would be closer to populated areas and would require dredging and construction of berthing and/or pipeline support facilities in sensitive nearshore waters. Construction and operation of a GBS terminal would result in much greater seabottom impacts than an FSRU and would require that the facility be closer to shore than the proposed Project. A GBS also would require construction of a large-scale graving dock facility, with the magnitude of associated impacts dependent on the location of the facility; no such impacts would be associated with the proposed Project. An SRV- or FRU-based LNG terminal also would result in greater seabottom impacts than those of the proposed Project, would not provide the LNG storage benefits of an FSRU, and would not be technically feasible within the waters of Long Island Sound due to the lack of deepwater areas. Therefore, the FSRU design was considered to have less environmental impact than the alternatives we assessed.

None of the alternative FSRU sites considered in our evaluation would result in fewer environmental impacts than those of the proposed Project site. The environmental impacts associated with an FSRU sited in either Block Island Sound or the Atlantic Ocean would be substantially greater than those of the proposed Project due to the need to construct a substantially longer pipeline to connect the terminal to the existing natural gas transmission system. In considering areas within Long Island Sound, we eliminated all areas west of a line drawn 3 miles east of the Bridgeport-Port Jefferson ferry route to avoid conflicts with the ferry system. In addition, an FSRU sited in western Long Island Sound would result in greater potential for visual impacts and likely would require construction in more sensitive marine habitats than the proposed Project.

An FSRU located east of the proposed site would require a longer pipeline to connect to the IGTS pipeline and would increase the environmental impacts without gaining other environmental advantages. In addition, the FSRU would be closer to shore and the visual impacts would be greater. Because sites to the west would be closer to the IGTS pipeline than the proposed Project, they would reduce the length of the required pipeline and associated benthic impacts; but these sites would increase visual impacts due to closer proximity to shore and would result in greater interference with commercial vessel traffic. Location of the FSRU north or south of the proposed site also would increase interference with commercial vessel traffic.

Alternative pipeline routes considered required a balance between engineering constraints on potential interconnection locations with the IGTS pipeline and the need to minimize impacts to the marine environment. Our assessment indicated that the proposed pipeline route would result in less environmental impact than the five alternative routes we considered.

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The shortest routes were the North Route, Shoreham Route, and Scott's Beach Route Alternatives. The North Route Alternative would require upgrades to the IGTS system that would involve additional compression, result in additional benthic impacts, involve sediment disturbance in areas of know contamination, and affect higher quality marine resources as compared to the impacts of the proposed route. A pipeline constructed along either the Shoreham Route or the Scott's Beach Route Alternative would affect higher quality nearshore marine resources and would require construction of an onshore pipeline through residential and recreational areas, as well as additional compression. The three remaining alternatives were slightly longer than the proposed route, involved more crossings of utility lines, and/or crossed areas where bedrock may be present and blasting could be required.

In our assessment of alternative methods for constructing the proposed pipeline, we concluded that use of a conventional anchored lay barge and use of a dynamically positioned lay barge would result in similar environmental impacts, provided that the anchored lay barge method included mid-line buoys on all anchor lines as we recommend. None of the alternatives considered for pipe lowering would result in fewer environmental impacts than the Project as proposed.

The proposed LNG vaporization method would result in the least environmental impacts of the alternatives evaluated. In its initial design, Broadwater considered the use of an SCV system, which would have been less costly to construct and operate than an STV-based system. However, air emissions are greater with SCV systems and Broadwater incorporated the STV system into the Project in response to agency concerns. ORV could be used during warmer months and STV during cooler months, but ORV would result in entrainment and impingement issues due to the large volume of water intake required by the system.

We evaluated the potential of using FSRU-derived electricity to power berthed LNG carriers. While such a system likely would reduce air emissions associated with the Project, it would require extensive redesign of the LNG carrier fleet serving the Project, would not allow for interrupted use of the LNG carrier's hazard detection and emergency management systems, and could hamper the departure of an LNG carrier from the FSRU in the event of an emergency.

In summary, we analyzed alternatives that could meet the purpose and need for the Project and determined that construction and operation of the proposed Broadwater Project, as modified by the mitigation measures recommended by FERC and the Coast Guard, would result in less of an environmental impact that the alternatives considered.