3.0 ALTERNATIVES

In considering Crown Landing's and Texas Eastern's applications, the FERC will review both the environmental and non-environmental record in deciding whether it is in the public convenience and necessity to issue any authorization for the project. The EIS addresses alternatives to the proposed actions before both the FERC and the Coast Guard. The proposed action before the FERC is to consider issuing to Crown Landing a section 3 authorization for the LNG import facilities and to Texas Eastern a section 7 Certificate for a new natural gas pipeline.

The proposed action before the Coast Guard is to consider issuing Crown Landing an LOR finding the waterway suitable for LNG marine traffic, with certain conditions. These conditions are outlined, in part, in the Coast Guard's December 1, 2005, letter to FERC (attached as Appendix L). Specifically, these conditions require that all agencies that would be involved in navigation safety and maritime security aspects of LNG vessels transiting to and operating at the Crown Landing terminal be adequately staffed, equipped, and funded to fully implement the safety and security measures. These measures include, but are not limited to, security zones around the LNG carriers, a vessel traffic control plan, escorts by armed law enforcement vessels, a variety of waterway and shoreline surveillance measures, and multi-agency cooperation and communication. Specific details of these measures are further outlined in the Coast Guard's December 19, 2005, letter to FERC which has been designated Sensitive Security Information as defined in Title 49 CFR Part 1520. Because any unauthorized disclosure of these details could be employed to circumvent the proposed security measures, they are not releasable to the public.

In accordance with NEPA and Commission policy, we have evaluated a number of alternatives to the Crown Landing LNG Project and Logan Lateral Project to determine if any are reasonable and environmentally preferable to the proposed actions. Alternatives described in the following sections include no action or postponed action, system alternatives, LNG terminal site alternatives, LNG pier alternatives, and pipeline alternatives. Reasonable alternatives to the Coast Guard proposed action include: 1) issuance of a Coast Guard LOR finding the waterway suitable for LNG marine traffic without any conditions; 2) postponing the issuance of a Coast Guard LOR pending further analysis and study; and, 3) issuance of a Coast Guard LOR finding the waterway not suitable for LNG marine traffic (no action alternative).

The evaluation criteria for selecting potentially reasonable and environmentally preferable alternatives include whether they:

- are technically and economically feasible, reasonable, and practical;
- offer significant environmental advantage over the proposed projects; and
- meet the project objectives of providing additional natural gas supplies to meet the increasing energy demand in the Mid-Atlantic region through its interconnection with the interstate natural gas pipeline grids.

With respect to the first criteria, it is important to recognize that not all conceivable alternatives are technically and economically feasible and practical. Some alternatives may be impracticable because they are unavailable and/or incapable of being implemented after taking into consideration costs, existing technologies, and logistics in light of the overall project purpose. In conducting a reasonable analysis, it is also important to consider the environmental advantages and disadvantages of the proposed action and to focus the analysis on those alternatives that may reduce impacts and/or offer a significant environmental advantage.

Through the application of evaluation criteria and subsequent environmental comparisons, each alternative was considered to a point where it was clear that the alternative was not reasonable or would result in significantly greater environmental impacts that could not be readily mitigated. Those alternatives that appeared to be the most reasonable with less than or similar levels of environmental impact are reviewed in the greatest detail.

3.1 NO ACTION OR POSTPONED ACTION

The Commission has three alternative courses of action in processing an application to construct an LNG import terminal and natural gas pipeline facility. It may: 1) deny the approvals; 2) postpone action pending further filings or study; or 3) grant the approvals with or without conditions.

For the Coast Guard's proposed action, the no action alternative would be issuance of an LOR which finds the waterway not suitable for LNG marine traffic.

If the Commission denies the section 3 authorization or section 7 Certificate or postpones action on the application, the short- and long-term environmental impacts identified in this EIS would not occur. If the Commission selects the no action or postponed action alternative, however, the objectives of the proposed project would not be met and Crown Landing would not be able to provide a new and competitively priced supply of natural gas to the Mid-Atlantic region. It is purely speculative to predict the resulting effects and actions that could be taken by other suppliers or users of natural gas in the region as well as any associated direct and indirect environmental impacts. However, demand for energy in the Mid-Atlantic region is predicted to increase, thus without the proposed projects, customers would have fewer and potentially more expensive options for obtaining natural gas supplies in the near future. Higher natural gas prices could adversely influence the regional economy by reducing realized household incomes and business profits (Greenspan, 2003). Higher natural gas prices (or the threat of higher gas prices) could also lead to alternative proposals to develop natural gas delivery or storage infrastructure, increased efficiency and conservation, reduced use of natural gas, and/or the use of other sources of energy. These might include renewable sources of energy, nuclear power, or other fossil fuels.

The effect of higher natural gas prices on the increased demand for other fuels is supported by the energy consumption projections provided in EIA's Annual Energy Outlook 2004 report. The projections for the national growth of total coal consumption increased 0.3 percent from 2003 to 2004 primarily due to higher natural gas prices. Higher natural gas prices were also cited as a reason for the projected increased demand for total renewable fuels (EIA, 2004).

Alternatives to the Coast Guard Action

Similar to the no action alternative to the FERC proposed action, the no action alternative for the Coast Guard would avoid any project related environmental effects in the waterway; however, it would also prevent LNG vessels from delivering LNG to the proposed an import terminal and the project objectives would not be met.

If the Coast Guard postpones issuance of an LOR pending further analysis and study, the effect is expected to be similar to FERC postponing its action. That is, although it is speculative to predict the resulting effects, postponing issuance of an LOR may lead to Crown Landing deciding to delay its entire project.

A reasonable alternative to the Coast Guard action of issuing a LOR which finds the waterway suitable for LNG marine traffic with certain conditions discussed on the previous page is to issue an LOR without any conditions. This would avoid the environmental effects related to any moving safety and/or

moored vessel security zones, or other related LNG safety and security activities, which the Coast Guard would determine to be necessary prior to the commencement of LNG vessels transiting the waterway. We are unable to quantify the impacts at this time due to uncertainty in the scope, frequency, prevailing maritime security levels, and the number of resources that would be dedicated on a recurring or episodic basis; however, we do not anticipate any significant environmental impacts. The Coast Guard will ensure the appropriate NEPA environmental documentation for such actions is completed prior to the commencement of these activities. Also, the Coast Guard will cooperate in any required NEPA environmental analysis initiated by another agency for projects related to the introduction of LNG vessels such as any prerequisite channel deepening or dredging by the COE.

Alternative Natural Gas Infrastructure Proposals

The adoption of the no action alternative would result in the need for other LNG facilities or additional pipeline capacity to meet the increasing demand for natural gas in the Mid-Atlantic region. This might include constructing or expanding regional pipelines as well as LNG import and storage systems. Any construction or expansion work would result in specific environmental impacts that could be less than, similar to, or greater than those associated with the Crown Landing LNG and Logan Lateral Projects. We have conducted and included in this EIS an analysis of what appear to be the most reasonable natural gas and LNG system alternatives that have the potential to meet the project objectives. Section 1.2 provides additional discussion of the need for natural gas in the region.

Conservation, Efficiency, and Renewable Sources of Energy

Conservation, increased efficiency, and renewable energy practices have been and will continue to be important in meeting the future energy needs of the Mid-Atlantic states. Beginning with the energy crisis of the 1970s, numerous aggressive energy conservation programs have been developed in the Mid-Atlantic region. In addition, numerous renewable energy incentives have been implemented, including solar income tax credits, solar access laws, solar rebate programs, property tax exemptions for geothermal heat pumps, net metering, and green power marketing (EIA, 2005).

Renewable energy sources, including wind, hydropower, municipal solid wastes, wood and other biomass, and solar are projected to have some role in meeting the Mid-Atlantic's future energy needs. According to the EIA, several renewable energy sources are being used or have the potential to be used in the Mid-Atlantic region including solar energy collected with photovoltaic flat-plate collectors; wind energy; limited geothermal energy; and biomass energy such as burning willow trees with coal and biodiesel fuels. The EIA estimates that in 2006, energy consumption in the Mid-Atlantic states from renewable sources will account for about 5 percent of the region's total energy consumption as compared to estimates of 22 percent from natural gas, 42 percent from petroleum, 17 percent from coal, and 14 percent from nuclear power. The EIA also predicts that consumption of renewable energy will increase by 0.5 percent a year between 2003 and 2025. In comparison, the EIA predicts that natural gas consumption will increase over the same period by 1.3 percent per year, consumption of petroleum and coal will increase by 1.0 and 1.3 percent per year, respectively, and consumption of energy from nuclear power will increase about 0.3 percent per year (EIA, 2005).

A 2003 report by the American Council for an Energy Efficient Economy (ACEEE) analyzed projected energy demands in the Northeast, which included New York, New Jersey, Pennsylvania, Delaware, and Maryland. The ACEEE reviewed the national and regional relationship between natural gas price effects of energy efficiency and renewable energy practices and policies (ACEEE, 2003). The report found that increased installation of renewable energy generation could affect natural gas price and availability. The report concluded that energy efficiency and renewable energy measures could result in a 0.9 percent reduction by 2008 in natural gas consumption in the northeastern states. However, the study

also recognized that energy efficiency and renewable energy are not the only policy solutions required to address the future natural gas needs of the United States and that additional sources of natural gas will be required either from domestic sources or through the importation of gas in the form of LNG. An EIA study, which considers renewable energy as well as other energy sources, supports this conclusion and suggests that nuclear or renewable energies such as hydroelectric, wind, or solar, while important to the overall mix of available energy sources, will not replace the demand for natural gas over the next 20 years (EIA, 2005). Furthermore, each of these sources of energy would have project- and site-specific environmental issues such as the disposal of toxic materials, alterations to hydrological/biological systems, and visual impacts.

Nuclear Power Energy

Energy from nuclear power, while important to the overall energy mix, is not projected to grow substantially and is not a commercially viable substitute able to replace or significantly offset the demand for natural gas over the next 20 years (EIA, 2003). Furthermore, nuclear power energy involves significant environmental issues such as the disposal of toxic materials (spent fuel), alterations to hydrological/biological systems, and other concerns.

Energy from Other Fossil Fuels

Compared to other fossil fuels such as coal or oil, natural gas is a relatively clean and efficient fuel that can reduce the emission of regulated pollutants (e.g., nitrogen oxides, sulfur dioxide, and particulate matter) or unregulated greenhouse gases (e.g., carbon dioxide). Given there are emissions associated with producing, processing, transmitting, and distributing natural gas and other fossil fuels, it is difficult to accurately quantify the impact of an LNG import project on air quality. However, credible estimates of air emissions can be developed based on reasonable assumptions regarding burning natural gas delivered by the project compared to burning fossil fuels that would likely be utilized if the gas from the project was not available. Table 3.1-1 lists the emissions that would result from the Crown Landing LNG Project assuming it provides a baseload rate of about 1.2 Bcfd of natural gas to the market and the corresponding emissions that would result if an equivalent amount of energy were generated using coal or fuel oil in lieu of natural gas. It is clear from the table that the use of either fuel oil or coal would increase emissions significantly. Additionally, to comply with current air emission regulations, emission control technologies could be required that could limit the economic viability of any new oil- or coal-fired facility.

TABLE 3.1-1

Comparison of Air Emissions from Burning Fossil Fuels a/

Fossil Fuel	SO_2 (tpy)	NO_x (tpy)	PM_{10} (tpy)	CO_2 (tpy)	C (tpy)
Natural Gas	132	19,866	1,590	21,999,999	6,000,000
Fuel Oil	103,971	39,735	2,253	31,899,999	8,700,000
Coal	278,142	139,071	6,159	41,799,999	11,400,000

a/ The emissions generated by coal, fuel oil, and natural gas were estimated using recent Best Available Control Technology (BACT) analyses identified on the EPA Reasonably Available Control Technology/BACT/Lowest Achievable Emission Rate Clearinghouse for boilers with heat input ratings between 100 and 250 million Btus per hour. The emissions from each fuel source are estimated based on a total annual fuel use of 438,000,000 million Btus per year (1.2 billion cubic feet per day, 365 days per year, 1,000 Btus/cubic foot).

SO_2 sulfur dioxide
NO_X nitrogen oxides
PM_{10} particulate matter
CO_2 carbon dioxide
C carbon
tpy tons per year

In addition to the increased emissions associated with the burning of coal or fuel oil, each of these fuels would also have to be imported into the project area and stored, similar to the proposed LNG. Also, since there is no pipeline infrastructure in place to distribute these fuels to market in the Mid-Atlantic, use of these fuels would require more truck, barge, and train trips than the distribution of an equivalent amount of energy derived from natural gas, which would increase air emissions and traffic congestion. The burning of coal would also require disposal of the resulting ash.

No Action or Postponed Action Conclusions

As described in section 1.2, the demand for natural gas is expected to continue to increase into the future. Although not expected, it is conceivable that this demand could be moderated by increasing use of other energy sources and/or conservation measures. Because natural gas is the least polluting of the fossil fuels, the increased use of other fossil fuels would result in higher air emissions that can contribute to climate change, acid rain, and smog. The economic, ecological, and human health benefits of reduced air emissions have been well documented (EPA, 1999). It is also conceivable that increasing energy efficiency and use of renewable sources of energy could reduce the projected future demand for natural gas. However, it is noteworthy that a report by the ACEEE (2003) concluded that additional energy efficiency and renewable energy projects could reduce the consumption of natural gas in the region by only about 0.9 percent by 2008. EIA (2004) estimates, which include increased use of renewable energies, support this conclusion. Neither conservation measures nor renewable energy sources are expected to replace or significantly offset the demand for additional natural gas supplies in the Mid-Atlantic region.

As noted above, if the no action or postponed action alternative is adopted by either the Commission or the Coast Guard there are two likely outcomes: 1) negative environmental (i.e., increased air emissions and disposal of spent fuel and ash) and economic impacts associated with more limited supplies of natural gas; and/or 2) the development of other natural gas infrastructure projects (i.e., construction of additional pipelines and LNG import terminals) that meet some or all of the project objectives identified by Crown Landing.

3.2 SYSTEM ALTERNATIVES

System alternatives are options to the proposed action that would make use of other existing or proposed LNG or natural gas facilities to meet the stated objectives of the proposed project. A system alternative would make it unnecessary to construct all or part of the proposed project even if some modifications or additions to the existing or proposed facilities are necessary. These modifications or additions would result in environmental impacts that could be less, similar to, or greater than those associated with construction of the proposed project. Ultimately, the purpose of identifying and evaluating system alternatives is to determine whether potential environmental impacts associated with the construction and operation of the Crown Landing LNG and Logan Lateral Projects could be avoided or reduced by using another system.

The Mid-Atlantic natural gas market is concentrated in Delaware, Maryland, New Jersey, New York, and Pennsylvania. Currently, this market area is supplied with natural gas and vaporized LNG through interstate pipeline systems and an existing LNG import terminal in Cove Point, Maryland. As described in section 1.2, the objectives of the Crown Landing LNG Project are to provide:

- a new LNG import terminal in the Mid-Atlantic region;
- storage facilities for LNG;

- access to natural gas reserves in production areas throughout the world that are inaccessible by conventional pipelines; and

- a new supply of up to 1.4 Bcfd of natural gas to the Mid-Atlantic region as well as other portions of the East Coast.

The analysis below examines other potential existing, modified, or proposed LNG terminals and pipeline systems and considers whether these systems could meet the proposed project objectives.

3.2.1 Existing Onshore and Offshore LNG Facilities

Currently, there are four onshore and one offshore LNG terminals in operation in the United States. These include the Cove Point LNG Terminal in Cove Point, Maryland; Distrigas LNG Terminal in Everett, Massachusetts; Trunkline LNG Terminal in Calcasieu Parish, Louisiana; Southern LNG Terminal on Elba Island in Chatham County, Georgia; and the Gulf Gateway Offshore LNG Terminal in the Gulf of Mexico, offshore of Louisiana. The closest of these terminals is the Cove Point LNG Terminal, which is located about 115 miles from the project area. The other LNG import terminals are located considerably further away. For these existing facilities to meet the proposed project objectives, one or more of the facilities would need to provide similar ship unloading, storage, and sendout capacities as the proposed project in addition to its current or planned expansion capacities.

Cove Point LNG Terminal

An LNG import terminal owned by Dominion Cove Point LNG, LP (Dominion) is located on the western shore of the Chesapeake Bay in Calvert County, Maryland. Although originally authorized in 1972, the Cove Point LNG Terminal was decommissioned as an LNG import facility in the early 1980s, and in 1995 returned to service as a peakshaving facility, liquefying, storing, and vaporizing LNG as needed to meet demand. In 2001 and 2002, Dominion received authorization from the FERC to reactivate, repair, and replace various offshore and onshore facilities to convert the existing peakshaving plant and recommission the LNG import terminal, and was completed and placed in service in December 2004. This reactivation included the replacement of the vaporizer components and the addition of a new 135,000 m^3 LNG storage tank in addition to the four existing 60,000 m^3 tanks. The LNG terminal now has 375,000 m^3 of LNG storage capacity and is capable of delivering a total of about 1.0 Bcfd of natural gas. The facility also has a maximum ship unloading capacity of 120 ships per year. The LNG terminal is connected to a mainline pipeline system by an 87-mile-long, 36-inch-diameter sendout pipeline. Dominion has long-term binding precedent agreements for 100 percent of the firm LNG unloading, storage, and delivery services.

On April 15, 2005, Dominion filed applications in Dockets No. CP05-130-000 , CP05-131-000, and CP05-132-000 to expand the LNG terminal and associated sendout pipelines, which would increase the daily sendout capacity from 1.0 Bcfd to 1.8 Bcfd and increase the storage capacity from 7.8 Bcf to 14.6 Bcf. The planned expansion, which is referred to as the Cove Point Expansion Project, would include the construction of two additional 160,000 m^3 LNG storage tanks on the existing LNG terminal site and the construction of five new natural gas pipelines totaling about 161 miles in length to deliver additional capacity to pipeline systems in Virginia and Pennsylvania. These pipelines would include about 48 miles of 36-inch-diameter pipeline in Maryland and about 81 miles of 24-inch-diameter pipeline in Pennsylvania. As part of the new pipeline system in Pennsylvania, Dominion plans to construct 17,335 horsepower (hp) of compression at two new compressor stations. In addition, three pipelines in Pennsylvania would be constructed to support the storage and transport of natural gas at the Leidy Hub, including two 24-inch-diameter pipeline loops totaling 23 miles in length and one 20-inch-diameter pipeline loop totaling 10 miles in length. The expansion would also include adding 8,550 hp of additional

compression at two compressor stations in West Virginia, pipeline upgrades and replacements, modifications at existing aboveground facilities, and other minor facility modifications.

The FERC issued a draft EIS for the Cove Point Expansion Project in October 2005. Based on the analysis in the draft EIS, the project would result in an additional 110 LNG ship deliveries to the terminal in a year. As proposed, the additional 6.8 million decatherms per day of LNG storage at the Cove Point Terminal would be gasified at the terminal and delivered into the pipeline system and to eventual customers as natural gas. A comparison of the environmental impacts of the project relative to the Crown Landing LNG and Logan Lateral Projects is presented in table 3.2.1-1.

As described above, and as outlined in table 3.2-1, the additional pipeline and aboveground facilities for the Cove Point Expansion Project, would (with the exception of dredging and residential impacts) result in as much, if not more, environmental impact than Crown Landing's proposed LNG terminal and Texas Eastern's proposed pipeline. Therefore, this alternative does not provide a clear environmental advantage over the proposed projects.

TABLE 3.2.1-1

Environmental Comparison of Crown Landing LNG and Logan Lateral Projects to the Cove Point Expansion Project

Engineering or Environmental Factor	Crown Landing LNG and Logan Lateral Projects	Cove Point Expansion Project
Anticipated LNG Ship Deliveries (numbers)	120-150	110
Total Storage Capacity (m^3)	450,000	320,000
Sendout Capacity (Bcfd)	1.2	0.8
Compression (hp)	0	25,785
Pipeline Length (miles)	11	161
Land Disturbed (acres)	379	1,900
Permanent Right-of-Way Required (acres)	95	1,137
Forest Land (acres)	23	699
Open and Agricultural Lands (acres)	86	964
Perennial Waterbodies Crossed (numbers)	8	97
Total Wetlands Affected (acres)	23	81
Forested Wetlands Affected (acres)	14	42
Residences within 50 feet of Construction Right-of-Way (numbers)	147	58+
Dredging Required (yds^3)	1.24 million	0
Federal or State Special Status Species Potentially Occurring in the Project Area (numbers)	11	39

Additionally, although the proposed Cove Point Expansion Project could potentially deliver a substantial amount of the volumes of natural gas proposed by Crown Landing, it would not introduce a new, alternative supply of LNG that would provide additional flexibility and reliability to customers in the Mid-Atlantic region. The proposed Cove Point volumes are also fully subscribed for 20 years by

Statoil Natural Gas, LLC and would not be available to Crown Landing's customers. Moreover, the potential for further expansion of the Cove Point LNG Terminal facility is limited by the terms of a new agreement that was signed in March 2005 between Dominion, the Sierra Club, and the Maryland Conservation Council. This agreement, which replaces all previous agreements and easement, states that the proposed expansion project is to be the final expansion of the fenced area at the site for the duration of LNG operations (FERC, 2005).

Distrigas LNG Terminal

The only existing LNG import terminal in New England is the Distrigas LNG facility owned by Tractabel LNG North America, L.L.C. (Tractabel). The facility occupies a 24-acre site on the Mystic River in Boston Harbor that is surrounded by industrial development on all sides. In service since 1971, the Distrigas facility is the oldest LNG import terminal in the United States. In 2000 and 2001, the FERC authorized installation of a vapor recovery system to recover flash gas during ship unloading (which is complete), replacement of all vaporizers to be compatible with a new thermal transfer system with a new adjacent power plant (which is pending), and the installation of additional vaporizers and pumps to provide natural gas service to an electric power generation plant under construction by Sithe Mystic Development, L.L.C. (which is under construction). The facility has two tanks that can store 155,000 m^3 of LNG. When ongoing and planned construction is complete, the facility will have an installed vaporization capacity of 1.035 Bcfd, although maximum sendout is limited to 715 million cubic feet per day (MMcfd) due to pipeline capacity. A significant quantity of LNG is loaded onto LNG trucks and delivered to peakshaving facilities throughout New England. The four-bay truck station on the site can fill up to 100 trucks per day. Recently, about 50 LNG ships per year have been unloading at this facility.

The Distrigas facility is dedicated to LNG imported by Tractabel and is not operated as an open-access import terminal that provides terminalling services to other parties. To provide the same service as proposed by Crown Landing, it would be necessary to add another 450,000 m^3 of storage and up to 1.4 Bcfd of vaporization. There is no space on the existing 24-acre site to construct the additional facilities associated with the proposed Crown Landing LNG Project, nor is there available adjoining property to accommodate these facilities and the associated exclusion zones. Additionally, there are no pending proposals to expand the Distrigas LNG facility. Therefore, expansion of the existing Distrigas LNG import terminal is not a reasonable system alternative.

While it does not appear this existing facility could be reasonably expanded to satisfy all of the objectives of the Crown Landing LNG Project, it is conceivable that the facility could be expanded to provide some additional natural gas sendout capacity. For example, in 2003 the FERC received an application to review the Everett Extension Project. Although this proposal was later withdrawn by the proponents because it was not thought to be economically viable, the Everett Extension Project would allow Distrigas to mitigate some take-away constraints and allow sendout of an additional 110 MMcfd of natural gas via a pipeline operated by Algonquin. The proposed project would depend on construction of the Deer Island Lateral, which was approved by the FERC in 2002 but never constructed, and a new lateral pipeline that would extend the Deer Island Lateral to a connection with Algonquin's existing J-System, which interconnects with the Distrigas LNG facility in Everett. The facilities required for the project would include reconfiguration of existing vaporization equipment within the existing boundaries of the Distrigas property and new pipeline facilities to be constructed by Algonquin.

The pipeline facilities for the Everett Extension Project would include 12.4 miles of pipeline (which includes the Deer Island Lateral Pipeline). About 4.2 miles of this pipeline would be onshore and the other 8.2 miles would be offshore pipeline in Boston Harbor. About 2.4 miles of the offshore pipeline would be installed using HDD techniques and the remaining portion would be installed by dredging, jetting, or plowing. About 36 percent of the pipeline would be adjacent to or within roads or other utility

rights-of-ways. Construction of the onshore facilities would disturb about 75 acres of land. Construction of the offshore pipeline would disturb about 860 acres of seabed. Impacts would include temporary disruption of local roadways and recreational trails, noise during construction, increased turbidity and sedimentation as a result of offshore construction, and direct and indirect impacts on aquatic resources. Because of environmental and permitting constraints, the working conditions in Boston Harbor, and other factors, the Everett Extension Project was not considered economically viable. We are not aware of other ways in which the Distrigas LNG facility could be reasonably expanded to allow additional natural gas sendout or provide more LNG storage.

Trunkline LNG Terminal

CMS Trunkline LNG Company, L.L.C. (Trunkline LNG) currently owns and operates an LNG import facility in Calcasieu Parish, Louisiana. The existing LNG terminal includes three 95,000 m^3 storage tanks, a ship unloading dock with a full design capacity of 120 ships per year, and vaporization facilities with a maximum sendout capacity of 1 Bcfd. In December 2002, the Commission approved plans to add a second ship unloading dock, a 140,000 m^3 LNG storage tank, three first stage LNG pumps, four second stage LNG pumps, three vaporizers, and two electric generators. With the addition of these facilities, which are currently under construction, the LNG terminal will have a sustainable sendout capacity of about 1.2 Bcfd (1.3 Bcfd maximum) and a ship unloading capacity of about 175 ships per year. In February 2004, Trunkline LNG and a related subsidiary, CMS Trunkline Gas Company, L.L.C. (Trunkline Gas), announced plans to further expand sendout capacity of the terminal by adding pumps, vaporizers, and new unloading facilities to a second dock at the terminal and constructing a new 23-mile-long, 30-inch-diameter pipeline between the LNG terminal and Trunkline Gas' existing mainline pipeline system. If approved, these new facilities would increase the maximum sendout capacity of the terminal to about 1.8 to 2.1 Bcfd. Trunkline LNG currently has signed agreements with BG LNG Services, L.L.C. (BG LNG) for all of the storage and sendout capacity that will be provided by the expanded facilities.

After these expansions are completed, the Trunkline LNG facility is unlikely to have space for more storage tanks within its 125-acre fenced site. Further expansion outside of the existing fenceline is limited by other industrial facilities. Another factor potential limiting additional expansion of the Trunkline LNG facility is its ability to deliver increased volumes of natural gas to an interstate natural gas pipeline system. If the proposed pipeline is constructed, the Trunkline LNG facility would be connected to a mainline pipeline by two (one existing and one proposed) 30-inch-diameter pipelines. To deliver volumes of additional natural gas from Trunkline LNG's terminal similar to those proposed by Crown Landing would likely require extensive expansion or looping of these sendout pipelines. It is also likely that additional ship unloading facilities would be needed to deliver a volume of natural gas similar to what is proposed by Crown Landing. For these reasons, we do not consider expansion of the Trunkline LNG Terminal a reasonable system alternative.

Southern LNG Terminal

Southern LNG, Inc. (Southern LNG) owns and operates an LNG import terminal located at Elba Island along the Savannah River in Chatham County, Georgia. Currently, the Elba Island site includes a single berthing facility and LNG storage capacity of 190,000 m^3. In 2001, the FERC authorized Southern LNG to replace the existing vaporizers, increase the sendout capacity of the facility, and add Btu stabilization facilities. In 2003, Southern LNG received FERC authorization to install a new 160,000 m^3 storage tank, a new ship unloading facility with two berths, two additional first stage pumps, three additional second stage pumps, three additional vaporizers, and desuperheaters. With the addition of these facilities, which are currently under construction, the sustainable sendout capacity of the terminal will increase to about 0.8 Bcfd (1.2 Bcfd maximum) and the ship unloading capacity of the terminal will increase to about 118 LNG ships per year. Southern LNG currently has a long-term, firm contract for 100

percent of the existing LNG unloading, storage, and delivery capacity and has a 30-year binding precedent agreement for the capacity that would be provided by the expanded facilities.

Currently, the Southern LNG facility is connected to Southern Natural Gas Company's (SNG) mainline pipeline system by two small-diameter (20-inch and 14- to 16-inch) pipelines that are about 200 miles long. To deliver significant additional volumes of natural gas from Southern LNG's terminal would likely require extensive expansion or looping of its sendout pipeline. Additionally, it may be necessary to expand SNG's mainline pipeline system to deliver the proposed volumes of natural gas to the broader U.S. market.

SNG filed an application for an expansion, Docket No. CP05-388-000, for authorization to construct and operate a total of 176.43 miles of 24-inch- and 30-inch-diameter pipeline, three new compressor stations (totaling approximately 31,050 hp), and other appurtenant facilities. This project, known as the Cypress Pipeline Project (located in Georgia and Florida), would be constructed in three phases with phased in-service dates of May 1, 2007; May 1, 2009; and May 1, 2010. If approved and constructed, the project would be able to provide 500,000 decatherms per day of firm transportation capacity to its potential customers, which are BG LNG; Florida Power Corporation, doing business as Progress Energy Florida, Inc.; and the City of Austell, Georgia. The Cypress Pipeline Project, which would serve customers in the southeast states of Florida and Georgia, would receive its gas from the Elba Island LNG supply.

On December 21, 2005, Southern LNG (through El Paso Corporation) announced plans to further expand the Southern LNG terminal. The proposed expansion, referred to in the announcement as the Elba Island Expansion and Related Pipeline Project, would more than double the LNG storage capacity at the terminal and would add 0.9 Bcfd of sendout capacity, increasing the total sendout capacity of the terminal to 2.1 Bcfd. In addition, the unloading docks at the terminal would be modified to accommodate new, larger LNG ships. A new 191-mile interstate natural gas pipeline with a total capacity of 1.1 Bcfd would also be constructed from Elba Island to markets in Georgia and through interconnections with other pipelines to the Southeastern and Eastern United States. This pipeline would consist of about 105 miles of 42-inch-diameter pipeline and 86 miles of 36-inch-diameter pipeline.

According to the project announcement, Shell NA LNG, LLC, a subsidiary of Royal Dutch Shell (NYSE: RDS.A & RDS.B), and BG LNG, a wholly owned subsidiary of BG Group PLC (NYSE: BRG.N), have entered into long-term agreements for the incremental storage and sendout capacity of the announced expansion and for the transportation capacity on the new Elba Express pipeline.

We do not believe it would be practicable to redesign either the Cypress Pipeline Project or Elba Island Expansion and Related Pipeline Project to serve Crown Landing's customers. Additionally, while it is difficult to speculate what additional facility upgrades would be needed to supply additional capacity proposed for Crown Landing's customers in the Mid-Atlantic states, the construction and operation of unknown pipeline facilities, in addition to the already proposed expansions, would likely result in as much or more environmental impacts as the proposed Crown Landing LNG and Logan Lateral Pipeline Projects.

Gulf Gateway Offshore LNG Terminal

Excelerate Energy, L.L.C. (Excelerate) currently owns and operates the only offshore LNG terminal in the United States. The terminal, which is based on the transport and regasification vessel design described in section 3.3.2.1, is located in the Gulf of Mexico offshore of Louisiana. The terminal requires use of a specialized LNG ship, which is able to dock at a mooring system made up of a submerged turret buoy and flexible riser connected to a natural gas pipeline on the seafloor. After

docking is complete, LNG is vaporized onboard the LNG ship and injected as natural gas directly into the offshore pipeline for delivery to onshore markets. When not in use, the buoy and flexible riser system would be lowered below the surface and held in position until retrieved by the next LNG ship. This design does not provide for LNG storage so it must be limited to an LNG fleet with regasification equipment on all of the vessels. Excelerate received its first shipment of LNG in March 2005 and achieved a maximum sendout of about 0.7 Bcfd using an open loop vaporization system that uses seawater to provide heat in the vaporization process (see section 3.3.2.1 for additional discussion of open and closed loop vaporization systems). Excelerate recently announced that it is considering expanding the Gulf Gateway terminal to a maximum sendout capacity of between 0.8 and 1.0 Bcfd by 2008.

A major limitation of the Gulf Gateway terminal is its inability to sustain the maximum sendout volume. The Gulf Gateway terminal currently only provides interruptible service and cannot provide the firm baseload transportation service proposed by Crown Landing. One factor affecting Excelerate's ability to provide a firm continuous gas supply is the number of specialized LNG ships currently available. Because the offshore facility does not include LNG storage, maintaining a continuous supply of sendout gas requires that at least one LNG ship be connected to the buoy at all times. Currently, there are only two such ships in the world but a third ship is scheduled to be completed in the fall of 2006, and two more ships have been ordered and are scheduled to be delivered in 2008 and 2009, respectively. Due to the travel times to and from LNG producing countries, more specialized ships would be necessary to ensure continuous delivery of natural gas. Excelerate has stated that "supply out of Egypt, for example, would require six vessels" (LNG Express, 2005a). To maximize the LNG ship's time connected to the buoy and reduce ship transit times, Excelerate has announced that it wants to begin transshipment of LNG (LNG Express, 2005a). This process would involve using conventional LNG ships to carry LNG from the producing countries to an ocean rendezvous point, probably in the Caribbean Sea, where the LNG would be offloaded to the specialized regasification vessels, which would then transport the LNG to the Gulf Gateway terminal.

Conclusions Regarding Existing LNG Terminals as System Alternatives

Crown Landing is proposing a facility that would have the capabilities of unloading and storing imported LNG and delivering up to a maximum rate of 1.4 Bcfd of natural gas into the Mid-Atlantic region. Because the capacity of each of the existing onshore LNG import terminals is fully committed, use of an existing onshore LNG terminal to meet the proposed project objectives would not be possible without significant expansions and/or modifications to their unloading, storage, and delivery systems and possibly substantial expansion or looping of the existing sendout pipeline(s). The additional facilities required for required expansion would likely result in as much if not more environmental impact as Crown Landing's proposed LNG terminal.

From a commercial perspective, the best location for an LNG terminal is close to the market it is intended to serve. The great distance of the existing Southern LNG, Trunkline LNG, and Gulf Gateway terminals from the project area (a distance of at least 800 miles) effectively limits them from serving the Mid-Atlantic market. Additionally, the Gulf Gateway terminal is currently incapable of providing a continuous supply of natural gas. The existing Distrigas and Cove Point LNG terminals are closer to the proposed LNG terminal (within 200 miles). The Distrigas LNG facility, however, has physical constraints (e.g., small site size, insufficient space for additional storage tanks, etc.) that make it unsuitable to supply the natural gas volumes proposed by Crown Landing. Dominion has recently proposed an expansion of the Cove Point LNG Terminal facility that would significantly increase both the LNG storage and the natural gas sendout capacity of this facility. However, the storage and additional sendout capacity of the proposed expansion is already fully subscribed and would not be available to Crown Landing's customers. Additionally, the proposed expansion would include the construction of

about 161 miles of pipeline which would result in as much if not more environmental impacts than the proposed projects.

3.2.2 Recently Approved, Proposed, or Planned LNG Projects

3.2.2.1 Onshore LNG Projects

In addition to the LNG terminals discussed above, a number of other onshore LNG terminal projects capable of supplying U.S. markets have been recently approved, proposed, or planned. Table 3.2.2-1 provides information about the location, facilities, and capacity of these projects: One project that is relatively close to the proposed Crown Landing site is the proposed expansion of the existing Port Richmond LNG Storage, Conversion, and Distribution Facility on the Delaware River in Philadelphia, Pennsylvania. This project, which is being referred to by the Mayor of Philadelphia as the Philadelphia Freedom Energy Center, is discussed in more detail below. An application for this project has not been filed at the FERC.

Port Richmond LNG Storage, Conversion, and Distribution Facility

Philadelphia Gas Works (PGW) owns and operates an existing LNG facility on a 47-acre site in an industrial section of Port Richmond in Philadelphia, Pennsylvania (see figure 3.3.3-8). The existing Port Richmond LNG Storage, Conversion, and Distribution Facility has been in service since the early 1970s and contains two storage tanks with a combined storage capacity of 200,000 m^3, a regasification capacity of 380 to 600 MMcfd, and a liquefaction capacity of 40 MMcfd. The facility currently liquefies natural gas, stores the LNG, and then during peak demand periods (throughout the winter months), converts the LNG back to natural gas for distribution throughout the city.

On November 15, 2004, PGW announced a plan to create the Freedom Energy Center. The proposed plan, which is part of the greater Philadelphia Delaware River redevelopment initiative, would include modifying the existing LNG facility to allow import of LNG by ship. The proposed LNG facility would use the existing Tioga Marine Terminal, which is owned by the Philadelphia Regional Port Authority, to unload shipments of LNG. The project would require new equipment to allow for docking and unloading of LNG ships and could include an additional LNG storage tank. In January 2005, PGW requested proposals from major energy companies to lease the existing LNG facility and convert it into the proposed LNG import terminal. The original startup date for the facility was 2007. However, no permit applications have been filed for the project and PGW has not signed binding agreements with any suppliers. As a result, the startup date (assuming regulatory approvals can be obtained) has slipped to sometime between 2008 and 2010 (LNG Express, 2005d).

There are several potential advantages of the Freedom Energy Center site. First, no portion of the site is located within Delaware so there would be no conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan. Second, the site is at an existing, operating LNG facility. The presence of existing LNG storage and other ancillary facilities reduces the amount of new development needed and thus minimizes the disturbance associated with converting the site to an LNG import terminal. For example, only one new LNG storage tank would need to be added to the Freedom Energy Center site to achieve the LNG storage capacity proposed by Crown Landing. Utilization of the current Tioga Marine Terminal and adjacent deep water channel would also minimize the amount of dredging required. The presence and use of these existing industrial facilities would mitigate other potential impacts, including visual, socioeconomic, land use, and vegetation impacts.

TABLE 3.2.2-1

Recently Approved, Proposed, or Planned Onshore LNG Terminals a/

Project Name and Owner/ *Applicant*	Location	Sendout Capacity	Number of Storage Tanks and Capacity	Status
Recently Approved Onshore Terminals				
Cameron LNG Project *Sempra Energy, LNG*	Hackberry, Louisiana	1.5 Bcfd	Three 160,000 m^3 tanks	FERC approval issued September 2003; construction pending; FERC Docket No. CP02-374-000
Freeport LNG Project *Freeport LNG Development L.P.*	Freeport, Texas	1.5 Bcfd (phase 1); 2.5 Bcfd (phase 2)	Two 160,000 m^3 tanks (phase 1) one 160,000 m^3 tank proposed (phase 2)	FERC approval issued June 2004; phase 1 under construction; FERC Docket No. cp03-75-000 Proposed phase 2 expansion application filed May 2005; FERC Docket No. CP-05-361-000
Ingleside Energy Center LNG Project, *Occidental Energy Ventures Corp.*	Ingleside, Texas	1.0 Bcfd	Two 160,000 m^3 tanks	FERC approval issued July 2005; FERC Docket No. CP-05-13-000
Weaver's Cove LNG Project *Weaver's Cove Energy, L.L.C. (Hess LNG)*	Fall River, Massachusetts	0.8 Bcfd	One 200,000 m^3 tank	FERC approval issued July 2005; other required permits still in process; FERC Docket Nos. CP04-36-000 and CP04-41-000
Sabine Pass LNG Terminal *Cheniere Sabine Pass Pipeline Company*	Sabine Pass Channel, Louisiana	2.6 Bcfd	Three 160,000 m^3 tanks	FERC approval issued December 2004; under construction; FERC Docket No. CP-04-47-000
Vista del Sol LNG Terminal Project, *ExxonMobil Corporation*	Corpus Christi, Texas	1.0 Bcfd	Three 155,000 m^3 tanks	FERC approval issued June 2005; construction pending; FERC Docket Nos. CP04-395-000, CP04-405-000, and CP04-374-000
Cheniere Corpus Christi LNG Terminal Project *Corpus Christi LNG LP.*	Corpus Christi, Texas	2.6 Bcfd	Three 160,000 m^3 tanks	FERC approval issued April 2005; construction pending; FERC Docket Nos. CP04-37-000, CP04-44-000, CP04-45-000, and CP04-46-000
Golden Pass LNG Terminal Project *ExxonMobil Corporation*	Sabine Pass, Texas	1.0 Bcfd (Phase 1), 2.0 Bcfd (Phase 2)	Three 155,000 m^3 tanks	FERC approval issued July 2005; construction pending; FERC Docket Nos. CP04-386-000 and CP04-400-000
Ocean Express Project *AES*	Bahamas	0.84 Bcfd	--	Bahamian government approval pending
Calypso Project *Suez LNG NA*	Bahamas	0.83 Bcfd	--	Bahamian government granted preliminary approval
Irving Canaport Project *Irving Oil/Repsol*	Saint John, New Brunswick	1.0 Bcfd	Three 160,000 m^3 tanks	Canadian government approvals issued August 2004; construction pending

TABLE 3.2.2-1 (cont'd)

Recently Approved, Proposed, or Planned Onshore LNG Terminals a/

Project Name and Owner/ *Applicant*	Location	Sendout Capacity	Number of Storage Tanks and Capacity	Status
Bear Head LNG Project *Anadarko Petroleum Corp.*	Point Tupper, Nova Scotia	1.0 Bcfd (Phase I) 1.5 Bcfd (Phase II)	Two 180,000 m^3 tanks (Phase I) One 180,000 m^3 tanks (Phase II)	Canadian government approvals issued mid-2004; facility currently under construction
Altamira *Shell/Total/Mitsui*	Altamira, Tamaulipas, Mexico	0.7 Bcfd	Two 150,000 m^3 tanks	Mexican state and federal agencies including Comision Reguladora de Energia approvals issued; facility currently under construction
Energy Costa Azul LNG *Sempra Energy LNG/Shell*	Baja California, Mexico	1.0 Bcfd	Two 160,000 m^3 tanks	Mexican state and federal agencies including Comision Reguladora de Energia approvals issued. Road construction currently under way; terminal construction expected to begin before the end of 2004
Proposed Onshore Terminals b/				
KeySpan LNG Facility Upgrade Project *KeySpan LNG, LP and Algonquin Gas Transmission, L.L.C.*	Providence, Rhode Island	0.5 Bcfd	--	Final EIS issued May 2005. FERC Docket Nos. CP04-223-000 and CP04-293-000 Application was denied in June 2005.
Port Arthur LNG Project *Sempra Energy LNG*	Port Arthur, Texas	1.5 Bcfd (Phase 1) 3.0 Bcfd (Phase 2)	Three 160,000 m^3 tanks	NEPA Pre-filing Process initiated April 2004. Application filed February 2005. Draft EIS issued August 2005. FERC Docket Nos. CP05-83-000, CP05-84-000, CP05-85-000, and CP05-86-000
Long Beach LNG Import Project, *Sound Energy Solutions (Mitsubishi)/ConocoPhillips*	Long Beach, California	0.7 Bcfd	Two 160,000 m^3 tanks	Draft EIS issued October 2005. FERC Docket No. CP04-58-000, et. al.
Creole Trail LNG *Cheneire Energy*	Cameron Parish, Louisiana	3.3 Bcfd	Four 160,000 m^3 tanks	Application Filed May 2005. Draft EIS issued December 2005. FERC Docket Nos. CP05-360-000 and CP05-357-000 through CP05-359-000
Casotte Landing LNG *Bayou Casotte Energy LNG*	Bayou Casotte, Mississippi	1.3 Bcfd	Three 160,000 m^3 tanks	Application filed October 2005; environmental review underway; FERC Docket No. CP05-420-000
LNG Clear Energy *Gulf LNG Energy, L.L.C.*	Pascagoula, Mississippi	1.5 Bcfd	Two 160,000 m^3 tanks	Application Filed October 2005. FERC Docket Nos. CP06-12-000 and CP06-13-000
Calhoun LNG Project *Calhoun LNG, L.P.*	Port Lavaca, Texas	1.0 Bcfd	Two 160,000 m^3 tanks	Application filed March 2005; FERC Docket No. CP05-91-000
Bradwood Landing LNG *Northern Star, L.L.C.*	Clatsop County, Oregon	1.5 Bcfd	Three 160,000 m^3 tanks	NEPA Pre-filing Process initiated in March 2005. FERC Docket No. PF05-10

TABLE 3.2.2-1 (cont'd)

Recently Approved, Proposed, or Planned Onshore LNG Terminals a/

Project Name and Owner/ *Applicant*	Location	Sendout Capacity	Number of Storage Tanks and Capacity	Status
Quoddy Bay LNG *Quoddy Bay, L.L.C*	Pleasant Point, Maine	0.5 Bcfd	Three 160,000 m^3 tanks	NEPA Pre-filing Process initiated in December 2005. FERC Docket No. PF06-11-000
Highrock LNG Project *El Paso/FPL*	Bahamas	1.0 Bcfd	--	FERC Docket No. PF04-8-000
Lazaro Cardenas *Tractebel/Repsol*	Lazaro Cardenas, Mexico	0.5 Bcfd	--	Pending at Mexican regulatory agencies
Puerto Libertad Sonora Pacific LNG	Puerto Libertad, Mexico	1.3 Bcfd	--	Pending at Mexican regulatory agencies
Cacouna LNG *TransCanada/PetroCanada*	Gros Cacouna Island, Quebec	0.5 Bcfd	Two 160,000 m^3 tanks	Announced September 2004; EA filed with Canadian regulatory agencies May 2005
Keltic Petrochemical LNG *Keltic Petrochemical, Inc.*	Goldboro, Nova Scotia	1.0 Bcfd	Three 160,000 m^3 tanks --	Filed with Canadian regulatory agencies August 2004
Downeast LNG *Kestrel Energy Parners, L.L.C. and Dean Girdis*	Robbinston, Maine	0.5 Bcfd	One 160,000 m^3 tank --	Pre-filing approved January 2006 FERC Docket No. PF06-13-000
Rabaska *Enbridge/Gaz Metro/Gas de France*	St. Lawrence River, Quebec City, Quebec	0.5 Bcfd	Two 160,000 m^3 tanks	Announced 2005 Environmental Preliminary Impact Study 2005
Kitimat LNG *Galveston LNG*	Kitimat, British Columbia	0.34 Bcfd	--	File with Canadian regulatory agencies May 2004 Application accepted June 2005.
Planned Onshore Terminals and Expansions d/				
Freedom Energy Center *Philadelphia Gas Works*	Philadelphia, Pennsylvania	0.4 to 0.6 Bcfd	Two and possibly three 100,000 m^3 tanks	Announced November 2004
Battery Rock LNG Terminal *AES Corp.*	Outer Brewster Island, Massachusetts	0.8 Bcfd	--	Announced September 2005
Calais LNG *St. Croix Development Company*	Calais, Maine	--	--	Announced November 2005
Point Tupper *Statia Terminals Canada*	Nova Scotia	0.5 Bcfd	--	--
Pelican Island *BP*	Galveston, Texas	1.5 Bcfd	--	Announced October 2004
Bradwood Landing *Northern Star Natural Gas LLC*	Bradwood, Oregon	1.3 Bcfd	Two 160,000 m^3 tanks	Application filed March 2005 Draft EIS being prepared FERC Docket No. PF05-10-000

TABLE 3.2.2-1 (cont'd)

Recently Approved, Proposed, or Planned Onshore LNG Terminals a/

Project Name and Owner/ *Applicant*	Location	Sendout Capacity	Number of Storage Tanks and Capacity	Status
Jordan Cove *Energy Projects Development, L.L.C.*	Coos Bay, Oregon	0.2 Bcfd	One 95,000 m^3 tank	Announced October 2005
Port Westward *Port Westward LNG, LLC*	St. Helens, Oregon	1.25 Bcfd	--	Announced August 2004
AES Sparrows Point Terminal *AES Corporation*	Dundalk, Maryland	1.5 Bcfd	--	Pre-filing Requested March 2006.

a/ Project information obtained from LNG Express, Natural Gas Intelligence Press, INC., EPA informal dockets, and project applications and EIS's. More specific information for many of these projects, including in depth environmental analysis, can be obtained from the FERC document management system (see http://www.ferc.gov/docs-filing/elibrary.asp).

b/ Proposed onshore terminals with applications submitted to the FERC.

c/ Proposed offshore terminals with applications submitted to the Coast Guard.

d/ Planned terminals with no applications submitted to the FERC or Coast Guard.

-- Blanks indicate that the definitive design information is unavailable or unknown.

The site is also located relatively close to existing interstate pipeline systems. We estimate that the LNG terminal could be interconnected with both the existing Texas Eastern and Transco pipeline systems by sendout pipelines ranging from 3 to 10 miles in length. Moreover, since the terminal is located on the west bank of the Delaware in the heart of Philadelphia, the pipelines would likely require less wetland and waterbody crossings than the proposed Logan Lateral pipeline.

A disadvantage of the Freedom Energy Center site is its relatively small size. There could be issues with the thermal radiation and vapor dispersion exclusions zones possibly extending beyond the site boundaries. Additionally, although the density of industrial development surrounding the site is greater than the proposed Crown Landing site, there is a higher concentration of people living nearby. Specifically, there are 6,323 people living within 1 mile and 63,986 people living within 2 miles of the Freedom Energy Center site, compared to 82 people within 1 mile and 383 people within 2 miles of the proposed Crown Landing site. Additionally, because of the density of development surrounding the site, it is possible that the sendout pipelines from the Freedom Energy Center site may result in more commercial and residential impacts than the proposed Logan Lateral pipeline.

Another disadvantage of the Freedom Energy Center site is the longer distance that LNG ships would need to transit the Delaware River. The ship route within the Delaware River and Bay would be about 82.5 nautical miles long, which is about 21 nautical miles longer than the ship route to the proposed Crown Landing site. The widths of the river and shipping channel also narrow significantly south of Philadelphia and Camden from about a mile to a half mile for the river and 800 feet to 400 feet for the channel. Additionally, the LNG ships would have to pass under three additional bridges, the Commodore Barry Bridge in Chester, and the Walt Whitman and Benjamin Franklin Bridges in Philadelphia. Depending on the security measures imposed by the Coast Guard for transiting LNG ships, there could be issues associated with the potential closure of one or more of these bridges. Any required bridge closures could result in delays of vehicle traffic on these bridges and associated roads. The additional length of the shipping route would also result in LNG ships en route to the Freedom Energy Center passing near several more communities than LNG ships en route to the proposed Crown Landing site, including the cities of Chester, Essington, Paulsboro, National Park, Gloucester City, Camden, and Philadelphia. Moreover, due to the deceased width of the river north of Gloucester City, LNG ships calling on the Freedom Energy Center site would be closer to developed and populated areas than ships traveling to Crown Landing's proposed site. Conflicts with and delays of other shipping due to LNG deliveries are also more likely at the Freedom Energy Center site due to the narrower width of the shipping channel in this area.

3.2.2.2 Offshore LNG Projects

To avoid many of the environmental issues and safety concerns associated with locating an LNG facility onshore, many companies have proposed locating LNG import terminals in offshore areas. A list of currently authorized, proposed, and planned offshore LNG terminals is provided in table 3.2.2-2. Offshore LNG import terminals located in federal waters are under the jurisdiction of the DOT and the Coast Guard (pursuant to the Deepwater Port Act of 1974, as amended by the Maritime Transportation Security Act of 2002 to include natural gas facilities). Offshore LNG import terminals located in state waters are under the jurisdiction of the FERC (pursuant to the NGA).

TABLE 3.2.2-2

Recently Approved, Proposed, and Planned Offshore LNG Terminals a/

Project Name and Owner/ *Applicant*	Location	Sendout Capacity	Number of Storage Tanks and Capacity	Status
Recently Approved Offshore Terminals				
Port Pelican Offshore Deepwater Port Project *ChevronTexaco*	Gulf of Mexico, Vermillion Block 140, Offshore Louisiana	1.6 Bcfd	Gravity-based structure; 330,000 m^3 of storage capacity	Coast Guard and DOT approvals issued in November 2003; project on hold indefinitely. Coast Guard Docket No. 14134
Gulf Landing Offshore Deepwater Port Project *Shell US Gas and Power, L.L.C.*	West Cameron Block 213, Offshore Louisiana	1.0 Bcfd	Gravity-based structure; 200,000 m^3 of storage capacity	Coast Guard and DOT approvals issued in February 2005; construction pending. Coast Guard Docket No. 16860
Proposed Offshore Terminals				
Northeast Gateway, *Excelerate Energy LLC*	Offshore Gloucester, Massachusetts	0.8 Bcfd	No storage tanks	Application filed June 2005. Coast Guard deemed application complete September 2005. NEPA review timeline suspended November 2005. Coast Guard Docket No. 22219
Neptune *Tractebel (Suez Energy)*	Offshore Gloucester, Massachusetts	0.8 Bcfd	No storage tanks	Revised application filed September 2005. Coast Guard deemed application complete October 2005. NEPA review ongoing. Coast Guard Docket No.22611
Main Pass Energy Hub Deepwater Port Project *Freeport-McMoRan Energy L.L.C.*	Main Pass Block 299, Offshore Louisiana	1.0 Bcfd	--	Application filed February 2004. Draft EIS published June 2005; NEPA review timeline suspended August 2005. Coast Guard Docket No. 17696
Clearwater Port Offshore Deepwater Port Project *Crystal Energy, L.L.C.*	MMS Lease Block 217,Offshore California	1.2 Bcfd	--	Application deemed incomplete May 2005.
Pearl Crossing Project *ExxonMobil Corp.*	West Cameron Block 220, Offshore Louisiana	2.0 Bcfd	Gravity-based structure; 250,000 m^3 of storage capacity	Application filed May 2004. Application withdrawn October 2005. Coast Guard Docket No. 18474
Compass Port Terminal Project *Compass Port, L.L.C. (ConocoPhillips)*	11 miles of Daupin Island, Alabama	1.0 Bcfd	Gravity-based structure; two 150,000 m^3 tanks	Application filed March 2004. NEPA review timeline suspended August 2005. Coast Guard Docket No. 17659
Beacon Port Deepwater Port *ConocoPhillips.*	MMS Lease Blocks HIA 27 and WC 167, Offshore Louisiana	1.0 Bcfd	Gravity-based structure; two tanks	Application filed January 2005. Draft EIS published June 2005; NEPA review timeline suspended. Coast Guard Docket No. 21232
Cabrillo Port Project *BHP Billiton*	Offshore California	1.5 Bcfd	Floating Storage and Regasification Unit	Coast Guard Docket No. 16877. NEPA timeline suspended November 2005. Coast Guard Docket No. 16877.

TABLE 3.2.2-2 (cont'd)

Recently Approved, Proposed, and Planned Offshore LNG Terminals a/

Project Name and Owner/ *Applicant*	Location	Sendout Capacity	Number of Storage Tanks and Capacity	Status
Broadwater LNG Facility *TransCanada Corporation and Shell US Gas & Power L.L.C.*	Offshore in New York waters of Long Island Sound	1.0 Bcfd	Floating Storage Regasification Unit, 350,000 m^3 of storage capacity	NEPA Pre-filing Process initiated February 2005; FERC Docket Number PF05-4-000
Terminal GNL Mar Adentro *Chevron Texaco*	Offshore, Baja California	1.4 Bcfd	Storage capacity of 250,000 m^3.	Pending at Mexican regulatory agencies. Received Environmental Approval
Planned Offshore Terminals				
Calypso Deepwater Port *Suez NA*			No storage tanks	
Chevron Texaco	Offshore, California	0.75 Bcfd	--	--
Liberty Gateway *Excelerate Energy L.L.C.*	Offshore New York/New Jersey	0.4+ Bcfd	No storage tanks	--
Safe Harbor Energy LNG Terminal *Atlantic Sea Island Group, LLC*	13.5 miles south of Long Beach, New York	2.0 Bcfd	Four 180,000 m^3 tanks	Announced January 26, 2006. Will begin federal regulatory process in the spring of 2006 under the jurisdiction of the USCG and MARAD.

Companies have introduced various strategies for constructing and operating LNG import terminals in offshore waters (LNG Express, 2003). These strategies include the following (see section 3.3.2.1 for more detailed discussions of these strategies):

- offshore docking/onshore storage
- fixed offshore terminals (gravity based structures (GBS) or platforms)
- transport and regasification vessels; or
- floating storage and regasification units (FSRU).

Conclusions Regarding Existing, Proposed, and Planned Onshore and Offshore LNG Terminals

All of the recently approved and most of the proposed or planned LNG projects listed in tables 3.2.2-1 and 3.2.2-2 are too far from the Mid-Atlantic region to efficiently provide the natural gas delivery volumes proposed by Crown Landing. Additionally, the use of the Gulf Coast, Canadian, and Bahamian projects as alternatives would likely require substantial expansion of the existing pipeline systems, which could have significant environmental impacts. Others of the proposed projects have not been sufficiently described or developed to conduct a detailed comparison with the proposed project.

The six closest proposed and planned projects to the Mid-Atlantic region for which there is sufficient information to conduct a comparative analysis include: the Freedom Energy Center Project in Philadelphia, Pennsylvania; KeySpan LNG Facility Upgrade Project in Providence, Rhode Island[1]; the Weaver's Cove LNG Project in Fall River, Massachusetts; the Northeast Gateway Project and Neptune Project in Massachusetts Bay, Massachusetts; and the Broadwater LNG Facility Project (see section 3.3.2.1 for more discussion of the Northeast Gateway Project, Neptune Project, and the Broadwater LNG Facility Project).

The Freedom Energy Center site is located on the Delaware River in the same general region of the proposed Crown Landing site. This site has the advantages of being located at an existing LNG facility with an adjacent existing pier that likely could be modified for use as an LNG ship unloading facility. Because the Freedom Energy Center site is in Pennsylvania, it also avoids conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Policy. Additionally, due to the highly developed nature of the area surrounding the site, the sendout pipeline from the site would likely cross fewer streams and wetlands than the proposed sendout pipeline. These advantages, however, are largely negated by the small size of the site, the greater population density surrounding the site, and the greater number of communities along passed by the ship route. For these reasons, we do not consider the Freedom Energy Center site preferable to the proposed site.

Each of the other five projects also has site-specific environmental issues and/or safety concerns, and none of these projects would provide the storage or sendout capacity proposed by Crown Landing. Additionally, although the Weaver's Cove LNG Project and any of the other projects combined could provide the sendout capacity proposed by Crown Landing, and the Weaver's Cove LNG Project and Broadwater LNG Facility Project collectively would be able to provide Crown Landing's proposed storage capacity, it seems unlikely that these projects, with the exception of the Freedom Energy Center Project could effectively serve the southern Mid-Atlantic region. Based on recent projections of natural gas demand in the New England region, by 2009 there will be demand for an additional 500 MMcfd of

[1] The FERC issued an Order in July 2005, which denied KeySpan LNG's proposal to site, construct, and operate the proposed LNG terminal in Providence. In August 2005 KeySpan LNG and BG LNG filed a timely, joint request for rehearing of the Order. In January 2006 the Commission denied KeySpan's and BG LNG's joint request for rehearing.

natural gas above what the current infrastructure is able to provide during peak periods of use (FERC, 2003). Demand in the New York market area is also increasing. Consequently, even if more than one of these projects are authorized and constructed, much of the capacity of these projects would likely be used to satisfy the increasing demand for natural gas in the New England and New York markets and would be unavailable for other areas of the Mid-Atlantic region.

3.2.3 Pipeline System Alternatives

As an alternative to developing a new LNG import terminal, we considered the feasibility of utilizing or expanding the existing pipeline systems in the region to provide an equivalent amount of natural gas to the Mid-Atlantic region as that proposed by Crown Landing. Existing pipeline systems in the Mid-Atlantic region include those owned and operated by Texas Eastern, Columbia Gas, and Transco (see figure 3.2.3-1). Texas Eastern's local pipeline system consists of four pipelines: two 20-inch-diameter pipelines that run south from Eagle, Pennsylvania to Chester Junction, Pennsylvania; a 16-inch-diameter pipeline that runs east from Chester Junction to a meter regulator; and a 16-inch-diameter pipeline that narrows down to a 14-inch-diameter pipeline and runs west from Chester Junction to meter regulators. Columbia Gas' pipeline system in the project area consists of a 20-inch-diameter pipeline that runs from Claymont, Delaware across the Delaware River to Gloucester County, New Jersey. Transco's pipeline system in the project area includes two pipelines: a 12-inch-diameter pipeline and a 20-inch-diameter pipeline. Transco's two pipelines cross the Delaware River from Pennsylvania and proceed north across northwest New Jersey. All of these pipeline systems primarily provide natural gas from production areas in Canada and the Gulf Coast. While new supplies of natural gas might be developed outside of the market area, including the construction or expansion of other LNG import terminals along the Gulf and East Coasts, the existing Columbia Gas, Transco, and Texas Eastern systems do not have sufficient capacity to deliver the volumes proposed by Crown Landing without expansion.

Expanding or modifying the existing pipeline systems to be able to deliver natural gas to the Mid-Atlantic region would result in a variety of environmental impacts depending on the project size, length, and design. It is typical for significant pipeline construction projects in the region to result in short- or long-term impacts on water resources, upland vegetation, wetlands, wildlife habitats, traffic patterns, and land use. Substantial expansion or modifications to the existing pipeline systems would be required to deliver the gas volumes to the Mid-Atlantic region as proposed by Crown Landing. In addition to construction-related effects, the operation of pipeline compressor stations also would result in permanent noise and air quality impacts.

We expect that new pipelines or proposals to modify existing pipelines will continue to increase the capacity of existing systems delivering natural gas to the Mid-Atlantic region. Nevertheless, these projects could not meet the project objectives of providing access to new natural gas supplies around the world. Additionally, since the production from conventional natural gas reserves in the United States and Canada has not experienced much growth, it is unlikely that pipeline alternatives connected to these reserves would be able to meet the project objective of providing up to a maximum rate of an additional 1.4 Bcfd of natural gas to the Mid-Atlantic region. Even if a pipeline system alternative was combined with the use of an existing, modified, or proposed LNG facility, the costs and environmental impacts of such an alternative would not provide a clear advantage over the Crown Landing LNG Project.

Non-Internet Public

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE
CROWN LANDING LNG PROJECT and
LOGAN LATERAL PROJECT
Docket Nos. CP04-411-000 and CP04-416-000

Figure 3.2.3-1 Existing Pipeline Systems

Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov.

3.3 LNG TERMINAL ALTERNATIVES

The examination of alternative sites for an LNG import terminal involved a comprehensive process that considered environmental, engineering, economic, safety, and regulatory factors. The first step included determining the most suitable area for an LNG terminal based on the stated purpose of the project of providing an additional supply of natural gas to the Mid-Atlantic region. The second step included identification of a specific port capable of accommodating ships that can transport up to 200,000 m^3 of LNG. The third step included comparatively evaluating specific sites within suitable ports that are capable of supporting the necessary docking, storage, and vaporization facilities.

3.3.1 Regional Review

As discussed in section 1.2, there is a current and growing demand for natural gas in the Mid-Atlantic region. Due to the limitations in the existing pipeline systems serving the region as well as the other disadvantages discussed in section 3.2.3, we believe an LNG import facility should be located somewhere in New York, New Jersey, Pennsylvania, Delaware, or Maryland to efficiently serve the Mid-Atlantic region. As such, we did not consider alternative LNG terminal sites north of Long Island, New York or south of the Virginia and Maryland border.

3.3.2 Port Review

Ships that are presently used to transport LNG typically have capacities of up to 138,000 m^3. These ships are up to 1,000 feet long with typical drafts up to 38 feet. To ensure that the LNG ships do not easily or frequently run aground, an additional 2 feet of water is required under the keel. This means that LNG ships will typically only access areas with depths of 40 feet Although dredging in shallow water areas could provide access for LNG ships, the dredging required in undeveloped ports would generally be cost prohibitive and would most likely result in significant environmental impacts. Consequently, our analysis of alternative LNG terminal sites was limited to offshore or existing deepwater coastal ports that could readily accommodate LNG ships without dredging or without significantly more dredging than would be required for use of the proposed site.

3.3.2.1 Offshore Ports

To avoid many of the environmental issues and safety concerns associated with locating an LNG facility onshore, many companies have considered locating LNG import terminals in offshore areas. As defined in the Deepwater Port Act of 1974 (as amended by the Maritime Transportation Security Act of 2002 to include natural gas facilities), deepwater ports include fixed or floating structures that are located off of the U.S. coast and that are used as a port or terminal for the transportation, storage, and further handling of oil or natural gas. This legislation further requires the DOT (Maritime Administration (MARAD)) and the Coast Guard to regulate the licensing, siting, construction, and operation of deepwater ports for natural gas.

The technology for offshore LNG terminals is being developed and guidance documents for building offshore LNG storage and regasification terminals have recently been produced (American Bureau of Shipping, 2002). Excelerate completed and began operating the first LNG import facility located entirely offshore in March 2005. There are currently several other proposals to build offshore LNG import terminals in the United States. Additional offshore LNG terminals have also been proposed and are under review in Australia, West Africa, Taiwan, Mexico, and Italy (LNG Express, 2002). The following sections provide a discussion of each major offshore import terminal strategy being proposed or considered.

Transport and Regasification Vessels

One strategy for importing LNG to an offshore terminal includes the use of conventional LNG ships fitted with regasification equipment (e.g., transport and regasification vessels). Several companies are investigating or proposing to install vaporization equipment on conventional LNG ships and Excelerate began operating the Gulf Gateway terminal using this design (see section 3.2.1).

No company has filed an application for a transport and regasification LNG import terminal in the Mid-Atlantic region, although LNG Express (2005a) indicated that Excelerate has future plans for such a terminal off the New York/New Jersey coast. According to LNG Express, this facility would have a sendout capacity of 400+ MMcfd and would be in service by 2009/2010.

Currently, there are independent proposals by Northeast Gateway Energy Bridge L.L.C. (Northeast Gateway), a subsidiary of Excelerate, and Neptune LNG, a subsidiary of Tractebel, to build these types of LNG import terminals in the northeast off the coast of Massachusetts. These projects would be the closest offshore LNG projects to the Mid-Atlantic region. Northeast Gateway filed an application with the Coast Guard and the MARAD on June 13, 2005 for licensing of a deepwater facility to import LNG into the New England region, to be sited offshore in Massachusetts Bay, about 13 miles south-southeast of Gloucester, Massachusetts. The Coast Guard deemed Northeast Gateway's application complete in September 2005. The proposed terminal would employ the use of two buoy systems that could enable uninterrupted gas flows to market with properly scheduled vessel deliveries. A metering platform would not be used. The Northeast Gateway deepwater port would deliver natural gas via a 24-inch-diameter pipeline to the existing 30-inch-diameter Algonquin HubLine Pipeline system. Assuming regulatory approvals are obtained, construction of the Northeast Gateway deepwater port is scheduled for late summer 2006 and startup for spring 2007. Northeast Gateway would have an average sendout of 400 MMcfd of LNG and a peak sendout of 800 MMcfd (LNG Express, 2005c).

In October 2005, the Coast Guard deemed the Neptune LNG application for a license to be complete. In October, the Coast Guard and MARAD also issued a NOI announcing their intent to prepare an environmental impact statement for the project. The terminal plans to moor specially designed ships offshore Gloucester, Massachusetts by means of a submerged unloading buoy system consisting of two buoys. The ships would store and vaporize LNG shipments and then sendout the gas through Algonquin's subsea HubLine pipeline system. Neptune plans to have an average sendout capacity of 400 MMcfd, and for peak demand, each Neptune vessel would be able to deliver 700 MMcfd. The Neptune terminal site is located approximately 2 miles from the Northeast Gateway site (LNG Express, 2005c).

The transport and regasification ships would be able to dock at a mooring system made up of a submerged turret buoy and flexible riser connected to a natural gas pipeline on the seafloor. After docking is complete, LNG could be vaporized onboard the LNG ship and injected as natural gas directly into the offshore pipeline for delivery to onshore markets. When not in use, the buoy and flexible riser system would be lowered to a depth of about 100 feet below the surface and held in position until retrieved by the next LNG ship. Based on the designs suggested to date, it appears that the submerged turret buoy and flexible riser system would be limited to areas where the water is between 130 and 490 feet deep. This design does not provide for LNG storage so it must be limited to an LNG fleet with regasification equipment on all of the vessels. Depending on the vaporizers and the size of the sendout

pipeline, an LNG transport and regasification ship could deliver between 400 to 900 MMcfd of natural gas to market[2].

Fixed Structures

Another strategy for importing LNG to an offshore terminal involves the use of fixed structures. There are basically two different types of fixed structures that can be used as an offshore LNG import terminal, either a GBS, located directly on the seafloor, or pile-based platforms. GBS facility would include placing LNG storage tanks and associated facility platforms on foundations directly on the seafloor. LNG could be offloaded from conventional LNG ships, placed in storage tanks, and then vaporized for delivery as natural gas to the onshore market via an undersea pipeline. GBS terminals would only be feasible in areas of relatively shallow water, where the depths range between 45 and 100 feet. Given the costs associated with constructing and operating a GBS, it appears that these facilities are only economically feasible for projects with relatively large LNG storage (e.g., 250,000 to 330,000 m^3) and natural gas sendout volumes (e.g., 800 to 2,000 MMcfd).

As shown in table 3.2.2-1, ChevronTexaco Corporation (ChevronTexaco) and Shell USA Oil & Gas (Shell) were recently authorized to build GBS offshore LNG import terminals in the Gulf of Mexico. These two projects are currently referred to as the Port Pelican Deepwater Port Project and the Gulf Landing Project, respectively. Neither project has begun construction. ChevronTexaco is still seeking approval from the Coast Guard and Texas regulatory agencies for its GBS construction yard in Corpus Christi, Texas. ChevronTexaco does not plan to begin construction of Port Pelican until it receives all necessary permits and secures an LNG supply source. Cost may be a potential obstacle to the successful development of a GBS facility. Current reports indicate that estimated costs for these types of projects have increased nearly three times the costs projected by ChevronTexaco last year (LNG Express, 2004).

Another strategy using a fixed offshore terminal involves constructing or converting existing offshore platforms. Because these platforms are or would be anchored using fixed-tower structures, they could be located in a much broader range of water depths than a GBS unit. These platforms could be fitted with docking, unloading, storage, and vaporization equipment. Similar to the GBS design, LNG could be unloaded from a conventional LNG ship, vaporized at the platform, and sent as natural gas to the onshore market via an undersea pipeline. Depending on the specific design, the use of an offshore platform may not include significant offshore storage of LNG. Given the lack of existing offshore platforms in the Mid-Atlantic region, this approach would require construction of a new platform.

Floating Structures

FSRUs are another approach being considered for importing LNG into the United States. In essence, an FSRU would be an oversized LNG ship that is outfitted with LNG vaporizers and docking/unloading equipment. The FSRU would be about 930 to 1,150 feet long, 195 to 215 feet wide, and be able to store between 250,000 and 290,000 m^3 of LNG - over twice the capacity of a typical LNG ship. These units would be anchored offshore of the proposed market area where conventional LNG ships could dock next to and unload LNG to the FSRU. After the LNG is unloaded, it could be vaporized and the natural gas transported to onshore markets through an undersea pipeline. Depending on the vaporizers and the size of the pipeline, these units could have a natural gas sendout capacity ranging from 700 to 1,500 MMcfd. Based on the designs suggested to date, it appears that FSRUs would be limited to depths greater than 90 feet to accommodate a flexible pipeline connection between the unit and the

[2] Neptune LNG has indicated that the project would have an average sendout capacity of 400 MMcfd and a peak capacity of 700 MMcfd. Excelerate has indicated that its Northeast Gateway Project would have a baseload capacity of 400 MMcfd and a peak capacity of 800 MMcfd. However, it appears the 800 MMcfd capacity could rarely if ever be achieved and that the actual maximum delivery capacity of the project would likely be between 500 and 690 MMcfd.

sendout pipeline. The proposed Broadwater LNG Facility Project would include an FSRU. BHP Billiton also recently proposed to use this design to import natural gas to markets in California.

Evaluation of Transport and Regasification Vessels and Fixed and Floating Structures

We have examined whether transport and regasification vessel or fixed or floating structures designs could provide an import service similar to the Crown Landing LNG Project. We have also evaluated the potential cost and impacts associated with each design.

Technical Feasibility Issues

Excelerate demonstrated the operational feasibility of the transport and regasification design with the successful delivery of the first LNG ship to its Gulf Gateway Energy Bridge facility in March 2005. However, the LNG regasification vessels are unique to this application and the docking and cargo transfers at the proposed Gulf Gateway site cannot presently be performed by conventional LNG vessels. Additionally, the Gulf Gateway design lacks the LNG storage proposed by Crown Landing. Moreover, as discussed in section 3.2.1, Excelerate currently lacks sufficient transport and regasification vessels to provide a steady flow of natural gas to its customers.

The technical issues associated with the feasibility of constructing and operating fixed and floating offshore LNG facility designs have not yet been demonstrated in practice and can not be fully evaluated within the timeframe of the Crown Landing LNG Project.

One particular challenge for an offshore LNG import terminal would be the effects of meteorological and oceanographic forces such as high winds, waves, and currents, and the potential for these weather conditions to disrupt LNG ship deliveries. These concerns are particularly pronounced in the Mid-Atlantic region during the winter, a period when the region experiences its most severe weather and its peak demand for natural gas supplies. The potential for severe weather equates with a need for increased storage volume at offshore terminals to maintain a predictable, constant flow of natural gas to shore. Due to the length of time required to unload and the open-sea location of the docking facilities, there would be an increased potential for delays associated with inclement weather and rough seas, which could make this design less reliable than an onshore facility. A particularly key technical issue for the successful operation of a fixed or floating LNG terminal in this environment includes designing the LNG transfer system (i.e., unloading arms) to compensate for the relative motion between the terminal and LNG ship during unloading operations. Although storage and unloading technologies similar to those that would be used with an offshore LNG terminal have been applied for many years at onshore LNG terminals and at offshore petroleum product facilities (LNG Express, 2002), the technologies needed to transfer a cryogenic liquid under the harsher conditions in an offshore setting have not yet been demonstrated. This may be problematic for offloading to a FSRU where the stresses on a transfer system could be even greater than what would be experienced at a fixed structure.

For the Gulf Gateway Project, Excelerate established the following docking and cargo transfer design criteria: a 5-meter (16-foot) sea condition maximum for connecting at the docking station and a 12-meter (39-foot) sea condition maximum for cargo unloading. Similar docking systems are currently in use for crude oil transfers in the North Sea, where docking maneuvers have occurred in seas up to 5.5 meters (18 feet) and loading/unloading operations have occurred in seas of 13 meters (43 feet) (Coast Guard, 2003). Based on weather and wave data from the Gulf of Mexico and Excelerate's design criteria, the Environmental Assessment for the Gulf Gateway Project estimated that the LNG import facility would be operable 98 percent of the year.

To evaluate sea conditions offshore from the Mid-Atlantic region, we examined wave height data from the National Data Buoy Center for Station Number 44025. This buoy is located about 33 nautical miles south of Islip, New York at 40° 15' 01'' North and 73° 10' 00'' West, and has a relatively continuous record of meteorological data extending back to 1992 (NOAA, 2004a). We evaluated wave height data from even-numbered years from 1992 through 2002 as well as 2003. Seasonal average wave heights ranged from 5.1 feet (winter) to 3.2 feet (summer), suggesting that the 16-foot sea condition for connecting to the buoy is achievable throughout much of the year. Because peak demand for natural gas is likely to coincide with periods of the worst weather conditions, we also looked at maximum wave heights for the months of November through March. Maximum wave heights ranged from 23.7 feet in January 1996 to 7.9 feet in March 2002. Maximum wave heights during the winter and early spring months suggest that the 39-foot sea condition established for unloading conditions of a transport and regasification vessel at least would be achievable in most years.

Estimated Project Costs

The relative cost of transport and regasification vessels compared to onshore LNG facilities cannot be fully evaluated due to the short operational history of the transport and regasification design. Excelerate submitted information to the FERC on November 16, 2004 regarding the economics of the Northeast Gateway Project. In its submittal, Excelerate indicated that the economics of its project are favorable compared to onshore LNG terminals. Excelerate estimated that the pipeline and buoy system required for the Northeast Gateway Project would cost about $200 million. The three specialized LNG ships required for the project would cost an additional $570 million, for a combined total delivery cost of about $770 million. Excelerate indicated that this would be more than $100 million less than the total delivery cost of an onshore facility of similar capacity. FERC staff notes that Excelerate's cost estimates for onshore facilities include the cost of construction of conventional LNG ships. Since a worldwide fleet of conventional LNG ships already exists, new ships are not necessarily required and are not typically considered part of the capital costs associated with an onshore facility. Excelerate also stated that the operating costs of the Northeast Gateway facility would have lower labor costs because no additional employees would be hired to operate the terminal. Additionally, Excelerate indicated that if it uses an open-loop vaporization system, the fuel consumed to operate its facility would be about half the fuel consumption of a comparable onshore LNG terminal. However, if a closed-loop vaporization system is used (which is the current plan), the fuel consumption during operations would be 50 percent more than a comparable onshore LNG terminal.

Estimates released to the public indicate that the capital costs for constructing a fixed or floating offshore terminal that includes significant LNG storage would be at least twice as expensive as a similar sized onshore facility. Operating costs would also be higher. For example, costs associated with the need for a larger staff and personnel to operate an offshore terminal would be greater than for the proposed LNG terminal.

LNG Terminal and Sendout Pipeline Impacts

Construction and operation of an offshore LNG terminal could result in environmental impacts related to aesthetics, water quality, biological communities, socioeconomics, and air quality. Aesthetic impacts could include impacts on the offshore viewshed. Because there is not any existing and available offshore infrastructure that could be utilized for an offshore LNG terminal in the Mid-Atlantic region (e.g., existing platforms), constructing an offshore facility would affect a number of marine and nearshore resources.

The docking stations for the Northeast Gateway Project, for example, would require the construction and use of a large, permanently-fixed anchor array. Depending on the orientation of the

anchor positions, each array would likely consist of eight anchors located in a circular fashion between 1,738 to 3,050 feet from the docking buoy. Depending on the design of the anchors, the entire anchor array for each project would disturb a small area of the seabed. Additional seafloor disturbance from anchor chain movements would occur each time the turret buoys are raised and lowered to dock and release the LNG vessels. According to information filed by Excelerate, the maximum total area of the seafloor affected during operation of the facility would be about 42 acres. This disturbance would be a periodic and long-term impact on the seafloor for the life of the project. In the case of the Broadwater LNG Facility Project, the FSRU would be constructed at a shipyard and towed to the project location for permanent mooring. This mooring system would also permanently impact a small area of the seafloor.

A safety and security zone would be established around the offshore terminal, which would restrict other fishing, boating, and ship traffic. Excelerate, for example, has indicated that the Coast Guard would probably require a minimum 1,640-foot safety and security zone around each docking station for the Northeast Gateway Project. Excelerate and the Coast Guard would also request from the International Maritime Organization (IMO) an additional "No Anchor Area" of about 1 nautical mile in diameter around each buoy. In addition, Excelerate has indicated they would request the Coast Guard to establish an "Area to be Avoided" of 2.2 nautical miles around each docking station. Although not a restricted area, the "Area to be Avoided" would be posted on nautical charts to provide a warning to vessels operating in the vicinity of the terminal.

Another issue is that the use of an offshore facility does not avoid the need for some onshore facilities. For example, temporary onshore facilities would be needed to construct the fixed or floating LNG structures, which would then be transferred to the offshore terminal site. While not specifically addressed in existing environmental documents and analyses, the construction of a GBS requires fabrication of the GBS in what is called a graving dock. The graving dock must be of sufficient size to fabricate the GBS, of sufficient depth, and constructed in an area adjacent to sufficient water depth to float the GBS. One side of the graving dock must be directly adjacent to the waterbody and that side must be removable to flood the dock and float the GBS, allowing it to be towed from the dock to its final destination. Graving for the size of the proposed LNG terminal can be on the order of 50 to 100 acres. Permanent onshore facilities would also be required for terminal support activities.

An offshore LNG facility would also require the construction and hydrostatic testing of a sendout pipeline from the offshore site to an interconnection with an existing pipeline system. Offshore pipeline construction typically involves laying the pipeline directly on the seafloor at depths greater than 200 feet, and excavating a shallow trench in areas with depths less than 200 feet. The level of impact of the offshore pipeline would depend on the resources in the vicinity of the pipeline route, the length of the pipeline, the seafloor substrate, and the type of equipment that is used for construction. The Broadwater LNG Facility Project, for example, would require a new 25-mile-long pipeline to connect the FSRU to the existing Iroquois pipeline system. This pipeline would be located in waters less than 200 feet deep and would likely need to be buried beneath the seafloor.

Construction methods for offshore pipelines include jetting, subsea plowing, and dredging. Excavating a shallow trench to bury the pipeline using any of these methods would have both direct and indirect impacts. Direct impacts would include the disturbance of bottom substrates and habitats located in the area of the trench. Other impacts could include the disturbance of substrates adjacent to the trench as a result of sidecasting the trench spoil, and impacts associated with anchor strikes and cable sweep resulting from the need to stabilize and position pipe-lay barges and other equipment and indirect impacts associated with the suspension and transport of disturbed sediments in the water column and the resettlement of suspended sediments on the seabed. Laying the pipeline directly on the seafloor could also displace and/or replace existing substrates and, in some cases, create a potential barrier to invertebrate movements (Glaholt et al., 2000).

Based on our analysis of the HubLine and Islander East pipeline projects (FERC, 2001; FERC, 2002), which are illustrative of the various environmental issues associated with offshore pipeline construction along the East Coast, we estimate that the in the case of the Northeast Gateway and Broadwater LNG Projects, which would connect to existing offshore pipelines, these impacts could include disturbance of more than 1,000 and 3,000 acres of seafloor[3], respectively. Impacts on water quality and aquatic resources could also result if seawater is utilized to help vaporize LNG at the terminal, which may be possible during the warmest months of the year. Water discharged from the vaporizer units would decrease the water temperature, increase the turbidity, and increase dissolved oxygen content in marine waters near the terminal. During water intake, fish eggs or larvae could be impinged or entrained from nearby waters. During colder months of the year, the LNG vaporizers would burn natural gas which would result in air emissions similar to the proposed project.

One advantage of an offshore LNG terminal is that they would be located in remote areas far from population centers, which would eliminate the shipping of LNG past populated communities and minimize the risk to the public. Although a recent congressional report suggests that offshore LNG facilities may be more vulnerable to terrorist attack compared to onshore facilities (Parfomak, 2003), the consequences of such an attack to the general public would be lower due to the remote locations of offshore facilities.

Summary and Conclusions

In summary, we recognize the potential for offshore docking and LNG regasification vessels and offshore storage and vaporization structures to have a future role in the gas supply mix, the current level of information and limited operational experience is not sufficient to justify consideration of this emerging application of offshore technology as a reasonable alternative to the Crown Landing LNG Project. Additionally, we have determined that if suitable offshore sites could be located and developed, an offshore LNG terminal could avoid some of the more significant environmental impacts associated with the proposed Crown Landing LNG Project (e.g., dredging the ship berth). An offshore facility would also have the advantage of being more remotely located and would avoid the transport of LNG past populated areas.

However, no applications for any such facilities in the offshore areas of the Mid-Atlantic region have yet been filed. Additionally, in the case of the transport and regasification design, the facilities would not provide the LNG storage that would be supplied by the proposed project. Our analysis also indicates that the construction and operation of an offshore facility could potentially result in substantial environmental impacts. Construction-related impacts would result from the installation of the physical structures necessary for the system to function. For a project off the Mid-Atlantic coast, where there are no existing offshore interstate pipeline systems, there would likely be additional impacts associated with both the offshore and onshore pipeline needed to interconnect the facility to an onshore interstate pipeline system. Operational impacts would also result from docking procedures and the vaporization of LNG prior to sending out the natural gas into the pipeline(s). These would include long-term impacts associated with a permanent anchor array for the buoy system, air emissions associated with vaporization equipment, and potential entrainment and impingement of aquatic organisms and water temperature impacts if an open-loop vaporization system is used (i.e., seawater is used to vaporize the LNG).

[3] Seafloor impacts could be reduced more than tenfold if dynamically positioned (DP) construction vessels are used to construct the pipeline. However, the number of DP construction vessels in the world is currently limited. Neptune has indicated that it intends to use DP construction vessels. Excelerate has not committed to a specific type of offshore pipeline construction equipment.

Offshore Docking/Onshore Storage

Where deepwater access to a coastal port or harbor is unavailable, LNG can be transported to onshore storage tanks from ships using specially designed cryogenic pipelines. Such facilities enable LNG ships to berth and transfer their LNG cargo to the cryogenic pipeline at docking facilities in offshore areas where natural water depths exceed 40 feet. Although feasible, a number of technical factors related to transporting LNG in a pipeline limit the practical maximum length of such a pipeline. In the draft EIS, we reported this length to be about 3 miles; however, we note that LNG Express (2005b) reported that recent research has been conducted to develop an insulated pipeline capable of transporting LNG for a distance of about 18 miles.

The offshore docking/onshore storage approach has been used at the existing Cove Point LNG Terminal, where the ship docking/unloading platform is located in the Chesapeake Bay about 1 mile from the shoreline. Similar facilities have been proposed for the Irving Oil LNG site in New Brunswick, Canada, and the Keltic Petrochemicals LNG and Bear Head LNG facilities in Nova Scotia, Canada. While it would be possible to transfer LNG to shore through a cryogenic pipeline from an offshore docking structure, such a design would still require locating LNG storage tanks and process facilities at an onshore location, which would involve most of the same disadvantages of an onshore terminal (in addition to the disadvantages associated with an offshore docking structure and pipeline). Furthermore, industrial ports in the Mid-Atlantic region are largely situated along narrow waterfronts that are accessible only from narrow navigational channels. Therefore, an offshore docking structure and a cryogenic pipeline would have to be located relatively close to a navigation channel which could interfere with other port operators or marine traffic. Although considered, we did not identify a site where the use of this approach appeared practical (see our discussion of Delaware Bay sites in section 3.3.2.2).

3.3.2.2 Specific Offshore Port Review

New Jersey Coast

As discussed previously, no formal applications to build an offshore LNG facility in the Mid-Atlantic region have been filed with the DOT or the Coast Guard. However, LNG Express (2005a) has identified a plan by Excelerate for a transport and regasification vessel LNG terminal located offshore of the New York/New Jersey coasts. In addition, Atlantic Sea Island Group, LLC announced in January 2006 plans for the Safe Harbor Energy LNG Terminal project, which would involve installation of four LNG storage tanks on an artificially created island about 13.5 miles south of Long Beach, New York.

A significant issue for any offshore facility in the Mid-Atlantic region is how the facility would connect with the existing interstate pipeline systems. The existing interstate pipeline systems in the Mid-Atlantic region include pipelines operated by Columbia, and Transco in Maryland, Pennsylvania, New Jersey, and New York; Texas Eastern and Tennessee Gas Pipeline Company in Pennsylvania and New York; Algonquin Gas Transmission in New Jersey and New York; and Eastern Shore Natural Gas Company (Eastern Shore) in Delaware, Maryland, and Pennsylvania. Most of these pipeline systems are located a fair distance inland between approximately New Brunswick, New Jersey and Norfolk, Virginia. Connecting an offshore facility to the interstate systems in this area would require a fairly long pipeline, which would likely have both offshore and onshore impacts.

An LNG terminal off the southern coast of New Jersey from Cape May to Mantoloking would be the least favorable site from an environmental perspective. This section of coast line comprises extensive coastal wetlands areas and intra-coastal waterways, much of which has been designated as national wildlife refuges, natural areas, state parks, national estuarine research reserves, and wildlife management areas. The few areas that are not wetland, refuges, parks, or reserves, such as Atlantic City, are highly

developed. Moreover, any LNG terminal located off the southern coast would require as much as 45 miles of onshore pipeline and possibly as much offshore pipeline to achieve the necessary depth for siting an offshore terminal. These pipelines could disturb thousands of acres of seabed as well as coastal marshes and numerous wetlands, waterbodies, and other sensitive resources.

The one area where the interstate pipeline systems are much closer to the coast is in northern New Jersey. Locating an offshore facility near this area would reduce both the costs and onshore impact of the sendout pipeline. The following paragraphs provide an assessment of potential issues and impacts of siting an LNG terminal off the Atlantic coast of New Jersey, recognizing that it is impossible to determine the specific impacts of a project without knowing its design and specific location. For the purpose of this assessment we have assumed a facility similar to Excelerate's transport and regasification vessel design.

Our review of the offshore area east of the northern New Jersey has identified a number of sensitive environmental resources and issues that would need to be addressed in order to build an offshore terminal. The Port of New York and associated New Jersey ports collectively represent one of the busiest ports in North America. Estimated ship traffic in and out of this area is about 12,000 ships per year. Most of the traffic traveling to and from the port uses one of three ship traffic lanes, which converge about 10 miles south of Long Island and east of Sandy Hook and the mouth of Raritan Bay. According to NOAA charts, there are numerous offshore submerged cables and dump sites in the area. There are also a large number of recorded shipwrecks in the area, particularly near shore. The traffic lanes, dump sites, and high density of other obstacles, particularly near shore, would likely restrict potential terminal sites to far offshore sites located between the traffic lanes.

Siting the terminal far offshore would have the advantages of avoiding the dredging associated with the pier and minimizing or eliminating the visibility of the LNG facility and ships from the shore. It would also increase the distance of the facility and ship route from populated onshore areas and thus would enhance public safety by reducing the potential consequences of an LNG spill and fire.

The primary impacts of an LNG terminal offshore of New Jersey would result from the sendout pipeline and the operation of the LNG ships and terminal. Based on our review, it appears that the sendout pipeline could include more than 40 miles of offshore and onshore pipe. The operation of the LNG ships and terminal would result in air emissions, ballast water impacts, potential water use and aquatic impacts associated with use of seawater in the vaporization process, and restrictions on marine fishing and other shipping in the vicinity of the LNG terminal and transiting LNG ships.

Aquatic resources off the New Jersey coast include endangered and threatened species, essential fish habitat, and shellfish growing and harvesting areas. Federal endangered and threatened species that could occur in the vicinity of the offshore terminal or along the offshore pipeline route include several species of whales (sperm whale, finback whale, sei whale, humpback whale, North Atlantic Right whale), turtles (Atlantic loggerhead turtle, Atlantic leatherback turtle, Kemp's ridley turtle, Atlantic hawksbill turtle), and the shortnose sturgeon. The waters off the coast are designated as essential fish habitat for a number of species including whiting, various flounder species, ocean pout, monkfish, scup, ocean quahog, king mackerel, cobia, various shark species, and bluefin tuna. Commercial fishing for finfish and shellfish also occurs off of the northern New Jersey coast. The primary commercially harvested shellfish include surf clam, quahog, and sea scallops. Construction of the offshore pipeline could disturb thousands of acres of seabed and impact these resources. Onshore resources that could be affected by the construction of an onshore pipeline include numerous streams and wetlands as well as commercial and residential developments. Thus the total acres of impact of the offshore and onshore pipelines for an offshore LNG facility would likely be greater than the impacts of the proposed LNG terminal and sendout pipeline.

The unloading process used by an LNG transport and regasification ship involves the vaporization of LNG and injection of natural gas directly into the sendout pipeline(s). Based on the vessels to be used for the Northeast Gateway Project, we have assumed the LNG ships would use a shell and tube vaporizer system that operates in both open- and closed-loop modes. In the open-loop mode, seawater is pumped through the shell and tube system to provide the heat necessary to convert the LNG to the vapor phase. In the closed-loop system, a natural gas-fired boiler is used to heat water circulated in a closed-loop through the shell and tube vaporizer and a steam heater. Excelerate has indicated that only closed-loop vaporization would be used to regasify LNG at the Northeast Gateway terminal. Based on information filed in Excelerate's deepwater port application each LNG ship has a cargo capacity of at least 138,000 m^3 of LNG (this is equivalent to about 2.95 billion cubic feet of natural gas). Using the closed-loop vaporization process, it would take about 7 to 8 days to unload a single cargo of LNG. The closed-loop vaporization process would result in longer durations of unloading than those at the proposed LNG terminal.

The longer times required to unload a cargo at the offshore ports would result in increased air quality impacts and biological impacts. Regasification would require each LNG ship to remain at the offshore terminal for about 7 days. Regardless of the mode of vaporization, the ship would need to operate its engines throughout the unloading process, resulting in air quality impacts. Excelerate has indicated that vessels unloading LNG at the terminal would operate using natural gas instead of diesel during cargo unloading operations. The use of this type of facility to provide baseload gas supplies would require one ship to be docked at an unloading platform every day of the year. Closed-loop vaporization would require the use of a gas-fired boiler to operate the vaporizers. Based on the deepwater port application for the Northeast Gateway Project (Northeast Gateway, 2005), the two marine boilers on the regasification vessel would use 10,800 million Btu per day, or 7.56×10^{10} Btu per cargo of LNG. The estimated air emissions presented in table 3.3.2-1 do not account for those times when two LNG ships would be unloading simultaneously to maintain baseload sendout and, therefore, underestimate potential air quality impacts slightly. Additionally, the listed emissions are based on a sendout capacity of 400 MMcfd. To achieve the proposed sendout capacity of the Crown Landing LNG Project up to three ships would need to be offloading simultaneously, which would triple the estimated emissions listed in table 3.3.2-1.

Although we recognize that air quality impacts occur within a broader global context, prevailing winds in the area are to the east, which might mitigate some of the direct air quality impacts within the onshore areas of the United States.

TABLE 3.3.2-1

Estimated Air Emissions from LNG Vessel Operations During Offshore Cargo Unloading a/

NO_x		CO		SO_2		VOC		PM	
lbs/year	tpy	lbs/year	tpy	lbs/year	tpy	lbs/year	tpy	lbs/year	tpy
83.8	366.6	37.0	162.4	<0.1	0.1	2.4	10.6	3.4	14.6

a/ emissions based in information in Northeast Gateway's deepwater port application and assumes two boilers are operating at 100 percent load, 24 hours per day, 365 days a year
NO_x oxides of nitrogen
CO carbon monoxide
SO_2 sulfur dioxide
VOC volatile organic compounds
PM particulate matter, all PM assumed to be smaller than 2.5 microns in diameter
lbs/year pounds per hour
tpy tons per year; (lb/day x 365 days/ year)/ 2000 lb per ton

Eggs and larvae of various marine species would also be subject to entrainment and impingement impacts from ballasting operations (see section 4.6.2) and other withdrawals of seawater. Based on the Northeast Gateway Project, the LNG ships would arrive at the port carrying no ballast water. As the LNG ships offload their cargo, ballast water would be taken onboard to maintain ship stability. Based on the Northeast Gateway Project, each LNG ship would need to appropriate about 1.4 to 2.0 million gallons per day or 13.5 million gallons of ballast water per cargo delivery. An additional 54 million gallons of seawater per day would be withdrawn for other uses while the ship is at the terminal.

To determine the potential for entrainment and impingement of ichthyoplankton from ballast water withdrawals, we used data provided in Northeast Gateway's deepwater port application. Based on the assumption that the ships would withdraw about 56 million gallons per day while connected to the terminal, we estimated that entrainment or impingement could be as high as about 767,000 eggs and larvae (from a variety of fish) each day a ship is moored at the terminal. Although these numbers appear relatively large, we note that impacts on ichthyoplankton can be difficult to interpret due to the low natural survival rates of fish eggs and larvae.

Delaware Bay

We received several comments on the draft EIS requesting that we evaluate an offshore terminal in Delaware Bay as a potential alternative. Our review of Delaware Bay indicates that the water depth of the bay, which is less than 80 feet except in a narrow area at the mouth of the Bay, is too shallow to support offshore LNG terminals based on the floating (FSRU) or transport and regasification design. However, it may be possible to locate either a fixed GBS offshore terminal or alternatively an offshore docking facility and onshore storage facility near the mouth of the bay. The advantages of an LNG terminal in the bay would be that it would be located farther from populated communities and the LNG ships would need to transit a shorter distance on the bay and river. A disadvantage of these types of permanent facilities would be that they would be visible from shore. Additionally, it is likely that the safety and security zones established around these facilities would affect the navigation of other ships transiting the bay and river. Any offshore terminal sited at this location would also require a lengthy sendout pipeline. Because the nearest existing interstate pipeline systems capable of transporting natural gas from such an LNG facility are located in northern New Jersey and southeastern Pennsylvania, we estimate that the sendout pipeline could be at least 100 miles long. This pipeline would have much greater wetland, waterbody, and land use impacts than the proposed sendout pipeline. Depending on the location, we anticipate that an LNG terminal in the Delaware Bay could have similar issues as the Crown Landing LNG Project with Delaware's Coastal Zone Act and Coastal Zone Management Program.

3.3.2.3 Coastal Ports

Our regional review of coastal areas that might be suitable for an onshore LNG terminal encompassed the Chesapeake Bay, Atlantic coasts of Maryland and Delaware, the Delaware Bay and River, the north and south Atlantic coasts of New Jersey, New York Harbor, and the north and south shores of Long Island. Our review focused on the following five major screening criteria:

- The first criterion was a minimum channel depth of 40 feet. The rational for this depth requirement is that LNG ships generally have drafts of 38 feet and water depths of at least 40 feet are typically required to navigate and prevent grounding. We recognize that the required depth might be achieved by dredging shallow waters, but in light of the relatively minor amount of dredging required for the proposed project, we considered the cost and environmental impacts of significant dredging to be substantial and likely outweigh any other advantages.

- The second criterion was a minimum channel width of 800 feet and a maneuvering area of 2,000 feet to provide sufficient space for the LNG ships to safely transit and berth at the terminal.

- The third criterion was a minimum air draft (vertical clearance) of 135 feet to allow the LNG ships to safely transit under any structures (e.g., bridges) spanning the navigation channel.

- The fourth criterion was a distance to natural gas pipeline systems of less than 50 miles. Because of the impacts associated with constructing a large diameter interstate natural gas pipeline, we considered 50 miles the maximum reasonable distance between the port and existing interstate pipeline systems.

- The fifth criterion was the compatibility of existing land uses in the area with the proposed development of an LNG terminal. Although not an absolute requirement, we considered industrial areas in sparsely populated areas preferable to siting either in densely populated residential and commercial areas, or undeveloped areas such as recreational areas or protected shorelines.

Using these five criteria, we reviewed the Chesapeake Bay area and determined that Baltimore is one area within the Chesapeake Bay region that is close to Crown Landing's intended market and has sufficient water depth to accommodate LNG ships. There is also considerable industrial land in the Baltimore area that is located in relatively low-density population areas. A primary disadvantage of an LNG terminal in the Baltimore area, however, would be its distance from existing natural gas pipeline systems. To develop an LNG terminal in Baltimore, a sendout pipeline about 30 miles long would need to be constructed to connect an LNG terminal to the existing Transco and Columbia Gas pipeline systems. This pipeline would result in more land disturbance and likely impact more streams and wetlands than the proposed sendout pipeline. This pipeline would also need to cross densely developed and urbanized areas in and around the city and, therefore, would probably have a similar if not greater impact on residences, streets, and businesses as the proposed Logan Lateral. For these reasons, we felt that the Baltimore area did not warrant further investigation.

We received a comment on the draft EIS from the DNREC that we should expand our analysis of potential sites in the Baltimore area to include more detail regarding specific direct impacts, secondary impacts, and cumulative impacts associated with and LNG terminal and sendout pipeline. An LNG facility has been proposed by the AES Corporation at the Sparrows Point shipyard in Baltimore. A pipeline would likely have to be constructed to existing transmission pipelines in southeastern Pennsylvania and dredging would likely occur to accommodate LNG ships. Impacts to this Baltimore site would likely be similar to the Crown Landing site and a longer sendout pipeline with greater possible environmental impacts than the Logan Lateral.

We determined that the Atlantic coasts of Maryland, southern New Jersey, and Delaware would also be unsuitable for the development of an LNG terminal because they lack the deepwater ports required for LNG ship navigation and are far from both the intended market and existing interstate natural gas pipeline systems. Additionally, the Atlantic coasts of these states tend to be more densely populated with little available industrial property. The Delaware Coastal Zone Act and Coastal Zone Management Plan also include provisions that would make siting of an LNG terminal difficult. Delawares' Coastal

Zone Act prohibits new heavy industrial uses[4] of any kind in the coastal zone and Delaware's Coastal Zone Management Plan includes a policy that states "there is no site in Delaware suitable for the location of any LNG import-export facility." Thus any LNG facility in Delaware, including the proposed project (the proposed ship unloading facility would be located in Delaware state waters) would require an exemption from these Act and Plan.

We identified a number of ports in northern New Jersey, including Perth Amboy, Woodbridge, Carteret, Linden, Port Elizabeth, Port Newark, Jersey City, and Bayonne that are close to the intended market as well as existing natural gas pipeline systems. We determined that there also appears to be ample industrial property available in the northern New Jersey area. The primary drawback of this area is that the northern New Jersey ports are designed for and typically serve only smaller vessels such as ocean-going barges, cruise ships, dry cargo bulk vessels, and container ships. As a consequence, the channel widths and turning basins associated with these ports are small and would require substantial improvement to accommodate LNG ships. Another issue is that LNG ships would not be able to access some of the northern New Jersey ports because there is insufficient vertical clearance for LNG ships at the bridges across the Kill Van Kull. For these reasons, we did not investigate the northern New Jersey area further.

We determined that New York Harbor has adequate channel depths, industrially zoned land, and is close to both the intended market and existing natural gas interstate pipeline systems. However, there is currently a high level of ship traffic within the New York Harbor and ports, which could increase the risk of LNG shipping. Additionally, it would be difficult and expensive to operate LNG ships within the harbor while still accommodating the use of the ports by these smaller vessels. There are also several bridges within the harbor that have insufficient vertical clearance for LNG ships, which would preclude them from being used as LNG terminal sites. Another drawback is that potentially suitable sites within the harbor are generally close to residential and commercial areas. For these reasons, we did not further investigate alternative LNG terminal sites in New York Harbor.

The north shore of Long Island is close to the intended market but there is only limited access to interstate natural gas pipelines. Currently, the Iroquois Pipeline is the only major natural gas pipeline serving eastern Long Island and it is fully subscribed. The FERC recently authorized a second pipeline across Long Island Sound, the Islander East Pipeline Project, which would provide additional transportation capacity, but the State of Connecticut has denied the section 401 Water Quality Certification for the Islander East Pipeline Project, which makes the timing of the Islander East Pipeline Project uncertain. Another issue is that the Long Island Sound generally lacks turning basins and ship channels sufficient for LNG ships, thus development of an LNG terminal would require substantial dredging. Finally, much of the coastline is commercially or residentially developed. For these reasons, we did not further investigate alternative LNG terminal sites along the north shore of Long Island.

We determined that the south shore of Long Island is both close to the intended market and existing natural gas pipeline systems. The primary problem with the south shore of Long Island is that it lacks industrial ports and adequate channel depths and turning basins for LNG ships. Additionally, a large portion of the south shore of Long Island comprises federally and state protected lands, including the Fire Island National Seashore, Jones Beach State Park, Gateway National Recreation Area, Tobay Beach Park, Gilgo State Park, Robert Moses State Park, and local area beaches and parks. Since development of an LNG terminal on the south shore of Long Island would require extensive dredging and

[4] Heavy Industrial Use is defined in the Coastal Zone Act as "a use characteristically involving more than 20 acres, and characteristically employing some but not necessarily all of such equipment such as, but not limited to, smokestacks, tanks, distillation or reaction columns, chemical processing equipment, scrubbing towers, pickling equipment and waste treatment lagoons; which industry, although conceivably operable without polluting the environment, has the potential to pollute when equipment malfunctions or human error occur."

would likely have direct and indirect impacts on recreational areas and parks, we did not consider this area further in our alternatives analysis.

We determined that the Delaware River and Bay at least as far north as the Philadelphia Naval Yard has deep water and a sufficiently wide channel that would meet the navigational requirements of LNG ships. We also found that portions of the Delaware River and Bay, excluding the Delaware shoreline, are close to the intended market and the existing Columbia Gas, Transco, and Texas Eastern natural gas pipeline systems. Additionally, at least in New Jersey, we found that there is ample rural and industrial land relatively far from residential and commercial areas that might be suitable for an LNG terminal. For these reasons, we further investigated specific potential site alternatives in Delaware River and Bay area.

3.3.3 Site Specific Review of Onshore Sites along the Delaware Bay and River

To narrow the range and fully evaluate site alternatives, we refined the five major screening criteria discussed above and developed additional criteria to assist in identifying and comparing specific sites for consideration as LNG terminal alternatives. The review process included the examination of additional required and favorable review criteria.

Required criteria included regulatory specifications regarding LNG facility layout and safety siting factors that are required to be met for the project to be feasible. Required criteria included:

- **Thermal Exclusion/Vapor Dispersion Zone** (49 CFR 193.2057 and 193.2059) - Thermal exclusion and vapor dispersion zones must be established in accordance with NFPA 59A. Based on the proposed project design, we have applied a thermal exclusion zone with a radius of 1,000 feet from the center of the LNG storage tanks.

- **Airports** (49 CFR 193.2155(b)) - LNG storage tanks must not be located within a horizontal distance of 1 mile from the ends of the runway, or 0.25 mile from the nearest point of a runway, whichever is longer. The height of LNG structures in the vicinity of an airport must also comply with Federal Aviation Administration requirements.

- **LNG Waterfront Handling Requirements** (33 CFR 127.105) - Waterfront facilities where LNG is handled must comply with Coast Guard regulations pertaining to layout and spacing of the marine transfer area. These regulations require that each LNG loading flange be located at least 985 feet from general public or railway bridges crossing navigable waterways or entrances to any tunnel under navigable waterways.

Our responsibility under NEPA as the lead federal agency is to determine if environmentally preferable alternatives to the proposed action exist. All alternative sites were, therefore, compared to the proposed LNG terminal site. Favorable review criteria, although not absolute alternative requirements, were applied to identify those sites that would be reasonable and most likely to provide some environmental advantage over the proposed project. Favorable criteria were not intended to strictly eliminate the evaluation of certain sites. Given the limited availability of suitable sized parcels in areas with deepwater access, it was not possible to locate an alternative that met all of the favorable review criteria. However, some sites were selected for further analysis because they satisfied a majority, but not all of the favorable criteria. Favorable criteria included:

- **Population Centers/Residences** - We made an effort to identify alternative LNG terminal sites in areas that are not in close proximity to population centers and/or residences. Similarly, alternative LNG terminal sites were considered preferable if the

location did not require LNG ships to transit near residentially and commercially developed shorelines. In addition to avoiding potential conflicts with existing land uses, application of this favorable criterion would ideally avoid conflicts regarding perceived safety issues related to transport and storage of LNG.

- **LNG Terminal Footprint -** Based on the proposed design and the need to contain the thermal exclusion zone, a waterfront site of about 135 acres would be preferable to accommodate the proposed configuration of the LNG unloading, storage, and sendout facilities. Assuming the LNG storage tanks are located near the waterfront, this site would have to be about 2,000 feet by 3,000 feet to contain the thermal exclusion zones that are centered on the LNG storage area. An ideal waterfront site available for development would include an area in excess of the exclusion zone which would provide an additional buffer from development. However, to expand the range of potential candidate sites, we have relaxed the preferred acreage limit, recognizing that the facilities would need to be compressed and that exclusion zones may extend offshore or onto adjacent properties.

- **Dredging Required** - Given the environmental impacts associated with significant dredging projects, we considered the amount of dredging necessary to provide access to LNG ship access one of the alternative site review criteria. Areas requiring either no or minimal dredging to develop and maintain a ship berth and a ship channel of sufficient depth for the LNG ships were considered more favorable than those areas requiring more substantial dredging. In addition to avoiding impacts on water quality and aquatic resources, minimal dredging requirements provide the added benefit of reducing costs associated with disposal of dredged material.

- **Parcel Availability -** One of the greatest challenges of siting an LNG facility in the Mid-Atlantic region is finding suitable property that is available for industrial development. Availability is critical since section 3 of the NGA does not provide the project proponent the authority of eminent domain in acquiring property for the LNG terminal project. In some cases, a site may possess the size required for an LNG terminal but the owner is unwilling to sell or has placed unacceptable conditions on the acquisition of the site.

- **Existing Land Use –** We considered areas previously disturbed or cleared for industrial or commercial activities (brownfield sites) preferable to undisturbed areas (greenfield sites) when identifying alternative LNG terminal sites. Additionally, we preferred sites where existing land use zoning, coastal zone management guidelines, or development plans were consistent with an LNG import terminal. Sites that could be developed consistent with existing land uses were considered the most practical alternatives to the proposed site.

- **Sendout Pipeline Length -** We considered sites proximate to existing interstate pipeline systems which could accommodate the proposed volume throughput more favorable than sites further from existing pipelines. For purposes of this analysis, we assumed a pipeline should be at least 30-inches in diameter to accommodate the normal project volumes. On top of the additional costs and environmental impacts, longer pipelines would likely directly and indirectly affect more landowners/residences.

- **Road Access-** Because there would be considerable traffic into and out of the site during construction and access to the site would be required during facility operations, we considered the available access to the site from public roads. In general, we considered

access from highways and other primary roadways preferable to access from undeveloped or secondary roads.

- **Navigational** Suitability **and Berth Orientation** - Sites that offer minimal disturbances to existing ship traffic and allow for good access by LNG ships were considered a favorable selection criterion. We considered a slip berth oriented perpendicular to the ship channel preferable to a berth oriented parallel to the ship channel. Because LNG ships require a vertical clearance of at least 135 feet and horizontal clearance of not less than 165 feet, we also considered bridge passage along the navigation channel in our site analysis,

- **Environmental Justice** - As part of our NEPA analysis, we are responsible for addressing the potential for a federal action to result in disproportionately high and adverse health or environmental effects on minority or low-income populations. We considered per capita income, the percentage of minorities within the population, and the percentage of the population below the poverty level as general measures of the potential for a site to have an environmental justice issue. Those sites in communities with the lowest per capita income, the highest percentage of minorities, or the highest percentage of the population below the poverty level were considered to have the highest potential to raise environmental justice issues.

- **Special Interest Areas** - We considered favorably sites that avoided conflicts with special interest areas such as state or national parks and marine sanctuaries. When applying this criterion, we considered potential conflicts with special interest areas from either an LNG terminal or its associated sendout pipeline.

- **Various Environmental Factors** - Environmental factors that were considered in our site selection included: minimizing wetland disturbance and preferring sites in uplands; identifying soil conditions with suitable foundation materials for the LNG storage tank development; avoiding areas that would conflict with recreational activities; and selecting sites where the LNG storage tanks would minimally impact the viewshed from roadways and surrounding communities. Due to the potential concerns regarding the consistency of the proposed site with Delaware Coastal Zone Act and Coastal Zone Management Plan, we also reviewed sites for any obvious inconsistency with existing regulatory policies concerning coastal zone management.

Through the application of these more detailed siting criteria we identified seven alternative sites to the proposed LNG terminal site (Church Landing, Carneys Point, Ferro, Shuran, Repaupo, Paulsboro, and Mantua Creek). The general locations of these seven sites relative to the proposed site are shown on figure 3.3.3-1. A comparison of these sites to the proposed site is presented in table 3.3.3-1. The specific issues associated with each of these sites are discussed below.

Church Landing Site

The Church Landing Site is located in Pennsville Township, New Jersey at River Mile (RM) 68 (see figure 3.3.3-2). The site encompasses Conectiv's Deepwater Generating Station and consists of approximately 170 acres with about 1,000 feet of shoreline along the Delaware River. The site is similar to the proposed site with respect to zoning, size, berth orientation, non-tidal wetland impacts, channel width and maneuverability, airport conflicts, availability of power, and adequacy of road access. Development of the Church Landing Site, like the proposed site, may also be inconsistent with Delaware's Coastal Zone Act and Coastal Zone Management Plan regarding LNG facilities.

The primary differences between the Church Landing Site and the proposed site are the amount of dredging and the length of sendout pipeline that would be required, the number of people living near the site, and the proximity of the site to bridges. The Church Landing Site would require less dredging than the proposed site. However, because it is further from existing natural gas pipeline systems, the Church Landing Site would require construction of about 11 miles of additional sendout pipeline to connect with the existing Transco, Columbia Gas, and Texas Eastern pipeline systems. The additional length of pipeline would double the amount of land disturbance and the costs of the sendout pipeline.

The Church Landing Site is also closer to more populated areas than the proposed site. Based on an analysis of 2000 census data (U.S. Census Bureau, Landview 5), we estimate that there are about fourteen times the number of people living within 2 miles and more than nineteen times the number of people living within 1 mile of the Church Landing Site than the proposed site. There is also a recreational area (including athletic fields) and a historic site (Church Landing Farmhouse) located approximately 1,000 from the site. Additionally, unlike the proposed site, the Church Landing Site is located adjacent to the Delaware Memorial Bridge. Although there appears to be adequate space to locate the pier more than 985 feet from the bridge to comply with Coast Guard requirements, Crown Landing expressed concerns regarding the safety of mooring an LNG ship so close to a bridge.

An advantage of the Church Landing Site is that it would shorten the LNG transit route by about 10 miles. This shorter distance would result in LNG ships not needing to pass under any bridges and avoiding fewer populated communities, including Holloway Terrace, Wilmington, Edgemoor, Bellefonte, Holly Oak, Claymont, Deepwater, Carneys Point, and Penns Grove.

Because the Church Landing Site does not appear to offer any significant environmental advantages over the proposed site except a little less dredging, we have determined that the Church Landing Site is not preferable to the proposed site.

TABLE 3.3.3-1

Environmental Comparison of the LNG Terminal Site Alternatives to the Crown Landing LNG Terminal Site

	Proposed Site	Church Landing Site	Carneys Point Site	Ferro Site	Shuran Site	Repaupo Site	Paulsboro Site	Mantua Creek Site	Salem and Hope Creek Site
	Delaware River Mile 78 Logan Township, NJ	Delaware River Mile 68 Pennsville Township, NJ	Delaware River Mile 69 Pennsville and Carneys Point Township, NJ	Delaware River Mile 79 Logan Township, NJ	Delaware River Mile 80 Logan Township, NJ	Delaware River Mile 86 Greenwich Township, NJ	Delaware River Mile 88 Paulsboro Borough, NJ	Delaware River Mile 90 West Deptford, NJ	Delaware River Mile 53 Lower Alloways Creek Township, NJ
Required Criteria a/									
Site Encompasses the Thermal Exclusion/Vapor Dispersion Zone	Yes	Yes	No	No	No	No	No	Yes	Yes
Site Meets Airport Setback Requirements b/	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Site Satisfies Waterfront Handling Requirements	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Favorable Criteria									
Estimated Population Within 1 mile/2 mile Radius	82/383	1,577/5,362	482/4,407	60/178	57/589	1,943/3,783	3,578/10,354	389/8,091	0/0
Site Size (acres)	175	170	30	80	210	86	90	277	175
Dredging Requirement (cubic yards)	1.24 million	0.6 million	0.2 million	1.5 million	2.0 million	0.75 million	0.1 million	1.5 million	~4.5 million
Parcel Availability c/	High	Medium (not available until 2007)	Low	Low	Medium	Medium	Medium	Unknown	Unknown
Existing Site Activities	Limited Agricultural Use	Connectiv's Deepwater Generating Station	DuPont Plant	Chemical Factory	DuPont Plant	Adjacent to DuPont Plant	BP/Mobil Corporate Industrial Park	PG&E Facility	Adjacent to Salem and Hope Creek Nuclear Facility
Existing Land Use	Agricultural	Industrial	Industrial	Industrial	Forested Wetland/Open	Forested/Wetland	Industrial	Open	Open
Existing Zoning	Industrial	Industrial	Industrial	Industrial	Industrial	Industrial	Industrial	Industrial	Industrial
Approximate Total Sendout Pipeline Length (miles) d/	11	22	20	9	8	10	12	14	~37

TABLE 3.3.3-1 (cont'd)

Environmental Comparison of the LNG Terminal Site Alternatives to the Crown Landing LNG Terminal Site

	Proposed Site	Church Landing Site	Carneys Point Site	Ferro Site	Shuran Site	Repaupo Site	Paulsboro Site	Mantua Creek Site	Salem and Hope Creek Site
	Delaware River Mile 78 Logan Township, NJ	Delaware River Mile 68 Pennsville Township, NJ	Delaware River Mile 69 Pennsville and Carneys Point Township, NJ	Delaware River Mile 79 Logan Township, NJ	Delaware River Mile 80 Logan Township, NJ	Delaware River Mile 86 Greenwich Township, NJ	Delaware River Mile 88 Paulsboro Borough, NJ	Delaware River Mile 90 West Deptford, NJ	Delaware River Mile 53 Lower Alloways Creek Township, NJ
Road Access	U.S. Route 130	State Route 49	U.S. Route 130	U.S. Route 130	U.S. Route 130	Township Road	Borough Road	Township Road	Alloways Creek Neck Road
Ship Channel Width and Maneuvering Area	adequate	adequate	adequate	adequate	adequate	adequate	adequate	adequate	not adequate d/
Ship Channel Transit Distance (nautical miles) e/	61.5	52.5	53.5	63.0	64.0	68.5	70.5	71.5	46.5
Berth Orientation	perpendicular	perpendicular	perpendicular	perpendicular	perpendicular	parallel	parallel	parallel	parallel
Distance of Shore from Ship Channel (feet)	4,000	2,500	1,700	4,200	4,500	900	200	2,800	10,000
Potential Shipping Conflicts	none	yes	yes	none	none	yes	yes	yes	none
Potential Bridge Conflicts	none	yes	yes	none	none	none	none	none	none
Per Capita Income	$22,708	$22,717	$22,717	$22,708	$22,708	$24,791	$16,368	$24,219	$21,962
Percent Minority	13	3.5	3.5	13	13	5.5	36.4	7.7	3.6
Percent of Population Below Poverty Level (all ages) f/	6.2	4.9	4.9	6.2	6.2	3.6	17.7	5.3	7.3

TABLE 3.3.3-1 (cont'd)

Environmental Comparison of the LNG Terminal Site Alternatives to the Crown Landing LNG Terminal Site

	Proposed Site	Church Landing Site	Carneys Point Site	Ferro Site	Shuran Site	Repaupo Site	Paulsboro Site	Mantua Creek Site	Salem and Hope Creek Site
	Delaware River Mile 78 Logan Township, NJ	Delaware River Mile 68 Pennsville Township, NJ	Delaware River Mile 69 Pennsville and Carneys Point Township, NJ	Delaware River Mile 79 Logan Township, NJ	Delaware River Mile 80 Logan Township, NJ	Delaware River Mile 86 Greenwich Township, NJ	Delaware River Mile 88 Paulsboro Borough, NJ	Delaware River Mile 90 West Deptford, NJ	Delaware River Mile 53 Lower Alloways Creek Township, NJ
Conflict with DE CZA and CZMP	yes	yes	yes	no	no	no	no	no	no
Special Interest Areas	none	none	none	none	none	none	none	none	none
Non-tidal Wetland Impacts (acres)	<1.0	<1.0	<1.0	>10.0	>1.0	>1.0	<1.0	<1.0	<1.0
Other Miscellaneous Environmental Factors	Site is located in an area that has known occurrences of federally and state-listed sturgeons	Site is adjacent to recreation areas and historical site.	--	Site is within bald eagle nest buffer. Site development would require large amount of wetland impacts.	Site is within bald eagle nest buffer.	Site development would require large amount of wetland impacts.	Site is within bald eagle nest buffer.	Site is within bald eagle nest buffer.	Site is adjacent to Wildlife Management Area

a/ Required criteria include regulatory specifications regarding LNG facility layout and safety siting.

b/ See text below for potential site conflicts in reference to the 2020 Philadelphia International Airport Master Plan.

c/ High availability - the site is available for industrial use and a negotiated settlement to use the property has been reached with the current landowner.
Medium availability - the site is available for industrial use but no negotiations have taken place with the current landowner.
Low availability - the site is not available based on discussions between Crown Landing with the current landowner.

d/ This site is located far from the federal navigation or other deepwater ship channels and does not provide a turning basin to maneuver LNG ships.

e/ Distance listed includes minimum distance needed to tie into existing pipeline.

f/ Transit distance = start of navigation channel to terminal site.

g/ Based on 2000 U.S. Census Bureau poverty thresholds.

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FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE
CROWN LANDING LNG PROJECT and
LOGAN LATERAL PROJECT
Docket Nos. CP04-411-000 and CP04-416-000

Figure 3.3.3-1 Proposed and Alternative LNG Terminal Sites Along the Delaware River

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Figure 3.3.3-2 Church Landing – LNG Terminal Site Alternative

Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov.

Carneys Point Site

The Carneys Point Site is located in Pennsville and Carneys Point Townships in New Jersey at RM 69 (see figure 3.3.3-3). The site is currently part of the Dupont Carneys Point Plant property but about 30 acres of the property are potentially available for redevelopment. This site is similar to the proposed site with respect to zoning, berth orientation, non-tidal wetland impacts, channel width and maneuverability, airport conflicts, availability of power, and adequacy of road access. Development of the Carney's Point Site, like the proposed site, may also be inconsistent with Delaware's Coastal Zone Act and Coastal Zone Management Plan regarding LNG facilities.

The primary differences between the Carneys Point Site and the proposed site are the size of the site, amount of dredging that would be required to develop the site, the number of people living near the site, and proximity to bridges. The Carneys Point Site would require much less dredging than the proposed site. However, because it is further from existing natural gas pipeline systems, the Carneys Point Site would require construction of about 9 miles of additional sendout pipeline to connect with the existing Transco, Columbia Gas, and Texas Eastern pipeline systems. The additional length of pipeline would increase the amount of land disturbance and the costs of the sendout pipeline and would probably increase stream and wetland impacts.

The Carneys Point Site is considerably smaller and located in a more densely populated area than the proposed site. Because of the small size of the site (which is about one fifth the size of the proposed site), the thermal radiation and vapor dispersion exclusion zones would extend beyond the terminal property. Additionally, based on an analysis of 2000 census data (U.S. Census Bureau, Landview 5), we estimate that there are more than eleven times the number of people living within 2 miles and more than five times the number of people living within 1 mile of the Carneys Point Site as the proposed site.

Another issue is that the Carneys Point Site is located close to the Delaware Memorial Bridge. Although there appears to be adequate space to locate the pier more than 985 feet from the bridge to comply with Coast Guard requirements, Crown Landing has expressed concerns regarding the safety of mooring an LNG ship so close to a bridge. Another disadvantage of the site is its proximity to the ship channel. We estimate that the moored vessel security zone around the LNG ship while at berth would extend into the ship channel, which may increase the need for the Coast Guard's services to maintain the security zone while the LNG ship is berthed at the site.

An advantage of the Carneys Point Site is that it would shorten the LNG transit route by about 9 miles. This shorter distance would result in LNG ships avoiding fewer populated communities, including Wilmington, Edgemoor, Bellefonte, Holly Oak, Claymont, and Penns Grove.

In summary, the Carneys Point Site's only advantage over the proposed site is that it would require less dredging. This advantage, however, is outweighed by the numerous relative disadvantages of the site. For this reason, we do not consider the Carneys Point Site preferable to the proposed site.

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FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE
CROWN LANDING LNG PROJECT and
LOGAN LATERAL PROJECT
Docket Nos. CP04-411-000 and CP04-416-000

Figure 3.3.3-3 Carneys Point – LNG Terminal Site Alternative

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Ferro Site

The Ferro Site is located in Logan Township, New Jersey at RM 79 (see figure 3.3.3-4). The site is currently part of a polymer additive chemical factory property but about 71 acres are potentially available for redevelopment. This site is similar to the proposed site with respect to zoning, berth orientation, channel width and maneuverability, airport conflicts, bridge conflicts, availability of power, and the adequacy of road access. No portion of the Ferro Site is located within Delaware so there would be no conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan regarding LNG facilities.

The primary differences between the Ferro Site and the proposed sites are the size of the site, length of sendout pipeline needed, amount of dredging that would be required to develop the site, amount of wetland impact that would result from site development, number of people living near the site, and the proximity of the site to endangered species habitat. The Ferro Site would require 2 miles less sendout pipeline than the proposed site. This reduction in length of sendout pipeline would reduce the amount of land disturbed and the cost of the pipeline. It may also reduce stream, wetland, residential, and roadway impacts associated with the proposed pipeline. Additionally, based on an analysis of 2000 census data (U.S. Census Bureau, Landview 5), we estimate that there are even fewer people living within 2 miles and 1 mile of the Ferro Site than the proposed site.

The Ferro Site is less than half the size of the proposed site and the thermal radiation and vapor dispersion exclusions zones would extend beyond the site boundaries. Another disadvantage of the Ferro Site is that more dredging and non-tidal wetland impacts would result from site development. Crown Landing conducted a reconnaissance of the site and determined that between 10 and 30 acres of wetlands would be affected to construct an LNG facility on the site. Additionally, development of the ship berth would nearly double the amount of dredging required. The site is also within a designated bald eagle nest buffer zone.

In summary, the Ferro Site's primary advantage over the proposed site is that it would avoid conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan. This advantage, however, is outweighed by the numerous relative disadvantages of the site. For this reason, we do not consider the Ferro Site preferable to the proposed site.

Shuran Site

The Shuran Site is located in Logan Township, New Jersey adjacent to the Ferro Site at RM 80 (see figure 3.3.3-5). The site is encompasses 210 acres and includes about 4,000 feet of shoreline along the Delaware River. The Shuran Site is similar to the proposed site with respect to zoning, berth orientation, channel width and maneuverability, size, airport conflicts, bridge conflicts, availability of power, length of sendout pipeline required, and adequacy of road access. No portion of the Shuran Site is located within Delaware so there would be no conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan regarding LNG facilities.

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Figure 3.3.3-4 Ferro – LNG Terminal Site Alternative

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Figure 3.3.3-5 Shuran – LNG Terminal Site Alternative

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The primary differences between the Shuran Site and the proposed site are the length of sendout pipeline required, amount of dredging that would be required, amount of wetland impact that would result from site development, number of people living near the site, and proximity of the site to endangered species habitat. The Shuran Site would require 3 miles less sendout pipeline than the proposed site. This reduction in sendout pipeline would reduce the amount of land disturbed and the cost of the pipeline. It may also reduce stream, wetland, residential, and roadway impacts associated with the proposed pipeline. These advantages, however, would be offset by several disadvantages. Despite its relatively large size, the thermal radiation and vapor dispersion exclusions zones would extend beyond the site boundaries due to the shape of the property. Additionally, based on an analysis of 2000 census data (U.S. Census Bureau, Landview 5), we estimate that there approximately 200 more people living within 2 miles (but slightly fewer people living within 1 mile) of the Shuran Site than the proposed site.

One disadvantage of the Shuran Site is the amount of dredging required and the amount of non-tidal wetlands that would be affected by site development. Construction of the ship berth would almost double the amount of dredging required compared to the proposed site. Additionally, much of the Shuran Site is covered with wetlands and development of the property would increase wetland impacts relative to the proposed site. Also, to minimize wetland impacts, the LNG tanks would need to be located further from the shoreline, which would increase the length and cost of the cryogenic liquid unloading line. The site is also within a designated bald eagle nest buffer zone.

A major issue of the Shuran Site that was found out after publication of the draft EIS is that the Gloucester County Improvement Authority has plans to develop a park on the site. The park, referred to as the Delaware River, Equine, Agriculture, and Marine Park will encompass 1,400 acres of land extending from the Delaware River to U.S. Route 130, and from Raccoon Creek to Birch Creek. Plans for the park include a horse stable, an indoor arena, a small office building, picnic areas, an organic farm, community garden plots, and a campground. Gloucester County has nearly completed the acquisition of about 40 properties for the park and construction could begin as early as this year. The development of this park essentially prevents the siting of an LNG terminal at the Shuran Site.

Repaupo Site

The Repaupo Site is located in Greenwich Township, New Jersey at RM 86 (see figure 3.3.3-6). The site encompasses 86 acres adjacent to the Dupont Repaupo Plant. This site is similar to the proposed site with respect to zoning, channel width and maneuverability, amount of dredging required, airport conflicts, bridge conflicts, and availability of power. No portion of the Repaupo Site is located within Delaware so there would be no conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan regarding LNG facilities.

The primary difference between the Repaupo Site and the proposed site are the size of the site, road access, amount of dredging and wetland impact that would result from site development, length of the sendout pipeline needed, number of people living near the site, and the orientation of the ship berth and potential shipping conflicts. The environmental advantages of the Repaupo Site are that it would reduce the amount of dredging required and would require about 1 mile less sendout pipeline than the proposed route. The reduction in dredging and pipeline length would decrease the impact on the riverbed and the amount of land disturbed and the cost of the pipeline. It could also reduce stream and wetland impacts.

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Figure 3.3.3-6 Repaupo – LNG Terminal Site Alternative

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The Repaupo Site is less than half the size of the proposed site. Due to the relatively small size of the site, the thermal radiation and vapor dispersion exclusions zones may extend beyond the site boundaries. Additionally, based on an analysis of 2000 census data (U.S. Census Bureau, Landview 5), we estimate that due to its proximity to Gibbstown, there are twenty-four times more people living within 1 mile and about ten times more people living within 2 miles of the Repaupo Site than the proposed site.

Two other disadvantages of the Repaupo Site are the orientation of the ship berth, which would need to be parallel versus perpendicular to the ship channel, and the proximity of the ship berth to the ship channel. We estimate that the moored vessel security zone around the LNG ship while at berth would extend into the ship channel, which may increase the need for the Coast Guard's services to maintain the security zone while an LNG ship is berthed at the site. Additionally, much of the Repaupo Site is covered by forest or wetlands, which would be affected by site development.

Another disadvantage of the Repaupo Site is that it would increase the distance LNG ships would need to transit within the Delaware River to reach the terminal by about 8 miles. Thus LNG ships en route to the Repaupo Site would need to pass under the Commodore Barry Bridge and would transit by additional populated communities, including Chester and Essington, and two islands (Monds Island and Little Tinicum Island).

In summary, the Repaupo Site's primary advantage over the proposed site is that it would avoid conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan and require less dredging and a shorter sendout pipeline. These advantages, however, are outweighed by the numerous relative disadvantages of the site. For this reason, we do not consider the Repaupo Site preferable to the proposed site.

Paulsboro Site

The Paulsboro Site is located in Paulsboro Borough, New Jersey at RM 88 (see figure 3.3.3-7). The 90-acre site is part of the BP/Mobile Oil Corporate Industrial Park and is surrounded by oil refineries on two sides. This site is similar to the proposed site with respect to zoning, channel width and maneuverability, non-tidal wetland impacts that would result from site development, bridge conflicts, and availability of power. No portion of the Paulsboro Site is located within Delaware so there would be no conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan regarding LNG facilities.

The primary differences between the Paulsboro Site and the proposed site are the size of the site, road access, amount of dredging required for site development, length of the sendout pipeline needed, number of people living near the site, orientation of the ship berth, and potential shipping and airport conflicts. The Paulsboro Site would require much less dredging than the proposed site. Less dredging would reduce the water quality and aquatic resource impacts of the project. The Paulsboro Site would require construction of about 1 mile more sendout pipeline than the proposed site. The additional length of pipeline would increase the amount of land disturbed and the cost of the pipeline and could also increase stream and wetland impacts. Additionally, due to the relatively small size of the site, the thermal radiation and vapor dispersion exclusions zones could possibly extend beyond the site boundaries. Also, based on an analysis of 2000 census data (U.S. Census Bureau, Landview 5), we estimate that there are more than forty-three times more people living within 1 mile and more than twenty-seven times more people living within 2 miles of the Paulsboro site than the proposed site.

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Figure 3.3.3-7 Paulsboro – LNG Terminal Site Alternative

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Two other disadvantages of the Paulsboro Site are the orientation of the ship berth, which would need to be parallel versus perpendicular to the ship channel, and the proximity of the ship berth to the ship channel. We estimate that the moored vessel security zone around the LNG ship while at berth would extend into the ship channel, which may increase the need for the Coast Guard's services to maintain the security zone while the LNG ship is berthed at the site. The site is also within a designated bald eagle nest buffer zone.

Another disadvantage of the Paulsboro Site is that it would increase the distance LNG ships would need to transit within the Delaware River to reach the terminal by about 10 miles. Thus LNG ships en route to the Repaupo Site would need to pass under the Commodore Barry Bridge and would pass by additional populated communities, including Chester and Essington, two islands (Monds Island and Little Tinicum Island), and a least a portion of the Philadelphia International Airport.

Another potential issue with the Paulsboro Site is its proximity to the Philadelphia International Airport. The Paulsboro Site is currently about 1.3 miles across the Delaware River from Runway 9Left/27Right. A Master Plan for the airport is being developed to address the needs of the airport over the next 20 years. The Master Plan examines two expansion alternatives, which would involve expansion and/or construction of new runways. One of these alternatives, the parallel alternative, would involve construction of a new 10,000-foot-long runway south of Runway 9Left/27Right. If approved and constructed, the LNG ship berth and a portion of the terminal site would be within 1 mile of the end of proposed runway. Although there appears to be sufficient space to site LNG storage tanks more than a mile from the end of the runways and thus avoid conflicts with 49 CFR 193.2155(b), the proposed runway changes could limit the locations on the site that would be suitable for tanks.

In summary, the Paulsboro Site's primary advantages over the proposed site are that it would avoid conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan and would require less dredging. These advantages, however, are outweighed by the numerous relative disadvantages of the site. For this reason, we do not consider the Paulsboro Site preferable to the proposed site.

Mantua Creek Site

The Mantua Creek Site is located in West Deptford, New Jersey at RM 90 and encompasses 277 acres of land owned by PG&E (see figure 3.3.3-8). The Mantua Creek Site is similar to the proposed site with respect to zoning, channel width and maneuverability, non-tidal wetland impacts, bridge conflicts, and availability of power. No portion of the Mantua Creek Site is located within Delaware so there would be no conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan regarding LNG facilities.

The primary differences between the Mantua Creek Site and the proposed site are the size of the site, road access, amount of dredging needed, length of the sendout pipeline needed, number of people living near the site, orientation of the ship berth, and potential for shipping and airport conflicts. The Mantua Creek Site is 102 acres larger than the proposed site and would provide a larger buffer zone around the LNG facility.

The Mantua Creek Site would require construction of about 3 miles more sendout pipeline than the proposed site. The additional length of pipeline would increase the amount of land disturbed and the cost of the pipeline and could increase stream and wetland impacts. The Mantua Creek Site would also require more dredging than the proposed site. Additionally, based on an analysis of 2000 census data (U.S. Census Bureau, Landview 5), we estimate that there are more than four times as many people living within 1 mile and twenty-one times as many people living within 2 miles of the Mantua Creek Site as the proposed site.

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Figure 3.3.3-8 Mantua Creek – LNG Terminal Site Alternative

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Two other disadvantages of the Mantua Creek Site are the orientation of the ship berth, which would need to be parallel rather than perpendicular to the ship channel, and the proximity of the ship berth to the ship channel. We estimate that the moored vessel security zone around the LNG ship while at berth would extend into the ship channel, which may increase the need for the Coast Guard's services to maintain the security zone while the LNG ship is berthed at the site. The site is also within a designated bald eagle nest buffer zone.

Another disadvantage of the Mantua Creek Site is that it would increase the distance LNG ships would need to transit within the Delaware River to reach the terminal by about 12 miles. Thus LNG ships en route to the Repaupo Site would need to pass under the Commodore Barry Bridge and would pass by additional populated communities, including Chester, Essington, and Paulsboro; two islands (Monds Island and Little Tinicum Island); and the Philadelphia International Airport.

Another potential issue with the Mantua Creek Site is its proximity to the Philadelphia International Airport. The Mantua Creek Site is currently about 1.3 miles across the Delaware River from Runways 17-35 and 9Right/27Left. As mentioned previously, the Master Plan for the airport examines two expansion alternatives, which would involve expansion and/or construction of new runways. Both alternatives would decrease the distance between the airport runways and the Mantua Creek Site. If either of the proposed runway alternatives are approved and constructed, the LNG ship berth and a portion of the terminal site shoreline would be within 1 mile of the end of proposed runways. Although there appears to be sufficient space to site LNG tanks more than 1 mile from the end of the runways and thus avoid conflicts with 49 CFR 193.2155(b), the proposed runway changes could limit the locations on the site that would be suitable for storage tanks.

In summary, the Mantua Creek Site's primary advantage over the proposed site is that it would avoid conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Policy. This advantage, however, is outweighed by the numerous relative disadvantages of the site. For this reason, we do not consider the Mantua Creek Site preferable to the proposed site.

Salem and Hope Creek Site

We received comments on the draft EIS requesting that we evaluate the existing Salem and Hope Creek Nuclear Generating Facility site as an alternative LNG terminal site. The Salem and Hope Creek Site is located on Artificial Island at RM 53 in Lower Alloways Creek Township, New Jersey (see figure 3.3.3-9). Artificial Island is bordered by the Delaware River to the south and west and extensive coastal wetlands to the north and east. The island was artificially created from dredged material. The Salem and Hope Creek Nuclear Facility, which includes both the Salem Nuclear Generating Station and the Hope Creek Nuclear Generating Station, occupies about 700 acres of the island. An additional 214 acres of the island north of the nuclear facilities is currently being actively used as a COE dredge disposal area.

Based on our review, there appears to be an undeveloped area on the island of adequate size (at least 175 acres) for an LNG terminal. This area is located to the east of the nuclear facilities and adjacent to the Mad Horse Wildlife Management Area. The only access to this area, is from Alloways Creek Neck Road, which connects with County Road 658 in Hancocks Bridge about 7 miles to the northeast.

The site is similar to the proposed site with respect to zoning, size, non-tidal wetland impacts, airport conflicts, and availability of power.

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Figure 3.3.3-9 Salem and Hope Creek - LNG Terminal Site Alternative

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The primary differences between the Salem and Hope Creek Site and the proposed site are ship maneuverability and berth orientation, the amount of dredging that would be needed, the length of sendout pipeline and pier that would be required, the number of people living near the site, access to the site, proximity to recreation areas, the distance of ship transit in the Delaware Bay and River, and potentially the parcel availability.

An advantage of the Salem and Hope Creek Site is that no portion of the site is located in Delaware so there would be no conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan regarding LNG facilities. Another advantage is that there are no people living within 2 miles of the site based on 2000 census data (U.S. Census Bureau, Landview 5).

LNG ships transiting to the site would need to travel about 26 fewer miles on the Delaware Bay and River. This shorter distance would result in LNG ships not passing under any bridges and avoiding transiting by many of the populated communities along the river.

The Salem and Hope Creek Site also has several disadvantages. One issue is that the shoreline is located about 10,000 feet from the navigation channel, which is 2.5 times the distance between the shoreline and the navigation channel at the proposed site. This increased distance would likely increase both the length of the pier and the amount of dredging required. To minimize dredging, we assumed the pier would be approximately 6,000 feet long, which is three times as long as the proposed pier. Based on information provided in Crown Landing's application, we estimated that this greater length could increase the pier cost by as much as $20 million. Even with a longer pier, dredging would be required to access the pier. We estimated based on existing water depths, which are about 16 to 17 feet in the vicinity of the pier, that approximately 850,000 cubic yards of dredging would be needed for an LNG ship berth parallel to the ship channel.[5] Moreover, since there is no turning basin near the site, we estimated that two lengthy channels approximately 6,000 feet long and 500 feet wide would need to be dredged for LNG ships to arrive and depart from the pier. Based on existing water depths, we estimated that these channels could require dredging an additional 3.7 million cubic yards. The combined dredging of these channels and the LNG berth would likely result in more than 3 million cubic yards of additional dredging than the proposed site. This increased dredging would also result in increased impacts on water quality and aquatic resources.

Another potential issue is the proximity of the site to the existing nuclear facilities. While there appears to be sufficient space to meet the requirements for thermal and vapor exclusion zones, it is unknown whether the Nuclear Regulatory Commission would have concerns regarding the siting of an LNG terminal adjacent to the existing nuclear facilities or whether the current landowner would be willing to provide the land necessary to develop an LNG terminal.

The Salem and Hope Creek Site would also require a substantially longer sendout pipeline than the proposed site. Based on the location of the existing pipeline systems, we believe the sendout pipeline route would most likely proceed north from the Salem and Hope Creek Site either along the Delaware Bay coats or further inland to an interconnect with the existing Columbia and Transco pipelines at or near the proposed site and the existing Texas Eastern pipeline at or near Chester Junction. Depending on the specific route, this would require construction of between 27 (coastal route) to 28 miles (inland route) of additional pipeline. We estimated that this pipeline would result in 3.7 (inland route) to 6.7 miles (coastal route) of additional wetland impacts, an additional 17 to 18 perennial waterbody crossings, and 27 to 34 road crossings.

[5] We assumed a parallel berth for two reasons. First, due to the distance of the pier from deep water and the shipping channel, a perpendicular berth would not provide any additional safety advantage. Second, we estimated that the amount of dredging for a perpendicular berth would be greater than for a parallel berth.

In summary, the primary advantages of the Salem and Hope Creek Sites over the proposed site are that it would be more remotely located than the proposed site, would avoid conflicts with Delaware's Coastal Zone Act and Coastal Zone Management Plan, and would require a shorter LNG transit distance than the proposed route. These advantages however are outweighed by the numerous challenges faced with the redevelopment of the site, including the additional dredging and pipeline impacts that would result. For this reasons, we do not consider the Salem and Hope Creek Site preferable to the proposed site.

3.4 PIER ALTERNATIVES

As described in section 2.4.1.3, development of the proposed ship berth would require excavation and disposal of about 1.24 million cubic yards of sediments using hydraulic dredging equipment, which would affect water quality and aquatic organisms (see sections 4.3.2 and 4.6.2). During scoping of this EIS, agencies expressed concern about impacts associated with the dredging required to develop the proposed pier perpendicular to the ship channel and suggested that these impacts could be eliminated or reduced by moving the pier closer to the ship channel.

Potential pier alternatives were evaluated in three steps. The first step was to determine whether it would be reasonable and practicable to use the existing pier for the Logan Generating Station in lieu of constructing a new pier. If the existing pier is not selected, then the next step was to determine a suitable location of the pier offshore of the LNG terminal site. The final step involved a more detailed assessment of potential pier and berth configurations and orientations in the same general area as the selected pier location.

One alternative that we considered was to co-locate the proposed LNG ship unloading facility with the existing coal barge unloading pier for the Logan Generating Station. We determined that the use of the existing pier is not preferable to the proposed pier design for several reasons. First, the existing pier would need to be modified to accommodate the unique requirements for offloading LNG. Since Crown Landing does not own the pier, it would be required to seek an agreement with National Energy Power Company, L.L.C. for the proposed modifications. Section 3 of the NGA, under which Crown Landing is seeking the FERC's authorization, does not include the authority to acquire land by eminent domain. Consequently, if National Energy Power Company, L.L.C. is unwilling to agree to such an arrangement, there is no means for Crown Landing to compel them to share the pier. Another issue is the orientation of the existing pier, which is parallel and near the edge of the Marcus Hook anchorage area. This orientation would put moored LNG ships close to other ships in the anchorage area, and thus increase the potential for allisions with errant ships. Finally, we believe the logistics of sharing the pier would be impracticable. Currently, the Logan Generating Station receives two coal barges per week, which require about 24 hours to berth, unload, and disembark. Crown Landing would receive an LNG ship every 2 to 3 days, which would take about 24 hours to berth, unload, and disembark. The use of a single pier by all these ships would be complicated and bad weather and tides would likely result in conflicts between scheduled deliveries.

The options for relocating the pier are limited by the presence of the several existing pipelines, which cross the river from Marcus Hook, Pennsylvania to the New Jersey shoreline at the southwestern corner of the proposed LNG terminal site. To avoid these pipelines, the pier could potentially be located upstream of the existing Transco pipeline (i.e., between the Transco pipeline and Logan Generating Station pier), or between the existing Transco, Columbia Gas, and Colonial Pipelines. We believe that the space between the Transco pipeline and the Logan Generating Station pier is insufficient for safe ship operations. Therefore, we focused our review of alternative pier locations on the area between the Transco, Columbia Gas, and Colonial pipelines

Crown Landing's proposed pier design is perpendicular to the ship channel and located adjacent to the Marcus Hook anchorage area (see figure 2.2.1-1). Conceptually, we evaluated how far the pier should be located from the shoreline. It was apparent that a pier further from shore would reduce the amount of dredging and minimize shallow water habitat impacts. However, locating the pier further out into the river would place it closer to and possibly in the ship channel or anchorage area, which would increase potential ship hazards. Locating the pier farther from shore would also lengthen the trestle and, therefore, increase the costs of the pier. Conversely, locating the pier closer to shore would provide additional safety to LNG ships and reduce trestle length and costs. A nearshore pier would also increase the amount of dredging and would affect more shallow water habitat. To balance these benefits and impacts, we determined that the preferable location for the pier would be between about 1,000 and 2,000 feet from the shore. We evaluated three alternative pier designs (Pier Options A, B, and C) that would be located within this preferred distance from shore. The proposed pier and Pier Option A are oriented perpendicular to the ship channel, Pier Option B is parallel to the ship channel, and Pier Option C is at an angle to the ship channel. Table 3.4-1 provides a comparison of the three alternative pier options to the proposed pier design. The alternative pier options are shown on figures 3.4-1 through 3.4-3.

TABLE 3.4-1

Comparison of Alternative Pier Options With the Proposed Pier Design

Environmental/Engineering Factor	Proposed Pier a/	Pier Option A	Pier Option B	Pier Option C
Shallow Water Habitat Impacts (acres)	9.7	12.7	16.1	0.5
Volume of Dredging (million cubic yards)	1.24	0.8	1.8	0.3
Riverbed Affected (acres)	30.3	27.7	52.4	19.4
Trestle Length (feet)	2,000	2,000	4,600	3,000

a/ The numbers for shallow water impacts, dredge volume, and amount of riverbed affected are greater than the numbers reported in the draft EIS. This is because Crown Landing revised the design the proposed ship berth after the draft EIS was issued to allow an enhanced margin of safety for LNG ship maneuvering. The revised design increased the length and width of the berth pocket. We did not apply these same increases to the alternatives, although similar design revisions would probably be necessary. Thus the shallow water impacts, dredge volume, and riverbed impacts listed for the alternatives pier locations are probably underestimated.

Pier Option C would result in the least disturbance of shallow water habitat and riverbed. Also, due to its location near the edge of the Marcus Hook anchorage area, it would also require the least amount of dredging. Pier Option B, conversely, would result in the most disturbance of shallow water habitat and riverbed and would require the most amount of dredging. These additional impacts and dredging requirements are the result of the berth for Pier Option B being mostly located closer to shore in shallow water. Pier Option A and the proposed pier would have similar trestle lengths. Pier Option A may reduce dredging requirements and riverbed impacts. However, the actual difference in dredging and riverbed impacts between the two sites would likely be less than listed in table 3.4-1 since the alternative berth length and width would probably need to be increased (see the footnote to table 3.4-1). Pier Option A would also affect about 23 percent more shallow water habitat than the proposed pier.

To assess ship traffic and safety issues associated with the various pier and slip options, Crown Landing conducted ship simulation studies at Marine Safety International in June 2004. Through these studies it was determined that Pier Option C would provide the least protection from errant ships because there would be essentially no shallow water area between the LNG ship berth and the anchorage area to slow or stop an errant ship from alliding with a berthed LNG ship. This pier option could also hinder the access of coal barges to the Logan Generating Station pier. All of the other pier configurations would avoid conflicts with the existing coal unloading pier and provide a protective shallow water barrier between berthed LNG ships and the anchorage area. For the proposed pier and Pier Option B, the pier itself, which would be located between the berth and the anchorage area, would provide additional protection to berthed LNG ships.

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Figure 3.4-1 Pier Option A

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Figure 3.4-2 Pier Option B

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Figure 3.4-3 Pier Option C

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Based on our evaluation of pier alternatives, we believe that Pier Option B would have more environmental impacts than the proposed pier. Pier Option A would have similar environmental impacts, except that less shallow water habitat is disturbed by the proposed pier compared with Pier Option A. Although it appears Pier Option C would provide some environmental advantages, it would expose berthed LNG ships to increased safety risks. For these reasons, we believe that the proposed pier configuration offers the best balance of increased safety and reduced environmental impacts.

3.5 PIPELINE ALTERNATIVES

3.5.1 Pipeline System Alternatives

Crown Landing proposes to deliver up to a maximum rate of 1.4 Bcfd of natural gas to the Mid-Atlantic region. The majority of this natural gas (a maximum of about 0.9 Bcfd) would be delivered to the Texas Eastern pipeline system via the proposed 11-mile Logan Lateral. The remainder would be delivered to the Columbia Gas and Transco pipeline systems (a maximum of about 0.5 Bcfd and 0.6 Bcfd, respectively) through interconnects on the proposed LNG terminal site. FERC staff conducted an engineering analysis to determine if either the existing Columbia Gas or Transco pipeline systems could transport the natural gas volumes proposed for the Texas Eastern system and thus avoid the impacts associated with construction and operation of the Logan Lateral. The FERC concluded from this evaluation that neither Columbia Gas' nor Transco's existing systems separately or combined has sufficient capacity to transport the volumes of natural gas proposed for the Texas Eastern pipeline system. These pipeline systems would need to be expanded to accommodate larger gas volumes. The Logan Lateral is also designed to meet a request for additional transportation capacity to markets off the Texas Eastern system to serve incremental market demand in the region.

Columbia Gas' existing local pipeline system consists of a 20-inch-diameter pipeline in Claymont, Delaware that becomes a 16-inch-diameter pipeline which crosses the Delaware River and connects with another 20-inch-diameter pipeline that is located north of the LNG terminal site. To transport the natural gas volumes proposed for the Texas Eastern pipeline system, Columbia Gas would need to construct the following pipeline and aboveground facilities:

- 37 miles of new 36-inch-diameter pipeline from the proposed LNG terminal site, across the Delaware River to Columbia Gas' existing Eagle Compressor Station located in Chester County, Pennsylvania.;
- 20,000 hp of additional compression at Columbia Gas' existing Downingtown Compressor Station located in a residential area of Chester County, Pennsylvania; and
- A new meter and regulation station at the proposed LNG terminal site.

Since the Columbia Gas pipeline expansion would be much longer and would require additional compression, there would be greater environmental impacts, including additional noise impacts at the Downingtown Compressor Station (which currently has noise compliance issues), than the proposed Logan Lateral Project. Therefore, we did not further investigate the Columbia Gas pipeline system alternative.

Transco's existing local pipeline system consists of three pipelines. Two of these pipelines, a 12-inch-diameter pipeline and 20-inch-diameter pipeline, cross from Marcus Hook, Pennsylvania under the Delaware River to the New Jersey shoreline at the southwestern corner of the proposed LNG terminal site. A third 20-inch-diameter pipeline crosses from Marcus Hook, Pennsylvania under the Delaware River to the New Jersey at a landfall location just north of the proposed LNG terminal site. After crossing the river, these pipelines proceed northeast and form part of Transco's Trenton-Woodbury Line. To

transport the volumes proposed for the Texas Eastern pipeline system, Transco would need to construct the following pipeline and aboveground facilities:

- 12 miles of 24-inch-diameter pipeline from the proposed LNG terminal site across the Delaware River to Transco's existing Compressor Station 200 located near Frazer, Pennsylvania; and
- A new meter and regulation station at the proposed LNG terminal site.

Transco would need to construction about 1 mile more pipeline than the proposed Logan Lateral. Since the Transco pipeline would cross similar areas and resources, we anticipate that it would have similar impacts as the Logan Lateral Project. Because it would not offer any significant environmental benefits over the proposed facilities, we do not believe expansion of the Transco pipeline system would be environmentally preferable to the proposed Logan Lateral Project.

3.5.2 Major Route Alternatives

In evaluating alternatives to the Logan Lateral Project, we also assessed whether it might be possible to reduce the environmental impacts associated with the proposed pipeline[6] by developing alternative pipeline routes. We assessed both environmental factors such as wetlands, waterbodies, land uses, public lands, forest land, cultural resources, residences, and engineering factors such as terrain, potential construction techniques, and the number of roads and railroads crossed. Through this process, we identified six pipeline route alternatives or variations. Four of these are major route alternatives, which begin and end at the same location as the proposed pipeline route, but share the same alignment as the proposed route in some areas. The relative locations of these four major route alternatives are shown on figure 3.5.2-1. A comparison of these four routes to the proposed route is provided in table 3.5.2-1.

3.5.2.1 Railroad Alternative

The Railroad Alternative begins at Texas Eastern's Chester Junction and follows the same alignment as the proposed route to MP 1.2. The alternative route then turns and proceeds southeast along Bridgewater Road for about a 0.1 mile where it enters Upland Park. Within Upland Park, the alternative route proceeds south across the park. At the southern end of the park property, the alternative route crosses the Caleb Pusey Historic District and proceeds across Chester Creek to an abandoned railroad grade. The alternative route then turns and follows the abandoned railroad grade east and then southeast for about 1.4 miles, crossing the CSX railroad, Interstate 95, an active Amtrak railroad, and several streets, until it reaches the active Norfolk Southern railroad. The alternative route then proceeds southwest adjacent to the Norfolk Southern railroad for about 0.9 mile. At this point, the alternative route rejoins the proposed route. The Railroad Alternative then follows the same alignment as the proposed route across the Delaware River into New Jersey and on to the proposed LNG terminal site.

As shown in table 3.5.2-1, the Railroad Alternative is about the same length and would disturb similar types of land as the proposed route. An advantage of this alternative is that it would cross about 0.3 mile less forest land and two less waterbodies than the proposed route. The Railroad Alternative would also cross 24 fewer roads and one less railroad. Another advantage of this alternative is that it would pass within 50 feet of 19 fewer residences than the proposed route.

[6] We did not consider alternatives to the Columbia Gas and Transco interconnects warranted because these interconnects would be accomplished on the LNG terminal site with minimal environmental impact.

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Figure 3.5.2-1 Major Route Alternatives

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TABLE 3.5.2-1

Environmental Comparison of Alternative Routes to the Proposed Route

Environmental Factor	Proposed Route	Railroad Alternative	Hayes Street Alternative	Sunoco Alternative	Upland Road Alternative
Length (miles)	11.00	10.90	12.92	8.86	10.29
Co-located with Existing Right-of-Way (miles)	4.95	5.00	7.49	5.13	4.93
Co-located with Existing Pipeline Right-of-Way (miles)	3.12	1.95	4.60	1.50	1.95
Construction Right-of-Way (acres)	101.1	101.7	125.1	81.5	95.9
Permanent Right-of-Way (acres)	54.0	52.3	72.9	45.2	52.8
State Lands Crossed (miles)	0.24	0.15	0.43	0.12	0.00
Wetlands Crossed (miles)	0.91	0.91	0.95	0.42	0.91
Parkland Crossed (miles)	0.23	0.60	0.44	0.43	0.00
Forest Land Traversed (miles)	1.71	1.41	2.30	0.85	0.91
Open Land Traversed (miles)	4.01	4.40	4.76	2.32	4.06
Agricultural Land Crossed (miles)	1.53	1.53	1.53	0.31	1.53
Industrial/Commercial Land Crossed (miles)	0.62	0.52	1.03	2.25	0.54
Waterbodies Crossed (numbers)	11	9	14	6	9
Residences within 50 feet of Construction Right-of-Way (numbers)	144	125	142	114	116
Other Buildings within 50 feet of Construction Right-of-Way (numbers)	11	21	27	20	25
Major Paved Roads Crossed (numbers)	36	12	20	15	17
Railroads Crossed (numbers)	4	3	5	5	3
Cultural Resources (potential sensitivity)	low	high	low	low	high

The major disadvantage of the Railroad Alternative is that it has a high potential to impact archaeological resources. The Railroad Alternative would cross a historic district associated with the Caleb Pusey House and Landingford Plantation that is listed on the NRHP. The historic district consists of several standing structures that are historic remnants from some of the earliest mills in Pennsylvania. Although none of the standing structures would lie within the construction right-of-way of the alternative route, a cursory review of the area has identified at least one historic mill race that would be crossed by the Railroad Alternative. It is expected that archaeological remains from other mills may still exist and that these remains would provide a source of information to verify historical accounts and provide additional historical information on daily activities associated with the mills. As such, it is expected that any archaeological remains associated with this site have a high potential to be considered eligible for listing on the NHRP.

Other disadvantages of the Railroad Alternative include the crossing of additional parkland and more difficult and possibly more costly construction requirements. The Railroad Alternative would cross almost three times as much parkland as the proposed route. In addition to crossing about 792 feet of Caleb Pusey Historic District, this alternative route crosses about 2,376 feet of Upland Park. The proposed route in comparison would cross only 1,214 feet of Veterans Memorial Park. The Railroad Alternative would be more difficult to construct than the proposed route in several locations. The alternative crossing of Interstate 95 would be more difficult because there is less space available on both sides of the highway. Additionally, there is more residential housing on the southeastern side of Interstate 95 along the alternative route, which could be affected if HDD techniques are used. Another complicated construction area along the alternative route would be where the former railroad grade crosses 7th Street in Chester. An elevated trestle at this location would require that the pipeline be installed using either conventional bore or HDD techniques, which would be difficult due to the location of the road and an electrical substation.

For the reasons discussed above, we do not believe the Railroad Alternative would be preferable to the proposed route.

3.5.2.2 Hayes Street Alternative

The Hayes Street Alternative begins at Texas Eastern's Chester Junction and follows the same alignment as the proposed route to MP 2.3. The alternative route then deviates to the west and continues to follow an existing Texas Eastern pipeline parallel to an active railroad for about 1.6 miles. In this segment, the alternative route crosses a railroad and Interstate 95. South of Interstate 95, the alternative route crosses Laughhead Avenue, Johnson Park, and Marcus Hook Creek twice. The alternative route then proceeds northeast adjacent to the railroad for about 1 mile until it reaches Hayes Street. The alternative route then follows Hayes Street for about 0.5 mile to MP 4.3 where it rejoins the proposed route. The Hayes Street Alternative then follows the same alignment as the proposed route across the Delaware River into New Jersey and on to the LNG terminal site.

As shown in table 3.5.2-1, the Hayes Street Alternative route and the proposed route would cross a similar amount of wetlands and would be constructed adjacent to a similar number of residences within 50 feet of the construction right-of-way. Two advantages of the Hayes Street Alternative are that it would be co-located with existing rights-of-way for a greater percentage of its length and would cross 16 fewer roads than the proposed route. However, these advantages are offset by several disadvantages. This alternative route would be longer and would result in more land disturbance, including more forest clearing, than the proposed route. The alternative route would also cross both Jack's Park and Johnson's Park, which would almost double the amount of parkland crossed compared to the proposed route. Additionally, the alternative route would cross three more waterbodies and one more railroad, and would be constructed within 50 feet of 16 more non-residential buildings than the proposed route.

Another disadvantage of the Hayes Street Alternative is that it has a higher risk than the proposed route to encounter hazardous wastes. This alternative route would cross a property that contains petroleum storage tanks and a property with large industrial waste ponds. Both of these properties have the potential to be contaminated by hazardous wastes. The presence of contaminated soils and/or groundwater in the pipeline construction right-of-way could require special construction techniques and remediation measures. These techniques and measures could be costly and could expose workers to increased health and safety risks.

For the reasons discussed above, we do not believe the Hayes Street Alternative would be preferable to the proposed route.

3.5.2.3 Sunoco Alternative

The Sunoco Alternative begins at Texas Eastern's Chester Junction and follows the same alignment as the Hayes Street Alternative, mostly adjacent to an existing Texas Eastern pipeline, for about 3.9 miles to a location north of Interstate 95. The Sunoco Alternative then deviates from the Hayes Street Alternative and continues to follow the existing Texas Eastern pipeline south and west across Interstate 95, State Route 452, and several other roads. After crossing Blue Ball Avenue, the alternative route stops following the existing pipeline and proceeds west along U.S. Route 13 to the Sunoco Marcus Hook refinery property. The Hayes Street Alternative then crosses the refinery property and the Delaware River to the proposed LNG terminal site.

As shown in table 3.5.2-1, the Sunoco Alternative would be more than 2 miles shorter than the proposed route and thus would result in less land disturbance and require less permanent right-of-way. The Sunoco Alternative would also be co-located with other rights-of-way for a greater percentage of its

length than the proposed route. Additionally, this alternative route would cross about 0.8 mile less forest land, about 0.5 mile less wetland, and about 1.2 miles less agricultural land than the proposed route. The alternative route would also cross five less waterbodies and 21 less roads, and would be constructed within 50 feet of 30 fewer residences than the proposed route.

A disadvantage of the Sunoco Alternative is that it would be constructed within 50 feet of 9 more non-residential buildings. It would also require construction activities within the vicinity of the industrial storage tank farm located north of Interstate 95, as well as within the limits of the Sunoco Marcus Hook refinery located adjacent to the Delaware River. The refinery has been in operation since 1902 and produces fuels and other petrochemical products. As a result of the long history of operation and nature of work done at this refinery, it is highly likely that contaminated soils and/or groundwater would be encountered during installation of a pipeline through this property. The presence of contaminated soils and/or groundwater in the pipeline construction right-of-way could require special construction techniques and remediation measures. These techniques and measures could be costly and could expose workers to increased health and safety risks.

The Sunoco Alternative would cross both Jack's Park and Lower Chichester Municipal Park, which would almost double the amount of parkland crossed compared to the proposed route. The alternative route would also require a 7,000-foot crossing of the Delaware River. Texas Eastern has indicated that a river crossing of this length has never been accomplished for a large diameter pipeline using HDD techniques. If HDD techniques would be infeasible for installing the pipeline along the alternative route across the Delaware River, the pipeline would need to be installed across the river using open-cut techniques. This type of construction technique would result in substantial more impacts on the river and could be difficult to get approved by the applicable regulatory agencies.

For the reasons discussed above, we do not believe the Sunoco Alternative would be preferable to the proposed route.

3.5.2.4 Upland Road Alternative

The Upland Road Alternative begins at Texas Eastern's Chester Junction and follows the same alignment as the proposed route for about 0.2 mile. It then deviates from the proposed route and proceeds southeast along Edgmont Avenue for about 800 feet. The alternative route then proceeds south along Upland Road for about 1.2 miles. At this point, the alternative route leaves the road and proceeds south and southeast across Chester Creek and Interstate 95. South of Interstate 95, the alternative route follows the same alignment as the Railroad Alternative for about 1.8 miles until it rejoins the proposed route at MP 4.3. From MP 4.3, the Upland Road Alternative follows the same alignment as the Railroad Alternative and the proposed route across the Delaware River to New Jersey and on to the LNG terminal site.

As shown in table 3.5.2-1, the Upland Road Alternative would be shorter than the proposed route and thus would result in less land disturbance and require less permanent right-of-way than the proposed route. This alternative route would cross two less waterways and 19 less roads than the proposed route. This alternative route would also reduce the crossing of forest land by about 0.8 mile. Additionally, the Upland Road Alternative would not cross any parkland and would be constructed within 50 feet of 28 fewer residences than the proposed route.

A disadvantage of this alternative route is that Upland Road is a heavily traveled, tree-lined thoroughfare that would be adversely affected by pipeline construction. Construction of a pipeline along this alternative route would likely require closing the street to traffic and establishing local detours, particularly near 10th Street where the road is narrow. This road closure would hinder or restrict access to

three churches, a school, and two businesses located along Upland Road and slow the flow of traffic, resulting in increased traffic congestion. The Upland Road Alternative would also pass within 50 feet of 14 more non-residential buildings than the proposed route.

Another complicated construction area along the alternative would be near Chester Creek and Interstate 95. There is limited space available on either side of the creek and highway at the alternative crossing location to set up equipment for a bore or HDD.

The Upland Road Alternative would also pass close to the National Historic District associated with the Caleb Pusey House and Landingford Plantation, which would increase the potential to encounter significant cultural resources.

For the reasons discussed above, we do not believe the Upland Road Alternative would be preferable to the proposed route.

3.5.3 Minor Route Variations

During the NEPA Pre-filing Process, Texas Eastern identified three minor route variations to avoid or minimize impact on specific resources along the pipeline route. Some of these minor variations were adopted as part of Texas Eastern's proposed route prior to filing its application. The other variations were either rejected by Texas Eastern or are still being evaluated.

Palmer Street Variation

The Palmer Street Variation was identified by Texas Eastern as an alternative to the proposed route between MPs 3.13 and 3.31, which is located within an existing wooded ravine behind several residential homes in the City of Chester. This variation deviates from the proposed route about 750 feet south of Interstate 95 and continues south within Palmer Street for about 1,000 feet until it dead ends near the end of Columbia Street. The street would need to be open cut to install the pipeline beneath the road pavement. At the end of Palmer Street, the variation proceeds west down a steep 15-foot embankment into a forested area. The variation then continues south across about 0.11 mile of forest land before crossing 9th Street (U.S. Route 13), and rejoining the proposed route in Veterans Memorial Park. The location of the Palmer Street Variation is shown on figure 3.5.3-1.

Where in-street construction is planned along the variation, the construction activities would occupy the entire width of Palmer Street. The construction work area within the street would be within 50 feet of approximately seven homes. The width of the trench within the street would vary from 6 to 10 feet depending on the presence or absence of obstructions beneath the street such as foreign lines, sewer line, storm water drains, and water mains. Excavation of the trench in the street would be limited to the length of pipe that could be laid in the ditch and covered up each day. Texas Eastern anticipates being able to lay between 1 and 5 (40- to 80-foot long) joints of pipe per day. Based on this rate of progress and the length of the variation in the street, we estimate that in-street construction could take 2 to 4 weeks. During construction, safety barriers would be installed and security measures would be in place to limit access of unauthorized personnel to the construction work area. Traffic control measures such as signage, warning lights, and flag personnel would be used as appropriate to maintain traffic patterns to the extent possible. Dust control measures would be used to minimize excessive dust and steel plates would be available on-site to span the open trench if emergency vehicle access is required.

There are three connecting side streets (11th, 12th, and 13th Streets) along the section of Palmer Street that would be affected by the variation. It appears that one or more of these streets could be kept open during construction to help maintain access to the residences along Palmer Street. However, Texas Eastern did not provide a plan to address how residential access would be maintained or whether other

measures such as limiting work hours to avoid the peak commuting hours would be used to reduce the inconvenience of in-street construction on the affected residents. We recommended in section 4.9.4.1 that Texas Eastern prepare a traffic and access plan for the project that would address these issues.

The primary advantage of the variation is that it would avoid the clearing of about 1.4 acres of forest land, and would avoid crossing a small man made ditch or drain at MP 3.19 and two forested wetlands located at MPs 3.22 and 3.34, respectively. The disadvantages of the variation are that it would be located within a residential street and would require construction near seven more residences than the proposed route. Construction within the street would also increase construction costs, increase traffic impacts on Palmer Street, and possibly hinder access of residents to their homes.

In the draft EIS, we reported that Texas Eastern rejected the Palmer Street Variation after holding public open houses, discussing the issue with the local community, and receiving requests from residents that the pipeline should be located along the proposed route within the wooded corridor west of Palmer Street. Subsequent to the issuance of the draft EIS, Texas Eastern provided notes of its meetings with the PADEP and COE on February 18, and December 20, 2004. At these meetings, the agencies expressed concern about the proposed route's impact on wetlands, particularly forested wetlands. According to Texas Eastern, the City of Chester also determined that it would be preferable to locate the pipeline in the roadway instead of the wooded ravine. Based on these concerns and the fact that the variation would reduce wetland impacts and forest clearing, we believe the variation would be preferable to the proposed route. Therefore, we **recommend that:**

- **Texas Eastern adopt the Palmer Street Variation as described in section 3.5.3 as part of the proposed route.**

Ward Street Variations

Texas Eastern met with officials of the City of Chester in August 2004 to discuss the crossing of Veterans Memorial Park. At the request of city officials, Ward Street Variations A and B were developed to avoid or minimize impacts on the park. Both variations would deviate to the west of the proposed route at MP 3.33 about 400 feet north of 9th Street (U.S. Route 13). From there, Variation A would proceed west until it reaches the western boundary of Veterans Memorial Park adjacent to Ward Street. Variation A would then proceed south following the edge of the park for 1,000 feet. At this point, Variation A would turn and proceed east across the southwest corner of the park for about 250 feet where it would rejoin the proposed route just north of the railroad at MP 3.67. Variation B would essentially follow the same alignment as Variation A except the pipeline would be located within Ward Street rather than along the edge of the park. The locations of Ward Street Variations A and B are shown on figure 3.5.3-2.

The Ward Street Variations would slightly increase the length of the pipeline. The primary advantage of these variations is that they would avoid or minimize impacts on the park, including disruption of recreational activities during pipeline construction. In addition, the variations would also avoid or minimize encumbrance of the pipeline on any future park developments such as swimming pools, club houses, memorials, or other amenities. The primary disadvantage is that the variations would result in the placement of the pipeline and associated construction activities closer to several residences located along Ward Street and 6th Street. Another disadvantage specific to Variation B is that it would require in-street construction, which would increase construction costs, increase traffic impacts on Ward Street, and possibly hinder access of residents to their homes. In a November 19, 2004 letter to Texas Eastern (Cartisano, 2004), the City Solicitor of Chester indicated a preference for Variation A because it would not encumber any future expansion of the park. Texas Eastern adopted the Ward Street Variation as part of the proposed route following issuance of the draft EIS. We concur that the Ward Street Variation is preferable to the original pipeline route.

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Figure 3.5.3-1 Palmer Street Variation

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Figure 3.5.3-2 Ward Street Variations

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Soil Safe Variation

The Soil Safe Variation in New Jersey was developed as an alternative to the last 3 miles of the original pipeline route, which followed an existing dirt road roughly parallel to and about 1,000 feet south of the Delaware River shoreline. The original route crossed the Soil Safe facility property and proceeded west behind the Ferro Polymer facility and in front of the Logan Generating Station. Based on consultations with representatives of the Soil Safe facility and the Ferro Polymer facility, a contaminated soil cleanup operation and areas of potentially contaminated soils were identified along the original route. The Soil Safe Variation avoids these contaminated soil areas by proceeding southwest adjacent to U.S. Route 130 about 2,000 feet south of the original route. Texas Eastern adopted the Soil Safe Variation as part of the proposed route prior to filing its application with the FERC. We concur that the Soil Safe Variation is preferable to the original pipeline route.