4.0 ENVIRONMENTAL ANALYSIS

The environmental consequence of constructing and operating the proposed Crown Landing LNG and Logan Lateral Projects would vary in duration and significance. Four levels of impact duration were considered: temporary, short term, long term, and permanent. Temporary impact generally occurs during construction with the resource returning to preconstruction condition almost immediately afterward. Short term impact could continue for up to 3 years following construction. Impact was considered long term if the resource would require more than 3 years to recover. A permanent impact could occur as a result of any activity that modifies a resource to the extent that it would not return to preconstruction conditions during the life of the project, such as the construction of an LNG terminal. We considered an impact to be significant if it would result in a substantial adverse change in the physical environment.

In this section, we discuss the affected environment, general construction and operational impact, and proposed mitigation for each resource. Crown Landing and Texas Eastern, as part of their proposals, agreed to implement certain measures to reduce impact. We evaluated Crown Landing's and Texas Eastern's proposed mitigation to determine whether additional measures are necessary to reduce impact. These additional measures appear as bulleted, boldfaced paragraphs in the text. We will recommend that these measures be included as specific conditions to the authorization and Certificate that may be issued to Crown Landing and Texas Eastern for their projects.

Conclusions in this EIS are based on our analysis of the environmental impact and the following assumptions:

- Crown Landing and Texas Eastern would comply with all applicable laws and regulations;
- the proposed facilities would be constructed as described in section 2.0 of this document; and
- Crown Landing and Texas Eastern would implement the mitigation measures included in their applications and supplemental filings to the FERC.

4.1 GEOLOGIC RESOURCES

4.1.1 Physiographic and Geologic Setting

The proposed project is located within two major physiographic provinces: the Atlantic Coastal Plain Province and the Piedmont Province. The demarcation between these provinces in the project area, referred to as the Fall Line, has been interpreted somewhat differently in the literature, but generally corresponds to the uplands that rise along the northwestern shore of the Delaware River (Fenneman and Johnson, 1946; WPC, 2003a). Therefore, the proposed LNG terminal site and the portion of the Logan Lateral route from approximate MP 4.0 to MP 11.0 are situated in the Atlantic Coastal Plain Physiographic Province, and the remainder of the Logan Lateral route, from MP 0 to MP 4.0, crosses the Piedmont Physiographic Province.

The Atlantic Coastal Plain forms a flat to gently rolling plain, with surface elevations at the LNG terminal site ranging between 5 and 10 feet North American Vertical Datum (NAVD) and along portions of the proposed pipeline ranging between sea level and 20 feet NAVD. Regionally, the Atlantic Coastal Plain is underlain by Cretaceous to Early Tertiary sediments that range from minimal thickness landward to more than 40,000 feet thick at the continental shelf break beneath the Atlantic Ocean. The sediments consist of sand, silt, and clay deposited alternately in deltaic and marine environments as sea level fluctuated during Cretaceous and Tertiary times. Bedrock beneath the Atlantic Coastal Plain consists of crystalline rocks of Precambrian, Early Paleozoic, and Triassic ages. The bedrock surface beneath the Atlantic Coastal Plain is highly irregular due to structural warping associated with past tectonism.

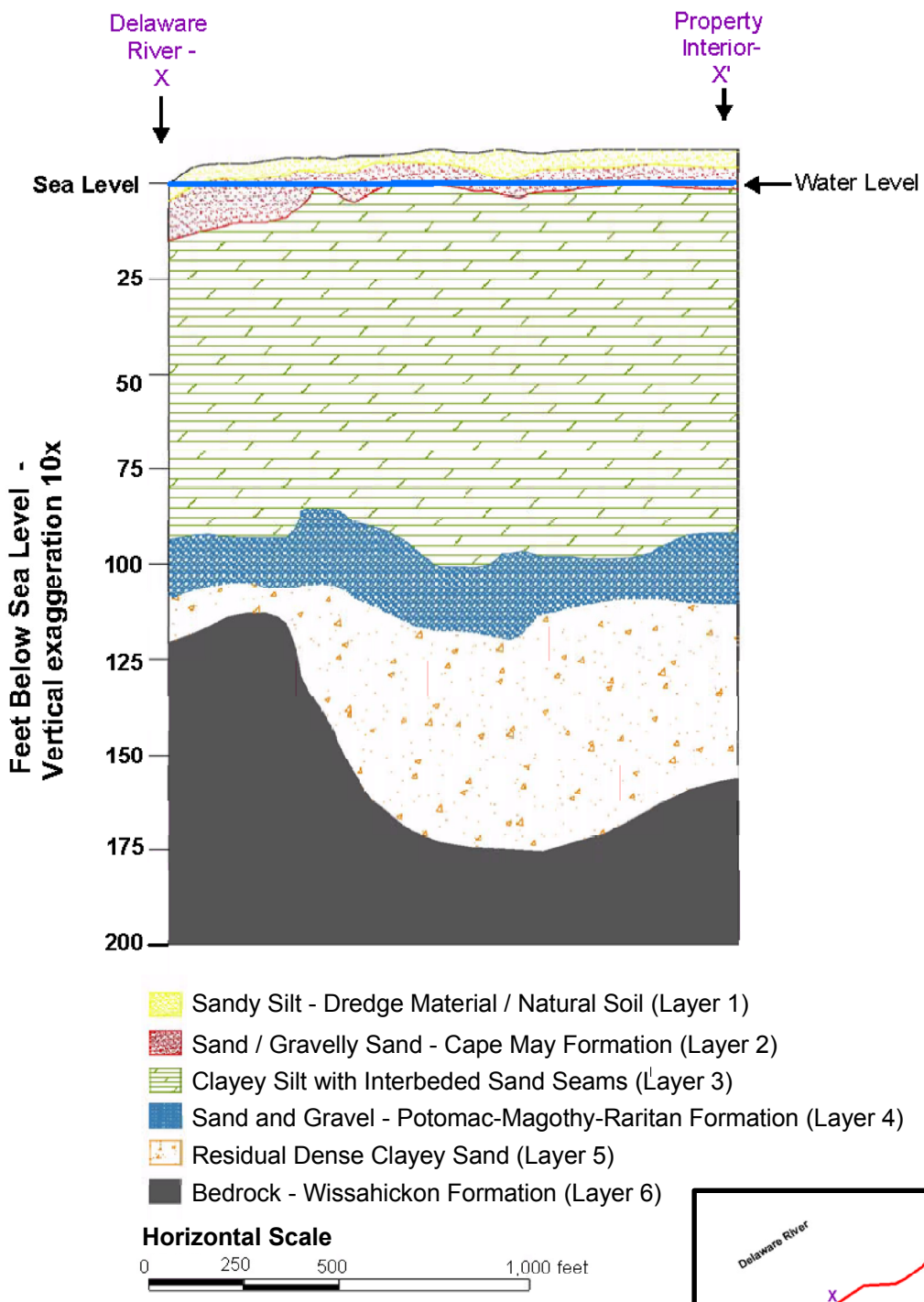
As shown on figure 4.1.1-1, site-specific soil boring data from the LNG terminal site indicate that the site is underlain by the following deposits and geologic units:

- Layer 1, Dredged Fill – The surficial layer is dredged material placed onsite between the 1930s and 1960s during dredging of the Delaware River. The unit extends from the surface to an average depth of 4 feet and is composed of silts and sands in varying proportions.

- Layer 2, Sand/Gravelly Sand – This unit is referred to as the Cape May Formation and is of Pleistocene alluvial origin. The unit is approximately 5 to 20 feet thick at the site.

- Layer 3, Clayey Silt – Layer 3 forms a confining unit between the overlying Cape May Formation and the underlying Potomac-Magothy-Raritan Formation (undifferentiated) of Layer 4. The unit is Upper Cretaceous or Tertiary in age and was deposited in marine or lacustrine environments. Layer 3 is 85 to 95 feet thick and consists primarily of clayey silt with interbedded sand seams. Due to its significant thickness and compressibility, Layer 3 poses geotechnical issues to the proposed LNG terminal, as discussed in section 4.1.4.2.

- Layer 4, Sand and Gravel – This unit forms the Potomac-Magothy-Raritan Formation and is believed to be of Cretaceous alluvial origin. The unit is 10 to 20 feet thick beneath the site. Piles proposed for the foundations of the LNG storage tanks and other critical structures would be driven to Layer 4.



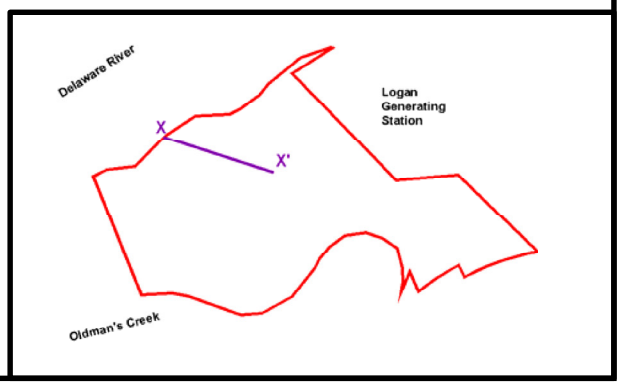


Figure 4.1.1-1
Crown Landing LNG Project
Geologic Cross Section of the LNG Terminal Site

- Layer 5, Residual Dense Clayey Sand – This unit was derived from extensive weathering of the underlying metamorphic basement rocks (Layer 6) during the Cretaceous. The unit is described in soil borings as a micaceous, clayey sand and is highly variable in thickness, ranging from 10 to 60 feet at the site.

- Layer 6, Metamorphic Bedrock – Bedrock beneath the LNG terminal site consists of Precambrian metamorphic schist and gneiss of the Wissahickon Formation. The Wissahickon Formation occurs at a depth of 110 to 200 feet beneath the surface of the LNG terminal site.

The portion of the proposed pipeline located within the Atlantic Coastal Plain Physiographic Province, from approximate MP 4.0 to MP 11.0, is underlain by unconsolidated sand, silt and clay, dredge spoil, gravelly fill, and recent swamp deposits. Metamorphic bedrock would not be expected to be encountered during construction of the pipeline through this area.

The remainder of the pipeline route, from MP 0 to approximate MP 4.0, crosses the Piedmont Physiographic Province. In this area, the pipeline would traverse areas of low to moderate relief, with elevations ranging from approximately 20 feet NAVD near MP 4.0 to approximately 100 feet NAVD between MPs 2.0 and 3.0. Surficial deposits along the pipeline route consist of unconsolidated sand, gravel, and clay of the Tertiary or Quaternary Pennsauken and Bridgeton Formations, which are up to 40 feet thick in the area. The unconsolidated deposits are underlain by Precambrian metamorphic bedrock of the Wissahickon Formation and isolated occurrences of Early Cambrian igneous intrusive rocks. Metamorphic or crystalline bedrock could be encountered at several locations along the proposed pipeline route (see section 4.1.2).

Construction and operation of the proposed project would not materially alter the geologic or natural topographic conditions in the project area. Over most of the area, natural topographic slope and contours would be temporarily altered. Crown Landing would place about 150,000 cubic yards of fill material in the process area on the LNG terminal site to raise the grade above the 1,000-year storm surge elevation and to construct a 10-foot-high earthen containment dike around the storage tank area. The final grade elevations at the onshore portions of the LNG terminal would range from about 3 feet NAVD at the base of the LNG spill impoundments to about 18 feet NAVD at the top of the earthen dike. Texas Eastern would restore topographic contours and drainage conditions along the pipeline corridor to preconstruction conditions to the extent practicable.

4.1.2 Blasting

Blasting would not be required for construction of the LNG terminal due to the presence of at least 110 feet of unconsolidated sand, silt, gravel and clay beneath the site.

Based on soil surveys for Gloucester County, New Jersey and Delaware County, Pennsylvania (U.S. Department of Agriculture (USDA), 1962; USDA, 1963), gneissic bedrock could be located within 5 feet of the ground surface between approximate MPs 1.45 and 1.46, and between MPs 1.74 and 1.84 of the proposed Logan Lateral. There is some potential that blasting could be required for construction of the pipeline in these areas; however, both areas identified as having shallow bedrock are located along Texas Eastern's existing Line 1-A-1, which did not require blasting for installation.

In the unlikely event that blasting would be necessary, contractors would be required to conform with Texas Eastern's blasting specification plan to ensure safety and minimize the potential for damage to adjacent areas and structures. The blasting plan meets or exceeds all applicable federal, state, and local

regulations governing the use of explosives, including PA Code Chapters 210 and 211 and New Jersey Administrative Code (NJAC) 12:190. The general provisions of the blasting plan include:

- Installation of blast mats in congested areas, in shallow waterbodies where necessary, and near structures to prevent damage by fly-rock;
- Posting of warning signals, signs, flags, and barricades in the area;
- Following procedures for the safe storage, handling, loading, firing and disposal of explosives;
- Manning adjacent pipelines at valves for emergency response; and
- Controlling excessive vibrations by limiting the size of the charge and staggering charges in a series of explosions.

4.1.3 Mineral Resources

Sand, gravel, and clay have been mined in the project area for construction and industrial purposes (U.S. Geological Survey (USGS), 1908; 2002a; 2002b). Two active sand and gravel pits and one active dimension-stone quarry were identified in Delaware County, Pennsylvania; however, none of these active operations are located within 1 mile of the project (Pennsylvania Geological Survey (PGS), 1997; USGS, 2004a). Aerial photograph review and site reconnaissance did not identify any abandoned or active mining operations within 0.25 mile of the project, and soil borings did not identify any commercially exploitable mineral deposits at the proposed LNG terminal site. Coal, petroleum, and other commercially exploitable mineral resources are not known to exist in the project area (PGS, 1993; 2002).

Construction and operation of the proposed projects would not impact any current mineral resource recovery operations. Based on the lack of significant and unique mineral resources and the high degree of development that exists in the area, the projects would not significantly reduce the future ability to recover sand, gravel, clay, or other mineral resources.

4.1.4 Geologic Hazards

Geologic or other hazards in the project area consist of seismic-related hazards; load-bearing capacity of soils at the LNG terminal site; slope instability, subsidence, and flooding. Conditions necessary for the development of other geologic hazards, including karst terrain, avalanches, and volcanism are not present in the project area.

In general, the potential for geologic or other natural hazards to significantly affect the construction or operation of the proposed projects is low. The risk of damage resulting from geologic or other natural hazards would be avoided or reduced by specific engineering design criteria, ground modification, and other construction techniques and operating procedures to be implemented by Crown Landing and Texas Eastern.

4.1.4.1 Seismic-related Hazards

The proposed projects are situated in an area with a relatively low potential for significant seismic activity. Potential seismic-related hazards that exist in the area include earthquakes, surface faulting, soil liquefaction and related soil failures, and tsunamis.

Crown Landing conducted detailed, site-specific geotechnical and geoseismic studies to evaluate the risk of seismic-induced damage to the proposed LNG terminal. Texas Eastern also conducted a general seismic review of the area for construction of the Logan Lateral. The results of the LNG terminal site studies are presented in reports entitled *Geotechnical Engineering Investigation Report – Liberty [now Crown Landing] LNG Project, Logan Township, Gloucester County, New Jersey* (WPC, 2003a) and *Seismic Hazard Study Report – Liberty [now Crown Landing] LNG Project, Logan Township, Gloucester County, New Jersey* (WPC, 2003b). These reports were reviewed by Dr. Felix Yokel (2004), an expert in geotechnical engineering. Dr. Yokel concluded that the geotechnical investigation was thorough and of a high quality, providing adequate and reliable data for the design of the project. Dr. Yokel also concluded that the seismic risk assessment was a state-of-the-art analysis which complied with seismic hazard provisions of 49 CFR 193 and NFPA 59A (2001 edition) *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)* and which met the guidelines in NBSIR 84-2833, *Data Requirements for the Seismic Review of LNG Facilities.*

Earthquakes

The majority of significant earthquakes around the world are associated with tectonic subduction zones, where one crustal plate is overriding another (e.g., the Japanese islands), or where plates are sliding past each other (e.g., California). Unlike these highly active tectonic regions, the East Coast of the United States is located on the "trailing edge" of the North American continental plate, which is relatively seismically quiet. Earthquakes, however, do occur in the project area, largely due to trailing edge tectonics and residual stress release from past orogenic (mountain building) events.

The project area is located near the border between Seismic Zones 1 and 2A as defined in the Uniform Building Code. The area is characterized by generally low magnitude events that have been recorded for the past 300 years, although stronger earthquakes have occurred in the region. Two notable earthquakes have occurred in relatively close proximity to the projects:

- An 1871 earthquake occurred in northern Delaware, about 12 miles from the LNG terminal site. This earthquake resulted in Modified Mercalli Intensity (MMI) VII damage, including toppled chimneys and broken windows. In an MMI VII event, damage is negligible to buildings of good design and construction (PGS, 2003); and

- A 1944 earthquake occurred approximately 7 miles from the LNG terminal site, resulting in MMI V damage such as broken windows and cracked plaster. The level of shaking associated with an MMI V event is generally below the threshold of damage to well built structures.

Other larger, but more distant, earthquakes have also affected the project area including the 1811 to 1812 earthquake sequence near New Madrid, Missouri and the 1886 earthquake near Charleston, North Carolina. These and other earthquakes were considered in the seismic hazard assessment for the LNG terminal site.

As required by NFPA 59A, a site-specific seismic hazard analysis was conducted to develop seismic design criteria for the proposed LNG terminal. The results of the site-specific seismic hazard analysis were used to predict the level of shaking associated with the Safe Shutdown Earthquake (SSE, defined as the 5,000-year mean return earthquake) and the Operating Basis Earthquake (OBE, scaled as two-thirds of the Maximum Considered Earthquake (MCE), which is the 2,500-year mean return earthquake). The OBE represents the level of shaking through which the facility should be able to operate and continue operating after its occurrence, with perhaps a brief shutdown for a safety inspection to

confirm that no damage occurred. The larger SSE represents the level of shaking that should not damage the vital, safety-related components of the facility to the extent that they could not function.

Detailed seismic design criteria are presented in the seismic report (WPC, 2003b). In general, the seismic hazard analysis indicates that the LNG terminal site would experience a peak ground acceleration (PGA) of 10.4 percent of the acceleration due to gravity (0.104 g) during the 2,500-year earthquake and a PGA of 0.129 g during the 5,000-year earthquake. The OBE would result in a PGA of 0.069 g.

To provide a higher level of safety, Crown Landing would construct the LNG storage tanks to allow for safe shutdown during an earthquake with a recurrence interval of 10,000 years, rather than 5,000 years as currently required by NFPA 59A. Based on the seismic hazard analysis performed for the site, the LNG terminal would experience a PGA of 0.153 g during the 10,000-year earthquake event.

In conclusion, based on the evaluation conducted for the LNG terminal site, the likelihood of a major earthquake occurring in the project area during the operating life of the LNG facility is low. Crown Landing's commitment to meet or exceed applicable seismic design standards would further reduce the potential effects associated with earthquakes to the LNG terminal. These seismic design elements include:

- installing a pile foundation system beneath the LNG tanks and other critical structures, which would dissipate a substantial portion of earthquake-induced vibrational energy into the supporting soil, thereby dampening the effects of ground motions to the LNG tanks themselves;

- designing the outer and inner LNG tanks to account for the predicted seismic motions in accordance with NFPA 59A and ACI 318 guidelines; and

- accounting for the calculated LNG slosh wave height in the dimensions and design of the LNG tanks resulting from the predicted seismic loads.

Ground shaking would not be expected to materially affect the proposed pipeline, which would be constructed of modern steel that is capable of remaining elastic during the level of shaking that could potentially occur in the area (O'Rourke and Palmer, 1994).

Surface Faulting

There are no mapped surface faults in the project area (USGS, 1908; 2004b) and site-specific geotechnical and seismic studies did not identify any evidence of active surface faults at the proposed LNG terminal site. Furthermore, the low to moderate level of seismic activity that does occur within 125 miles of the project has not been associated with movement on any specific fault (Yokel, 2004).

In conclusion, the potential for surface faulting to occur in the project area is low. The proposed LNG storage tanks and other LNG facility structures and the proposed pipeline would be constructed to meet or exceed all applicable engineering and seismic design standards, further reducing any potential damage that could occur in the highly unlikely event of surface faulting in the project area.

Soil Liquefaction

Secondary seismic effects triggered by strong ground shaking are often more serious than the shaking itself. One such secondary effect, soil liquefaction, is a physical process in which saturated, cohesionless soils temporarily lose their load-bearing strength when subjected to strong and prolonged

shaking. Soil liquefaction can also lead to other ground failures, including settlement and lateral spreading.

Standard penetration tests (SPT), cone penetration tests (CPT), flat-blade dilatometer (DMT) soundings, geophysical measurements, and laboratory analyses were performed to evaluate the physical and engineering properties of existing soils at the LNG terminal site. A liquefaction analysis was performed based on the CPT data using a commercial computer program (LiquefyPro), which employs the Robertson and Wride (1998) method. CPT gathers data at a much smaller sampling interval than SPT and DMT, which helps detect weak pockets or lenses within the soil column. The analysis indicates that soils at the LNG terminal site would not liquefy if subjected to the level of ground shaking associated with the 10,000-year earthquake predicted for the site (WPC, 2003a). The installation of deep foundation piles beneath the LNG tanks and other critical structures, as proposed, would further reduce any potential for liquefaction to affect those structures.

Because the risk of a strong earthquake in the project area is low, the potential for soil liquefaction to occur along the proposed pipeline is low. Due to their strength and ductility, modern steel pipelines can span considerable distances unsupported without threatening the integrity of the pipeline.

Tsunamis

Tsunamis are long oceanic waves generally caused by seismic activity. While a tsunami could potentially occur along the East Coast of the United States, only two Atlantic Ocean tsunamis have been recorded: a tsunami which struck Lisbon, Portugal in 1755, and one which struck eastern Canada in 1929. The probability of a significant tsunami occurring along the East Coast is very low (NOAA, 2003) and would not pose a significant risk to the projects.

4.1.4.2 Load-Bearing Capacity

The physical and engineering properties of existing geologic materials at the LNG terminal site were determined using SPT, CPT, DMT soundings, geophysical measurements, test pits, and laboratory analyses (WPC, 2003a). These analyses determined that, without foundation improvement, excessive settlement would occur beneath the LNG tanks and process area due to the compressibility of the thick, clayey silt layer at the site (Layer 3).

Preliminary recommendations for the LNG tank foundation system include a reinforced concrete pile cap supported by 18-inch-diameter steel pipe piles driven into the hard sand and gravel layer (Layer 4) at an approximate depth of 100 feet below ground surface. Other preliminary LNG tank foundation design elements include placement of 6 inches of coarse granular fill beneath the center of the concrete pile cap to protect the foundation from frost heave during construction, and installation of heating cables in conduit embedded within the concrete pile cap to prevent frost heave during operation of the terminal. Corrosion protection could also be necessary to further protect the steel piles.

Final settlement criteria have not been developed for the LNG tanks; however, settlement criteria for similar projects included permissible tilting of 7 inches across the tank and 6 inches of differential settlement between the center and edge of the tank. The preliminary foundation design for the proposed LNG tanks would result in an estimated total settlement of 1.5 inches, a majority of which should be uniform and occur during hydrostatic testing of the tanks (WPC, 2003a). Crown Landing will conduct additional CPT tests and field pilot tests to finalize the LNG foundation design.

Excessive settlement is also the primary concern for equipment foundations in the LNG process area. Existing grades in the process area vary from 5 to 10 feet NAVD. Assuming a final grade elevation

of up to 12 feet NAVD in this area, 2 to 3 feet of fill would be needed in the majority of the process area, with up to 7 feet of fill required in some areas. An estimated total settlement of 10.5 inches would occur from 7 feet of fill and approximately 8.5 inches of settlement would occur due to foundation loads. The total settlement to be experienced by the equipment in the process area would be somewhere between one-half to two-thirds of the total combined settlement due to the fill and foundation loads, or approximately 9.5 to 12.5 inches. Preliminary foundation improvement options considered for the process area include mat foundations in conjunction with surcharging and piles. Crown Landing will conduct additional field tests to finalize the foundation designs for the process area and other terminal structures.

The engineering and construction of the proposed LNG tanks are discussed in more detail in section 4.12. Based on preliminary engineering analysis, it appears that the potential for excessive settlement to occur at the LNG terminal site can be effectively mitigated through foundation design.

4.1.4.3 Slope Instability

An earthen dike with sideslopes would be constructed around the three LNG tanks to prevent LNG from flowing off the terminal site in the unlikely event of a double failure of the steel inner tank and the concrete outer tank. Initial designs indicate that the dike would be approximately 780 feet by 900 feet, with a top elevation of 18 feet NAVD. The engineering and construction of slopes to be created at the proposed LNG terminal site are discussed in more detail in section 4.12. Based on preliminary analysis, it appears that the stability of site slopes can be ensured by implementing sound engineering and construction methods.

The proposed pipeline would traverse areas of low relief in New Jersey and low to moderate relief in Pennsylvania. Elevations along the proposed route vary from sea level near the Delaware River to approximately 100 feet NAVD between MPs 2.0 and 3.0. The project is in an area of moderate landslide susceptibility but low landslide occurrence, (USGS, 1982) as no Holocene debris flows or landslides have been identified in the area (USGS, 1999a). Therefore, the potential for landslides or other slope failures to affect the proposed pipeline is low, and would be further reduced through the use of appropriate erosion control measures during construction and operation.

4.1.4.4 Subsidence

Regional subsidence is most often caused by significant groundwater use or petroleum production. The proposed projects are not located in an area of regional subsidence and they do not cross any known underground mines or karst areas. Therefore, subsidence or localized land surface collapse events would not be expected to affect the projects.

4.1.4.5 Flooding

Flash Flooding

The potential for flash flooding to occur and significantly impact construction or operation of the proposed projects is low. The greatest potential for flash flooding to occur in the project area is associated with tropical storms or severe frontal storms, which are usually accompanied by significant precipitation over a short period of time. The potential effects associated with high rainfall events during construction of the LNG terminal would be mitigated by implementing our Plan and Procedures and Crown Landing's SESC Plan. After construction, the proposed LNG terminal would be stabilized with permanent erosion control measures such as vegetative cover, and a stormwater management system would be constructed to treat and manage stormwater runoff. Texas Eastern's implementation of our Plan

and Procedures and its SESC Plan would also minimize the effects of rainfall events during construction and operation of the proposed pipeline.

Storm Surge

Storm surge, the abnormal rise in sea level due to the wind and pressure forces associated with hurricanes and other tropical storms, is often the most significant cause of damage to facilities and property in low-lying coastal areas. According to the NOAA (2004b), one Category I hurricane made landfall in New Jersey from 1900 through 1996. Category I storms have sustained winds of 74 to 95 miles per hour (mph) and storm surges on the order of 4 to 5 feet. No hurricanes made landfall in Delaware during the same time period.

A storm surge study of the proposed LNG terminal site determined the 1,000 year flood elevation to be 12 feet NAVD. The terminal area to the east of the LNG tanks and the metering area to the west of the tanks would be constructed with a finished grade of at least 12 feet NAVD. The base of the LNG tanks themselves would be approximately 7 feet NAVD, but the top of the earthen dike surrounding the tanks would be 18 feet NAVD. Therefore, the proposed LNG terminal site would be protected against storm surge associated with tropical storms of the magnitude that are likely to affect the project area.

4.1.5 Paleontological Resources

Construction and operation of the LNG terminal would not impact important paleontological resources. The project area is not known to contain sensitive paleontological resources, but is underlain by Cretaceous age sediments which often contain paleontological artifacts (New Jersey Paleontological Society, 2003). Cretaceous age sediments are not found at the surface of the proposed LNG terminal site, but occur at an approximate depth of 10 feet below ground surface. No paleontological resources were discovered during the cultural resource surveys on the LNG terminal site, which included the excavation of several trenches and shovel test pits.

Construction of the proposed pipeline would be unlikely to encounter any significant paleontological resources, and the route does not cross any protected paleontological resources (PGS, 2004; New Jersey Geological Survey, 2004; New Jersey Natural History Museum, 2004).

4.2 SOILS AND SEDIMENTS

4.2.1 Soil Resources

Soil Characteristics at the LNG Terminal Site

Soils at the proposed LNG terminal site are highly variable with textures ranging from gravelly sandy soils to silts and clays. Table 4.2.1-1 summarizes the characteristics of the soils on the site. Borings indicate that the majority of the proposed construction area is primarily sands and gravels, with some traces of silt and clay. Soil testing and USDA soil mapping indicate that approximately 147 acres or 84 percent of the soils at the site consist of Made-land. This Made-land, which is up to 4 feet in depth, consists of dredged material that was placed onsite during dredging of the Delaware River, primarily between the 1930s and 1960s (USDA, 1962). The Made-land materials consist of two textural types: Made-land/coarse (Mc), which predominates on the northern and central portions of the site; and Made-land/fine (Mf), which is present along the southern and southeastern portions of the site. Based on the distribution of these two Made-land types, it seems likely that dredged materials were placed on the northern end and then the finer textured materials were redeposited to the southern portions of the site during dewatering operations.

The remaining soils on the LNG terminal site include 20 acres of Woodstown/Klej and Downer loamy sands, 4 acres of Fallsington sandy loam, and 4 acres of tidal marsh. None of the soils on the LNG terminal site are classified as prime farmland.

TABLE 4.2.1-1

Acreage of Soils and Soil Characteristics at the Proposed LNG Terminal Site

Soil Series	Area on Site (acres)	Temporary Disturbance Area (acres)	Permanent Disturbance Area (acres)	Soil Characteristics	Prime or Unique Farmland
Made-Land/ Coarse	61.2	37.3	37.3	Moderately well-drained, coarse-textured material, poor structure, variable in texture and depth	Undetermined
Made-Land/ Fine	85.7	< 0.86	< 0.86	Fine-textured material with poor structure, variable texture and depth	Undetermined
Fallsington Sandy Loam	3.5	< 0.3	0	Poorly drained, permeable sandy loam	No
Tidal Marsh	3.5	0	0	Saturated soils	No
Woodstown Loamy Sand	19.2	3.7	0.5	Deep, moderately well-drained loamy sand	No
Downer Loamy Sand	< 1.7	< 0.3	0	Deep well-drained loamy sand	No
Total	174.8	42.5	38.7		

Soil Quality at the LNG Terminal Site

Seventy-one soil samples from the proposed LNG terminal site were analyzed for EPA priority pollutants, semi volatile organics (SVOCs), volatile organics (VOCs), polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), phenols, cyanide, total petroleum hydrocarbons

(TPH), and metals. The soil sampling locations are shown on figure 4.2.1-1. The results were compared with New Jersey Soil Cleanup Criteria (NJSCC). The soil samples that exceeded NJSCC criteria are listed in table 4.2.1-2.

TABLE 4.2.1-2

Analytical Results of Soil Samples Collected within the Proposed LNG Terminal Site

Parameter	Type	NJSCC (residential) a/	NJSCC (non-residential) a/	Sampling Locations b/	Analytical Results
Arsenic	Metal	20 mg/kg	20 mg/kg	AST-3 AST-4 AST-5 AST-6 AST-7 AST-8 SB-32	24.7 mg/kg 23.0 mg/kg 26.8 mg/kg 24.3 mg/kg 23.5 mg/kg 22.9 mg/kg 24.3 mg/kg
Dieldrin	Pesticide	42 µg/kg	180 µg/kg	SB-1 SB-2 SB-21 SB-22 GTB 6 GTB 11-18 GTB 21-29	54 µg/kg 84 µg/kg 74 µg/kg 79 µg/kg 82 µg/kg 50 µg/kg 72 µg/kg
TPH	Petroleum	10,000 mg/kg	No Criteria	AST-1 AST-2	46,800 mg/kg 53,000 mg/kg
Benzo(a)anthracene	SVOC/PAH/Fuel/ Hydrocarbons	900 µg/kg	4,000 µg/kg	SB-24 GTB-Area 31	1,600 µg/kg 1,900 µg/kg
Benzo(b)flouranthrene	SVOC/PAH/Fuel/ Hydrocarbons	900 µg/kg	4,000 µg/kg	SB-24 GTB-Area 31	1,500 µg/kg 1,100 µg/kg
Benzo(k)flouranthrene	SVOC/PAH/Fuel/ Hydrocarbons	900 µg/kg	4,000 µg/kg	SB-24 GTB-Area 31	960 µg/kg 1,400 µg/kg
Benzo(a)pyrene	SVOC/PAH/Fuel/ Hydrocarbons	660 µg/kg	660 µg/kg	SB-24 GTB-Area 31	830 µg/kg 1,200 µg/kg

a/ NJDEP Soil Cleanup Criteria, May 1999 New Jersey Administrative Code 7:26D.
b/ See figure 4.2.1-1 for sampling locations. AST – aboveground storage tank; SB – soil boring; GTB – geotechnical boring.
mg/kg milligrams per kilogram
µg/kg micrograms per kilogram

The results of the laboratory analyses indicated elevated concentrations of TPH, SVOCs, arsenic, and dieldrin in a few limited areas. The elevated TPH concentrations were only found in the vicinity of two abandoned 275-gallon aboveground storage tanks (AST 1 and 2). The SVOCs were only found in the upper 6 inches of soil in two adjacent borings (SB-24 and GTB-Area 31).

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 4.2.1-1 Soil Sampling Locations

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

Elevated arsenic levels were detected in the vicinity of an abandoned 1,500-gallon storage vessel (AST-3 to AST-8), and one other isolated boring (SB-32). All of the results were slightly above the NJSCC (i.e., 22.9 to 26.8 milligrams per kilogram (mg/kg) relative to the cleanup criterion of 20 mg/kg). The cause of the elevated arsenic level is unknown but could be the result of a spill from a storage vessel, historic use of arsenic-containing pesticides in the project area[1], or high native arsenic levels associated with the dredged materials that were removed from the Delaware River. The NJDEP estimates that background arsenic concentrations in the New Jersey Coastal Plain province are between 1.15 and 6.15 mg/kg in rural areas and between 5.2 and 13.6 mg/kg in urban areas (Sanders, 2003). Thus the arsenic concentrations on the site soils are between five and twenty times higher than background estimates for rural areas of the Coastal Plain.

The analytical results also indicated elevated levels of dieldrin near the soil surface in 7 of the 71 soil borings. Dieldrin, a persistent organic compound that degrades very slowly in the environment, was once commonly used in agriculture as an insecticide. The use of dieldrin has been banned in the United States by the EPA since 1987 (Agency for Toxic Substances and Disease Registry (ATSDR), 2003). All seven of the soil borings containing elevated levels of dieldrin were located in historic dredge disposal areas above the elevation of the underlying natural soil. None of the concentrations in these seven samples were above the NJSCC for non-residential use, but all exceeded NJSCC residential standards. The source of dieldrin is unknown but may be from the dredged material that was deposited on the site or the result of the spraying of insecticides associated with agricultural operations subsequent to the dredged materials being deposited.

Soil Impacts from LNG Terminal Construction and Operation

Crown Landing proposes to use fill material to raise the LNG process area above the 1,000-year design storm surge elevation of 11.4 feet NAVD and to create a containment dike around the LNG storage tanks. Approximately 150,000 cubic yards of fill would be needed. Crown Landing would import soils of suitable structural and chemical quality for use as fill material. Some of this material could consist of reclaimed and dewatered dredged material obtained from offsite sources.

Initial site preparation (grading and other soil disturbing activities), including the removal of existing vegetation, and placement and grading of fill to raise the site grade, could increase the potential for soil compaction, soil erosion, and sedimentation of adjacent waterbodies and wetlands. Of these potential effects, compaction is not anticipated to be a significant issue since the soils on the terminal site are almost entirely moderately-well drained sands and gravels, which are not compaction prone.

Crown Landing would minimize the potential for erosion and sedimentation by implementing the measures specified in our Plan and in a site-specific SESC Plan that would require approval from the Gloucester County Soil Conservation District. These measures would include installation of sediment filters and barriers during construction to prevent the flow of silt-laden water into adjacent wetlands and the Delaware River. Following construction, Crown Landing would permanently stabilize disturbed soils on the site by establishing a vegetative or gravel cover and installing other appropriate landscaping.

Soil contamination from a variety of sources was identified on the LNG terminal site. Most of the contamination occurs in limited areas and at low concentrations. Only TPH and benzo(a)pyrene exceeded the NJSCC for non-residential use. Arsenic and dieldrin were identified at concentrations above the residential NJSCC but below the non-residential NJSCC.

[1] Gloucester County had some of the highest agricultural arsenic usage in New Jersey between 1900 and 1980 (Vowinkel, et al., 2001); therefore, it seems more likely that elevated arsenic concentrations are a result of former agricultural practices.

Construction workers would have higher risk of exposure to the contaminated soils. To minimize this risk and protect construction workers, Crown Landing proposes to further delineate the extent of TPH- and SVOC-contaminated soils and excavate and dispose of the contaminated soils and the associated aboveground tanks at a permitted disposal facility prior to construction. Crown Landing would also further delineate the areas of elevated arsenic and dieldrin contamination and consult with the NJDEP regarding whether any remedial actions other than the removal of the 1,500-gallon storage vessel and/or institutional controls (e.g., restricting any future residential use of the LNG terminal site) would be necessary to mitigate the arsenic and dieldrin contamination.

All of the samples with elevated contaminant concentrations, except core SB-32, occur in areas that would be located beneath the LNG process area. Thus most of the contaminated soils would be buried by a significant volume of fill material placed to raise the site grade and to create the containment berm for the storage tanks. The fill pad, containment berm, and LNG process facilities would effectively isolate the contaminated soils from future human exposure.

Soils Along the Pipeline Route

According to published soils information (USDA, 1963), the proposed pipeline route from MP 0 to MP 4.9 crosses eight different soil series and one miscellaneous land type in Pennsylvania. The soil series include:

- Manor series - well to somewhat excessively drained soils with loam and channery loam textures and moderate permeability;
- Sassafras series - well drained soils with a sandy loam texture and moderate to moderately slow permeability;
- Glenelg series - well drained soils with a channery silt loam texture and moderate permeability;
- Congaree series - well to moderately well drained soils with a silt loam texture and moderate permeability;
- Beltsville and Butlertown series - moderately well drained soils with a silt loam texture and slow to very slow permeability;
- Chewacla series - somewhat poorly to moderately well drained soils with a silt loam texture and moderate permeability; and
- Othello series - poorly drained soils with a silt loam texture and moderately slow permeability.

The miscellaneous land types that would be crossed by the Pennsylvania portion of the pipeline include two Made-Land map units: map unit Ma, which is dominated by gravelly-textured materials, and map unit Me, which is dominated by materials derived from metamorphic bedrock (schist or gneiss).

In New Jersey, the proposed pipeline route from MP 4.9 to MP 11 crosses four soil series and two miscellaneous land types (USDA, 1962). The soil series include:

- Klej series - moderately well drained soils with a loamy sand texture and rapid to very rapid permeability;

- Downer series - moderately well drained soils with a loamy sand texture and moderate to moderately rapid permeability;
- Woodstown series - moderately well drained soils with a loamy sand texture and moderate permeability;
- Fallsington series - poorly drained soils with a sandy loam texture and moderate to moderately slow permeability; and
- Pocomoke series - very poorly drained soils with moderate to moderately rapid permeability.

The miscellaneous land types that would be crossed by the New Jersey portion of the pipeline include tidal marsh and two Made-land map units: map unit Mc, which consists of coarse material, and map unit Mf, which consists of fine materials.

Soils along the proposed pipeline route were evaluated for characteristics that would affect construction or increase the potential for construction-related soil impacts. Table 4.2.1-3 provides a summary of significant soils characteristics along each segment. Each soil characteristic is discussed separately below.

TABLE 4.2.1-3

Acreage of Soil Characteristics for the Proposed Pipeline Right-of-Way a/

Route	Total	Prime Farmland b/	Hydric Soils c/	Compaction Prone d/	Highly Erodible e/	Revegetation Concerns f/
Pennsylvania						
MP 0 – MP 4.9	42.1	10.5	2.1	2.1	2.4	16.6
New Jersey						
MP 4.9 – MP 11	59.0	0.0	10.9	2.7	8.1	0.0
Pipeline Total	101.1	10.5	13.0	4.9	10.6	16.6

a/ Acreage is based on a variable-width construction right-of-way, but does not include access roads or temporary extra workspace. Soil characteristics do not add across rows because soils may occur in more than one characteristic class, or may not occur in any class listed.
b/ As designated by the Natural Resources Conservation Service (NRCS) and includes farmland of local or statewide importance.
c/ As designated by the NRCS.
d/ Includes soils in somewhat poor to very poor drainage classes with surface textures of sandy clay loam and finer.
e/ Includes soils with slopes greater than 8 percent and soils designated by NRCS as highly erodible land and potentially highly erodible land.
f/ Includes soils with slopes greater than 8 percent, high content of surface stones, and dense subsoils, including fragipans.

Pipeline construction activities such as clearing, grading, excavation, backfilling, and the movement of construction equipment along the right-of-way could impact soil resources in several ways. Clearing would remove protective cover and expose soil to the effects of wind, sun, and precipitation, which could increase the potential for soil erosion and the movement of sediments into sensitive areas. Grading and equipment traffic could compact soil, reducing porosity and percolation rates resulting in increased runoff potential and decreased soil productivity. Trench excavation and backfilling could lead to mixing of topsoil and subsoil which could lower soil productivity. Contamination from spills or leaks of fuels, lubricants, and coolants from construction equipment could also impact soils.

Prime Farmland

About 25 percent (10.5 acres) of the soils that would be affected by the pipeline in Pennsylvania are designated prime farmland. None of the soils that would be affected by the pipeline in New Jersey are designated prime farmland. Most of the prime farmland soil in Pennsylvania is within or directly adjacent to commercial or residential developments and none of it is actively cultivated or available for farming. Pipeline construction would temporarily impact this soil. Since no aboveground facilities would be constructed on prime farmland, no prime farmland would be permanently lost as a result of the construction activities. Texas Eastern would minimize temporary impacts on prime farmland by segregating topsoil from subsoil prior to trenching and returning the segregated topsoil to the trench following backfilling of the trench spoil. Other potential impacts on prime farmland would be reduced and controlled by minimizing erosion, replacing or repairing damaged tile drainage systems (if present), and preventing the introduction of invasive/nuisance plant species.

Hydric Soils

Hydric soils are defined as "soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Federal Register, July 13, 1994). Soils that are artificially drained or protected from flooding (e.g., by levees) are still considered hydric if the soil in its undisturbed state would meet the definition of a hydric soil. Hydric soils include poorly and very poorly drained soils and some somewhat poorly drained soils.

About 13 percent (13.0 acres) of the soils along the entire pipeline route are hydric soils. Two percent (2.1 acres) of the hydric soils occur in Pennsylvania and 11 percent (10.9 acres) of these soils occur in New Jersey. Hydric soils can be susceptible to compaction (as discussed below). In addition, high groundwater levels associated with hydric soils could create a buoyancy hazard for the pipeline. Special construction techniques such a concrete coating and other weighting methods would be used to overcome buoyancy hazards during operation of the pipeline. Practices such as dry season construction and/or trench dewatering would typically be used to minimize buoyancy problems during construction.

Compaction Potential

Construction equipment traveling over wet soils could disrupt the soil structure, reduce pore space, increase runoff potential, and cause rutting. The degree of compaction is dependent on moisture content and soil texture. Fine-textured soils with poor internal drainage that are moist or saturated during construction are the most susceptible to compaction and rutting.

As noted above, hydric soils can be susceptible to compaction. Of the total acreage of hydric soils along the proposed pipeline route, about 38 percent (4.9 acres) have surface layers with silt loam or finer textures that are somewhat poorly drained or wetter. The Othello series and areas mapped as Tidal Marsh account for most of these soils (4.1 acres). The other 0.7 acre consists of very poorly drained Pocomoke loam soils The remaining hydric soils are not susceptible to compaction but may be susceptible to rutting impacts if construction activities occur when the soils are wet.

Impacts related to soil compaction would be minimal due to the limited acreage of compaction-prone soils. Texas Eastern would minimize compaction and rutting of some soils by using construction mats where wetland soils cannot support equipment. In addition, in agricultural areas Texas Eastern would implement the compaction mitigation measures in its SESC Plan. In residential areas Texas Eastern has requested a variance from the FERC's Plan requirement for compaction mitigation. As outlined in section 1.2 of the SESC Plan, Texas Eastern has proposed to not conduct compaction testing and mitigation in residential areas. Instead, the SESC Plan specifies topsoil segregation or replacement in

all residential areas. Texas Eastern suggests that subsequent freeze thaw cycles of the upper portion of the subsoil would provide sufficient natural mitigation of any compacted areas of the right-of-way in residential areas within 2 to 3 years.

Soil compaction in residential areas not only affects the rooting depth of grasses and shrubs but also influences water movement through the soil. Excessive application of water to lawns and shrubs in soils with substantial subsurface soil compaction could lead to water-logged conditions and increased incidence of disease and insect damage. However, because Texas Eastern would segregate or replace topsoil in residential areas, and because its SESC Plan requires that they monitor the right-of-way following construction and rectify any landowner complaints regarding revegetation (as discussed in section 8.1 of its SESC Plan), we grant this variance request to omit compaction testing and mitigation in residential areas.

Erosion

Erosion is a continuing natural process that can be accelerated by human disturbance. Factors that influence the degree of erosion include soil texture, soil structure, length and percent of slope, vegetative cover, and rainfall or wind intensity. Soils most susceptible to erosion by water are typified by bare or sparse vegetative cover, noncohesive soil particles with low infiltration rates, and moderate to steep slopes. Wind erosion processes are less affected by slope angles. Clearing, grading, and equipment movement could accelerate the erosion process and, without adequate protection, result in discharge of sediment to waterbodies and wetlands. Soil loss due to erosion could also reduce soil fertility and impair revegetation.

Erosion potential is moderate to slight for the majority of soils that would be affected by the proposed pipeline. Only about 0.4 acre of Manor soils and 2.1 acres of Glenelg soils located in Pennsylvania exhibit severe erosion potential. The New Jersey segment contains no highly erodible soils. However, this segment does contain 6.7 acres of Downer soils and 1.4 acres of Sassafras soils which are considered potentially highly erodible. Texas Eastern's SESC Plan specifies the use of erosion control devices and construction practices that would minimize erosion during construction such as silt fence, hay bales, and soil berms. After construction is complete, Texas Eastern would minimize further erosion by re-grading and reseeding disturbed areas. Following restoration and clean up, Texas Eastern would monitor the disturbed areas to maintain erosion control structures and repair any developing erosion.

Stony/Rocky Soils and Shallow-to-Bedrock Soils

Grading, trenching, and backfilling may bring stones to the surface that could interfere with or damage agricultural equipment, and hamper revegetation efforts by reducing soil moisture holding capacity. Additionally, ripping and blasting of shallow bedrock during construction could incorporate bedrock fragments into the topsoil.

Stony and rocky soils present in the Pennsylvania segment include the Glenelg channery silt loam (GeB2, GeC2) and Manor loam and channery loam (MhE) map units. These soils account for 5.1 acres along the proposed pipeline right-of-way. In addition to having stony/rocky surface layers, the Manor soils in Pennsylvania also contain shallow bedrock. These soils account for less than 1 percent of the total route (about 0.5 acre) but could require blasting to excavate the trench. Stony/rocky soils and shallow bedrock or fragipan are not present along the New Jersey segment of the pipeline route. Impacts on soils due to excess rock in surface horizons would be minimal due to the limited acreage of these soils. In addition, Texas Eastern would remove excess rock from the upper 12 inches of the soil in all rotated and permanent cropland, hayfields, pastures, residential areas, and other areas at the landowner's request.

Rock would be removed until the size, density and distribution of rock in surface soils are similar on and off the right-of-way.

Revegetation Potential

Successful restoration and revegetation are important to maintain soil productivity and to protect the underlying soil from potential damage such as erosion. About 16 percent (16.6 acres) of the soils that would be affected by pipeline construction activities exhibit poor revegetation potential (table 4.2.1-3). All of these soils are in Pennsylvania. Soils with poor revegetation potential include those that have stony or rocky surface layers, dense subsoils (e.g., fragipans) that could restrict root penetration, and soils with slopes greater than 8 percent that are potentially erosive and would require additional stabilization, such as mulch, to promote germination and seedling establishment. In accordance with its SESC Plan, Texas Eastern would mitigate the effects of poor revegetation potential by applying fertilizer, pH modifiers, and using mulch (where appropriate) in areas with poor revegetation potential in order to create a favorable environment for the re-establishment of vegetation. Texas Eastern would further enhance revegetation potential by using seed mixes approved by local soil conservation authorities to reseed the right-of-way following construction.

The discussion of revegetation success in section 8.3.1 of Texas Eastern's SESC Plan (see Appendix D) does not appear to be consistent with section VII.A.2 of our Plan. Determining if revegetation measures have been successful should be consistent with the guidelines in our Plan.

Soil Contamination

Contamination from spills or leaks of fuels, lubricants, and coolant from construction equipment could adversely affect soils. The effects of contamination would typically be minor because of the low frequency and volumes of spills and leaks. Texas Eastern has developed an SPCC Plan that specifies cleanup procedures in the event of soil contamination from spills or leaks of fuel, lubricants, coolants, or solvents. This SPCC Plan, which is included in Texas Eastern's SESC Plan (see Appendix D), would minimize the potential to contaminate soils.

Texas Eastern conducted a database search of all areas within 0.25 mile of the proposed pipeline route to determine the location of federal and state hazardous waste sites as identified in various government databases. Twenty-seven hazardous, potentially hazardous, and solid waste sites are located within 0.25 mile of the proposed pipeline route. Of these 27 sites, the proposed pipeline route would cross two hazardous waste sites and would run parallel to a leaking underground storage tank (LUST), a solid waste facility, and an abandoned, uncontrolled, or inactive hazardous waste site. Further details about the database search results are provided in sections 4.3.1 and 4.8.4. Construction of the pipeline in the vicinity of these sites could disturb contaminated soils. Although Texas Eastern has included a Contaminated Contingency Plan in its SPCC Plan, it does not adequately address potential impacts and mitigative measures associated with encountering contaminated soils during construction. To be prepared in the event of encountering contaminated soils and groundwater in the construction right-of-way, Texas Eastern has indicated that it would prepare and file with the FERC a Plan for the Discovery and Management of Contaminated Soils and Groundwater. This Plan would comply with applicable state and federal regulations and would provide for management of contaminants at known sites and include procedures for the identification and management of unknown contaminants in other locations.

4.2.2 Sediments

Construction of the LNG terminal would require dredging about 1.24 million cubic yards of sediment to create the berth area for the ship unloading facility. To provide initial characterization of the

sediments that would be dredged and to determine the compatibility of the sediment for placement in the Weeks Marine facility, Crown Landing collected a series of six vibracores from within or near the proposed dredging footprint (see figure 4.2.2-1). Each core was advanced to about 30 feet below the sediment water interface. Samples were collected from three strata within each core (one from 18 inches below the surface; one at about 12 feet below the surface; and one at about 30 feet below the surface), resulting in a total of 18 sediment samples from the 6 cores. None of the cores were composited for analytical purposes. Each of the 18 samples represents a discreet stratum from an individual core.

Physical Analyses

Crown Landing did not conduct an analysis of the physical properties of the sediment samples. However, sediment samples were collected and analyzed by the COE from the Marcus Hook reach of the river as part of the Delaware River Comprehensive Navigation Study (Black and Veatch Waste Science, 1996). Vibracores collected from the berth area of the BP Oil facilities across the river from the LNG terminal site consisted primarily of organic silts overlying layers of well-graded sands. These sediments extended from about 41 feet to 49 feet below MLLW. This is deeper than the proposed depth of dredging for the LNG ship berth, but the upper, silty sediment observed in the berth area cores probably represents recently deposited material and is likely representative of the sediment that would be dredged from most of the proposed berth area at the Crown Landing site. Crown Landing has indicated that it will conduct analyses of the physical properties of samples collected from the proposed berth area as part of its (SAP) for the proposed dredged sediments. The sampling and analysis program has been delayed as a result of a jurisdictional dispute between the states of Delaware and New Jersey. Crown Landing will conduct the sampling and analyses once the appropriate regulatory authority grants permission to conduct the sediment coring. Because data regarding the physical characteristics of the proposed dredged material are import for evaluating potential water quality impacts from the proposed dredging operations, **we recommend that**:

- **Crown Landing file with the Secretary of the Commission (Secretary) the results of the physical characterization analyses of any new sediment cores collected for the project for review and comment by the Director of OEP <u>prior to construction</u>. The complete results, including supporting quality assurance/quality control data, should be filed as public information.**

Chemical Analyses

Preliminary chemical analyses of the proposed dredged sediments included the EPA list of 126 priority pollutants and an additional 40 non-priority organic compounds. The samples were analyzed using standard EPA protocols in accordance with the New Jersey Technical Standards for Site Investigations (NJAC 7:26E). Of the 166 constituents that were analyzed, the following 8 metals were detected in the sediment samples at concentrations above method detection limits: arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc. Additionally, beryllium was detected in one deep core sample at less than 1 mg/kg. The original sediment characterization data and supporting laboratory quality assurance forms were filed under the pre-filing docket for the project (PF04-2) as confidential information. Additional information was filed as part of Crown Landing's application; however, this material was also marked privileged/confidential. We received comments from both NOAA and DNREC that the complete data report for the sediment characterization should be included as an appendix to the EIS. We do not feel that inclusion of these data are necessary in the EIS; however, we recognize that agencies with jurisdictional authority over the proposed project need to review and evaluate data that impact their respective jurisdictions. As a result, we requested that Crown Landing file the complete results of the preliminary sediment analysis on the public record. The data are now available for public review on our e-library website.

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 4.2.2-1 Sediment Core Locations

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Average metal concentrations for the surface, middle, and bottom of each sediment core in comparison to NOAA sediment screening values are presented in table 4.2.2-1. In addition, seven SVOCs were identified at concentrations above method detection limits. Average concentrations of these constituents are also included in table 4.2.2-1.

The highest concentrations of all metals were detected in the surface sample of Core 104. This sample was also the only sample in which cadmium was detected. Arsenic was detected in all but one sample and ranged from 3.1 to 31 mg/kg (parts per million [ppm]). Mercury was detected in only 2 core samples (both from the surface layer) at concentrations less than 0.20 mg/kg. The five remaining metals were detected in all samples. Chromium concentrations ranged from 20.2 to 46.5 mg/kg; copper concentrations ranged from 5.7 to 36.2 mg/kg; lead concentrations ranged from 6.8 to 78.2 mg/kg; nickel concentrations ranged from 13.2 to 26.9 mg/kg; and zinc concentrations ranged from 39.2 to 279 mg/kg. Similar concentrations for all of these metals have been reported at several sites along the Marcus Hook reach of the Delaware River (Black and Veatch Waste Science, 1996). Except for the arsenic concentrations from the surface of two cores, all of the detected metals were below current New Jersey residential and non-residential soil cleanup criteria. The arsenic concentrations from all six cores exceed the recently proposed New Jersey soil remediation standards. As noted in the discussion of soils in section 4.2.1, arsenic levels in soils and sediments in the Delaware River basin of New Jersey are generally elevated.

As with the metals, the highest concentrations of SVOCs were detected in the near-surface sediments. None of the measured concentrations of any SVOC exceeded the current New Jersey soil cleanup criteria. The concentrations of only three compounds (Benzo(a)anthracene, Benzo(a)pyrene, and Benzo(b)fluoranthene) exceeded the most recently proposed New Jersey soil remediation standards. Elevated SVOC concentrations in the surface layers of sediment at the site likely represent local background conditions, given the site's location in the vicinity of several oil refineries and the Logan Generating Station. Catalytic petroleum cracking operations and industrial power generation are both important stationary sources of airborne deposition of SVOCs (ATSDR, 1995).

Table 4.2.2-1 provides a comparison of average sediment concentrations with ecologically risk-based screening values to assess the potential hazards posed to the aquatic environment by the dredged sediment. Freshwater sediment values presented in the NOAA Screening Quick Reference Tables (Buchman, 1999) were used in assessing the sediment core results. The following NOAA screening levels for freshwater sediments were used for comparisons:

- Threshold Effects Level (TEL) represents a conservative screening value at which the sediments are not expected to pose a threat; and
- Probable Effects Level (PEL) represents a concentration screening value above which adverse biological effects are frequently expected.

TABLE 4.2.2-1

Comparison of Average Metal Concentrations in the Sediment Samples and NOAA Sediment Screening Values

	Dredged Sediment Samples			NOAA Sediment Screening Values	
	Surface (18 inches)	Middle (12 feet)	Deep (30 feet)	TEL a/	PEL b/
Metals (concentrations in mg/kg)					
Arsenic	11.4	5.3	6.4	5.9	17.0
Cadmium	1.1 c/	ND d/	ND	0.596	3.53
Chromium	35.1	31.6	35.7	37.3	90.0
Copper	18.1	8.7	8.7	35.7	197.0
Lead	33.1	10.9	9.5	35.0	91.3
Mercury	0.17 e/	ND	ND	0.174	0.486
Nickel	16.3	17.8	20.3	18.0	35.9
Zinc	116.6	53.2	54.6	123.1	315.0
Semi-Volatile Organic Compounds (concentrations in μg/kg)					
Phenanthrene	610	ND	ND	41.9	515
Fluoranthene	575	ND f/	ND	111	2355
Pyrene	793	ND f/	ND	53	875
Benzo(a)anthracene	610	ND f/	ND	31.7	385
Benzo(b)fluoranthene	655	ND f/	ND	NA g/	NA
Chrysene	630	ND f/	ND	57.1	862
Benzo(a)pyrene	570	ND f/	ND	31.9	782

a/ TEL = Threshold Effects Level
b/ PEL = Probable Effects Level
c/ Value represents a single analytical result from Core 104; the remaining surface samples contained non-detectable levels of cadmium.
d/ ND – not detected.
e/ Value represents the mean of two analyses from Cores 104 and 105; the remaining surface samples contained non-detectable levels of mercury.
f/ Includes two qualified estimated concentrations measured below method detection limits.
g/ NA – not available.

The concentrations of most metals in all samples were below the TEL values, indicating that the sediments would not be expected to pose a threat to the aquatic environment. Only the concentrations of arsenic, cadmium, and nickel exceeded the TEL screening criteria. The average concentration of arsenic in the surface and bottom core increments varied from 1.1 to 1.9 times the TEL value but was still below the PEL criterion. Similar concentrations of arsenic were reported from vibracore samples collected in the Marcus Hook reach of the Delaware River by the COE (Black and Veatch Waste Science, 1996). Arsenic is widespread in the geologic formations and soils of the Delaware River basin and the concentrations in the sediment cores are similar to those reported as background for soils in urban areas of the Atlantic Coastal Plain Province (Sanders, 2003). Cadmium was only detected in a single sample from the surface of Core 104. The concentration of cadmium in the sample from Core 104 was about twice the TEL but well below the PEL value. Similar cadmium concentrations were reported for other parts of the Marcus Hook reach (Black and Veatch Waste Science, 1996). Elevated nickel concentrations were limited to the bottom segment of the core samples. The average nickel concentration of 20.3 mg/kg is only slightly higher than the TEL value of 18 mg/kg, but well below the PEL criterion. Similar nickel

concentrations were reported in other parts of the Marcus Hook segment of the Delaware River (Black and Veatch Waste Science, 1996).

The average concentrations of all detected SVOCs within the surface samples exceeded the TEL screening values, but were generally below the PEL screening values. The average concentrations of two compounds, phenanthrene and benzo(a)anthracene, exceeded the PEL values by 1.2 and 1.6 times, respectively. SVOC concentrations in the proposed dredged sediments were generally higher than the compliance averaged concentrations in bulk sediments reported by the COE for the Delaware Deepening Project, but were within the range of concentrations reported by the COE (Black and Veatch Waste Science, 1996). SVOC concentrations decreased rapidly with depth to undetectable levels in the middle and lower portions of the cores. SVOC concentrations greater than or equal to the PEL screening values indicate a potential for adverse biological effects from dredging; however, elutriate testing conducted for the Delaware Deepening Project indicated that no organic compounds exceeded initial screening levels (Black and Veatch Waste Science, 1996). This finding suggests that SVOC compounds are likely to be adsorbed to the sediments and are unlikely to be released to the water column in concentrations that would result in adverse biological effects. In addition, Crown Landing would conduct project-specific elutriate testing as outlined in the SAP for the project.

We received several comments on the draft EIS regarding the potential for PCB contamination of near-surface sediments. A study by the Delaware River Basin Commission (DRBC) indicated that total PCB concentrations in 90 percent of sediment samples analyzed in river zones 2, 3, 4, and 5 of the Delaware River were less than or equal to 200 micrograms per kilogram (µg/kg) (parts per billion (ppb)) in the upper 5 centimeters (cm) (Yagecic, 2002). The proposed LNG terminal site is located in zone 5 and zones 2, 3, and 4 are located further upstream of the site. The average total PCB concentration in sediments from river zone 5 was 59 ppb based on studies conducted by the DRBC, COE, and NOAA (Yagecic, 2002). This average concentration is only slightly above the level that would require specialized disposal techniques. Total PCB concentrations in the upper 5 cm of sediment near RM 78 (the proposed terminal site location) ranged from near zero to about 60 ppb (Yagecic, 2002). In a more recent study, PCB concentrations in the upper 5 cm of sediments from river zone 5 averaged between 1.75 to 2.67 ppb (wet weight). Samples collected from near the mouth of Oldmans Creek averaged 1.75 ppb (Ashley et al., 2004). Based on these studies, the potential for significant PCB contamination in the sediment proposed to be dredged for the proposed LNG ship berth appears to be low. In addition, the act of hydraulic dredging will substantially mix any PCB-containing sediment with uncontaminated materials and result in a dredged slurry with greatly reduced PCB concentrations. The hydraulic cutterhead dredges proposed for use on the Crown Landing LNG Project would likely have pump diameters that range from 28 to 30 inches, and would create a dredge cut of about 3 to 4 feet in depth (Steady, 2005). This depth of dredge cut would effectively mix the contents of the upper 3 to 4 feet of sediment, and yield a slurry that would have a lower PCB concentration than the uppermost layers of sediment discussed in the studies described above.

We received additional PCB-related comments regarding the potential need to dispose of PCB-contaminated sediments at a facility approved to handle these materials. The Weeks Marine facility currently proposed for disposal of the dredged materials is approved by the NJDEP to accept PCB-contaminated sediments below the Toxic Substance Control Act threshold of 50 ppm (mg/kg). As discussed above, PCB concentrations in sediments near the proposed berth area ranged from 0 to 60 ppb (µg/kg), or about 1,000 times lower than the regulatory threshold concentration. Given the low potential for significant PCB contamination in the area proposed for dredging, and the regulatory threshold concentrations approved at the proposed disposal facility, special disposal procedures for PCB contaminated sediment are not likely to be required.

We also received comments from NOAA and DNREC regarding the potential for additional sediment contamination resulting from oil spilled by the tanker Athos in November 2004. Procedures that would be used in the sampling and analysis of the proposed dredged materials would allow detection of oil-related contamination. Crown Landing has indicated that the oil spill and its potential impact on the proposed dredged sediments were discussed with NJDEP staff during its review of the SAP for the project. Because the procedures included in the SAP already included methods that would identify contamination specific to the Athos spill, the NJDEP did not request any additional sampling or analytical procedures.

Crown Landing has indicated that it will conduct additional sampling and analysis of sediment from the proposed ship berth area when it receives permission to collect the required sediment cores from the applicable regulatory agencies. A copy of the SAP approved by the NJDEP is provided in Appendix I. Crown Landing indicated that the SAP was prepared to satisfy NJDEP requirements (NJDEP, 1997) because the dredged material would be disposed of in New Jersey at the Weeks Marine facility. The SAP was also prepared to satisfy DNREC requirements because the dredging would take place in Delaware waters. Modifications to the NJDEP dredging methodology were proposed due to the large volume of sediment to be characterized. It is our understanding that although proposed guidance for dredged material characterization exists for Delaware, current DNREC guidance does not specify sampling parameters or sample frequency for dredged material characterization. A draft version of the SAP was provided to NJDEP in December 2004 for review and comment. The draft SAP was revised based on the NJDEP's comments, and in late December 2004, the NJDEP indicated that the revised SAP addressed the agency's concerns regarding the adequacy of sampling to characterize the materials. Crown Landing's SAP was subsequently approved by the NJDEP on October 19, 2005.

The SAP specifies that 12 cores would be collected from the proposed dredging footprint (see figure 4.2.2-1). The majority of these cores would be collected using vibracore equipment, but two cores (cores 1 and 2 in figure 4.2.2-1) in the shallowest water portions of the dredging footprint would be collected using split-spoon samplers to ensure adequate retrieval of sediment material. Crown Landing would subsample the cores by splitting each core into four depth increments: 0 to 10 feet; 10 to 20 feet; 20 to 30 feet; and 30 to 41 feet ,or maximum core depth if less than 41 feet).

If any cores exhibit internal stratification greater than 2-feet in thickness, the individual strata would be analyzed independently. Crown Landing would notify the NJDEP and DNREC of any sampling plan modifications made as a result of observed sediment stratification. In addition, if visually observable differences are detected among the cores during sampling, additional core samples may be collected between some or all of the original core sample locations, at the discretion of the project scientist directing the sample collection event. Crown Landing would notify the NJDEP and DNREC regarding the number and approximate location of any additional cores collected. Some or all of these additional cores may also be submitted for chemical analysis based on the best professional judgment of the project scientist conducting the sampling. Additional quality control samples would also be collected.

The sediment samples would be characterized for both physical and chemical properties. These analyses would be conducted by a laboratory certified to meet both New Jersey and Delaware quality control guidelines. The following general analyses would be conducted:

- Bulk sediment Analyses (physical and chemical);
- Modified Elutriate testing (total concentrations); and
- Modified Elutriate Testing (dissolved concentrations).

Bulk sediment material would be analyzed for ten parameters: grain size, total organic carbon, percent moisture, SVOCs, PCBs (Aroclors), PCB cogeners, total PCBs, pesticides, metals, and cyanide. Specific information about the analytical methods and constituents that would be analyzed are described in Appendix I. Elutriate test samples would be prepared according to COE guidelines for all samples containing less than 90 percent sand. Extremely sandy samples would not be analyzed because these materials would have limited potential to resuspend in the water column and generally contain limited quantities of adsorbed contaminants. Samples containing more than 90 percent sand would not pose a significant risk to the aquatic environment. Chemical analyses of the elutriate samples would follow COE testing procedures (COE 1985).

We have reviewed Crown Landing's SAP and believe it will adequately characterize the proposed dredged materials. Because the results of the sediment characterization are necessary to fully evaluate potential impacts of the proposed dredging operations on surrounding water quality and aquatic organisms, and because Crown Landing has not yet been able to collect and analyze the additional sediment cores from the proposed dredging footprint, **we recommend that:**

- **Crown Landing file the results of all additional sediment characterization analyses with the Secretary for review and comment by the Director of OEP <u>prior to construction</u>. The complete results, including supporting quality assurance/quality control data, should be filed with the Commission as non-confidential, non-privileged information so that the Commission may provide access to the data to all agencies with jurisdiction over the project.**

To minimize the resuspension of sediment during dredging, Crown Landing would primarily use hydraulic cutterhead dredging to excavate the berth area. Studies by the COE indicate that cutterhead dredging generally results in lower sediment resuspension than other forms of dredging (e.g., clamshell or hopper barge) (COE, 1986; COE, 1988a). If resuspension of sediments during dredging resulted in unacceptable water quality impacts, Crown Landing's dredging contractor could adjust the operational parameters of the dredge to further reduce sediment resuspension. Additional mitigation measures to minimize sediment-related water quality impacts (e.g., the use of silt curtains) may be implemented through the other federal and state permit processes.

It is anticipated that most of the dredged material would be transported by pipeline directly to an existing, permitted upland confined disposal facility. The disposal facility is located about 4 miles from the berth area (see section 2.4.1.3 for further discussion of dredging and dredge disposal activities). The pipeline for the dredged material placement activities would be operated in accordance with New Jersey state dredging regulations and the 401 Water Quality Certification for the project. In addition, operation of this underwater pipeline would comply with the Coast Guard navigational safety requirements and any necessary permits or approvals from the COE.

As described in Crown Landing's SAP, beneficial reuse of some portion of the proposed dredged sediments would be undertaken if the physical and chemical properties of the materials are appropriate. Based on data from adjacent portions of the Delaware River, Crown Landing anticipates that surface sediments from the proposed berthing area are likely to be dominated by silt and clay (poor material for beneficial uses); however, sediments from the deeper portions of the dredging footprint are anticipated to contain higher concentrations of sand. The deeper, sandier sediments may be appropriate for re-use onsite at the LNG facility as part of construction fill, or they could be used offsite for various beneficial use projects (e.g., road fill). If sandy sediments are encountered and characterization analyses indicate they may be beneficially reused, these sandy sediments would be dredged using a clamshell bucket. Crown Landing has indicated that additional permits from the state of New Jersey would be required to both store and beneficially use dredged sediments. If the results of the sediment characterization analyses

indicate that the beneficial use of some portion of the proposed dredged materials is possible, Crown Landing would submit the necessary permit applications.

Dredging operations to excavate the ship berth would suspend sediments and affect water quality. In general, dredging-related water quality impacts would include both the physical effects of suspended sediment and alterations of water chemistry due to the release of various chemical constituents associated with the sediment (see section 4.3.2 for further discussion of water quality impacts).

4.3 WATER RESOURCES

4.3.1 Groundwater

Regional Groundwater Quality and Quantity

The proposed LNG terminal site and pipeline route in New Jersey are located within the Northern Atlantic Coastal Plain aquifer system, which underlies an area of approximately 50,000 square miles and extends from North Carolina north to Raritan Bay, New Jersey (USGS, 1997). The western limit of the aquifer system is the Fall Line between the Atlantic Coastal Plain and Peidmont Physiographic Provinces; the eastern limit is effectively the Atlantic Ocean.

The Northern Atlantic Coastal Plain aquifer system consists of six regional aquifers. The boundaries of these aquifers are irregular and none extend over the entire area. The majority of groundwater withdrawn in the project area is from the Potomac-Raritan-Magothy aquifer, which is part of the Northern Atlantic Coastal Plain aquifer system. The Potomac-Raritan-Magothy aquifer is composed of alternating layers of clay, silt, sand, and gravel of Cretaceous age. Regionally, this aquifer extends to a depth of between 50 and 1,800 feet, and typically yields 500 to 1,000 gallons per minute (gpm) but can exceed 2,000 gpm (USGS, 2003). Most of the wells completed in this aquifer are 90 to 105 feet deep. Water from the Potomac-Raritan-Magothy aquifer is generally low in dissolved solids, although iron and manganese present localized problems due to the low pH of the groundwater. In southern New Jersey, the Potomac-Raritan-Magothy aquifer contains salty groundwater with chloride concentrations ranging from less than 250 milligrams per liter (mg/L) to as high as 27,000 mg/L. Chloride concentrations in the groundwater increase with depth as well as toward the ocean.

In Pennsylvania, the pipeline route crosses crystalline rock and sand and gravel aquifers. Crystalline rock aquifers have very small fractures so storage capacity and yield are relatively low. The water is generally soft and yields are commonly 5 to 25 gpm (Water Resources Education Network (WREN), 2003). The sand and gravel aquifers contain large quantities of water, which can be easily withdrawn and commonly yield 1,000 gpm. The natural quality of this groundwater is good to excellent (WREN, 2003).

Sole Source Aquifers

The proposed LNG terminal site and the pipeline route in New Jersey are located within the New Jersey Coastal Plain Sole Source Aquifer and the proposed pipeline route in Pennsylvania is located within the stream flow source zone for the New Jersey Coastal Plain Sole Source Aquifer (EPA, 2003). EPA-designated sole source aquifers are those that contribute more than 50 percent of the drinking water to a specific area and for which there are no reasonably available alternative sources of water should the aquifer become contaminated. The proposed projects are not on or do not cross any state-designated sole-source aquifers.

Public and Private Water Supply Wells

Crown Landing consulted with the Gloucester County Department of Health to identify the locations of water wells proximate to the LNG terminal site. Based on this consultation, the nearest water supply well is located approximately 1,600 feet to the northeast at the Logan Generating Station. The LNG terminal site is not located within any designated wellhead protection zones (New Jersey Geographic Information Network, 2004).

Well location information from Environmental Data Resources, the DRBC, and Gloucester County identified eight water supply wells within 150 feet of the proposed construction right-of-way for the Logan Lateral (see table 4.3.1-1). Civil surveys of the proposed right-of-way indicate that the two wells identified at MP 9.3 in table 4.3.1-1 likely represent the same well, which is owned by Solutia Inc. and Ferro Corp. No public water supply wells were identified within 0.25 mile of the proposed pipeline route in New Jersey or within 3 miles of the pipeline route in Pennsylvania.

TABLE 4.3.1-1

Water Supply Wells Located Within 150 Feet of the Logan Lateral Route

Milepost	Location	Supply Type	Approximate Distance From Construction Right-of-Way (feet)
3.2	Delaware, PA	Domestic Use	150
3.8	Delaware, PA	Groundwater Well	150
3.9	Delaware, PA	Groundwater Well	150
9.3	Gloucester, NJ	Unknown	Located within the construction right-of-way
9.3	Gloucester, NJ	Industrial	Located within the construction right-of-way
9.9	Gloucester, NJ	Industrial	150
10.3	Gloucester, NJ	Industrial	150
10.3	Gloucester, NJ	Industrial	150

The proposed Logan Lateral would cross one designated wellhead protection zone in Gloucester County, from approximate MP 6.0 to MP 7.3.

Groundwater Conditions at the LNG Terminal Site

A detailed description of the geologic units present at the LNG terminal site is provided in section 4.1.1. In general, the water table occurs at a depth of 2 to 6 feet below the surface of the site within the unconsolidated Pleistocene sand and silt deposits of the Cape May Formation. This formation is underlain by an approximately 85- to 95-foot-thick clayey silt confining unit that limits groundwater movement from the Cape May Formation to the underlying Potomac-Raritan-Magothy aquifer.

Crown Landing installed eight monitoring wells to obtain site-specific groundwater data at the LNG terminal site. The monitoring wells were installed in the surficial aquifer of the Cape May Formation to a depth of approximately 20 feet below ground surface. Based on the results of groundwater elevation monitoring in these wells, the surficial aquifer flows towards the Delaware River in the northern and western portions of the site and towards Oldmans Creek in the eastern and southern portions of the site.

The monitoring wells on the site were sampled in accordance with NJDEP requirements. Groundwater samples from the wells were analyzed for petroleum products, VOCs, SVOCS, priority pollutant metals, priority pollutant pesticides, PCBs, cyanide, and phenols. All of these compounds except arsenic were either not detected in the groundwater samples or detected at concentrations below groundwater quality standards. Arsenic was detected at concentrations ranging from 13.9 to 114 micrograms per liter in five of the eight wells, exceeding the New Jersey Class IIA Groundwater Quality Standard of 8 micrograms per liter.

As discussed in section 4.2.1, the cause of the elevated arsenic level at the site is unknown but could be the result of a spill from an abandoned onsite storage vessel, historic use of arsenic-containing

pesticides in the project area, or high native arsenic levels associated with the dredged materials that were historically removed from the Delaware River. Crown Landing will enter into a Memorandum of Agreement (MOA) with NJDEP to perform further site investigations and remediation, if needed. The MOA will allow NJDEP to review, comment, and approve of all documentation submitted in support of site investigation, remediation, and contaminated media management. The MOA process should result in NJDEP issuance of a No Further Action letter, possible establishment of a classification exemption area for impacted groundwater, and possible issuance of a deed restriction for impacted soils. The MOA process would benefit the environment by ensuring that any remediation is conducted according to NJDEP regulations and by reducing the potential for human exposure to existing contamination at the site.

LNG Terminal Groundwater Requirements

Because the LNG terminal site is not located near an existing municipal water supply system, at least one water supply well would be installed at the site to provide freshwater for short-duration construction-related uses and long-term facility operations. The number of wells to be installed would depend on the well yield. Preliminary information indicates that more than one well, but probably not more than two wells, would be needed to meet the construction and operation needs of the facility. The well or wells would likely be completed in the Potomac-Raritan-Magothy aquifer in accordance with a NJDEP Bureau of Safe Drinking water well construction permit. The well or wells would provide a one-time demand of 250,000 gallons of freshwater to rinse each LNG tank after completion of hydrostatic testing and an estimated 500 to 1,500 gallons per day for normal facility operations such as firewater makeup, lawn sprinkling, and sanitary purposes. Potable water would be delivered to the LNG facility.

Groundwater Resources Impacts and Mitigation

LNG Terminal

Construction and operation of the proposed LNG terminal and pipeline facilities would not significantly affect groundwater quality or quantity in the project area. Most groundwater impacts would be avoided or minimized by use of standard construction techniques as set forth in our Plan and Procedures, and by implementing project-specific SESC and SPCC Plans.

Dredging of the berth area for the ship unloading facility could affect groundwater recharge through introduction of salt- or brackish water into the Potomac-Raritan-Magothy aquifer. The COE evaluated the effects of dredging on saltwater intrusion into the Potomac-Raritan-Magothy aquifer as part of the Delaware River Main Channel Deepening Project Final Supplemental Environmental Impact Statement (COE, 1997). The COE concluded that dredging the Delaware River navigation channel to 45 feet deep would have a negligible effect on the recharge characteristics of the aquifer, and not pose undue risk to water quality of the aquifer. Because the Crown Landing LNG Project would require significantly less dredging (0.8 million cubic yards) than the Delaware River Main Channel Deepening Project (33 million cubic yards), dredging associated with construction of the LNG terminal is also anticipated to have negligible effects on the recharge characteristics and groundwater quality of the Potomac-Raritan-Magothy aquifer.

Other construction activities at the LNG terminal, including grading, excavation, and construction of footings and foundations could potentially cause minor fluctuations in the Cape May Formation surficial aquifer and/or increase turbidity within this aquifer. These impacts would be temporary and localized and would not extend off of the LNG terminal site. Due to the presence of the thick confining unit below the Cape May Formation, these relatively shallow impacts would not be expected to affect the underlying Potomac-Raritan-Magothy aquifer. Deep pile foundations would be used to support the

proposed LNG tanks, pier, and possibly some process equipment. These piles would extend from the ground surface, through the 85- to 95-foot-thick clayey silt confining unit, and into the underlying Potomac-Raritan-Magothy aquifer. These piles would be driven, thus forming a tight seal between the piles and surrounding soil, and likely decreasing the vertical permeability of soils adjacent to the piles. Therefore, the use of deep driven piles should not increase the potential for shallow, arsenic-impacted groundwater in the Cape May Formation to migrate vertically down to the Potomac-Raritan-Magothy aquifer.

Potential impacts on groundwater associated with the use of oils, lubricants, and other hazardous substances during construction and operation of the LNG terminal would be minimized by Crown Landing's compliance with federal regulations related to fuel transport, handling, and spill response procedures and its implementation of a project-specific SPCC Plan.

Pipeline Facilities

As shown in table 4.8.4-1, Texas Eastern reviewed state and federal environmental regulatory databases and identified several known and potential sources of contamination within approximately 0.25 mile of the proposed pipeline route. The pipeline route crosses two of these sites and is adjacent to three other sites. The pipeline route also crosses property associated with the PECO Chester Generating Station located in Chester, Pennsylvania adjacent to the Delaware River. This site is not included in table 4.8.4-1; however, according to the PADEP, this site was contaminated as a result of its historical use as a coal-fired power plant and has undergone remediation. Based on the presence of these known contaminated sites in the vicinity of the proposed pipeline route, contaminated soils and groundwater could be encountered during construction of the pipeline. As discussed in section 4.2.1, Texas Eastern has indicated that it would develop a site-specific Plan for the Discovery and Management of Contaminated Soils and Groundwater. Implementation of this Plan would protect the safety of workers and ensure that any contaminated media encountered during construction is properly managed in accordance with applicable regulations.

Limited blasting may be necessary for construction of the Logan Lateral (see section 4.1.2). However, blasting is not anticipated within 1 mile of any of the wells listed on table 4.3.1-1. If blasting is required within 150 feet of any wells, pre- and post-construction monitoring of well yield and water quality would be conducted with the well owner's permission. If it is determined that any private water supply is damaged as a result of the project, Texas Eastern would provide a temporary source of water until the damaged well is restored to its former capacity. Similarly, for wells located within 150 feet of the construction right-of-way but not within any blasting areas, Texas Eastern would also provide pre- and post-construction monitoring of well yield and water quality at the landowner's request.

Other pipeline construction activities could result in minor, temporary impacts to shallow groundwater resources in proximity to the proposed pipelines. These impacts could include increased turbidity, groundwater level fluctuations, short-term disruption of recharge, localized flow along the pipeline trench, contamination from a spill or leak of hazardous substances, and decreased water yield. Most potential impacts would be avoided or minimized by the use of standard construction methods and measures set forth in our Plan and Procedures, and appropriate hazardous materials management and spill response procedures contained in Texas Eastern's SPCC Plan. Therefore, construction and operation of the proposed pipeline would not have a significant impact on overall groundwater quality in the area.

4.3.2 Surface Water

Watershed Descriptions

The Crown Landing LNG and Logan Lateral Projects would be located within the Delaware River Basin. The mainstem of the Delaware River extends approximately 330 miles from the confluence of its east and west branches near Hancock, New York to the Atlantic Ocean near Cape May, New Jersey. The Delaware River Basin is 13,539 square miles in size and drains portions of Delaware, New Jersey, New York, and Pennsylvania (DRBC, 2004). The tidal influence along the Delaware River extends to Trenton, New Jersey at approximate RM 133 (USGS, 2002c). The tidal range within the project area is between 5.53 and 5.86 feet, with salinity levels ranging between 0.0 and 0.5 parts per thousand (ppt), which indicates a predominantly freshwater system. The average annual flow of the river upstream of Trenton is about 11,700 cubic feet per second (USGS, 1999b).

Based on information provided by the PADEP and the NJDEP, the LNG terminal and pipeline facilities would not be located within a surface water protection area (Newbold, 2003; NJDEP, 2003a). In addition, no surface water intakes are currently located along the Delaware River in the vicinity of the LNG terminal site or the proposed pipeline crossing.

Waterbody Classifications

LNG Terminal

The proposed LNG terminal would be constructed adjacent to and within the Delaware River and near Oldmans Creek. The DRBC classifies and regulates uses of water within the Delaware River. The DRBC establishes the water quality standards for the Delaware River in cooperation with the States of Delaware, Pennsylvania, New Jersey, and New York. The LNG terminal site is located in Zone 5 at approximate RM 78.4. The designated uses in Zone 5 include:

- industrial water supplies after reasonable treatment;
- maintenance of resident fish and other aquatic life;
- propagation of resident fish from RM 48.2 to 70.0;
- passage of anadromous fish;
- wildlife;
- recreation; and
- navigation.

The State of Delaware also regulates water use for the portion of the Delaware River that lies within the Delaware state boundaries. The DNREC designates the following uses between RMs 48.2 and 78.8:

- industrial water supply;
- primary contact recreation;

- secondary contact recreation; and
- fish, aquatic life, and wildlife.

The water quality classification for Oldmans Creek is FW2-NT/SE1. The designated uses in FW2 waters include:

- maintenance, migration, and propagation of the natural and established biota;
- industrial and agricultural water supply;
- public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation, and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and
- any other reasonable use.

The NT designation for Oldmans Creek indicates non-trout waters. These waters are generally not suitable for trout because of their physical, chemical, or biological characteristics, but are suitable for a variety of other fish species.

The designated uses in SE1 waters include:

- shellfish harvesting in accordance with NJAC 7:12;
- maintenance, migration, and propagation of the natural and established biota;
- primary and secondary contact recreation; and
- any other reasonable uses.

Pipeline Facilities

Construction of the Logan Lateral Project would require crossing seven perennial waterbodies, including the Delaware River, and five intermittent streams. Waterbodies crossed by the proposed pipeline are listed in table 4.3.2-1. Descriptions of the fishery resources in these waterbodies are provided in section 4.6.2.

Sensitive Waterbodies

None of the waterbodies identified in table 4.3.2-1 are designated as a National Wild and Scenic River in the vicinity of the LNG terminal site or pipeline facilities (National Park Service, 2004). The Delaware River is listed on the EPA's National Estuary Program. The National Estuary Program was established in 1987 to improve the quality of estuaries of national importance. Section 320 of the Clean Water Act directs the EPA to develop plans for attaining or maintaining water quality in these estuaries. None of the other waterbodies crossed by the Logan Lateral Project are characterized as sensitive by any state or federal agency (Newbold, 2003; Springer, 2003).

TABLE 4.3.2-1

Waterbodies Crossed by the Logan Lateral Project

State/ Milepost	Waterbody Name	Flow Regime a/	Crossing Width (feet)	State Water Quality Classification b/	Fishery Classification	Proposed Crossing Method c/
Pennsylvania						
1.5	Chester Creek	P	104	TSF	Warmwater	HDD
1.7	Baldwin Run	P	20	WWF	Warmwater	HDD
1.8	Unnamed Tributary of Chester Creek	I	2	TSF, MF	Warmwater	Open-cut
3.2	Unnamed Ditch d/	I	10	Not Classified	Warmwater	Open-cut
Pennsylvania and New Jersey						
4.9	Delaware River	P	4,576	WWF, MF (PA) Zone 4 (DRBC) FW2-NT/SE2 (NJ)	Warmwater	HDD
New Jersey						
7.3	Raccoon Creek	P	606	FW2-NT/SE2	Warmwater	HDD
7.4	Unnamed Ditch	I	20	Not Classified	Warmwater	Open Cut
8.0	Unnamed Ditch	I	15	Not Classified	Warmwater	Open-cut
8.3	Unnamed Ditch	I	10	Not Classified	Warmwater	Open-cut
9.2	Birch Creek	P	50	FW2-NT/SE2	Warmwater	HDD
10.3	Tributary of Oldmans Creek	P	30	FW2-NT/SE2	Warmwater	Open-cut
10.9	Tributary of Oldmans Creek	P	40	FW2-NT/SE2	Warmwater	Open-cut

a/ P =Perennial, I=Intermittent

b/ Pennsylvania
TSF – Trout Stocking Fishery
WWF – Warmwater Fishery
MF – Marine Fishery
Delaware River Basin Commission
Zone 4– Designated uses include:

- industrial water supplies after reasonable treatment;
- maintenance of resident fish and other aquatic life;
- passage of anadromous fish;
- wildlife;
- recreation below RM 81.8; and
- navigation.

New Jersey
FW2 – General surface water classification applied to freshwaters that are not designated as FW1 or Pineland Waters.
NT – Non-trout waters
SE – Saline Estuaries

c/ HDD – horizontal directional drill

d/ In section 3.5.3, we recommend that Texas Eastern adopt the Palmer Street Variation, which would avoid crossing the unnamed ditch at MP 7.4.

Contaminated Sediments

Based on review of Integrated Monitoring and Assessment Reports prepared by the PADEP and NJDEP, none of the waterbodies in the project area, except the Delaware River, are suspected of containing contaminated sediments (PADEP, 2004; NJDEP, 2004a). Crown Landing collected and analyzed sediment samples from the proposed dredge area within the Delaware River. The sediments were found to have detectable levels of eight metals (arsenic, cadmium, chromium, copper, lead, mercury,

nickel, and zinc) and seven SVOC compounds. A detailed discussion of the sediment sampling and analysis program is provided in section 4.2.2.

Surface Water Resources Impacts and Mitigation

LNG Terminal Construction Impacts

Construction of the Crown Landing LNG Project could adversely affect surface water quality in the Delaware River during dredging operations, construction of the ship unloading facility and stormwater outfall, and the appropriation and discharge of hydrostatic test water. In addition, surface water runoff during clearing, grading, and the placement of fill material at the LNG terminal site could impact water quality in the Delaware River and the wetlands located adjacent to the LNG terminal site. Because Crown Landing would maintain a buffer zone of wetlands between Oldmans Creek and the LNG storage and process facilities, construction and operation of the LNG terminal is not anticipated to have any effects on the creek.

The primary impact on water quality associated with dredging would be the resuspension of sediment into the water column. The suspended sediment could: reduce light penetration and lower the rate of photosynthesis and aquatic productivity in the area; introduce organic material and/or nutrients which could lead to an increase in biological oxygen demand and reduce dissolved oxygen; and release chemical constituents, such as metals, contained in the sediment. In addition, an accidental release of fuel or other hazardous materials during construction could degrade water quality.

Crown Landing is proposing to primarily use hydraulic dredging to remove approximately 1.24 million cubic yards of sediment from the Delaware River. The hydraulic dredge operates by displacing bottom sediments with a cutterhead and then capturing the sediment slurry using pumps that transport the slurry via a pipe to an existing confined disposal facility. In addition to the hydraulic dredge, Crown Landing indicated that it may be necessary to mechanically dredge in select areas if boulders or other obstructions are encountered during dredging operations that would preclude the use of the hydraulic dredge. The mechanical dredge would differ from the hydraulic dredge in the method of sediment removal and transportation to the disposal site. The mechanical dredge would operate using a crane to lower a clamshell bucket to the river bottom to excavate a load of sediment. After picking up a load of sediment, the clamshell bucket would be raised through the water column and emptied into a scow for transportation to the disposal site.

As part of the environmental analysis for the Delaware River Main Channel Deepening Project, the COE conducted computer modeling of dredging-induced sediment impacts on water quality in the Marcus Hook segment of the river, which is located adjacent to the LNG terminal. The purpose of this modeling was to determine whether potential sediment contaminants that may be released during dredging operations could exceed Delaware River water quality criteria. The DREDGE model (Hayes and Je, 2000) was used to estimate the suspended sediment concentrations, the size and extent of the suspended sediment plume, and the particulate and dissolved contaminant concentrations in the water column from hydraulic and mechanical dredging operations within a 200-foot mixing zone (Versar, 2001).

Bulk sediment data collected from the Marcus Hook channel and Marcus Hook ship berths were used by the COE to model impacts from hydraulic dredging and mechanical dredging, respectively. Table 4.3.2-2 provides a comparison of the metal concentrations in the sediments located at the proposed LNG terminal site, Marcus Hook channel, and Sun Marcus Hook berth.

TABLE 4.3.2-2

A Summary of Metal Concentrations in Sediments from the Proposed LNG Terminal Site and the Marcus Hook Channel and Berth

	Proposed LNG Terminal Site		Marcus Hook Channel a/		Sun Marcus Hook Berth a/	
Metal (mg/kg)	Mean b/	Maximum	Mean c/	Maximum	Mean d/	Maximum
Arsenic	7.84	31.0	7.25	18.4	3.78	6.4
Cadmium	0.06 e/	1.1	1.15	4.0	0.17	0.39
Chromium	34.12	46.5	28.54	63.7	22.25	37.8
Copper	11.81	36.2	13.54	38.4	15.73	24.70
Lead	17.87	78.2	22.41	78.9	10.2	22.8
Mercury	0.019 f/	0.183	0.180	0.484	0.13	0.16
Nickel	18.13	26.9	19.27	31.6	14.43	21.8
Zinc	74.78	279	74.84	240	46.68	98.6

a/ Data obtained from a report titled *Near-Field Water Quality Modeling of Dredging Operations in the Delaware River* (Versar, 2001)
b/ Number of samples = 18
c/ Number of samples = 23
d/ Number of samples = 4
e/ Mean is based on only a single detectable concentration
f/ Mean is based on only two detectable concentrations

Hydraulic Dredging

The model results indicated that the concentration of suspended sediments resulting from hydraulic dredging (based on total suspended solids (TSS)) would be highest close to the channel bottom and would decrease rapidly downstream and higher in the water column (i.e., further from the channel bottom). Modeled total suspended sediment levels more than 0.5 meter (1.6 feet) above the river bottom were predicted to be no higher than background levels. Actual field results from a monitored dredging project in the same area were consistent with the total suspended sediments predicted by the DREDGE model, although measured and predicted sediment concentrations varied (Farrar et al., 2001 as cited in Versar, 2001). Elevated total suspended sediment levels measured near the river bottom extended downstream from the dredge site for a distance of up to 300 feet. Field measurements of suspended solids at the water surface and middle of the water column downstream of the dredging operation were not measurably different than background levels (Farrar et al., 2001, as cited in Versar, 2001).

Crown Landing used the DREDGE model to predict total suspended sediment concentrations that could be expected from dredging the ship berth. Based on a conservative TSS background concentration of 5 mg/L,[2] the modeling results indicate that TSS concentrations would be less than background concentrations at points within the water column located 2 meters or more above the river bottom. The model predicted that background TSS concentrations would be exceeded at a point 1 meter above the river bottom beginning approximately 820 feet downstream of the dredge for a distance of approximately 1,150 feet.

As described previously and shown in table 4.3.2-2, the concentrations of metals in the proposed dredged sediments at the LNG terminal site are similar to those in the sediments modeled by the COE in the Marcus Hook Range of the river. Based on these similarities, it is possible to estimate the potential

[2] Based on TSS monitoring completed by Crown Landing between March and June 2003, TSS concentrations ranged from 13.9 to 24.9 mg/L. Other TSS data obtained from the Delaware River Basin Commission indicates that, for this reach of the Delaware River, TSS concentrations may range from 3 to 60 mg/L.

for water quality impacts associated with alterations of water chemistry due to the release of various chemical constituents from the sediments at the LNG terminal site.

The COE estimated dissolved concentrations of various metal constituents in the water column near the cutterhead of the hydraulic dredge using the equilibrium partitioning method in the DREDGE model. Based on the maximum metal concentrations for the Marcus Hook segment listed in table 4.3.2-2, only mercury and chromium concentrations were predicted to exceed the water quality criteria. Predicted mercury concentrations exceeded the chronic exposure water quality standard near the river bottom and up to 0.5 meter (1.6 feet) above the bottom. River bottom mercury concentrations exceeded chronic exposure levels for a distance of as much as 350 meters (1,148 feet) downstream of the point of dredging. At 0.5 meter above the bottom, mercury concentrations exceeding chronic exposure levels extended about 180 meters (590 feet) downstream. Generally, chronic exposure criteria apply to continuous releases of contaminants, rather than short duration releases from activities such as dredging. Predicted mercury concentrations 0.5 meter and higher above the bottom were within acceptable water quality criteria. Because the valence state of chromium was not indicated for the COE data, we conservatively assumed that all chromium was hexavalent (a more toxic form of the metal with the most stringent water quality criteria). Under this assumption, predicted chromium concentrations at the river bottom exceeded both acute and chronic exposure criteria up to 80 meters (262 feet) downstream of the point of dredging. Predicted chromium concentrations at 0.5 meter and higher in the water column were within acceptable water quality criteria. The predicted concentrations of the remaining six metals did not exceed acute or chronic water quality standards at any depth in the water column.

The COE also conducted additional modeling using a much more conservative approach to estimate dissolved metals. This approach assumed that 80 percent of the adsorbed metals could be dissolved in solution. Using this highly conservative model, chromium, copper, and zinc exceeded acute water quality criteria at the edge of a 60 meter (about 200 feet) mixing zone, but only near the river bottom. Cadmium, chromium, copper, lead, and mercury exceeded chronic exposure criteria near the bottom out to 60 meters. Most metals were below chronic exposure water quality criteria at 0.5 meter or higher in the water column. Only chromium, lead, and mercury exceeded chronic exposure criteria at 0.5 meter above the river bottom at the edge of the 60-meter mixing zone.

Mechanical Dredging

The COE model results indicated that the concentration of total suspended solids for mechanical dredging would be approximately 162 mg/L at the point of dredging and decrease to approximately 50 mg/L within 100 meters (328 feet) downstream of the dredging operation. Unlike the modeling completed for the hydraulic dredge, which calculates the suspended sediment concentration at any position in the water column, the modeling for the mechanical dredge calculates the depth-averaged concentration throughout the water column.

The COE estimated dissolved concentrations of metals in the water column near the mechanical dredge. Based on the maximum metal concentrations for the Sun Marcus Hook Berth identified in table 4.3.2-2, none of the dissolved metal concentrations exceeded the water quality criteria at the edge of a 60-meter mixing zone.

Similar to the modeling completed for the hydraulic dredging, the COE completed a more conservative model, which assumed that 80 percent of the metals adsorbed to the sediment could be dissolved into the water column upon suspension. Using the maximum metal concentrations for the sediments in Sun Marcus Hook Berth, the COE determined that, with the exception of chromium and mercury, none of the other metals exceeded water quality criteria at any point within the 60-meter mixing zone. Chromium exceeded water quality criteria out to a distance of 40 meters (131 feet) from the point

of dredging and mercury exceeded water quality criteria out to a distance of 100 meters (328 feet). However, mercury concentrations were below method detection limits and the value used in the model was one-half the detection limit, which could be substantially higher than actual values. Therefore, even using a conservative approach, no metals with measurable sediment concentrations exceeded water quality criteria outside of a 60-meter mixing zone during the modeling of the mechanical dredge.

The modeling results described above indicate that using even the most conservative assumptions, metal concentrations in the water column from hydraulic dredging activities associated with the proposed ship berth would only be likely to exceed water quality criteria for a short distance from the dredging operations, and generally within about 0.5 meter of the river bottom. For mechanical dredging, metal concentrations would not be expected to exceed water quality criteria beyond a 60-meter mixing zone.

Ship Unloading and Land-Based Facilities

As described in section 2.4.1.2, construction of the LNG ship unloading facility would be completed using land-based equipment to build the pier from the shore out into the Delaware River. This construction technique would avoid dredging in the near-shore waters that would otherwise be required to provide sufficient water depths to install the pier using barge-based construction methods. Approximately 0.05 acre of river bottom would be filled as a result of constructing the pier and stormwater outfall. While installation of the pier and stormwater outfall would disturb the river bottom, the impacts on water quality would be localized and temporary. Crown Landing is evaluating several mitigation options to compensate for the subtidal habitat that would be filled. A description of these mitigation options is provided in section 4.6.2.

Construction of the proposed LNG terminal would require importing approximately 150,000 cubic yards of fill material to raise the LNG terminal above the 1,000 year storm range elevation and to construct the LNG storage tanks containment dike. Stormwater runoff from the disturbed soils on the construction site could affect water quality by increasing suspended sediment and turbidity levels in the river near the construction activities. Erosion and sedimentation at the site would be controlled and mitigated through implementation of the measures specified in our Plan and in a site-specific SESC Plan. Crown Landing would also develop and implement a stormwater management plan to control and treat stormwater runoff

LNG Terminal Operation Impacts

In addition to the construction-related impacts discussed above, the Delaware River could be affected during operations of the proposed facilities. During operation of the LNG terminal, maintenance dredging and prop wash from LNG ships and tugs would temporarily increase suspended sediments and turbidity within the ship channel and berth area. Crown Landing estimated that as much as 65,000 to 97,000 cubic yards of sediment may be deposited in the LNG ship berth each year and indicated that annual maintenance dredging would likely be required to remove these sediments. Impacts associated with prop wash would occur more frequently than dredging since as many as 100 to 150 LNG ships may travel to and from the terminal annually.

The LNG ships would also need to take on ballast water to stablilize the ship during transit. Crown Landing indicates that a 138,000 m^3 LNG ship would withdraw approximately 13.7 million gallons of water and a 200,000 m^3 LNG ship would withdraw about 19.8 million gallons from the Delaware River. Crown Landing estimates that the water would be taken in over about a 10-hour period at intake rates of about 1.4 million gallons/hour (23,000 gpm) for a 138,000 m^3 LNG ship and about 2 million gallons/hour (34,000 gpm) for a 200,000 m^3 LNG ship. The intake rates of 23,000 gpm to 34,000

gpm for ballasting represents less than 0.1 percent of the average flow of the Delaware River. Assuming 100 to 150 LNG ships (138,000 m^3 capacity) offload at the terminal each year, a total of between 1.4 and 2.1 billion gallons of water could be removed from the Delaware River by LNG ships annually. Because fewer 200,000 m^3 LNG ships would be needed, the total ballast withdrawal volumes on an annual basis would be similar for these ships. No ballast water would be discharged to the Delaware River.

An LNG spill on the water of the river is another potential impact that could occur during operations of the terminal. Although we consider the potential for a spill of LNG on the Delaware River unlikely, if a spill were to occur on the river, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water. Being less dense than water, the LNG would float on the surface before vaporizing. Because LNG is not soluble in water and the LNG would completely vaporize shortly after being spilled, there would be no liquid left that could mix with and/or contaminate the water. Therefore, water quality would not be affected by an LNG spill.

To manage stormwater runoff from the developed LNG terminal site during operations of the facility, Crown Landing would provide stormwater management facilities that would be designed in accordance with NJDEP guidelines. The stormwater management system would include a treatment pond located outside of the LNG storage area containment dike. Stormwater runoff in the storage area would be collected in a sump and pumped to the treatment pond. Runoff from other portions of the facility would flow to the pond through a gravity system. After treatment in the pond, the stormwater would be discharged to the Delaware River.

Pipeline Construction and Operation Impacts

Texas Eastern has proposed to install the Logan Lateral across Chester Creek, Baldwin Run, Delaware River, Raccoon Creek, and Birch Creek using the HDD construction technique. The HDD technique is a trenchless crossing method that involves drilling a hole beneath the waterbody and installing a pre-fabricated section of pipe through the hole to complete installation. This technique would avoid disturbing the bed or banks of the waterbodies and minimize environmental impacts. Texas Eastern has completed geotechnical investigations at the five waterbodies to characterize subsurface conditions along the drill path and to determine the feasibility of using the HDD construction technique for crossing each waterbody. Based on the results of these investigations, it was determined that HDD techniques are feasible at Chester Creek (including Baldwin Run), Delaware River, Raccoon Creek, and Birch Creek. While drilling has been determined to be feasible at Chester Creek, the geologic formations located along the drill path consist of coarse gravel underlain by weathered bedrock. These types of geologic formations tend to be more complicated to drill through due to the presence of fractures and void space, which can increase the likelihood of an inadvertent release of drilling fluid or collapse of the borehole.

Texas Eastern prepared a Monitoring and Contingency Plan, which outlines monitoring procedures, measures to minimize environmental impacts associated with an inadvertent release of drilling fluids, and contingency plans for alternative construction techniques in the event that the HDD technique fails. We have reviewed the Monitoring and Contingency Plan and believe that implementing the measures would minimize impacts associated with the HDD construction technique. If the initial HDD installation attempts at the Delaware River, Raccoon Creek, and Birch Creek were to fail, Texas Eastern would reposition the drill equipment and make a second attempt at installation using the HDD technique. If the HDD technique were not successful at Chester Creek, the pipeline would be installed by the open-cut construction technique. If Texas Eastern changes its plans to use the HDD technique to install the pipeline across these waterbodies, an alternative crossing technique would need to be developed; therefore, **we recommend that:**

- **Texas Eastern prepare a site-specific crossing plan if a crossing technique other than a HDD is proposed at Chester Creek, Delaware River, Raccoon Creek, or Birch Creek. The site-specific crossing plans should identify the method to be used to excavate the trench; the location of the spoil storage both in the river and onshore and the mitigative measures that would be used to control and store the spoil; the method to be used to backfill the trench; an explanation of the size requirements of the extra workspaces on each bank; a discussion of any special mitigation to minimize impact on riparian vegetation; and for navigable streams, include a discussion on how boat traffic interruption would be minimized. Texas Eastern should file this plan with the Secretary concurrent with its application for other federal and state agencies for a permit to construct using the alternate method. The Director of OEP must review and approve these plans <u>prior to construction</u>.**

Texas Eastern would install the pipeline across the other waterbodies listed in table 4.3.2-1 using the open-cut construction technique. Pipeline construction across perennial streams using the open-cut construction technique could adversely affect surface waters. Potential impacts from clearing and grading, in-stream trenching, trench dewatering, and backfilling could modify aquatic habitat, increase sedimentation rates and turbidity levels, decrease dissolved oxygen concentrations, increase water temperature, and introduce fuels and oils from accidental spills.

The impacts of the open-cut construction method on perennial streams located along the proposed pipeline would generally be localized and short term. Clearing, grading, and trenching within and adjacent to these streams would have the greatest affect on water quality. Sediments would be resuspended by in-stream construction activities or by erosion of cleared stream banks and riparian areas. Turbidity resulting from the resuspended sediments could reduce light penetration and the corresponding photosynthetic oxygen production. Resuspension of deposited organic material and inorganic sediments could cause an increase in consumption of biological and chemical oxygen, decreasing available dissolved oxygen. Texas Eastern would be required by our Procedures to complete most in-stream work within 24 hours for minor waterbody crossings (i.e., those less than 10 feet wide) and within 48 hours for intermediate waterbody crossings (i.e., those greater than 10 feet wide, but less than 100 feet wide). In addition, Texas Eastern would be required to stabilize and restore the stream banks after construction is completed.

Construction impacts would be temporary and suspended sediment and turbidity levels would be expected to return to preconstruction levels soon after the stream crossing is completed. By implementing the construction and restoration methods identified in our Procedures and in Texas Eastern's SESC Plan, we believe that the impacts would be minimized and no long-term impacts on surface water quality would occur. Other federal, state, or local agencies may require Texas Eastern to implement additional protective measures as part of their permit requirements.

Hydrostatic Testing

Hydrostatic water for testing of the LNG storage tanks would be obtained from the Delaware River. Crown Landing estimates that a total of about 75 million gallons of water would be required to test the 3 tanks. Water would be appropriated from the Delaware River over a 2-week period at an intake rate of approximately 2,000 to 4,000 gpm. We received a comment regarding the feasibility of reusing water to test all three tanks. While reusing test water would minimize the volume of water appropriated from the Delaware River and reduce impacts associated with impingement and entrainment of aquatic species, Crown Landing indicated that this would not be practicable. Because the tanks would be tested on different schedules, the additional residence time between tank transfers would increase the risk of corrosion as a result of contact with the brackish water. To avoid appropriating water from the Delaware

River, we evaluated the feasibility of obtaining water from a municipal source to complete hydrostatic testing. As discussed in section 4.3.1, the LNG terminal site is not located near an existing municipal water supply system.

To minimize entrainment and impingement of aquatic organisms, Crown Landing would screen the intake with a 2 mm wedgewire screen, limit the velocity at the intake to 0.5 feet per second, position the intake about 6 to 8 feet below mean low water, and avoid appropriating water during the month of May (see section 4.6.2). Crown Landing indicated that the hydrostatic test water may need to be chlorinated to prevent microbiologically influenced corrosion, a condition that could lead to corrosion of the tanks and piping from the presence and interaction of bacteria, fungi, and/or algae, if not treated. Following the testing, Crown Landing would discharge the test water back to the Delaware River over a 1 to 2 week period in accordance with National Pollutant Discharge Elimination System (NPDES) permitting requirements. To minimize erosion and scour that could occur if the water were discharged in the nearshore portion of the Delaware River, Crown Landing indicated that it would discharge test water in deeper waters in the vicinity of the Marcus Hook anchorage area. Crown Landing would then flush each tank with approximately 250,000 gallons of freshwater obtained from onsite wells to remove the remaining brackish river water from the tanks. The rinse water would also be discharged into the Delaware River.

Based on preliminary plans, Texas Eastern proposes to appropriate water from Ridley Creek (located adjacent to Chester Junction at MP 0.0), Delaware River (MPs 4.5, 5.3, and 11.0), and/or municipal sources located within the project area to hydrotest the pipeline. Texas Eastern estimated that about 2.1 million gallons of water would be needed from these sources to test the pipeline. Texas Eastern also indicated that no chemical additives would be required to complete hydrostatic testing and that intakes would be screened with wire mesh to prevent the entrainment or impingement of aquatic species. After the testing is completed, Texas Eastern proposes to discharge the water back to Ridley Creek (MP 0.0) and the Delaware River (MPs 5.3 and 11.0) in accordance with NPDES permitting requirements.

4.4 WETLANDS

Regulatory Permits

Wetlands affected by the proposed projects would be regulated by federal, state, and local agencies. At the federal level, the COE has authority under section 404 of the CWA and section 10 of the Rivers and Harbors Act to review and issue permits for activities that would result in the discharge of dredged or fill material into waters of the United States. In 1994, the NJDEP assumed responsibility for administering section 404 of the CWA for the majority of the wetlands and waterbodies located in the state under the New Jersey Freshwater Wetlands Protection Act rules as specified in the New Jersey Administrative Code (NJAC 7:7A). In addition to section 404 responsibilities, the NJDEP uses the standards and procedures identified in NJAC 7:7, 7:7A, and 7:7E to determine whether the activity complies with the state's water quality standards, a prerequisite to issuing a section 401 water quality certificate. While New Jersey's Freshwater Wetlands Protection Act Rules operates in lieu of the section 404 program in certain waters, the COE has retained jurisdiction over interstate and navigable waters, such as the Delaware River and its adjacent wetlands.

In Pennsylvania, construction activities within wetlands and waterbodies would be regulated by the PADEP under the Chapter 105 Water Obstruction and Encroachment Permit Program. The Chapter 105 Program regulates obstructions and encroachments located in, along or across, or projecting into a watercourse, floodway or body of water, whether temporary or permanent, and is the nexus for determining whether the activity complies with the state's water quality standards as required by section 401 of the CWA. The two types of Chapter 105 authorizations include General Permits and Individual Permits. General Permits are used to streamline the permitting of activities that are sufficiently similar in design or construction to warrant general requirements or conditions, such as utility line stream crossings. The PADEP has delegated the processing of General Permits to local agencies, including the Delaware County Conservation District.

Construction within wetlands would require compliance, at a minimum, with the requirements of sections 401 and 404 of the CWA, section 10 of the Rivers and Harbors Act, and the respective state permitting programs. As part of complying with federal, state, and/or local regulatory requirements, Crown Landing and Texas Eastern must demonstrate that impacts on wetlands have been avoided to the extent practicable. Where unavoidable wetland impacts would occur, the agencies would require measures to mitigate the effects of construction. We believe this is consistent with the CEQ Regulations for Implementing the Procedural Provisions of the NEPA (40 CFR 1508.20), which defines mitigation to include the following criteria:

- avoiding the impact altogether by not taking a certain action or parts of an action;
- minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
- compensating for the impact by replacing or providing substitute resources or environments.

Wetlands on the LNG Terminal Site

Crown Landing conducted wetland delineations at the proposed LNG terminal site using the methods specified in the *1987 COE Wetlands Delineation Manual* (COE, 1987). As shown on figure 4.4-1, six wetlands were identified and delineated within the 175-acre LNG terminal site. The wetland boundaries were reviewed and approved by the COE and the NJDEP. The wetlands occupy about 109 acres of the site and consist of emergent, scrub-shrub, and forested types. Table 4.4-1 provides a summary of wetlands located on the proposed site. A description of vegetation in these wetlands is provided in section 4.5.

TABLE 4.4-1

Wetlands and Wetland Transition Areas Located on the Proposed LNG Terminal Site Property

Wetland Identification	Wetland Classification a/	Total Wetland Area (acres)	Temporary Impact Area (acres)	Transition Area Width (feet)/ Acres of Impact b/
Wetland I	PEM	7.4	0.0	50 / 0.0
Wetland D	PFO	7.8	<0.1 c/	150 / 4.1
Wetland E	PEM/PFO	63.2	0.3 d/	50 / 0.3
Wetland H	PSS	1.8	0.0	50/ 0.9
Wetland J	PFO	8.5	0.0	50 / 0.0
Wetland K	PEM/PFO	20.5	0.2 e/	50 / <0.01
Project Total		109.2	0.6	NA / 5.3

a/ Cowardin Classification System:
PEM Palustrine Emergent
PSS Palustrine Scrub Shrub
PFO Palustrine Forested

b/ Wetland transition areas regulated by the NJDEP under the New Jersey Freshwater Wetlands Protection Act (N.J.S.A. 13:9B)

c/ Area affected by installation of the stormwater outfall.

d/ Area affected by construction of the Columbia Gas pipeline interconnect.

e/ Area affected by installation of the septic line.

Crown Landing designed the proposed LNG terminal facilities to avoid wetlands on the site. Although no wetlands would be permanently filled or drained as a result of construction of the LNG terminal, construction of the Columbia Gas pipeline interconnect, stormwater outfall, and septic line would temporarily impact approximately 0.6 acre of wetlands (see figure 4.4-1). Following construction, the disturbed wetland areas would be restored to original contours and allowed to naturally revegetate.

In addition to wetlands, the NJDEP regulates transition areas of varying widths along the borders of wetlands in the State of New Jersey. Transition areas provide an ecological transition zone from uplands to freshwater wetlands and provide temporary refuge for wildlife during high water episodes, critical habitat for animals dependent upon but not resident in freshwater wetlands, and slight variations of freshwater wetland boundaries over time due to hydrologic or climatologic effects. In addition, transition areas provide sediment and stormwater control zones to reduce the impacts of development on freshwater wetlands and associated plants and animals. The transition areas are based on the resource value of the wetland and can be 50- or 150-feet wide. Wetlands of ordinary resource value do not have a regulated transition area. Wetlands of intermediate and exceptional resource value have regulated transition area widths of 50 and 150 feet, respectively. With the exception of the forested wetland located adjacent to the Delaware River (Wetland D), all of the wetlands located on the LNG terminal site are classified by the NJDEP as having intermediate resource value. Due to the potential presence of foraging bald eagles, Wetland D is classified as having exceptional resource value.

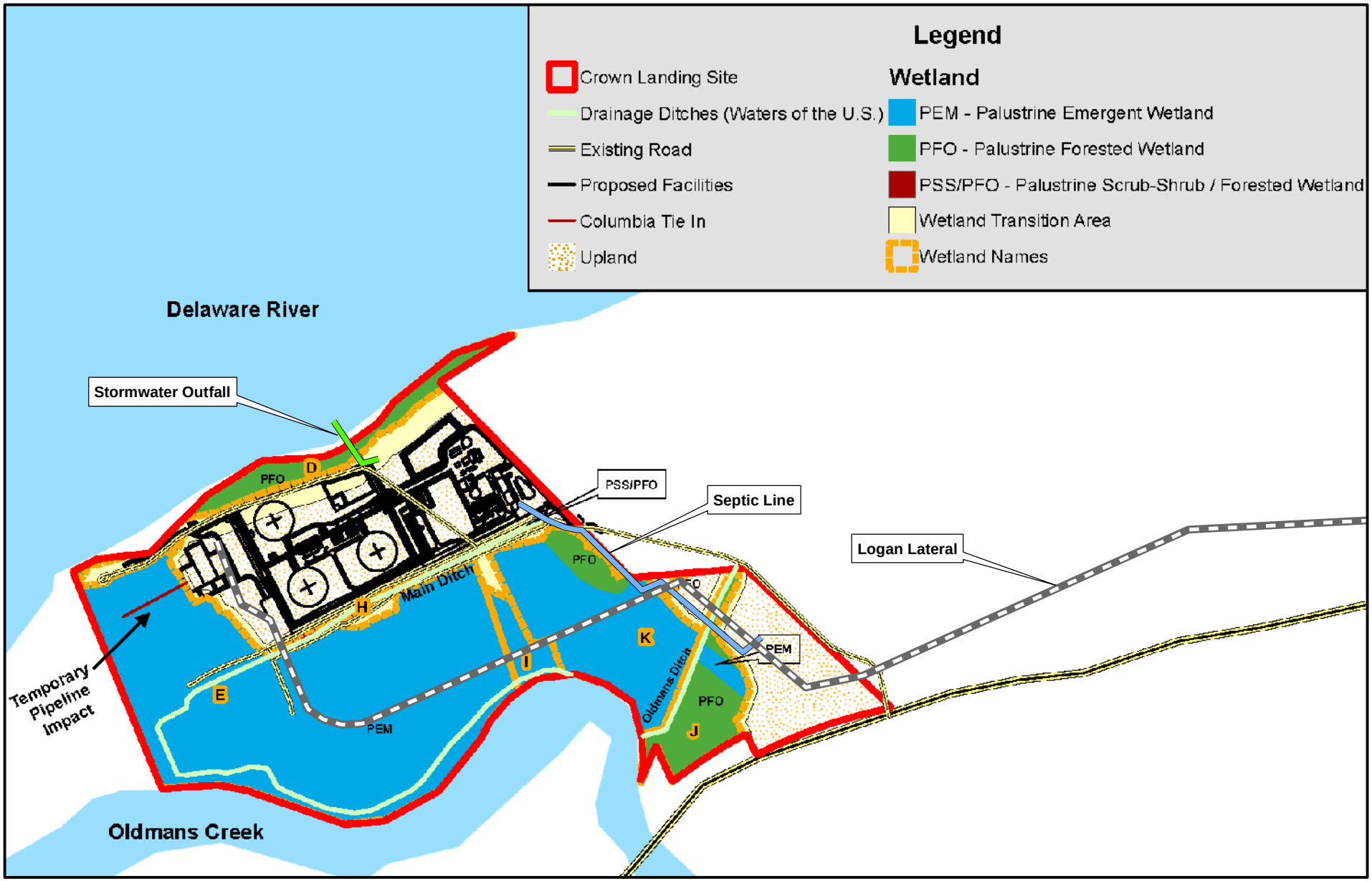


Figure 4.4-1
Crown Landing LNG Project
Wetlands Located in the LNG Terminal Site

As shown in table 4.4-1, construction of the LNG terminal would permanently impact about 5.3 acres of transition area. During construction, ground-disturbing activities in the wetland transition areas could increase erosion and sedimentation and alter wetland hydrology and drainage patterns. To minimize these impacts, Crown Landing would implement the measures contained in our Plan and Procedures and its SESC Plan, including, but not limited to, installing and maintaining sediment barriers and restoring disturbed areas following construction. While these measures would minimize impacts during construction, the resource values provided by the transition area (e.g., habitat, flood control) would be modified during operation of the facility and would require a transition area permit from the NJDEP. The NJDEP indicated that impacts on transition areas, especially the area adjacent to Wetland D which provides wintering and foraging habitat for bald eagles, would require some type of mitigation. Crown Landing discussed mitigation options with the NJDEP and the FWS on September 13, 2004 (Clark, Mars, Wilkinson, 2004). Based on agency consultations, Crown Landing has proposed the following two mitigative measures to compensate for transition area impacts:

- planting a 50-foot-wide band of native tree species along a segment of Oldmans Creek to provide a buffer and habitat for bald eagles, and.

- enrolling undeveloped portions of the LNG terminal site into a conservation easement program.

Crown Landing indicated that it would continue to coordinate with the NJDEP and the FWS on the development of an appropriate mitigation plan. Because these mitigation measures have not been approved by the applicable agencies and thus may not be final measures, **we recommend that:**

- **Crown Landing continue to consult with the NJDEP, FWS, and other appropriate agencies, and prepare a final wetland transition area mitigation plan. This plan should include details regarding the amount, location, and forms of mitigation proposed; a monitoring plan with clearly defined criteria for determining if and when the mitigation is successful; and remedial measures, as necessary, to ensure that compensatory mitigation is successful. Crown Landing should file the wetland transition area mitigation plan with the Secretary <u>prior to construction</u>.**

Wetlands Located Along the Proposed Pipeline Route

Texas Eastern completed a wetland survey in June 2004 using the current federal and state delineation methodologies to identify and delineate wetlands along the Logan Lateral route. Based on the results of this survey, the Logan Lateral would cross about 2.0 miles of wetlands (approximately 20 percent of the total pipeline length). Table 4.4-2 identifies the state, milepost location, wetland classification, wetland identification number, crossing length, acreage affected during construction, and acreage affected during operation for wetlands located along the proposed pipeline route.

No wetlands would be permanently filled or drained as a result of construction. In addition, none of the access roads identified by Texas Eastern would affect wetlands. In addition to siting the facilities outside of wetlands to the extent practicable, Texas Eastern would utilize specialized construction techniques to avoid trenching across wetlands. For example, Texas Eastern proposes to cross Birch Creek utilizing the HDD construction method, which would avoid trenching across about 1,500 feet of wetlands at MP 2.21.

TABLE 4.4-2

Wetlands Located Along the Logan Lateral Route

State/ Milepost Location	Wetland Classification a/	Wetland I.D.	Crossing Length (feet) b/	Acreage Affected by Construction c/	Acreage Affected by Operation d/
Pennsylvania					
1.80	PEM	W-DE-100	48	0.04	0.0
2.11	PEM/PFO	W-DE-101	100	0.08	0.06
2.21	PEM/PSS/PFO	W-DE-102	1,680	1.09	0.34
2.34	PFO	W-DE-103	197	0.22	0.07
2.44	PFO/PEM	W-DE-104	480	0.7	0.11
3.22	PFO	W-DE-105 e/	215	0.29	0.13
3.34	PFO	W-DE-106 e/	70	0.03	0.0
Subtotal			**2,790**	**2.45**	**0.71**
New Jersey					
5.38	PFO/PEM	W-GL-100	300	0.64	0.25
5.45	PEM/PSS	W-GL-102	3,550	3.44	0.0
7.29	PEM/PFO	W-GL-119	156	0.1	<0.1
8.03	PEM	W-GL-109	61	0.14	0.0
8.29	PEM/PFO	W-GL-112	0	0.03	0.0
8.33	PEM/PFO	W-GL-111	50	0.1	0.03
8.72	PEM	W-GL-114	800	1.66	0.0
8.92	PEM/PFO	W-GL-115	757	1.29	0.23
9.08	PEM/PFO	W-GL-116	2,038	2.01	0.01
9.89	PEM/PFO	W-GL-113	270	1.02	0.0
10.88	PEM/PSS/PFO	f/	2,516	7.18	0.33
Subtotal			**10,498**	**17.61**	**0.95**
Project Total			**13,288**	**20.06**	**1.66**

a/ Cowardin Classification System:
- PEM Palustrine Emergent
- PSS Palustrine Scrub Shrub
- PFO Palustrine Forested
- OW Open Water

b/ A crossing length of zero (0) indicates that the pipeline would not cross the wetland, but that temporary workspace would be located within the wetland.

c/ Acreage affected by construction includes the temporary construction right-of-way and temporary workspaces.

d/ Acreage reflects a maintained permanent right-of-way width of 30 feet centered over the pipeline in forested wetlands Emergent wetlands would not be affected during operation of the pipeline.

e/ In section 3.5.3, we recommend that Texas Eastern adopt the Palmer Street Variation, which would avoid impacting these two wetlands.

f/ The Logan Lateral would cross wetlands E, I, J, and K within the LNG terminal site (see figure 4.4-1).

The primary impact of pipeline construction and right-of-way maintenance activities on wetlands would be the temporary alteration of wetland vegetation and the permanent conversion of forested wetland to scrub-shrub or emergent wetlands. Construction of the Logan Lateral would temporarily disturb approximately 20.06 acres of wetlands and, through right-of-way maintenance activities, approximately 1.66 acres of forested wetlands would be permanently maintained in an herbaceous or scrub shrub state. Impacts on emergent wetlands would be considered temporary because herbaceous vegetation would likely regenerate within a few growing seasons following restoration of the right-of-way. In a letter dated September 14, 2004, the FWS recommended that Texas Eastern compensate for

permanent wetland impacts (FWS, 2004a). The FWS indicated that mitigation should be in the form of in-kind compensation at a 2:1 ratio (i.e., 2 acres created for every 1 acre of wetland impacted). Texas Eastern submitted a preliminary wetland mitigation plan with its application to the COE and PADEP to address wetland impacts in Pennsylvania. Based on the preliminary wetland mitigation plan, Texas Eastern is planning to restore emergent and scrub shrub wetlands disturbed during construction and to compensate for lost forest habitat either through the purchase of wetland mitigation bank credits, land swap, or by donating to a conservation organization. Texas Eastern indicated that it is currently developing a wetland mitigation plan for New Jersey. Because the wetland mitigation plans have not been finalized and approved by the applicable agencies, **we recommend that:**

- **Texas Eastern continue to consult with the NJDEP, PADEP, COE, and other appropriate agencies on the preparation of the wetland mitigation plan. The wetland mitigation plan should include details regarding the amount, location, and forms of mitigation proposed; a monitoring plan with clearly defined criteria for determining if and when the mitigation is successful; and remedial measures, as necessary, to ensure that compensatory mitigation is successful. Texas Eastern should file the final wetland mitigation plan with the Secretary <u>prior to construction</u>.**

Clearing, trenching, and other ground disturbing activities in wetlands could affect wetland hydrology and water quality. Operating heavy equipment could compact wetland soils, create ruts, and result in increased sedimentation and turbidity. In addition, the pipeline trench could act as a conduit for subsurface water flow which could impact wetland hydrology. These effects would be greatest during and immediately following construction.

To minimize potential impacts on wetlands during construction of the pipeline, Texas Eastern would implement the protective measures specified in our Procedures and its SESC Plan, including the following:

- limiting the construction equipment operating in the wetland to that necessary to complete construction;
- facilitating revegetation by leaving existing root systems in place except over the trench and where safety considerations requires their removal;
- segregating topsoil from the trench in unsaturated wetland soils;
- installing and maintaining sediment barriers across the entire construction right-of-way and along the edges of the right-of-way as necessary to prevent sediment from entering wetlands; and
- installing trench breakers as necessary to prevent the draining of wetlands.

We believe that these measures would minimize impacts on wetlands and promote revegetation following pipeline installation.

Operational impacts are primarily limited to periodic vegetation clearing over the pipeline centerline and Texas Eastern would minimize impacts on wetlands by adhering to the wetland vegetation maintenance requirements specified in our Procedures. Specifically, Texas Eastern would limit vegetation maintenance in wetlands to annual mowing of a 10-foot-wide strip centered over the pipeline and the periodic cutting of trees greater than 15 feet in height that are located within 15 feet of the pipeline centerline.

4.5 VEGETATION

LNG Terminal

The proposed LNG terminal site is an undeveloped parcel located adjacent to the Delaware River. The vegetation communities on the site consist primarily of agricultural land and emergent wetland, with scattered areas of open, forest, and shrub lands. These vegetative communities are described below. The offshore portion of the proposed LNG terminal (i.e., ship unloading facility) would be partially located in a shallow, intertidal area of the river that is almost devoid of vegetation.

Agricultural crops are the most predominant upland cover type on the LNG terminal site. Typical crops grown on the site include soybeans and wheat. The onshore LNG facilities would be located within an agricultural field that has recently been planted in soybeans.

Emergent wetlands on the site are dominated by common reed grass, also called *Phragmites*. Other species within these wetlands include soft rush, cattails, reed canary grass, straw colored sedge, lady's thumb, jewelweed, blue flag iris, arrow arum, and sensitive fern. Scrub-shrub wetlands primarily bordering onsite drainage ditches are dominated by black willow, silky dogwood, false indigo, blue flag iris, common reed grass, and square stem monkey flower.

Open land on the site consists of existing farm roads and dikes. Common species in these areas include late-flowering thoroughwort, yellow foxtail, pineapple-weed, jimsonweed, lady's thumb, bull thistle, Canada thistle, Asiatic tearthumb, Pennsylvania smartweed, ground cherry, switchgrass, and crabgrass.

Upland shrub land, including young forest, occurs as narrow strips located adjacent to field roads. These areas are dominated by common elder and white mulberry interspersed with common reed, Asiatic tearthumb, pokeweed, and Japanese honeysuckle in the understory.

Forest land on the site includes a narrow strip of forested wetland along the river and some remnant areas of forested wetland scattered throughout the site. The forested wetland along the river is dominated by black willow and has an understory consisting predominantly of false indigo, soft rush, and silverweed. The other forested wetlands are dominated by black willow, green ash, common reed grass, stilt grass, Asiatic tearthumb, and Japanese honeysuckle. Some upland areas adjacent to the forested wetlands are being invaded by the tree-of-heaven.

Crown Landing designed the LNG terminal facilities to avoid the natural vegetation communities on the site to the extent practicable. Most of the facilities would be constructed within cropland. Of the 38.6 acres of vegetative communities that would be permanently developed into LNG facilities, 35.4 acres (91 percent) would be in agricultural fields that have most recently been planted in soybeans and at present are fallow. Table 4.5-1 summarizes the vegetative communities that would be affected by construction and operation of the LNG terminal. A more detailed discussion of the wetland impacts is provided in section 4.4.

To minimize disturbance to vegetative communities, Crown Landing would restrict construction activities to the area disturbed within the permanent facility footprint to the extent practicable. A 3.8-acre temporary staging area would be needed during construction and would be located in an agricultural field adjacent to U.S. Route 130. About 0.6 acre of wetland on the site would also be temporarily affected during construction of the Columbia Gas pipeline interconnection, the stormwater outfall, and the septic line. Both of these temporary construction areas as well as other disturbed areas that are not required for buildings, roads, gravel, or other hard surfaces would be restored in accordance with our Plan and

Procedures and Crown Landing's SESC and Vegetation Management Plans after construction of the LNG terminal. The Vegetation Management Plan includes active revegetation of the stormwater management pond and two rainwater gardens within the diked process and storage area. The containment dike and other areas within the dike would also be seeded with a grass mixture and maintained as manicured lawn. Undisturbed natural areas on the site would remain in their existing natural states with the exception of a 50-foot band along Oldmans Creek, which would be supplemented with planted trees.

TABLE 4.5-1

Acreage of Vegetative Communities Affected by Construction and Operation of the Proposed LNG Terminal a/

	Cropland	Open Land b/	Shrub Land	Wetland	Total
Area Affected by Construction (acres)	39.2	1.7	1.5	0.6	43.0
Area Affected by Operation (acres)	35.4	1.7	1.5	0.0	38.6

a/ Portions of the Logan Lateral would be located within the boundaries of the proposed LNG terminal. These impacts are discussed under the Pipeline Facilities section.

b/ Includes existing farm roads and dikes

Pipeline Facilities

Vegetative communities crossed by the Logan Lateral route include forest land, open land, shrub land, and cropland interspersed among developed commercial and residential areas. Most of the pipeline route in Pennsylvania crosses urban areas with limited vegetative communities. The pipeline route in New Jersey crosses mostly undeveloped areas that are predominantly open land and cropland (soybean fields).

Upland forest located along the proposed pipeline route includes mixed-forest communities of maple-ash and beech-oak. The maple-ash communities are dominated by red maple, green ash, box elder, and tulip tree with an understory dominated by honeysuckle. The beech-oak communities are dominated by American beech and white oak with an understory consisting mostly of black cherry, white mulberry, bittersweet, and honeysuckle. Forested wetlands crossed by the pipeline route are primarily located in bottomlands and floodplains adjacent to waterbodies and are dominated by black willow, red maple, sweet gum, black gum, pin oak, and ash.

Open areas located along the proposed pipeline route include undeveloped areas and existing utility and road rights-of-ways. Plant species such as stinging nettle, bristle foxtail, curly dock, pink knotweed, goldenrod, and blackberry are common. Shrub lands are also considered open areas and along the pipeline route are dominated by red maple, sweet gum, and willow.

The proposed pipeline would cross numerous emergent and scrub-shrub wetlands. The emergent wetlands are dominated by common reed grass, foxtail, deer tongue, switchgrass, rushes, and cattails. The scrub-shrub wetlands are dominated by willows, red maple, sweet gum, arrow wood, alder, foxtail, bushy bluestem, and locust.

Table 4.5-2 summarizes the impacts of pipeline construction and operation on each vegetative community. The Pennsylvania portion of the pipeline route is primarily composed of open and forest lands accounting for 9.4 acres and 17.8 acres, respectively, of the construction right-of-way and extra workspace. The New Jersey portion of the pipeline route is mostly composed of croplands and open

lands accounting for 50.8 acres and 25.6 acres, respectively, of the construction right-of-way and extra workspace.

TABLE 4.5-2

Acreage of Vegetative Communities Affected by Construction and Operation of the Logan Lateral Project a/

Facility	Forest Lands b/		Wetlands c/		Open Lands		Cropland d/		Totals	
	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.
Pennsylvania										
Pipeline Right-of-way	12.4	4.8	0.6	0.3	5.6	5.0	0.0	0.0	18.6	10.1
Temporary Extra Workspaces	5.4	0.0	<0.1	0.0	3.8	0.0	0.0	0.0	9.2	0.0
Aboveground Facilities	0.0	0.0	0.0	0.0	<0.1	<0.1	0.0	0.0	<0.1	<0.1
Pennsylvania Subtotal	17.8	4.8	0.7	0.3	9.4	5.1	0.0	0.0	27.9	10.1
New Jersey										
Pipeline Right-of-way	3.7	3.8	13.9	4.7	18.1	14.0	18.7	9.3	54.4	31.8
Temporary Extra Workspaces	1.9	0.0	1.9	0.0	7.5	0.0	31.7	0.0	42.9	0.0
Aboveground Facilities	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5
New Jersey Subtotal	5.6	3.8	15.8	4.7	25.6	14.0	50.8	9.7	97.8	32.3
Pipeline Facilities Subtotal										
Pipeline Right-of-way	16.1	8.5	14.6	5.0	23.7	19.1	18.7	9.3	73.0	41.9
Temporary Extra Workspaces	7.3	0	1.9	0.0	11.3	0.0	31.7	0.0	52.2	0.0
Aboveground Facilities	0.0	0.0	0.0	0.0	<0.1	<0.1	0.5	0.5	0.5	0.5
Pipeline Facilities Total	23.4	8.5	16.5	5.0	35.0	19.1	50.8	9.7	125.7	42.4

a/ Based on a 100-foot-wide construction right-of-way. Some areas would have a reduced construction right-of-way to avoid impacts on residential and wetland areas. Operation acreage is based on a 50-foot-wide permanent right-of-way in all areas except at road crossings and within roadways where the right-of-way width would be as permitted by the local agencies. Beginning at approximately MP 10, the pipeline right-of-way would be located within the proposed 175-acre LNG terminal site but does not overlap the 39 acres that would be permanently developed for the terminal facilities.

b/ Forest lands include both upland and wetland forest. In forested areas where portions of the existing right-of-way are used for both permanent and temporary right-of-way, the acreages for both open land (existing right-of-way) and forested (new right-of-way) have been determined and separated accordingly. Operation impacts on forest lands include those areas that will be maintained free of trees. Forested areas avoided by HDD are not included.

c/ Impacts on wetlands include those areas affected by construction and retention of a permanent right-of-way. These impacts do not include forested wetlands and farmed wetlands.

d/ Cropland impacts include farmed wetlands.

Const. Construction Impacts
Oper. Operation Impacts

Note: The totals shown in this table may not equal the sum of addends due to rounding.

During construction, existing vegetation would be temporarily removed from within the construction right-of-way and other necessary workspaces to facilitate the installation of the pipeline. The impact of clearing and the amount of time required for complete recovery of vegetation to pre-disturbance levels would depend on the size and age of the pre-existing vegetation. In general, impacts would be greatest in forest lands because they are more structurally complex than other vegetation types and take longer (perhaps 30 to 40 years) than other vegetation types to become reestablished to preconstruction conditions. In addition, as discussed below, trees would be prevented from growing on the permanent right-of-way by routine pipeline maintenance activities. Texas Eastern would avoid most impacts to forest land adjacent to Chester Creek and Raccoon Creek by using the HDD technique to

install the pipeline at these stream crossings; impacts on vegetation would be limited to a 3-foot-wide corridor cleared over the pipeline for a line-of-sight down the corridor.

The loss of vegetation could also have secondary impacts, including forest fragmentation and the loss of wildlife habitat. Other secondary impacts could include increased erosion, from the conversion of deep rooted vegetation to shallow rooted vegetation on the right-of-way and increased solar radiation, which could dry the soil and stimulate the growth of early successional species within and immediately adjacent to cleared areas. The removal of trees on the right-of-way could also expose trees growing adjacent to the newly cleared areas to higher levels of wind, which may increase the risk of blow downs. The majority of these effects would be minor and temporary and would diminish upon restoration and revegetation of the right-of-way.

In its comments on the draft EIS, the Department of the Interior expressed concern about the spread of invasive species, specifically *Phragmites* sp. and stated that control measures should be implemented in addition to the best management practices required by our Plan and Procedures. Specifically, the Department of the Interior recommended the following provisions be required in areas of wetland disturbance: 1) best management practices to prevent the introduction or spread of *Phragmites* sp., such as avoiding creation of elevated berms and the spread or burial of *Phragmites* sp. rhizomes; 2) 2 to 5 years of post-construction monitoring to detect the introduction or spread of *Phragmites* sp.; and 3) control efforts, if *Phragmites* sp. is detected, including grading or hydrologic corrections for any construction-related disturbances that promote the spread of *Phragmites* sp., if other control methods (i.e., herbicides) prove insufficient in the long term. As controlling the spread of *Phragmites* sp. is a regional initiative currently being pursued at the federal, state, and local levels, **we recommend:**

- **Crown Landing and Texas Eastern develop control plans to prevent the spread of *Phragmites* sp. in wetlands disturbed by the proposed projects that currently do not contain this species. These plans should include those measures recommended by the Department of the Interior, as applicable, and should be filed with the Secretary for the review and approval of the Director of OEP, <u>prior to construction</u>.**

Operation and maintenance of the proposed pipeline facilities would have additional effects on vegetation after site clearing and right-of-way restoration are completed. The pipeline right-of-way would be maintained in accordance with our Plan and Procedures and Texas Eastern's SESC Plan. Implementation of the measures provided in these Plans and Procedures would minimize potential long-term impacts by allowing annual maintenance of only a 10-foot-wide strip centered over the pipeline. Additionally, routine vegetation maintenance across the entire permanent right-of-way could occur only once every 3 years in uplands and would be restricted in wetlands to the periodic clearing of trees greater than 15 feet in height that are within 15 feet of the pipeline centerlines.

4.6 WILDLIFE AND AQUATIC RESOURCES

4.6.1 Wildlife Resources

The proposed LNG terminal site consists primarily of agricultural lands with small areas of open land, forest, shrub land, and wetland. The two active agricultural fields, which encompass most of the proposed area to be developed, provide foraging and cover habitat for mammals and birds; however, these fields provide limited breeding habitat since spring tilling and planting occur during the breeding season for most of the mammal and bird species that may use the site. Wildlife species that utilize active croplands in the project area include locally common species typical of agricultural lands in New Jersey such as the white-footed mouse, meadow vole, eastern cottontail rabbit, white-tailed deer, mourning dove, northern bobwhite, and ring-necked pheasant. Canada geese and white-tailed deer were observed foraging in these fields.

The open land at the LNG terminal site was previously used for farming but is now covered by old field vegetation. Typical wildlife that utilize open land habitat in the project area include cottontail rabbit, coyote, red fox, raccoon, opossum, common crow, rock dove, European starling, common grackle, field sparrow, Carolina wren, brown-headed cowbird, red-tailed hawk, and many species of rodents.

The three narrow bands of forest land on the site may provide more vegetatively and structurally diverse wildlife habitat than the agricultural fields and open areas. However, their small size reduces their suitability for many wildlife species. The microhabitat components (e.g., snags, cavities, downed wood, open water) of the forested areas provide breeding habitat for amphibians and birds. Birds likely to nest in these areas include riparian forest species such as downy and hairy woodpecker, American crow, red-eyed vireo, and great-crested flycatcher. Three amphibian species, spring peeper, gray tree frog, and bull frog, may breed in the open waters within the forested areas. The narrow forested and scrub-shrub wetlands along the drainage ditches and along the shoreline of the Delaware River also provide cover and foraging habitat for riparian wetland species such as the green heron, snowy egret, belted kingfisher, water shrew, white-footed mouse, and raccoon.

The LNG terminal site also includes intertidal and open water habitats associated with the Delaware River and Oldmans Creek. Aquatic species known to inhabit these waterbodies are described in section 4.6.2. No marine mammals (e.g., whales, dolphins, or seals) are known to travel this far up the Delaware River. Common mammals using the open water or coastal habitats of the river and creek include muskrat, mink, river otter, and raccoon. The shoreline habitats associated with the waterbodies also support a diverse assemblage of avian species, including shorebirds, wading birds, and waterfowl. Some of these bird species are year-round residents but most are migratory and spend only a portion of the year in the area.

Habitat types crossed by the proposed Logan Lateral route include remnant open land, wetland, open water, forest, shrub land, and agricultural land interspersed among developed commercial and residential areas.

The open land habitat consists primarily of existing utility rights-of-way and undeveloped land adjacent to residential and commercial/industrial areas. Wildlife associated with these areas is similar to those discussed for open land areas at the proposed LNG terminal site.

The wetlands that would be crossed by the proposed pipeline consist primarily of monotypic stands of common reed grass. These wetlands are often of little value to most wildlife due to the density of the vegetation and because they lack other native plants. Bird species that are known to nest in common reed grass include red-winged blackbird, common yellowthroat, swamp sparrow, marsh wren,

and black-crowned night-heron. Several waterfowl species are also known to use common reed grass for nesting sites and as nest material, including American black duck, Canada goose, ruddy duck, pied-billed grebe, American coot, and green-winged teal (Kane, 2001). Common reed grass also provides protective cover for turtles, snakes, and small mammals throughout the year; ducks during their flightless molting period in late summer; and resident wildlife species such as deer, foxes, coyotes, and raccoons in the winter.

The forested areas along the pipeline route consist of isolated second growth stands dispersed within developed areas and a larger forested area adjacent to Chester Creek. Common mammalian species that may utilize these forests for feeding, breeding, and cover include white-tailed deer, red fox, Virginia opossum, gray squirrel, flying squirrel, and striped skunk. Common bird species in these forests may include rufous-sided towhee, downy woodpecker, red-tailed hawk, screech owl, and tufted titmouse (Goodrich et al., 2003).

Aquatic habitats along the pipeline route include intertidal and open water habitats within the Delaware River and some of its tributaries such as Birch Creek, Chester Creek, and Raccoon Creek. Aquatic species known to inhabit these areas are described in section 4.6.2. Mammals associated with these open water areas are similar to those described for the open water areas at the LNG terminal site.

Sensitive or Significant Wildlife Areas

DNREC (2004a) expressed concern regarding a colony (referred to as a heronry) of nesting herons and other wading birds on Pea Patch Island. Pea Patch Island is located in the Delaware River about 15 miles downstream of the proposed LNG terminal site. Several thousand pairs of 10 species of heron, egret, and ibis nest on the island each year. In the late 1980s, this heronry supported over 12,000 nesting pairs. However, in recent years, only about 3,000 nesting pairs have been documented at the site. In an effort to identify causes of the decline and protect the heronry and the resource on which it depends, the DNREC Coastal Program has developed a Special Area Management Plan (DNREC, 1998) for the region surrounding the heronry.

The original Special Area Management Plan identified a 15-kilometer-radius area around the heronry as the primary area used for foraging by individuals nesting on the island. This original area extended to within about 6 miles of the LNG terminal site. A progress report issued in 2001 (DNREC, 2001) included an expanded heronry region that included about 1,500 square miles. The northern edge of the expanded region follows the boundary between New Castle County, Delaware and Delaware County, Pennsylvania, across the Delaware River to the Salem County – Gloucester County boundary in New Jersey. The LNG terminal site is located in the section of Gloucester County that is included in the expanded region.

Although the proposed project area occurs within the expanded heronry region, the original 15 kilometer radius likely captures the majority of critical foraging areas used by species nesting at the site. The proposed conversion of agricultural land to industrial land is not likely to affect the ability of foraging individuals to locate adequate food. The addition of LNG ships in transit to the LNG terminal would slightly increase the overall amount of ship traffic that passes the heronry, but the effect would be similar to the effects of other large ships that currently pass the island, and thus would not be expected to deter individuals from nesting at the heronry or result in long-term impacts on Pea Patch Island. The slight increase in ship traffic on the Delaware River also would not likely increase shoreline erosion on the island.

Potential risks of an accidental or intentional breach of an LNG ship during transit are discussed in section 4.12.5. Due to the low probability of an LNG release from a ship during transit, the heronry on

Pea Patch Island would be at low risk to be affected by an LNG ship accident. However, if a release and subsequent fire were to occur, while an LNG ship was transiting near Pea Patch Island, substantial fire damage to the heronry could occur, primarily involving the burning of vegetation on the island, including nest trees. Individual birds at the heronry would also likely be burned. If a release and fire occurred during the breeding season, the impacts would be magnified as the reproducing adults could be lost as well as the offspring from those adults. Between the loss of individuals and the loss of habitat at the site, the impacts of an LNG release and fire near the Pea Patch Island heronry could have substantial impact on the local population of wading birds using the site.

Wildlife Resources Impacts and Mitigation

Construction and operation of the Crown Landing LNG and Logan Lateral Projects would result in both short term and permanent alteration of wildlife habitat, directly impacting wildlife through disturbance, displacement, injury, and/or mortality.

Vegetation clearing necessary to construct the LNG terminal would reduce cover, nesting, and foraging habitat for some wildlife. Of the wildlife species present in the project area, the larger more mobile species would be temporarily displaced from the construction areas to similar adjacent habitats, where available. Because most of the project area is developed and fragmented, the area is not likely to support abundant wildlife populations. However, the developed nature of the project area also limits the amount of habitat that would be available to wildlife displaced by construction. It is expected that wildlife displaced by construction would return to the temporary construction areas and adjacent undeveloped habitats soon after completion of construction and the restoration and revegetation of disturbed areas. However, some individuals of less mobile species, such as small mammals, reptiles, and amphibians, as well as nesting birds located in the construction areas, could be injured or killed by construction activities.

Development of the terminal would convert approximately 35.4 acres of cropland to developed land. Additionally, the improvement and widening of the existing dirt road to provide access to the proposed LNG terminal would convert a small area of ruderal vegetation and roughly 1.7 acres of open land to impervious surface. While these areas provide only marginal habitat and, therefore, are unlikely to support much wildlife, any wildlife using the areas would be displaced to other habitats on the site or in the immediate vicinity. The construction of the containment dike around the LNG tanks could also alter or interfere with the movement patterns of some mammals, amphibians, and reptiles at the site, particularly between the southern portion of the site and Oldmans Creek and the Delaware River.

Construction of the liquid unloading pipeline between the pier and the LNG storage tanks and construction of the foundation for the flare would result in the loss of 1.5 acres of shrub and young deciduous forest along the existing berm that runs between the shoreline and the active cropland. The affected habitat provides limited wildlife value because it occurs in a narrow band (less than 20 feet wide) between the shoreline and the dirt access road, contains no mature trees, and supports abundant Japanese knotweed, an invasive species.

Construction of the Columbia Gas pipeline interconnection at the LNG terminal would result in the temporary disturbance of about 0.3 acre of wetland habitat on the western portion of the site. Wildlife species that inhabit the affected area would be temporarily displaced and required to compete with other species in adjacent areas for habitat requirements.

Operation of the low- and high-pressure flares at the terminal could pose a threat to raptors that like to use tall objects such as trees and power poles as perches. The flares would be incorporated into a 120-foot-high self-supporting stack and located within 150 feet of the Delaware River shoreline, which is

an area used by foraging raptors. In general, the risk of the flares to raptors would be minimal since use of the flare would be limited to emergency situations. To further reduce the risks to raptors and other birds, Crown Landing proposes to install perch guards on the flares to discourage or eliminate perching.

Wildlife would also be affected by construction of the Logan Lateral, which would require the clearing of about 23.4 acres of forested vegetation and result in the permanent conversion of 8.5 acres of forest land to commercial/industrial, herbaceous, and shrub cover types. The forest land adjacent to Chester Creek likely contains the most diverse and abundant terrestrial wildlife populations. Impacts on this area would be minimized by using the HDD method to cross the creek and by constructing the pipeline adjacent to an existing pipeline right-of-way. Forest habitat on the temporary construction right-of-way for the pipeline would be allowed to re-establish to preconstruction conditions following construction. However, it could take several years for tree saplings to become established and many decades before there are mature trees on the restored right-of-way

Generally, forest clearing can contribute to fragmentation, which has been shown to have an adverse impact on forest interior species. The project would not contribute significantly to forest fragmentation since most of the proposed facilities would be located in open non-forested areas and the majority of the pipeline would be adjacent to existing utility or road corridors. Additionally, Texas Eastern proposes to cross the large forested areas along Chester Creek and Raccoon Creek using the HDD method, which would avoid impacts on these areas.

The non-forested habitats that would be affected by construction and operation of the pipeline include wetlands, open land, agricultural land, residential areas, and open water. The impact of the proposed project on most of these habitats and associated wildlife species would generally be minor and short term. Following construction, these areas would be restored and, except for open water areas, revegetated.

To minimize the clearing of vegetated areas for construction activities, Texas Eastern proposes to install 16 percent of the pipeline within existing streets, use the HDD method to cross several waterbodies, and co-locate 58 percent of the pipeline with existing utility corridors. Furthermore, in areas designed for HDD, clearing of vegetation would be limited to that necessary to comply with operation and inspection under the FERC and DOT requirements.

The impact of the pipeline on birds and mammals using the shoreline and surface water habitats of the Delaware River and its tributaries is expected to be minor and temporary. Some birds may move away from the construction area but would return after site restoration. Impacts on Chester Creek, the Delaware River, Raccoon Creek, and Birch Creek are not anticipated because these areas would be crossed using HDD techniques. Potential impacts on pied-billed grebe habitat along Birch Creek are discussed in section 4.7.

Long-term impacts on wildlife resources along the pipeline route would be minimized by Texas Eastern's adherence to its SESC Plan and our Plan and Procedures. As discussed in section 4.5, these plans only allow annual maintenance of a 10-foot-wide strip centered over the pipeline. Routine vegetation maintenance across the entire permanent right-of-way could occur only once every 3 years in uplands and would be restricted in wetlands to the periodic clearing of trees greater than 15 feet in height that are within 15 feet of the pipeline centerline. To further protect nesting birds and in accordance with our Plan and Procedures, Texas Eastern would conduct routine vegetation maintenance only between August 1 and April 15, which is outside of the typical nesting season for most bird species.

4.6.2 Aquatic Resources

The proposed LNG terminal site is located on the Delaware River which is listed on the EPA's National Estuary Program (EPA, 2004). The salinity distribution in the Delaware River is primarily the result of saltwater inflow from the Atlantic Ocean and freshwater inflow from the Delaware River Basin. The mixing of salt and fresh water forms a salinity gradient that ranges from less than 0.5 ppt in the freshwater tidal portion of the Delaware River to about 32 ppt at the mouth of the Delaware Bay. This salinity gradient is not static, but is subject to change based on freshwater inflow, weather conditions, and other factors. Fish, benthic invertebrates, aquatic vegetation, and, to a lesser extent, wildlife distribute themselves within the Delaware River in accordance with their salinity tolerances (COE, 1997).

The riverine area near the project site (located at about RM 78) supports a warmwater fish assemblage that includes anadromous, resident, and catadromous species. The LNG terminal site is located in the oligohaline to freshwater transition zone. Salinity at the site typically ranges up to about 1 ppt.

New Jersey legally defines fisheries downstream of the Commodore Barry Bridge as marine fisheries (NJDEP, 2003b). However, NOAA Fisheries considers Oldmans Creek to be the upstream limit of saltwater intrusion (National Marine Fisheries Service (NMFS), 2003) and fisheries biologists with the NJDEP (2003c) indicated that the project area supports a tidal freshwater fishery. Therefore, for the purposes of regulating fishery resources at the state level, the fishery offshore of the LNG terminal site is considered marine, even though most of the species found there are more characteristic of freshwater environments.

Historically, the section of the Delaware River near the proposed LNG terminal site was considered heavily polluted due to upstream discharges. However, in recent years, water quality in the area has been improving. As water quality improves, the suitability of the general project area as potential spawning habitat increases. The discussion below of species occurring at or near the project site is based on current studies and recent literature. Future changes to water quality may alter species occurrence and distribution in this area.

Table 4.6.2-1 lists fish species that based on correspondence with resource agencies and/or field assessments are known to occur in or near the project area.

Three general types of aquatic habitat exist within the Delaware River at the LNG terminal site:

- open waters of the Delaware River ship channel, Marcus Hook anchorage, and the area between the anchorage and the subtidal shallows;
- intertidal and subtidal shallows; and
- benthic habitat.

TABLE 4.6.2-1

Representative Game and Commercial Fish Species Known to Occur in the Project Area

Common Name	Commercial Fishery	Recreational Fishery	Nursery and/or Spawning Habitat	Fishery Management Plans	Threatened or Endangered
Alewife			X	X	
American eel	X	X		X	
American shad			X	X	
Atlantic croaker				X	
Atlantic menhaden			X	X	
Atlantic sturgeon			X	X	State-listed endangered (Delaware and Pennsylvania)
Banded killfish	X				
Black crappie		X			
Blueback herring			X	X	
Brown bulhead		X			
Chain pickerel		X			
Channel catfish		X			
Golden shiner	X				
Hickory shad				X	
Norfolk spot				X	
Largemouth bass		X			
Redear sunfish		X			
Redfin pickerel		X			
Shortnose sturgeon			X		Federally endangered, state-listed endangered (New Jersey and Pennsylvania) and threatened (Delaware)
Smallmouth bass		X			
Striped bass		X	X	X	
Striped killfish	X				
White catfish		X			
White perch		X			
White sucker		X			
Yellow perch		X			

The open water habitat includes all of the waters channelward of the subtidal shallows. This habitat ranges from 4 feet deep to more than 40 feet deep at MLLW and is characterized by turbid, low-salinity (brackish) water over a substrate of fine sand and silt. Atlantic croaker, white perch, bay anchovy, hogchoker, channel catfish, and striped bass are the most abundant species using this habitat in the project area (O'Herron et al., 1994). The project area also provides habitat for Atlantic sturgeon, brown bullhead, white catfish, yellow perch, Norfolk spot, naked goby, and golden shiner. Most of these fish are polyhaline species, which can tolerate a wide range of salinities, and all are physiologically adapted to the natural variations in water quality and the general environmental conditions characteristic of the estuarine environments. Most of these species are also habitat generalists. Some of the smaller species, including hogchoker, naked goby, and bay anchovy, use both the deep open water and shallow water areas of the Delaware River.

The areas between the spring high water line to a depth of 4 feet below MLLW include both shallow water habitat (subtidal shallows) and areas exposed during low tide (intertidal shallows). Within the project area, the slope and width of the subtidal and intertidal zones is relatively uniform along the river and the substrate is a mix of sand, gravel, sparse cobble, and silt. The subtidal shallows extend an average of 550 feet channelward from the mean low water line and are characterized by moderate wave action, generally turbid conditions, and silt substrate. Based on several observations made during June, July, and August 2003, there is almost no aquatic vegetation within the offshore areas of the site area. Several smaller species of fish, such as eastern silvery minnow, banded killifish, tessellated darter, and mummichog are residents of the subtidal and intertidal shallows almost year round. Some of these species, particularly mummichog, are common in the tidal ditches. These species may exhibit a slight shift to deeper environments during winter, however, they rarely move significant distances during seasonal migration. Juvenile Atlantic sturgeon, striped bass, white catfish, channel catfish, yellow perch, white perch, Atlantic croaker, and Norfolk spot also utilize the subtidal zone, particularly in the summer months. Managed species that use shallow water habitat are discussed below in the Special Concern Aquatic Resources section.

The NJDEP (2003c) reported that there are no commercial shellfisheries in the project area. However, adult male blue crabs have been collected on industrial intake screens at RM 81.2, approximately 3 miles upstream of the project site. This data suggests that the project area may provide suitable habitat seasonally (during the summer) for blue crabs.

A study conducted by Crown Landing in 2003 revealed the presence of five major macroinvertabrate taxa in the Delaware River at the site: Bivalvia, Isopoda, Amphipoda, Oligochaeta, and Chironomidae. Asiatic clam (*Corbicula fluminea*) was determined to be the dominant species in the subtidal shallows. Data from the study revealed that the abundance of benthic macroinvertebrates is closely related to substrate condition, water quality, and macrohabitat features. The study also revealed that the species composition of the benthic community in the project area differs from benthic communities elsewhere in the Delaware River estuary in the following ways:

- the overall density of benthic macroinvertebrates at the project site is low when compared to densities elsewhere in the estuary, and is also low compared to the mean total density of organisms documented for Zone 5 (approximately 1,300 per square meter), which was the lowest for all five zones evaluated during the COE study in 1993[3]; and

- excluding the Asiatic clam, the overall biomass of the benthos at the project site is low when compared to biomass of benthos across all five zones documented by the COE (1993).

In addition to those species identified in the project area during project-specific surveys, the DNREC reported that the common rangia (a brackish water bivalve) is likely to occur at the site and has been documented both upstream and downstream of the proposed LNG terminal site.

Oldmans Creek constitutes the only tidal creek habitat near the project site. The creek is generally turbid, has a silt or sand bottom, extensive vegetated shallows, and lacks significant bathymetric complexity. Numerous small tidal streams and ditches on the LNG terminal site flow into Oldmans

[3] The COE conducted a study in 1993 of the benthic habitats in the Delaware River estuary between the C&D Canal (near RM 59) and Trenton, New Jersey (near RM 133). This study stratified the river into five zones, each with three physical habitat types (intertidal zone, shallow intermediate habitat, and navigation channel), and evaluated the biomass, species composition, and relative density of benthic macroinvertebrates within each zone and physical habitat type. The proposed LNG terminal site occurs near the upriver boundary of Zone 5 of the COE's study (COE, 1993).

Creek. These streams and ditches have mud or sand bottoms and generally lack significant aquatic vegetation. The proposed project would not directly impact any of these waterbodies.

The proposed pipeline route runs perpendicular to the Delaware River in Pennsylvania and parallel to the Delaware River in New Jersey. The pipeline route crosses eight perennial waterbodies. The largest of these is the Delaware River, which would be crossed using HDD techniques. Chester Creek (about 105 feet wide), Raccoon Creek (about 300 feet wide), and Birch Creek (about 50 feet wide) would also be crossed using HDD techniques to avoid impacts on the waterbodies and adjacent wetlands. The four other streams that would be crossed by the pipeline are Baldwin Run, which is a tributary to the Delaware River, and three unnamed tributaries to Oldmans Creek. Texas Eastern currently proposes to cross all four of these waterbodies using open-cut construction methods. Because these latter waterbodies have limited fisheries and the in-stream pipeline construction activities would be temporary, the aquatic resources in these streams would not be adversely affected by the proposed project.

Special Concern Aquatic Resources

There are no exceptional or rare recreational fisheries in the project area, but there are two protected fish species that may occur in the waterbodies that would be affected by the project (see section 4.7). Aquatic areas near the project have been identified as spawning and/or nursery habitat and commercial and recreational fisheries for several finfish species (see table 4.6.2-1).

The Upper Delaware River provides key spawning and nursery habitat for the American shad along its entire length. The LNG terminal site is located within a section of the Delaware River considered as a critical nursery area for striped bass and the general project vicinity is considered the primary spawning grounds for the Delaware River stock of striped bass. Tyrawski (1979) also found that the Marcus Hook area on the opposite side of the river as the project site has high densities of anadromous fish larvae from April through June. The value of subtidal shallows as nursery habitat for young finfish generally relates to the abundance of food in these areas and availability of refuge habitat. The abundance of macroinvertebrates is a direct indication of the availability of food for the juvenile fish. Studies conducted for the project indicate that macroinvertebrates are not abundant in the shallow areas surrounding the LNG terminal site. The subtidal shallows in the project area may provide limited refuge from large predatory fish due to the extremely shallow depths and the nearly complete lack of submerged aquatic vegetation, woody debris, and other large habitat features. However, shallow water and the lack of structure in the area also increase the vulnerability of juvenile fish to avian predators. Therefore, the limited availability of food and lack of refuge habitat likely limits the value of subtidal shallows in the area as nursery habitat. Juveniles of several of these predatory species are also commonly found in near-shore open water and, to a lesser extent, deepwater, especially in the upper reaches of the Delaware River estuary.

The American eel is the only true catadromous fish (a species that spawns in the ocean but completes most of its life cycle in fresh water) that may occur in the project area. Several age classes of eels could be present at any given time. Like many of the fish discussed above, the American eel is a habitat generalist and, thus may occur in both deep and shallow water.

Aquatic Resources Impacts and Mitigation

<u>LNG Terminal Construction</u>

<u>Dredging</u>

The proposed LNG terminal was to initially require dredging of about 800,000 cubic yards (approximately 27.4 acres) of material from the Delaware River to create a berth for the LNG ships.

However, Crown Landing subsequently revised its project design for safety and security reasons, specifically changing the berth layout to include upstream and aft sheet piles and a stabilized soil terrace on the downriver side of the berth. This change in berth layout and configuration increased the amount of proposed dredging to 1.24 million cubic yards. In addition to the berth, the project would require construction of an approximate 2,000-foot-long pier that would be supported by approximately 80 steel pilings, each 3 feet in diameter. Dredging in the vicinity of the pier would result in the conversion of existing subtidal shallow water habitat to deeper, channel-like habitat. This dredging would directly impact up to 30.3 acres of benthic habitat and result in a net loss of approximately 9.7 acres of subtidal shallow habitat and a net gain of 9.7 acres of deep channel habitat.

The conversion of 9.7 acres of subtidal shallow habitat to deepwater habitat could affect most of the resident species within the project area to some degree. NOAA Fisheries, NJDEP, and DNREC expressed specific concerns about the potential impacts of this habitat loss on spawning adults (primarily striped bass) and migrating anadromous fish within the Delaware River. These agencies have indicated that mitigation would be necessary to offset the loss of shallow water habitat and its permanent conversion to deepwater habitat. NOAA Fisheries recommended that mitigation should involve creation of shallow water habitat from uplands in the vicinity of the proposed project area at a ratio of 1:1. NOAA also recommended that construction work for mitigation should occur concurrently with dredging activities. Crown Landing coordinated with the applicable resource agencies to develop a conceptual mitigation plan for potential impacts on shallow water habitat. This plan included creating subtidal shallows by excavating a portion of the existing berm between Oldmans Ditch and Oldmans Creek. However, Crown Landing's mitigation plan only accounts for the loss of subtidal shallows within the footprints of the LNG pier piles and sheet piles and the loss of subtidal shallows within the footprint of the stormwater outfall. This plan does not take into account the conversion of approximately 9.7 acres of shallow water habitat to deepwater habitat through dredging of the terminal berth. Thus although Crown Landing has better defined its proposed mitigation measures for impacts on shallow water habitats, because the mitigation plan does not include measures to account for all impacts on subtidal habitat nor has it been finalized or approved by the appropriate agencies, **we recommend that:**

- **Crown Landing continue coordinating with NOAA Fisheries and other applicable agencies in developing a plan to mitigate for impacts on shallow water habitats. The plan, along with agency consultation, should be filed with the Director of OEP for review and approval <u>prior to initiating dredging activities in the Delaware River</u>.**

The dredging of the ship berth may adversely affect fish and fish habitat. Potential adverse effects on fish and fish habitat include impairment of water quality, destruction of benthic habitat, and direct and indirect effects on fish and their prey species. The extent of these effects depends on project timing and duration, sediment texture and composition, and fish life stage and behavior.

The water quality of the Delaware River is currently degraded by upstream discharges and runoff. The proposed dredging could contribute to further degradation of water quality through increases in turbidity, releases of chemical and nutrient pollutants from sediments, and introduction of chemical contaminants. Turbidity resulting from the suspension of sediments would reduce light penetration and the corresponding primary production of aquatic plants, algae, and phytoplankton. Additionally, the suspension of organic materials and sediments could cause an increase in biological and chemical use of oxygen, resulting in a decrease of dissolved oxygen concentrations in the affected area. Lower dissolved oxygen concentrations could cause a temporary displacement of motile organisms and may stress or kill sessile benthic organisms within the affected area.

Dredging activities would result in the disturbance of about 30.3 acres of benthic substrate in the Delaware River. As previously indicated, there is no commercial shellfishery or abundance of

commercially important shellfish species in the project area. Project dredging would primarily affect the Asiatic clam, as well as various oligochaetes, amphipods, and isopods. These benthic invertebrates are a food source for demersal species of finfish during part or all of their life cycles. The benthic macroinvertebrate data collected at the project site for the channel and shallow water areas suggest that the species composition of the benthic communities in both areas is impoverished and similar. Additionally, the relative importance of the major taxa in terms of biomass in the shallow water area and the channel is nearly identical.

The direct alteration of the benthic substrate via dredging would remove the existing benthic community and may adversely affect finfish through loss of or changes in prey species abundance or availability. However, pioneering benthic invertebrates would likely colonize the dredged area soon after completion of dredging. Also, conversion of shallow benthic habitat to deeper, channel-like benthic habitat would not likely alter the benthic community in the project vicinity.

Dredging also has the potential to introduce deleterious compounds currently in the bottom sediments (e.g., metals) into the water column. In addition to potentially causing behavioral responses in fish, certain chemical contaminants could have acute and/or chronic growth and physiological effects in fish. To evaluate these risks, Crown Landing performed a sediment characterization study that analyzed a number of organic and inorganic chemicals in the sediments. We compared the average concentrations of these chemicals to ecologically risk-based screening criteria to assess the potential hazard of the sediments on the aquatic environment. The results of this analysis showed eight metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) with detectable concentrations in the sediment samples collected from the proposed dredging area. All of these metals were detected at concentrations below the PEL (i.e., below the value at which adverse biological effects are frequently expected), suggesting that no adverse effects on aquatic resources are likely from the resuspension of the sediments. A detailed discussion of the study and its results are provided in section 4.2.2.

In addition to potentially releasing deleterious compounds into the water column, suspended sediments could have direct and indirect physical effects on pelagic and benthic communities in the Delaware River. Direct impacts could result from the exposure to sediment particles and indirect impacts could result from habitat alteration caused by sediment deposition. Crown Landing's proposal to primarily use a hydraulic dredge would only minimally increase suspended sediments, thus impacts from sediment suspension and/or subsequent sediment deposition are not expected to result in long-term or substantial effects on aquatic resources near the project area.

Dredging could affect all life stages of the smaller, common resident species (e.g., eastern silvery minnow, banded killifish, tessellated darter, and mummichog), juveniles of the large resident species, and juveniles of anadromous species. However, the larger polyhaline species, such as brown bullhead, white catfish, channel catfish, yellow perch, white perch, Norfolk spot, and Atlantic croaker, are more commonly found in deep, open-water habitats. Thus dredging associated with the project would likely have only a limited effect on the adults of these species as they would be able to use the deep habitat created by the dredged berth.

Use of a hydraulic dredge would reduce turbidity and sedimentation associated with dredging and limit the extent of impacts on aquatic resources. However, dredging could entrain or impinge juvenile fish, fish larvae, and eggs during certain times of the year. To address this potential impact, resource agencies have recommended that Crown Landing adhere to specific dredging windows. In response to these recommendations and to protect anadromous fish during fish migration and spawning, Crown Landing revised its dredging schedule to avoid dredging and other in-stream construction activities from March 15 to August 1.

Pier Construction

The pier for the ship unloading facility would be supported on approximately 80 steel pilings, each 3 feet in diameter and 100 to 120 feet long. The pier and unloading platform would be constructed over about 2.4 acres of riverbed. Construction of the pier and breasting dolphins would result in a direct loss of approximately 1,900 square feet (0.04 acre) of benthic substrate within the footprints of the individual pilings, of which 1,800 square feet would occur in the intertidal or subtidal shallows.

The pier would be constructed using driven steel piles, which would produce sound waves that could injure fish. The degree to which an individual fish exposed to sound waves would be affected is dependent upon variables such as the peak sound pressure level and frequency as well as the species, size, and condition of a fish (e.g., small fish are more prone to injury by intense sound waves than are larger fish of the same species). In some cases, sound pressure levels greater than 155 decibels can illicit avoidance behaviors or stun small fish (NOAA Fisheries, 2003). Sound levels greater than 190 decibels are thought to physically injure some fish (Hastings, 2002). The presence of predators can also influence how a fish might be affected by pile driving (e.g., fish stunned by pile-driving activities may be more susceptible to predators). The intensity of the sound pressure levels produced during pile driving depends on a variety of factors including, but not limited to, the type and size of the pile, the firmness of the substrate into which the pile is being driven, the depth of water, and the type and size of the pile-driving hammer.

It is anticipated that the majority of the piles would be installed with a Delmag D46-32 diesel impact hammer. Each pile would take approximately 5 hours to install. However, the actual driving time per pile would only be about 30 to 45 minutes depending on the load criteria and the soils encountered. Additional time would be required for barge positioning, pile handling, and bracing for the batter piles. The entire pile driving operation would take about 6 to 8 months to complete.

Driving tubular steel piles with an impact hammer in similar settings has been shown to generate sound levels from 192 to 194 decibels[4], which are above the level that is thought to injure some fish. Depending on the specific conditions at the site, these sounds can have a transmission loss rate of 0.021 to 0.046 decibels per foot (Nedwell and Edwards, 2002; Nedwell et al., 2003). Based on these values, the use of an impact hammer during construction of the proposed ship unloading facility could generate underwater sound levels of 190 decibels as far as 190 feet from a steel pile and sound levels of 155 decibels as far as 1,860 feet from a steel pile. Although the sound waves of the greatest intensity would be limited to the immediate vicinity of the piles, sound levels of 155 decibels could extend out into the Delaware River while piles for some of the mooring dolphins are being driven.

Driving hollow steel piles with impact hammers produce intense, sharp spikes of sound that can injure fish. In some cases, fish may be startled by the first few strikes of an impact hammer. However, this response can wane and the fish may remain in the area (NOAA Fisheries, 2001). As such, the potential effect on fish from impact hammers could be magnified because fish would not only be exposed to intense sound waves but may not avoid pile-driving activities, which would prolong their exposure to the potentially harmful sounds and increase their risk of injury or death.

Although some fish may become acclimated to certain sounds, acoustic disturbance could cause other fish to avoid the construction area. If pile installation occurred during anadromous fish migrations, the avoidance of the nearshore areas could restrict migrating fish to deepwater areas that are less suitable for some species, which could in turn increase the susceptibility of some smaller species to predation. Although given the small area that would be affected by acoustical disturbance, it seems unlikely that

[4] All sound levels are expressed as decibels at a reference pressure of 1 micropascal.

these effects would substantially alter migration patterns, the relationship of predator or prey species, or their abilities to find shelter or forage. Additionally, Crown Landing has committed to avoiding construction activities in the Delaware River between March 15 and August 1 to avoid impacts on migrating and spawning fish species. In comments on the Waterfront Development Application, the New Jersey Division of Fish and Wildlife (NJDFW) reported that timing restrictions imposed upon in-stream work in the Delaware River may be sufficient for addressing impacts from hydroacoustic affects. Nonetheless, because the area is considered a critical nursery area for anadromous fish species and both federally and state-listed fish species are known to occur in the area (see section 4.7), **we recommend that:**

- **Crown Landing consult with federal and state agencies to determine the need for additional measures to further avoid or minimize impacts on aquatic resources as the result of pile-driving activities. Copies of consultations with these agencies should be filed with the Secretary <u>prior to construction</u>.**

The bottom of the pier deck and unloading platform would be approximately 25 feet above the surface of the water, depending on tidal fluctuations, and would shade a total of approximately 2.25 acres of intertidal, subtidal, and open-water habitat. Predatory species, especially those that forage primarily by sight, are often sensitive to intense sunlight and seek shade or deeper water during periods of intense sunlight. The aquatic habitat in the Delaware River is almost completely devoid of aquatic vegetation in the offshore area of the site and lacks shaded areas where fish can avoid direct sunlight during the day. Shading of the area underneath the pier could enhance the habitat for predatory species, such as striped bass and other species that avoid intense direct sunlight during the day.

Construction of the pier and the marine dolphins could increase the complexity of the aquatic habitat, provide an additional hard substrate for colonization by sessile aquatic organisms, and provide eddy habitat downstream of the pilings that could be used by resident and migrating fish species during high flow periods. Blueback herring and American shad could utilize the shallows for nursery habitat because they do not specifically require vegetation for shelter.

<u>Other Potential Impacts</u>

Construction of the onshore portions of the LNG terminal would temporarily increase erosion, stormwater runoff, and the potential for sediments to reach the Delaware River. If uncontrolled, this sediment could degrade water quality, increase turbidity, affect fish usage of the affected area, and smother aquatic life, especially benthic invertebrates. To minimize the effects of erosion and sedimentation on the river, Crown Landing would construct the facility in accordance with our Plan and its SESC Plan.

Stormwater runoff during operation of the LNG terminal also has the potential to adversely affect water quality and thereby indirectly affect aquatic life. To minimize this potential impact, Crown Landing proposes to construct a permanent stormwater management system at the LNG terminal site in accordance with the New Jersey Stormwater Management Manual (NJDEP, 2004b).

Direct spills of petroleum products into the Delaware River from construction equipment could be toxic to fish. To reduce the potential for direct surface water contamination during construction and dredging, Crown Landing would implement a SPCC Plan. This plan would include provisions that prohibit the storage of fuel and other potentially toxic materials within specified distances of waterbodies and procedures to minimize potential spills during the refueling of equipment. This plan would also outline procedures for containing, cleaning up, and reporting spills.

LNG Terminal Operation

Natural river sedimentation would occur within the LNG ship berth. It is estimated that 60,000 to 90,000 cubic yards would be deposited annually. Crown Landing anticipates annual maintenance dredging would be required to remove the sediment from the ship berth. The dredged material would be disposed of at the Weeks Marine disposal facility, which is also proposed for initial dredged material disposal. This facility reportedly has capacity to handle maintenance dredged material for many years. Impacts associated with annual maintenance dredging would be similar to those described above for initial dredging activities, but would occur on a shorter and smaller scale compared to initial dredging operations.

The NJDFW and NOAA Fisheries expressed concern about the proposed ship berth functioning as a collection basin for eggs and larvae transported by tidal movements from adjacent shallow water habitats and the potential for higher rates of entrainment, impingement, or loss of these organisms during ballast water intake from within the proposed ship berth. In response to these concerns, Crown Landing modified its proposed berth design. Specifically, Crown Landing is proposing to install a stabilized soil terrace on the downriver side of the berth pocket instead of sheet piling; the upstream and shoreline sides of the berth would still be contained with sheet-pile walls. The terrace would be approximately 85 feet wide at the base and 22 feet tall and would extend approximately 820 feet along the edge of the berth. This terrace would allow for tug maneuvering in the area as the tugs have a shallower draft than the LNG ships. The use of a terrace on the downriver side also provides the possibility that ichthyoplankton may more readily float freely through the berth pocket and reduces the hydrological conditions that could potentially lead to ichthyoplankton collection within the basin.

During operation of the LNG terminal, prop wash from LNG ships and tugs could temporarily increase suspended sediments and turbidity within the ship channel and ship berth. As a vessel navigates through a waterway, it generates hydraulic disturbances in the form of waves and currents, mainly drawdown, return current, slope supply currents, wash waves, and jet wash (Wolter and Arlinghaus, 2003). These activities have the potential to suspend and redeposit sediments similar to but not necessarily on the same scale as dredging.

Modeling was conducted for the Boston Harbor Navigation Improvement Project to assess the effect of ship passage on the resuspension of surface sediments in a federal ship channel (COE, 1995). The modeling was developed based on the post-dredging dimensions of the channel and information collected during interviews with pilots regarding the operation of various types of vessels. The analysis modeled the effects of an LNG ship, a container ship, a 41,000 ton displacement weight tanker, an ocean tug, and a harbor tug. The modeling assumed a channel depth of 45 feet and varying vessel drafts from 12 to 42 feet. The study concluded that silt, the predominant grain size of the surface sediments assessed in the model, can be resuspended by currents as slow as 0.65 feet per second. The study also found that bottom velocities generated by cargo vessels passing at slow speeds through the harbor can exceed this value up to 1,312 feet astern of the vessel and that tugs can generate bottom velocities above this value up to 656 feet astern of the vessel. Ship turning areas were found to be particularly susceptible to this influence. The COE modeling results indicated that the surface sediments in the federal channels and berth areas are subject to resuspension during essentially every ship passage. Thus impacts associated with prop wash would occur more frequently than dredging since 100 to 150 ships may berth at the proposed LNG terminal annually. However, the results of the modeling also indicated that ship-induced bottom velocities dissipate rapidly following the passage of the ship and that sediments resuspended by these currents settle back to the substrate after being transported relatively short distances, suggesting that the substrate and water column would return to ambient conditions during periods between ship passages.

Prop wash could also affect the substrate within and adjacent to the navigation channel and could limit the recolonization of benthic species in those areas. Vessel propellers also have the potential to directly strike fish species that use the navigation channel and proposed ship berth. Adult Atlantic sturgeon have been found along the shoreline of the river that have been killed by vessel propellers (DNREC, 2004a). Potential indirect effects of vessel movement through the waterway could include disturbances preventing fish from nest-guarding (Mueller, 1980; cited in Wolter and Arlinghaus, 2003) or feeding (Barrett et al., 1992; cited in Wolter and Arlinghaus, 2003), and dislodgement of eggs and redistribution of eggs and larvae in less suitable habitats (Hofbauer, 1965, Jude et al., 1998; cited in Wolter and Arlinghaus, 2003). Obstructing nest-guarding behavior and dislodgement and redistribution of eggs into less suitable habitats could lower the reproductive success of affected fish species.

LNG ships calling from international ports could potentially introduce aquatic invasive species into U.S. waters. Alternatively, visiting LNG ships could transport native species to other parts of the world. Although the potential for this to occur cannot be entirely eliminated, several factors, both general and specific to the project, tend to mitigate this potential impact. First, LNG ships would not discharge ballast water into the Delaware River, which would significantly reduce the potential to spread invasive aquatic species. Second, the LNG ships that would visit the proposed terminal would arrive from ports located primarily throughout the Atlantic region, which is also where the project is located. Third, Delaware River is not a new port and ships of all types originating from different ports have and will continue to visit the Delaware River. Fourth, legislation is currently being considered by the U.S. Senate that would require all ships entering U.S. ports to have on board an aquatic species management plan outlining actions to minimize the transfer and introduction of invasive species. Finally, in February 2004, a new international convention to prevent the potentially devastating effects of the spread of harmful aquatic organisms carried by ships' ballast water was adopted by the IMO, the United Nations agency responsible for the safety and security of shipping and the prevention of marine pollution from ships. The Convention will require all ships to implement a Ballast Water and Sediments Management Plan. All ships will have to carry a Ballast Water Record Book and will be required to carry out ballast water management procedures to a given standard. Existing ships will be required to do the same, but after a phase-in period. With the adoption of this Convention, the IMO has made global provisions to control and manage ships' ballast water and thus prevent, minimize, and eliminate the transfer of harmful aquatic organisms and pathogens.

LNG ships are equipped with a ballast water system that pumps water into ballast tanks as cargo is unloaded. The maximum ballast demand for a 138,000 m^3 and 200,000 m^3 LNG ship is about 13.7 million gallons and 19.8 million gallons, respectively. Typical LNG ships have three ballast water intakes, each with ballast pumps rated at 3,000 m^3/hr. Two of the pumps are generally operated during ballasting with the third as a back-up in case of failure of one of the primary pumps. The average intake rates are about 5,200 m^3/hr for a 138,000 m^3 ship and about 7,500 m^3 for a 200,000 m^3 ship. Thus intake rates for the 138,000 m^3 and 200,000 m^3 ships are generally about 23,000 gpm and 34,000 gpm, respectively. However, Crown Landing proposes to extend ballast water intake withdrawals for LNG ships at the terminal to a 12-hour period which reduces the intake rate for the proposed project to about 11,000 gpm. The total area of the two lower intake openings is 3.55 square meters. Openings are protected by bar-type grids having 4.5 mm bars spaced 25 mm apart, reducing the clear flow area to 2.36 square meters. The highest and lowest points of the openings are about 8.4 and 9.5 meters below the ship’s waterline, respectively.

LNG ships would unload LNG at the proposed terminal up to about 150 times annually and during all seasons. Although each ship could require up to about 13.7 million gallons of ballast water (for a 138,000 m^3 ship), Crown Landing has indicated that it would minimize the amount of ballast water withdrawal (approximately 8 million gallons) needed for ship stability while moored at the ship berth. Nonetheless, since data are currently not available showing differences in ichthyoplankton density at the

proposed terminal site compared to the ship channel, regardless of where the total ballast water volume is withdrawn, it is likely that any ballast water intake in the Delaware River would result in the entrainment, impingement, or loss of aquatic resources, especially larvae and eggs.

To assess the potential impacts of ballast water withdrawals on fish populations within the Delaware River, we reviewed data included in a Delaware River case study (EPA, 2002) and used in the EPA's analysis of potential impacts from cooling water intake structures within the Delaware River system. In the case study, actual impingement and entrainment data were available only for the Salem Nuclear Generating Station. The EPA extrapolated potential impingement and entrainment losses at other facilities withdrawing water from the Delaware River system using the actual data from the Salem facility. One of the facilities the EPA estimated potential impacts for was the Logan Generating Station, which is located immediately adjacent to the proposed LNG terminal site. The Logan Generating Station withdraws about 730 million gallons annually from the Delaware River. Using a simple extrapolation formula based on volume of water withdrawn and assuming a maximum of 150 138,000 m^3 ships would unload cargo at the LNG terminal annually, each requiring 13.7 million gallons of ballast water, for a total annual water withdrawal volume of about 2.1 billion gallons, we estimated annual fish losses from ballast water intakes associated with operation of the proposed LNG terminal (see table 4.6.2-2). Although the potential exists for Crown Landing to utilize 200,000 m^3 LNG carriers, which would withdraw more water per ship, ships of that size would unload at the terminal less frequently than 138,000 m^3 ships. Thus total annual withdrawals for ballast water for 200,000 m^3 carriers would be similar to ballast water volumes withdrawn for 138,000 m^3 carriers. In addition to water withdrawn for ballast, LNG ships may also withdraw water for cooling the ship boilers. The specific volumes needed for this operation are not available; however, based on the limited annual LNG ship traffic, it would not result in appreciative impingement and entrainment impacts beyond what is described for ballast water.

As shown in table 4.6.2-2, annual ballast water intake is estimated to impinge or entrain the equivalent of about 1.2 million age-1 fish, would reduce fish harvest by over 33,000 pounds, and would result in over 154,000 pounds of production foregone. Although when compared to other existing facility intake related losses along the Delaware River (see table 4.6.2-2), the impacts associated with ballast water intake by LNG ships at the proposed LNG terminal would account for about 0.2 percent of the total loss of fish species and thus would not likely result in adverse population level effects on managed species, other recreationally important fish species, or forage species. These estimates do not take into account the entrainment losses that currently result from ballasting of other ships on the Delaware River. Additionally, these estimates assume that ichthyoplankton are relatively evenly distributed throughout the water column when in effect, it is more likely that ichthyoplankton densities are higher at the surface and lower at the depth of the ballast water intakes, thus revising this number downward to some degree. Despite the estimated magnitude of potential entrainment and impingement losses associated with ballast water withdrawals when compared to other losses of fish in the Delaware River, in comments on the draft EIS, NOAA Fisheries, FWS, NJDEP, and DNREC continued to express concern about impact levels and reiterated the need for consideration of additional mitigation measures. Thus in response to those continued concerns and because the area is considered a critical nursery area for anadromous fish species and both federally and state-listed fish species are known to occur in the area (see section 4.7), **we recommend that:**

- **Crown Landing continue to consult with federal and state agencies to determine the need for mitigative measures to avoid or minimize impacts on aquatic resources as the result of LNG ship ballast water intakes. Copies of consultations with these agencies should be filed with the Secretary <u>prior to construction</u>.**

TABLE 4.6.2-2

Estimate of Potential Impacts on Selected Fish Species in the Delaware River as the Result of Ballast Water Withdrawal by LNG Ships Unloading Cargo at the Proposed LNG Terminal a/

Fish Species	Age-1 Equivalents (individuals) b/	Yield Lost (pounds) c/	Production Foregone (pounds) d/
Alewife	42	0	39
American Shad	3	0	28
Atlantic Croaker	54,043	11,004	30,722
Atlantic Menhaden	7,630	3,830	666
Bay Anchovy	956,693	0	22,912
Blue Crab	5,561	176	1,036
Blueback Herring	185	0	101
Silverside	350	0	0
Spot	78,322	8,772	21,140
Striped Bass	1,456	2,022	10,489
Weakfish	4,287	3,368	12,292
White Perch	4,287	6	1,137
Non-RIS Fishery Species e/	45,800	4,091	52,746
Non-RIS Forage Species e/	27,202	0	978
Estimated Total Entrained by LNG Ships	1,185,861	33,269	154,286
Estimated Total Entrained by Delaware River Facilities (EPA, 2002) f/	630,733,201	16,679,018	61,215,570

a/ Assumes a maximum of 150 LNG ships would unload cargo at the proposed LNG terminal annually and that each ship would intake about 13.7 million gallons of ballast water .

b/ "Age-1 Equivalents" are the number of impinged and entrained individuals that would otherwise have survived to be age-1 plus the number of impinged individuals which are assumed to be impinged at age 1.

c/ "Yield Lost" is a measure of the amount of fish or shellfish that is not harvested because the fish are lost to impingement and entrainment.

d/ "Production Foregone" is the expected total amount of future growth of individuals that would be impinged or entrained had they not been impinged or entrained. Foregone production for forage species is used to estimate the subsequent reduction in harvested species yield that results from a decrease in the food supply.

e/ RIS are "recreationally important species" as defined by EPA (2002). See EPA (2002) for a list of species in these categories.

f/ This estimation includes 12 other currently operating facilities along the Delaware River. See EPA (2002) for additional details on these facilities.

Pipeline Construction and Operation

In general, pipeline construction results in temporary impacts on streams and rivers, and there are no long-term effects on water temperature, pH, dissolved oxygen, benthic invertebrate populations, or fish populations (Vinkour and Shubert, 1987; Blais and Simpson, 1997). Some potential impacts on fishery resources, such as sedimentation and turbidity, destruction of stream bank cover, introduction of water pollutants, or entrainment of fish could result from construction activities. Overall, the impact of construction on fish and other aquatic organisms is expected to be localized and short term. To minimize these potential impacts, Texas Eastern proposes to install the pipeline across Chester Creek, Delaware River, Raccoon Creek, and Birch Creek using the HDD method, if feasible. The use of this method would avoid direct disturbance of these waterbodies and should allow construction to occur without timing restrictions. Texas Eastern would also adhere to the protective measures for crossing waterbodies outlined in its SESC Plan, our Procedures, and other federal, state, or local agencies permit requirements.

Sedimentation and Turbidity

Increased sedimentation and turbidity as the result of construction activities have the greatest potential to adversely affect fishery resources. Sedimentation is known to bury demersal fish eggs, while turbidity affects juvenile and adult fish by reducing oxygen uptake by the gills. In-stream turbidity levels generally increase during construction but decrease rapidly after construction activities are completed (Vinkour and Shubert, 1987; Blais and Simpson, 1997). Turbidity also reduces photosynthesis of aquatic vegetation, which results in reduced dissolved oxygen levels in the water column.

Standard open-cut crossing techniques as proposed for portions of this project could elevate the concentration of suspended solids, but the elevated levels would be high for relatively short periods and short distances downstream of the stream crossing. In addition, increased sedimentation may affect fish nesting sites and areas where eggs and young fry concentrate, and may reduce access to some food sources. In the immediate area of disturbance, if construction occurs during the spawning period or immediately after, fish reproductive activities would be affected due to temporary destruction of spawning areas, disturbances to fish, and reduced egg survival from increased sedimentation. In compliance with our Procedures, Texas Eastern would complete in-stream construction within a 24-hour period at each minor waterbody. Therefore, impacts would be temporary, and suspended sediment concentrations would be expected to return to preconstruction levels soon after construction in each stream is completed.

Impacts on fisheries from construction-induced sedimentation and turbidity would be reduced to short-term, temporary disturbances by implementing the measures contained in our Procedures. For the waterbodies that would be crossed using the open-cut construction method, trench spoils would be stored on or above the stream banks. Waterbodies would be protected with silt fence, hay bales, or other erosion control devices that would minimize the potential for sediment-laden water to enter the stream. Additionally, in accordance with our Procedures, all staging areas would be located at least 50 feet back from the water's edge where topographic conditions permit (unless otherwise permitted). This setback distance would reduce the loss of riparian vegetation and minimize the potential for erosion and sedimentation along the stream banks.

Loss of Cover

Stream bank vegetation, in-stream logs and rocks, and undercut banks provide important cover for fish. Some in-stream and shoreline cover would be altered or lost at open-cut stream crossings, and fish that normally reside in these areas would be displaced. However, these effects would be relatively minor because of the small area affected at each stream. In addition, our Procedures limit vegetation maintenance on stream banks and require long-term revegetation of all shoreline areas with native herbaceous and woody plant species, except for a 10-foot-wide corridor over the pipelines maintained with herbaceous species.

Minimal impact on fisheries is expected from maintenance mowing or manual removal of woody vegetation in the vicinity of the pipeline rights-of-way. Vegetation control would be conducted solely by mechanical means. No herbicides, which could be transported to nearby aquatic resources, would be used.

Other Potential Impacts

Other potential effects of pipeline construction include interruption of fish migration and spawning and mortality from toxic substance (e.g., fuel) spills. Construction may cause temporary emigration of fish populations from the immediate area, and fish movements and migrations upstream or

downstream may be temporarily disrupted by construction activities. However, it is unlikely that relocation or disrupted migration would significantly affect fish populations because construction would be a short-term activity and the waterbodies that would be affected by the project contain only limited fish resources.

Direct spills of petroleum products into streams and rivers could be toxic to fish, depending on the type, quantity, and concentration of the spill. To reduce the potential for direct surface water contamination, Texas Eastern would implement its SPCC Plan, including restrictions on refueling equipment and storing fuel and other potentially toxic materials at least 100 feet from waterbodies.

Hydrostatic Testing

Crown Landing would hydrostatically test each of the three proposed LNG storage tanks to insure their structural integrity. A total of approximately 25 million gallons of water would be required for each storage tank test. Approximately 250,000 gallons of additional water would be used to flush each LNG storage tank following hydrostatic testing. Crown Landing proposes to withdraw the water needed for hydrostatic testing from the Delaware River. Onsite wells would provide the flushing water.

Our Procedures generally prohibit the use of waterbodies like the Delaware River, which contain federally listed species, as hydrostatic test water sources or discharge locations except where permitted in writing by appropriate permitting and resource agencies. However, in this case, the Delaware River appears to be the only practicable source capable of providing the necessary volume of water for testing the LNG tanks. Therefore, in accordance with our Procedures, Crown Landing would be required to consult with appropriate permitting and resource agencies to obtain authorization to use the Delaware River as a hydrostatic test water source and disposal location.

Water would be appropriated from the Delaware River over a 2-week period at an intake rate of approximately 2,000 to 4,000 gpm. Similar to ballast water withdrawals by LNG carriers during operation of the proposed LNG terminal, withdrawal of hydrostatic test water from the Delaware River during construction would result in entrainment and impingement of ichthyoplankton. Using the same analysis technique as discussed previously for ballast water, we estimated entrainment and impingement losses from hydrostatic test water withdrawals (see table 4.6.2-3). Unlike ballast water withdrawals that would occur throughout the year during the operations of the facility, water withdrawals for hydrostatic testing of the LNG tanks would only require a one-time withdrawal of 25 million gallons for each tank. However, since the estimates presented in table 4.6.2-3 are based on a proportion of the losses at the Logan Generating Station which occur throughout the year, the actual number of individuals that are lost due to hydrostatic test water withdrawals could increase or decrease depending on whether test water withdrawals were conducted during periods of high or low ichthyoplankton densities, respectively.

To minimize entrainment and impingement of aquatic organisms, particularly eggs and larvae, Crown Landing would screen the intake with a 2 mm wedgewire screen and limit the velocity at the intake to 0.5 feet per second pursuant to the recommendations of NOAA Fisheries. Additionally, Crown Landing proposes to withdraw the water from the dredged berth area at a depth of 6 to 8 feet below the water surface.

TABLE 4.6.2-3

Estimate of Potential Impacts of Hydrostatic Test Water Withdrawal during Construction of the Proposed LNG Terminal on Selected Fish Species in the Delaware River a/

Fish Species	Age-1 Equivalents (individuals) b/	Yield Lost (pounds) c/	Production Foregone (pounds) d/
Alewife	2	0	1
American Shad	0	0	1
Atlantic Croaker	1,930	393	1,097
Atlantic Menhaden	273	137	24
Bay Anchovy	34,168	0	818
Blue Crab	199	6	37
Blueback Herring	7	0	4
Silverside	13	0	0
Spot	2,797	313	755
Striped Bass	52	72	375
Weakfish	153	120	439
White Perch	268	0	41
Non-RIS Fishery Species e/	1,636	146	1,884
Non-RIS Forage Species e/	972	0	49
Total	42,470	1,187	5,525

a/ Assumes three LNG storage tanks would be hydrostatically tested and that each tank would require the withdrawal of about 25 million gallons of water from the Delaware River.

b/ "Age-1 Equivalents" are the number of impinged and entrained individuals that would otherwise have survived to be age-1 plus the number of impinged individuals which are assumed to be impinged at age 1.

c/ "Yield Lost" is a measure of the amount of fish or shellfish that is not harvested because the fish are lost to impingement and entrainment.

d/ "Production Foregone" is the expected total amount of future growth of individuals that would be impinged or entrained had they not been impinged or entrained. Foregone production for forage species is used to estimate the subsequent reduction in harvested species yield that results from a decrease in the food supply.

e/ RIS are "recreationally important species" as defined by EPA (2002). See EPA (2002) for a list of species in these categories.

The discharge of hydrostatic test water could create minor, localized, and temporary increases in turbidity in the project area. To avoid impacts on the subtidal shallows and minimize erosion and scouring of the river bed, Crown Landing proposes to discharge the hydrostatic test water and flushing water in the dredged berth area over a multi-week period in accordance with NPDES permitting requirements. Fish and other aquatic species that occur in the vicinity of the project are adapted to the turbid conditions that are common to the Delaware River; therefore, a temporary, localized increase in turbidity in this location would not likely cause significant stress to these organisms. The hydrostatic testing process would not involve significant changes in the temperature of the test water and would not result in any thermal impacts as a result of its discharge to the Delaware River. Crown Landing indicated that chlorine may need to be added to the test water at concentrations significantly below EPA water quality standards.

Texas Eastern would also conduct hydrostatic tests to ensure the integrity of the proposed pipeline before placing it in service. The test water would be obtained from municipal sources, the Delaware River, and Ridley Creek. Texas Eastern would be required to consult with appropriate permitting and resource agencies to obtain authorization to use the Delaware River and Ridley Creek as a hydrostatic test water source and disposal location. The impacts on these waterbodies would be similar to those impacts described above for hydrotest water for the LNG storage tanks.

4.6.3 Essential Fish Habitat

The MSA (Public Law 94-265 as amended through October 11, 1996) was established, along with other goals, to promote the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined in the Act as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

Federal agencies which authorize, fund, or undertake activities that may adversely impact EFH must consult with NOAA Fisheries. Although absolute criteria have not been established for conducting EFH consultations, NOAA Fisheries recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as the NEPA, Fish and Wildlife Coordination Act, ESA, or the Federal Power Act (50 CFR 600.920(e)) in order to reduce duplication and improve efficiency. Generally, the EFH consultation process includes the following steps:

1) **Notification** - The action agency should clearly state the process being used for EFH consultations (e.g., incorporating EFH consultation into EIS, section 10 permit, etc.).

2) **EFH Assessment** - The action agency should prepare an EFH Assessment that includes both identification of affected EFH and an assessment of impacts. Specifically, the EFH should include: 1) a description of the proposed action; 2) an analysis of the effects (including cumulative effects) of the proposed action on EFH, the managed fish species and major prey species; 3) the federal agency's views regarding the effects of the action on EFH; and 4) proposed mitigation, if applicable.

3) **EFH Conservation Recommendations** - After reviewing the EFH Assessment, NOAA Fisheries would provide recommendations to the action agency regarding measures that can be taken by that agency to conserve EFH.

4) **Agency Response** - Within 30 days of receiving the NOAA Fisheries recommendations, the action agency must respond to NOAA Fisheries. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. For any conservation recommendation that is not adopted, the action agency must explain its reason to NOAA Fisheries for not following the recommendation.

FERC staff proposes to consolidate EFH consultations for the Crown Landing LNG Project and the Logan Lateral Project with the interagency coordination procedures required under NEPA. For purposes of reviewing this project under NEPA, the FERC is the lead federal agency and the COE, EPA, FWS, NOAA Fisheries, and Coast Guard are cooperating federal agencies (see section 1.4). As such, the FERC requested that NOAA Fisheries consider the draft EIS notification of initiation of EFH consultation. The EFH Assessment includes the analysis in section 4.6 as well as the document in Appendix E of the draft EIS. In comments on the draft EIS and the EFH Assessment, NOAA Fisheries reported that it did not agree with our conclusion that the project would have negligible effects on EFH. Specifically, NOAA Fisheries expressed concern regarding loss of shallow water habitat and the ecological functions it provides and the resulting potential losses of prey species dependent on that habitat. As previously discussed, NOAA Fisheries also continued to be concerned about potential losses of prey species through ballast water intakes. Given these concerns, NOAA Fisheries provided the following conservation recommendation:

- NOAA Fisheries recommends that offshore alternatives for siting of the project be investigated. This recommendation is necessary because of the cumulative impacts

identified in the draft EIS and because no additional measures to minimize impacts to fisheries resources have been developed for this project.

As required pursuant to the MSA, we responded to NOAA Fisheries within 30 days of receipt of its comments and indicated that additional information was being considered that pertained to its conservation recommendation. That response letter also indicated that a complete alternatives analysis was included in the draft EIS and that the analysis discussed in detail the potential for offshore alternatives to the proposed action. Although difficult to quantify, it is expected that entrainment and impingement of eggs and larvae would be higher in an estuarine setting similar to the proposed project site than in an area offshore. However, we believe that the analysis of offshore alternatives presented in section 3.0 of the EIS shows that the proposed terminal location is the environmentally preferred alternative based on consideration of multiple factors. We also believe that measures required of Crown Landing for impacts on shallow water habitats should appropriately mitigate for those impacts such that a net loss of that habitat type would not occur. Finally, throughout section 4.6 of this EIS, measures proposed by Crown Landing or recommended by FERC staff are discussed that, when implemented, would mitigate for the potential impacts on fishery resources expected as a result of construction and operation of the proposed action. Nonetheless, based on further review of the project's potential impacts and consideration of NOAA Fisheries' comments, we now conclude that the project is likely to have minor, rather than negligible, impacts on EFH. However, we do not believe these impacts would have population level effects.

4.7 THREATENED, ENDANGERED, AND OTHER SPECIAL STATUS SPECIES

Federal agencies are required by section 7 of the ESA (Title 19 United States Code Part 1536(c)), as amended (1978, 1979, and 1982), to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed endangered or threatened species, or result in the destruction or adverse modification of the designated critical habitat of a federally listed species. The action agency (i.e., the FERC) is required to consult with the FWS and/or NOAA Fisheries to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the proposed project, and to determine the proposed action's potential effects on those species or critical habitats. For actions involving major construction activities with the potential to affect listed species or designated critical habitat, the federal agency must prepare a BA. The action agency must submit its BA to the FWS and/or NOAA Fisheries and, if it is determined that the action may adversely affect a listed species, the federal agency must submit a request for formal consultation to comply with section 7 of the ESA. In response, the FWS or NOAA Fisheries would issue a Biological Opinion as to whether or not the federal action would likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat. In compliance with section 7, the FERC requested that the FWS and NOAA Fisheries consider the draft EIS as the BA for the Crown Landing LNG and Logan Lateral Projects. Using the draft EIS as the BA, the FWS completed its review of the project as discussed below. However, NOAA Fisheries requested additional information pertaining to the shortnose sturgeon and potential ship strikes of northern right whales. In correspondence subsequent to the issuance of the draft EIS, the FERC provided the requested information, much of which has also been added below. Our section 7 consultation with NOAA Fisheries is currently ongoing.

For purposes of this environmental analysis, special status species of plants and animals include:

- species that are listed by the federal government as endangered, threatened, or candidate species; and
- species that are listed by Pennsylvania, New Jersey, or Delaware as endangered, threatened, or species of concern.

Crown Landing LNG initiated preliminary informal consultations with the FWS, NOAA Fisheries, and the Natural Heritage and Nongame and Endangered Species Programs of the PADEP, NJDEP, and DNREC in April 2003 to assess impacts on special status species. These consultations resulted in the identification of nine federal and/or state special status species (one of which is also a federal species of concern undergoing status review) that might occur in the project area. During subsequent review of the project, NOAA Fisheries indicated that the environmental analysis of the project should also include indirect effects of increased vessel traffic on federally endangered marine mammals with the potential to occur in the project area, specifically the right whale. NOAA Fisheries also reported that the loggerhead sea turtle should be addressed in addition to the green and Kemp's ridley sea turtles. With the addition of these two species, 11 special status species were considered during the analysis of the project. These 11 species are listed in table 4.7-1 and are discussed in the following sections.

In comments on the draft EIS, the FWS concurred that except for an occasional transient bald eagle, no other federally listed or proposed threatened or endangered species under FWS jurisdiction in New Jersey are known to occur within the project area and that the proposed projects would not adversely affect federally listed species. Additionally, the FWS stated that for project activities in Pennsylvania, the proposed Logan Lateral Project would not adversely affect the bog turtle or any other federally listed species under FWS jurisdiction in Pennsylvania. Therefore, no additional consultation with the FWS is necessary for the proposed projects. We are currently continuing formal consultation with NOAA

Fisheries regarding potential project impacts on shortnose sturgeon and informal consultation for the North Atlantic right whale and sea turtles. Construction of the project would not be allowed to begin until we have completed all our section 7 responsibilities.

TABLE 4.7-1

Special Status Species Potentially Occurring in the Project Area

Species	Federal Status a/	State Status a/	Comments
Mammals			
North Atlantic Right Whale *Eubalaena glacialis*	E	NJ-E	Not likely to occur in the project area, but could be affected by increased ship traffic and LNG carriers entering Delaware Bay while in transit to the proposed LNG terminal.
Birds			
Bald Eagle *Haliaeetus leucocephalus*	T	PA-E; NJ-E	Active nests are located within 3, 5, and 12 miles of LNG terminal; the closest nest is 2 miles from the proposed pipeline route. Foraging habitat is located within the project area at the proposed LNG terminal site and along the pipeline route.
Pied Billed Grebe *Podilymbus podiceps*	None	NJ-E	This species has the potential to occur on the site and along the proposed pipeline route. The NJDFW indicated that timing restrictions may be necessary during construction to avoid impacts on breeding individuals.
Peregrine Falcon *Falco peregrinus*	None	NJ-E	Known to nest near the project on the Commodore Barry Bridge.
Fish			
Shortnose Sturgeon *Acipenser brevirostrum*	E	PA-E; NJ-E; DE-T	Known to occur within the project area, but abundance is unknown.
Atlantic Sturgeon *Acipenser oxyrhynchus*	SC	PA-E; NJ-E; DE-E	Likely to occur within the project area throughout the year, but age distribution in project area is unknown.
Reptiles			
Bog Turtle *Clemmys muhlenbergii*	T	PA-E; NJ-E	Surveys determined that suitable habitat for this species was not present within the project area. The FWS concurred that the projects are not likely to adversely affect the bog turtle.
Kemp's Ridley Sea Turtle *Lepidochelys kempi*	E	PA-E; NJ-E	Not likely to occur within the project area, but could be affected by increased ship traffic and LNG carriers entering Delaware Bay while in transit to the proposed LNG terminal.
Green Sea Turtle *Chelonia mydas*	E	DE-E; NJ-E	Not likely to occur within the project area, but could be affected by increased ship traffic and LNG carriers entering Delaware Bay while in transit to the proposed LNG terminal.
Loggerhead Sea Turtle *Caretta caretta*	T	DE-E; NJ-E	Not likely to occur within the project area, but could be affected by increased ship traffic and LNG carriers entering Delaware Bay while in transit to the proposed LNG terminal.
Red-bellied Turtle Pseudemys rubriventris	None	PA-T	Suitable habitat present at Delaware River and Chester Creek. Proposed HDD crossings would avoid impacts on this species. Agency consultation would occur prior to implementing non-HDD crossing methods.

a/ Status definitions:
E = endangered
T = threatened
SC = species of concern
None = no designation under the Endangered Species Act
PA = Pennsylvania
DE = Delaware
NJ = New Jersey

4.7.1 Federally Listed Threatened and Endangered Species

North Atlantic Right Whale

The North Atlantic right whale is a federally listed endangered species and a state-listed endangered species in New Jersey. The North Atlantic right whale population was historically depleted by commercial whaling and has not recovered despite protection from commercial harvest (NOAA, 2004c). The current population is thought to number about 300 individuals and thus is considered one of the most critically endangered large whales in the world (NOAA, 2004c). The Mid-Atlantic region of the United States is a principal migratory corridor for right whales that travel between the calving and nursery areas in the southeastern United States to the feeding grounds in the northeastern United States and Canada.

The two most significant human-caused threats to right whales are entanglement in fishing gear and collisions with ships. Because right whales are known to occur in or adjacent to many major shipping corridors along the eastern United States and collisions are known to account for over 50 percent of human-induced mortality in right whales, NOAA Fisheries established a right whale ship strike reduction program. Despite the measures implemented as part of that program (e.g., aerial surveys to notify mariners of whale locations, supporting shipping industry liaisons, mandatory reporting programs, etc.), right whales continue to be killed by vessel strikes. In response to this continuing problem, NOAA Fisheries developed a Strategy to Reduce Ship Strikes of Right Whales (Strategy), which is intended to minimize the overlap between ships and whales and reduce the likelihood of ship strikes to the extent practicable (NOAA, 2004c).

Although NOAA's Strategy is not yet finalized, the primary regulatory measure proposed to reduce ship strikes in the Mid-Atlantic region is the establishment of uniform speed restrictions within 20 to 30 miles of the approaches of specific ports and areas, including Delaware Bay (NOAA, 2004c). NOAA indicated that proposed speed restrictions may be in the range of 10 to 14 knots. For Delaware Bay, these speed restrictions would be enforced from February through April and from October through December.

In comments on the draft EIS, NOAA Fisheries requested additional traffic analysis to assist in evaluating the risk of increased vessel traffic on endangered species. Specifically, NOAA Fisheries requested information on the LNG ship routes and operational procedures to allow development of appropriate mitigation measures to reduce the potential for vessel strikes of listed species. Although ships transiting the Atlantic Ocean are not bound to specific travel lanes until in proximity of eastern seaboard port cities, Crown Landing provided the approximate routes LNG ships could follow during transit to and from the proposed terminal site within the moving safety zone. These routes would avoid crossing the two major areas of designated critical habitat for the right whale along the east coast of the United States, which are located in Cape Cod Bay, Massachusetts and east of Cape Cod, and along the coast near Port Canaveral, Florida north to near the Port of Savannah, Georgia. Crown Landing has reported that if an LNG ship is diverted into one of these areas of critical habitat, the ship would comply with mandatory ship reporting requirements imposed by NOAA.

Assuming that up to 150 LNG carriers could unload cargo at the proposed terminal each year, about 75 of those ships would be expected to unload at the terminal during the total 6 months from February to April and from October to December. These 75 vessels approaching and entering Delaware Bay would be in addition to the existing ship traffic entering the bay and visiting various ports along the Delaware River. The LNG ships are expected to transit at a speed of approximately 19 knots in the Atlantic Ocean and would transit at convoy speed established by the Coast Guard while in the Delaware Bay and River. Expected speeds in these areas are approximately 12 knots up to the Delaware Memorial

Bridge and approximately 6 knots north of the bridge. The additional ship traffic likely increases the potential risk of a right whale ship strike. However, adherence of LNG ships to NOAA Fisheries' recommended speed restrictions during the applicable time periods, in addition to other currently required measures, would be expected to effectively minimize the potential for strikes, consistent with NOAA Fisheries' goals of the Strategy. Crown Landing has agreed to implement the following measures for LNG ships to avoid or minimize impacts on right whales: 1) review whale identification with appropriate crew members; 2) maintain watches for marine mammals while underway; 3) reduce speed, as appropriate, during periods of reduced visibility; and 4) report the precise location and time of any sightings of entangled or injured right whales, or collisions with right whales. In a letter dated March 30, 2006 to NOAA Fisheries, Crown Landing agreed to slow the forward speed of LNG ships servicing its terminal to 12 knots, from November through April, within the identified 30 nautical mile radius of the Delaware Bay, subject to the requirement of safe navigation.

Although LNG ships servicing the proposed terminal have the potential to strike right whales in the vicinity of Delaware Bay, adherence to speed restrictions proposed by NOAA Fisheries would minimize the potential for strikes such that the proposed project *is not likely to adversely affect* North Atlantic right whales.

Bald Eagle

The bald eagle is a federally listed threatened species and a state-listed endangered species in New Jersey and Delaware. A proposal to remove the bald eagle from the federal list of threatened species was submitted in 1999 and is currently under review by the FWS. In the Delaware Bay region, bald eagles inhabit freshwater and estuarine shoreline habitats and their associated tributaries throughout the year and require large blocks of mature forest in proximity to aquatic foraging areas for nesting (FWS, 1996). Nests are typically located within 1 mile of shallow surface water feeding areas. Preferred nest sites typically occur in areas with minimal human disturbance; however, bald eagles successfully nest in close proximity to human activity and development throughout their range (Livingston et al., 1990).

The NJDEP Landscape Project has identified and mapped most of the LNG terminal site as potential bald eagle foraging habitat (NJDEP, 2004c) and bald eagles are known to forage near the site, particularly during the breeding and chick-rearing season from January through August. Designated bald eagle foraging habitat has also been identified along Raccoon Creek (NJDEP, 2004c). Because the Landscape Project designates foraging habitat primarily through spatial analysis rather than biological evaluation or ground-truthing of specific areas, not all mapped areas have been confirmed as preferred foraging sites.

Crown Landing designed the terminal such that the forested areas along the river, the only areas of the terminal site considered preferred foraging habitat, would be avoided to the extent practicable. Construction of the stormwater outfall would temporarily affect less than 0.1 acre of the riparian forested area. Therefore, construction of the LNG terminal would not adversely affect preferred bald eagle foraging habitat. The pipeline across Raccoon Creek would be crossed by the HDD method, which would also avoid permanently disturbing foraging habitat and potential perch trees adjacent to the creek. Nonetheless, the LNG facilities would be constructed within mapped foraging habitat. The identification of a new bald eagle nest by the NJDEP in 2005 (approximately 5 miles from the Crown Landing site) is expected to result in additional mapped foraging habitat. The NJDEP (2004c) stated that the loss of these foraging habitat areas as mapped by the Landscape Project should be mitigated for. Crown Landing has coordinated with the NJDEP and the FWS to develop a mitigation plan and is currently proposing two

mitigation measures: 1) plant a forested buffer along Oldmans Creek using native tree species; and 2) establish a conservation easement along Oldmans Creek. Impacts on bald eagle habitat largely overlap with wetland impacts in the project area and Crown Landing is preparing a single mitigation plan to address impacts on these resources. Because mitigation plans have not yet been finalized, we recommend in section 4.4 that Crown Landing should continue coordinating with the FWS and NJDEP to develop appropriate mitigation plans for potential impacts on wetlands which will also mitigate for impacts on bald eagle foraging habitat.

Bald eagles could be temporarily displaced from the foraging areas during construction activities, but would be expected to return to utilize the areas once construction activities are completed. Bald eagles are not particularly sensitive to disturbance when foraging (FWS, 1996) and thus would likely only be displaced during the major construction activities. This displacement would not adversely affect bald eagles because foraging habitat is not limited in the immediate vicinity of the terminal site and pipeline route and there is sufficient foraging habitat nearby. Bald eagles do not exhibit high site fidelity to foraging areas and typically move among different foraging sites, so any displacement caused by the project should not cause a major disruption in foraging activity.

The shoreline of the Delaware River in the vicinity of the proposed LNG terminal, especially that portion that contains tall, mature trees, is suitable for perching by foraging bald eagles. The proposed project would not affect the forested wetland on the LNG terminal site and would not remove potential bald eagle perch trees. However, construction of the proposed 120-foot-high emergency flare at the LNG terminal would provide a potential eagle perch site. Any bald eagle using this perch when the flare is activated could be injured or killed. Crown Landing proposes to eliminate the potential risk of the flare on bald eagles by installing perch guards on top of the flare to restrict or eliminate perching.

The FWS initially reported that two bald eagle nests occur in the project area (FWS, 2003). These nests, referred to as the Raccoon Creek and Mantua Creek nests, occur about 3 and 12 miles north of the LNG terminal site, respectively. The Raccoon Creek nest has been active since 1996 and is in a forested area adjacent to an industrial facility. In the past 5 years, the eagle pair using the Raccoon Creek nest have been unsuccessful in producing their own young (hatch failure), possibly due to organochlorine contaminants (Smith, 2003). However, every year from 1999 to 2002, the nesting pair has successfully raised a foster chick to a fledging (Smith, 2003). The Mantua Creek nest has been active since 2001 and is also located in a forested area adjacent to another industrial facility. The bald eagles nesting at the Mantua Creek nest were unsuccessful in producing young in 2001 and 2002, possibly due to disturbances associated with the proximity of the nest to a road. The pair produced two eaglets in 2003 after moving their nest site further from the road and closer to the Delaware River (but still adjacent to the industrial facility) (NJDEP, 2001, 2002a; Smith, 2003). As noted above, the FWS and NJDEP reported that a new bald eagle nest was identified along Oldmans Creek during 2005, about 5 miles from the proposed LNG terminal site. The proposed site is outside of the new bald eagle nest buffer and a timing restriction would not be required for construction.

Although most eagles in this region are relatively habituated to human activity and disturbance, they are sensitive to disturbance during the early nesting cycle, which typically occurs in New Jersey between January and April. Eagles are least sensitive to disturbance after the young are fledged (late July and August) and before nest selection begins (September to January).

The Raccoon Creek nest site is located approximately 2 miles from the nearest point of the proposed pipeline route, and the Mantua Creek nest is approximately 12 miles away. Thus, potential impacts on nesting bald eagles are not likely and the FWS has indicated that project restrictions due to nesting eagles are not warranted. Furthermore, equipment used during construction of the pipeline would be lower than tree height. Therefore, imposition of restrictions due to foraging eagles is similarly not

anticipated (FWS, 2004b). However, the FWS has indicated that it will continue to monitor the project area for bald eagle activities. Should conditions change (i.e., new eagles nesting in the area), the FWS would reevaluate potential effects of the project on eagles and, if impacts are anticipated, mitigation measures may be required.

Construction and operation of the proposed LNG terminal and pipeline facilities would not destroy or remove any known bald eagle nests or roost trees but may disrupt foraging activities of individual bald eagles and eagles may temporarily avoid some foraging habitats. Crown Landing has committed to providing mitigation for the permanent loss of foraging habitat. This mitigation would alleviate potential long-term impacts on bald eagle foraging and the impacts associated with construction would be short term and minor. Thus we determined that construction and operation of the proposed LNG terminal *may affect* but *are not likely to adversely affect* the bald eagle. Additionally, given the distance of the proposed pipeline route from known nest locations and the avoidance of potential foraging areas by completing HDD crossings of suitable foraging habitat, construction of the proposed pipeline would have no effect on either nesting or foraging eagles. The FWS has concurred with these determinations and has reported that no further consultation pursuant to section 7 of the ESA is required for this project.

Shortnose Sturgeon

The shortnose sturgeon is a federally listed endangered species and a state-listed endangered species in New Jersey and Delaware. Shortnose sturgeon occur along the Atlantic Ocean seaboard near river mouths, estuaries, and major rivers from the St. John's River in Florida to the St. John River in New Brunswick, Canada. The shortnose sturgeon is not known to undertake large-scale oceanic migrations, and typically spends its entire life cycle within its native estuary or river system. The Delaware River population of shortnose sturgeon is thought to be 1 of 19 separate, reproductively isolated populations on the Atlantic Coast.

In the Delaware River and Bay, shortnose sturgeon occur from the lower bay upstream to Lambertville, New Jersey at approximate RM 148. Based on tagging studies (O'Herron, 1993), most sturgeon activity occurs between RM 118 and RM 137 and they tend to congregate in upper tidal reaches of the river primarily between RM 118 and RM 130.5 from November through March. Recent surveys have identified shortnose sturgeon along the west side of the ship channel on the northern and southern ends of the Cherry Flats (approximate RM 71; Shirey et al., 1999). NOAA Fisheries (unpubl. data, 2004) documented shortnose sturgeon downstream of Philadelphia in 2003 and 2004.

Shortnose sturgeon typically spawn in areas with clean gravel or cobble bottom in swift water (Jenkins and Burkhead, 1994), although some evidence exists that the firmness of the substrate may be a more important indicator of habitat suitability than particle size. Shortnose sturgeon spawning typically occurs in late March through April, mostly north of Trenton, New Jersey. Male sturgeon typically stay on the spawning grounds longer than females. After spawning, the adults rapidly migrate downstream to summer foraging areas (COE, 1997) and then return upriver during the summer (NOAA Fisheries, 1996).

Shortnose sturgeon are moderately tolerant of a range of salinities. Although sturgeon have occasionally been found in salinities a high as 30 ppt, they prefer minimally saline conditions (0 to 5 ppt) and are primarily residents of estuaries and large, brackish coastal rivers. The proposed LNG terminal site is located at the oligohaline-freshwater interface, and thus is in an area where sturgeon are likely to congregate, especially juveniles during winter. Although not expected near the project area in summer months, a juvenile shortnose sturgeon was captured near the mouth of Oldmans Creek, just downstream of the proposed terminal location, during August 2004 (Shirey, 2004). Juvenile sturgeon are not normally caught in this portion of the river, but this capture indicates that juvenile shortnose sturgeon may occur in

the vicinity of the project area, especially when salinities are low as they were in the summer of 2004. With the exception of the spawning season, adult and juvenile shortnose sturgeon prefer areas with little or no current (FWS, 1989). Shortnose sturgeon tend to occupy deepwater habitats during the day where sufficient oxygen is available but move into shallow areas at night to feed. Adults show a general tendency to use deeper areas (approximately 30 to 100 feet deep) more often in winter than in summer when they are usually found in water from approximately 4 to 30 feet deep. Although not strictly nocturnal, shortnose sturgeon tend to be most active at night.

Shortnose sturgeon are benthic feeders. Adults primarily feed on mollusks, insects, crustaceans, and small fish while juveniles eat crustaceans and insects. O'Herron and Hastings (1985) reported that the primary food source for shortnose sturgeon in the Delaware River was the Asiatic clam. This mollusk, although generally more numerous in shallow water areas, is known to be widely distributed at all depths in the upper tidal areas of the Delaware River (NOAA Fisheries, 1996) and was the predominant benthic invertebrate identified in samples collected from the proposed dredging area at the LNG terminal site.

NOAA Fisheries (1996) reported that due to the limited information available for shortnose sturgeon, it has not been able to accurately identify the ecological patterns of all age classes and sexes of the sturgeon in the Delaware River. In its comments on the draft EIS and during discussions with Crown Landing, NOAA Fisheries and other resource agencies have continued to express concern about the lack of information on shortnose sturgeon in the Delaware River. To address this concern, in May 2005, Crown Landing initiated a 1-year study of juvenile sturgeon in the Delaware River adjacent to and in the vicinity of the project site. The study was conducted in accordance with survey methods approved by the applicable agencies. A progress report for the study period of May through August 2005, filed with the FERC in October 2005, indicated that three juvenile shortnose sturgeon and two juvenile Atlantic sturgeon were captured in the vicinity of the proposed LNG terminal site. One juvenile shortnose sturgeon was captured during each sampling period on June 24, July 22, and August 24. During June and August, the sturgeon were found at the proposed site; in July, the sturgeon were found downstream of the proposed site.

Dredging in areas of suitable habitat for any life stage, if individuals are present, could affect sturgeon by disrupting migratory movements, destroying habitat/prey resources, and/or entraining fish in hydraulic dredges (NOAA Fisheries, 1996). The migration of sturgeon moving upstream from their overwintering grounds to spawn during March could be affected if individuals encounter dredging activities. Although turbidity does not seem to negatively affect sturgeon and individuals encountering suspended sediment plumes could pass through the plumes, some individuals may avoid the dredging activities and not return to spawn. Fish movements or feeding patterns may also be slightly altered due to turbid conditions. For example, the higher turbidity levels resulting from dredging may cause some sturgeon to be more active during the day than normal, particularly in shallow waters. Crown Landing proposes to avoid dredging between March 15 and August 1, which would mostly avoid impacts on migrating adults returning to spawning grounds.

As discussed in section 4.6.2, fish are likely to be affected by noise resulting from pile-driving activities during pier construction. Since sturgeon could occur in the area during pile driving, they would be susceptible to the same potential impacts as other fish (e.g., death, injury, or avoidance of construction areas, especially during migrations). Our recommendation in section 4.6.2, which requires Crown Landing to discuss with applicable agencies the need for additional conservation measures to avoid or minimize potential effects of pile driving on fish, could possibly alleviate potential impacts on sturgeon.

Dredging could also remove and reduce the availability of benthic food sources. As mentioned above, the Asiatic clam was the predominant invertebrate identified in benthic samples collected in the

proposed dredging area and is the primary food source of shortnose sturgeon in the Delaware River. Removal of Asiatic clams during dredging activities could reduce the amount of forage available for sturgeon. Based on previous studies, it is expected that Asiatic clams would recolonize disturbed areas quickly following construction, although the individuals in the recolonized areas could be smaller and thus provide less biomass (O'Herron and Hastings, 1985). Additionally, maintenance dredging and prop wash from LNG ships could result in the periodic removal of invertebrates from the proposed ship berth and result in a long-term reduction in forage available in the project area. However, this impact would not likely affect sturgeon populations since Asiatic clams are known to inhabit all depths of the Delaware River and are common upstream of the proposed LNG terminal site, where sturgeon occur in greater abundance.

The NJDFW (NJDEP, 2004c) expressed concern about the potential for entrainment of sturgeon during initial dredging activities. Crown Landing proposes to primarily use a hydraulic dredge to excavate the ship berth. Because sturgeon are typically on or close to the bottom substrate, hydraulic dredges have the potential to entrain sturgeon, particularly juveniles, in the suction area immediately surrounding the aperture of the cutterhead. The NJDEP (2004c) has recommended that the outlet at the dredge disposal site be monitored to determine whether sturgeon are being entrained. If monitoring indicates that entrainment of protected species is occurring, the NJDEP (2004c) suggested that dredging be suspended until further studies are completed and the entrainment of sturgeon is addressed. Crown Landing has proposed to monitor the dredge outlet but has not committed to suspending dredging operations if sturgeon are detected in the dredge disposal outlet. To minimize the repeated taking of sturgeon during the dredging operations, **we recommend that:**

- **Crown Landing hire a qualified biologist to monitor the outlet at the dredge disposal site to determine whether sturgeon are being entrained. If monitoring indicates that sturgeon are being entrained, Crown Landing should notify the Commission and NOAA Fisheries within 24 hours and should suspend dredging operations until the Commission and NOAA Fisheries complete any necessary consultation and the Director of OEP allows dredging to resume.**

Crown Landing estimates that sedimentation is expected to occur in the ship berth at a rate of 60,000 to 90,000 cubic yards per year and proposes to conduct maintenance dredging on an annual basis. Impacts on shortnose sturgeon described for the initial dredging effort could also occur during annual maintenance dredging.

Water withdrawals from the Delaware River for hydrostatic testing of the LNG storage tanks and by LNG ships during intake of ballast water could also entrain shortnose sturgeon. Crown Landing proposes to withdraw the hydrostatic test water from the river over a 2-week period. As discussed in section 4.6.2, Crown Landing would screen the intake with a 2 mm wedgewire screen and limit the velocity at the intake to 0.5 feet per second to minimize entrainment and impingement of aquatic organisms, particularly eggs and larvae. Crown Landing proposes to withdraw the water from the dredged berth area at a depth of 6 to 8 feet below the water surface. In addition, Crown Landing proposes to avoid hydrostatic test water withdrawals during the month of May, which is typically a period of high ichthyoplankton densities.

Because LNG ships would unload LNG at the proposed terminal between 100 and 150 times annually and during all seasons, each time requiring about 13.7 million gallons of ballast water at the marine terminal, it is likely that ballast water intake would result in the entrainment, impingement, or loss of aquatic resources. Also, NOAA Fisheries and the NJDFW expressed concern about the proposed ship berth functioning as a collection basin for eggs and larvae transported by tidal movements from adjacent shallow water habitats and the potential for higher rates of entrainment or impingement of these

organisms during ballast water intake. To account for these potential impacts, Crown Landing has proposed to limit ballast water withdrawals at the berth to the minimum amount necessary for ship stability and take on the remaining water while in transit back down the Delaware River. Crown Landing has also proposed to increase the withdrawal period, thereby reducing the intake velocity. As discussed in section 4.6.2, although these measures may result in reductions in the number of organisms entrained or impinged during ballast water withdrawals, limited available data on ichthyoplankton distribution and abundance prevent a quantitative assessment of the actual benefits of these measures. Therefore, in response to continued concerns expressed by resource agencies during our environmental review process, we retained our recommendation in section 4.6.2 that Crown Landing coordinate with resource agencies to determine the need for additional mitigative measures to avoid or minimize these impacts on aquatic resources in the project area (see section 4.6.2 for additional discussion on potential effects of ballast water intake).

Although water withdrawals have the potential to impact aquatic resources, these activities are not likely to affect shortnose sturgeon eggs or larvae. The primary spawning area for shortnose sturgeon is about 70 miles upstream of the proposed LNG terminal site. Given that sturgeon eggs are adhesive and attach to available substrate or structure within minutes of being spawned, eggs are not likely to occur in the project area. Larval shortnose sturgeon exhibit demersal behavior shortly after hatching and are exclusively demersal by the time the post-yolk sac stage is reached (within 10 days of hatching). Although it is possible that demersal larvae could travel the 70 miles from the spawning grounds to the proposed terminal site while still of a size susceptible to water intakes, the hydrostatic test water intake structure would be located in the mid to upper levels of the water column and would not likely affect demersal organisms. Depending on final configurations of the ballast water intakes and intake rates, juvenile fish occurring in the area have the potential to be entrained during ballast water intake if they have not reached a size in which they are able to swim faster than the intake velocity.

In summary, although Crown Landing would avoid dredging during the period when sturgeon are migrating to spawning grounds, dredging associated with the proposed project could still reduce the amount of forage available and could entrain juvenile and adult individuals if present near the cutterhead. Additionally, ballast water intakes have the potential to entrain juveniles if present in the water column and not of sufficient size to swim faster than the intake velocity. Given these potential impacts and that shortnose sturgeon were identified at the project site during project-specific sampling in the Delaware River, we have determined that the Crown Landing LNG Project *is likely to adversely affect* shortnose sturgeon. With the issuance of the draft EIS, we requested NOAA Fisheries to open formal consultation and issue a Biological Opinion specific to the shortnose sturgeon for potential impacts from the Crown Landing LNG Project. As of the issuance of this final EIS, NOAA Fisheries had not yet provided a Biological Opinion for the project. To complete our section 7 responsibilities, **we recommend that:**

- **Crown Landing should not begin construction activities <u>until</u>:**

  a. FERC staff completes formal consultation with NOAA Fisheries, Protected Resources Division; and

  b. Crown Landing receives written notification from the Director of the OEP that construction may begin.

Because Texas Eastern proposes to use HDD techniques to install the pipeline across the Delaware River, impacts on the river and associated biological communities would be avoided. Therefore, the Logan Lateral Project would have *no effect* on the shortnose sturgeon.

Bog Turtle

The bog turtle is a federally listed threatened species known to occur in wetlands within Chester and Delaware Counties in Pennsylvania (Pennsylvania Fish and Boat Commission (PAFBC), 2003a). Bog turtles are a semi-aquatic, omnivorous species that prefer relatively open sphagnum bogs and marshy wetlands. Bog turtles have specific habitat requirements that include specific vegetative communities, mucky soils for burrowing, and open wetlands associated with slow moving springs and/or groundwater (Pennsylvania Department of Conservation and Natural Resources (PADCNR), 2003). Bog turtles are threatened as a result of a loss of habitat, degradation of the remaining suitable habitat, and poaching. Due to the lack of suitable habitat, bog turtles in some cases have become accustomed to disturbed, low quality wetlands that often have a semi-enclosed canopy (PAFBC, 2003a). Bogs turtles are also known to use forested wetlands with small streams or springs as dispersal corridors to other more open marshes.

The PAFBC (2003a) indicated that a Phase 1 habitat suitability assessment for bog turtles would be required if any direct or indirect impacts to wetlands are expected. Texas Eastern conducted a Phase 1 study of the proposed pipeline corridor during early summer 2004. The assessment determined that none of the wetlands traversed by the proposed project provide suitable bog turtle habitat. The PAFBC (2004) reviewed the assessment and concurred that the project is not likely to cause adverse impacts on bog turtles. In comments on the draft EIS, the FWS also concurred that the project is *not likely to adversely affect* the bog turtle and stated that no further consultation pursuant to section 7 of the ESA is necessary..

Sea Turtles

Three sea turtle species were identified by NOAA Fisheries as having the potential to occur near the project area: the Kemp's ridley, green, and loggerhead sea turtles. The Kemp's ridley and green sea turtles are federally listed (and state-listed) as endangered. The loggerhead sea turtle is federally listed as threatened and is a state-listed endangered species in Delaware and New Jersey. None of these species are known to nest in the project area.

Green turtles occupy three habitat types: high energy oceanic beaches (nesting), convergence zones in pelagic habitat (juvenile foraging), and benthic feeding grounds in relatively shallow, protected waters (adult foraging). The primary green turtle nesting area within the United States is limited to a six-county area in east central and southeast Florida. Common adult foraging habitats are pastures of seagrasses and/or algae but small green turtles can also be found over coral reefs, worm reefs, and rocky bottoms (NMFS and FWS, 1991a). Coastal development threatens nesting habitat and populations while commercial fisheries and pollution pose significant threats to the marine environment.

The major nesting beach where Kemp's ridley turtles emerge in any concentration to lay eggs is on the northeastern coast of Mexico, although additional nesting has been reported from Texas, Florida, and South Carolina. Juveniles frequent bays, coastal lagoons, and river mouths. Although adults are sometimes found on the eastern seaboard of the northwestern Atlantic Ocean, they are typically confined to the Gulf of Mexico. Members of this genus are usually found in water with low salinity, high turbidity, high organic content, and where shrimp are abundant. Major threats to this species include incidental mortality in commercial shrimping, marine pollution, and dredging activities.

Loggerhead turtle nesting in the United States occurs primarily on the beaches of Florida but has also been reported from North Carolina, South Carolina, and Georgia (NMFS and FWS, 1991b). Post-hatchling and juvenile habitat use is associated with sargassum and/or debris in pelagic drift lines. Subadult habitat usage is associated with nearshore and estuarine waters along continental margins, which are used as developmental habitat. Adult habitat selection is not well understood but it seems clear that

adults can use a variety of habitats. Coastal development threatens nesting habitat and populations, while commercial fisheries and pollution pose significant threats to their marine environment.

The greatest potential threat to sea turtles, if present in the project area, would be impingement or entrainment into the hydraulic dredge cutterhead. However, NOAA Fisheries has previously determined that pipeline dredges are unlikely to adversely affect sea turtles (NOAA Fisheries, 1996). In addition, it is likely that turtles would be able to avoid hydraulic dredges. Noise impacts from pile driving could also have adverse effects on sea turtles, if present, since turtles would likely avoid the noise and be precluded from the area for foraging. Dredging and pile driving are not currently scheduled to occur during the summer months when sea turtles have the greatest potential to occur in the project area. Therefore, construction of the proposed LNG terminal *is not likely to adversely affect* sea turtles.

Because Texas Eastern proposes to use HDD techniques to install the pipeline across the Delaware River, impacts to the river and associated biological communities would be avoided. Therefore, the Logan Lateral Project would have *no effect* on the sea turtles.

4.7.2 State-listed Species

Atlantic Sturgeon

The Atlantic sturgeon is a state-listed endangered species in Pennsylvania and New Jersey and a candidate species for federal listing. Although petitioned for federal listing in 1998, it was determined that listing the Atlantic sturgeon as a federally endangered or threatened species was not warranted. However, NOAA Fisheries has retained Atlantic sturgeon on its list of candidate species to monitor. The Atlantic sturgeon is protected by several federal, state, and international programs and the Atlantic States Marine Fisheries Commission has prepared a Fisheries Management Plan to regulate the harvest and coordinate the management of stocks from Maine to Florida (NOAA Fisheries and FWS, 1998).

The Atlantic sturgeon is an anadromous species that inhabits large estuaries and Atlantic coastal waters. Atlantic sturgeons are occasionally found within different salinity regions in the Delaware River. Juveniles also spend time in the Delaware River before going to the ocean (PAFBC, 2001). Atlantic sturgeons generally remain in the Delaware Bay area throughout much of the year but may migrate up the river in June when the water warms. The abundance of sturgeon in the upper reaches of the river tends to decline in September, which likely reflects an outward migration of adults to the Atlantic Ocean in early fall. Juveniles live in freshwater for about 4 years before moving to ocean waters to mature (PADCNR, 2003; NJDFW, 2003) and thus could be present in the river near the proposed LNG terminal site throughout the year.

Preferred Atlantic sturgeon spawning areas consist of clay, rubble, gravel, or shell with fast-flowing water at depths less than 30 feet (Vladykov and Greeley, 1963). Spawning runs generally begin in April and peak in May. Records indicate that most spawning occurs downstream of the LNG terminal site. However, a study conducted by the Atlantic Sturgeon Status Review Team (ASSRT) in 1998 indicated that the primary spawning and nursery habitat for the Atlantic sturgeon in the Delaware River is located upstream of the proposed LNG terminal site between the Delaware-Pennsylvania border and Trenton (ASSRT, 1998). A similar study also determined that the Marcus Hook area appears to be primary habitat for immature Atlantic sturgeon during the summer months (O'Herron, 1993). Thus the project could impact spawning migrations, egg development, and individuals that may occupy the site during the summer months. However, because the shallow water areas in the proposed dredging area for the proposed ship unloading facility contains a substrate of fine sand and silt, which is unsuitable as spawning habitat, the project is not expected to impact spawning habitat.

Crown Landing proposes to adhere to agency recommended timing restrictions for dredging activities and would not conduct dredging operations between March 15 and August 1. Avoiding dredging during this period would likely avoid potential impacts on Atlantic sturgeon migrating upstream in the spring to spawn and sturgeon migrating upstream in summer to locate warmer water. However, sturgeon migrating downstream to the Atlantic Ocean in late summer or early fall could pass by active dredging operations. Potential impacts on sturgeon during out-migration would be similar to those discussed previously for shortnose sturgeon. Specifically, dredging could disrupt migratory movements, destroy habitat/prey resources, and/or entrain fish in hydraulic dredges. Although adults and larger juveniles would be expected to avoid dredging operations, smaller sturgeon, which remain in the Delaware River for several years, could be present and potentially affected in the project area during dredging operations. The NJDEP (2004c) has recommended that the discharge outlet be monitored at the dredge disposal site to determine whether sturgeon are being entrained. As stated in section 4.7.1 regarding the shortnose sturgeon, we recommend that Crown Landing monitor the outlet at the disposal site. If monitoring indicates that sturgeon are being entrained, we recommend that dredging operations be suspended until NOAA Fisheries and the FERC are contacted and provide guidance on how to proceed.

Similar to comments received regarding shortnose sturgeon, resource agencies have also expressed concern about the lack of information on Atlantic sturgeon in the Delaware River. To address this concern, Crown Landing initiated a 1-year study of juvenile sturgeon in the Delaware River adjacent to and in the vicinity of the project site. During sampling in the summer of 2005, Crown Landing captured two juvenile Atlantic sturgeon, one downstream of the proposed project site on July 22 and one upstream of the project site on August 17.

Similar to the shortnose sturgeon, water withdrawals from the Delaware River for hydrostatic testing of the LNG storage tanks and by LNG ships during intake of ballast water could also entrain Atlantic sturgeon. To account for these potential impacts, Crown Landing has proposed to limit ballast water withdrawals at the berth to the minimum amount necessary for ship stability and take on the remaining water while in transit back down the Delaware River. Crown Landing has also proposed to increase the withdrawal period, thereby reducing the intake velocity. As discussed in section 4.6.2 and above for shortnose sturgeon, although these measures may result in reductions in the number of organisms entrained or impinged during ballast water withdrawals, limited available data on ichthyoplankton distribution and abundance prevent a quantitative assessment of the benefits of these measures. Nonetheless, in response to continued concerns expressed by resource agencies during our environmental review process, we retained our recommendation in section 4.6.2 that Crown Landing coordinate with resource agencies to determine the need for additional mitigative measures to avoid or minimize these impacts on aquatic resources in the project area (see section 4.6.2 for additional discussion on potential effects of ballast water intake). Although spawning by Atlantic sturgeon is not expected to occur within the proposed dredging area, spawning in adjacent suitable habitats could occur and eggs and developing larvae have the potential to be transported via currents or active migration into the proposed project area. Thus, eggs and larvae could be entrained during water intakes. However, similar to shortnose sturgeon, Atlantic sturgeon eggs are adhesive and are expected to adhere to the substrate or other suitable structure soon after being spawned. Additionally, Atlantic sturgeon larvae become primarily demersal within 10 days of hatching; therefore, the likelihood of Atlantic sturgeon eggs or larvae being withdrawn into water intakes located in the mid to upper level of the water column is low.

Because Atlantic sturgeon could occur in the area during pile driving, they would be susceptible to the same potential impacts as other fish (e.g., avoidance of construction areas, especially during migrations, injury, or death). Our recommendation in section 4.6.2, which requires Crown Landing to discuss with applicable agencies the need for additional conservation measures to avoid or minimize potential effects of pile driving on fish, could possibly alleviate potential impacts on sturgeon.

In summary, because juvenile Atlantic sturgeon have been confirmed as occupying shallow water areas of the project site, there is a potential for the project to affect the species, directly thorough entrainment and indirectly through habitat and prey loss. It is likely that measures implemented to avoid and/or minimize impacts on shortnose sturgeon would also provide conservation benefits to the Atlantic sturgeon. However, there is a potential for individuals to be impacted by the proposed project.

Because Texas Eastern proposes to use HDD techniques to install the pipeline across the Delaware River, impacts to the river and associated biological communities would be avoided. Therefore, the Logan Lateral Project would have no effect on the Atlantic sturgeon.

Red-bellied Turtle

The red-bellied turtle is state listed as threatened in Pennsylvania due to limited habitat, draining and filling of wetlands, water pollution, and competition from the non-native red-eared slider. Red-bellied turtles can be found in relatively large, deep creeks, rivers, ponds, lakes, and marshes (PADCNR, 2003). The streams, lakes, and marshes inhabited by the red-bellied turtle must have permanent water and plenty of basking sites. The red-bellied turtle is known to inhabit the Delaware River and may be found in other waterbodies that would be crossed by the Logan Lateral. At the recommendation of the PAFBC (2003a), Texas Eastern conducted a habitat assessment of the proposed pipeline route in early summer 2004. The habitat assessment determined that although some of the streams that would be crossed by the pipeline could provide basking habitat for red-bellied turtles, none provide the required habitat for nesting or foraging.

The PAFBC (2004) reviewed Texas Eastern's assessment and determined that only Chester Creek and the Delaware River provide suitable habitat for the red-bellied turtle. The PAFBC concluded that use of the HDD method would avoid impacts on any turtles inhabiting these waterbodies. Texas Eastern proposes to use the HDD method to cross these two waterbodies, if feasible. Texas Eastern has indicated that the open-cut method would be used to install the pipeline across Chester Creek if the HDD method is unsuccessful (see section 4.3.2). Therefore, impacts on suitable red-bellied turtle habitat and individual turtles, if present, could occur as the result of installing the pipeline across Chester Creek using this alternative crossing method. In section 4.3.2, we have recommended that Texas Eastern prepare a site-specific crossing plan, including mitigative measures that would be implemented, if an alternative crossing technique is used to install the pipeline across Chester Creek. To avoid or minimize impacts on red-bellied turtle if an alternative crossing method is necessary, **we also recommend that:**

- **Texas Eastern consult with the PAFBC to identify measures to avoid or minimize impacts on red-bellied turtle habitat and individuals during construction of the pipeline across Chester Creek using an open-cut crossing method. Copies of correspondence with the PAFBC should be filed with the Commission <u>prior to construction of the non-HDD crossing method</u>.**

Pied-billed grebe

The pied-billed grebe is a state-listed endangered species in New Jersey. Pied-billed grebes are not known to use the proposed LNG terminal site but have been documented in the vicinity of the site (NJDEP, 2003d). The pied-billed grebe is a small duck-like diving bird of freshwater marshes, lakes, ponds, bogs, reservoirs, and slow moving rivers. Historically, pied-billed grebes were a common nesting species in suitable habitat in New Jersey. By 1940, however, human activities (primarily hunting for both food and feathers) had reduced the numbers of nesting pairs in the state to 12. From the 1940s through the 1960s, pied-billed grebe populations increased as large amounts of land were protected and managed for waterfowl. Since then, the number of nesting grebe populations has declined.

Pied-billed grebes spend nearly all of their time in water. They are particularly well adapted to swimming underwater where they forage for mollusks and crustaceans. Pied-billed grebes nest in freshwater marshes associated with slow moving rivers, ponds, bogs, lakes, and reservoirs. Breeding sites are typically associated with areas of fairly deep water interspersed with submerged or floating aquatic vegetation and dense emergent vegetation such as cattails, common reed, and bulrushes (NJDFW 2003). During the non-breeding season, pied-billed grebes can be found in a variety of aquatic habitats, including brackish and tidal areas when freshwater freezes (Andrle and Carroll, 1988).

Wetland surveys identified emergent wetlands at the LNG terminal site that could be used by grebes during the non-breeding season, when individuals have less rigid habitat requirements, are highly mobile, and move according to weather patterns and food availability. The emergent wetlands on the proposed site, however, do not contain open-water areas that would make them suitable breeding habitat for pied-billed grebes. The only open-water areas on the site are drainage ditches, which have strong, tidally influenced currents that make them unsuitable for nesting grebes. Additionally, no grebes were seen or heard during wetland surveys in April, May, and August 2003 (Environmental Resource Management, 2003). Pied-billed grebes are extremely secretive during the breeding season, but when disturbed, they make a distinctive alarm call that would likely have been heard during wetland surveys if individuals were on the site.

The agencies did not request that Texas Eastern conduct surveys for pied-billed grebe along the pipeline route. However, records indicate that pied-billed grebes nest in the wetlands adjacent to Birch Creek near MP 9.2 and may also use suitable habitat along Raccoon Creek (Enviroweb, 2003). A habitat assessment conducted by Texas Eastern determined that suitable habitat for the pied-billed grebe does not exist at these wetland areas due to the lack of open-water wetland habitat. Results of this assessment were submitted to the NJDFW in August 2004. The NJDFW replied in January 2005 and indicated that grebes are known to inhabit at least a portion of the proposed project area year-round. The NJDFW expressed concern about potential impacts on grebes during the breeding season and stated that it would likely require timing restrictions to avoid or minimize potential impacts during this period.

Texas Eastern proposes to use the HDD method to cross Birch and Raccoon Creeks, thus minimizing potential impacts on pied-billed grebes that may utilize these waterbodies as foraging habitat. However, the current proposed alignment of the HDD for Birch Creek does not avoid all of the emergent wetland area adjacent to the waterbody. Because the NJDFW has indicated that grebes are known to occur in the area and are concerned with potential impacts during the breeding season the NJDFW may impose restrictions on constructing in this area. **We recommend that:**

- **Texas Eastern file copies of correspondence with the NJDFW documenting any mitigation measures for the pied-billed grebe with the Secretary <u>prior to construction of the pipeline</u>.**

With implementation of our recommendation and the use of the HDD method to cross Birch and Raccoon Creeks, the proposed project is not likely to have adverse impacts on the pied-billed grebe.

Peregrine Falcon

The peregrine falcon was federally listed as endangered in 1970 and state-listed as endangered by New Jersey in 1974 and by Pennsylvania in 1984. The breeding population of peregrine falcons in eastern North America was extirpated by the mid-1960s primarily due to the use of the pesticide dichlorodiphenyltrichloroethane (DDT) (PADCNR, 2003, NJDFW, 2003). The use of DDT was banned in the United States in 1972 and a Peregrine Falcon Recovery Plan was initiated in 1975. Since that time, a reintroduction program as well as the installation of artificial nest sites have resulted in stable breeding populations in most of the eastern United States. Because of these programs the national recovery goals

were met and the peregrine falcon was removed from the federal endangered species list in 1999 (NJDFW, 2003). However, the peregrine falcon remains a state-listed species in New Jersey and Pennsylvania. Peregrine falcons historically nested along the cliffs and rocky outcrops of the Delaware River. As humans moved into their habitats, peregrine falcons incorporated the use of man-made structures such as bridges and tall buildings into its breeding and foraging habitats.

Peregrine falcons are found near the project and have been known to nest on the Commodore Barry Bridge (COE, 1997). Given the distance of the bridge from the LNG terminal site (upstream about 3 miles) and the regular disturbance associated with traffic on the bridge and boat traffic on the Delaware River, it is unlikely that the falcons would be affected by the project even if a pair of peregrine falcons is nesting on the bridge during construction.

4.8 LAND USE, RECREATION, AND VISUAL RESOURCES

4.8.1 Land Use

4.8.1.1 LNG Terminal

The proposed LNG terminal would be located on a privately owned site on the south side of the Delaware River in Logan Township, Gloucester County, New Jersey. The site consists of approximately 175 acres of land between U.S. Route 130 and the Delaware River. The site is currently undeveloped and contains mostly wetlands and active and inactive farm fields. The active farm fields have most recently been planted in soybeans. Historically (primarily between the 1930s and 1960s) the site was used for dredged material disposal. The site is currently zoned as 'light industrial' by Logan Township. Permitted uses within light industrial areas include freight terminals, light manufacturing, and warehousing. Ten pipelines (two natural gas pipelines, one nitrogen pipeline, three inactive pipelines, and four product pipelines) traverse the site.

Of the 175-acre site, about 39 acres would be permanently developed for the LNG terminal facilities. Table 4.8.1-1 summarizes the acres of each land use that would be affected by the proposed LNG terminal. In addition to the 39 acres permanently developed for the LNG terminal facilities, about 4 acres would be used as a temporary staging and expanded work area during construction. The 4-acre area would be located in the southeast corner of the site adjacent to the access road and approximately 300 feet north of U.S. Route 130 and would include construction offices, material storage, and parking. The facility septic system would also be located in this area. The majority of the 4 acres would be graded and returned to open space after construction; however, 0.5 acre would be used for a septic system drain field. Dual feed electric transmission lines would be extended to the LNG terminal site from the existing Conectiv electric substation across U.S. Route 130 from the site entrance and along the site access road to the terminal area. About 3,500 feet of transmission line would be supported by transmission poles spaced an average of 225 feet apart.

TABLE 4.8.1-1

Land Area Affected by the Proposed LNG Terminal

Description	Wetlands (acres)	Cropland (acres)	Upland Shrub (acres)	Industrial/Developed (acres)	Total (acres)
Existing Site Conditions	109.2	60.8	3.1	1.7 a/	174.8
Proposed Site Conditions	109.2	25.4	1.6	38.6 b/	174.8
Land Use Change	0.0	(35.4)	(1.5)	36.9	0.0

a/ Includes existing farm roads.

b/ Includes the 1.7 acres of existing farm roads plus an additional 2.4 acres for roads, 1.3 acres for administrative areas, 18.1 acres for LNG storage, 13.9 acres for LNG process areas, and 1.2 acres for tie-in to the existing natural gas pipeline systems on site.

The Crown Landing LNG Project would also require about 32.55 acres of riverbed associated with the Delaware River for a pier (approximately 2.25 acres) and berthing facilities (approximately 30.3 acres, including the area to be dredged). The majority of the offshore ship unloading facility would be located in Delaware waters within the boundaries of New Castle County.

Existing land uses surrounding the proposed LNG terminal site include a mixture of industrial, agricultural, open space, and scattered residential uses. Land use on the New Jersey side of the Delaware River is dominated by agricultural and open space uses with scattered residential and industrial uses. Northeast of the proposed LNG terminal site are two industrial facilities, the Logan Generating Station

and Ferro Industries plant. The Delaware and Pennsylvania side of the Delaware River, which is about 1.1 miles wide at the proposed LNG terminal site, is more heavily developed than the New Jersey side. The river frontage on the Delaware and Pennsylvania side is dominated by heavy industrial uses such as oil refineries and petrochemical industries.

4.8.1.2 Pipeline Facilities

The Logan Lateral Project would involve construction of a 30-inch-diameter pipeline that would connect the LNG terminal with the existing Texas Eastern natural gas pipeline system in Brookhaven Borough, Delaware County, Pennsylvania.[5] The pipeline would consist of about 11 miles of 30-inch-diameter pipeline in Delaware County, Pennsylvania (4.9 miles) and Gloucester County, New Jersey (6.1 miles). Table 4.8.1-2 summarizes the land uses crossed by the proposed pipeline route.

TABLE 4.8.1-2

Land Uses Crossed by the Pipeline Route for the Logan Lateral Project

State	Open Land a/ (miles)	Roadway/ Railroads b/ (miles)	Forest Land c/ (miles)	Agricultural Land d/ (miles)	Open Water e/ (miles)	Commercial/ Industrial Land f/ (miles)	Other Land g/ (miles)	Residential Land h/ (miles)	Total (miles)
Pennsylvania	0.9	1.6	0.9	0.0	0.5	0.6	0.3	0.1	4.9
New Jersey	3.1	0.2	0.8	1.5	0.5	0.0	0.0	0.0	6.1
Project Total	4.0 (36%)	1.8 (16%)	1.7 (15%)	1.5 (14%)	1.0 (9%)	0.6 (6%)	0.3 (3%)	0.1 (1%)	11.0 (100%)

a/ Open land consists of vacant parcels or open space not specifically designated for outdoor recreation. Includes mowed areas (not residential lawns) and undeveloped areas of property owned by commercial/industrial operations or private residents. Also includes open field regrowth and upland scrub. Emergent and scrub-shrub wetlands and open maintained existing pipeline right-of-way are also included in this land use category.
b/ Roadway and railroads include both state and federal road and road right-of-way crossings and all active railroad crossings.
c/ Forest land consists of upland and wetland forest areas not being used for agricultural or forestry specific purposes.
d/ Agricultural land consists of areas primarily used for active cropland, orchards, vineyards, or hay fields.
e/ Open water includes stream crossings greater than 10 feet in width (e.g., the Delaware River crossing).
f/ Commercial/industrial land includes electric power plants or gas utility stations, manufacturing or industrial plants, and commercial or retail facilities.
g/ Other land includes special use areas including schools, parks, and churches.
h/ Residential land consists of areas used primarily for private dwellings. Residential yards, subdivisions, and planned new residential developments are also included in this land use category.

Of the 11 miles of the proposed pipeline, about 6.4 miles (58 percent) would be constructed within or adjacent to various existing rights-of-way. Of the 6.4 miles, 3.1 miles would be located within Texas Eastern's existing pipeline easement (1.4 miles) or other existing pipeline easements (1.7 miles), 3.1 miles would be located within existing roadways, and 0.2 mile would be located within an existing railroad right-of-way. The remaining 4.6 miles (42 percent) would be constructed on newly created right-of-way. The predominant land use that would be crossed is open land comprising about 4.0 miles (36 percent) of the pipeline route. The remaining land uses crossed include roadway/railroads (1.8 miles or 16 percent), forest land (1.7 miles or 15 percent), agricultural land (1.5 miles or 14 percent), open water (1.0 mile or 9 percent), commercial/industrial land (0.6 mile or 6 percent), other land (0.3 mile or 3 percent), and residential land (0.1 mile or 1 percent). The construction right-of-way associated with the pipeline would also be located within 50 feet of several residences (see section 4.8.3.2).

Land use impacts associated with the pipeline would include the disturbance of existing land uses within the right-of-way during construction and retention of a new permanent right-of-way for operation

[5] The tie in with the Columbia Gas and Transco natural gas pipeline systems would occur within the proposed LNG terminal site.

of the pipeline. Texas Eastern proposes to use a maximum 100-foot-wide construction right-of-way. The construction right-of-way would be reduced as necessary in residential and wetland areas. A 50-foot-wide right-of-way would be permanently retained in all areas except at road crossings and within roadways where the right-of-way width would be as permitted by the local agencies. The typical right-of-way cross sections that Texas Eastern would use for the proposed pipeline are provided in Appendix B. In addition to the construction right-of-way, Texas Eastern would use various temporary extra workspaces, staging areas, and access roads to facilitate construction activities. No pipe yards have been identified by Texas Eastern at this time. The locations and sizes of the identified temporary extra workspaces and staging areas are listed in table C-1 in Appendix C. Table C-2 in Appendix C lists the proposed access roads that would be used during construction of the Logan Lateral Project.

Texas Eastern proposes to modify and upgrade one existing aboveground facility and would construct two new aboveground facilities. Modifications and upgrades would be made to Chester Junction, which is an existing 1.3-acre fenced facility located on a 5.7-acre site owned by Texas Eastern within a residential neighborhood in the Borough of Brookhaven. The work would be conducted within the limits of the existing site and no new property would need to be acquired by Texas Eastern. The Logan mainline valve at MP 2.1 would be a new facility located partially within Texas Eastern's existing right-of-way in an open area behind buildings associated with the I-95 Industrial Park. Texas Eastern would need to acquire an additional 0.1 acre of land for construction and operation of this facility. The new Crown Landing meter and regulation station would be located within the proposed developed area of the 175-acre LNG terminal site. The facility would require a 0.5-acre area within the site.

Construction of the pipeline facilities would disturb a total of about 177.3 acres of land, including the pipeline construction right-of-way, temporary extra workspace and staging areas, access roads, and aboveground facilities. Of this total, 101.1 acres would be disturbed by the pipeline construction right-of-way, 65.6 acres would be disturbed by temporary extra workspace and staging areas, 4.4 acres would be disturbed by access roads, and 6.2 acres would be disturbed by aboveground facilities. Table 4.8.1-3 summarizes the acres of each land use that would be affected by construction and operation of the proposed pipeline facilities.

Open land would be the primary land use affected by construction of the pipeline facilities totaling about 51.5 acres (29 percent). The remaining land uses that would be disturbed consist of 50.8 acres (29 percent) of agricultural land, 23.4 acres (13 percent) of forest land, 17.7 acres (10 percent) of roadway/railroad, 16.8 acres (9 percent) of commercial/industrial land, 15.4 acres (9 percent) of other land, 1.4 acres (1 percent) of residential land, and 0.3 acre (<1 percent) of open water.

Of the 177.3 acres of land affected by construction of the pipeline facilities, about 54.1 acres would be retained as permanent right-of-way for the pipeline and 1.8 acres for the aboveground facilities. The land that is retained as permanent right-of-way for the pipeline would be allowed to revert to former use with certain restrictions. Activities such as the construction of aboveground structures, including houses, house additions, garages, patios, pools, or any other object not easily removable, or the planting and cultivating of trees or orchards, would be prohibited within the permanent right-of-way. The remaining 121.5 acres that are used for construction would be allowed to revert to prior uses following construction with no restrictions.

TABLE 4.8.1-3

Acres of Land Affected by Construction and Operation of the Pipeline Facilities for the Logan Lateral Project

State/Facility	Open Land (acres)		Agricultural Land (acres)		Forest Land (acres)		Roadway/Railroad (acres)		Commercial/Industrial Land (acres)		Other Land (acres)		Residential Land (acres)		Open Water (acres)		Total (acres)	
	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.
Pennsylvania																		
Pipeline Right-of-Way a/	6.2	5.3	0.0	0.0	12.4	4.8	8.8	0.0	9.4	3.8	3.8	2.0	1.4	0.3	0.1	2.8	42.1	18.9
Temporary Extra Workspace and Staging Areas	3.8	0.0	0.0	0.0	5.4	0.0	0.1	0.0	1.6	0.0	11.5	0.0	0.0	0.0	0.0	0.0	22.5	0.0
Access Roads	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
Aboveground Facilities b/	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	5.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	5.8	1.3
Pennsylvania Subtotal	10.1	5.4	0.0	0.0	17.8	4.8	9.8	0.0	16.8	5.1	15.4	2.0	1.4	0.3	0.1	2.8	71.4	20.2
New Jersey																		
Pipeline Right-of-Way a/	32.0	18.8	18.7	9.3	3.7	3.8	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	3.3	59.0	35.1
Temporary Extra Workspace and Staging Areas	9.4	0.0	31.7	0.0	1.9	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.2	0.0
Access Roads	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0
Aboveground Facilities c/	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
New Jersey Subtotal	41.4	18.8	50.8	9.7	5.6	3.8	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	3.3	106.0	35.6
Pipeline Facilities Subtotal																		
Pipeline Right-of-Way	38.2	24.1	18.7	9.3	16.1	8.5	13.1	0.0	9.4	3.8	3.8	2.0	1.4	0.3	0.3	6.1	101.1	54.1

TABLE 4.8.1-3 (cont'd)

Acres of Land Affected by Construction and Operation of the Pipeline Facilities for the Logan Lateral Project

State/Facility	Open Land (acres)		Agricultural Land (acres)		Forest Land (acres)		Roadway/Railroad (acres)		Commercial/Industrial Land (acres)		Other Land (acres)		Residential Land (acres)		Open Water (acres)		Total (acres)	
	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.
Temporary Extra Workspace and Staging Areas	13.2	0.0	31.7	0.0	7.3	0.0	0.3	0.0	1.6	0.0	11.5	0.0	0.0	0.0	0.0	0.0	65.6	0.0
Access Roads	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0
Aboveground Facilities	0.1	0.1	0.5	0.5	0.0	0.0	0.0	0.0	5.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	6.2	1.8
Pipeline Facilities Total	51.5	24.1	50.8	9.7	23.4	8.5	17.7	0.0	16.8	5.1	15.4	2.0	1.4	0.3	0.3	6.1	177.3	55.8

a/ Based on a 100-foot-wide construction right-of-way. Some areas would have a reduced construction right-of-way to avoid impacts on residential and wetland areas. Operation acreage is based on a 50-foot-wide permanent right-of-way in all areas except at road crossings and within roadways where the right-of-way width would be as permitted by the local agencies. Beginning at approximately MP 10, the pipeline right-of-way would be located within the proposed 175-acre LNG terminal site but does not overlap the 39 acres that would be permanently developed for the terminal facilities.

b/ The modifications and upgrades at Chester Junction would be conducted within the existing 1.3-acre fenced facility located on a 5.7-acre site owned by Texas Eastern. The work would be conducted within the limits of the existing site and no new property would need to be acquired by Texas Eastern. The Logan mainline valve would require an additional 0.1 acre outside of Texas Eastern's existing right-of-way.

c/ The Crown Landing meter and regulation station would be located within the developed area (i.e., 39 acres) of the 175-acre LNG terminal site.

Const. Construction Impacts
Oper. Operation Impacts
Note: The totals shown in this table may not equal the sum of addends due to rounding.

The majority of the pipeline would be located on privately owned lands. Public lands that would be crossed include roads, waterbodies, one small tract of forested property associated with a sewage treatment plant south of Chester Creek owned by Aston Township, two small tracts of forested property owned by Chester Township, and one municipal park owned by the City of Chester (see section 4.8.5.1). Texas Eastern would need to acquire easements or property to construct and operate the proposed facilities. The easement would convey both temporary (for construction) and permanent rights-of-way to Texas Eastern and would give Texas Eastern the right to construct, operate, and maintain the pipeline facilities. Texas Eastern would negotiate a one-time payment for each easement. An easement agreement between a company and a landowner typically specifies compensation for losses resulting from construction, including losses of non-renewable and other resources, damages to property during construction, and restrictions on existing uses that would not be permitted on the permanent right-of-way after construction.

If an easement cannot be negotiated with a landowner and the project has been certificated by the FERC, the company may use the right of eminent domain granted to it under section 7(h) of the NGA and the procedures set forth under the Federal Rules of Civic Procedure (Rule 71A) to obtain the right-of-way and extra workspace areas. The company would still be required to compensate the landowner for the right-of-way and damages incurred during construction. However, the level of compensation would be determined by a court according to state or federal law. In either case, Texas Eastern would compensate landowners for use of the land.

4.8.2 Existing Residences and Planned Developments

4.8.2.1 LNG Terminal

Existing Residences

Based on a review of aerial photographs and supported by a field survey, about 20 residences are located within 1 mile of the entrance to the proposed LNG terminal site. The closest residence is approximately 2,300 feet from the proposed LNG terminal. All but three of the houses are located across U.S. Route 130 from the proposed LNG terminal site. Of the 20 houses, nearly all are located in clusters south and southeast of the site along U.S. Route 130 and Center Square Road. The other houses are scattered along the south side of U.S. Route 130 and in Oldmans Township. As of 2000, the population living in a 1 mile radius of the proposed LNG terminal site was approximately 28. The population living in a 2 mile radius of the site, which includes portions of Delaware and Pennsylvania on the other side of the river, was approximately 3,538 (U.S. Bureau of the Census, 2001).

During construction of the LNG terminal, short-term impacts on nearby residences could include increased construction-related traffic on local roads, dust generated during site construction, and noise from construction equipment. In general, as the distance to the construction site increases, the impacts on these areas decrease. Additional information on measures Crown Landing would implement to reduce impacts associated with increased traffic, dust, and noise is presented in sections 4.9.4, 4.11.1, and 4.11.2, respectively.

Potential impacts on nearby residences during operation of the LNG terminal include increased visibility of aboveground structures associated with the facility, increased traffic, changes in air quality, and safety hazards. These impacts and applicable mitigation measures are discussed in sections 4.8.6.1, 4.9.4, 4.11.1, and 4.12 respectively.

Planned Developments

There are no planned residential, commercial, or industrial developments within 2 miles of the proposed LNG terminal site. The closest planned development to the LNG terminal site is a proposal for residential development approximately 2 miles northeast of the site on land adjacent to the eastern side of the Ferro Industries plant and southwest of Raccoon Creek. Logan Township has also expressed possible interest in developing a riverfront park on land near the Commodore Barry Bridge. The Wharf on the Boardwalk is a commercial development currently under construction on the site of a former power plant in Chester, Pennsylvania about 3.2 miles northwest of the LNG terminal site. Because of the distance between these developments and the proposed LNG terminal site, the facility is not expected to conflict with the development plans. However, the pipeline associated with the Logan Lateral Project would cross a portion of the Wharf on the Boardwalk development (see section 4.8.2.2).

4.8.2.2 Pipeline Facilities

Existing Residences

Texas Eastern's proposed construction work area for the pipeline facilities (i.e., construction right-of-way and temporary extra workspaces) would be located within 50 feet of 147 residences or residential structures (e.g., garages, sheds). Of these 147 residential structures, 29 would be located within 25 feet of the construction work area, including 18 within 10 feet. There are also nine commercial/industrial buildings located within 50 feet of the construction work area. Table F-1 in Appendix F lists these residences and commercial/industrial buildings by milepost and indicates the distance of each from the proposed construction work area. There are no additional residences or commercial/industrial buildings located within 50 feet of the proposed aboveground facilities.

In residential areas, typically the two most significant impacts associated with construction and operation of a pipeline are disturbance during construction and encumbrance of property for future uses (e.g., the limitation on future permanent structures within the permanent right-of-way). Residences within 50 feet of the construction work area would be most likely to experience the effects of construction and operation of the project. In general, as the distance to the construction work area increases, the impacts on residences decrease.

Temporary construction impacts on residential areas could include inconvenience caused by noise and dust generated by construction equipment, personnel, and trenching of roads or driveways; ground disturbance of lawns; removal of trees, landscaped shrubs, or other vegetative screening between residences and/or adjacent rights-of-way; potential damage to existing septic systems or wells; and removal of aboveground structures, such as sheds or trailers, from within the right-of-way. In addition, as previously discussed, Texas Eastern proposes to construct the pipeline immediately adjacent to or within five city streets in Pennsylvania (Trimble Boulevard, Clearwater Avenue, Felton Avenue, Bethel Road, and Palmer Street).

Texas Eastern would implement the following general measures to minimize construction-related impacts on residences and other structures located within 50 feet of the construction right-of-way:

- notify landowners in advance of construction activities and any scheduled disruption of household utilities;
- adhere to the residential mitigation measures contained in the SESC Plan;

- fence the construction work area for a length of 100 feet on either side of a residence to ensure that construction equipment and materials stay within the confines of the approved construction right-of-way;

- maintain a minimum of 25 feet between the residence and the construction work area for a distance of 100 feet on either side of the residence;

- secure all open ditches with orange safety fencing;

- minimize the duration of an open trench to the contractor's working hours for a distance of 100 feet on either side of a nearby residence;

- use the stovepipe or drag section construction method;

- offer to temporarily relocate the landowner to a motel and provide a meal allowance if construction activities in a residential area disrupts landowner ingress/egress to the affected residence;

- attempt to leave mature trees and landscaping intact within the construction right-of-way unless the trees and landscaping interfere with the pipe installation techniques or present unsafe working conditions;

- restore all lawn areas immediately after backfilling the trench;

- restore fences, mailboxes, and other structures that were removed during construction;

- restore sidewalks, driveways, and roads as soon as practical after construction; and

- contact landowners after construction to ensure that conditions of all agreements have been meet.

In addition, Texas Eastern would prepare site-specific residential construction mitigation plans to minimize disruption and maintain access to the residences located within 50 feet of the construction work area. We have also recommended that Texas Eastern prepare a Traffic Management Plan for construction within or adjacent to city streets to ensure that impacts associated with in-street construction are minimized (see section 4.9.4.1).

Residential properties encumbered by pipeline easements would sustain long-term impacts associated with the permanent right-of-way. The easements would prohibit certain types of use, such as the construction of aboveground structures, including house additions, garages, patios, pools, or any other object not easily removable, or the planting and cultivating of trees or orchards. However, because the pipeline would be installed within roadways for much of the route through residential areas, many of the residences within 50 feet of the construction work area would not be affected by the permanent right-of-way.

Texas Eastern would also apply the mitigation measures identified above to the nine commercial/industrial structures located within 50 feet of the construction work area.

Planned Developments

Six planned developments have been identified as being crossed or located within 0.25 mile of the proposed pipeline route. The locations of these planned development and the distance to the proposed pipeline route are presented in table 4.8.2-1.

TABLE 4.8.2-1

Planned Developments within 0.25 Mile of the Proposed Pipeline Route

State	Approx. Milepost	Planned Development	Approx. Distance from Pipeline Route	Project Start and End Dates
Pennsylvania				
	0.0	Proposed Senior Home /Active Adult Community Development	1,000 feet	None Given
	0.08-0.15	10,000 SF Office Space	NA – Crossed	None Given
	1.66	Rails-to-Trails Project	NA – Crossed	None Given
	2.59	Chester Charter School/Franklin Elementary	500 feet (Would be used for a staging area)	None Given
	4.47	Renovated Office Space – Parking Lot/Wharf on the Boardwalk	NA – Crossed	None Given/Currently Under Construction
New Jersey				
	7.57	Delaware River, Equine, Agriculture, and Marine Park	NA – Crossed	Construction may begin early 2006

Within the Borough of Brookhaven an active adult community development is proposed south of Ridley Creek between Brookhaven Road and Radio Park Lane about 1,000 feet northwest of the beginning of the pipeline route at Chester Junction. According to both the Borough Zoning Officer and the County Planning Board, this development is currently under preliminary review and no construction schedule has been provided. The installation of the proposed pipeline would not interfere with the future construction of this development (Hampton, 2003).

According to the Delaware County Planning Board, Faith Baptist Church owns a portion of the area located between Williamson Avenue and Edgemont Avenue. In July 2002 the church was given approval to subdivide their property and construct a 10,000 square foot office building; however, this development has not been built and no construction schedule has been filed with the county. Because the proposed pipeline would be constructed adjacent to Texas Eastern's existing pipeline in this area, no impacts on this planned development are anticipated.

The proposed pipeline would cross an abandoned railroad line within the limits of a sewage treatment facility at about MP 1.66. A community group called the Friends of Chester Creek is in the process of trying to turn the inactive rail line into a trail. According to the Friends of Chester Creek, the proposed rails-to-trails project is in the final planning stages and they are trying to secure right-of-way (Fusco, 2003); however, no permits have been obtained and no plans have been submitted to the township. Construction of the pipeline could temporarily affect this planned development if it were to occur after the trail is in operation or if the construction schedules of both projects overlap. Because of its location below ground, operation of the Logan Lateral Project would not affect use of the proposed trail.

Within Chester Township plans have also been filed with the county for the expansion of the Chester Charter School located on Green Avenue. The school is currently vacant and partially burned-out but the plans indicate an expansion of this facility although construction plans are currently on hold. The

proposed pipeline route would be about 500 feet south of the building but Texas Eastern is planning to utilize the property surrounding the school for a staging area. The staging area would be used temporarily during construction and should not interfere with future development plans.

The existing PECO Chester Generating Station located adjacent to the Delaware River is currently being renovated for "Class A" office space by Rivertown Developers LP. A parking lot associated with the building is currently under construction. The proposed pipeline would cross the Delaware River adjacent to the office building and would cross the associated parking lot, which would be completed before pipeline construction. As a result, the installation of the pipeline would impact the newly constructed parking lot. To minimize parking-related impacts, Rivertown Developers LP has indicated that they could provide a vacant lot that Texas Eastern could asphalt in order to provide alternate parking for tenants during construction. Texas Eastern would repair any construction-related damage to the permanent parking lot after completion of construction. The portion of the development referred to as the Wharf on the Boardwalk would not be directly affected by pipeline construction or operation. Prior to construction, Texas Eastern would work with Rivertown Developers LP to minimize noise and traffic-related impacts on the development. We also evaluated alternative Delaware River crossing locations that would avoid this new development. However, these alternatives were not considered to be environmentally preferable to the proposed pipeline route (see section 3.5.2).

Within Logan Township, Gloucester County, New Jersey, a project proposal championed by the County Improvement Authority is in the final planning stages and would include conversion of a dredge spoil area to a proposed equestrian park south of Raccoon Creek and west of U.S. Route 130. The park, referred to as the Delaware River, Equine, Agriculture, and Marine Park would encompass 1,400 acres of land extending from the Delaware River to U.S. Route 130, and from Raccoon Creek to Birch Creek. Construction could begin on the equestrian park in 2006 (Gloucester County Improvement Authority, 2005). The proposed pipeline would cross the property under consideration for the equestrian park; however, no conflicts have been identified.

In addition to these planned developments, two dredge disposal sites proposed by the COE for its Delaware River Main Channel Deepening Project could be affected by the proposed Logan Lateral Project. One of the dredge disposal sites is located on Raccoon Island. The portion of the proposed pipeline route along Ferry Road on the island crosses this proposed disposal site. The other dredge disposal site is located west of Raccoon Creek adjacent to U.S. Route 130 (Site 15D). Texas Eastern met with the COE to discuss the proposed dredging of the Delaware River and the use of the proposed Raccoon Island Site and Site 15D for the disposal of dredged material. Texas Eastern is currently evaluating several options discussed with the COE to accommodate both the proposed dredging project and the Logan Lateral Project.

4.8.3 Coastal Zone Management

In 1972, Congress passed the CZMA to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the nation's coastal zone for this and succeeding generations" and to "encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone" (16 USC 1452, section 303 (1) and (2)).

Section 307 (c)(3)(A) of the CZMA states that "any applicant for a required federal license or permit to conduct an activity, in or outside the coastal zone, affecting any land or water use or natural resource of the coastal zone of that state shall provide a certification that the proposed activity complies with the enforceable policies of the state's approved program and that such activity will be conducted in a manner consistent with the program." In order to participate in the coastal zone management program, a

state is required to prepare a program management plan for approval by the NOAA, Office of Coast and Ocean Resource Management (OCRM). Once the OCRM has approved a plan and its enforceable program policies, a state program gains "federal consistency" jurisdiction. This means that any federal action (e.g., a project requiring federally issued licenses or permits) that takes place within a state's coastal zone must be found to be consistent with state coastal policies before federal action can take place.

The Crown Landing LNG and Logan Lateral Projects are subject to a federal Coastal Zone Consistency Review because they would 1) involve activities within the coastal zones of New Jersey, Delaware, and Pennsylvania as described in sections 4.8.3.1, 4.8.3.2, and 4.8.3.3, respectively; and 2) require several federal permits and approvals (see tables 1.3-1 and 1.3-2). New Jersey, Delaware, and Pennsylvania all have approved coastal zone management programs administered by the NJDEP, the DNREC, and the PADEP, respectively. A description of each state's program, the applicable project activities, and information provided by Crown Landing in its FERC section 3(a) application and Texas Eastern in its FERC section 7(c) application regarding consistency of the projects with state policies is provided below. NOAA has indicated that because neither Delaware, New Jersey, nor Pennsylvania have completed the interstate consistency consultation and program change processes described in 15 CFR 930 subpart I, New Jersey can only review that part of the Crown Landing LNG and Logan Lateral Projects located in New Jersey, Delaware can only review that part of the Crown Landing LNG Project located in Delaware, and Pennsylvania can only review that part of the Logan Lateral Project located in Pennsylvania. However, the NJDEP claims that the Compact of 1905 between New Jersey and Delaware gives New Jersey exclusive riparian jurisdiction of every kind and nature on its side of the Delaware River (see section 4.8.3.2).

4.8.3.1 New Jersey

The New Jersey Coastal Management Program (NJCMP) was approved by the OCRM in 1980 and updated in 2000. Federal consistency reviews are conducted by the NJDEP using the Coastal Zone Management rules, which contain several state laws that are the primary implementing authorities for the NJCMP. These laws included the Coastal Area Facility Review Act (CAFRA), the Waterfront Development Law, and the Wetlands Act of 1970, Tidelands Statues, and the Hackensack Meadowlands Reclamation and Development Act (NJDEP, 2002b). In addition to its coastline along the Atlantic Ocean, New Jersey's coastal zone includes, among other areas, the Delaware River and Bay and other tidal streams of the Atlantic Coastal Plain. New Jersey defines its coastal management area as including all lands up to 500 feet from mean high water.

The activities associated with the Crown Landing LNG and Logan Lateral Projects within the coastal zone of New Jersey and subject to the policies of the NJCMP include:

- LNG ship transit in New Jersey waters;
- the portion of the pier associated with the LNG terminal in New Jersey waters;
- the LNG terminal and associated transmission line facilities; and
- approximately 0.9 mile of the pipeline adjacent to and within the Delaware River, Raccoon Creek, Birch Creek, and two unnamed tidal waterways.

Although only a portion of the pier would be located in New Jersey waters, the NJDEP has stated that construction of the entire pier and any associated dredging would be subject to New Jersey's exclusive review and permitting authority (see section 4.8.3.2).

The Crown Landing LNG Project is not subject to the CAFRA or the Hackensack Meadowlands Reclamation and Development Act because the project facilities are not located within the areas subject to these laws[6]; however, it is subject to the other laws associated with the NJCMP. On January 7, 2005, Crown Landing filed a compliance statement for coastal zone management rules as part of its Waterfront Development Permit application. The compliance statement indicated that the Crown Landing LNG Project was designed to comply with the coastal zone rules; however, on February 4, 2005, the NJDEP indicated that Crown Landing's Waterfront Development Permit application was deficient and requested additional information. Crown Landing provided the additional information on May 11, 2005 but received a second notice of deficiency from the NDJEP on July 15, 2005. On August 23, 2005, Crown Landing provided the NJDEP with additional information requested in the second notice of deficiency.

On June 10, 2005, Texas Eastern filed a compliance statement for coastal zone management rules as part of its Waterfront Development Permit application. Texas Eastern indicated that the Logan Lateral Project would be in compliance with all applicable coastal zone rules; however, in late September 2005, the NJDEP requested that Texas Eastern withdraw its Waterfront Development Permit application because it was approaching the time limit for department review under New Jersey's 90-day Construction Law. The NJDEP indicated that Texas Eastern could not adequately justify the purpose and need for the Logan Lateral Project until the issues associated with the Crown Landing LNG Project were resolved (see section 4.8.3.2). Texas Eastern withdrew its permit application on October 7, 2005.

If the Crown Landing LNG and Logan Lateral Projects are approved by the Commission, concurrence from the NJDEP that the projects are consistent with the NJCMP must be received prior to any issuance of a Notice to Proceed with construction from the Secretary of the FERC. Therefore, **we recommend that:**

- **Crown Landing and Texas Eastern file documentation of concurrence from the NJDEP that the projects are consistent with the NJCMP with the Secretary <u>prior to construction</u>.**

4.8.3.2 Delaware

The agency responsible for implementing Delaware's coastal zone management program is the DNREC. The Delaware Coastal Management Program (DCMP) was approved by the OCRM in 1979 and updated in 1993 and 1998. Delaware differentiates between the 'coastal zone' and the 'coastal strip' of the state. The coastal zone includes the entire state, which is managed by the DCMP through several state laws and authorities, including the federal CZMA. The coastal strip was defined by the Delaware State Coastal Zone Act of 1971 (DSCZA) as a band of land approximately 4 miles wide that parallels the entire Delaware coastline. The DSCZA is the primary authority for regulating heavy industry, manufacturing, and bulk transfer facilities in the coastal strip (DNREC, 2004b). The DSCZA is also incorporated into the DCMP.

The offshore facilities of the Crown Landing LNG Project would be located within the coastal zone of Delaware, which extends to the New Jersey shoreline. The offshore facilities would also be located within the coastal strip as defined by the DSCZA. For these reasons, the State of Delaware has claimed permitting authority for these facilities.

[6] The CAFRA area begins where the Cheesequake Creek enters Raritan Bay in Old Bridge in Middlesex County and extends south along the coast around Cape May and north along Delaware Bay to the Kilcohook National Wildlife Refuge in Salem County, about 15 miles downstream of the proposed LNG terminal site. The Hackensack Meadowlands District is a 19,730-acre area of water, wetlands, and associated uplands in Hudson and Bergen Counties.

According to the DSCZA, "heavy industry uses of any kind not in operation on June 28, 1971, are prohibited in the coastal zone and no permits may be issued therefore. In addition, offshore gas, liquid or solid bulk product transfer facilities which are not in operation on June 28, 1971, are prohibited in the coastal zone, and no permit may be issued therefore" (7 Del. C. 1953, § 7003; 58 Del. Laws, c. 175; 64 Del. Laws, C. 240, § 6; 66 Del. Laws, c. 256, § 1; 71 Del. Laws, c. 348, § 2). Bulk product transfer facilities are defined as "any port or dock facility, whether an artificial island or attached to shore by any means, for the transfer of bulk quantities of any substance from vessel to onshore facility or vice versa. Not included in this definition is a docking facility or pier for a single industrial or manufacturing facility for which a permit is granted or which is a nonconforming use. Likewise, docking facilities for the Port of Wilmington are not included in this definition" (7 Del. C. 1953, § 7002; 58 Del. Laws, c. 175; 61 Del. Laws, c. 116, § 88(a); 62 Del. Laws, c. 119, § 1,2; 63 Del. Laws, c. 191, § 1(a); 71 Del. Laws, c. 348, §).

Because the Crown Landing LNG Project would involve transit of LNG ships and construction of a new pier and other facilities within Delaware's coastal zone to convey LNG from ships to the terminal, a determination on whether the facilities would be a permissible use under the DSCZA is required. On December 7, 2004, Crown Landing submitted an application to the DNREC for a status determination on the new pier within Delaware's coastal zone. The application is the first step in determining whether the pier would be permitted under the DSCZA. In its application, Crown Landing claimed that the construction of the proposed pier is a permissible use under the DSCZA pursuant to the provisions of § 7002(f) of title 7 because it would exclusively support a single facility that meets the definition of "manufacturing" pursuant to § 7002(d).

In a letter dated February 3, 2005 from DNREC to Crown Landing, the DNREC issued a Coastal Zone Act Status Decision, which determined that the proposed LNG off-loading pier in the Delaware River is prohibited by the State's Coastal Zone Act. On February 15, 2005, Crown Landing filed an appeal of the February 3, 2005 ruling with the State Coastal Zone Industrial Control Board. The State Coastal Zone Industrial Control Board held a public hearing on March 30, 2005 to consider Crown Landing's appeal. The DNREC's ruling was upheld by the State Coastal Zone Industrial Control Board at the March 30, 2005 hearing. Crown Landing had 20 days to appeal the State Coastal Zone Industrial Control Board's decision to the Delaware Superior Court but no appeal was made.

Because the DSCZA is incorporated into the DCMP, Crown Landing has not filed a draft federal consistency certification with the DNREC. The DNREC's decision on the DSCZA would likely result in its objection to a consistency certification for the project. If the DNREC did object to a federal consistency certification, Crown Landing could appeal Delaware's decision to the U.S. Department of Commerce. The provisions of 15 CFR Part 930, Subpart H, outline procedures by which the Secretary of Commerce may override a state's objection if the Secretary of Commerce finds that a federal license or permit activity, which is inconsistent with the DCMP, may be federally approved because the activity is consistent with the objectives or purposes of the federal CZMA or is necessary in the interest of national security (DCMP, 2004). In order to be consistent with the objectives or purpose of the federal CZMA, an activity determined to be inconsistent with the DCMP must be found by the Secretary of Commerce to be permissible because it satisfies the following four requirements:

- the activity furthers one or more of the competing national objectives or purposes contained in sections 302 or 303 of the CZMA;
- when performed separately or when its cumulative effects are considered, it would not cause adverse effects on the natural resources of the coastal zone substantial enough to outweigh its contribution to the national interest;
- the activity would not violate any requirement of the CAA or CWA as amended; and

- there is no reasonable alternative available that would permit the activity to be conducted in a manner consistent with the DCMP.

In another development, the NJDEP in a letter dated May 24, 2005 stated that although a portion of the pier would be located in Delaware waters, construction of the entire pier and any associated dredging would be subject to New Jersey's exclusive review and permitting authority and not that of the State of Delaware. The NJDEP cited the Compact of 1905 between New Jersey and Delaware, which was approved by the legislatures of both states and the United States Congress and gives New Jersey exclusive riparian jurisdiction of every kind and nature on its side of the Delaware River. The State of New Jersey has advised the State of Delaware that Article VII of the Compact of 1905 prohibits Delaware from using its DSCZA authority or any other state permitting authority to block the construction of projects appurtenant to the New Jersey shoreline. In July 2005, New Jersey asked the U.S. Supreme Court to hear the case and in November 2005 the U.S. Supreme Court agreed (New Jersey v. Delaware, 126 S. Ct. 713 (U.S. Nov. 28, 2005)).

At the present time, this issue is not resolved. Therefore, **we recommend that:**

- **Crown Landing file documentation of concurrence from the DNREC that the projects are consistent with the DCMP with the Secretary <u>prior to construction</u>:**

4.8.3.3 Pennsylvania

Pennsylvania's coastal zone management program is administered by the PADEP and its Coastal Zone Management Plan (PCZMP) was approved by the OCRM in 1980. The PCZMP is based on a network of regulatory and non-regulatory policies that require specific coastal activities to comply with performance standards defined in the plan and in the regulations of other state authorities (PADEP, 2002). Pennsylvania's coastline along the Delaware River is 57 miles long and includes land in Bucks, Philadelphia, and Delaware Counties. The coastal zone along this area varies from about 0.1 mile wide in urban areas to over 3.5 miles in rural areas and extends to the boundary with New Jersey in the middle of the Delaware River. In the proposed project area, the coastal zone parallels the active Amtrak/SEPTA rail line running north to south. About 0.8 mile of the pipeline associated with the Logan Lateral Project would be located within the coastal zone of Pennsylvania and subject to the policies and performance standards of the PCZMP.

On October 4, 2005, Texas Eastern submitted its Commonwealth of Pennsylvania/COE Joint Permit Application, which was sent to the PADEP for a federal consistency determination. The PADEP provided its determination that the project is consistent with the PCZMP on February 17, 2006.

4.8.4 Hazardous Waste Sites

No hazardous waste sites have been identified within the proposed LNG terminal site; however, eight potential areas of concern were identified through site reconnaissance and a prior Phase I Environmental Site Assessment. Soils around two of the sites contained elevated concentrations of total petroleum hydrocarbons and one site contained elevated concentrations of arsenic. No contamination was found at the remaining five sites. Additional information on potential contamination of soils and groundwater within the LNG terminal site are provided in sections 4.2.1 and 4.3.1, respectively, and potential contamination of sediments within the Delaware River is provided in section 4.2.2.

A search of several databases was conducted to identify hazardous waste sites within 0.25 mile of the proposed pipeline facilities. The databases identified a total of 30 hazardous, potentially hazardous,

and solid waste sites crossed by or located within 0.25 mile of the proposed pipeline facilities (see table 4.8.4-1).

The proposed pipeline would cross three hazardous waste sites and would be located adjacent to three others. Two of the sites crossed by the pipeline are located in Logan Township in New Jersey and include the former Monsanto Chemical Company facility (currently Ferro Solutions) and the Logan Generating facility. Both sites have a history of spills and releases involving chemical substances such as nitrogen oxide, diesel fuel, chlorine gas, hydrochloric acid gas, and other chemicals. The Monsanto Company is a Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) site that has received no further remedial action and is listed for spill and releases in addition to other corrective actions. The Logan Generating facility is also listed for spills and releases. The third site is the PECO Chester Generating Station located adjacent to the Delaware River. The site is listed as a small-quantity generator and according to the PADEP has undergone past remediation associated with its historical use as a coal-fired generating plant. The site was reportedly remediated under the PADEP Act 2 program.

The three sites located adjacent to the proposed pipeline route include a LUST site, a solid waste facility, and a CERCLIS site. The AMF Auto Clinic is located along Edgemont Avenue and had a LUST resulting in petroleum contamination that has since been remediated. The state waste facility located adjacent to the pipeline route is the Haulaway/Bantas Transfer Station located at 2nd Street. This site is registered as a solid waste facility and landfill and is a private facility that processes municipal waste. The last site is Front Street Tanker, which is a CERCLIS site owned by the City of Chester. Two abandoned tankers were discovered onsite in 1988, one of which contained oil contaminated with PCBs.

Contaminated soils associated with these or other, undocumented hazardous waste sites could be encountered during construction of the proposed pipeline facilities. To reduce any potential impacts, we have recommended that Texas Eastern prepare a Plan for the Discovery and Management of Contaminated Soils and Groundwater (see section 4.2.1).

TABLE 4.8.4-1

Potential Hazardous and Solid Waste Sites within 0.25 Mile of the Proposed Pipeline Facilities

State	Name/Address	Milepost	Distance/Direction from Centerline (feet)	Description
Pennsylvania				
	Neary Property 165 Ridge Blvd, Brookhaven	0.20	1,320/west	Unregulated leaking tanks. Contaminant is BTEX and the status of the case is unknown.
	Atlantic 4236 Edgemont Ave, Brookhaven	0.20	1,320/west	Leaking underground storage tank containing petroleum. Remedial actions have been initiated or completed.
	Brookhaven Boro Bldg Edgemont Ave/Brookhaven Rd	0.20	660/west	Leaking underground storage tank containing petroleum. Case is inactive. Also unregulated leaking tanks with fuel oil #2. Case is closed.
	AMF Auto Clinic 3808 Edgemont Ave, Brookhaven	0.20	Adjacent	Leaking underground storage tank containing petroleum. Cleanup has been completed.
	Sec Cleaner Service 3401 Edgemont Ave, Brookhaven	0.20	792/east	Leaking underground storage tanks containing fuel oil #2. Status of case is unknown.
	M&M Restaurant Supply One McDonald Drive, Aston	2.00	924/west	Leaking underground storage tank containing petroleum. Cleanup has been completed.
	Penske Truck Leasing 10 McDonald Blvd, Aston	2.00	924/west	Two leaking underground storage tanks both containing petroleum. One has had cleanup completed and the status of the second is unknown.
	Jefferson Smurfit 100 McDonald Blvd, Aston	2.00	924/west	Unregulated leaking tanks containing PHC's. The status of the case is unknown.
	Action Mailers 90 Commerce Drive, Chester	2.27	528/northwest	Unregulated leaking tanks with BTEX as a contaminant. The status of the case is unknown.
	Ashland Aston Chemical Dis. Fac. 100 N. Commerce Drive, Aston	2.27	670/northwest	Voluntary Cleanup Program and Act 2. Non-residential and site specific cleanup standards.
	Delco Beverage Co. 100 Commerce Drive, Aston	2.27	670/northwest	Leaking underground storage tank containing petroleum. Cleanup completed.
	Alloy Surfaces Co., Inc. 121 N. Commerce Drive, Chester	2.27	1,320/northwest	Site has numerous FINDS violations dating from 2000 to 2003. Site is also a large quantity generator and has three ASTs containing chemicals.
	Benjamin Beeneker Plaza Apts 2101 W. 7th St, Chester	3.55	1,320/east	Contains unregulated tanks with fuel oil #2. Cleanup is required but status of the case has not been reported.
	Teledyne Packaging 2300 W. Fourth St, Chester	3.76	550/east	Leaking underground storage tanks containing petroleum. Also unregulated tanks with BTEX contaminant. Closure not reported.
	B&S Mobile 2200 W. 2nd St, Chester	3.92	770/east	Leaking underground storage tank containing petroleum. Remedial action initiated in 1994 and 2001. No status given.

TABLE 4.8.4-1 (cont'd)

Potential Hazardous and Solid Waste Sites within 0.25 Mile of the Proposed Pipeline Facilities

State	Name/Address	Milepost	Distance/Direction from Centerline (feet)	Description
	West End Boat Club Jeffery St/Delaware Ave, Chester	3.92	1,210/east	Leaking underground storage tank. Release of petroleum contaminant in 1989. Status inactive.
	Haulaway/Bantas Transfer Station 24-1 W. 2nd St, Chester	3.92	Adjacent	State waste facility landfill. Private operation that does municipal processing.
	Shahadis Landfill 2614 W. 3rd St, Chester	3.83	650/northeast	Historic inactive landfill.
	PECO Gould Chemclear Jeffery St/Delaware Ave, Chester	4.00	880/southeast	Site has designation of FINDS, RAATS, CORRACTs, and small quantity generator.
	Front Street Tanker Front/Ward Streets, Chester	4.10	Adjacent	CERCLIS site owned by the municipality. Two abandoned tankers onsite, one containing oil contaminated with PCBs.
	Chestrees Coalition 235 Hayes Street, Chester	4.24	660/northwest	Unregulated leaking tanks containing fuel oil #2. Status of case is unknown.
	Westinghouse Electric Corp. Front/Thurlow Streets, Chester	4.24	800/west	State waste facility and landfill. Facility type is residential incinerator and has a private operating status. Also acts as a municipal transfer station.
	Delaware WTE Chester City	4.36	600/southwest	State waste facility and landfill. Municipal facility type.
	PECO Chester Generating Station Chester	4.47	Traverse	Small quantity generator. Site has undergone past remediation associated with is historical use as a coal-fired generating plant.
New Jersey				
	Bridgeport Boat Yard 116 Buttonwood Lane, Bridgeport	6.26	1,320/south	Leaking underground storage tank. Site has been issued letter of no further action. Site has one area of concern with one media of concern.
	Bridgeport Maintenance Facility Rt. 130, Logan Twp.	7.19	402/east	State hazardous waste site. Active site with on-site sources of contamination.
	Monsanto Chemical Co (aka Solutia, Ferro) Route 130, Bridgeport	9.65	Traverse	Numerous spills and releases of chlorine gas, hydrochloric acid gas, butyl benzyl phthalate.
	Bridgeport Airport Route 322, Logan Twp.	8.52	1,320/southeast	State hazardous waste site. Site with on-site sources of contamination. Case status pending.
	Logan Twp. Municipal Utility Authority Jefferson Lane & Route 130, Bridgeport	9.00	660/southeast	Numerous spills of raw sewage exist and releases to the Delaware River.
	Logan Generating Station (aka Keystone Co-Gen Plant) Route 130, Logan Twp.	10.00	Traverse	Numerous historical spills and releases of nitrogen oxide, diesel fuel, and sulfur dioxide.

4.8.5 Recreation and Public Interest Areas

The Crown Landing LNG and the Logan Lateral Projects would not affect any state forest land, national or state parks, Indian reservations, wild and scenic rivers, designated natural or scenic areas, game management areas, or registered natural landmarks. There are no developed recreation sites located on or adjacent to the LNG terminal site. There are, however, several other designated recreation and public interest areas located near the proposed facilities or crossed by the proposed pipeline. Areas for general recreational activities, including boating and fishing, are also located in the project area.

4.8.5.1 Designated Recreation and Public Interest Areas

New Jersey

The closest recreational areas to the LNG terminal in New Jersey are located approximately 4 miles from the site. About 13 acres of public recreation land is located on Beckett Road approximately 4 miles south of the terminal site and a 0.5-acre playground is located approximately 4 miles east of the terminal site in Bridgeport. Because of the distance from the proposed LNG terminal site, the Crown Landing LNG Project would not affect recreational uses in these areas.

The portion of the proposed pipeline in New Jersey would not cross any designated recreation or public interest areas.

Delaware

The closest recreational site in Delaware to the proposed LNG terminal is Fox Point State Park, which is located approximately 3.3 miles southwest of the site along the Delaware River. The park is about 171 acres in size and includes picnic pavilions, bike and pedestrian trails, playgrounds, and volleyball courts. In the summer, the park averages about 300 visitors per day. Because of the distance from the proposed LNG terminal site, the Crown Landing LNG Project would not affect recreational activities at Fox Point State Park. Crown Landing did, however, conduct a visual analysis from Fox Point State Park to determine if the proposed LNG terminal would be visible from the park and to determine the potential impacts on visual resources (see section 4.8.6.1).

The pipeline would not affect any recreational areas in Delaware.

Pennsylvania

The closest recreational sites in Pennsylvania to the LNG terminal site include the Marcus Hook Public Park and the Wharf on the Boardwalk, both of which are located along the Delaware River. Marcus Hook Public Park is located about 1.1 miles northwest of the LNG terminal site. The park includes a picnic pavilion and playground equipment. The Wharf on the Boardwalk is a planned commercial development, which will be located immediately downriver from the Commodore Barry Bridge and approximately 3.2 miles from the LNG terminal site. Because of the distances from the proposed LNG terminal site, the Crown Landing LNG Project would not affect recreational activities or other uses at either of these facilities. Crown Landing did, however, conduct a visual analysis from both Marcus Hook Public Park and the Wharf on the Boardwalk development to determine if the proposed LNG terminal would be visible from these locations and to determine the potential impacts on visual resources (see section 4.8.6.1).

The Pennsylvania portion of the proposed pipeline would cross Veteran's Memorial Park in the City of Chester for about 1,200 feet at MP 3.59. This municipal park consists mainly of maintained grass

and baseball and football playing fields. The peak period for park usage is during the summer months but the park does not have any seasonal restrictions. Disruption and noise during construction could preclude the use of the park and temporarily restrict park activities. The degree of these impacts would depend on the timing of construction. Construction of the pipeline during the summer months when park activities are at their peak would cause more of a disruption than construction during the off-peak, winter months. Some of the construction-related impacts would be unavoidable but the duration of the impacts would be short-term, lasting several days to several weeks until the right-of-way and affected park areas are restored in accordance with the requirements specified in the easement agreement between the City of Chester and Texas Eastern. Texas Eastern would also implement measures to minimize disruption to the park, including scheduling work during non-peak hours of the day. Operation of the pipeline would not affect long-term park activities because the construction and permanent right-of-way would be allowed to revert to former use; however, certain activities such as the construction of aboveground structures or the planting of trees would be prohibited within the permanent right-of-way.

The pipeline would also cross land associated with the First Baptist Church (between MPs 0.08 and 0.15) and Toby Farms School (MP 1.32). Disruption and noise during construction would temporarily restrict activities in these areas. Some of the construction-related impacts would be unavoidable but the duration of the impacts would be short-term, lasting several days to several weeks until the right-of-way and affected areas are restored in accordance with the requirements specified in the easement agreement between the owners of these facilities and Texas Eastern. Operation of the pipeline would not affect long-term activities in these areas because the construction and permanent right-of-way would be allowed to revert to former use; however, certain activities such as the construction of aboveground structures or the planting of trees would be prohibited within the permanent right-of-way. A proposal by Faith Baptist Church to subdivide its property and construct a 10,000 square foot office building and the potential impacts associated with pipeline construction and operation is discussed in section 4.8.5.1.

4.8.5.2 General Recreation

The Delaware River provides ample opportunities for recreational boating and fishing. There are six public boating access points to the Delaware River and its tributaries in the vicinity of the proposed projects. The closest of these boating access points to the LNG terminal site is the Borough of Marcus Hook Boat Ramp approximately 1.3 miles to the north. The others include the Richards Buttonwood Marina (2.5 miles east), Bridgeport Boat Yard (2.7 miles northeast), Raccoon Creek Boat Club (2.8 miles northeast), City of Chester Boat Ramp (3.5 miles northeast), and 7th Street Park Boat Ramp (7.7 miles southwest).

The Richards Buttonwood Marina, Bridgeport Boat Yard, and Raccoon Creek Boat Club are all located on Raccoon Creek within Logan Township in New Jersey and have 12, 20, and 30 boat slips, respectively. There is an operating drawbridge where U.S. Route 130 crosses Raccoon Creek, allowing larger boats access to the upstream segment of Raccoon Creek. The bridge is opened an average of 300 times per year, primarily during the summer months, and is operated by the New Jersey Department of Transportation (NJDOT). Approximately half of the annual openings are for boats and the other half are for testing and training (NJDOT, 2003).

There are no marinas on Oldmans Creek but there is a single, private residential dock in use on the west side of Oldmans Creek downstream of the U.S. Route 130 bridge near the LNG terminal site. This bridge is still used as part of U.S. Route 130 but the drawbridge is no longer functional. Bridge clearance over Oldmans Creek is approximately 5 feet, allowing only limited passage to low boats.

Delaware River boat access from the Pennsylvania side of the river in the project area is provided by the Borough of Marcus Hook Boat Ramp or the City of Chester boat ramp at the base of the Commodore Barry Bridge (PAFBC, 2003b). River access from Delaware is provided by the Christina River at the 7th Street Park Boat Ramp in Wilmington (DNREC, 2003).

Boating on the Delaware River in the project area is primarily limited to power boating for recreation and fishing. Water-skiing is rare. Sailboats are occasionally observed on the river but the trips originate from outside the project area. There is some evidence that the proposed LNG terminal site has been used informally for recreational fishing and hunting. These activities have not been permitted by the property owners and the site is posted with "No Trespassing" signs.

The Delaware River Creel Survey (DRCS) prepared for the DRBC provides the most recent fishing data for the Delaware River. The objectives of the DRCS were to determine the amount of recreational angler fishing that took place on the Delaware River from mid-March through October 2002. The survey area included the tidal and non-tidal portions of the river, from the Delaware Memorial Bridge to Downsville, New York.

For the purposes of water-based recreation, the project area was defined as a 7-mile-long portion of the Delaware River from RM 75, located 6 miles upstream of the Delaware Memorial Bridge, to RM 82 at the Commodore Barry Bridge. Uniform distribution of fishing activity throughout the tidal portion of the Delaware River was assumed, which means that the project area for water-based recreation represents approximately 10 percent of the total tidal fishing activity in the DRCS. Highlights of the DRCS as applied to the project area using the assumptions mentioned above are as follows:

- total fishing effort for the project area is estimated to be about 4,019 trips encompassing 13,962 hours of fishing;
- the average length of a fishing trip for boat anglers was 4.3 hours. Shore angler trips averaged 2.1 hours;
- approximately 66 percent of the total fishing effort occurred from March through June, coinciding with major fish spawning runs;
- daytime fishing (7 AM to 9 PM) accounted for 92 percent of the total fishing effort;
- aerial surveys showed that 90 percent of the fishing was from boats. Many anglers were observed fishing from large (greater than 20 feet in length) recreational fishing boats, especially on weekends;
- approximately 85 percent of the fishing was catch and release; and
- channel catfish was the most common species caught.

Overall the popularity of recreational fishing in the immediate project area is limited due to fish consumption advisories for the lower Delaware River associated with the risks of PCB or dioxin contamination (NJDEP, 2003e). There is a small commercial bait fishery in the project area but there is no commercial fishery for human consumption. In addition to the Delaware River, the mouth of Oldmans Creek is a popular fishing area and is located approximately 3,500 feet downriver of the LNG terminal site.

Construction-related activities associated with the LNG terminal could impact recreational boating and fishing within the Delaware River and its tributaries. These include the dredging of the ship berth at the LNG terminal site and construction activities associated with the pier. Construction of the pipeline across the river would not have an affect on recreational boating and fishing because it would be installed using the HDD construction method (see section 2.4.2.2). In accordance with federal and state restrictions to protect anadromous fish during migration and spawning, dredging would only be conducted between August 2 and March 14. According to the DRCS, less than one third of the annual recreational fishing effort occurs during this period because most fishing activities coincide with the major fish spawning runs from March through June. As a result, the proposed dredging should not have a significant impact on recreational fishing in the area. Security zones would not be required around the pier during construction but noise from pile driving associated with the pier could discourage recreational fishing in the immediate vicinity. However, pile driving for the pier would also be limited to between August 2 and March 14 and would not coincide with the prime fishing season.

Operation of the project facilities would impact recreational boating and fishing during the arrival, unloading, and departure of the LNG ships. Crown Landing estimates that about two to three ships per week would transit the Delaware River to deliver its cargo to the LNG terminal. Docks in the area currently accommodate both industrial and commercial ships, including liquefied petroleum gas (LPG) ships. LNG ships would access the proposed LNG terminal via the navigation channel in the Delaware River and Bay and Marcus Hook Anchorage Area. As a result, marine traffic associated with the project would not introduce any significant new type of impacts on recreational boating or fishing. However, as part of its Letter of Recommendation, the Coast Guard would impose a moving safety zone around LNG ships during transit up the Delaware River and while berthed at the LNG terminal. The Coast Guard has determined the extent of a moving safety zone that would be enforced around LNG ships on the Delaware River and Bay during its review of Crown Landing's WSA which is discussed further in section 4.12.5. The Coast Guard currently enforces a Regulated Navigation Area (RNA) under 33 CFR 165.510 for vessels carrying "dangerous cargoes" within the Delaware River and Bay. This RNA places additional requirements on vessels carrying dangerous cargoes as well as vessels operating in the vicinity of those carrying dangerous cargoes. In addition, there is currently a 100 yard zone for moored or anchored vessels carrying dangerous cargo.

The moving safety zone enforced around each LNG ship and the moored vessel security zone around the ship unloading facility while a ship is docked would be restricted to boaters. This could cause impacts on recreational boating and fishing but the impacts would be temporary while the boat is in transit or moored at the ship unloading facility. Because the safety zone would be a moving zone around the ship, the impacts would be of short duration at any given point along the shipping route. Many recreational boats should be able to go around the LNG ships at points in the river that are sufficiently wide for them to be outside of the safety zone. In locations were the waterway is narrow, a recreational craft attempting to travel in the opposite direction of an LNG ship traveling at 10 knots may need to wait up to 18 minutes for the LNG ship to pass before proceeding on its way. The delay would increase to up to 36 minutes when the LNG ship is traveling at 5 knots and up to 60 minutes when the LNG ship is traveling at 3 knots. For boaters near or upstream of the facility, an additional 60 minute delay may be experienced while the LNG ship is berthed or turned. The Coast Guard has stated that it would make every effort to minimize disruption to other water way users around moored LNG ships. Because of the relatively low volume of recreational boating in the immediate project area, any impacts are expected to be minor. Moreover, the Coast Guard moving safety and moored vessel security zones would not be treated as absolute exclusion zones that would preclude all other vessel movements. Rather, other vessels may be allowed to transit through the moving safety and moored vessel security zones with the permission of the Captain of the Port.

The popular fishing area at the mouth of Oldmans Creek could be temporarily affected during LNG ship transit past the area but any impacts would be minor and short term (i.e., lasting only several minutes). If the Coast Guard requires a 1,500-foot security zone for the LNG ships, the area would not be affected when an LNG ship is berthed at the terminal because the moored vessel security zone would not extend to the mouth of the creek, which is 3,500 feet from the proposed pier. Additional information on marine traffic and the safety and security zones is presented in sections 4.9.4.2 and 4.12.5.

Shoreline fishing from the LNG terminal site would be prohibited due to safety and security concerns at the facility. As previously discussed, the site is posted with "No Trespassing" signs so only those currently using the site without the owner's permission would be affected. In addition, according to the DRCS, shoreline fishing accounts for only approximately 10 percent of the total fishing effort on the Delaware River. However, New Jersey Resource Rule 7:7E-8.11 requires that coastal development adjacent to all coastal waters provide permanent perpendicular and linear access to the waterfront to the maximum extent practicable, including both visual and physical access. The NJDEP acknowledges the safety and security concerns relating to public access at the LNG terminal facility but has indicated that Crown Landing must comply with this rule.

The NJDEP suggested compliance with this rule could be addressed either by providing a secured and limited area of ingress/egress to the waterfront onsite or acquiring or enhancing offsite waterfront areas. In addition to security concerns, Crown Landing has indicated that onsite waterfront access is not possible due to physical constraints. There are extensive wetlands located between the upland and navigable waters outside the areas proposed to be developed for the terminal facilities. The entire northern shoreline of Oldmans Creek, including the shoreline on the Crown Landing site, and the shoreline between the Crown Landing site boundary and U.S. Route 130 are considered wetland. To comply with the rule, Crown Landing evaluated eight options for providing public waterfront access at other offsite locations (see table 4.8.5-1).

The eight sites were discussed with the NJDEP on August 9, 2005. Based on these discussions, it was determined that site number 4 offered the most significant opportunities for public water access. The site is located just south of the Commodore Barry Bridge and has relatively deep water, which would allow boat access to the Delaware River. Crown Landing is currently developing a specific enhancement plan for this site and has indicated that it will provide the plan to the NJDEP when it becomes available.

4.8.6 Visual Resources

4.8.6.1 LNG Terminal

The degree of visual impact that may result from a proposed project is typically determined by considering the general character of the existing landscape and the visually prominent features of the proposed facility. The proposed LNG terminal would be constructed at a currently undeveloped site, primarily consisting of wetlands and agricultural fields. The site is surrounded by a mixture of industrial, agricultural, open space, and scattered residential uses. The site is bordered on the north and west by the Delaware River; the east by industrial uses and U.S. Route 130; and the south by Oldmans Creek and open areas. The terrain in the area of the site is relatively level and low-lying with elevations ranging from sea level to approximately 10 feet above mean sea level.

TABLE 4.8.5-1

Summary of Public Waterfront Access Sites Evaluated for the Crown Landing LNG Project

Site Number	Site Name	County/Location	Ownership	Existing Facilities	Existing Facilities Requiring Improvement	Potential New Facilities
1	West Deptford Public Boat Access	Gloucester County/end of Center Street, West Deptford, NJ	West Deptford Township	Dual-lane ramp, small dock, parking for over 100 cars/trailers	Informal trails upstream and downstream of boat ramp	None
2	Red Bank Battlefield Park	Gloucester County/100 Hessian Avenue, National Park, NJ	Gloucester County	Small wooden pier, concrete trail along riverfront	None	Fishing pier, floating dock
3	Raccoon Creek Wildlife Management Area (WMA)	Gloucester County/along Route 322 approximately 1 mile SW of intersection of Route 322 and Route 295	State of New Jersey	Trail (does not extend to waterfront), grassy pull-off parking area	Trail, parking area	Extended trail to waterfront, elevated walkway across wetlands
4	State Route 324 at Delaware River	Gloucester County/western terminus of Route 324 at Delaware River	Unknown	Informal waterfront trails, unmaintained parking area	Trails, parking areas	Boat ramp, lighting, fishing pier, expanded parking areas
5	DOD Ponds WMA	Salem County/West of Route 130 approximately 1 mile north of Penns Grove, NJ	Federally owned, managed by State of New Jersey	Small boat ramp to ponds, dirt road to riverfront	Roads, parking areas	Fishing pier, lighting, signage, boat ramp on Delaware River, handicap accessible ramp to beach/pier
6	Riverview Beach Park	Salem County/West of Route 49 between Lakeview Avenue and W. Pittsfield Street	Public	Lake, walking trail along riverfront, sports fields, playground equipment	None	Fishing pier/ observation deck, boat ramp
7	Pennsville Municipal Boat Access	Salem County/Riviera Drive in Pennsville, NJ	Public	Small park with playground equipment, two-lane boat ramp, gravel parking area	Lighting	None
8	Railroad Avenue Property	Salem County/Railroad Avenue, Pedricktown, NJ	Private	None	None	Access trail, waterfront trail, dock, boat launch

The dominant visual feature in the area of the LNG terminal site is the Logan Generating Station. The station itself is 180 feet high and the combustion stack is 430 feet high, which is visible from public roads, bridges, and the Delaware River. A coal pier serving the Logan Generating Station extends approximately 1,500 feet into the Delaware River and the coal storage facility is located along the shoreline. Northeast of the Logan Generating Station is the Ferro Industries facility. The Ferro plant includes industrial buildings, aboveground pipes, and tanks that are clearly visible from U.S. Route 130. The primary visual character along other areas on U.S. Route 130 is rural with views of open land, farm

fields, small clusters of one and two story residential structures, and scattered businesses. The right-of-way along U.S. Route 130 is heavily vegetated and provides limited views into the proposed LNG terminal site. The shoreline along the Delaware River at the LNG terminal site is mostly wooded and currently has a relatively natural appearance from the water with the exception of two large warning signs on the site indicating the presence of underwater pipeline crossings. Powerlines and cell phone towers in the project area also interrupt views of an otherwise rural landscape.

The western shore of the Delaware River in Pennsylvania and Delaware (e.g., Marcus Hook) is a heavily industrialized area. The oil refineries and other heavy industry located in this area are visually prominent with large storage tanks, emission stacks, and burning flares from almost all vantage points.

The COE uses a Management Classification System (MCS) to provide general guidelines on the degree of and nature of visual change acceptable in a landscape (COE, 1988b). The five management classes include: preservation, retention, partial retention, modification, and rehabilitation, with preservation area having the most distinct visual quality and rehabilitation having the least distinct visual quality. The characteristics and visual management objectives for these areas include:

- *Preservation:* areas considered to be unique and having the most distinct visual quality in the region. They are highly valued and are often protected by federal and state policies and laws. While limited project activity is not precluded, it should not be readily evident.

- *Retention:* areas are regionally recognized as having distinct visual quality but may not be institutionally protected. Project activity may be evident but should not attract attention.

- *Partial Retention:* areas are locally valued for above average visual quality but are rarely protected by institutional polices. Project activity may attract attention and dominate the existing visual resource.

- *Modification:* areas are not noted for their distinct qualities and are often considered to be of average visual quality. Project activity may attract attention and dominate the existing visual resource.

- *Rehabilitation:* areas are noted for their minimal visual quality and are often considered blighted areas. Project activity should alter the existing undesirable visual resources.

Based on the characteristics of these management classes, the proposed LNG terminal site would be included in the 'modification' class.

The most prominent visual feature of the proposed LNG terminal would be the LNG storage tanks. The tanks would be about 250 feet in diameter and about 175 feet high. Other prominent visual features include:

- an approximately 2,000-foot-long pier that would extend approximately 1,650 feet into the Delaware River and be located approximately 25 feet above the water surface;

- a 140-foot-high nitrogen distillation tower;

- a 120-foot-high emergency flare tower; and

- a berth for a single LNG ship. The LNG ships would be up to about 1,000 feet long and would be berthed at the LNG terminal approximately 30 to 40 percent of the year.

The facility would also include one story buildings to the east of the LNG storage tanks, including administrative shelters and offices, and meter and regulation stations to the west of the LNG storage tanks. Approximately 3,500 feet of dual feed electric transmission line supported on transmission poles spaced about 225 feet apart would also be installed as part of the project. The poles would be approximately 47.5 feet high. This transmission line would replace a smaller existing powerline that extends along the site entrance road to the proposed terminal area.

The terminal and pier would be lit at night for safety and security reasons. Lighting at the terminal would be based on nationally recommended practices and in accordance with recommended illumination levels. Outdoor area lighting would be provided for all process areas and certain roadways. Security lighting would be provided on the perimeter fence around the terminal, on the pier roadway, and beneath the pier structure. The LNG storage tanks and other elevated structures would be equipped with warning lights to comply with air safety regulations. Navigational lighting would be installed on the marine structures in accordance with applicable code requirements.

A visual analysis was completed from eight vantage points to determine the potential visual impacts associated with the LNG terminal. A summary of the visual analysis is presented in table 4.8.6-1.

As previously discussed, the project area is in the modification management class landscape where projects may display aesthetic characteristics of form, line, color, texture, scale, and composition that differ from those of the existing visual resources and where project should exhibit good design and visual compatibility with its surroundings (COE, 1988b).

From most vantage points, views of the LNG terminal would be far ground or distant views. Near ground or close views would be limited to views from the Delaware River from commercial ships and the few recreational boats that use the area around the LNG terminal site. Moderate to distant views would occur from Marcus Hook Public Park. Views form the Commodore Barry Bridge would be brief and intermittent. Similar views would occur from the Wharf on the Boardwalk development except that these views may be long or short in duration. The views from both the Commodore Barry Bridge and the Wharf on the Boardwalk would be distant and partially obscured.

The terminal facilities would be partially visible from U.S. Route 130 and areas in Logan or Oldmans Township but would be somewhat screened by vegetation. By using the existing site entrance, Crown Landing would preserve and possibly enhance the vegetative screening between the terminal facilities located along the shoreline and U.S. Route 130.

While the LNG terminal would be visible and permanently impact visual resources in the area, the overall aesthetic effect would be minor. The visual character in the project area is defined by heavy industrial uses, dredged material disposal sites with clearly engineered slopes, the Commodore Barry Bridge, Interstate 495, and the large commercial ships that transit through this segment of the Delaware River. Many of these existing uses have already introduced large vertical and horizontal elements into the landscape along the Delaware River. The facilities associated with the Crown Landing LNG Project would be visually compatible with their surroundings and consistent with the management objectives of the modification class.

4.8.6.2 Pipeline Facilities

The pipeline facilities would be located on private or local lands that are not subject to federal or state visual management standards. Visual resources along the pipeline route are a function of geology, climate, and historical processes and include topographic relief, vegetation, water, wildlife, land use, and human uses and development. The vegetation along the pipeline route consists largely of grasses, shrubs, and small- to medium-diameter trees on mostly flat to rolling terrain. In Pennsylvania, the proposed pipeline route crosses predominantly mixed commercial and residential areas with maintained lawns.

Texas Eastern proposes to use a maximum of a 100-foot-wide construction right-of-way. Some areas along the route would be widened for temporary extra workspaces. Visual impacts associated with the construction right-of-way and temporary extra workspaces would include the removal of existing vegetation and the exposure of bare soils, as well as earthwork and grading scars associated with heavy equipment tracks, trenching, and machinery and tool storage. Other visual effects could result from the removal of large individual trees that have intrinsic aesthetic value; the removal or alteration of vegetation that may currently provide a visual barrier from undesirable views; or landform changes that introduce contrasts in visual scale, spatial characteristics, form, line, color, or texture.

Visual impacts would be greatest where the pipeline route parallels or crosses roads and the pipeline right-of-way may be seen by passing motorists, on residents where landscaping and vegetation would be removed, and in forested areas. The duration of visual impacts would depend on the type of vegetation that is cleared or altered. The impact of vegetation clearing would be shortest in open lands consisting of scrub-shrub vegetation, where the reestablishment of vegetation following construction would be relatively fast (generally less than 5 years). The impact would be greater in forest land, which would take many years to regenerate mature trees. The greatest potential visual impact would result from the removal of large specimen trees, which would take longer than other vegetation types to regenerate and would be prevented from reestablishing on the permanent right-of-way.

Construction and operation of the modified and new aboveground facilities associated with the pipeline would have a permanent impact on visual resources. However, the modifications at Chester Junction would occur within the limits of the existing facility so no significant impacts on visual resources are anticipated. The site for the new Crown Landing meter and regulation station is currently undeveloped but would be part of the proposed 175-acre LNG terminal site. The meter station would be located adjacent to the buildings and facilities associated with the LNG terminal so they would not have a significant impact on visual resources. As previously discussed, the LNG terminal would be visually compatible with its surroundings and consistent with the management objectives of the modification class (see section 4.8.6.1).

TABLE 4.8.6-1

Summary of Visual Analysis Conducted for the Crown Landing LNG Project

Vantage Point (State)	Depth of View	View Type and Duration	Number of Daily Viewers	Spatial Dominance a/	Scale Contrast b/	Compatibility c/	Overall Visual Effect d/
Delaware River (Delaware)	Near, middle, and distant views depending on boat location	Unobstructed view. Short or long duration.	An average of 22 recreational boats and 8 commercial vessels per day.	Co-dominant to subordinate, depending on view	Moderate	Somewhat compatible	Slight to high, depending on boat location
Marcus Hook Public Park	Distant View (1.1 miles)	Unobstructed view. Short or long duration.	Unknown	Co-dominant to subordinate, depending on view	Moderate	Somewhat compatible	Slight to moderate depending on location and interest
Fox Point State Park (Delaware)	Distant View (3.3 miles)	Unobstructed. Short or long duration.	An average of 300 visitors per day (summer average).	Subordinate	Moderate	Somewhat compatible	Slight
Interstate 495, MP 8 (Delaware)	Distant View (1.2 miles)	Intermittent sightlines. Short duration.	An average of 81,200 vehicles per day.	Subordinate	Moderate	Somewhat compatible	Slight
Commodore Barry Bridge, east & west bound travel (New Jersey/Pennsylvania)	Elevated but distant view (3.1 miles)	Obscured by bridge and barriers. Short duration.	An average of 16,500 vehicles per day.	Co-dominate	Moderate to minimal	Compatible	Slight
The Wharf on the Boardwalk	Distant View (3. 2 miles)	Unobstructed. Shore or long duration.	Unknown, still under construction	Subordinate	Moderate to minimal	Compatible	Slight
U.S. Route 130, including the bridge over Oldmans Creek (New Jersey)	Mid-ground view (0.5 mile)	Partially obscured by vegetation. Short duration.	An average of 4,700 vehicles per day.	Co-dominant to subordinate depending on the view.	Moderate	Somewhat compatible	Slight to moderate
Delaware Memorial Bridge, east & west bound travel (Delaware)	Distant view (10 miles)	Obscured by bridge. Short duration.	An average of 80,000 vehicles per day.	Subordinate	Moderate to minimal	Compatible	Negligible

a/ Spatial dominance is the prevalent occupation of a space in a landscape by an object(s) or landscape element. Spatial dominance can be described in terms of being dominant, co-dominant, or subordinate.
Dominant – the modification is the major object or area in a confined setting and occupies a large part of the setting.
Co-dominant – the modification is one of the major objects or areas in the confined setting and its features are of equal visual importance.
Subordinate – the modification is insignificant and occupies a minor part of the setting.

b/ Scale contrast is the difference in absolute or relative scale in relation to other distinct objects or areas in the landscape. Scale contrast can be described in terms of being severe, moderate, or minimal.
Severe – the modification is much larger than the surrounding objects.
Moderate – the modification is slightly larger than the surrounding objects.
Minimal – the modification is much smaller than the surrounding objects.

c/ Compatibility is the degree to which landscape elements and characteristics are still unified within their setting. Compatibility can be described in terms of being compatible, somewhat compatible, or not compatible.
Compatible – the modification is harmonious within the setting.
Somewhat Compatible – the modification is more or less harmonious within the setting.
Not Compatible – the modification is not harmonious within the setting.

d/ High – clear, unobstructed views of the project.
Moderate – project will be visible, but views will be of short or medium duration and wholly or partially obscured.
Slight – project will be visible, but views will be of short duration and/or blend into the background and will be dominated by existing features in the landscape.
Negligible – site will be scarcely visible.

4.9 SOCIOECONOMICS

The potential socioeconomic effects from construction, operation, and maintenance of the Crown Landing LNG and Logan Lateral Projects are related to the number of construction workers that would work on the project and their impact on population, public services, nearby homes and businesses, and temporary housing during construction. Other potential impacts are related to construction and operation of the LNG terminal, such as increased ship traffic or disruption of normal vehicular traffic patterns in the vicinity of the terminal site.

The potential impacts of the project on land use and residences in the project area are discussed in section 4.8. A discussion of the project's effects on population and employment, housing, public services, transportation and traffic, property values, tax revenue, and environmental justice is provided below.

4.9.1 Population, Economy, and Employment

Table 4.9.1-1 provides a summary of selected demographic and socioeconomic statistics for the state, county, and communities where project facilities are proposed. The population of Gloucester County, New Jersey was 254,673 in 2000, which was a 10.7 percent increase over the 1990 population. The population of Delaware County, Pennsylvania was 550,864 in 2000, which was a 0.6 percent increase over the 1990 population. New Castle County, Delaware, located across the Delaware River from the proposed LNG terminal site, had a population of 500,265 in 2000, which was a 13.2 percent increase over the 1990 population.

Logan Township, where the proposed LNG terminal would be located, has a population density lower than the rest of Gloucester County and the State of New Jersey. Of the communities crossed by the proposed pipeline, the City of Chester and Brookhaven Borough have the highest populations and population densities in the project area. These communities have higher population densities than that of Delaware County and the State of Pennsylvania.

The main industries in the counties and communities that would be affected by the projects are trade, transportation, and utilities, and educational, health, and social services. The unemployment rate for Logan Township is well below the unemployment rate for Gloucester County and the State of New Jersey (5.8 percent). In Pennsylvania, the unemployment rates in the communities crossed by the Logan Lateral are higher than the state rate of 3.5 percent. Specifically, the City of Chester has the highest unemployment rate (9.9 percent), which is more than triple the unemployment rate for Delaware County (3.1 percent). The City of Claymont has a lower unemployment rate (3.0 percent) than both New Castle County and the State of Delaware.

Crown Landing estimates that an average of 360 workers would be employed during the 36-month-long construction period for the LNG terminal, with a peak workforce of approximately 650 personnel during construction months 15 through 22. Texas Eastern estimates that 275 workers would be required to construct the natural gas pipeline facilities. Crown Landing and Texas Eastern estimate that the vast majority of the workers would be hired locally (i.e., within 50 miles of the project facilities), with a total of approximately 90 non-local workers temporarily relocating from outside the project area. The non-local hires would include personnel highly qualified in mechanical, electrical, and instrumentation work and control tradesmen.

TABLE 4.9.1-1

Existing Socioeconomic Conditions for the Crown Landing LNG and Logan Lateral Projects

State/County/ Community	Population		Population Density a/		Per Capita Income (2000)	Civilian Labor Force (2000)	Unemploy-ment Rate (percent) 2000	Major Industry b/
	1990	2000	1990	2000				
NEW JERSEY	7,730,188	8,414,350	1,042	1,134	27,006	4,194,931	5.8	Trade, transportation, and utilities
Gloucester County	230,082	254,673	709	784	22,708	132,737	6.0	Trade, transportation, and utilities
Logan Township	5,147	6,032	228	267	26,853	3,138	1.9	Trade, transportation, and utilities
DELAWARE	666,168	783,600	341	401	23,305	401,152	3.4	Educational, health, and social services
New Castle County	441,946	500,265	1,037	1,174	25,413	263,440	3.5	Educational, health, and social services
City of Claymont	9,800	9,220	4,645	4,371	20,211	4,799	3.0	Educational, health, and social services
PENNSYLVANIA	11,877,228	12,281,054	265	274	20,880	6,000,512	3.5	Educational, health, and social services
Delaware County	547,579	550,864	2,976	2,990	25,040	272,268	3.1	Educational, health, and social services
City of Chester	41,856	36,854	8,636	7,604	13,052	15,898	9.9	Educational, health, and social services
Chester Township	5,399	4,604	3,856	3,302	16,072	2,015	5.4	Educational, health, and social services
Brookhaven Borough	8,567	7,985	5,048	4,705	23,706	4,392	3.2	Educational, health, and social services

a/ Persons per square mile.
b/ Based on North American Industry Classification System and U.S. Census classifications.
Source: U.S. Census Bureau, Census of Population and Housing: 2000 and 1990

Population impacts within the project area are expected to be temporary and relatively minor. Most impacts would come from the temporary influx of construction personnel. The total population change would equal the total number of non-local construction workers, plus any family members accompanying them. Assuming all 90 non-local construction workers relocate to the project area with family members, this would equate to 233 people using a typical household size of 2.59 persons (U.S. Census, 2003). This temporary increase in population corresponds to less than 1 percent of the existing population and would not have a permanent impact on population. A brief decrease in the unemployment rate could occur as a result of construction due to the hiring of local workers for construction and the increased demands on the local economy. However, given the relatively short construction period, the impacts on the economy and employment as a whole would be temporary and minimal.

About 60 permanent employees would be required for operation of the LNG terminal. Crown Landing has indicated it would hire and train local workers to the extent possible. Operation of the pipeline would be undertaken by existing employees from Texas Eastern's Eagle Station facility in Delaware County. Given the small number of permanent workers that would be added, the projects would not have a significant impact on the permanent population, economy, or employment in the area.

4.9.2 Housing

Housing is relatively abundant in the vicinity of the Crown Landing LNG and Logan Lateral Projects. In the three counties within the project area, there over 500,000 housing units with approximately 25,000 of these classified as vacant (see table 4.9.2-1). Logan Township, New Jersey had 76 vacant housing units in 2000, while the community across the Delaware River, the City of Claymont, Delaware, had 401 vacancies in 2000. The communities crossed by the pipeline route had a combined total of 2,470 vacant housing units in 2000. The highest housing vacancy rates are in the City of Chester (14.4 percent) and the City of Claymont (9.6 percent).

TABLE 4.9.2-1

2000 Housing Characteristics for the Project Area

State/County/Community	Total Housing Units	Total Vacant Housing Units	Vacancy Rate (percent)
NEW JERSEY	3,310,275	245,630	7.4
Gloucester County	95,054	4,337	4.6
Logan Township	2,077	76	3.7
DELAWARE	343,072	44,336	12.9
New Castle County	199,521	10,586	5.3
City of Claymont	4,193	401	9.6
PENNSYLVANIA	5,249,750	472,747	9.0
Delaware County	216,978	10,658	4.9
City of Chester	14,976	2,162	14.4
Chester Township	1,754	113	6.4
Brookhaven Borough	3,595	119	3.3

Source: U.S. Census Bureau, American FactFinder.

Table 4.9.2-2 provides the number of temporary housing units for the counties and communities in the vicinity of the proposed projects. The largest number of total vacant temporary housing units (707) is in New Castle County, Delaware. The rental vacancy rate is highest in the City of Claymont, Delaware (14.2 percent). The rental vacancy rates in the communities crossed by the pipeline route range from <1.0 percent in Logan Township to 7.4 percent in the City of Chester.

Construction of the LNG terminal and associated pipeline could affect the availability of housing. Assuming that local construction workers do not require housing, and given the number of available vacant units and existing temporary housing available, the current housing conditions should be sufficient to meet the demand for short-term housing required by the non-local construction workforce. Additionally, abundant temporary housing is available in the form of motels, hotels, inns, or campsites within the project area.

The additional 60 employees anticipated for operation of the LNG terminal would not significantly affect local housing availability.

TABLE 4.9.2-2

Temporary Accommodations Available in the Project Area

State/County/Community	Rental Vacancy Rate (percent)	Vacant Housing Units Available for Seasonal, Recreational, or Occasional Use (2000)
NEW JERSEY		
Gloucester County	5.7	274
Logan Township	<1.0	6
DELAWARE		
New Castle County	7.4	707
City of Claymont	14.2	7
PENNSYLVANIA		
Delaware County	6.0	423
City of Chester	7.4	24
Chester Township	4.9	0
Brookhaven Borough	6.7	6

Sources: U.S. Census Bureau, DP-1. Profile of General Demographic Characteristics: 2000

4.9.3 Public Services

Two hospitals are located in Gloucester County, New Jersey, with a combined total of 917 beds. The closest hospital to Logan Township, New Jersey is 16 miles from the project site. There are two hospitals in Delaware County, Pennsylvania within 2 miles of the project area. These hospitals have a combined total of over 700 beds. The closest hospital to the pipeline route is the Community Hospital of Chester, which is located adjacent to proposed pipeline corridor at approximate MP 3.4. Given the projects' proximity to medical services, and the extent of these services, no impacts on these services are anticipated during construction or operation of the proposed facilities.

The Logan Township Police Department had a law enforcement workforce of 17 police officers in 2003. The Logan Township Fire Department has two engine companies with a total of 64 volunteer personnel. This fire department also provides emergency medical services. Brookhaven Borough has a fire department that also provides emergency medical services. Several other fire departments and companies are located within 5 miles of the proposed pipeline route. Brookhaven Borough, City of Chester, and Chester Township each have police departments that provide local law enforcement services. Sufficient law enforcement and fire response services are located within the project area to the extent that temporary impacts on these services are anticipated to be minimal.

The limited number of permanent employees associated with the proposed project would not result in long-term impacts on public services. However, fire and other emergencies at the proposed LNG terminal could require the services of local fire departments and emergency response units. To assist in this effort, Crown Landing provided LNG-specific fire fighting training to over 90 members of the New Jersey and Delaware emergency response community during 2005. In addition, Crown Landing is working with local emergency service providers to develop other procedures to ensure sufficient and efficient response to potential emergencies at the LNG terminal. The procedures would be included in an Emergency Response Plan for the facilities. Section 4.12.5 provides more information regarding the Emergency Response Plan as well as evacuation planning.

We received scoping comments regarding the public costs of ensuring the security of LNG ships as they transit and dock at the LNG terminal. These costs have not yet been determined. The final costs associated with security would be determined after the specific security needs and responsibilities have

been established by the Coast Guard through consultations with other federal, state, and local agencies. The specific security-related costs for the proposed project are not yet available. However, the security practices presently employed to secure the LNG vessel transit through Boston Harbor to the Distrigas facility in Everett, Massachusetts provide an indication of the potential magnitude of the costs involved. A recent report for Congress (Parfomak, 2003) indicates that the per-ship costs associated with the LNG terminal in Everett, Massachusetts after September 11, 2001 are approximately $80,000, of which $37,500 are covered by local and state governments. Crown Landing has stated that it is continuing to work with the applicable agencies to identify the required security and emergency management practices required for the proposed facility, as well as the potential costs associated with these practices. To ensure that this issue is addressed, we have recommended that Crown Landing provide a plan identifying the mechanisms for funding project-specific costs that would be imposed on federal and state agencies and local communities to better define the potential financial burden on these entities (see section 4.12.5).

4.9.4 Transportation and Traffic

4.9.4.1 Vehicle Traffic

LNG Terminal

The LNG terminal site is located directly adjacent to U.S. Route 130 and will share an access road with the Logan Generating Station. U.S. Route 130 is a major, four-lane, north-south transportation corridor that generally follows the Delaware River. To the east of the project area, U.S. Route 130 intersects with Interstate 295 in Bridgeport, New Jersey, near the Commodore Barry Bridge. To the west of the LNG terminal site, U.S. Route 130 intersects with Interstate 295 near the Delaware Memorial Bridge.

Traffic levels near the LNG terminal site are generally low. The average annual daily traffic (AADT) on U.S. Route 130 east of the Commodore Barry Bridge was 20,176 in 2000. The AADT west of the Commodore Barry Bridge was 4,700 in 2001. Specifically, traffic levels during peak hours in the morning and evening on U.S. Route 130 are between 400 and 500 vehicles. Based on a traffic study of U.S. Route 130 conducted by Crown Landing using the Highway Capacity Manual (Transportation Research Board, 2000), the two intersections nearest the site (the intersection with the proposed entrance road and the intersection with Center Square Road) both currently operate at acceptable Levels of Service (Levels A or B) during the morning and evening peak hours. Level of Service is a qualitative measure of the effect of traffic flow factors, such as speed, travel time, interruption, freedom to maneuver, driver comfort, convenience, and indirectly, safety and operating costs. It is expressed as levels of service "A" through "F." Level "A" is a condition of free traffic flow where there is little or no restriction in speed or maneuverability caused by presence of other vehicles. Level "F" is forced-flow operation at low speed with many stoppages.

Construction activities at the LNG terminal site are estimated to generate about 650 vehicle trips per day based on the peak workforce of up to 650 workers traveling to and from the site during LNG terminal construction and dredging activities. Additionally, 20 vehicle trips per day related to construction equipment and materials delivery (including concrete) are anticipated during a normal day, with a peak of 100 trips a day during construction months 2 through 6 for the delivery of fill material. Construction workers and material delivery trucks would access the site via U.S. Route 130 and Center Square Road within the Pureland Industrial Complex. It is expected that some construction workers would park in a temporary parking lot located along Center Square Road, and be shuttled to the main construction area. Crown Landing has indicated that it is evaluating two other mitigative measures to minimize traffic impacts during construction: 1) increase the length of the left turn lane on U.S. Route 130 into the entrance road to accommodate larger trucks and/or multiple cars; and 2) install a temporary

traffic signal at the intersection of U.S. Route 130 and the entrance road to be used during peak construction periods. The increased traffic levels would be temporary and limited to the period of construction (about 3 years) and would be minimized by implementation of the mitigative measures discussed above.

The traffic during operation of the LNG terminal would be primarily limited to the employees traveling to and from the terminal and an occasional delivery of supplies and materials. About 60 employee vehicle trips are estimated per day during average operating conditions, with about 25 of these trips occurring during the morning and evening peak hours. These new vehicular trips would result in only a minimal increase in the existing road traffic. As discussed above, the left turn lane on U.S. Route 130 may be extended to accommodate additional and/or larger vehicles turning into the entrance road to the LNG terminal.

Pipeline Facilities

Construction of the pipeline would involve 275 workers consisting of one pipeline spread (200 workers) and one aboveground facility spread (75 workers), generating up to 275 vehicle trips per day from these spreads. Additional vehicular traffic would result from equipment or material deliveries into and out of the pipe/storage yards each day. Many of the roads adjacent to the pipeline right-of-way are narrow and may not be able to easily accommodate high volumes of construction workers' vehicles. The parking of vehicles along these roads could increase traffic congestion. Typically, construction workers use contractor yards as the primary parking area for employee's personal vehicles and then are transported from the contractor yards to the construction site in buses.

Traffic may also be slowed where construction of the pipeline crosses roads or where construction occurs within existing roads. The pipeline would cross 34 paved roadways and 2 unpaved roads. In addition to road crossings, the majority of the pipeline route is either parallel to or within existing road rights-of-way. In Pennsylvania, the pipeline route is located within dense residential and industrial areas. In these areas, the pipeline would be constructed within five city streets, including Trimble Boulevard, Clearwater Avenue, Felton Avenue, Bethel Road, and Palmer Street. In New Jersey, the pipeline route follows the old Ferry Road (formerly U.S. Route 324) after crossing the Delaware River. This road was previously used to access a ferry service that operated on the river. It is now mostly abandoned except for the eastern portion which is used to access a few residences and businesses. The remainder of the route to the LNG terminal site is mostly adjacent to U.S. Route 130.

The pipeline would be installed by boring beneath many of the paved roads, which would minimize impacts on traffic. Where roads must be open cut, Texas Eastern would attempt to keep at least one lane of traffic open. All open-cut road crossings would be completed as quickly possible. During the brief period when a trench is completely excavated across the road, steel plates would be available onsite to cover the open area to permit travel by emergency vehicles. Traffic lanes and home access would be maintained except for the temporary periods essential for laying the pipeline. Texas Eastern would also implement appropriate control measures such as detouring traffic where possible, signage, and flashing lights.

Where the pipeline would be installed within or adjacent to city streets, Texas Eastern would generally use the stovepipe or drag section construction methods to minimize traffic-related impacts. Pipeline trenches in or adjacent to these streets would be backfilled or covered with steel plates daily. In addition, steel plates would be readily available to cover the trench in the event of an emergency that requires access across the trench. All roadway surfaces would be restored to the specifications of the local or state authorities. Impacts on local traffic would be temporary and limited to the period of

construction; however, to ensure that impacts associated with in-street construction are minimized, we **recommend that:**

- **Texas Eastern prepare a Traffic Management Plan for construction within or adjacent to town and city streets in Chester, Aston, and Brookhaven in consultation with the appropriate town or city. The plans should identify specific measures that would be used to minimize the temporary inconvenience of in-street construction, including anticipated work hours relative to commuting periods and how Texas Eastern would maintain non-emergency access to residences. The plans should be filed with the Secretary for review and approval by the Director of OEP <u>prior to construction</u>.**

No impacts on traffic would occur along the pipeline route as the result of pipeline operation.

4.9.4.2 Ship Traffic

Approximately 3,200 to 3,300 vessels traverse the Delaware River each year. These vessels use approximately 60 different ports between the Delaware Bay and the Port of Philadelphia, a distance of approximately 86 miles. Vessels that currently use the Delaware River on a daily basis include LPG ships, crude oil tankers, barges, and other commercial vessels.

The Coast Guard regulates ship traffic on the river. Coast Guard regulations and several other factors influence transit times and shipping schedules within Delaware Bay and River. The Coast Guard requires all vessels participating in foreign trade or weighing over 100 tons to have a pilot on board. Historically, approximately 2,000 of the total vessels per year fall into one of these two categories. These include all of the LPG vessels and crude oil barges and about one quarter of the other vessels. In addition, vessels with a draft equaling or exceeding 37 feet must enter Delaware Bay within 1 hour of flood tide. About half of the crude oil vessels and about one quarter of the other vessel types are subject to the flood tide restriction.

Current transit conditions on the Delaware River do not require interruption of vehicular traffic across the one major bridge that spans the river downstream of the proposed LNG terminal (the Delaware Memorial Bridge). The Coast Guard does not currently require the closure of the bridge during transits of vessels carrying dangerous cargoes. However, Coast Guard restrictions on vessels carrying dangerous cargo (e.g., LPG) do include moving safety and security zones. These existing safety and security zones consist of 500 yards on either side of the vessel, and 1,000 yards ahead and astern (on either end) of the vessel. Further, the risk of a collision between an LNG ship and the bridge would also be negated through the use of two tugs to assist the LNG ship under the bridge and to the LNG terminal location. The ship channel passes under the center of the bridge which should also prevent the collision between an LNG vessel and the bridge as the river is shallower outside of the ship channel preventing ship movement towards the base of the bridge towers.

The proposed LNG terminal is located at approximate RM 78 of the Delaware River, adjacent to the Marcus Hook anchorage area, which experiences heavy commercial tanker traffic. LNG ships are expected to arrive at the terminal every 2 to 3 days (approximately 100 to 150 ships per year). The average transit time for commercial vessels from Delaware Bay to the Marcus Hook area is about 5.5 hours. LNG ships would travel at approximately 12 knots south of the Delaware Memorial Bridge, and at approximately 6 knots north of the bridge. Based on the dimensions, type of cargo, and the current regulations controlling ship traffic, it is assumed that the LNG ships entering Delaware Bay and River would be required to have a pilot on board and would be restricted to entering the channel within 1 hour of flood tide. In addition, based on Crown Landing's consultation with the Coast Guard, it is assumed

that at a minimum, the current regulations applicable to vessels carrying dangerous cargoes (such as LPG), contained in the RNA in 33 CFR 165.510, would also apply to the proposed LNG ships. Additional restrictions were developed during the Coast Guard's Waterway Suitability Review described further in section 4.12.5. Given these restrictions, duration of passage, location of Marcus Hook, and the relatively low number of proposed LNG vessels compared to the current volume of commercial traffic on the river, delays experienced by other vessels would be minor. Based on a ship traffic study conducted by Crown Landing (Moffatt and Nichol, 2003), the total annual delays are anticipated to be less than 5 hours for most vessels and up to 22 hours per year for barges, which are more abundant and slower.

During operation of the LNG terminal, although there would be moving safety zones around transiting LNG ships, the addition of 100 to 150 LNG ships per year would not have a long-term impact on commercial ship traffic in the area. The safety zones enforced around each LNG ship and the moored vessel security zone around the ship unloading facility while a ship is docked would be restricted to other commercial traffic, unless permission to enter the zone is obtained from the Captain of the Port. Although the Coast Guard's current RNA is subject to change based on the results of their risk assessment, the Delaware River is wide enough in this area to avoid significant impacts to other commercial ship traffic. The moving safety and moored vessel security zones could cause impacts on recreational boating and fishing, but the impacts would be temporary and minor while the ship is in transit or while moored at the ship unloading facility. Because of the relatively low volume of recreational boating in the immediate area, any impacts are expected to be minor (see section 4.8.5.2). See section 4.12.5 for additional discussion of shipping safety during operation of the proposed project.

We received a scoping comment regarding potential impacts on the Big Stone Beach anchorage area, Cape May-Lewis Ferry service, and the cruise industry in the Port of Philadelphia as a result of LNG ship traffic. Both the anchorage area and the ferry service are located in Delaware Bay at the mouth of the Delaware River, which is more than 60 miles downstream of the LNG terminal site. Because Delaware Bay is the widest portion of the waterbody, any impacts associated with moving safety zones around the transiting LNG ships are expected to be minimal. The number of cruise liners calling or departing from the Port of Philadelphia is negligible compared to the number of commercial ships navigating the Delaware River. They are also only present in the Port of Philadelphia during the summer months. Given these conditions and the distance from the LNG terminal site, impacts on cruise ships in the Port of Philadelphia are expected to be minimal. The review of Crown Landing's WSA by the Coast Guard, which is discussed further in section 4.12.5, determined that impacts to ship traffic would be minimal.

4.9.5 Property Values

Comments were received during the scoping process regarding property devaluation and impacts on homeowner's insurance rates caused by the presence of an LNG terminal. The LNG terminal would be constructed on upland fields previously used for dredge disposal and is currently traversed by several pipeline rights-of-way. The site is currently zoned for industrial uses. The Logan Generating Station is located immediately adjacent to the proposed site and has been in operation since 1992.

The nearest residential property to the LNG terminal site is located on U.S. Route 130 and is approximately 2,300 feet from the proposed construction area. Given the presence of the power plant, the location across a four-lane highway, and the overall distance from the LNG terminal, no negative effects on property values are anticipated. The values of properties proximate to the site may already reflect their location near an industrial area.

A real estate study performed by the Real Estate Counseling Group of Connecticut, Inc. for a planned Granite State Gas facility in Wells, Maine indicates that property values or price increases are not

diminished because of an LNG facility (Real Estate Counseling Group of Connecticut, 1995). In this study, local assessors were contacted and asked: 1) whether they had received property owner requests for lower valuations due to the presence of an LNG facility; and 2) whether the presence of a storage tank was a factor they considered in doing their valuations. Assessors were contacted in a number of towns including Haverhill, South Yarmouth, and Ludlow, Massachusetts. The study concluded that in no case did the planned LNG facilities play a role in either the assessment or homeowner complaints.

A 1993 study conducted by the Argonne National Laboratory examined the economic impacts of the presence of "noxious" facilities on local wages and property values (Clark and Nieves, 1993). Eight types of these facilities were studied: nuclear power plants; coal-, gas-, or oil-fired power plants; military chemical weapons sites; hazardous waste sites; refineries; chemical weapon storage facilities; former storage sites that are now contaminated; and LNG facilities. The study examined the effects of 262 facilities on standardized 1,000 square-mile areas across the United States. Eleven of these were LNG facilities. The results of the study concluded that the presence of five of the eight types of "noxious" facilities have a significantly negative effect on property values and a positive effect on wages. However, the study concluded that the presence of an LNG facility did not have a significant positive or negative effect on either wages or property values (Clark and Nieves, 1993).

Based on the location of the LNG terminal on an existing industrially zoned site and the information from these studies, we do not believe that the construction and operation of the LNG terminal would negatively affect property values in the surrounding area.

Homeowner insurance rates are generally set on a county-wide basis, with individual rate adjustments made to reflect the age and value of the property and the claims record of the owner; insurance rates are not based on the surrounding landscape or structures at the local level. Properties in the vicinity of an industrial facility may be older and not as well maintained, which can affect the availability of insurance coverage or the insurance rates. It is not anticipated that the presence of an LNG terminal would affect the insurance rates of nearby residences.

Comments were also received during the scoping process regarding property devaluation caused by the construction and operation of the Logan Lateral Project. Appraisal methods used to value land are based on objective characteristics of the property and any improvements. The impact a pipeline may have on the value of a tract of land depends on many factors, including the size of the tract, the values of adjacent properties, the presence of other utilities, the current value of the land, and the current land use. Subjective valuation is generally not considered in appraisals. This is not to say that the pipeline would not affect resale values. A potential purchaser of property may make a decision to purchase based on his or her planned use, such as agricultural, future subdivision, or second home on the property in question. If the presence of a pipeline renders the planned use infeasible, it is possible that a potential purchaser would decide not to purchase the property. However, each potential purchaser has different criteria and differing capabilities to purchase land.

The effect that an easement may have on property values is a damage-related issue and should be negotiated between the parties during the easement acquisition process or would be determined during condemnation proceedings. This negotiation is beyond the scope of this EIS.

Property taxes for a piece of property are generally based on the actual use of the land. Construction of the pipeline would not change the general use of the land, but it would preclude construction of aboveground structures on the permanent right-of-way. If a landowner feels that the presence of a pipeline easement reduces the value of his or her land, resulting in an overpayment of property taxes, he/she may appeal the issue of the assessment and subsequent property taxation to the local property tax agency. This is the proper forum for this issue to be addressed.

4.9.6 Tax Revenues

Construction and operation of the Crown Landing LNG Project would have beneficial impacts on local sales tax revenue. The total revenue of Logan Township in 2003 was $6,796,000 and $117,792,000 for Gloucester County, New Jersey. Property taxes in Logan Township account for approximately 22 percent of that amount, and 77 percent for Gloucester County.

The construction of the Crown Landing LNG Project is anticipated to generate at least $600,000 annually in direct revenues for state and local governments. This estimate does not include additional revenues generated from secondary sources. Operation of the proposed LNG terminal is anticipated to generate approximately $6 million is annual revenues for state and local governments. Although only a portion of this tax money would be received by Logan Township, it would be a significant portion of the local government's annual revenues.

The construction of the Logan Lateral is expected to generate revenues to state and local governments within Pennsylvania and New Jersey. These revenues would be generated from the $77.3 million cost to construct the pipeline. The majority of these revenues would be collected from payroll taxes and sales taxes on materials purchased during construction. The operation of the pipeline is expected to generate approximately $1.1 million in property tax revenue annually to the states of Pennsylvania and New Jersey. The estimated $3,900 in yearly payroll taxes would be negligible.

4.9.7 Environmental Justice

Executive Order 12898 on Environmental Justice requires that each federal agency address disproportionately high and adverse health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. Each federal agency must also ensure that public documents, notices, and hearings are readily available to the public. As part of the preparation of this EIS, the NEPA review process must provide opportunities for effective community participation and involve consultation with affected communities. If the proposed action will result in significant adverse effects to minority or low-income populations or Native American tribes, the NEPA analysis should address those impacts as part of the alternatives analysis and identify appropriate mitigation measures to address the effects.

The mailing list for the Crown Landing LNG and Logan Lateral Projects was initiated when the FERC's NOI was issued and has been continually updated throughout the EIS process. All property owners affected by the two projects received notices about the projects without any distinction based upon minority or income status. The distribution list for this draft EIS included federal, state, and local agencies; elected officials; environmental and public interest groups; Native American tribes; affected landowners; intervenors to the FERC's proceeding; and local libraries and newspapers (see Appendix A). Sections 1.4 and 1.5 of this EIS further describe the stakeholder involvement process and the public notification and review process, respectively. Section 4.10.2 describes contacts with Native American tribes that traditionally occupied the area.

Crown Landing sponsored three informational open houses: March 9 in Claymont, Delaware; March 10 in Logan Township, New Jersey; and March 11 in Marcus Hook, Pennsylvania. Texas Eastern participated in the March 10 open house in Logan Township and then held additional open houses in Pennsylvania on March 30 in Brookhaven, March 31 in Chester Township, and April 1 in Chester. The primary purpose of these open houses was to provide project information to interested stakeholders and to respond to questions and comments regarding the projects. A FERC representative was in attendance at these open houses to provide information on its regulatory process. The FERC held public scoping meetings and site visits on May 5, May 6, and June 9, 2004 to provide the general public and

governmental agencies with the opportunity to comment on both the proposed LNG terminal and pipeline. The locations and dates of these meetings were published in the NOI.

Environmental Justice Areas and Potential Impacts

We received comments regarding the environmental justice of siting the proposed pipeline facilities in Delaware County, Pennsylvania. To address these concerns, we identified environmental justice areas in the vicinity of the proposed project and conducted an analysis of potential impacts that could disproportionately affect these areas. We also evaluated both system and route alternatives to determine if there were other options for transporting the natural gas from the proposed LNG terminal (see section 3.0).

To identify potential environmental justice areas, we reviewed available state, county, and municipal statistics regarding median income and poverty levels. Table 4.9.7-1 provides the general ethnic mix of the counties and communities that would be affected by the proposed pipeline. As shown on this table, the percentages of minority populations within Gloucester County and Logan Township are lower than the state averages. However, in Pennsylvania the African American and Native American minority populations in the City of Chester and Chester Township are considerably higher than the state or county average.

TABLE 4.9.7-1

Racial/Ethnic Statistics for the Project Area

State/County/Community	Racial/Ethnic Group, 2000 (percent)							Persons of Hispanic or Latino Origin (percent) a/
	White	Black	Native American and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Persons Reporting Some Other Race	Persons Reporting Two or More Races	
NEW JERSEY	72.6	13.6	0.2	5.7	0.0	5.4	2.5	13.3
Gloucester County	87.1	9.1	0.2	1.5	0.0	0.9	1.3	2.6
Logan Township	82.0	13.5	0.1	1.8	0.0	1.2	1.4	2.7
PENNSYLVANIA	85.4	10.0	0.1	1.8	0.0	1.5	1.2	3.2
Delaware County	80.3	14.5	0.1	3.3	0.0	0.6	1.2	1.5
City of Chester	18.9	75.7	0.2	0.6	0.0	3.0	1.5	5.4
Chester Township	22.7	73.3	0.3	0.6	0.0	1.0	2.1	2.1
Brookhaven Borough	95.6	2.0	0.1	1.2	0.0	0.4	0.6	1.1

a/ People who identify themselves as Hispanic or Latino may be of any race. Thus the percent Hispanic should not be added to the percentage for racial categories.

Source: U.S. Department of Commerce, U.S. Census Bureau, State and County QuickFacts.

Table 4.9.7-2 provides the general economic status of the counties and communities where the proposed projects would be located. In Logan Township, the median household income ($67,148) is greater than the Gloucester County average of $54,273 and the State of New Jersey average of $55,146. In addition, the percentages of individuals below the poverty level and households receiving public assistance are lower than the county and state averages. In Pennsylvania, the communities of the City of Chester and Chester Township have median household incomes that are much lower than the Delaware County and State of Pennsylvania averages. The same trend can be seen in the percentage of persons below the poverty line and the percentage of households receiving public assistance. However, Brookhaven Borough has a median household income ($48,289) more indicative of the county average of

$50,092. The percentages of persons below the poverty level and households receiving public assistance also follow the same trend in this community.

TABLE 4.9.7-2

Economic Statistics for the Project Area

State/County/Locality	Median Household Income (2000)	Persons Below the Poverty Level (1999) (percent)	Households Receiving Public Assistance (percent)
NEW JERSEY	$55,146	8.5	2.8
Gloucester County	$54,273	6.2	1.5
Logan Township	$67,148	4.3	0.8
PENNSYLVANIA	$40,106	11.0	3.1
Delaware County	$50,092	8.0	2.6
Chester City	$25,703	22.8	9.6
Chester Township	$32,576	17.1	5.9
Brookhaven Borough	$48,289	3.6	1.7

Source: U.S. Department of Commerce, U.S. Census Bureau

The site for the LNG terminal is located in Logan Township. In economic terms, the population of Logan Township is better off than the average Gloucester County resident or New Jersey resident. At the proposed site specifically, the percentages of minority residents and persons living below the poverty level are less than 10 percent. Based on the economic status of residents in Logan Township, the siting of the proposed LNG terminal would not disproportionately affect minorities or persons living below the poverty level.

An environmental justice area is defined as an area where the community's minority population is equal to or greater than 50 percent of the community population and/or a community in which the percentage of persons living below the poverty level is higher than the county average. Figure 4.9.7-1 shows environmental justice areas crossed by the proposed pipeline. The pipeline facilities associated with the Logan Lateral Project would traverse areas within the City of Chester and Chester Township where more than 70 percent of the population is a minority and the percentage of persons living below the poverty level is higher than the Delaware County average (see tables 4.9.7-1 and 4.9.7-2).

Although the proposed pipeline route crosses environmental justice communities, it would not disproportionately affect these communities for the following reasons. First, the purpose and need of a pipeline from the LNG terminal would necessarily route the pipeline though this area. The route must cross these areas because the pipeline must provide service from the proposed LNG terminal to Texas Eastern's Chester Junction Facility. Without this service, a portion of the purpose and need of the project would not be met. Second, Texas Eastern has routed the pipeline to follow, as much as possible, existing Texas Eastern pipeline rights-of-way and other existing rights-of-way. Finally, although the pipeline route does traverse areas of high minority population and areas with a greater number of persons living below the poverty level, the route also crosses areas of higher-income communities and areas with a minority population more indicative of the two counties where these communities are located. More specifically, of the approximately 10 miles of the proposed route on land, less than 3 miles traverse through environmental justice areas. The remaining portion of the on-land route crosses areas that are not classified as environmental justice areas, and are more indicative of the project area in general. In addition, 155 structures are located within 50 feet of the proposed construction right-of-way. Of this total, only 48, or about one-third, of these structures occur within the environmental justice areas and the other two-thirds of the structures are located outside of environmental justice areas.

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 4.9.7-1 Environmental Justice Communities

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

We received several comments on the draft EIS regarding routing the proposed pipeline through contaminated and polluted industrial areas within the low-income and minority communities. As discussed in section 4.11, construction of the proposed pipeline through these areas would be primarily limited to impacts on noise and air quality related to the construction vehicles. These impacts would temporarily occur during the construction period and would not further exacerbate existing pollution or contamination problems in theses areas. Operation of the proposed pipeline would not result in or contribute to permanent impacts on noise or air quality in the project area. To minimize the potential to contaminate soils along the pipeline route, Texas Eastern developed an SPCC Plan which specifies measures to prevent spills and leaks and procedures to be implemented in the event of a spill or leak during construction (see Appendix D). To minimize the spread of any existing contaminated soils that could be encountered along the pipeline route, Texas Eastern has indicated that it would develop a Plan for the Discovery and Management of Contaminated Soils and Groundwater. With these mitigative measures, we do not believe that the proposed natural gas pipeline would cause or contribute to pollution problems within the communities crossed by the pipeline route.

In addition to the siting of the project, potential impacts during construction and operation of the project could also include visual impacts from the presence of the LNG storage tanks, traffic impacts associated with the construction and operation of the project, and air quality and noise impacts. A summary and analysis of these impacts as they may pertain to environmental justice is presented below. More detailed assessments of visual resources, traffic, air quality, and noise are included in sections 4.8.6, 4.9.4, 4.11.1, and 4.11.2 of this final EIS, respectively.

As discussed in section 4.8.6, the primary visual impact of the project on the surrounding area would be the LNG storage tanks. The LNG storage tanks would be equally visible from the Pennsylvania side of the Delaware River, the location of the low income and high minority areas, as the New Jersey side of the Delaware River. Furthermore, the Logan Generating Station, located adjacent to the proposed LNG terminal site, stands 180 feet and the associated combustion stack stands 430 feet. Therefore, visual impacts would not be disproportionate given that the LNG storage tanks would not be dissimilar from the current landscape and would be equally visible from both sides of the Delaware River.

The increased amount of vehicular traffic during the construction of the Logan Lateral would impact the environmental justice areas crossed by the proposed pipeline. As described in section 4.9.4, these impacts would be minor and limited to the construction period. Increased traffic levels on U.S. Route 130 during the construction of the LNG terminal would be minimized through the implementation of the proposed mitigation measures described in section 4.9.4. Because similar impacts would occur in both environmental justice and non-environmental justice areas, disproportionate impacts would not occur from increased vehicular traffic.

As discussed in section 4.11.1, operation of the proposed project would result in air emissions from two sources: LNG ships and tugs and stationary equipment (heaters and emergency engines) associated with the LNG facility. These air emissions would not cause or significantly contribute to a violation of an ambient air quality standard. Therefore, the environmental justice areas would not be disproportionately affected by the project.

Impacts from noise during the construction and operation of the LNG terminal are discussed in section 4.11.2. The increased amount of noise during construction of the Logan Lateral would impact the environmental justice areas crossed by the proposed pipeline. These noise impacts would be temporary and limited to the construction area. Also, these temporary noise impacts would occur along the entire length of the pipeline and would not disproportionately affect the environmental justice areas in Pennsylvania. The construction and operation of the LNG terminal would not result in disproportionate

impacts on environmental justice areas given the location of the proposed facility across the Delaware River from the environmental justice areas.

In summary, we do not believe construction and operation of the proposed project would result in disproportionate adverse impacts on environmental justice communities. The projects are expected to generate a number of temporary and permanent employment opportunities, taxes and other revenue streams within the project area, and, with the use of appropriate mitigation measures, would not result in significant adverse impacts on the local environment and natural resources. Although some of the neighborhoods crossed by the proposed pipeline route have lower incomes than average, the potential impacts described above would affect all of the communities crossed by the pipeline, and would not disproportionately impact only the environmental justice areas.

4.10 CULTURAL RESOURCES

Section 106 of the NHPA (16 USC 470) requires the FERC to take into account the effects of its undertakings (including the issuance of a Certificate) on properties listed, or eligible for listing, on the NRHP and to provide the ACHP an opportunity to comment on its undertakings. Crown Landing and Texas Eastern, as non-federal parties, are assisting the FERC in meeting its obligations under section 106 and the implementing regulations in 36 CFR 800.

4.10.1 Results of the Cultural Resources Surveys

LNG Terminal

Aboveground Cultural Resources

Crown Landing conducted background research and a field survey to identify aboveground historic properties that could be affected by construction of the proposed LNG terminal (Cleven and Williams, 2004). Crown Landing defined the area of potential effects (APE) for this investigation as the proposed terminal site plus a 1.5-mile-radius viewshed.

Background research identified only one previously recorded historic property within the APE: the U.S. Route 130 Bridge across Oldmans Creek (Structure 1710152). The bridge is located outside the LNG terminal site but within the viewshed of the proposed facility. It consists of a two-lane, Waddell-type, vertical lift truss bridge built in 1936 and an adjoining operator's house. The structure was listed on the NRHP in 1992 for its engineering and design.

The field survey revisited Structure 1710152 and identified 31 additional built resources greater than 50 years in age within the APE. All 31 of the newly documented structures are located outside the LNG terminal site but within the viewshed of the facility. Of these, 28 structures are dwellings, one is a farmstead, one is a gas and service station, and one is a commercial building. The dwellings generally consist of simple, wood-frame, gabled houses dating from the late nineteenth to the mid twentieth centuries, with examples of Colonial Revival, Cape Cod, and Four Square style homes also present. The farmstead contains a ca. 1900, two-story, wood-frame house and five associated wood-frame outbuildings. The gas and service station is a ca. 1930 wood-frame, gable-front building. The commercial building consists of a ca. 1955, two-story masonry building. Crown Landing recommended all of the newly documented structures except the farmstead as ineligible for listing on the NRHP. Crown Landing indicated that the ca. 1900 farmstead may be significant for its association with the history of agriculture in Gloucester County and for the design and construction of its constituent buildings; and recommended it as potentially eligible for inclusion on the NRHP.

Crown Landing subsequently assessed the potential affects of its project on the U.S. Route 130 bridge and the ca. 1900 farmstead. Although both properties are located outside the LNG terminal site, the LNG tanks would be partially visible from both resources, and thus could potentially have a visual affect on the bridge and farmstead. Crown Landing concluded, however, that because the viewshed is not a character-defining feature of the bridge or the farmstead, the project would not affect either property.

Crown Landing submitted a report on the results of its architectural survey to the New Jersey State Historic Preservation Officer (SHPO) (Cleven and Williams, 2004) and the FERC. In a letter dated August 31, 2004, the New Jersey SHPO indicated that "the project will have no adverse effect on the U.S. Route 130 Bridge over Oldmans Creek". We agree.

Terrestrial Archaeological Resources

Crown Landing conducted background research and a field survey to identify any terrestrial archaeological sites that could be affected by construction of the proposed LNG terminal (Child et al., 2004). The APE for this investigation was defined as the terminal site and an associated construction staging area.

Background research identified four previously documented sites (28GL241, 28GL242, 28GL243, and 28GL244) located immediately adjacent to, but outside of, the LNG terminal site and construction staging area. Sites 28GL242, 28GL243, and 28GL244 each were characterized as small concentrations of historic materials dating from the late nineteenth and twentieth centuries. Site 28GL241 consisted of a prehistoric lithic artifact scatter dating from the Late Archaic through Late Woodland periods. All four sites previously were recommended eligible for listing on the NRHP.

The field investigation combined pedestrian reconnaissance, shovel and auger testing, and backhoe trenching. One archaeological site was identified in the vicinity of the construction staging area. It consisted of a moderately dense scatter of prehistoric lithic materials, and appeared to represent an extension of previously documented Site 28GL241. Evidence of potentially intact cultural deposits was identified at the site, and the newly recorded extension of Site 28GL241 was recommended as eligible for listing on the NRHP. Crown Landing subsequently modified its construction plans to create a no-work buffer zone around the site, which would avoid disturbance or impact on the site and any area within 100 feet of the site.

A diffuse scatter of both prehistoric and historic artifacts also was observed within the construction staging area but outside the extension of Site 28GL241. This material was recovered from disturbed depositional contexts and could not be associated with Sites 28GL241, 28GL242, 28GL243, or 28GL244, described above. Crown Landing concluded that the "prehistoric and historic materials located outside 28GL241 lack sufficient material and integrity to be designated as archaeological sites" (Child et al., 2004), and no additional testing of this area was recommended. No other archaeological sites were identified during the survey.

Crown Landing submitted a report (Child et al., 2004) on the results of its terrestrial archaeological survey to the New Jersey and Delaware SHPOs and to the FERC. In its letter of August 31, 2004, the New Jersey SHPO accepted the report and indicated that the project would have "no effect" on Site 28GL241, predicated on installation of the 100-foot protective buffer around the site, maintenance of the buffer throughout the duration of the project, installation and maintenance of heavy duty temporary fencing, and monitoring by an archaeologist to ensure appropriate installation and integrity throughout the project. In a letter dated September 16, 2004, the Delaware SHPO also accepted the report agreeing that no historic properties would be affected by the project. We concur with both SHPOs.

Crown Landing subsequently accepted the avoidance conditions for Site 28GL241 in a written plan submitted to the New Jersey SHPO and the FERC. In a letter dated October 1, 2004, the SHPO agreed with the provisions of the plan. We also concur.

Underwater Archaeological Resources

Crown Landing conducted background research and a field survey to identify any marine archaeological sites that could be affected by construction of the proposed LNG terminal (Child et al., 2004). The APE for this investigation was defined as the proposed pier and berthing area in the Delaware River between the New Jersey shoreline and the Marcus Hook anchorage area. The portion of the project

located within the anchorage area was excluded from the APE because it was disturbed by previous dredging.

Background research failed to document any previously recorded cultural resources or shipwrecks within the APE. The field investigation consisted of a marine remote-sensing survey utilizing a magnetometer, depth sounder, sub-bottom profiler, and side-scan sonar to examine the bed of the Delaware River. No evidence of shipwrecks or other cultural resources was identified during the survey, and no additional archaeological investigations of the pier and berthing area were recommended.

Crown Landing submitted a report (Child et al., 2004) on the results of its marine archaeological survey to the New Jersey and Delaware SHPOs, and to the FERC. The New Jersey SHPO accepted the report in its letter dated August 31, 2004, as did the Delaware SHPO in a letter dated September 16, 2004.

Pipeline Facilities

Aboveground Cultural Resources

Texas Eastern examined its proposed construction corridor to identify built resources that could be affected physically by construction of the proposed pipeline facilities in New Jersey and Pennsylvania (Breetzke, 2004a, 2004b). One aboveground resource, the Chester Creek Railroad Bridge, was identified in Pennsylvania. This bridge consists of a train trestle dating from the mid-nineteenth century. Texas Eastern recommended this resource as ineligible for inclusion on the NRHP. No built resources were identified within the construction corridor in New Jersey.

In its initial review of the project, the Pennsylvania SHPO concluded that although significant built resources may be present in the project area, "there will be no effect on these properties" (Pennsylvania Historical and Museum Commission, 2003). The Pennsylvania SHPO also reviewed the site form for the Chester Creek Railroad Bridge and concurred with Texas Eastern that this resource is ineligible for listing in the NRHP (Pennsylvania Historical and Museum Commission, 2004). We also concur.

Texas Eastern submitted separate reports (Breetzke, 2004a, 2004b) on the results of its survey to the New Jersey and Pennsylvania SHPOs, and to the FERC. In a letter dated October 7, 2004, the Pennsylvania SHPO concurred with the results of the investigation in Pennsylvania, and in a letter dated April 27, 2005, the New Jersey SHPO concurred with the survey results for New Jersey. We concur with both SHPOs.

Texas Eastern subsequently conducted additional fieldwork to examine two reroutes (MPs 1.47 to 1.68 and MP 3.34 to 3.68) in Pennsylvania, and two pipeline segments (MPs 7.26 to 7.90 and MPs 10.34 to 10.85) and an HDD pull-back area in New Jersey. No built resources were identified as a result of these surveys. Texas Eastern submitted separate reports (Breetzke, 2005; Breetzke and Whitlatch, 2005) on the results of the fieldwork to the Pennsylvania and New Jersey SHPOs, and to the FERC. In a letter dated May 31, 2005, the Pennsylvania SHPO concurred with the survey results and recommendations for Pennsylvania and in a letter dated April 27, 2005, the New Jersey SHPO concurred with the survey results and recommendations for New Jersey. We concur with both SHPOs.

Terrestrial Archaeological Resources

Texas Eastern conducted background research and a field survey to identify any terrestrial archaeological sites that could be affected by construction of the proposed pipeline facilities in New Jersey and Pennsylvania (Breetzke, 2004a, 2004b). The APE for this investigation was defined as the proposed construction corridor as well as extra workspace areas and ancillary facilities.

Background research identified two previously documented sites in Pennsylvania (36DE25 and 36DE26) and one in New Jersey (28GL241) located within or immediately adjacent to the survey corridor. Site 36DE25 was characterized as a historic farmstead. Site 36DE26 was described as a prehistoric artifact scatter with an unidentified cultural/temporal affiliation. Site 28GL241, as discussed previously for the LNG terminal, consisted of a prehistoric lithic artifact scatter dating from the Late Archaic through Late Woodland periods. Site 36DE25 was not previously evaluated for listing in the NRHP. Site 36DE26 was previously recommended potentially eligible and Site 28GL241 as eligible for inclusion on the NRHP.

The field investigation for the pipeline facilities combined pedestrian reconnaissance with shovel and auger testing and unit excavation. The survey examined a majority of the proposed pipeline lateral. Survey was not completed, however, from MPs 7.26 to 7.90 and MPs 10.34 to 10.85 in New Jersey. In addition, survey was not completed within a pull-back area for one of the HDD crossings in New Jersey.

The investigation revisited Sites 36DE25 and 36DE26 and identified three previously undocumented resources (Sites 36DE127, 36DE128, and 36DE129). Two of the three previously unidentified sites (Sites 36DE127 and 36DE129) were found during the survey of an alternative pipeline corridor, and are not located along the proposed pipeline route.

Although Sites 36DE25 and 36DE26 were recommended as potentially eligible for listing on the NRHP, Texas Eastern concluded that both sites are located outside of the proposed construction right-of-way and, therefore, would not be affected by the project. No additional testing of these two sites was recommended. However, installation of a barrier fence along the boundaries of the construction right-of-way in the vicinity of Site 36DE26 was recommended.

Sites 36DE128 and 36DE129 both were characterized as historic artifact scatters associated with partially intact building foundations. Site 36DE127 was described as a light scatter of historic materials. Texas Eastern assessed all three sites as ineligible for listing on the NRHP, and no additional testing of these sites was recommended.

Texas Eastern did not attempt to relocate or conduct additional testing at Site 28GL241. The delineation of site boundaries by Crown Landing indicated to Texas Eastern that the site is located outside the proposed construction corridor for the pipeline facilities and, therefore, would not be impacted by the project. Texas Eastern recommended installation of a fence along the boundaries of the construction corridor in the vicinity of the site.

Texas Eastern submitted separate reports (Breetzke, 2004a, 2004b) on the survey results to the New Jersey and Pennsylvania SHPOs, and to the FERC. The Pennsylvania report contained avoidance plans for Sites 36DE25 and 36DE26, and the New Jersey report contained an avoidance plan for Site 28GL241. In its October 7, 2004 letter, the Pennsylvania SHPO concurred with the recommendations of the Pennsylvania report, including the avoidance plans for Sites 36DE25 and 36DE26. In a letter dated April 27, 2005, the New Jersey SHPO concurred with the recommendations of the New Jersey report, including the avoidance plan for Site 28GL241. We concur with both SHPOs.

Texas Eastern subsequently conducted additional fieldwork to examine two reroutes (MPs 1.47 to 1.68 and MPs 3.34 to 3.68) in Pennsylvania, and two pipeline segments (MPs 7.26 to 7.90 and MPs 10.34 to 10.85) and an HDD pull-back area in New Jersey. Fieldwork consisted of pedestrian reconnaissance and auger testing; in addition, the results of geological coring and previous backhoe trenching in the vicinity of the New Jersey pipeline segments were reviewed. Texas Eastern also conducted deep testing along the pipeline corridor from MPs 9.5 to 9.7. Fieldwork for this investigation consisted of backhoe trenching and auger testing.

No archaeological sites were identified during the survey of the reroutes, pipeline segments, and HDD pull-back area. Backhoe trenching near MP 9.5 documented a buried A horizon but no archaeological materials were recovered. No additional testing of the examined areas was recommended.

Texas Eastern submitted separate reports (Breetzke, 2005; Breetzke and Whitlatch, 2005) on the results of the fieldwork to the Pennsylvania and New Jersey SHPOs. In a letter dated May 31, 2005, the Pennsylvania SHPO concurred with the survey results and recommendations in the Pennsylvania report, and in a letter dated April 27, 2005, the New Jersey SHPO concurred with the survey results and recommendations in the New Jersey report. We concur with both SHPOs.

4.10.2 Native American Consultation

Crown Landing identified and contacted four Indian tribes with historical ties to its project area: the Delaware Tribe of Indians, Delaware Nation of Western Oklahoma, Nanticoke Lenni-Lenape Indians, and the New Jersey Commission of Indian Affairs-Rankokus Indian Reservation. Each tribe expressed an interest in or commented on the project. The Delaware Tribe of Indians requested consulting party status for the project as well as a copy of the archaeological survey report, and they asked to be notified in the event that human remains or artifacts are discovered during construction. The Delaware Nation of Oklahoma and the Nanticoke Lenni-Lenape Indians each requested a copy of the archaeological survey report and asked to be notified in the event that human remains or artifacts are discovered during construction. The New Jersey Commission of Indian Affairs-Rankokus Indian Reservation advised Crown Landing that there are several known archaeological sites located in the project area.

Crown Landing submitted copies of its archaeological survey report (Child et al., 2004) to the three tribes who requested them. Only the Delaware Tribe of Indians commented on the report. The tribe concurred with the findings of the investigation as well as the plans to avoid Site 28GL241, and deferred comment on the project to the New Jersey SHPO.

Texas Eastern identified and contacted 16 Indian tribes with historical ties to its project area: the Absentee-Shawnee Tribe of Oklahoma, Cayuga Nation, Delaware Nation of Oklahoma, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, Oneida Indian Nation, Oneida Tribe of Indians of Wisconsin, Onondaga Indian Nation, Seneca Nation of Indians, Seneca-Cayuga Tribe of Oklahoma, St. Regis Mohawk Tribe, Stockbridge-Munsee Community of Wisconsin, Tonawanda Band of Seneca Indians, Tuscarora Nation, Nanticoke-Lenni Lenape Indian Center, and New Jersey Commission of Indian Affairs-Rankokus Indian Reservation. Eight of these tribes responded to Texas Eastern. The Cayuga Nation stated that it has an interest in the project. The Delaware Nation of Oklahoma and Delaware Tribe of Indians each requested a copy of the archaeological survey reports and asked to be notified in the event of an unanticipated discovery during project construction. The Eastern Shawnee Tribe of Oklahoma, Seneca Nation of Indians, Seneca-Cayuga Tribe of Oklahoma, and the Nanticoke-Lenni Lenape Indian Center each asked to be notified in the event of an unanticipated discovery during project construction. The Oneida Indian Nation stated that the project area is located outside its aboriginal territory and, therefore, the tribe has no comment on the project. None of the other tribes responded to Texas Eastern's project consultation letter.

Texas Eastern subsequently contacted the eight remaining tribes in addition to the Oneida Indian Tribe by telephone. The Oneida Indian Tribe, Onondaga Indian Nation, St. Regis Mohawk Tribe, and Tuscarora Nation each had no comment on the project but asked to be notified in the event of an unanticipated find during construction. The Absentee-Shawnee Tribe of Oklahoma requested additional information on the project. The Stockbridge-Munsee Community of Wisconsin stated that the project is located outside its area of interest. The Oneida Tribe of Indians of Wisconsin requested copies of the archaeological survey reports and asked to be notified in the event of an unanticipated find during construction. The New Jersey Commission of Indian Affairs-Rankokus Indian Reservation did not comment on the project. .

Lastly, Texas Eastern submitted copies of its cultural resources survey reports to four tribes: the Absentee-Shawnee Tribe of Oklahoma, Delaware Nation of Oklahoma, Delaware Tribe of Indians, and Oneida Tribe of Indians of Wisconsin. In a follow-up telephone call, the Delaware Nation of Oklahoma advised Texas Eastern that it had no comments on the reports. In a reply letter, the Oneida Tribe of Indians of Wisconsin concurred with the results and recommendations in the survey reports, but asked to be notified in the event of an unanticipated find during construction. Neither the Absentee-Shawnee Tribe of Oklahoma nor the Delaware Tribe of Indians provided comments on the reports.

4.10.3 Unanticipated Discoveries

Crown Landing developed a plan for responding to the unanticipated discovery of historic properties or human remains during construction of the LNG terminal and submitted it to the New Jersey and Delaware SHPOs, and to the FERC, as an appendix to its archaeological survey report (Child et al., 2004). The New Jersey SHPO accepted this report in its letter dated August 31, 2004 (New Jersey SHPO, 2004), as did the Delaware SHPO in its letter dated September 16, 2004 (Delaware SHPO, 2004).

Texas Eastern also developed a plan for responding to the unanticipated discovery of historic properties or human remains during construction of the pipeline facilities and submitted it to the New Jersey and Pennsylvania SHPOs, and to the FERC. The New Jersey SHPO concurred with the plan in a letter dated July 19, 2005, and the Pennsylvania SHPO concurred with the plan in a letter dated July 28, 2005.

4.11 AIR QUALITY AND NOISE

4.11.1 Air Quality

Climate

The climate in New Jersey is extremely variable. Cold continental air masses from central Canada and the northcentral United States produce cold winter weather often as low as 0˚ F. In the summer, the major system that influences New Jersey's weather is a high pressure cell (the Bermuda High) generally located over the area extending from the Sargasso Sea region of the North Atlantic to the eastern Gulf of Mexico. The clockwise movement of winds around the Gulf of Mexico brings warm, moist air from the Gulf of Mexico to the eastern United States; resulting in hot and muggy summer days that occasionally reach 100˚ F. The wind direction in New Jersey varies, although wind observations indicate that the predominant wind direction is north.

National Ambient Air Quality Standards

The EPA has established National Ambient Air Quality Standards (NAAQS) for six pollutants: sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 10 microns in diameter (PM_{10}), and lead (Pb). The EPA is currently working to implement a NAAQS for particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). The NAAQS were set at levels the EPA believed were necessary to protect human health (primary standards) and human welfare (secondary standards). The federal NAAQS for criteria pollutants are the same as the state standards established by the NJDEP and DNREC with the exception of a few secondary standards and a 1-hour NO_2 "guideline" that the NJDEP uses to assess air quality. This NJDEP guideline is not an ambient air quality standard under the New Jersey regulations; however, it is used by NJDEP to assess the impacts of NO_2 on a short-term basis. The standards established by the NJDEP are referred to as the New Jersey Ambient Air Quality Standards (NJAAQS). The project area is in attainment of the NAAQS for all criteria pollutants except ozone. The entire States of New Jersey and Delaware are designated as moderate "nonattainment" for ozone. The federal and state ambient air quality standards are summarized in table 4.11.1-1.

TABLE 4.11.1-1

Ambient Air Quality Standards

Air Pollutant	Averaging Period	Primary NAAQS ($\mu g/m^3$)	Secondary NAAQS ($\mu g/m^3$)	Primary NJAAQS ($\mu g/m^3$)	Secondary NJAAQS ($\mu g/m^3$)	Primary DAAQS ($\mu g/m^3$)	Secondary DAAQS ($\mu g/m^3$)
Ozone	1-Hour a/	235	235	235	160 c/	235	235
	8-Hour b/	157	157	-	-	157	157
Hydrocarbons	3-Hour i/	-	-	-	-	160	-
Carbon Monoxide	1-Hour c/	40,000	-	40,000	40,000	40,000	-
	8-Hour c/	10,000	-	10,000	10,000	10,000	-
Nitrogen Dioxide	1-Hour d/	-	-	470	-	-	-
	Annual e/	100	100	100	100	100	100
Particulate Matter less than 2.5 microns i/	24-Hour f/	65	65	-	-	65	65
	Annual g/	15	15	-	-	15	15
Total Suspended Particulate	24-Hour c/	-	-	260	150	260	150
	Annual h/	-	-	75	60	75	60
Lead	Quarter e/	1.5	1.5	1.5	1.5	1.5	1.5
Particulate Matter less than 10 microns	24-Hour c/	150	150	-	-	150	150
	Annual e/	50	50	-	-	50	50
Sulfur Dioxide	3-Hour c/	-	1,300	-	1,300	-	1,300
	24-Hour c/	365	-	365	260	365	-
	Annual e/	80	-	80	60	80	-

a/ The expected number of days with maximum hourly average concentrations greater than the standard must be equal to or less than one. EPA revoked the 1-hour ozone standard on June 15, 2005.

b/ The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations at each location within an area over each year must not exceed standard

c/ Not to be exceeded more than once per year (NAAQS)/12-month period (NJAAQS)

d/ Not to be exceeded

e/ Arithmetic mean not to be exceeded

f/ The 3-year average of the 98th percentile of 24-hour concentrations must not exceed standard

g/ The 3-year average of the annual concentrations from a single or multiple local sites must not exceed standard

h/ Geometric mean of 24-hour concentrations during a 12 consecutive month period not to exceed standard

i/ Concentration of hydrocarbons, exclusive of methane, taken over a 3-hour period from 6:00 to 9:00 a.m., local time

i/ Values presented are based on existing NAAQS. It should be noted that on December 20, 2005 the EPA signed proposed revisions to the NAAQS for PM_{10} and $PM_{2.5}$ and introduced a new NAAQS for $PM_{10-2.5}$, and plans to take final action on the proposed revision in September 2006.

$\mu g/m^3$ micrograms per cubic meter

Existing Air Quality

Air quality data contained in reports from the NJDEP and monitoring data provided by the EPA Airdata network for 2001 were reviewed to characterize ambient air quality related to regulated criteria pollutants in the vicinity of the project area. The pollutants include O_3, CO, NO_2, $PM_{2.5}$, total suspended particulate (TSP), Pb, PM_{10}, and SO_2. A summary of these data is presented in table 4.11.1-2.

Air Quality Control Regions

Air Quality Control Regions (AQCRs) were established by the EPA and local agencies, in accordance with section 107 of the CAA, as a means to implement the CAA and comply with the NAAQS through state implementation plans (SIPs). The AQCRs are intra- and interstate regions such as large metropolitan areas where the improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR. The project area is located in the Metropolitan Philadelphia Interstate AQCR. The AQCR was designated as a "severe nonattainment area" for the 1-hour ozone standard prior to June 15, 2005, when the standard was revoked. The AQCR is currently designated a

"moderate nonattainment area" for the 8-hour ozone standard. On April 5, 2005, the AQCR was designated nonattainment for the existing $PM_{2.5}$ NAAQS. On December 20, 2005, the EPA signed proposed revisions to the NAAQS for PM_{10} and $PM_{2.5}$ and introduced a new NAAQS for $PM_{10-2.5}$. The EPA is currently taking comments on the proposed revisions and must issue final standards by September 27, 2006. Based on the EPA finalizing the standards in September 2006, the NJDEP and DNREC would be required to make recommendations to the EPA by November 2007 and July 2012 for areas to be designated attainment and nonattainment for the $PM_{2.5}$ and $PM_{10-2.5}$ NAAQS, respectively. For $PM_{2.5}$ and $PM_{10-2.5}$ NAAQS it is anticipated that the EPA would make final designations in November 2009 and May 2013, which would become effective April 2010 and July 2013, requiring SIPs to be developed after designations. If required, New Jersey and Delaware would have to meet the revised $PM_{2.5}$ and new $PM_{10-2.5}$ NAAQS by April 2015 and July 2018, respectively, unless granted additional time to meet the standards.. The NJDEP and DNREC are responsible for enforcing compliance with the existing $PM_{2.5}$ NAAQS under Nonattainment New Source Review (NNSR) and Prevention of Significant Deterioration (PSD) permitting, if applicable. Emissions of $PM_{2.5}$ from construction are evaluated below and in the General Conformity Analysis.

TABLE 4.11.1-2

Existing Ambient Air Concentrations for the Project Area

Air Pollutant	Monitoring Station	Averaging Period	Existing Air Quality ($\mu g/m^3$)
Ozone	Clarksboro	1-Hour	244 a/
	Clarksboro	8-Hour	200 b/
Carbon Monoxide	Camden Lab	1-Hour	7,105 c/
	Camden Lab	8-Hour	5,824 c/
Nitrogen Dioxide	Camden Lab	1-Hour	134 c/
	Camden Lab	Annual	38 d/
Particulate Matter less than 2.5 microns	Gibbstown	24-Hour	45 c/
	Gibbstown	Annual	15 d/
Total Suspended Particulate	Pennsauken	24-Hour	156 c/
	Pennsauken	Annual	54 d/
Sulfur Dioxide	Clarksboro	3-Hour	109 c/
	Clarksboro	24-Hour	72 c/
	Clarksboro	Annual	16 d/
Particulate Matter less than 10 microns	Camden Lab	24-Hour	64 c/
	Camden RRF	Annual	26 d/
Lead	Pennsauken	Quarter	0.02 c/

a/ Concentration represents the 4th highest 1-hour average between 1999 and 2001 but number of days with 1-hour average over the standard is zero.

b/ Concentration represents the 4th highest 8-hour average between 1999 and 2001 and the number of days with an 8-hour average over the standard is 17.

c/ Concentration is the maximum concentration measured for 2001.

d/ Concentration is the annual average for 2001.

$\mu g/m^3$ micrograms per cubic meter

Regulatory Requirements for Air Quality

The proposed LNG terminal would generate air emissions through both short-term construction activities and long-term operation of the stationary emission units at the facility. Emissions from all

phases of construction and operation of the emission units would be subject to applicable state and federal air regulations.

The new stationary air emission sources associated with operating the proposed LNG terminal are listed in table 4.11.1-3.

Air emission sources in New Jersey and Delaware are regulated at the federal level under the CAA, as amended, and in New Jersey at the state level by the New Jersey Air Pollution Control Act (NJAPCA). The federal regulations established as a result of the CAA and the NJAPCA that are potentially applicable to the project include:

- New Source Performance Standards (NSPS);
- PSD/NSR;
- Title V Operating Permits;
- National Emission Standards for Hazardous Air Pollutants (NESHAPs);
- Federal Class I Area Protection;
- General Conformity; and
- State Regulations.

TABLE 4.11.1-3

Emission Source Information for LNG Terminal Equipment

Air Emission Source (quantity)	Input Rating (MMBtu/hr)	Output Rating	Energy Source
Water/Ethylene-Glycol Heaters (10)	98.4 (each)	NA	Natural Gas
High-Pressure Flare (1)	0.085 (pilot)	NA	Natural Gas
Low-Pressure Flare (1)	0.034 (pilot)	NA	Natural Gas
Emergency Generator (1)	NA	1 MW	Diesel Fuel
Diesel Fire Pump (1)	NA	275 Hp	Diesel Fuel
LNG Ships (at berth)	NA	NA	Fuel Oil/Natural Gas

MMBtu/hr million British thermal units per hour
NA No data available

New Source Performance Standards

NSPS regulations (40 CFR 60) establish pollutant emission limits and monitoring, reporting, and recordkeeping requirements for various emission sources based on source type and size. These regulations apply to new, modified, or reconstructed sources.

Subpart Dc of 40 CFR 60 applies to small industrial, commercial, or institutional steam generating units that are modified, constructed, or reconstructed after June 9, 1989 and have maximum heat input rates of more than 10 million British thermal units per hour (MMBtu/hr) but less than 100 MMBtu/hr. Subpart Dc establishes specific emissions limits for SO_2 (for coal- and oil-fired units) and PM (for coal- fired units). The proposed boilers would not be coal- or oil-fired, so the emission limitations would not be applicable. However, Subpart Dc would be applicable for reporting and recordkeeping requirements.

Subpart Kb of 40 CFR 60 applies to any volatile organic liquid storage unit that is modified, constructed, or reconstructed after July 23, 1984 and has a capacity of 75 m^3 or greater. Even though the LNG would contain only a small quantity of volatile organic compounds it may still be, by definition, a

volatile organic liquid because it has the potential to emit VOCs. However, there are several exemptions that may apply to LNG storage tanks at the proposed terminal. Subpart Kb exempts tanks that operate at an absolute pressure of greater than 204.9 kilopascals (kPa) or whose vapor pressure at storage temperature is less than 3.5 kPa. The proposed LNG storage tanks would operate above atmospheric pressure but below 204.9 kPa; however, the LNG tanks would operate at approximately -260E F and the vapor pressure of the VOC (assumed to be propane) at this temperature is 0.007 kPa. This is well below the applicability threshold of 3.5 kPa; therefore, the tank is not subject to NSPS Subpart Kb.

Prevention of Significant Deterioration

Title I of the CAA establishes guidelines for the preconstruction/modification review of large air emission sources. Construction of sources in attainment areas must be reviewed in accordance with the PSD regulations. To be classified as a new major PSD source, the potential to emit (PTE) for the source must be either greater than 100 tons per year (tpy) for any pollutant regulated by the EPA under the CAA for sources that are among the 28 source categories listed in section 169 of the CAA, or greater than 250 tpy for any pollutant regulated by the EPA under the CAA for sources that are not among the 28 source categories listed in section 169 of the CAA. A Best Available Control Technology (BACT) analysis and detailed dispersion modeling are required if a facility is classified as a major PSD source.

The Crown Landing's permit application has identified the closed loop shell-and-tube heat exchangers as fossil fuel boilers (or combination thereof) totaling more than 250 MMBtu/hr heat input. These are on of the 28 source categories identified in section 169 of the CAA; therefore, the applicability threshold for PSD review for the proposed LNG terminal is 100 tpy.

Nonattainment New Source Review

Construction of sources in nonattainment areas must be reviewed in accordance with the nonattainment NSR regulations. As discussed above, the project area is designated "nonattainment" for ozone (40 CFR 81.331). As such, there are special requirements for sources of VOC and NO_x because these pollutants are precursors to ground-level ozone formation and are regulated by section 182(f) of the CAA for ozone nonattainment areas. The EPA has delegated responsibility of the nonattainment NSR program to the NJDEP and DNREC. The NJDEP and DNREC have established nonattainment NSR requirements in NJAC 7:27-18 and DAC Regulation No. 25, respectively, outlining the review requirements for sources with a PTE greater than 25 tpy for NO_x or VOC. The NJDEP and DNREC have also established several NO_x and VOC regulations for specific source types. These regulations are discussed in the State Regulations section of this EIS.

Table 4.11.1-4 presents the annual maximum potential emissions from the proposed LNG terminal and relevant PSD and NSR threshold criteria.

As shown in table 4.11.1-4, the PTE NO_x is greater than the NSR threshold. Therefore, the proposed LNG terminal would be subject to nonattainment NSR. The nonattainment NSR would require emission offsets and demonstration of compliance with the lowest achievable emission rate (LAER). The LAER is the most stringent emission limitation established in the SIP, or achieved in practice, for a similar source of air emissions. Crown Landing has proposed ultralow NO_x burners achieving a NO_x concentration of less than 9 parts per million by volume at 3 percent oxygen in the stack gas. Approval of the LAER determination would be made by the NJDEP and DNREC during the preconstruction NSR permitting process.

TABLE 4.11.1-4

Operating Air Emissions Summary for the Proposed LNG Terminal a/

	NO_2		CO		VOC		SO_2		$PM_{10}/PM_{2.5}$	
Emission Unit (Quantity)	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
Water/Ethylene-Glycol Heaters (10) b/	11.0	43.2	20.8	82.2	3.8	14.9	0.7	2.85	0.98	3.7
Common Pilot for Flares c/	0.02	0.07	0.04	0.18	1.2E-03	5.0E-3	1.3E-04	5.5E-4	1.6E-3	6.9E-3
Emergency Generator (1) d/	17.1	1.7	1.5	0.2	3.3	0.3	3.0	0.30	1.3	0.13
Fire Pump (1) d/	2.2	0.2	5.2	0.5	0.6	0.06	0.7	0.07	0.2	0.2
LNG Ships (at berth) e/	19.0	12.5	7.8	5.1	0.5	0.3	46.6	30.6	2.6	1.7
Total	-	57.7	-	88.1	-	15.6	-	33.8	-	5.6
PSD Threshold Criteria	NA	100	NA	100	NA	100	NA	100	NA	100
NSR Threshold	NA	25	NA	NA	NA	25	NA	NA	NA	NA

a/ Emissions of lead, beryllium, mercury, sulfuric acid mist, asbestos, vinyl chloride, fluorides, hydrogen sulfide, total reduced sulfur, reduced sulfur compounds, CFCs, halons, and ozone depleting substances are negligible.

b/ Annual emissions are based on the lb/hr emission rates and 8,760 hours of operation per year for nine heaters.

c/ Annual emissions are based on the lb/hr emission rates and 8,760 hours of operation per year.

d/ Annual emissions are based on the lb/hr emission rates and 250 hours of operation per year.

e/ Hourly emissions are based on ships burning fuel oil and LNG. Annual emissions are based on 146 ship calls/year (73 ship calls running diesel electric and 73 ship calls burning fuel oil and natural gas)

NO_2 nitrogen dioxide
CO carbon monoxide
VOC volatile organic compound
SO_2 sulfur dioxide
PM_{10} particulate matter less than 10 microns in diameter
$PM_{2.5}$ particulate matter less than 2.5 microns in diameter
lb/hr pounds per hour
tpy tons per year

Because the air emission estimates for CO and VOC are based on manufacturer's emission estimates and these emissions guarantees are used to avoid classification as a PSD or NSR major source for these pollutants, **we recommend that:**

- **Crown Landing provide to the Commission a copy of the final manufacturer's emission guarantees and the NJDEP and DNREC final permits prior to construction. If the estimated PTE for CO or VOC is determined to be greater than the major source threshold, additional information regarding the method of compliance demonstration should also be provided prior to construction. This may include air dispersion modeling for CO or an LAER determination for VOC.**

Title V Operating Permits

Title V of the CAA requires states to establish an air operating permit program. The requirements of Title V are outlined in 40 CFR 70 and the permits required by these regulations are often referred to as Title V or Part 70 permits. New Jersey has incorporated this program in NJAC 7:27-22. Delaware has incorporated this program in Delaware Administrative Code (DAC) Regulation No. 30.

Under NJAC 7:27-22 and DAC Regulation No. 30, major sources (i.e., sources with a PTE greater than a major source threshold level) are required to obtain a Title V operating permit. Title V major source threshold levels in New Jersey and Delaware are: 100 tpy for CO and PM_{10}, 25 tpy for NO_x or VOC, 10 tpy for an individual hazardous air pollutant (HAP), or 25 tpy for any combination of HAPs. As shown in table 4.11.1-4, the PTE for NO_x is greater than the major source threshold; therefore, the proposed LNG terminal would need to apply for and obtain a Title V operating permit from the NJDEP and, if determined to be necessary, from the DNREC. The requirement to obtain a Title V operating permit is post-construction and is not required for Commission approval.

National Emission Standards for Hazardous Air Pollutants

The NESHAPs, codified in 40 CFR Parts 61 and 63, regulate HAP emissions. Part 61 was promulgated prior to the 1990 Clean Air Act Amendments (CAAA) and regulates only eight types of hazardous substances (asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride).

The 1990 CAAA established a list of 189 HAPs; resulting in the promulgation of Part 63. Part 63, also known as the Maximum Achievable Control Technology (MACT) standards, regulates HAP emissions from major sources of HAP emissions and specific source categories that emit HAPs. Part 63 defines a major source of HAPs as any source that has the potential to emit 10 tpy of any single HAP or 25 tpy of HAPs in aggregate.

LNG storage and process facilities are not one of the source categories regulated by Part 61; therefore, the requirements of Part 61 are not applicable. Part 63 establishes HAP emission standards for marine vessel loading operations (Subpart Y); oil and gas production facilities (Subpart HH); natural gas transmission and storage facilities (Subpart HHH); industrial, commercial, and institutional boilers and process heaters (proposed as Subpart DDDDD); and reciprocating internal combustion engines (Subpart ZZZZ). These subparts establish requirements for major sources of HAPs only. As indicated above, the potential HAP emissions (in aggregate) from the LNG terminal would be 8.3 tpy. The single largest HAP emitted by the terminal would be hexane with a PTE of 7.9 tpy. Therefore, the LNG terminal would not be a major source of HAPs and would not be subject to the NESHAPs.

Federal Class I Area Protection

The U.S. Congress designated certain lands as Mandatory Federal Class I (Class I) areas in 1977. Class I areas were designated because the air quality was considered a special feature of the area (e.g., national parks or wilderness area). These Class I areas, and any other areas that have been redesignated Class I areas since 1977, are given special protection under the PSD program. The PSD program establishes air pollution increment increases that are allowed by new or modified air pollution sources. If the new source is required to comply with PSD program requirements and is near a Class I area, the source is required to determine its impacts at the nearby Class I area(s). The source is also required to notify the appropriate federal land manager(s) for the nearby Class I area(s).

The proposed LNG terminal would not be subject to PSD review for CO and the nearest Federal Class I area is the Brigantine Wilderness Area located approximately 50 miles east of Logan Township. Therefore, the operational impacts of the proposed LNG Terminal on the Brigantine Wilderness Area are not required as part of the preconstruction permitting process.

General Conformity

Section 176(c)(1) of the CAA requires that a conformity determination be made if a federal action would generate emissions that would exceed the conformity thresholds levels (*de minimis*) of the pollutant(s) for which an air basin is in nonattainment. A conformity determination must show that the emissions would conform to the SIP and would not reduce air quality in the air basin, which can be demonstrated through offsets, SIP provisions, or modeling. Emissions from sources subject to NSR or PSD requirements are exempt and are deemed to have conformed. The requirements for a conformity determination are listed in 40 CFR Parts 6, 51, and 93, and became effective March 15, 1994.

As described above, the project area was previously designated as a "severe nonattainment area" for the 1-hour ozone standard, but as of June 15, 2005 is only designated a "moderate nonattainment area" for the 8-hour ozone standard. A federal conformity determination is required for any project in a "moderate nonattainment area" that would result in combined direct and indirect emissions of either NO_x or VOCs equal to or greater than 100 and 50 tpy thresholds, respectively. Since the combined potential direct and indirect emissions of NO_x from the proposed LNG terminal would be greater than 100 tons per year, a general conformity determination is required.

As previously discussed, the project area is designated as a "moderate" nonattainment area for the 8-hour ozone standard and non-attainment for $PM_{2.5}$. There is currently no General Conformity applicability threshold listed for $PM_{2.5}$ nonattainment areas; however, as recommended in a March 2005 EPA memorandum regarding the implementation of the NSR requirements in $PM_{2.5}$ nonattainment areas, a surrogate threshold of 100 tpy for PM_{10} moderate nonattainment areas has been used as the threshold.

A draft General Conformity Determination was prepared and submitted for public comments on August 26, 2005. Based on comments received on the draft General Conformity Determination, a final General Conformity Determination will be prepared and published in accordance with 40 CFR §51.856. See Appendix K for a copy of the draft General Conformity Determination.

Each federal agency is required to make a Conformity Determination before the action is taken. To allow FERC staff to complete the analysis and issue a final General Conformity Determination, we **recommend that:**

- **Prior to construction, Crown Landing and Texas Eastern should provide a full air quality analysis identifying all mitigation requirements required to demonstrate conformance with the applicable SIP and submit detailed information documenting how the project would demonstrate conformity in accordance with Title 40 CFR Part 51.858. The documentation should address each regulatory criteria listed in Part 51.858; provide a detailed explanation as to whether or not the project would meet each requirement; and for each criteria being satisfied, provide all supporting information on how the project would comply. Should any element of the project change substantially, Crown Landing and Texas Eastern should resubmit the aforementioned information so the OEP staff may determine the Conformity Determination of the revised action.**

New Jersey Regulations

Preconstruction Permits

The NJDEP requires a preconstruction permit for all new facilities meeting specific criteria set forth in NJAC 7:27-8. The regulation requires commercial fuel burning equipment with maximum heat

input rates of 1 MMBtu/hr or greater to obtain preconstruction permits. In accordance with the regulation, Crown Landing would need to obtain air permits for the water/ethylene-glycol heaters, emergency generator, and fire water pump prior to construction.

Smoke and Particulate from Combustion Sources

NJDEP regulation NJAC 7:27-3 (Subchapter 3) and 7:27-4 (Subchapter 4) limit visible (smoke) and particulate emissions from combustion equipment. Subchapter 3 establishes a 20 percent opacity limit for internal combustion sources, which includes the emergency generator, diesel water pump, mobile sources, and marine installations. Subchapter 3 also requires no visible emissions from the water/ethylene-glycol heaters except for 3 minutes in any consecutive 30-minute period. Subchapter 4 establishes a particulate emission limit of 0.17 pounds per MMBtu for the water/ethylene-glycol heaters. The heaters would comply with the emission limitation and visible emission requirement by burning natural gas.

Fuel Sulfur Content

Subchapter 9 of NJAC 7:27 limits sulfur content of liquid fuels. Crown Landing proposes to use liquid fuels in the generator and fire pump. Crown Landing would comply with NJAC 7:27 by using low sulfur distillate oil with a sulfur content of less than 0.2 percent by weight to run the proposed liquid fuel equipment.

Control of Volatile Organic Compounds and Oxides of Nitrogen

Subchapter 16 of NJAC 7:27 applies to any stationary source or group of sources that emits or has the potential to emit VOCs. Subchapter 19 applies to any stationary source or group of sources that emits or has the potential to emit 25 tpy of NO_x. Together these subchapters are referred to as the "VOC RACT Rule." The heaters and emergency generator at Crown Landing would be subject to these regulations. Specifically, the heaters must have VOC emissions no higher than 50 parts per million by volume on a dry basis (ppmvd) at 7 percent oxygen, CO emissions no higher than 100 ppmvd at 7 percent oxygen, NO_x emissions no higher than 0.1 pounds per MMBtu, and adjusted combustion processes that comply with NJAC7:27-16.24 annually. The generator must have limited NO_x emissions, CO emissions no higher than 500 ppmvd at 15 percent oxygen, and adjusted combustion processes that comply with NJAC7:27-16.24 annually.

Emission Offset Rule

Subchapter 18 of NJAC 7:27 applies to new air emission sources in or affecting nonattainment areas. As described above, the project area is designated as a "nonattainment area" for ozone. As such, NO_x and VOC are regulated as nonattainment pollutants for the area. Prior to commencing construction, Crown Landing would be required under Subchapter 18 to obtain emission offsets from existing sources that have implemented a permanent, enforceable emission reduction. The emission offsets must be obtained at a ratio of 1.3 to 1 (i.e., Crown Landing must obtain 1.3 tons of offsets for every 1 ton of emissions it would generate). In addition to offsets, Crown Landing would be required to implement LAER for NO_x emissions. The NJDEP would provide a LAER determination as part of the pre-construction permitting process. Crown Landing currently proposes the installation of ultra low NO_x burners on the heaters to reduce NO_x emissions and to comply with LAER.

Operating Permits

The operating permit program in New Jersey is regulated under Subchapter 22 of NJAC 7:27. As discussed in detail above, the LNG terminal would require a Title V operating permit.

State-of-the-Art Requirements

Under NJAC 7:27-8.12, new equipment and control apparatus are required to incorporate advances-in-the-art of pollution control for emission units that have the potential to emit more than a threshold quantity of an air pollutant. These requirements are typically referred to as the state-of-the-art (SOTA) requirements. The SOTA thresholds, which apply to each individual piece of equipment, are 5 tpy for all criteria pollutants except lead, which has a SOTA threshold of 20 pounds per year. The SOTA thresholds for HAPs and toxic substances vary per compound. The proposed LNG terminal would be subject to the SOTA requirements for the NO_x emissions from the heaters and the emergency generator and for the CO emissions from the heaters. Crown Landing's implementation of LAER for NO_x emissions would satisfy the SOTA requirements. The NJDEP SOTA manual for boilers currently sets the limit for CO emissions at 0.05 pounds per MMBtu. NJDEP recently published proposed revisions to the boiler manual that would lower the CO emissions level to 0.039 pounds per MMBtu. The NJDEP would determine Crown Landing's compliance with SOTA for CO emissions during the preconstruction permitting process.

Delaware Regulations

The portion of the project constructed and operated in the State of Delaware would be potentially subject to the following air regulations:

- DAC Regulation No. 2 and No. 25 (NNSR/PSD) – Preconstruction Permits
- DAC Regulation No. 4 – Particulate Emissions from Fuel Burning Equipment
- DAC Regulation No. 6 – Particulate Emissions from Construction and Materials Handling
- DAC Regulation No. 8 – Sulfur Dioxide Emissions from Fuel Burning Equipment
- DAC Regulation No. 12 – Control of Nitrogen Oxides Emissions
- DAC Regulation No. 14 – Visible Emissions
- DAC Regulation No. 17 – Source Monitoring, Record Keeping and Reporting
- DAC Regulation No. 19 – Control of Odorous Air Contaminants
- DAC Regulation No. 22 – Restriction on Quality of Fuel in Fuel Burning Equipment
- DAC Regulation No. 24 – Control of Volatile Organic Compound Emissions
- DAC Regulation No. 30 – Title V State Operating Permit Program
- DAC Regulation No. 35 – Conformity of General Federal Actions to the State Implementation Plans

- DAC Regulation No. 43 – Not to Exceed California Heavy Duty Diesel Engine Standards

- DAC Regulation No. 45 – Excessive Idling of Heavy Duty Engines

As a requirement of the preconstruction permitting process, Crown Landing would prepare and submit documentation to the DNREC demonstrating how the project would comply with applicable Delaware regulations. The DNREC would evaluate and approve the compliance documentation prior to issuing a final permit to construct and operate.

Air Quality Impacts and Mitigation

Construction of the proposed LNG terminal and pipeline facilities would have temporary adverse impacts on air quality due to fugitive dust emissions. The amount of fugitive dust would depend on several factors including the amount of exposed soil, moisture content of the soil, amount of vehicular traffic, and wind speed. Construction of the LNG terminal and pipeline would also result in tailpipe emissions from a variety of sources, including bulldozers, cranes, trucks, backhoes, side boom tractors, pile drivers, and dredging vessels.

The fugitive dust and tailpipe emissions from construction of the LNG terminal and pipeline are expected to be localized, minor, and temporary. This would be particularly true for pipeline construction, which would be of relatively short duration in any one area. Both Crown Landing and Texas Eastern propose to control fugitive dust resulting from construction activities by applying water as necessary**.** The construction vehicle emissions would be minimized by complying with the EPA mobile source emission regulations which may include 40 CFR Parts 85, 86, 89, and 90.

Operation of the LNG terminal would result in air emissions from mobile sources (LNG marine vessels, tugs, and commuter and delivery vehicles) and stationary equipment (heaters and emergency equipment) associated with the LNG facility. The estimated emissions from the stationary sources are summarized in table 4.11.1-4 and the mobile source emissions are summarized in table 4.11.1-5.

Marine vessel emissions would be minimized by using diesel electric ships approximately half of the time. These ships are capable of using electricity while at berth to eliminate air emissions. When diesel electric ships are not used, Crown Landing would use ships that burn a combination of fuel oil and LNG. Emissions from mobile sources, not including LNG ships, are regulated primarily through fuel mandates and engine emission standards that must be met by the engine manufacturers. These fuel mandates and engine standards would likely reduce the mobile source emissions identified above. One of the most significant reductions would be the SO_2 emissions from fuel oil and diesel fuel combustion as fuel mandates significantly reduce the allowable sulfur content in these fuels.

The mobile source emissions from operation of the facility will be assessed in the general conformity determination for compliance with the SIP and demonstrate that the proposed project would not delay attainment of the ozone NAAQS.

No air emissions would be directly generated by the pipeline during normal operation. Rare situations may require blowing down a segment of the pipeline; however, the only regulated emission that would be generated in such event is a small quantity of VOC.

TABLE 4.11.1-5

Estimated Air Emissions from the Crown Landing LNG Mobile Sources a/

	PM_{10}		SO_2 b/		NO_x		CO		VOC	
Source	lb/delivery	tpy	lb/delivery	tpy	lb/delivery	tpy	lb/delivery	tpy	lb/delivery	tpy
Tugs – Transport	25	1.9	195	14.3	664	48.4	84	6.1	30	2.2
LNG Ships – Transport c/	47	1.8	839	31.2	486	30.2	309	16.4	221	8.4
LNG Ships – Berthing c/	47	1.7	839	30.6	342	12.5	141	5.1	9	0.3
Commuter/Delivery Vehicles	---	0.0	---	0.0	---	2.0	---	7.3	---	0.6
Total	---	5.4	---	76.1	---	93.1	---	34.9	---	11.5

a/ The emissions assume 146 deliveries per year.
b/ The SO_2 emissions from the LNG ships are based on an estimated fuel sulfur content of 2.25 weight percent.
c/ The emissions estimates per delivery are based on the worst case scenario. It was assumed that half of the LNG ships would be powered by diesel electric systems and half would be powered by dual fuel steam boilers running fuel oil and LNG.

NO_x oxides of nitrogen
CO carbon monoxide
SO_2 sulfur dioxide
PM_{10} particulate matter less than 10 microns in diameter
VOC volatile organic compounds
lb/delivery pounds per LNG ship delivery
tpy tons per year

4.11.2 Noise

Noise Environment

Project-related noise would affect the local environment during construction and operation of the proposed LNG terminal and pipeline. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week. This variation is caused in part by changing weather conditions and the effects of seasonal vegetative cover. Two measures used by federal agencies to relate the time-varying quality of environmental noise to its known effect on people are the 24-hour equivalent sound level ($L_{eq(24)}$) and the day-night sound level (L_{dn}). The $L_{eq(24)}$ is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{dn} is the average of the daytime sound level (L_{day}) and the nighttime sound level (L_{night}) with 10 decibels on the A-weighted scale (dBA) added to the L_{night}, to account for people's greater sensitivity to sound during nighttime hours. L_{day} is the average sound level from 7 am to 10 pm L_{night} is the sound representative of the location between the hours of 10 pm and 7 am.

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. This publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. The FERC has adopted this criterion for new compression and associated facilities and it is used here to evaluate the potential noise impact from operation of the LNG terminal. An L_{dn} of 55 dBA is equivalent to a continuous noise level of 48.6 dBA for facilities that operate at a constant level of noise. The NJDEP regulates noise under NJAC 7:29-1; which prohibits continuous noise levels from industrial, commercial, public service, or community service facilities in excess of 65 dBA during the daytime (7 am to 10 pm) and 50 dBA during the nighttime (10 pm to 7 am) at any affected residential property line. Assuming a continuous noise source, the FERC standard of 55

dBA L_{dn} is more stringent (i.e., compliance with the FERC standard will ensure compliance with the NJDEP noise regulation).

There are several noise sensitive areas (NSAs) within 1 mile of the LNG terminal site. Figure 4.11.2-1 shows the location of NSAs relative to the LNG terminal site.

Table 4.11.2-1 lists the distance and direction of each NSA from the LNG terminal site. The closest NSA (NSA 1) is a residence located about 2,300 feet east of the site.

TABLE 4.11.2-1

Noise Sensitive Areas Near the Proposed LNG Terminal Site

NSA	Distance and Direction a/	Description
NSA 1	2,312 feet Southeast	Residence
NSA 2	2,488 feet Southeast	Residence
NSA 3	3,841 feet Southeast	Residence
NSA 4	4,432 feet Southeast	Residence

a/ Distance and direction of each NSA is relative to the eastern most LNG storage tank.
NSA: Noise sensitive area

An ambient sound survey of existing noise levels near the NSAs in the vicinity of the LNG terminal was conducted between August 19 and 21, 2003. The purpose of the sound survey was to document the existing acoustical environment near the NSAs prior to operation of the LNG terminal. Noise measurements were made for a period of about 40 hours at two locations: one adjacent to the boundary of NSA 1 approximately 20 feet from U.S. Route 130 and the other on the LNG terminal site approximately 450 feet from the Delaware shoreline. The data obtained from the sound survey were used to estimate the existing background noise levels at the NSAs for evaluating compliance with our noise requirement of 55 dBA L_{dn} and the New Jersey noise requirement of 65 dBA $L_{eq(24)}$ at any nearby residential property line. The estimated existing noise levels for the NSAs based on the sound survey are listed in table 4.11.2-2.

There are a total of 124 residences and 9 business establishments within 50 feet of proposed pipeline construction work areas. No background data are available for the noise sensitive areas along the pipeline route. Because most of these residences are located along streets in the City of Chester, the expected ambient noise levels at these residences are likely higher than the ambient noise levels measured at the NSAs near the LNG terminal site.

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 4.11.2-1 Noise Sensitive Areas

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

TABLE 4.11.2-2

Existing Noise Levels at the Closest Noise Sensitive Areas

Location	$L_{eq(24)}$	L_{day}	L_{night}	L_{dn}
NSA 1	54.2	56.3	52.2	59.5
NSA 2	54.2	56.3	52.2	59.5
NSA 3	54.2	56.3	52.2	59.5
NSA 4	54.2	56.3	52.2	59.5

$L_{eq(24)}$ 24-hour equivalent sound level
L_{day} daytime sound level
L_{night} nighttime sound level
L_{dn} day-night sound level

Noise Impacts and Mitigation

Construction of the LNG terminal would occur over approximately 3 years. Pile driving for the LNG storage tanks and the pier would be the most significant noise generating activity during the construction period. Pile driving would occur intermittently for approximately 6 to 8 months during daytime hours only. When in use, pile driving would generate noise approximately 60 percent of the time due to moving, attaching pile, and lifting activities. When the non-pile driving background noise is factored into the daytime L_{eq} sound pressure level, the estimated noise produced by pile driving is reduced by approximately 2 decibels. Utilizing logarithmic noise attenuation calculations, the estimated pile driving noise impact at the nearest NSA would be about 64.5 dBA, which is just below the 65 dBA sound pressure level for daytime operations specified in the New Jersey Noise Control Regulations NJAC 7:29. Vibration impacts associated with the pile driving is not expected to impact the nearest NSA due to the distance and vibration attenuation associated with the underlying unconsolidated soil/sediment conditions at the site.

The overall intensity of noise at nearby receptors would vary based on the type of equipment operating, the mode of operation, the amount of equipment in use, and the distance between construction equipment and the sensitive receptor. As a result, noise impacts from construction activities are difficult to estimate. It is known that the noise associated with these construction activities would be intermittent, as equipment would be operated on an as-needed basis. Construction activities at the LNG terminal would generate short-term increases in sound levels predominately during daylight hours, when the most significant construction activities would occur. Generally, noise at a large construction site is about 95 dBA at 10 feet. Based on a 6 dBA reduction per doubling of distance and approximately 2,300 feet to the nearest receptor, the construction noise level at the nearest NSA would be 47.8 dBA $L_{eq(24)}$ and 45.7 dBA L_{dn}. This equates to a total noise level of 55.1 dBA $L_{eq(24)}$ and a noise increase of 0.9 dBA at the nearest NSA when construction activities are occurring. The increase in noise would be perceptible to the nearby residences due to noise level fluctuations from such activities as pile driving; however, the equivalent noise increase would not be significant because this increase would only occur during construction activities.

Construction of the proposed pipeline would require operating construction equipment close to residential areas over a period of several months. With the exception of specific activities such as hydrostatic testing and critical stages of HDD, pipeline construction activities would occur largely during daylight hours. Pipeline construction is like having an assembly line, with crews conducting separate but sequential activities, each generally proceeding at rates ranging from several hundred feet to a mile per day. Depending on the distance between each crew in the assembly line, construction activities in any

one area could last from several days to several weeks on an intermittent basis. While receptors in the immediate vicinity of the construction activities would experience an increase in noise, this effect would be temporary and local. The average noise level generated by the construction equipment that would be used for pipeline construction activities ranges between about 79 and 89 dBA at a distance of 50 feet (EPA, 1971). Therefore, the 124 residents located closest to the pipeline route would experience a noise level of approximately 89 dBA at peak noise conditions. An 89 dBA noise level for 8 hours a day is equivalent to an L_{dn} of 84 dBA. Because noise levels diminish rapidly with distance, this noise level would be of limited duration and would decrease significantly as the construction equipment moves away from the residence.

Texas Eastern proposes to use the HDD technique in several locations. HDD is a special situation since the source of noise (the drill engine) remains in a fixed location during construction for a much longer period of time than other pieces of equipment on a pipeline construction right-of-way. HDD may also require nighttime operation. However, mitigation is available for this activity such that it is possible to reduce impacts to an insignificant level in most situations.

To ensure that NSAs are not exposed to excessive noise during nighttime HDD operations, **we recommend that:**

- **Prior to construction, Texas Eastern should submit a HDD noise analysis, mitigation and compliance plan for review and approval. This plan should demonstrate that noise generated by HDD operations is below 55 dBA L_{dn} at the nearest NSAs, and specify all noise mitigation equipment necessary to reduce noise below 55 dBA L_{dn}. Texas Eastern should detail the method by which they would ensure compliance and where noise surveys indicate that noise attributable to drilling exceeds 55 dBA L_{dn}, Texas Eastern should:**

  a. immediately stop drilling and mitigate the noise at the affected NSAs to reduce the noise levels at those NSAs to 55 dBA L_{dn} or below, or

  b. offer temporary housing until project-related L_{dn} levels at the NSAs are 55 dBA or below.

Stationary equipment at the proposed LNG terminal would also generate noise during operation of the LNG facilities. The primary stationary noise generating equipment at the LNG terminal would include water/ethylene-glycol heaters and pumps, boil-off gas compressor, high-pressure flare, LNG sendout pumps, and emergency equipment. The expected noise generated by each stationary source and the type of noise mitigation are listed in table 4.11.2-3.

TABLE 4.11.2-3

Noise Specifications for Proposed LNG Terminal a/

Description	Quantity	Overall Noise (dBA) at Distance (feet) b/		Shelter
LNG Sendout Pump	7	<85	3.3	No Shelter
Boil-off Gas Compressor	3	92	3.3	Boil-off Shelter
High-Pressure Flare	*1*	*107*	*50*	*No Shelter*
Boil-off Gas Blower	3	95	3.3	Boil-off Shelter
Electric Firewater Pump	1	90	3.3	Utility Shelter
Diesel Firewater Pump (Cat. engine)	*1*	*100*	*3.3*	*Utility Shelter*
Water/Ethylene-Glycol Heater (Blowers)	10	95	3.3	Heater Shelter
Water/Ethylene-Glycol Circulation Pump	4	92	3.3	Heater Shelter
Warm Water/Ethylene-Glycol Circulation Pump	2	90	3.3	Heater Shelter
Warm Water/Ethylene-Glycol Cooler	6	85	3.3	No Shelter
Warm Water/Ethylene-Glycol Circulation Pump	3	90	3.3	Heater Shelter
Plant/Instrument Air Compressor	2	80	3.3	Utility Shelter
Main Booster Air Compressor	2	85	3.3	No Shelter
Baseload Nitrogen Compressor	2	85	3.3	No Shelter
Emergency Generator (Diesel)	*1*	*109*	*3.3*	*Weather Protection*
Emergency Generator (Diesel)	*1*	*86*	*23*	*Weather Protection*
Total Noise from Daily Operating		101.4	3.3	

a/ The emergency equipment (identified in italics) are not included in the noise analysis because the equipment would not operate during normal daily plant operation.

b/ The overall noise level represents the total noise from the equipment category and does not account for noise reductions from the enclosures and dike interference.

Noise impacts associated with stationary sources were estimated using spreadsheet-based calculations which assume 6 dBA reduction per doubling of distance. The results of this analysis are summarized in table 4.11.2-4.

TABLE 4.11.2-4

Estimated Noise Impact from Proposed LNG Terminal

NSA	Distance to NSA (feet) a/	Existing Noise Level (dBA)		Level Attributable to Project (dBA)		Total Noise (dBA)		Future Increase (dBA) b/
		$L_{eq(24)}$	L_{dn}	$L_{eq(24)}$	L_{dn}	$L_{eq(24)}$	L_{dn}	
NSA 1	2,312	54.2	59.5	44.5	50.9	54.6	60.1	0.4
NSA 2	2,488	54.2	59.5	43.9	50.3	54.6	60.0	0.4
NSA 3	3,841	54.2	59.5	40.1	46.5	54.4	59.7	0.2
NSA 4	4,432	54.2	59.5	38.8	45.2	54.3	59.7	0.1

a/ Measured from the center of the LNG storage tank to the NSA.

b/ Based on the increase in 24-hour equivalent sound levels.

NSA noise sensitive area

dBA decibels of the A-weighted scale

$L_{eq(24)}$ 24-hour equivalent sound level

L_{dn} day night sound level

These results suggest that the maximum predicted L_{dn} and $L_{eq(24)}$ attributable to the operation of the LNG facilities would be 50.9 and 44.5 dBA, respectively, and would occur at NSA 1. In addition, the predicted noise increase would be no more than 0.4 dBA at any noise sensitive area. The noise level

attributable to the proposed LNG terminal would be less than 55 dBA L_{dn} (i.e., the FERC noise criterion) at all NSAs and the estimated $L_{eq(24)}$ noise level would be less than 50 dBA (i.e., the NJDEP noise criterion for nighttime noise) at all nearby residential properties. Because the proposed LNG terminal and pipelines do not include the addition of new compressors, no perceptible increase in vibration at any NSA is anticipated under normal operating conditions.

Because the noise analysis is based on preliminary design, and to ensure that the proposed LNG terminal operates in compliance with these guidelines, **we recommend that:**

- **Crown Landing make all reasonable efforts to assure its predicted noise levels from the LNG terminal are not exceeded at the NSAs and file noise surveys showing this with the Secretary no later than 60 days after placing the LNG terminal in service. However, if the noise attributable to the operation of the LNG terminal exceeds 55 dBA L_{dn} at an NSA or 50 dBA $L_{eq(24)}$ at a residential property line, Crown Landing should file a report on what changes are needed and should install additional noise controls to meet the level within 1 year of the in-service date. Crown Landing should confirm compliance with these requirements by filing a second noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

4.12 RELIABILITY AND SAFETY

Three federal agencies share in the oversight of the safety and security of LNG import terminals: the Coast Guard, the DOT, and the FERC. The FERC authorizes the siting and construction of LNG import terminals and is the lead federal agency under NEPA to analyze the environmental, safety, security, and cryogenic design of proposed facilities. The Coast Guard has authority over the safety of the LNG vessels and the marine transfer area. The Coast Guard also has authority over the security of LNG vessels and the entire LNG facility. In conjunction with this, the Coast Guard determines the suitability of waterways for LNG marine traffic by issuing a LOR. The DOT has exclusive authority to promulgate and enforce safety regulations and standards over the onshore LNG facilities beginning at the last valve immediately before the LNG storage tank(s).

In February 2004, the three participating agencies entered into an Interagency Agreement to assure that they work in a coordinated manner to address the full range of issues regarding safety and security at LNG import terminals, including the terminal facilities and tanker operations, and to maximize the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. The Interagency Agreement ensures a seamless safety and security review by the three federal agencies.

The operation of the proposed Crown Landing LNG terminal poses a potential hazard that could affect the public safety without strict design and operational measures to control potential accidents. The primary concerns are those events that could lead to an LNG spill of sufficient magnitude to create an offsite hazard including events occurring during the course of but not limited to LNG vessel transits. However, it is also important to recognize the stringent requirements for the design, construction, operation, and maintenance of the facility as well as the extensive safety systems to detect and control potential hazards.

With the exception of the October 20, 1944 fire at the LNG facility in Cleveland, Ohio, the operating history of U.S. LNG facilities has been free of LNG safety-related incidents resulting in adverse effects to the public or the environment. The 1944 Cleveland incident was attributed to the use of materials inadequately suited for cryogenic temperatures and the lack of spill impoundments at the site[7]. More recently, an operational accident occurred in 1979 at the Cove Point LNG facility in Lusby, Maryland, when a pump seal failed, resulting in gas vapors entering an electrical conduit and settling in a confined space. When a worker switched off a circuit breaker, the gas ignited, resulting in heavy damage to the building and a worker fatality. Lessons learned from this accident resulted in changing the national fire codes, with the participation of the FERC, to ensure that the situation would not occur again. The proposed facilities would be designed, constructed, and operated in compliance with these codes.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria LNG liquefaction facility that killed 27 and injured 56 workers. No members of the public were injured. Preliminary findings of the accident investigation suggest that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced to the high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler fire box which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and LPG separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998-1999, Train 40 had been operating with its original equipment since start-up in 1981.

[7] For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944, February 1946."

Although there are major differences between the equipment involved in the accident at Skikda and that of the proposal by Crown Landing (i.e., high-pressure steam boilers that power refrigerant compressors would not be used here nor are they used at any LNG facility under FERC jurisdiction), the sequence of cascading events identifies potential failure modes that warrant further evaluation. To ensure that all potential hazards are addressed, we have provided a recommendation in section 4.12.2, *Cryogenic Design and Technical Review*, to address this issue.

A discussion of the principal properties and hazards associated with LNG is presented in section 4.12.1. A summary of our preliminary design and technical review of the cryogenic aspects of the LNG terminal is presented in section 4.12.2. Storage and retention systems are discussed in section 4.12.3. An analysis of the thermal radiation and flammable vapor cloud hazards resulting from a credible land-based LNG spill is presented in section 4.12.4, while the safety aspects of LNG transportation by ship is discussed and summarized in section 4.12.5. A discussion on security awareness related to terrorism is presented in section 4.12.6. The reliability and safety issues related to the natural gas pipeline are discussed in section 4.12.7. Additional safety issues identified in scoping are addressed in section 4.12.8. Conclusions on safety issues are in section 4.12.9.

4.12.1 LNG Hazards

LNG's principal hazards result from its cryogenic temperature (-260º F), flammability, and vapor dispersion characteristics. As a liquid, LNG will neither burn nor explode. Although it can cause freeze burns and, depending on the length of exposure, more serious injury, its extremely cold state does not present a significant hazard to the public, which rarely, if ever, comes in contact with it as a liquid. As a cryogenic liquid, LNG will quickly cool materials it contacts, causing extreme thermal stress in materials not specifically designed for ultra cold conditions. Such thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These hazards, however, are not substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296º F) or several other cryogenic gases that have been routinely produced and transported in the United States.

Methane, the primary component of LNG, is colorless, odorless, and tasteless, and is classified as a simple asphyxiant. Methane could, however, cause extreme health hazards, including death, if inhaled in significant quantities within a limited time. At very cold temperatures, methane vapors could cause freeze burns. Asphyxiation, like freezing, normally represents a negligible risk to the public from LNG facilities.

When released from its containment vessel and/or transfer system, LNG will first produce a vapor or gas. This vapor, if ignited, represents the primary hazard to the public. LNG vaporizes rapidly when exposed to ambient heat sources such as water or soil, producing 620 to 630 standard cubic feet of natural gas for each cubic foot of liquid. LNG vapors in a 5 to 15 percent mixture with air are highly flammable. The amount of flammable vapor produced per unit of time depends on factors such as wind conditions, the amount of LNG spilled, and whether it is spilled on water or land. Depending on the amount spilled, LNG may form a liquid pool that will spread unless contained by a dike.

Once a flammable vapor-air mixture from an LNG spill has been ignited, the flame front will propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. An unconfined methane-air mixture will burn slowly, tending to ignite combustible materials within the vapor cloud, whereas fast flame speeds tend to produce flash burns rather than self-sustaining ignition.

LNG is not explosive as it is normally transported and stored. However, LNG vapors (primarily methane) can explode if contained within a confined space, such as a building or structure, or confined space aboard an LNG ship, and ignited. There is no evidence, however, suggesting that LNG is explosive in unconfined open areas. Experiments to determine if unconfined methane-air mixtures will explode have been conducted and, to date, have all been negative. Unconfined methane-air mixtures will burn but will not explode. Nevertheless, a number of experimental programs have been conducted to determine the "amount of initiator charge" required to detonate an unconfined methane-air mixture.

Over the years, various parties have occasionally expressed the energy content of an LNG storage tank or LNG ship in equivalent tons of trinitrotoluene (TNT), as an implied measure of its explosive potential. However, such a simplistic analogy fails to consider that explosive forces are not just a function of the total energy content but also of the rate of energy release. For an explosion to occur, the rate of energy release must be nearly instantaneous, such as with a TNT charge initiated by a blasting cap. Unlike TNT or other explosives which inherently contain an oxidizer, an unconfined vapor cloud must be mixed with oxygen within the flammability range of the fuel for combustion to occur. For a large unconfined vapor cloud, the flammability range tends to exist at the mixing zone at the edges of the cloud. When ignited, flame speeds about 66 to 82 feet per second (20 to 25 meters per second) and local over pressures up to 0.2 psig have been estimated for methane rich fuels, well below the flame speeds and over pressures associated with an explosion.

A rapid phase transition (RPT) can occur when a portion of LNG spilled onto water changes from liquid to gas, virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction as described above, an RPT is the result of heat transferred to the liquid inducing a change to the vapor state. The rapid expansion from the liquid to vapor state can cause locally large overpressures. RPTs have been observed during LNG test spills onto water. In some test cases, the overpressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. The sizes of the overpressure events have been generally small, and are estimated to be equivalent to several pounds of TNT. Such a small overpressure is not expected to cause significant damage to an LNG vessel. However, the RPT may increase the rate of LNG pool spreading and the LNG vaporization rate.

4.12.2 Cryogenic Design and Technical Review

The cryogenic design and technical review emphasizes the engineering design and safety concepts as well as the projected operational reliability of the proposed facilities. The principle areas of coverage include: materials in cryogenic environments; insulation systems; cryogenic safety; thermodynamics; heat transfer; instrumentation; cryogenic processes; and other relevant safety systems.

Study and evaluation of information for the proposed design and installation of the Crown Landing LNG terminal has been performed by FERC staff. The design and specifications submitted for the proposed facility to date are considered to be preliminary but would be the basis for any detailed design to follow. A significant amount of the design involving final selection of equipment manufacturers, process conditions, and resolution of some safety related issues would be completed in the next phase of the project development if authorization is granted by the Commission. This information would need to be submitted to FERC staff for review and approval.

As a result of the technical review of the information provided in the submittal documents, a number of concerns were identified by staff relating to the reliability, operability, and safety of the proposed design. In response to staff's questions, Crown Landing provided written answers prior to the site visit and technical conference on January 11-12, 2005. However, several areas of concern are noted that require additional consideration and/or action on behalf of the company. Follow up on those items

requiring additional action should be documented in reports to be filed with the FERC. As a result, **we recommend that:**

The following measures should apply to the LNG terminal design and construction details. Information pertaining to these specific recommendations should be filed with the Secretary for review and approval by the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; or prior to commencement of service as indicated by each specific recommendation. Items relating to Resource Report 13-*Engineering and Design Material* and security should be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR § 388.112 and PL01-1. Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements would be subject to public disclosure. This information should be submitted a minimum of 30 days before approval to proceed is required.

- **Crown Landing provide a technical review of its facility design that:**

  a. Identifies all combustion/ventilation air intake equipment and the distance(s) to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases).

  b. Demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion equipment whose continued operation could add to or sustain an emergency.

  Crown Landing should file this review <u>prior to initial site preparation</u>.

- **Procedures should be developed to measure, monitor and if necessary, remove water from beneath the pile cap, to prevent freezing and frost heave, during construction. Procedures should be filed <u>prior to initial site preparation</u>.**

- **An evaluation of the relief and flare systems should be made and filed <u>prior to initial site preparation</u>.**

- **A complete plan and list of the hazard detection equipment should be filed <u>prior to initial site preparation</u>. The information should include a list with the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment. Plan drawings should clearly show the location of all detection equipment.**

- **A complete plan and list of the fixed and wheeled dry-chemical, fire extinguishing, high expansion foam, hazard control equipment should be filed <u>prior to initial site preparation</u>. The information should include a list with the equipment tag number, type, size, equipment covered, and automatic and manual remote signals initiating discharge of the units. Plan drawings should clearly show the planned location of all fixed and wheeled extinguishers.**

- **Facility plans showing the proposed location of, and area covered by, each monitor, hydrant, deluge system, hose, and sprinkler, as well as piping and instrumentation diagrams, of the fire water system should be filed <u>prior to initial site preparation</u>.**

- **The final design of the hazard detection equipment should identify manufacturer and model.**

- **The final design of the fixed and wheeled dry-chemical, fire extinguishing, high expansion foam hazard control equipment should identify manufacturer and model.**

- **The final design should include equipment and instrumentation for the measurement of translational and rotational movement of the inner vessel for use during and after cool down.**

- **The final design should include details of the boil-off gas flow measurement system provided for each tank.**

- **The final design should include a minimum of three onsite seismic instruments that would have the capability of actuating an automatic plant wide emergency shutdown in the event of seismic activity approaching the site Operating Basis Earthquake. Crown Landing should specify the set point to be used.**

- **The final design should include a reliable measurement system to monitor deflections during the hydraulic test. At a minimum, this system should include two slope indicator ducts which bisect the tank in mutually perpendicular directions, monitoring points at the terminals of these ducts, and other monitoring points along the perimeter of the concrete shell, so that sag, warping, tilt, and settlement can be monitored. Tolerances for sag, tilt, and shell warping should meet or exceed the limits specified by the tank manufacturer.**

- **The final design should include details of the LNG tank tilt settlement and differential settlement limits between each LNG tank and piping and procedures to be implemented in the event that limits are exceeded.**

- **The final design should include drawings and specifications of the spill protection system to be applied to the LNG tank roofs.**

- **The final design should include provisions to measure the discharge flow of each intank pump.**

- **The final design of the vaporizers should include double block isolation on the suction and double block isolation and check valve on the discharge of each vaporizer. One of the valves on the suction and one valve on the discharge should be automatically actuated.**

- **The final design should include provisions to ensure that hot glycol/water circulation is in operation at all times, except during power failures, when LNG is present in the LNG booster pump discharge piping or when the temperature in the LNG inlet channel to any vaporizer is below 0° F.**

- **The final design should include detection instrumentation and shut down procedures for vaporizer tube leak, shell side overpressure, or bursting disc failure.**

- **The final design should include temperature measurement of the vaporizer common discharge header which should alarm the low temperature condition.**

- **The final design should include provisions to install temporary high pressure boiloff compression in the event that sendout operation is curtailed, or ceased for a period in excess of thirty days. Details should include plans and drawings of the boiloff gas recovery system and specifications of the equipment and compressors to be installed.**

- **The final design should include automatic shutdown valves at the suction and discharge of the each boiloff blower and each boiloff compressor.**

- **The final design should ensure that air gaps are installed downstream of all seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that: would continuously monitor for the presence of a flammable fluid; would alarm the hazardous condition; and would shutdown the appropriate systems.**

- **The final design should include a fire protection evaluation carried out in accordance with the requirements of National Fire Protection Association Standards for the Production, Storage, and Handling of LNG 59A, chapter 9.1.2.**

- **In the event that open path detectors are used in the final design, they should be calibrated to detect the presence of flammable gas and alarm at the lowest reliable set point, in addition to the required 25 percent lower explosive limit set point.**

- **The final design should include details of the shut down logic.**

- **The final design should include emergency shutdown of equipment and systems activated by hazard detection devices for flammable gas, fire, and cryogenic spills, when applicable.**

- **Security personnel requirements prior to and during LNG vessel unloading should be filed prior to commissioning.**

- **Operation and maintenance procedures and manuals, as well as safety procedure manuals, should be filed prior to commissioning.**

- **Copies of the Coast Guard security plan and vessel operation plan should be provided to FERC staff prior to commissioning.**

- **The contingency plan for failure of the outer LNG tank containment should be filed prior to commissioning.**

- **FERC staff should be notified of any proposed revisions to the security plan and physical security of the facility prior to commencement of service.**

- **Progress on the proposed construction project should be reported in monthly reports filed with the Secretary. Details should include a summary of activities, projected schedule for completion, problems encountered and remedial actions taken. Problems of significant magnitude should be reported to the FERC within 24 hours.**

In addition, we recommend that the following inspection and reporting measures be applied throughout the life of the facility:

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least a biennial basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Crown Landing should respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted annual report, should be submitted.**

- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported LNG, vaporization quantities, boil-off/flash gas, etc.), plant modifications including future plans and progress thereof. Abnormalities should include, but not be limited to: unloading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, vapor or liquid releases, fires involving natural gas and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boiloff rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant plant modifications proposed for the next 12 months (dates)" also should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.**

- **In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material the Commission should be notified within 24 hours and procedures for corrective action should be specified.**

- **Significant non-scheduled events, including safety-related incidents (i.e., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (i.e., attempts to enter site, suspicious activities) should be reported to FERC staff within 24 hours. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable LNG-related incidents include:**

  a. fire;

b. explosion;

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

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

e. free flow of LNG for 5 minutes or more that results in pooling;

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

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

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

i. a leak in an LNG facility that contains or processes gas or LNG that constitutes an emergency;

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

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes gas or LNG;

l. safety-related incidents to LNG vessels occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

4.12.3 Storage and Retention Systems

LNG storage tanks come in a variety of categories. The following are descriptions of the tank designs most commonly used world wide:

- Single containment cylindrical metal tanks (predominately used in the United States);
- Spherical storage tanks (predominately used in LNG carriers);
- Double containment cylindrical metal inner tank and metal or concrete outer tank (commonly thought of as an LNG tank with a high wall dike);
- Full containment cylindrical metal inner tank and metal or concrete outer tank (two authorized by the Commission; several applications currently proposed to the Commission, including Crown Landing);
- Pre-stressed cylindrical concrete tank with an internal metal membrane (membrane tank). (None in the United States); and
- Cryogenic cylindrical concrete tank; internal cryogenic tank and pre-stressed concrete outer tank (one operational in the United States; the remainder worldwide).

These tank categories are described in Annex H of the European Standard for LNG facilities (EN 1473) are summarized below for the LNG storage tanks commonly found in proposals before the Commission.

H.1 Single containment tank

A single primary container and generally an outer shell designed and constructed so that only the primary container is required to meet the low temperature ductility requirements for storage of the product.

The outer shell (if any) of a single containment storage tank is primarily for the retention and protection of insulation and to contain the purge gas pressure, but is not designed to contain refrigerated liquid in the event of leakage from the primary container.

An above ground single containment tank shall be surrounded by a bund (dike) wall to contain any leakage. Examples of single containment are given in Figure H.1.

H.3 Double containment tank

A double containment tank is designed and constructed so that both the inner self supporting primary container and the secondary container are capable of independently containing the refrigerated liquid stored. To minimize the pool of escaping liquid, the secondary container should be located at a distance not exceeding 6 meters from the primary container.

The primary container contains the refrigerated liquid under normal operating conditions. The secondary container is intended to contain any leakage of the refrigerated liquid, but it is not intended to contain any vapor resulting from this leakage.

Examples of double containment tanks are given in Figure H.3. Figure H.3 does not imply that the secondary container is necessarily as high as the primary container.

H.4 Full containment tank

A tank designed and constructed so that both self supporting primary container and the secondary container are capable of independently containing the refrigerated liquid stored and for one of them its vapor. The secondary container can be a distance of 3 to 6 feet (1 to 2 meters) from the primary container.

The primary container contains the refrigerated liquid under normal operating conditions. The outer roof is supported by the secondary container. The secondary container shall be capable both of containing the refrigerated liquid and of controlled venting of the vapor resulting from product leakage after a credible event. Examples of full containment tanks are given in Figure H.4.

Single-, double-, and full-containment LNG storage tanks have been authorized by the Commission for use at new LNG import facilities or expansions of existing terminals; and single- and double-containment tanks have been constructed and operated. Several full-containment tanks have started construction in the United States, while approximately 50 have been constructed worldwide. During the review of earlier proposals, a number of issues have surfaced concerning the applicability of existing codes and regulations to full-containment tank. Specifically, the term "full containment" does not appear in U.S. codes or standards for LNG facilities, including the Federal Safety Standards in 49 CFR Part 193, NFPA 59A, or American Petroleum Institute 620. As a result some have made the assumption that to design and construct a full-containment tank in accordance with the EN 1473 will satisfy the U.S. code and standards.

For example, it has been suggested that thermal exclusion zones are not required for a full-containment tank because EN 1473 does not consider a tank fire scenario for full-containment tanks with a pre-stressed concrete wall and concrete roof. The staffs of the FERC and OPS do not agree because neither NFPA 59A nor Part 193 exclude full containment from thermal exclusion zone requirements. As a result, a thermal exclusion zone analysis is required for an LNG storage tank fire at the top of the secondary container (see section 4.12.4).

Further, EN 1473 does not specify a minimum distance to the property line for full-containment tanks because no tank fire scenario is considered. However, NFPA 59A requires a separation of 0.7 times the diameter from the property line. The proposed tanks for the Crown Landing project meet the separation requirement.

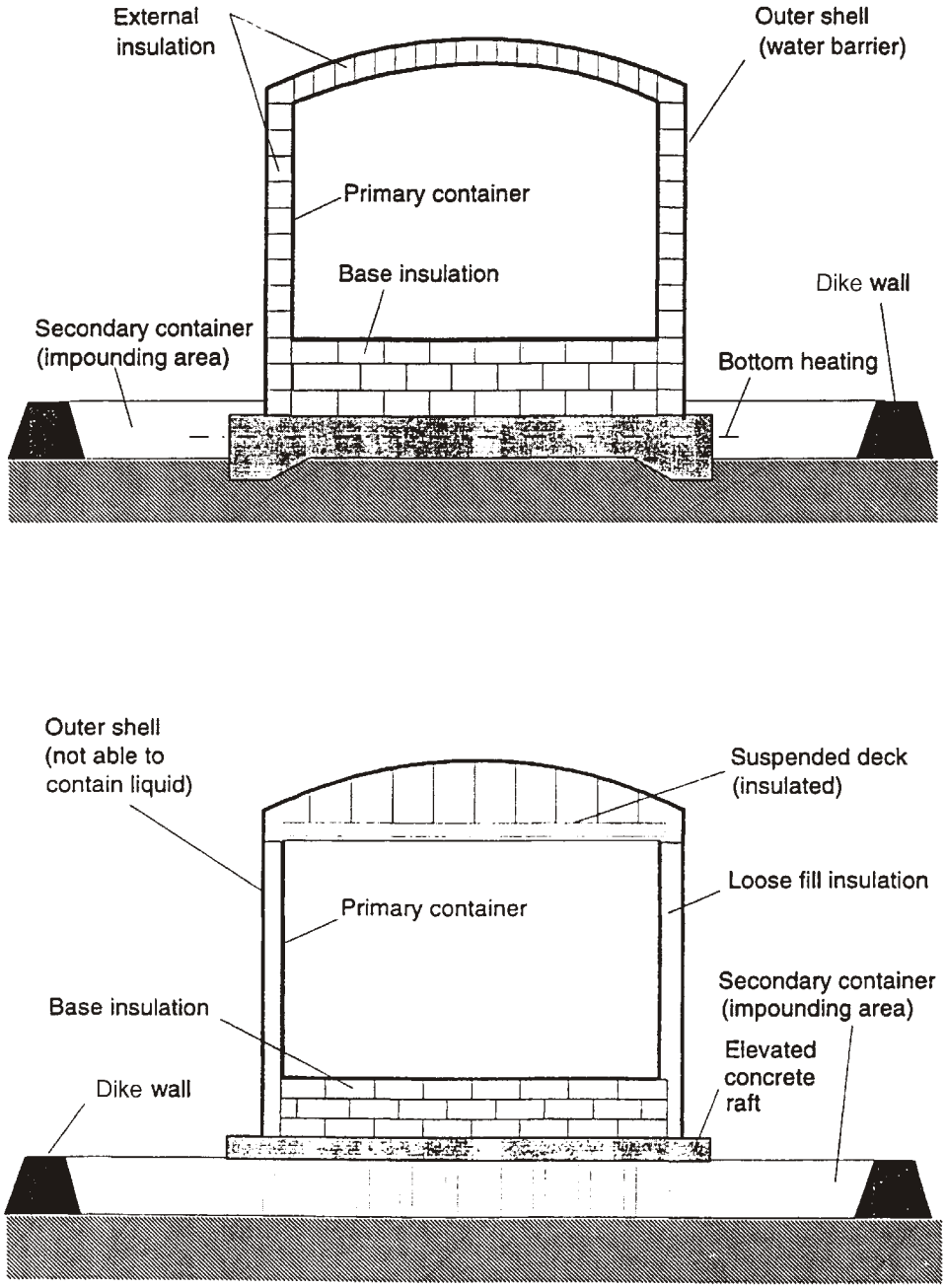


Figure H.1 Examples of single containment tanks

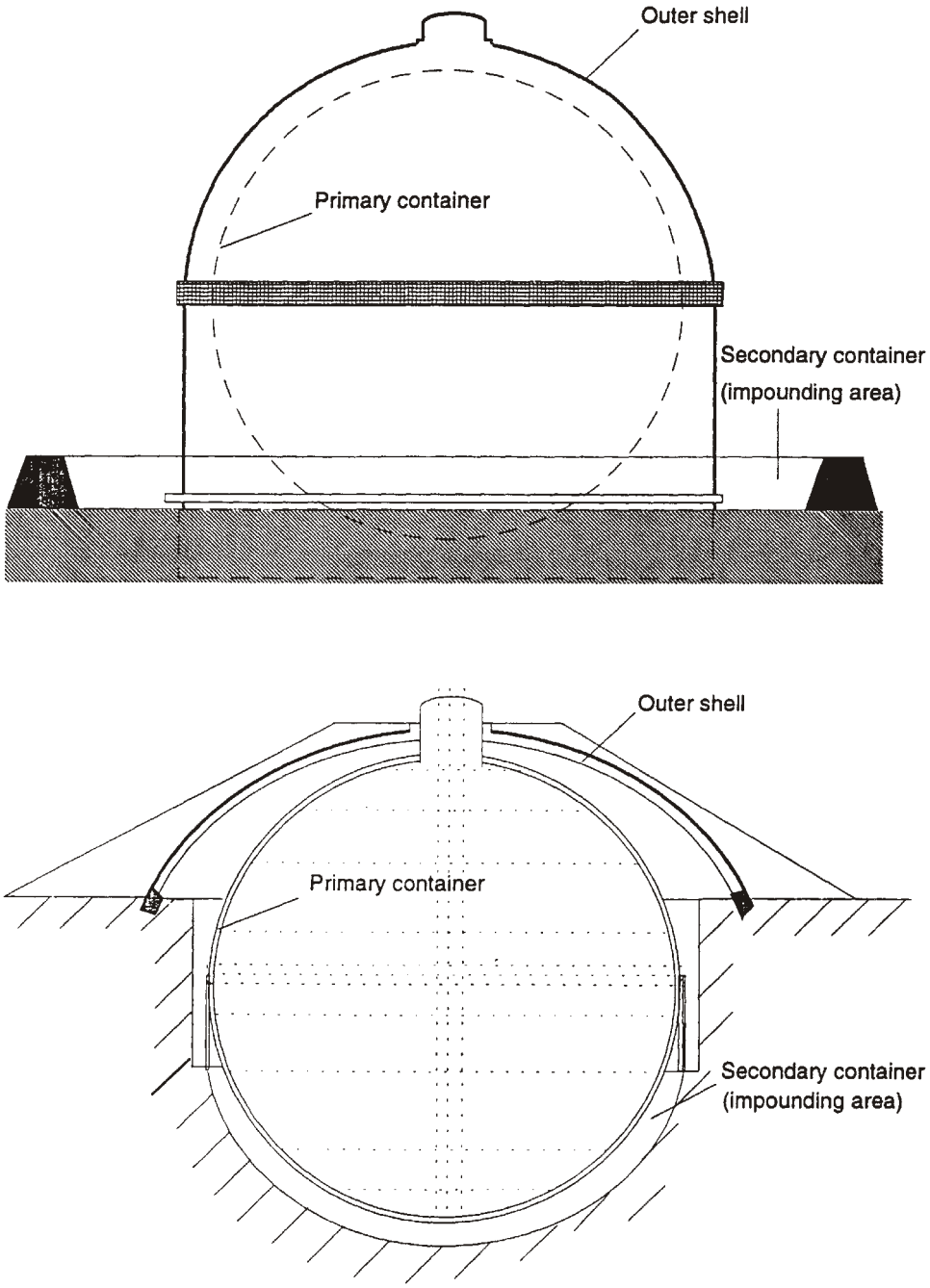
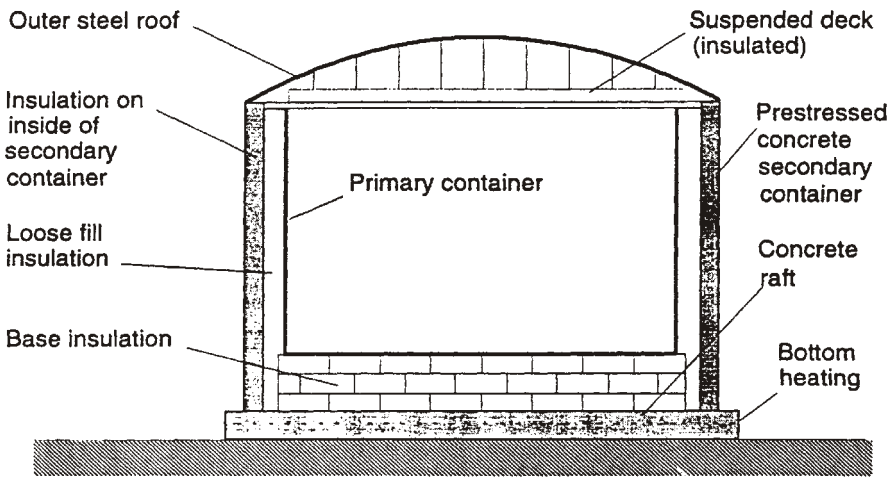


Figure H.2 Examples of spherical storage tanks



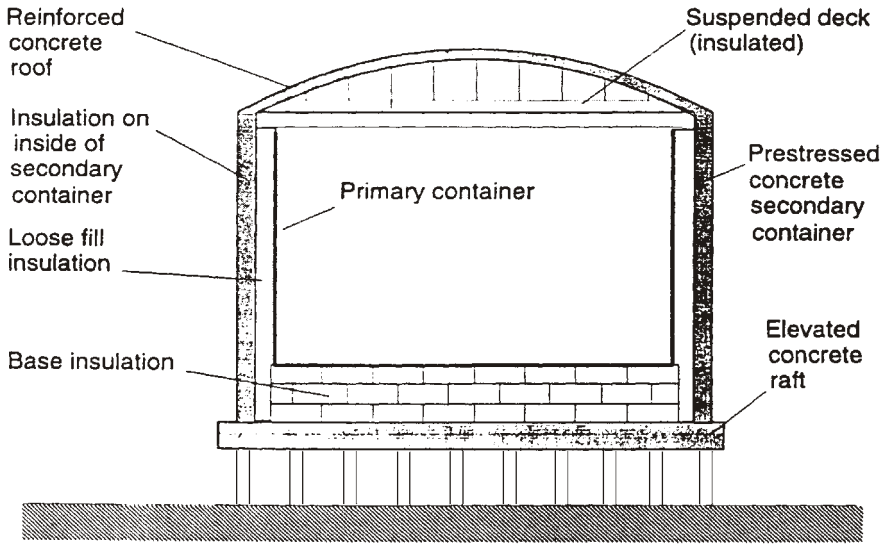


Figure H.4 Examples of full containment tanks

Another issue regarding the full-containment design is that the tank outer wall (secondary containment) serves as the impoundment, a concept allowed under Parts 193.2161 and 193.2167, and under the "exception" in figure 2.2.2.6 of NFPA 59A. A specific concern is the dual function of the concrete secondary container - it serves both the operational function of holding the insulation and gas pressure, and a safety function of containing liquid in the event of an inner tank failure. Conversely, in single- and double-containment tanks, independent systems provide operational and safety functions. While recognition must be given to the benefits of a concrete secondary container with respect to external events, such as projectiles or small aircraft, its ability to provide the dual functions while retaining its integrity has not been convincingly supported for all scenarios. This becomes increasingly important as proposed site acreage is reduced and buffer zones between adjacent properties are minimized. As such, FERC staff considers prudent design practice to provide some form of barrier to prevent liquid from flowing to an unintended area (i.e. outside the plant property) in the event that the storage tank primary and secondary containers fail.

Concerns have also been expressed that the barrier could be considered a containment and prohibit certain equipment being located within the barrier and/or may conflict with other parts of the various codes with respect to hazardous and electrical code classifications. Other concerns are that the barrier could be considered an impounding area that would require new thermal and vapor cloud calculations. The purpose of the barrier is to prevent liquid from flowing off the plant property, and it is not the intent to define a containment or impounding area for thermal radiation or flammable vapor exclusion zone calculations or other code requirements.

Crown Landing has proposed to install an earthen barrier around all three of the LNG tanks. The structure would have a height of 10 feet and would enclose an area of approximately 780 feet by 900 feet. The structure's volumetric capacity would exceed 100 percent of a single LNG tank's maximum liquid capacity. Rainwater collected by the barrier would be drained into a sump and pumped out in accordance with 49 CFR Part 193.2173 and Crown Landing's stormwater management plan. This barrier would confine LNG on the project property in the event of any hypothetical catastrophic event, and would also prevent process area spills from leaving the plant.

4.12.4 Siting Requirements – Thermal and Dispersion Exclusion Zones

Regulatory Requirements

The LNG facilities proposed in this project must comply with the siting requirements of 49 CFR 193, subpart B. On March 30, 2000, DOT revised 49 CFR 193 to incorporate NFPA 59A (1996 edition) into the LNG regulations. On April 9, 2004, DOT further revised 49 CFR Part 193 to incorporate the 2001 edition of NFPA. The following sections specifically address offsite hazards:

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

- **Part 193.2051, Scope,** states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in accordance with Subpart B and NFPA 59A. In the event of a conflict with NFPA 59A, then Part 193 prevails.

- **Part 193.2057, Thermal radiation protection,** requires that each LNG container and LNG transfer system have thermal exclusion zones based on three radiation flux levels in accordance with Section 2.2.3.2 of NFPA 59A.

- **Part 193.2059, Flammable vapor-gas dispersion protection,** requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with Sections 2.2.3.3 and 2.2.3.4 of NFPA 59A.

For the following LNG facilities that are proposed for this project, we have identified the applicable siting requirements from Part 193 and NFPA 59A:

- Three 41,739,184 gallon (158,000 m^3) LNG storage tanks - Parts 193.2057 and 2059 require the establishment of thermal and flammable vapor exclusion zones for LNG tanks. NFPA 59A Section 2.2.3.2 specifies four thermal exclusion zones based on the design spill and the impounding area. Sections 2.2.3.3 and 2.2.3.4 specify a flammable vapor exclusion zone for the design spill which is determined in Section 2.2.3.5.

- One marine LNG unloading berth and a cargo transfer system consisting of three 16-inch-diameter unloading arms, and one 44-inch-diameter transfer line to the storage tanks - Parts 193.2001, 2057, and 2059 require thermal and flammable vapor exclusion zones for the transfer system. NFPA 59A does not address LNG transfer systems.

- Nine 3,770 gpm low-pressure in-tank pumps (three in each tank) and seven 1,920 gpm high-pressure sendout pumps (one spare) - Parts 193.2057 and 2059 require thermal and flammable vapor exclusion zones. NFPA 59A Section 2.2.3.2 specifies the thermal exclusion zone and Sections 2.2.3.3 and 2.2.3.4 specify the flammable vapor exclusion zone based on the design spill in a process area.

- Seven vaporizers (one spare) - Same requirements as for LNG pumps.

The incorporation of the NFPA 59A requirements into Part 193 has resulted in some confusion and possible misinterpretation in applying the siting requirements.

Parts 193.2057 and 2059 require exclusion zones for LNG transfer systems, which are defined to include transfer piping. However, NFPA 59A only requires exclusion zones for "transfer areas" which are defined as the part of the plant where liquids are introduced or removed from the facility such as truck loading or ship unloading areas. The definition of transfer area in NFPA 59A specifically excludes permanent plant piping such as cargo transfer lines. Additionally, NFPA 59A section 2.2.3.1 (2001) specifically excludes transfer areas at the water edge of marine terminals. When the DOT incorporated NFPA 59A into its regulations, it removed the requirement for impounding systems around transfer piping (old Part 193.2149). In the preamble to the final rule, the DOT determined that the most likely sources of leaks within LNG plants are LNG storage tanks, cargo transfer areas, and vaporizers and process equipment, which are all addressed in NFPA 59A section 2.2.1.2. The result is that while Part 193 retains exclusion zones for LNG transfer systems, neither Part 193 nor NFPA 59A requires the impoundment from which to base the calculations. We do not believe that this was the intent, nor do we believe that omitting containment for transfer piping is a sound engineering practice. FERC staff will continue to require containment for all LNG transfer piping within a plant site.

The incorporation of NFPA 59A also changed the way in which design spills and impoundment capacities may be determined. Under section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume during a 10-minute period from any single accidental leakage source or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the authority having jurisdiction. Similar criteria appear in section 2.2.3.5 for determining the design spill used in thermal and flammable vapor exclusion zone calculations. Prior to the incorporation of NFPA 59A, the design spill in Part 193 assumed the rupture of a single

transfer pipe with the greatest overall flow capacity, for not less than 10 minutes (old Part 193.2059(d)). As a result, the spill rate for vaporization, process, or LNG transfer areas may be assumed to be a "leakage source" rather than a full pipe rupture; however, the spill duration must be 10 minutes unless the authority having jurisdiction (i.e., DOT's OPS) determines that a shorter time is acceptable. Again, given the confusion in applying the two requirements, FERC staff will continue to utilize the 10-minute spill criteria at the maximum flow possible for containment sizing. This will ensure that impoundments are sized for a catastrophic failure, while recognizing that less conservative spill scenarios may be appropriate for exclusion zone calculations. In giving recognition to the integrity of all-welded transfer piping, the determination of the single accidental leakage source should be based on an evaluation of all small diameter attachments to the transfer piping for instrumentation, pressure relief, recirculation, etc., and any flanges that may be used at valves or other equipment, in order to determine the largest spill rate. This approach is the result of discussions with DOT OPS concerning the basis for design spills and application to exclusion zone determinations for proposals before the Commission.

Impoundment Systems and Design Spills

The calculations of thermal and flammable exclusion zones for the proposed LNG facilities are based on the dimensions of the proposed impoundment systems and the spill volumes specified by Part 193 and NFPA 59A. Part 193.2181 specifies that the impoundment system serving a single LNG storage tank must have a volumetric capacity of 110 percent of the LNG tank's maximum liquid capacity. Crown Landing's proposed LNG storage tank impoundments would be full containment storage tanks with a 246 foot inside concrete wall diameter surrounding a 238 foot inner tank diameter, approximately 175 feet high at the apex. The volumetric capacity of 6,250,696 cubic feet (ft^3) (177,000 m^3) would exceed the 110 percent requirement by 670,978 ft^3 (19,000 m^3). The site would also be surrounded by an earthen berm with dimensions of 900 feet wide by 780 feet long and 10 feet tall and an encompassing volume of 7,020,000 ft^3.

Crown Landing's proposed impoundment system would have a series of troughs under piping that drain to three co-located sumps. The largest of the sumps, the Unloading Line Sump which has dimensions of 240 feet wide by 171 feet long with a depth of 4 feet, is the outer and largest sump. The Tank Header Sump, which has dimensions of 83 feet long by 83 feet wide with a depth of 3 feet, is located inside the Unloading Line Sump.

The design spill for an LNG storage tank with no penetrations below the liquid level is determined in accordance with section 2.2.3.5 of NFPA 59A and is defined as the largest flow from any single line that could be pumped into the impounding area from the tank withdrawal pumps at full rated capacity over a 10-minute period. Each LNG storage tank would be equipped with three in-tank pumps, individually rated for 3,770 gpm. The rupture of the in-tank pump discharge header would result in a spill rate of 11,310 gpm. For a 10-minute spill, the volume would be 131,335 gallons after accounting for increased flow due to the line break. This spill would be contained within impoundment troughs that are sloped to the Tank Header Sump, which has dimensions of 83 feet long by 83 feet wide with a depth of 3 feet. The volume capacity of this sump would be 154,600 gallons.

The largest single line that can be pumped into the impoundment system is the 44-inch-diameter transfer line from the marine unloading berth. The piping for the marine cargo transfer system would be contained within an impoundment trough that is sloped to the Unloading Line Sump located northeast of the LNG storage tanks. The Unloading Line Sump would be sized to contain a 10-minute spill from the 44-inch-diameter transfer line that connects the dock to the LNG storage tanks. The design flow through transfer line would be 70,915 gpm. The 10-minute design spill would be 1,098,087 gallons after adding the existing volume of LNG already in the 44-inch-diameter transfer line to the line's design flow rate. This design spill would be contained by the Unloading Line Sump, which measures 240 feet wide by 171 feet long, with a depth of 4 feet. The design capacity of the sump would be 1,229,438 gallons.

The area containing the vaporizers and sendout pumps would be curbed and graded so that any LNG spill would flow back to the sump system to the northeast, located approximately midway between the process area and the earthen berm and inside the Unloading Line sump. The design spill for the process area would be the same as the 18-inch-diameter LNG tank withdrawal header and would flow through troughs to the Withdrawal Header Sump.

FERC staff performed an evaluation of all small diameter attachments to the transfer piping for instrumentation, pressure relief, recirculation, etc., and any flanges that may be used at valves or other equipment. FERC staff determined that the appropriate single accidental leakage source off the 44-inch-diameter unloading line was a 4-inch-diameter attachment. For the process area, the design spill from the 2-inch-diameter line downstream from the LNG booster pumps would be an appropriate single accidental leakage source. Table 4.12.4-1 presents the impounding area and spill volumes for the various spill scenarios. As shown the table, the corresponding design spill volumes from the unloading line and process area would be less than the design spill for the 18-inch LNG tank withdrawal header. Therefore, since the sumps are co-located and each of the design spills flow into the LNG Tank Header Sump, the largest spill, the 18-inch LNG tank withdrawal header design spill, would be the controlling spill and used to calculate the thermal and vapor dispersion exclusion zones.

TABLE 4.12.4-1

Impoundment Areas for LNG Spills

Source	Spill Size (gallons)	Impoundment System	Impoundment Size (gallons)
Impoundment Sizing Spills:			
LNG Storage Tank	41,739,184	LNG Storage Tank Impoundment (concrete outer tank)	46,758,453
Marine Transfer Line	1,098,087	Unloading Line Sump	1,229,438
LNG Tank Withdrawal Header	131,335	Tank Header Sump	154,600
Sendout Pumps and Vaporizers	131,335	Tank Header Sump	154,600
Design Spills:			
Marine Transfer Line (4-inch-diamater attachment)	56,113	Tank Header Sump	154,600
LNG Tank Withdrawal Header	131,335	Tank Header Sump	154,600
Sendout Pumps and Vaporizers (2-inch-diameter attachment)	68,451	Tank Header Sump	154,600

Thermal Exclusion Zone

If a large quantity of LNG is spilled in the presence of an ignition source, the resulting LNG pool fire could cause high levels of thermal radiation. Exclusion distances for various flux levels were calculated according to 49 CFR 193.2057 and section 2.2.3.2 of NFPA 59A, using the "LNGFIRE III" computer program model developed by the Gas Research Institute. Thermal radiation distances were determined for 1,600 to 10,000 British thermal units per square foot per hour (Btu/ft^2-hr) incident flux levels for a fire from the full impoundment area surrounding the tank. In addition, the thermal radiation distances were also determined for the 1,600 Btu/ft^2-hr incident flux level centered the both the process area sump.

NFPA 59A establishes certain atmospheric conditions (0 mph wind speed, 70° F, and 50 percent relative humidity) which are to be used in calculating the distances. However, Part 193.2057 supercedes these requirements and stipulates that wind speed, ambient temperature, and relative humidity which produce the maximum exclusion distances must be used, except for conditions that occur less than 5

percent of the time based on recorded data for the area. For its analysis, Crown Landing selected the following ambient conditions to produce the maximum distances: wind speed of 27 mph; ambient temperature of 18° F; and 30 percent relative humidity. FERC staff agrees that these conditions yield longer distances than the 0 mph wind speed, 70° F ambient temperature, and 50 percent relative humidity specified in NFPA 59A.

FERC staff calculated thermal radiation distances for incident flux levels ranging from 1,600 to 10,000 Btu/ft^2-hr for an LNG storage tank fire. The following conditions were selected to produce the maximum distances: wind speeds of 18 to 27 mph; ambient temperature at 18° F, and 30 percent relative humidity. These thermal exclusion zones are governed by a fire from the LNG Storage Tank Impoundment (concrete outer tank). The distances to the various thermal exclusion zones for the LNG Storage Tank Impoundment are shown in table 4.12.4-2. FERC staff concludes that the thermal exclusion zones from the LNG Storage Tank Impoundment comply with 49 CFR 193 and NFPA 59A.

TABLE 4.12.4-2

Thermal Exclusion Zones

Source	Exclusion Area NFPA 59A Section 2-2.3.2(a)	Incident Flux (Btu/ft^2-hr) a/	Exclusion Zone (feet)
LNG storage tank impoundment	Outdoor assembly area occupied by 50 or more people.	1,600	933
LNG storage tank impoundment	Offsite structures used for occupancies or residences.	3,000	727
LNG storage tank impoundment	Property line that can be built upon.	10,000	426
Tank Header Sump	Property line that can be built upon.	1,600	422

a/ The 1,600 Btu/ft^2-hr flux level is associated with an exposed person experiencing burns within about 30 seconds. At 3,000 Btu/ft^2-hr, an exposed person would experience burns within 10 seconds, however a wooden structure would not be expected to burn and affords protection to sheltered persons. At 10,000 Btu/ft^2-hr, clothing and wood can ignite spontaneously.

Crown Landing's application for the proposed LNG terminal contained thermal radiation analysis for a 10-minute design spill into the Tank Header Sump within the system of impoundments. Crown Landing selected the design spill based on a release from the 18-inch LNG tank withdrawal header. The design spill size, flowing at full capacity for 10 minutes, for the 18-inch LNG tank withdrawal header would be 131,335 gallons. Thermal radiation distances were determined for the 1,600 Btu/ft^2-hr incident flux level centered on the Tank Header Sump and is shown in table 4.12.4-2. FERC staff concludes that thermal exclusion zone for the Tank Header Sump complies with 49 CFR 193 and NFPA 59A.

The thermal exclusion zones for the LNG Storage Tank Impoundment and the Tank Header Sump are shown in figure 4.12.4-1 and figure 4.12.4-2, respectively.

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 4.12.4-1 LNG Full Containment Tank Thermal Exclusion Zones

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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 4.12.4-2 LNG Design Spill Thermal Exclusion Zone

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Vapor Dispersion Zone

A large quantity of LNG spilled without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limits or encountered an ignition source. Part 193.2059 and sections 2.2.3.3 and 2.2.3.4 of NFPA 59A require that provisions be made to minimize the possibility of flammable vapors from reaching a property line that can be built upon and that would result in a distinct hazard. Part 193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration (½ the lower flammability limit [LFL] of LNG vapor) under meteorological conditions which result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for stability Class F, a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature. The section allows the use of the DEGADIS Dense Gas Dispersion Model, or the FEM3A model, to compute dispersion distances. Design spills into impounding areas serving LNG containers, transfer systems and piping are to be determined in accordance with section 2.2.3.5 of NFPA 59A.

In accordance with section 2.2.3.3 of NFPA 59A, an average concentration of methane in air of 50 percent of the LFL cannot cross a property line that can be built upon from a design spill into each impoundment. In this case, where all design spills flow into the common Tank Header Sump, compliance with section 2.2.3.3 would also meet the requirements of section 2.2.3.4 of NFPA 59A.

As discussed in the draft EIS, Crown Landing used a cold vapor to liquid volumetric ratio of 235:1 and calculated that 4,125,876 ft^3 of cold vapor would result from the vaporization of an 18-inch-diameter LNG tank withdrawal header spill producing a volume of 17,557 ft^3 of LNG. Crown Landing claimed that since the entire volume of cold vapor would be contained by the facility's earthen berm, occupying 4,125,876 ft^3 of the 6,755,000 ft^3 capacity, and that the vapor dispersion exclusion zone would not extend beyond the LNG terminal site.

Comments filed on other projects have disputed the assertion that the entire volume of cold vapor would be contained within the main dike impoundment because it would be physically impossible for the vapor from the spill to fill the impoundment without warming and mixing with air while being evolved.

The effects of provisions for containing vapors as a means of mitigating flammable vapor hazards are permitted to be considered in the calculations by NFPA 59A section 2.2.3.3. Increasing the vapor retention capacity can reduce the vapor source strength and correspondingly reduce the downwind distance to the ½ LFL. It is acknowledged that the calculations of vapor overflow rates do not account for the mixing of evolved vapor that is likely to occur over extended periods of time. This can be especially problematic for certain sump/impoundment configurations which allow for longer term vapor retention.

As a result, FERC staff performed a supplementary vapor dispersion analysis for the 18-inch-diameter LNG tank withdrawal header design spill by conservatively assuming no earthen impoundment surrounding the LNG tank area. The Unloading Line Sump was treated as a dike for the Tank Header Sump, which is located inside the Unloading Line Sump. A DEGADIS simulation, with the atmospheric conditions specified by 49 CFR 193, predicts that 2.5 percent average gas concentration would extend 738 feet. Therefore, the flammable vapor exclusion zone would not extend offsite, satisfying the requirements of 49 CFR 193 and NFPA 59A.

Although the impoundment system technically complies with 49 CFR 193.2059, the issue of the lengthy distance from potential spill locations to the co-located sumps needs to be addressed. While it is an appropriate design philosophy to direct potential spills away from process equipment to remote impoundments, and it is technically correct to base exclusion zone calculation on these impoundments, it is also relevant to consider the control of vapors produced in the channels or trenches leading to these

sumps. Long trenches increase the surface area available for heat transfer and, correspondingly, increase vapor generation. A number of vapor control options are available including: vapor fences; fixed high expansion foam generators; reduced trench lengths and/or surface area; and additional sumps at intermediate locations along transfer piping. As a result, **we recommend that:**

- **Crown Landing should examine provisions to retain any vapor produced along the transfer line trenches and other areas serving to direct LNG spills to associated impoundments. Measures to be considered may include, but are not limited to: vapor fencing; intermediate sump locations; or trench surface area reduction. Crown Landing should file final drawings and specifications for these measures with the Secretary <u>prior to initial site preparation</u>.**

4.12.5 Marine Safety

The February 2004 Interagency Agreement provides the framework for the participating agencies to work in a coordinated manner to address the full range of issues regarding safety and security at LNG import terminals and the suitability of waterways for LNG marine traffic. The FERC closely coordinated its pre-certificate review of the proposal with the Coast Guard, which has authority over the safety of LNG vessels and the marine transfer area as well as the security of the LNG vessels and the entire LNG facility, and the suitability of waterways for LNG marine traffic.

The hazards associated with the marine transportation of LNG differ from land-based hazards. Whereas the land-based facilities have features to both limit the duration of LNG spills and contain credible spill volumes, an LNG spill on water may be unconfined and may vaporize rapidly due to heat input from the water.

The history of LNG shipping has been free of major incidents, and none have resulted in significant quantities of cargo being released (see section 4.12.5.4). No incidents have occurred at existing LNG terminals during the 50 years of operation that resulted in any significant quantities of cargoes being released. However, the possibility of an LNG spill from a ship over the duration of the proposed project must be considered. Historically, the events most likely to cause a significant release of LNG were a ship casualty such as:

- a vessel colliding with an LNG ship in transit;
- an LNG ship alliding[8] with the terminal or a structure in Delaware Bay or River;
- a vessel alliding with an LNG ship while moored at the terminal; or
- a grounding sufficiently severe to puncture an LNG cargo tank.

However, the attacks on September 11, 2001, have made the public keenly aware of additional risks that must be considered in the evaluation of marine safety and security:

- a deliberate attack on an LNG ship by a terrorist group.

[8] "Allision" is the action of dashing against or striking upon a stationary object (e.g., the running of one ship upon another ship that is docked) – distinguished from "collision", which is used to refer to two moving ships striking one another.

Any of the above events would have to occur with sufficient impact to breach the LNG ship's double hull and cargo tanks. Previous incidents with LNG ships have primarily involved grounding, and none of these have resulted in the breach of the double hull and subsequent release of LNG cargo.

The following discussion provides a chronology of a conceptual LNG ship voyage, as proposed by the applicant, from the liquefaction facility to the import terminal, disclosing the risks at each step and how they would be managed. Details and analysis are provided in subsequent sections.

LNG Ships and Ocean Voyage

Imported LNG could be obtained from exporting terminals throughout the world and delivered by LNG ships to the proposed terminal. Exporting countries include Algeria, Australia, Brunei, Indonesia, Malaysia, Nigeria, Oman, Qatar, Trinidad, and United Arab Emirates. In 2003, LNG imports to the United States included: 72 percent from Trinidad, 12 percent from Nigeria, 10 percent from Algeria, 3 percent from Qatar, 2 percent from Oman, and 1 percent from Malaysia. Crown Landing anticipates that the proposed LNG terminal would receive LNG from Trinidad and West Africa (Nigeria or Algeria).

The LNG ships used to import LNG to the United States would be constructed and operated in accordance with the IMO Code for the Construction and Equipments of Ships Carrying Liquefied Gases in Bulk, the International Convention for the Safety of Life at Sea (SOLAS), and 46 CFR Part 154, which contain the U.S. safety standards for vessels carrying bulk liquefied natural gas. Foreign flag LNG ships are required to possess a valid IMO Certificate of Fitness and a Coast Guard Certificate of Compliance.

In 1993, amendments to the IMO's Code for the Construction and Equipments of Ships Carrying Dangerous Chemicals in Bulk require all tankers to have monitoring equipment with an alarm facility which is activated by detection of over-pressure or under-pressure conditions within a cargo tank. In addition, the cargo tanks are heavily instrumented, with gas detection equipment in the hold and inter-barrier spaces, temperature sensors, and pressure gauges. Fire protection must include the following systems:

- a water spray (deluge) system that covers the accommodation house control room and all main cargo valves;
- a traditional firewater system that provides water to fire monitors on deck and to fire stations found throughout the ship;
- a dry chemical fire extinguishing system for hydrocarbon fires; and
- a carbon dioxide system for protecting machinery, including the ballast pump room, emergency generators, and compressors.

As a result of September 11, 2001, the IMO agreed to new amendments to the 1974 SOLAS addressing port facility and ship security. The International Ship and Port Facility Security Code was adopted in 2003 by the IMO. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to prevent and suppress terrorism against ships, improve security aboard ships and ashore, and reduce the risk to passengers, crew, and port personnel on board ships and in port areas, for vessels and cargoes. All LNG ships, as well as other cargo vessels 300 gross tons and larger and ports servicing those regulated vessels, must adhere to these IMO and SOLAS standards. Some of the IMO requirements are as follows:

For the ships, these requirements must include:

- Ships must develop security plans and have a Ship Security Officer;
- Ships must be provided with a ship security alert system. These alarms transmit ship-to-shore security alerts to a competent authority designated by the Administration, which may include the company, identifying the ship, its location and indicating that the security of the ship is under threat or it has been compromised;
- Ships must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and
- Ships may have certain equipment onboard to help maintain or enhance the physical security of the ship.

For the port facilities, the requirements must include:

- Port facility security plan;
- Facility Security Officer (FSO); and
- Certain security equipment may be required to maintain or enhance the physical security of the facility.

Both ships and ports must include the following:

- Monitoring and controlling access;
- Monitoring the activities of people and cargo;
- Ensuring security communications and that they are readily available; and
- Completion of the Declaration of Security.

LNG Ship Transit in the Delaware River

An internationally recognized Traffic Separation Scheme established by the IMO serves vessel traffic in the approach to the Delaware Bay and River. This provides inbound and outbound routes which are separated by a central buffer zone. All foreign-registered and many U.S. flagged large ships entering Delaware Bay and River are boarded by a pilot from the Delaware River Pilots who directs the transit to one of the destination docks at Wilmington, Marcus Hook, or Philadelphia.

If the Coast Guard issues a LOR, as described in Section 1.3 "Permits, Approvals, and Regulatory Requirements", finding the waterway suitable for LNG marine traffic, LNG ships would access the proposed LNG terminal via the federal navigation channel in the Delaware Bay and River (see figure 4.12.5-1). One pilot would direct the LNG ship from Cape Henlopen on Delaware Bay to a point several miles downstream of the Delaware Memorial Bridge. From this location, two tractor tugs would escort the LNG ships up the Delaware River to the Marcus Hook anchorage area where an additional tractor tug would join the escort and a docking pilot would guide the vessel to the proposed unloading facility.

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 4.12.5-1 Proposed Shipping Route as Described in Letter of Intent to the Coast Guard

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The LNG ship would normally transit Delaware Bay and River on a rising tide during daylight hours. Docking, LNG cargo unloading, and undocking would take approximately 24 hours. The LNG ship would normally depart during daylight hours on the second day.

If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, in addition to the Delaware River Pilots, the Coast Guard would monitor the transit of the LNG vessel on the river and bay and while unloading cargo. The Coast Guard currently exercises control over vessels carrying dangerous cargoes within the Delaware River and Bay through enforcement of a Regulated Navigation Area (RNA) promulgated in 33 CFR 165.510. It is expected that controls placed on LNG ship transits would at a minimum reflect requirements contained in the current RNA. Typical Coast Guard requirements for other LNG import terminals include 96- and 24-hour advance notification of the ship arrival at which time Coast Guard personnel may board the LNG ship offshore for an inspection of the ship safety systems and a security sweep. Other Coast Guard requirements may include: establishment of a moving safety zone around the vessel while en route, a fixed security zone around the vessel during unloading operations, an inspection of the dock safety systems prior to commencing cargo transfer, and monitoring all operations until the vessel departs. Maintaining security of the dock and vessel would be the responsibility of the facility in cooperation with other federal, state, and local agencies as described in the Facility Security Plan (see section 4.12.6).

LNG Vessel Casualties

If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, the operational controls that would be imposed by the Coast Guard and the Delaware River pilots, as well as the characteristics of Delaware Bay and River, would minimize the possibility of an LNG cargo spill from groundings, collisions, and allisions. The Coast Guard would enforce a moving safety zone around the LNG ship that would clear the channel of all vessels in the vicinity of the LNG ship to reduce the likelihood of any collisions, including those of the tonnage and speed required to cause an LNG spill (see section 4.12.5.4). The federal navigation channel extends approximately 74 nautical miles to the Marcus Hook area and approximately 86 miles to the Port of Philadelphia, Pennsylvania. The navigation channel downstream of Marcus Hook has a maintained navigation depth of 40 feet and a width of 800 feet.

Deliberate Attack on an LNG Vessel

In addition to addressing the potential hazards from LNG vessel incidents, the possibility of a deliberate attack on an LNG ship by a terrorist group must also be considered. Security of the LNG vessel would be the responsibility of the owner/operator and the master of the vessel. Security of the LNG facility would be the responsibility of the owner/operator of the facility. Protection of the LNG vessel and the import terminal would involve personnel from the Coast Guard, Crown Landing security staff, and state and local law enforcement. If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, the Coast Guard would establish a moving safety zone around the LNG vessels in transit and a security zone around the LNG vessels while docked. Only personnel or vessels authorized by the Captain of the Port would be permitted in the safety and security zone.

Crown Landing would provide security for the marine terminal according to a Facility Security Plan that must be prepared under 33 CFR Part 105. This plan would need to be approved by the Coast Guard Captain of the Port (see section 4.12.6). The requirements of this plan may include:

- a Facility Security Assessment to identify site vulnerabilities, possible security threats, consequences of an attack, and facility protective measures;

- a Facility Security Plan with procedures for responding to security incidents;

- a designated FSO responsible for implementing and periodically updating the Facility Security Plan and Assessment;

- scalable security measures to provide increasing levels of security at increasing Maritime Security (MARSEC) levels;

- security exercises at least once each calendar year and drills at least every 3 months; and

- mandatory reporting of all breaches of security and security incidents.

Security at the facility would be provided by both active and passive systems. The entire site would be surrounded by a protective enclosure (i.e., a fence) with sufficient strength to deter unauthorized access. The enclosure also would be illuminated with not less than 2.2 lux between sunset and sunrise. Intrusion detection systems and day/night camera coverage would identify unauthorized access. A separate security staff would conduct periodic patrols of the plant, screen visitors and contractors, and assist in maintaining security of the marine terminal during cargo unloading. Crown Landing would be required to submit their Facility Security Plan to the Captain of the Port for approval 60 days prior to commencement of operations. In order to ensure that the responsibilities of Crown Landing's security staff enhance overall security, **we recommend that:**

- **<u>Prior to commissioning</u>, Crown Landing should coordinate, as needed, with the Coast Guard to define the responsibilities of Crown Landing's security staff in supplementing other security personnel and in protecting the LNG ships and the terminal.**

The Department of Energy (DOE) has released a study by Sandia National Laboratories entitled, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water* (Sandia Report) December 2004. The report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for credible accidental and intentional LNG spill events. The analysis of accidental events found that groundings and low speed collisions could result in minor ship damage but not a cargo spill; while high speed collisions could cause a 0.5 to 1.5 square meters cargo tank breach area. For intentional scenarios, the size of the cargo tank hole depends on the location of the ship and source of threat. Intentional breach areas were estimated to range from 2 to 12 square meters. In most cases, an intentional breaching scenario would not result in a nominal hole of more than 5 to 7 square meters, which is a more appropriate range to use in calculating potential hazards from spills. These hole sizes are equivalent to circular hole diameters of 2.5 and 3 meters.

The FERC commissioned a study by ABSG Consulting Inc. (ABSG) to search and review the literature on experimental LNG spills and on consequence methodologies that are applicable to modeling incidents of LNG spills on water. The methodology described in the ABSG study, *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*, and revised in staff's responses to comments on the report (issued June 18, 2004), was used to calculate the thermal radiation and flammable vapor dispersion distances for several holes ranging in diameter from 1 meter to 3.9 meters. Using the methodology, we have estimated distances for a nominal 2.5-meter and 3-meter diameter hole to range from 4,372 to 4,883 feet for a thermal radiation of 1,600 Btu/ft^2-hr, the level which is hazardous for persons located outdoors and unprotected, to 3,374 to 3,764 feet for 3,000 Btu/ft^2-hr, an acceptable level for wooden structures; and to 2,033 to 2,261 feet for 10,000 Btu/ft^2-hr, a level sufficient to damage process equipment for these size holes respectively.

These intentional breach scenarios provide guidance to the Coast Guard in developing the operating restrictions for LNG vessel movements through Delaware Bay and the federal navigation channel in the Delaware River, as well as in establishing potential impact areas for emergency response and evacuation planning. The inbound vessel transit through the Delaware Bay ship channel would pass by Cape May, Arnold Point, Elsinboro Point, and Pennsville, New Jersey on the east side and Cape Henlopen, Delaware Point, Port Penn, Delaware City, and New Castle, Delaware on the west side. After passing New Castle, Delaware on the west side, the LNG vessel would pass under the Delaware Memorial Bridge, and by Penns Grove and Pedricktown, New Jersey on the east side and Wilmington, Edgemoor, Bellefonte, Claymont, and Marcus Hook, Delaware on the west side. Some areas of development along the shoreline in these communities could be within a potential hazard area during the LNG vessel transit. Assuming an LNG ship would transit the Delaware River and Bay between 3 and 11 knots, the adjacent communities would be exposed to a potential transient hazard between an estimated 10 to 30 minutes. In addition, a temporary hazard would exist around the ship unloading facility during part of the 16- to 17-hour period when the LNG ship is at the dock and unloading cargo.

If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, the operational restrictions that would be imposed by the Delaware River pilots on LNG vessel movements through this area, as well as the requirements that the Coast Guard would impose in its *LNG Vessel Transit Management Plan* (see Section 4.12.5.2) would minimize the possibility of a hazardous event occurring along the vessel transit.

Emergency Response and Evacuation Planning

Prior to commencing service, Crown Landing would be required to prepare emergency procedures manuals, as required by 49 CFR Part 193.2509 that provide for: (a) responding to controllable emergencies and recognizing an uncontrollable emergency; (b) taking action to minimize harm to the public including the possible need to evacuate the public; and (c) coordination and cooperation with appropriate local officials. Specifically, section 193.2059(b)(3) requires "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…"

While the worst-case scenarios evaluated for the onshore facility in section 4.12.3 and for marine spills in section 4.12.5 provide guidance on the maximum extent of potential hazards, they should not be assumed to represent the evacuation zone for *every* potential incident. As with any other fuel or hazardous material, the actual severity of the incident will determine what area needs to be evacuated, if any, rather than a worst-case maximum zone. It is anticipated that the emergency evacuation plans will identify evacuation distances based upon increasing severity of events.

On several LNG import terminal proposals, a number of organizations and individuals commented on the need to consider emergency response procedures. Subsequently, Section 311 of the Energy Policy Act of 2005 stipulated that the FERC must require the LNG operator to develop an Emergency Response Plan in consultation with the Coast Guard and state and local agencies. The FERC must approve the Emergency Response Plan prior to any final approval to begin construction. Therefore, **we recommend that:**

- **Crown Landing should develop an Emergency Response Plan (including evacuation) and coordinate procedures with the Coast Guard, state, county, and local emergency planning groups, fire departments, state and local law enforcement, and appropriate federal agencies. This plan should include at a minimum:**

  a. designated contacts with state and local emergency response agencies;

b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

c. procedures for notifying residents and recreational users within areas of potential hazard;

d. evacuation routes/methods for residents along the route of the LNG vessel transit;

e. locations of permanent sirens and other warning devices; and

f. an "emergency coordinator" on each LNG vessel to activate sirens and other warning devices.

The Emergency Response Plan should be filed with the Secretary for review and written approval by the Director of OEP <u>prior to initial site preparation</u>. Crown Landing should notify FERC staff of all planning meetings in advance and should report progress on the development of its Emergency Response Plan at <u>3-month</u> intervals.

FERC has also received comments on other LNG terminal proposals expressing concern that the local community would have to bear some of the cost of ensuring the security and emergency management of the LNG facility and the LNG vessels while in transit and unloading at the berth. In addition, section 311 of the Energy Policy Act of 2005 stipulates that the FERC must require the LNG operator to develop an Emergency Response Plan that includes a Cost-Sharing Plan before any final approval to begin construction. The Cost-Sharing Plan shall include a description of any direct cost reimbursements to any state and local agencies with responsibility for security and safety at the LNG terminal and near vessels that serve the facility. To allow the FERC an opportunity to review the plan, **we recommend that:**

- **The Emergency Response Plan should include a Cost-Sharing Plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. The Cost-Sharing Plan should be filed with the Secretary for review and written approval by the Director of OEP <u>prior to initial site preparation</u>.**

4.12.5.1 Delaware Bay and River and the Marcus Hook Area

Delaware Bay and River combine to form a sizable body of navigable water open to the sea and accessible to large oceangoing vessels of varying types and sizes up to 100,000 tons.

An internationally recognized Traffic Separation Scheme established by the IMO serves vessel traffic at the entrance to the Delaware Bay. This provides inbound and outbound routes which are separated by a central buffer zone. All foreign-registered and many U.S. flagged large ships entering Delaware Bay are boarded by a pilot from the Delaware River Pilots, who directs the transit to one of the over 60 waterfront facilities located along the Delaware River .

If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, the Coast Guard would require that one pilot direct the LNG ship throughout the entire approximately 74 nautical-mile transit of Delaware Bay and River to the LNG terminal site. The LNG ships would also be required to enter the channel during a rising tide to ensure sufficient water depth for safe navigation. Further, two tractor tugs would be required to make fast to the LNG ship to aid in passage beneath the Delaware Memorial Bridge. Once the LNG ship arrives at Marcus Hook, an additional tractor tug would escort the ship to the LNG terminal.

If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, the Coast Guard would require that the three tugs maneuver the LNG ship to the dock and assist with berthing. It is further anticipated that the Coast Guard would require, after the LNG is offloaded, that the ship be detached from the unloading arms and mooring and breasting dolphins, moved from the berth with tug assistance, and then proceed seaward under the supervision of a Delaware River Pilot. In addition, at least one tug would be required to remain on standby to assist in emergency situations, for example the breaking of mooring lines. Other potential emergency situations would be evaluated on a case-by-case basis which would allow the Coast Guard to determine if the LNG ship would remain at the dock or be towed down the Delaware River, depending on the nature of the hazard, weather conditions, tides, and other factors.

Current Ship Traffic

Table 4.12.5-1 provides a summary of large commercial vessels transiting the Delaware Bay and River from 1999 to 2002. The ship traffic data are separated into ships that transited from the mouth of Delaware Bay to the Delaware Memorial Bridge, the Marcus Hook berths, and the Port of Philadelphia. In total, the commercial traffic entering Delaware Bay averages roughly 9 to 10 commercial vessels per day with traffic declining steadily over the past few years.

TABLE 4.12.5-1

Number of Commercial Vessels Transiting Delaware Bay and River

Destination	1999	2000	2001	2002
Delaware Memorial Bridge	244	198	206	194
Marcus Hook Berths	825	837	741	685
Port of Philadelphia	2,317	2,335	2,309	2,237
Total	3,386	3,370	3,256	3,116

Rice Unruh & Raynolds Company (September 2003)

Three types of vessels are included in the above ship traffic data: crude oil tankers, LPG ships, and other commercial vessels (e.g. barges). Less than 1 percent of the total ship traffic on the Delaware River are LPG ships.

In addition, there are several passenger ferries, cruise ships, and water taxi services operating within Delaware Bay and River. These vary from year to year depending upon demand and economic conditions. There are no specific data available on the density of recreational traffic in the Delaware Bay and River but it is a yachting center and contains many marinas.

Future Ship Traffic

The proposed project would result in one additional vessel entering the Delaware Bay every 2 to 3 days, for a total of about 120 to 150 ships each year. This number of additional ships would be

approximately double the current number of coal barges delivering to the Logan Pier at Marcus Hook. Based on the number of ships alone, the proposed project would have minimal impact on current ship traffic. However, if the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, the vessel security requirements may cause delays to other marine traffic (see section 4.12.5.2 "Impact of Vessel and Facility Security Requirements").

Ship Traffic in the Navigation Channel

There are a number of factors that influence the movement of ship traffic in Delaware Bay and River. These include:

- *Channel Depth* - The channel has a depth of 40 feet. Crown Landing would dredge the berth at the LNG terminal to a depth of 40 feet. To ensure adequate navigation depth, LNG ship traffic (if Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic) would enter the bay and river on flood tide, as is currently the case for vessels transiting the river with a fresh water draft in excess of 37 feet.

- *Tugs* - If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, it is anticipated that LNG ships delivering cargo to the proposed terminal would have tug support from a point prior to the Delaware Memorial Bridge to the LNG terminal, during phases of arrival and departure, channel navigation, and for standby and fire fighting duties during LNG unloading operations. Crown Landing proposes providing three dedicated tractor tugs with firefighting capability. These tugs would be available for use by other shippers when not assisting LNG vessels.

- *Moving Safety Zone* - The Coast Guard currently imposes a moving safety zone around vessels carrying dangerous cargoes (i.e. LPG ships) up the navigation channel. The details of this zone are outlined in RNA requirements for the Delaware River and Bay under 33 CFR 165.150. If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, it is anticipated that the Coast Guard regulations which would be promulgated for the proposed LNG vessels would, at a minimum, be as protective as the regulations currently affecting vessels carrying dangerous cargoes within the Delaware River and Bay.

- *Reduced Visibility* – The Delaware Bay and River experiences fog mostly during spring and fall months. If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, LNG vessels would not be allowed to transit during times when visibility is less than 2 miles. Impacts from fog on the LNG shipping schedule are not expected to be significant given the small number of ships annually.

- *High Winds* - Based on initial simulations, Crown Landing believes operations could be conducted safely at wind speeds up to 20 knots but that high winds may delay operations. Impacts from wind on the LNG shipping schedule are not expected to be significant.

- *Pilotage* – If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, a licensed Delaware River Pilot would advise the LNG ship Captains on the navigation of the ships on the Delaware Bay and River. In addition, a Docking Pilot would board each ship approximately 2-miles down river of the terminal and then proceed to maneuver the vessel to navigate the ship upriver to the LNG terminal berth.

If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, additional navigational safety measures may be necessary for LNG ships based on the procedures to be developed in the Coast Guard's *LNG Vessel Transit Management Plan*.

4.12.5.2 Requirements for LNG Ship Operations

The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 USC section 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC section 1221, et seq.); and the Maritime Transportation Security Act of 2002 (46 USC section 701). The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval and compliance verification as provided in Title 33 CFR Part 105, and siting as it pertains to the management of vessel traffic in and around the LNG facility.

The Coast Guard regulations found in 33 CFR 127, apply to the marine transfer area of waterfront facilities between the LNG ship and the last manifold or valve located immediately before a storage tank. Title 33 CFR 127 regulates the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, fire fighting, and security of LNG waterfront facilities. The safety systems, including the communications, emergency shut down, gas detection, and fire protection must comply with the regulations in 33 CFR 127. Under 33 CFR 127.019, Crown Landing would be required to submit two copies of its Operations and Emergency Manual to the Captain of the Port Sector Delaware Bay for examination.

Title 33 CFR 127 separates cargo transfer operations into three distinct phases: Preliminary Transfer Inspection (section 127.315); Declaration of Inspection (section 127.317); and LNG Transfer (section 127.319). These different sections require specific actions to be completed prior to and during the transfer. Additionally, there are specific actions required in the case of a release of LNG (section 127.321).

As required by its regulations (section 127.009), the Coast Guard is responsible for issuing a Letter of Recommendation (LOR) as to the suitability of the waterway for LNG marine traffic with respect to the following items:

- Density and character of marine traffic;
- Locks, bridges, or other manmade obstruction in the waterway; and
- The following factors adjacent to the facility:
    - Depth of water;
    - Tidal range;
    - Protection from high seas;
    - Natural hazards, including reefs, rocks, and sandbars;
    - Underwater pipes and cables; and

- Distance of berthed vessels from the channel and the width of the channel.

On June 14, 2005, the Coast Guard published a *Navigation and Vessel Inspection Circular – Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC). The purpose of this NVIC is to provide Coast Guard Captains of the Port/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic that takes into account conventional navigation safety/waterway management issues contemplated by the existing LOI/LOR process, but in addition, will also take completely into account maritime security implications. In accordance with this guidance, each LNG project applicant is to submit a Waterway Suitability Assessment (WSA) to the cognizant COTP. The WSA is to address the transportation of LNG from the LNG tanker's entrance into U.S. territorial waters, through its transit to and from the LNG receiving facility, including operations at the vessel/facility interface. In addition, the WSA should address the navigational safety issues and port security issues introduced by the proposed LNG operations. The NVIC 05-05 also provides specific guidance on the timing and scope of the WSA.

The process of preparing the LOR begins when an applicant submits a Letter of Intent (LOI) to the local Captain of the Port. In accordance with 33 CFR 127.007, Crown Landing submitted a LOI to the Coast Guard on July 30, 2004 (see Appendix L). On December 3, 2004, the Coast Guard issued a notice in the Federal Register, requesting comments pertaining specifically to the maritime safety and security aspects of the proposed LNG Facility. In preparation for issuance of a LOR and the completion of certain other regulatory mandates, the comments received were incorporated into a formalized risk assessment process to assess the safety and security aspects of the facility, adjacent port areas, and navigable waterways. The Coast Guard held a public meeting on January 11, 2005, pursuant to the notice, which was attended by about 80 people. The Coast Guard's comment period ended on January 18, 2005.

If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, the arrival, transit, cargo transfer, and departure of LNG ships in the Delaware River would be required to adhere to the procedures of a *LNG Vessel Transit Management Plan* to be developed by the Coast Guard Sector Delaware Bay. In addition, Crown Landing would develop Operations and Emergency Manuals in consultation with the Coast Guard. These procedures would be developed to ensure the safety and security of all operations associated with LNG ship transit and unloading. The *LNG Vessel Transit Management Plan* would contain specific requirements for the LNG ship, pre-arrival notification, transit through the Delaware Bay and River, the waterfront facility, cargo transfer operations, Coast Guard inspection and monitoring activities, and emergency operations. The Coast Guard Sector Delaware Bay would monitor each LNG ship in accordance with the *LNG Vessel Transit Management Plan.*

Some of the anticipated key provisions of the *LNG Vessel Transit Management Plan* would be the establishment of a moving safety and/or security zone for all inbound and moored LNG ships, the use of tugs to assist in the Delaware River and to maneuver the ship into the berth, and the requirement that tug(s) remain with the LNG ship while it is moored at the berth. Additional provisions may be necessary given changing circumstances.

Crown Landing Waterway Suitability Assessment (WSA)

On June 14, 2005, Crown Landing submitted a WSA for the proposed project to the Captain of the Port for Coast Guard Sector Delaware Bay. The Coast Guard, with input from a special subcommittee of the Sector Delaware Bay Area Maritime Security Committee (AMSC), has completed a review of Crown Landing's WSA in accordance with the guidance in NVIC 05-05. The AMSC LNG Review Subcommittee was composed of law enforcement, security, and public safety officials from the Federal

government, and the states of Delaware, New Jersey and Pennsylvania, as well as regional maritime industry professionals. Its review focused on the navigation safety and maritime security risks posed by LNG marine traffic, and the measures needed to responsibly manage these security risks.

Coast Guard Letter to FERC

On December 1, 2005, the Coast Guard sent a letter to FERC, based on the above WSA and AMSC review, providing input on the capability of the port community to implement the risk management measures necessary to responsibly manage the risks of LNG marine traffic in the port (see Appendix L). As described in this document, the Coast Guard has preliminarily determined that the Delaware Bay and Delaware River to the proposed LNG terminal in Logan Township, NJ, may be suitable for accommodating the type and frequency of LNG vessels being proposed by the applicant. This determination, however, is preliminary because the required NEPA analysis has not yet been completed. This determination is also contingent upon the port security community having the appropriate resources to implement all the measures necessary to responsibly manage the safety and security risks of LNG marine traffic in this area.

The Coast Guard's letter to FERC discusses the relevant safety and security issues from the broad viewpoint of impact on the entire port, as well as provides a detailed review of specific points of concern along the LNG tanker's proposed transit route. A detailed supplemental letter, also based on the WSA and AMFS review, describing the conceptual prevention/mitigation strategies, along with resource needs, has also been sent from the Coast Guard to the FERC on December 19, 2005. Specific details of these measures have 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, it is not releasable to the public. Additionally, any security plan is a dynamic document that is subject to change with advances in technologies and improvements in intelligence gathering.

As a result of the subcommittee's review, the Coast Guard has preliminarily identified additional resources, public and/or private, that would be needed to implement prevention and mitigation strategies necessary for LNG operations. As stated in the above mentioned December 1, 2005 letter, neither the Coast Guard, nor the other state and local agencies that would have a safety and security role, are adequately staffed, equipped or funded to carry out the risk mitigation measures necessary to accommodate LNG vessel traffic for the Crown Landing LNG facility at this time. Consequently, the Coast Guard has recommended that Crown Landing submit to FERC, concurrent with its Emergency Response Plan, a comprehensive plan identifying the mechanisms for funding all project-specific security/emergency management costs (see section 4.12.5 "Emergency Response and Evacuation Planning").

If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, the security measures outlined in the letter to FERC and the above mentioned supplemental letter will be further developed into a detailed *LNG Vessel Transit Management Plan*, which would be become the basis for appropriate security measures for each Maritime Security threat level. This plan would clearly spell out roles, responsibilities and specific procedures for an LNG vessel transiting the Delaware Bay and River up to the proposed Crown Landing LNG terminal, as well as for all agencies involved in implementing security and safety during the operation. It would be required that, prior to the LNG vessel being granted permission to enter the Delaware Bay, both the vessel and facility must be in full compliance with the appropriate requirements of the Maritime Transportation Security Act and International Ship and Port Facility Security Code, and the security protocols to be established by the Captain of the Port in the *LNG Vessel Transit Management Plan*. The plan may include security measures such as: armed Coast Guard and other law enforcement agency vessels to enforce safety and

security zones around the LNG vessels while in transit and moored at the terminal; shoreside and aerial surveillance along designated sections of the transit route; and other prevention/mitigation strategies.

We recognize that the *LNG Vessel Transit Management Plan* would be a dynamic document that would be prepared well before import operations would commence, and that the port's overall security picture may change over that time period. New port activities may commence, infrastructure may be added, or population density may change. Improvements in technology to detect, deter and defend against intentional acts may also develop. Therefore, **we recommend that:**

- **Crown Landing should <u>annually</u> review its waterway suitability assessment relating to LNG vessel traffic for the project; update the assessment to reflect changing conditions which may impact the suitability of the waterway for LNG marine traffic; provide the updated assessment to the Sector Delaware Bay Captain of the Port/Federal Maritime Security Coordinator (COTP/FMSC) for review and validation and if appropriate, further action by the COTP/FMSC relating to LNG vessel traffic; and provide a copy to FERC staff.**

Impact of Vessel and Facility Security Requirements

The potential impacts of the proposed LNG vessel traffic for Crown Landing on other commercial and recreational boaters can be addressed in relation to several general security requirements: 1) a moving safety zone for inbound LNG vessels; 2) a security zone around a moored LNG vessel; and 3) other measures as deemed appropriate.

If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic the Coast Guard would promulgate a moving safety zone which would affect other vessels. Pursuant to such a regulation, no vessel would be allowed to enter the safety zone without first obtaining permission from the Coast Guard Captain of the Port. The Captain of the Port currently places similar restrictions on all vessels transiting the Delaware River and Bay carrying certain dangerous cargoes (CDC) by regulation in 33 CFR 165.510. Presently, the moving safety zone around LPG ships is 1,000 yards ahead and behind, and 500 yards on either side of the vessel. If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, it is anticipated that the LNG ships would transit about 74 nautical-miles from the entrance of the Delaware Bay to the Crown Landing LNG terminal. For the majority of this trip, an LNG vessel would travel at an average speed of 10.5 to 11 knots. The LNG vessel would then slow to approximately 7 knots as it approaches and passes under the Delaware Memorial Bridge. After that point, it would travel at an average speed of 3 knots through the final 2-nautical-miles of the transit. Based on these assumed speeds, it would take about 7 hours for LNG ships to complete the trip from the entrance to the Delaware Bay to the LNG terminal as that is about the time it takes other deep draft vessels to reach the Marcus Hook berths. Minimum visibility conditions would have to be satisfied before the LNG ship would be allowed to proceed inbound from the ocean, ensuring that the Coast Guard could adequately monitor the safety zone.

Currently there is a 100 yard security zone for moored or anchored vessels carrying dangerous cargo. The regulation provides the Coast Guard and local law enforcement personnel with the authority to implement additional control measures within the zone, such as check points, should such action be warranted based on a specific threat or credible intelligence. Additionally, it is important to note that the requirements of 33 CFR 165.150 were designed to apply to any CDC vessel transiting the Delaware Bay and River, and does give consideration to security measures that may be applied to mitigate risk. If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, the *LNG Vessel Transit Management Plan* would require a LNG-specific moored vessel security zone. Pursuant to this, although

a specific zone has not been determined, one for moored LNG vessels would be designated by the Captain of the Port.

The Coast Guard has preliminarily determined that if appropriate resources were available to implement certain necessary security measures, the Delaware River could accommodate the two or three LNG carriers per week that would supply Crown Landing's proposed LNG terminal. This determination is preliminary because the required NEPA analysis has not yet been completed. This determination is also contingent upon the port security community having the appropriate resources to implement all the measures necessary to responsibly manage the safety and security risks of LNG marine traffic in this area. If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, in addition to the moving safety and security zones around the LNG vessels, it is anticipated that an *LNG Vessel Transit Management Plan* would minimize impact to other ship traffic, the Marcus Hook anchorage, escorts by armed law enforcement officials and a variety of waterway and shoreline surveillance measures. The Coast Guard preliminarily determined that under normal conditions, these measures should not affect vehicular traffic, nor restrict the public's access to shore side recreation sites or unreasonably impede recreational boating. Nor do we believe they would have any other significant impacts.

The Delaware Memorial Bridge is the only bridge that crosses the LNG vessel route to the proposed LNG terminal site. The bridge consists of two spans that have horizontal and vertical clearances of 2,150 and 188 feet, respectively. The horizontal distance between the outer bridge lanes is about 300 feet. At speeds ranging between 4 to 10 knots it would take about 1 to 3 minutes for a 1,000 foot long LNG vessel to transit under both spans of the bridge. While bridge closures are one of the many tools available to the Coast Guard, it should <u>not</u> be assumed that bridge closures would be used. Other alternatives to a complete bridge closure include closing the outboard lanes only, placing law enforcement officials on the bridge at strategic locations, or employing technology that provides suitable security alternatives. Closure of the Delaware Memorial Bridge is not currently used for passing LPG ships.

If moving safety zones, security zones at the terminal, and one-way traffic were implemented, they would affect other commercial, ferry, and recreational traffic using the bay and river. The magnitude of the effect would also be influenced by three other factors: the amount of time it takes to obtain a pilot, other competing ship traffic in the federal navigation channel, and interaction with ferry traffic.

The moving safety zones, if implemented, may have the effect of temporarily limiting some commercial shipping route in the Delaware Bay and River to one-way traffic. This presently occurs with vessels carrying dangerous cargo (i.e., LPG) which can sometimes delay other vessels using the waterway as they wait or anchor at suitable locations to allow these vessels to pass. It is expected that if the proposed LNG terminal is constructed, and if the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, as many as 120 to 150 LNG ships could potentially move in and out of Delaware Bay and River every year. This is a 5 percent increase over the existing 3,000 vessels per year currently transiting these waterways.

To evaluate current conditions and the potential impact of LNG vessels on existing commercial ship traffic, Crown Landing retained Moffatt & Nichol International (MNI). The purpose of MNI's <u>Delaware Bay and River Traffic Study</u> was to assess the impact of LNG operations on barge traffic to and from the Logan Generating Station, which is located adjacent to the proposed LNG terminal site.

The study assessed six case scenarios, three of the cases modeled variations of current conditions (without proposed LNG terminal) and three of which modeled variations of future conditions (with LNG terminal). Vessel types included in the study were future LNG carriers, LPG carriers, crude oil tankers, other vessels, and coal barges to/from Logan power plant. The simulations included over 3,000 vessels per year to ports in the Delaware River up to Philadelphia, 150 LNG vessels per year, and 70 coal barges

per year to Logan. Tugs were not counted as separate entities because it was assumed that they travel as an integrated entity with the barges. Recreational boats were not included in the simulation; however, it can be assumed that the impacts on recreational boaters would be less than on deep draft vessels since recreational boats have shallower drafts and are less restricted on where they can travel in the bay and river.

The MNI study concluded that the introduction of LNG operations into the Delaware Bay and River would have a minor effect on the Logan power plant operations. MNI found that:

- The presence of LNG vessels slightly increases the delays caused by the moving safety and security zone requirement; however, the delays are not significant at 4.4 hours per year.

- The in-bound and out-bound delay of barges at Marcus Hook Range as a result of maneuvering crude oil tankers and LNG carriers increase by a factor of 2 to 3, at 22 hours per year. This represents a 15 minute delay per barge.

The impact on ferry traffic would generally be small because most of the ferry routes only cross the LNG ship route and conflicts could be managed by schedule coordination. Commercial fishing boats might also be affected by the moving safety zone that could be imposed by the Coast Guard as LNG ships transit the Delaware Bay and River, particularly if the width of any moving safety zone encompasses a large portion of the width of the waterway. However, the majority of the Delaware River is over 1 mile wide, except a portion near the Wilmington area or the Delaware Memorial Bridge. Additionally, any moving safety zone regulation that would be promulgated by the Coast Guard would affect a moving zone around the ship, so these impacts would be temporary and of short duration at any given point along the shipping route. In addition, depending on their individual drafts, commercial fishing boats might be able to go around the LNG ships at points in the river that are sufficiently wide for them to be outside of any moving safety zone. If the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, to mitigate any adverse impacts of moving safety zone, the Coast Guard would routinely provide Notice to Mariners prior to the arrival and departure of LNG ships as the Coast Guard currently does for LPG vessels and for other activities. The current notification system includes broadcasts on radio frequencies used by mariners and loudspeaker announcements made from Coast Guard, police or other agency boats that precede the ship.

Operation of the LNG terminal could also affect recreational boating and fishing during the 2 to 3 LNG vessel transits per week and unloading of the LNG ships. The security zone around a moored LNG ship may prevent recreational boaters from boating or fishing in the vicinity of the moored ship for approximately 24 hours. In most areas, the waterway that would be traveled by the LNG ships is sufficiently wide to allow recreational craft, which generally are not confined to the channel, to navigate around the LNG ships without significant delay. To estimate what kind of delay might result from a passing LNG ship in areas where the waterway is narrower, we identified the locations where the moving safety zone has the greatest potential to encompass the majority of the waterway width. For an LNG vessel in transit at traveling between 3 and 11 knots, recreational craft attempting to travel in the opposite direction at one of the narrow locations might need to wait between 7 and 26 minutes for the LNG ship to pass before proceeding on its way. Although LNG vessel maneuvers into and out of the LNG terminal berth are estimated to range from 2 to 3 hours, the usable width of the Delaware River in this location following installation of Crown Landing's pier would be approximately 3,500 feet wide. Recreational vessels would have ample room to pass by or have only minor delays.

During the public meetings, several people commented on the cost of applying additional security measures and the potential burden on local taxpayers. To meet its anticipated security responsibilities the

Coast Guard most likely would need to request additional resources through its internal resource reprogramming process for inclusion in future appropriations. Additional funding for state and local resources would be provided by Crown Landing. In order to precisely determine the additional resources that would be necessary to provide the additional security to ensure safe transit of the LNG vessels, it would be necessary to finalize the *LNG Vessel Transit Management Plan*. Funding for security and management costs are discussed further in section 4.12.5 "Emergency Response and Evacuation Planning".

While the LOR would address the suitability of Delaware Bay and River for LNG ship transportation, it would not constitute a final authority to commence LNG operations. Issues related to the public impact of safety and security zones would be addressed later in the development of the Coast Guard's *LNG Vessel Transit Management Plan*. This plan would be developed in conjunction with state and local law enforcement and emergency response communities. In addition, the Coast Guard would establish a moving safety zone and moored vessel security zone under 33 CFR 165 for LNG vessels in transit and while docked. Only personnel or vessels authorized by the Captain of the Port are permitted within these zones.

4.12.5.3 Environmental Impacts Associated with Coast Guard Actions

The Coast Guard's issuance of a LOR is a federal action which requires compliance with NEPA, just as the FERC's authorization for construction and operation of a LNG facility requires compliance with NEPA. Alternatives regarding these actions are discussed in section 3.

Some of the potential environmental impacts resulting from LNG vessel activities and transit would not be unique to LNG carriers and may also be addressed by previous Coast Guard NEPA analyses for existing regulations. Per the Coast Guard NVIC 05-05, all required Coast Guard NEPA analysis and documentation must be complete prior to the issuance of any LOR.

Potential impacts on wildlife and aquatic resources are discussed in section 4.6. The potential impacts that result from LNG vessels in transit would be similar to those resulting from other ships using the navigation channel. Impacts include those related to prop wash, invasive species, and water withdrawal for ballast and cooling. Although no significant impacts on wildlife or aquatic resources a result of LNG marine traffic is expected, we recommend in section 4.6.2 that Crown Landing continue to consult with federal and state agencies to determine the need for mitigative measures to avoid or minimize impacts on aquatic resources as the result of LNG ship ballast water intakes.

LNG ships and support vessels would emit criteria pollutants, VOCs and HAPs during transit. We have identified the magnitude of these emissions in section 4.11.1. LNG vessel emissions while in transit and during maneuvers are considered indirect emissions and are applicable towards the general conformity determination (see Appendix K). Currently emissions from the LNG ships while at berth would be subject to Delaware state permitting. However, should the location or jurisdiction of the dock change to New Jersey, emissions from the LNG ship while at berth would be included in the general conformity determination. All LNG ship and support vessel emissions while in transit would be required to conform to the Delaware SIP.

The LNG tanker would be operating in the federally approved channel and anchorage area en route to the terminal. We believe the use of this channel is consistent with the coastal zone management plan. Consistency with the Coastal Zone plans would be determined by New Jersey and Delaware as appropriate. The coastal effects associated with the Project, including coastal effects resulting from vessel transit, are addressed in section 4.8.3 to the extent this statute is applicable. As such, consistency

with the CZMA is required as appropriate. We have recommended conditions in sections 4.8.3.1 and 4.8.3.2 that Crown Landing obtain CZMA consistency from each state.

The potential impacts associated with a release of LNG are discussed generally in the preceding and following sections. The establishment of temporary safety and security zones by the Coast Guard has been considered as a potential effect on recreational use of the waterway (see section 4.8.5). However, we do not expect these zones to have a significant effect on environmental resources.

As a linear feature, the LNG transit corridor transects an assemblage of varying socioeconomic character determined by the presence of the waterway or other adjacent features. Further, the shipping route used by LNG vessels is not discretional. That is, the corridor was developed prior to the concept of its use for LNG traffic and alternative corridors are not available. Therefore, it is not possible to determine the vessel transit corridor based on environmental justice considerations.

The transit corridor for the LNG carriers would traverse open water and estuarine habitats. Approximately 21 miles of the transit corridor are within confined waters where shoreline could be affected by accidental spills. Portions of the transit corridor are proximal to shoreline habitats from Elsinboro Point to the LNG terminal site, as most of the transit route is open water. Shoreline habitats adjacent to the transit corridor include salt marsh, emergent wetlands, forested wetlands, grasslands, upland forest, and shrublands. The aquatic and shoreline habitats support a variety of wildlife which are described in section 4.6 and 4.7. Figure 4.12.5-2 shows the potential extent of hazard distance from an accidental spill, the locations of significant parks, refuges, and other public recreation areas along the transit corridor. The Coast Guard would manage the Markus Hook Anchorage Area to allow the LNG ships into and out of the berth at the LNG terminal, there would be no environmental effect on the Marcus Hook Anchorage Area.

LNG is less dense than fresh or sea water, so it floats on the surface. Immediately upon contact with any warmer substance such as water or air, it begins to evaporate. As the LNG vaporizes, a vapor cloud may form which is initially heavier than air and may be dispersed by wind. An LNG vapor cloud cannot explode in the open atmosphere, but it could burn.

Since LNG is a cryogenic liquid, the greatest threat to aquatic life from an LNG spill would be thermal stress. Any aquatic life (including plankton, fish, birds, sea turtles, marine mammals, and any federally-listed species) that came into direct contact with the LNG would probably experience a sudden cold shock, and, depending in what context that contact occurred, the exposure could be lethal, especially to non-motile species. Most mobile underwater organisms would detect the temperature change and avoid the area. Wildlife occupying the water's surface near the release could intercept the vapor cloud and suffer asphyxiation. However, the duration of this exposure is short, as noted below. Impacts to shoreline habitats and associated wildlife could occur, primarily, through the subsequent ignition of the LNG. The potential damage could involve the combustion of both vegetation and wildlife.

The accident scenarios evaluated in Section 4.12.5.4 include release and ignition of natural gas formed by evaporation of spilled LNG. Natural gas combustion typically is not complete in spill scenarios. The products of incomplete combustion of natural gas include criteria pollutants, ozone precursors, toxic air contaminants and soot (carbon particulates). It should be noted that LNG fires typically do not last as long as liquid petroleum fires.

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 4.12.5-2 Potential Sensitive Resources Along Ship Route

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

The duration of an ignited accidental LNG spill detailed in 4.12.5.4 is approximately 48 minutes. For an ignited intentional LNG spill, the duration is approximately 11 minutes. The maximum increases in ambient pollutant concentrations due to the natural gas fire would occur downwind of the LNG spill. Ambient air pollutant concentrations in downwind areas could potentially exceed short-term NAAQS and State Ambient Air Quality Standards over the duration of the fire as well as soot deposition and diminished visibility due to soot transport. Given the distance to shore from a potential fire from most of the transit route in the Delaware Bay or River, it is unlikely that sensitive receptors (i.e., schools, day care centers, hospitals, retirement homes, convalescence facilities, and residences) would be exposed to substantial pollutant concentrations for a significant period. In the more populated area of the transit route closer to the terminal some of these receptors may be exposed to higher pollutant concentrations for the short duration of the fire. There would be no long-term effects.

The pool formed from an unignited accidental LNG spill would completely evaporate in approximately 94 minutes. For an ignited intentional LNG spill, the pool would completely evaporate in approximately 7 minutes. As natural gas is not a criteria pollutant, no air quality impact would be expected from the evaporation of the LNG spill. However, methane, the primary component of LNG, is considered a greenhouse case and may contribute to global warming (Coast Guard, 2005).

However, the history of LNG shipping has been free of major incidents, and none have resulted in significant quantities of LNG being released. No incidents have occurred at existing LNG terminals during the 50 years of operation that resulted in any significant quantities of cargoes being released. Historically, the events most likely to cause a significant release of LNG were ship casualties such as collisions, allisions[9], or groundings. Any event causing a release of LNG would have to occur with sufficient impact to breach the LNG ship's double hull and cargo tanks. During the 44,000 voyages that have been completed since the inception of LNG maritime transportation, there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. Based on the extensive operational experience of LNG shipping, the structural design of an LNG vessel, and the operational controls imposed by the Coast Guard and local pilots, the likelihood of a cargo containment failure and subsequent LNG spill from a vessel casualty – collision, grounding, or allision – is highly unlikely. However, the possibility of an LNG spill from a ship over the duration of the proposed Project must be considered.

Given that an LNG cargo spill is highly unlikely, no significant socioeconomic impact associated with an accidental LNG release along the transit route would be expected. As described below, the duration of an LNG pool fire would be of short duration, i.e., from 1 to 2 ½ hours. If there is an LNG spill on the transit route, it may result in a temporary interruption in ship traffic in the navigation channel; however, traffic in the navigation channel would quickly resume normal operations and any economic impact on the maritime industry would be minimal.

If a pool fire occurred where the transit route is closer to shore, businesses within 2,200 feet of the center of a spill could be subject to a long-term loss of use. Vegetation and wooden structures subjected to greater than 3,000 Btu/ft^2-hr[10] may ignite. However, because the hazard area surrounding an LNG cargo vessel is transient (moving with the vessel along its route) it is not possible to accurately quantify the economic impact of an incident. Section 4.12.5.4 discusses the effects of an LNG spill in greater detail.

[9] "Allision" is the action of dashing against or striking upon a stationary object (e.g., the running of one ship upon another ship that is docked) – distinguished from "collision," which is used to refer to two moving ships striking one another.

[10] At 3,000 Btu/ft^2-hr, an exposed person would experience burns within 10 seconds, however a wooden structure would not be expected to burn and affords protection to sheltered persons.

In accordance with Section 311 of the Energy Policy Act of 2005, we recommend in section 4.12.5 that Crown Landing develop an Emergency Response Plan in consultation with the Coast Guard and state and local agencies that includes a Cost-Sharing Plan before any final approval to begin construction. Therefore, no long-term impact relating to emergency evacuation of communities would be expected.

The December 2004 Sandia Report, discussed in section 4.12.5 "Deliberate Attack on an LNG Vessel", included an analysis of potential LNG cargo tank breaches due to accidental causes. The report found that accidental groundings, collisions with small vessels and low speed collisions with large vessels could cause minor ship damage but would not result in a cargo spill. This is due to the protection provided by the double hull structure, the insulation layer and the primary cargo tank of an LNG vessel. We do not believe that there would be any environmental significance attributed to these types of accidents.

High speed collisions with large vessels striking at 90 degrees were found to potentially cause cargo tank breach areas of 0.5 to 1.5 square meters. For the resulting LNG spill and pool fire on water, the Sandia Report determined that the most significant impact on public safety and property would exist within about 800 feet, with minimal impact beyond 2,400 feet. Depending on the actual size of the cargo tank breach, the duration of the spill and ensuing pool fire could range from approximately 1 to 2 ½ hours. Using the methodology in the ABSG study, FERC staff determined that the site-specific distance to the 1,600 Btu/ft^2-hr transient hazard area for an accidental cargo tank breach in the Delaware Bay and River would be approximately 2,867 feet.

However, if the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, it must also be recognized that the operational controls that would be imposed by the Coast Guard and local pilots, such as a moving LNG vessel safety zone and one-way traffic in narrow channels, would be specifically designed to prevent the collision scenarios that could result in an LNG cargo tank breach. As a result, the likelihood of an LNG spill from accidental causes is considered to be negligible.

In the unlikely event of an LNG spill, the physical properties of LNG would limit any potential impacts. If spilled into water, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water over a period of approximately 1 to 2 ½ hours. Being less dense than water, LNG would float on the surface prior to vaporizing. Because LNG is not soluble in water and the LNG would completely vaporize shortly after being spilled, there would be no liquid left that could mix with and/or contaminate the water.

In the event of a collision or allision of sufficient magnitude to rupture an LNG cargo tank, it is likely that sparks or flames would ignite the flammable vapors at the spill site. In the unlikely event that ignition did not occur, an LNG spill would rapidly vaporize on water and form a potentially flammable cloud. If the flammable vapor cloud encountered an ignition source, the cloud would burn back to the spill site, rather than outward towards shoreline habitats.

Given these considerations, impacts to shoreline habitats as a result of an accidental LNG spill are unlikely to occur. A spill would be unlikely to result in significant impacts to shoreline habitats and wildlife that occur along the transit route. Hazard distances for intentional breaches are discussed in section 4.12.5.4. Although an intentional breach scenario may result in greater hazard distances, such scenarios are associated with the desire to inflict damage to major infrastructure, population and commercial centers, rather than to environmentally sensitive areas along the vessel route. Also, given the navigation controls and safety and security procedures in place to specifically prevent such accidents and intentional spill scenarios, the indirect impact associated with Coast Guard actions are not reasonably foreseeable events.

As discussed in section 4.12.5.2, if the Coast Guard issues a LOR finding the waterway suitable for LNG marine traffic, the Coast Guard may establish a moving safety zone, moored vessel security zone, and/or a regulated navigation area around the transiting LNG vessels and provide some level of escort as part of finalizing the *LNG Vessel Traffic Management Plan*. The LNG vessels would also undergo safety and security inspections to ensure compliance with U.S. and international standards. In addition, the LNG facility would submit a facility security plan for review and approval by the Coast Guard. However, 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, the Coast Guard would ensure the appropriate NEPA environmental documentation for such actions is complete prior to commencement of these activities rather than in this EIS.

4.12.5.4 LNG Ship Safety

Since 1959, LNG has been transported by ship without a major release of cargo or a major accident involving an LNG ship. Starting in 1971, LNG began arriving at the Distrigas facility in Everett, Massachusetts. To date, more than 680 cargoes, with volumes ranging from 60,000 to 125,000 m^3, have been delivered into the Port of Boston without incident. During 2005, an estimated total of 631 billion cubic feet (241 cargoes) of LNG was imported into the United States. For 35 years, LNG shipping operations have been safely conducted in the United States. The world's LNG ship fleet currently exceeds 173 carriers.

Over the last 45 years, LNG ships have made over 44,000 voyages. Currently, all of the ships in the LNG fleet operate under a foreign flag with foreign crews. A foreign flag ship must have a Certificate of Compliance inspection by the Coast Guard to ensure compliance with International safety standards.

History

During the 44,000 voyages that have been completed since the inception of LNG maritime transportation, there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG vessels, including minor collisions with other vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels. Some of the more significant LNG vessel incidents are described below:

- ***Pollenger*** had an LNG spill onto the steel cover of cargo tank number one during unloading at Everett, Massachusetts in April 1979. The spill caused cracking of the steel plate.

- ***El Paso Paul Kayser*** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, the cargo tanks were not damaged, and no cargo was released. The complete cargo of LNG was subsequently transferred to another LNG ship and delivered to its United States destination.

- ***LNG Taurus*** grounded in December 1980 near the entrance to Taboata Harbor, Japan. The grounding resulted in extensive bottom damage, but the cargo tanks were not affected. The ship was refloated and the cargo unloaded.

- ***Isabella*** had LNG spill onto its deck due to a cargo tank overflow in June 1985, causing severe cracking of the steelwork. The spill had been attributed to a cargo valve failure during discharging of cargo.

- ***Tellier*** was blown from its docking berth at Skikda, Algeria in February 1989 during severe winds causing damage to the loading arms and the ship and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck causing fracture of some plating.

- ***Mostefa Ben Boulaid*** had LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The ship was required to discharge its cargo, after which it proceeded to dock for repair.

- ***Khannur*** had a cargo tank overfill into the ship's vapor handling system on September 10, 2001 during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After re-inspection by the Coast Guard, the Khannur was allowed to discharge its LNG cargo.

- ***Norman Lady*** was struck by the USS Oklahoma City nuclear submarine while rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 cubic meter LNG tanker, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull but not to its cargo tanks.

- ***Tenaga Lima*** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over an approximate area of 20 feet by 80 feet, and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The ship was refloated, repaired and returned to service.

- ***Golar Freeze*** moved away from its docking berth during unloading on March 14, 2006 in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed and transfer operations were shut down.

Ship Construction

In 1980, at the initial peak of LNG import activity in the United States, the Coast Guard published the report, *Liquefied Natural Gas and Liquefied Petroleum Gas – Views and Practices – Policy and Safety*. The report summarized the Coast Guard's extensive research into the safety hazards of LNG and its view that "...the nature of both LNG and LPG presents an acceptable risk for transportation in maritime commerce." This is due to the fact that LNG ships are well constructed, robust vessels designed to withstand low-energy type incidents that are prevalent in harbors and during docking operations. Moreover, safety measures, both equipment and training, are planned and designed into these LNG ships to prevent or control all types of potential incidents.

The insulation of cargo tanks on LNG carriers is a complex assembly of many layers. The relief valve capacity of LNG ships is designed to compensate for over-pressure caused by fire. The potential that impingement by a cryogenic liquid could cause brittle fracture of the ship's hull was known to the Coast Guard in the mid-1970s when the U.S. regulations for LNG ships in 49 CFR Part 154 were being developed. LNG carriers used in the U.S. waters must also be constructed in accordance with the IMO Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk. This standard requires that the vessel inner hull adjacent to the cargo tanks be protected against contact from liquid cargo through a combination of proper material selection, adequate insulation, and use of heating systems.

As required by the IMO conventions and design standards, hold spaces and insulation areas on an LNG ship are equipped with gas detection and low temperature alarms. These devices monitor for leaks of LNG into the insulation between primary and secondary LNG cargo tank barriers. In addition, hazard detection systems are also provided to monitor the hull structure adjacent to the cargo tank, compressor rooms, motor rooms, cargo control rooms, enclosed spaces in the cargo area, specific ventilation hoods and gas ducts, and air locks.

LNG carriers are equipped with a firewater system with the ability to supply at least two jets of water to any part of the deck in the cargo area and parts of the cargo containment and tank covers above-deck. A water spray system is also available for cooling, fire prevention, and crew protection in specific areas. In addition, certain areas of LNG ships are fitted with dry chemical powder-type extinguishing systems and CO_2 smothering systems for fighting fires.

Unlike many conventional crude oil tankers, all LNG ships used to deliver LNG to this proposed project would have double-hull construction, with the inner and outer hulls separated by about 10 feet. Furthermore, the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1-foot thick. As a result, many grounding incidents severe enough to cause a cargo spill on a single-bottom oil tanker would be unable to penetrate both inner and outer hulls of an LNG ship. An earlier Federal Power Commission (FPC, predecessor to the FERC) study estimated that the double-bottom of an LNG ship would be sufficient to prevent cargo tank penetration in about 85 percent of the cases that penetrated a single-bottom oil tanker.

The probability of an LNG ship sustaining cargo tank damage in a collision would depend on several factors – the displacement and construction of both the struck and striking vessels, the velocity of the striking vessel and its angle of impact with the struck vessel, and the location of the point of impact. The previous FPC study estimated the additional protection afforded by the double-hull would be effective in low energy collisions, and overall it would prevent cargo tank penetration in about 25 percent of the cases that penetrated a single-hull oil tanker.

In 1995, to assist the Coast Guard in San Juan, Puerto Rico, EcoEléctrica L.P. prepared an analysis of the damage that could result from an oil tanker striking an LNG ship at berth (FERC, 1996). The analysis assumed a 125,000 m^3 LNG ship and an 82,000 dead weight ton tanker carrying number 6 fuel oil without tug assistance. The analysis determined the minimum striking speed to penetrate the cargo tanks of an LNG ship for a range of potential collision angles. The resulting minimum striking speeds are presented in table 4.12.5-2 for the two principal cargo systems.

TABLE 4.12.5-2

Minimum Striking Speed to Penetrate LNG Cargo Tanks

	Minimum Striking Speed (knots)	
Angle of Impact	Spherical Tanks	Membrane Tanks
Greater than 60 degrees	4.5	3
45 degrees	6.3	4
30 degrees	9	6
15 degrees	18	12

For membrane tanks, the critical beam-on striking speed is 3.0 knots, and for spherical tanks, the critical on-beam speed is 4.5 knots. For both containment types, lower angles of impact result in much greater minimum striking speeds to penetrate LNG cargo tanks. In the July/August, 2002 issue of the "LNG Journal", the SIGTTO General Manager provides a table that shows the critical speed necessary for a 20,000-ton vessel to puncture the outer hull of an LNG carrier is 7.3 knots. For a 93,000-ton ship, the

impact speed is 3.2 knots. In neither case does such an impact result in damage to the LNG cargo containment system or the release of LNG.

In December 2004, the DOE released a study by Sandia National Laboratories, Sandia Report. The Sandia Report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for credible accidental and intentional LNG spill events. The analysis of accidental events found that groundings, collisions with small vessels and low speed (less than 7 knots) collisions with large vessels striking at 90 degrees could cause minor ship damage but would not result in a cargo spill. This is due to the protection provided by the double hull structure, the insulation layer, and the primary cargo tank of an LNG vessel. High speed (12 knots) collisions with large vessels striking at 90 degrees were found to potentially cause cargo tank breach areas of 0.5 to 1.5 square meters.

Hazards

In the event of a collision or allision of sufficient magnitude to rupture an LNG cargo tank, it is likely that sparks or flames would ignite the flammable vapors at the spill site. In a grounding of sufficient magnitude to rupture an LNG cargo tank, the damage would occur under water and the potential for ignition would be less than for collisions or allisions. In either case, an LNG spill would rapidly vaporize from contact with water and form a potentially flammable cloud. If not ignited, the flammable vapor cloud would drift downwind until the effects of dispersion would dilute the vapors below the lower flammable limit for methane. The maximum range of potentially flammable vapors (i.e., the distance to the lower flammable limit) is a function of the volume of LNG spilled, the rate of the spill, and the prevailing meteorological conditions. If the flammable vapor cloud encountered an ignition source, the cloud would burn back to the spill site.

The final EIS for the Calcasieu LNG Project (Lake Charles, LA) (September 1976) analyzed the maximum range of a flammable vapor cloud and hazardous radiation levels from an instantaneous one-tank spill. As was consistent with risk analyses at that time and for nearly 25 years thereafter, the instantaneous spillage of one cargo tank was considered to be the “worst case” scenario. Physical constraints on maximum vessel speeds and maximum depths of penetration required to rupture one LNG cargo tank render the possibility of an instantaneous release of more than one cargo tank to be implausible. This is not to imply that the loss of multiple cargo tanks could never occur, but that the extent of the hazard would not exceed that of the instantaneous spillage of one tank.

For an instantaneous one-tank spill with ignition, the final EIS for the Calcasieu LNG Project estimated that a hazardous thermal radiation level of 5,300 Btu/hr-ft^2 would extend 3,595 feet from the center of the spill. For an instantaneous one-tank spill without ignition, the final EIS for the Yukon Pacific LNG Project (FERC, March 1995) estimated that potentially flammable vapors could travel up to 3.3 miles with a 10 mph wind and typical atmospheric stability.

In October 2001, the use of a one-tank instantaneous release as the "worst case" scenario was re-examined by Quest Consultants, Inc. (Quest) as part of an effort by the DOE to determine the hazards associated with reopening the Distrigas LNG import terminal following the terrorist attacks of September 11, 2001. It was determined that time-release spills through 1-meter and 5-meter diameter holes would more accurately simulate credible "worst case" damage scenarios. Maximum flammable vapor cloud and radiation hazards were calculated for the two spill scenarios. For a spill on water with ignition, the maximum distance to a radiant flux level of 1,500 Btu/ft^2-hr was estimated to be 1,770 feet. For a spill on water without ignition, a flammable vapor cloud of 2.5 miles was estimated. In November 2003, in response to comments concerning its October 2001 study, Quest clarified that its study only applied to

LNG spills resulting from a collision with a large ship in Boston's Outer Harbor where waves would restrict the spreading of LNG on water.

Since the 2001 Quest study, there has been an emergence of studies by various parties to define the "worst case" scenario that would result from a deliberate, terrorist attack on an LNG ship and the subsequent release of cargo. Distances have been estimated to range from 1,770 to 4,200 feet for a thermal radiation level of 1,500 Btu/ft^2-hr. Part of the reason for the apparent discrepancies is the lack of large-scale historical incidents, and the need to extrapolate small-scale field test data to a worst case event. This inevitably leads to differing conservative assumptions among the various parties. For example, some models calculate a time-release cargo discharge through 1-meter or 5-meter diameter holes, while others assume that the cargo tank empties instantaneously.

As a result, the FERC commissioned a study by ABSG to search and review the literature on experimental LNG spills and on consequence methodologies that are applicable to modeling incidents of LNG spills on water. Further, the goal of the study was to identify appropriate methods for estimating flammable vapor and thermal radiation hazard distances for potential LNG vessel cargo releases during transit and while at berth. The resulting study, *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*, was released for public comment on May 14, 2004. On June 18, 2004, staff's responses to comments on the consequence assessment methods were issued. As discussed in greater detail in staff's responses, various components of the consequence assessment methodologies were revised based on comments received. In addition, the model was updated to include a lower limit on the characteristic wind speed. The revised study provides the methodology for calculating: (1) the rate of release of LNG from a cargo tank penetration for various sized holes; (2) the spreading of an unconfined LNG pool on water for both continuous spills and rapid (nearly instantaneous) releases; (3) the rate of vapor generation from a unconfined spill on water; (4) thermal radiation distances for LNG pool fires on water; and (5) and flammable vapor dispersion distances.

A detailed evaluation of the consequences of a terrorist attack on a modern membrane LNG tanker was prepared by Lloyds Register North America for the Weaver's Cove LNG Project and filed under CEII. The study evaluated the consequences of attacks on an LNG tanker by missiles and explosives. Finite element analysis was used to evaluate the effect of various sized charges on both the outer and inner hulls. A 1-meter diameter hole of the inner hull at the waterline was found to be the average most probable "worst case" scenario for hazard consequence assessments. This finding is consistent with the attack on the double-hull oil tanker *Limberg* which caused greater than a 5-meter diameter hole on the outer hull but only minor damage to the inner hull. A failure modes and effects analysis was used to understand internal LNG release characteristics; and a residual strength analysis used to investigate damage scenarios for a loaded LNG tanker.

The December 2004 Sandia Report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for credible accidental and intentional LNG spill events. The analysis of accidental events found that groundings and low speed collisions could result in minor ship damage but not a cargo spill; while high speed collisions could cause a 0.5 to 1.5 square meters cargo tank breach area. For intentional scenarios, the size of the cargo tank hole depends on the location of the ship and source of threat. Intentional breach areas were estimated to range from 2 to 12 square meters. In most cases, an intentional breaching scenario would not result in a nominal hole of more than 5 to 7 square meters, which is a more appropriate range to use in calculating potential hazards from spills.

The Sandia Report also included guidance on risk management for intentional spills, based on the findings that the most significant impacts to public safety and property exist within approximately 500 meters (1,640 feet) of a spill due to thermal hazards from a fire, with lower public health and safety

impacts beyond 1,600 meters (5,250 feet). Large, unignited LNG vapor releases were found to be unlikely, but could extend to 2,500 meters (8,200 feet) for nominal intentional spill.

Cascading damage due to brittle fracture from exposure to cryogenic liquid or fire-induced damage to foam insulation was evaluated and while possible under certain conditions is not likely to involve more than two or three cargo tanks. Cascading events are not expected to increase the overall fire hazard by more than 20 to 30 percent (1,920 to 2,080 meters or 6,300 to 6,825 feet), but would increase the expected fire duration. RPTs are possible for large spills but the effects would be localized near the spill source and should not cause extensive structural damage.

The methodology described in the ABSG study and revised in staff's responses to comments was used to calculate the thermal radiation and flammable vapor dispersion distances for several holes ranging in diameter from 1 meter to 3.9 meters. Based on the penetration of the largest cargo tank of a typical 140,000 m^3 LNG ship, a potential spill of 23,000 m^3 is estimated for the volume of LNG above the waterline. The estimated pool spread results and thermal radiation hazard distances are identified in table 4.12.5-3. Thermal radiation calculations are based on an ambient temperature of 18º F, a relative humidity of 30 percent, and a 20 mile per hour wind speed.

TABLE 4.12.5-3

LNG Spills on Water

LNG Release and Spread					
Hole diameter	1.0 meter	1.4 meters	2.5 meters	3.0 meters	3.9 meters
Hole area	0.8 $meter^2$	1.5 $meters^2$	5.0 $meters^2$	7.0 $meters^2$	12.0 $meters^2$
Spill time	94.0 minutes	48.0 minutes	15.0 minutes	10.4 minutes	6.2 minutes
Pool Fire Calculations					
Maximum pool radius	340 feet	477 feet	816 feet	939 feet	1,102 feet
Fire duration	94.1 minutes	48.1 minutes	15.2 minutes	10.7 minutes	6.5 minutes
Distance to:					
1,600 Btu/ft^2-hr	2,239 feet	2,861 feet	4,343 feet	4,833feet	5,457 feet
3,000 Btu/ft^2-hr	1,746 feet	2,245 feet	3,352 feet	3,726 feet	4,201 feet
10,000 Btu/ft^2-hr	1,075 feet	1,369 feet	2,020 feet	2,239 feet	2,518 feet

However, Crown Landing proposes the potential use of up to a 200,000 m^3 LNG ship. The limited information available regarding the design of future 200,000 m^3 LNG ships suggests that the draft of the larger ships would remain the same due to the limited draft of the channel, while the length and width of the larger ships would increase. This would in effect increase the length and width of the cargo tanks, but not change the height, therefore not change the hydrostatic head. Preliminary information shows that the larger class ships would have five cargo tanks instead of four as on the 140,000 m^3 ships. For a 200,000 m^3 LNG ship compared to the results for a 140,000 m^3 ship, the estimated distance to the 1,600 Btu/ft^2-hr zones would be less than 3 percent farther and the fire duration would be extended by about 13 percent.

Although Crown Landing would design the terminal and unloading berth for LNG ships with capacities up to 200,000 m^3, detailed dimensions of these future ships and the associated cargo tanks is unavailable. FERC staff was required to make assumptions in order to analyze the LNG spills on water from these larger ships. Therefore, in order to allow the Coast Guard to determine the continued suitability of the waterway for LNG marine traffic, **we recommend that:**

- **<u>Prior to accepting</u> ships greater than 140,000 m^3 in capacity, Crown Landing should provide the necessary information to demonstrate that the transient hazard areas identified in the final EIS are applicable. Crown Landing should file this information with the Secretary for review and written approval of the Director of OEP. This information should also be provided to the Coast Guard.**

Flammable vapor dispersion calculations were based on an ambient temperature of 49 ºF, 50 percent relative humidity, a 4.5 mph wind speed and atmospheric stability class F. Based on a 1-meter-diameter hole, an unignited release would result in an estimated pool radius of 421 feet. The unignited vapor cloud would extend to 9,736 feet to the lower flammability limit and 13,171 feet to one half the lower flammability limit. It is important to identify certain key assumptions of conditions that must exist in order to achieve the maximum vapor cloud distances. First it would be necessary for an event to create a 1-meter-diameter hole by penetrating the outer hull, the inner hull, and cargo containment <u>without ignition</u>. Far more credible is that the event creating a 1-meter-diameter hole would also result in a number of ignition sources which would lead to an LNG pool fire and subsequent thermal radiation hazards. It is also unlikely that a flammable vapor cloud could achieve its maximum distance over land surfaces without encountering an ignition source, and subsequently burning back to the source. Flammable vapor dispersion for larger holes was not performed since, realistically, the cloud would not even extend to the maximum distance for a 1-meter-diameter hole before encountering an ignition source.

The inbound transit through the Delaware Bay ship channel would pass by Cape May, Arnold Point, Elsinboro Point, and Pennsville, New Jersey on the east side and Cape Henlopen, Delaware Point, Port Penn, Delaware City, and New Castle, Delaware on the west side. After passing New Castle, Delaware on the west side, the LNG vessel would pass through the Delaware Memorial Bridge, and by Penns Grove and Pedricktown, New Jersey on the east side and Wilmington, Edgemoor, Bellefonte, Claymont, and Marcus Hook, Delaware on the west side. Some areas of development along the shoreline in these communities would be within a potential transient hazard area during the LNG vessel transit; while a small part of Marcus Hook and a generating station would be exposed to a potential hazard while the LNG vessel is at the dock and unloading cargo.

The LNG ship would transit approximately 74 nautical-miles from the entrance of the Delaware Bay to the Crown Landing LNG terminal. The LNG vessel would transit the Delaware Bay at an average speed of 10.5 - 11 knots resulting in the adjacent communities located within the 4,883-foot distance to the 1,600 Btu/ft^2-hr thermal radiation level for a nominal 3-meter diameter hole to be exposed to a potential transient thermal hazard for less than 10 minutes. After passing New Castle, Delaware on the west side the LNG vessel would slow to approximately 7 knots as it passes under the Delaware Memorial Bridge and makes it way upriver to within approximately 2 nautical miles of the Crown Landing Terminal. After that point the LNG vessel would travel at an average speed of 3 knots until reaching the Crown Landing terminal. While transiting the Delaware River after the Delaware Memorial Bridge, the transient hazard to shoreside communities would be approximately 30 minutes. In addition, a temporary hazard would exist around the slip during part of the 16- to 17-hour period while the LNG vessel is maneuvering and berthed at the dock including a portion of Allied Pier Chemical Ships located in Marcus Hook, the Logan power plant, Ferro Chemical Plant, a tanker truck cleaning area, and Marcus Hook Anchorage #1.

For potential spills near Elsinboro, New Jersey, the number of housing units located within the 4,883-foot distance to the 1,600 Btu/ft^2-hr transient hazard area would be approximately 130. In the vicinity of Pennsville, New Jersey and New Castle, Delaware, 510 and 360 housing units would be located in the transient hazard area. About 1,710 and 160 housing units in Edgemoor and Bellefonte, Delaware would be located in the transient hazard area. Additionally, about 2,890 and 750 housing units in Claymont and Marcus Hook, Delaware would be located in the 1,600 Btu/ft^2-hr transient hazard area.

In addition, the potential impact on the infrastructure and industrial development was also evaluated. A thermal radiation level of 10,000 Btu/ft^2-hr is associated with potential damage to equipment and infrastructure. A fire associated with a potential spill resulting from a nominal cargo tank hole of an intentional event could expose the following infrastructure and industry within approximately 2,239 feet to a thermal radiation level of 10,000 Btu/ft^2-hr for 10- to 15-minutes: a small portion of the Allied Pier at Marcus Hook; approximately 1.3 miles of Interstate 495; approximately 1.5 miles of the Amtrak and Septa Transit railways; Dupont Edgemoor; a small portion of the Port of Wilmington; a small portion of Dupont Chamberworks; and the Delaware Memorial Bridge. In addition, a fire associated with a potential spill in the vicinity of Crown Landing's dock resulting from a nominal cargo tank hole of an intentional event could expose the proposed LNG storage tanks to a thermal radiation level of 10,000 Btu/ft^2-hr for 10- to 15-minutes.

For potential spills due to an accidental breach, a small portion of the residential area of Edgemoor was identified within the 2,891-foot distance to the 1,600 Btu/ft^2-hr transient hazard area. Additional shore-side outdoor public use areas identified within 1,600 Btu/ft^2-hr transient hazard area due to an accidental breach include Fox Point State Park, Pea Patch Island (Fort Delaware State Park), and Elsinboro Point.

The operational restrictions to be imposed by the Delaware River Pilots on LNG vessel movements through the Delaware Bay and River, as well as the requirements that the Coast Guard would impose in its operating plan would minimize the possibility of a hazardous event occurring along the vessel transit.

By focusing on the "worst case" intentional breach scenarios for LNG transportation, there is a tendency to dismiss the potential hazards for other fuels and products commonly transported on our waterways. Some of the previously identified studies that calculate long hazard distances for LNG cargo fires also estimate similarly long distances for gasoline, propane, and jet fuel cargo fires. Also, it should not be assumed that the hazard distances identified are the assured outcome of an LNG ship accident or attack, given the conservatisms in the models and the level of damage required to yield such large scale releases. Further, these "worst case" intentional breach scenarios should not be misconstrued as defining an exclusionary zone. Rather the average most probable "worst case" scenarios provide guidance in developing the operating restrictions for LNG ship movements in the Delaware River, as well as in establishing potential impact areas for emergency response and evacuation planning.

4.12.6 Terrorism and Security Issues

The security requirements for the onshore component of the proposed project are governed by 49 CFR 193, Subpart J - Security. This subpart includes requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. Requirements for maintaining safety of the marine terminal are in the Coast Guard regulations in 33 CFR Part 127. Requirements for maintaining security of the marine terminal are in 33 CFR Part 105.

In the aftermath of the terrorist attacks that occurred on September 11, 2001, terrorism has become a very real issue for the facilities under the Commission's jurisdiction. The FERC, like other federal agencies, is faced with a dilemma in how much information can be offered to the public while still providing a significant level of protection to the facility. Consequently, the FERC has removed energy facility design plans and location information from its website to ensure that sensitive information filed under CEII is not readily available (RM02-4-000 and PL02-1-000 issued February 20, 2003).

Since September 11, 2001, the FERC has been involved with other federal agencies in developing a coordinated approach to protecting the energy facilities of the United States. The FERC continues to coordinate with theses agencies, specifically with the Coast Guard to address this issue. The Coast Guard now requires arriving ships to provide them with a 96-hour advance notice of arrival that includes key information about the vessel and its crew which allows the Coast Guard to conduct a terrorism risk assessment and put in place appropriate mitigation before the ship reaches the ship channel. In addition, interstate natural gas companies are actively involved with several industry groups to chart how best to address security measures in the current environment. A Security Task Force has been created and is addressing ways to improve pipeline security practices, strengthen communications within the industry and the interface with government, and extend public outreach efforts.

In September 2002, the DOT's OPS issued non-public guidelines to LNG operators that direct them to develop new security procedures for onshore facilities. Operators were required to prepare a security plan within 6 months that responds to the five threat levels defined by the Office of Homeland Security. OPS conducts subsequent on-site reviews of the security procedures.

On October 22, 2003, the Coast Guard issued a series of six final rules that promulgated the maritime security requirements of the Maritime Transportation Security Act of 2002: Implementation of National Maritime Security Initiatives; Area Maritime Security; Vessel Security; Facility Security; Outer Continental Shelf Facility Security; and the Automatic Identification System. The entire series of rulemakings established a new subchapter H in 33 CFR. In support of the rulemakings, the Coast Guard applied a risk-based decision making process to comprehensively evaluate the relative risks of various target and attack mode combinations and scenarios for those vessel types and port facilities that pose a risk of a security incident. This approach provides a more realistic estimation of risk than a simple "worst-case outcome" assessment. Risk management principles acknowledges that while risk generally cannot be eliminated, it can be reduced by adjusting operations to lower consequences, threats, or vulnerability, recognizing that it is easier to reduce vulnerabilities by adding security measures.

On December 29, 2003, terminal owners or operators subject to 33 CFR Part 105 were required to submit a *Facility Security Assessment and Facility Security Plan* to the Coast Guard Captain of the Port for review and approval. The Facility Security Plans were required to be implemented no later than July 1, 2004 or for facilities constructed after July 1, 2004, 60 days prior to operations. Some of the principal owner or operator responsibilities include:

- designating a FSO with a general knowledge of current security threats and patterns, risk assessment methodology, and the responsibility for implementing the Facility Security Plan and Assessment and performing an annual audit for the life of the project;

- conducting a Facility Security Assessment to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures;

- developing a Facility Security Plan based on the Facility Security Assessment, with procedures for responding to transportation security incidents, notification and coordination with local, state and federal authorities, prevent unauthorized access; measures and equipment to prevent or deter dangerous substances and devices, training, and evacuation;

- implementing scalable security measures to provide increasing levels of security at increasing MARSEC levels for facility access control, restricted areas, cargo handling, vessel stores and bunkers, and monitoring;

- conducting security exercises at least once each calendar year and drills at least every 3 months; and

- reporting of all breaches of security and security incidents.

Increased security awareness has occurred throughout the industry and the nation. President Bush established the Office of Homeland Security with the mission of coordinating the efforts of all executive departments and agencies to detect, prepare for, prevent, protect against, respond to, and recover from terrorist attacks within the United States. The Commission, in cooperation with other federal agencies and industry trade groups, has joined in the efforts to protect the energy infrastructure, including the more than 300,000 miles of interstate natural gas transmission pipeline and associated LNG facilities.

Safety and security are important considerations in any Commission action. The attacks of September 11, 2001 have changed the way pipeline operators as well as regulators must consider terrorism, both in approving new projects and in operating existing facilities. However, the likelihood of future acts of terrorism or sabotage occurring at the proposed LNG import terminal, or at any of the myriad natural gas pipeline or energy facilities throughout the United States is unpredictable given the disparate motives and abilities of terrorist groups. The continuing need to construct facilities to support the future natural gas pipeline infrastructure is not diminished from the threat of any such unpredictable acts.

4.12.7 Pipeline Facilities

The transportation of natural gas by pipeline involves some risk to the public in the event of an accident and subsequent release of gas. The greatest hazard is a fire or explosion following a major pipeline rupture.

Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic, but is classified as a simple asphyxiate, possessing a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death.

Methane has an ignition temperature of 1,000° F and is flammable at concentrations between 5.0 percent and 15.0 percent in air. Unconfined mixtures of methane in air are not explosive. However, a flammable concentration within an enclosed space in the presence of an ignition source can explode. It is buoyant at atmospheric temperatures and disperses rapidly in air.

4.12.7.1 Safety Standards

The DOT is mandated to provide pipeline safety under Title 49, U.S.C. Chapter 601. The RSPA's, OPS, administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards which set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. RSPA ensures that people and the environment are protected from the risk of pipeline incidents. This work is shared with state agency partners and others at the federal, state, and local level. Section 5(a) of the Natural Gas Pipeline Safety Act provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while section 5(b) permits a state agency that does not qualify under section 5(a) to perform certain inspection and monitoring functions. A state may also act as DOT's agent to inspect interstate facilities within its

boundaries; however, the DOT is responsible for enforcement action. The majority of the states have either 5(a) certifications or 5(b) agreements, while nine states act as interstate agents.

The DOT pipeline standards are published in Parts 190-199 of Title 49 of the CFR. Part 192 of 49 CFR specifically addresses natural gas pipeline safety issues.

Under a Memorandum of Understanding on Natural Gas Transportation Facilities (Memorandum) dated January 15, 1993 between the DOT and the FERC, the DOT has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a)(9)(vi) of the FERC's regulations require that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a certificate is requested in accordance with federal safety standards and plans for maintenance and inspection, or shall certify that it has been granted a waiver of the requirements of the safety standards by the DOT in accordance with section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards other than the DOT standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the Memorandum to promptly alert DOT. The Memorandum also provides for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipeline under the Commission's jurisdiction.

The FERC also participates as a member of the DOT's Technical Pipeline Safety Standards Committee which determines if proposed safety regulations are reasonable, feasible, and practicable.

The pipeline and aboveground facilities associated with the Logan Lateral Project must be designed, constructed, operated, and maintained in accordance with the DOT Minimum Federal Safety Standards in 49 CFR Part 192. The regulations are intended to ensure adequate protection for the public and to prevent natural gas facility accidents and failures. Part 192 specifies material selection and qualification, minimum design requirements, and protection from internal, external, and atmospheric corrosion.

Part 192 also defines area classifications, based on population density in the vicinity of the pipeline, and specifies more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1 mile length of pipeline. The four area classifications are defined as follows:

Class 1	Location with 10 or fewer buildings intended for human occupancy.
Class 2	Location with more than 10 but less than 46 buildings intended for human occupancy.
Class 3	Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period.
Class 4	Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. Pipelines constructed on land in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil and 18 inches in consolidated rock.

Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require a minimum cover of 36 inches in normal soil and 24 inches in consolidated rock. Class locations also specify the maximum distance to a sectionalizing block valve (e.g., 10.0 miles in Class 1, 7.5 miles in Class 2, 4.0 miles in Class 3, and 2.5 miles in Class 4). Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, maximum allowable operating pressure, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. Preliminary class locations for the Logan Lateral Project have been developed based on the relationship of the pipeline centerline to other nearby structures and manmade features. The proposed project would be located within Class 1, 2, and 3 locations. Texas Eastern has indicated that it would construct the entire pipeline in accordance with the specifications for Class 3.

In 2002, Congress passed an act to strengthen the Nation's pipeline safety laws. The Pipeline Safety Improvement Act of 2002 (HR 3609) was passed by Congress on November 15, 2002, and signed into law by the President in December, 2002. No later than December 17, 2004, gas transmission operators must develop and follow a written integrity management program that contains all the elements described in §192.911 and addresses the risks on each covered transmission pipeline segment Specifically, the law establishes an integrity management program which applies to all high consequence areas (HCAs). The DOT (68 FR 69778, 69 FR 18228, and 69 FR 29903) defines HCAs as they relate to the different class zones, potential impact circles, or areas containing an identified site as defined in §192.903 of the DOT regulations.

OPS published a series of rules from August 6, 2002 to May 26, 2004 (69 Federal Register 29903), that defines HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate in 49 U.S.C. 60109 for OPS to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density population area.

The HCAs may be defined in one of two ways. In the first method an HCA includes

- current class 3 and 4 locations;
- any area in Class 1 or 2 where the potential impact radius[11] is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle[12]; or
- any area in Class 1 or 2 where the potential impact circle includes an identified site[13].

In the second method an HCA includes any area within a potential impact circle which contains

- 20 or more buildings intended for human occupancy; or
- an identified site.

[11] The potential impact radius is calculated as the product of 0.69 and the square root of the maximum allowable operating pressure of the pipeline in psi multiplied by the pipeline diameter in inches.

[12] The potential impact circle is a circle of radius equal to the potential impact radius.

[13] An identified site is an outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12-month period; a building that is occupied by 20 or more persons on at least 5 days a week for any 10 weeks in any 12-month period; or a facility that is occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate.

Once a pipeline operator has determined the HCAs on its pipeline, it must apply the elements of its integrity management program to those segments of the pipeline within HCAs. The DOT regulations specify the requirements for the integrity management plan at § 192.911.

Texas Eastern would identify HCAs once the pipeline design has been undertaken to determine the pipeline centerline with respect to other structures or identified sites. The pipeline integrity management rule for HCAs requires inspection of the entire pipeline in HCAs every 7 years.

Part 192 prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under section 192.615, each pipeline operator must also establish an emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency. Key elements of the plan include procedures for:

- receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response;
- emergency shutdown of system and safe restoration of service;
- making personnel, equipment, tools, and materials available at the scene of an emergency; and
- protecting people first and then property, and making them safe from actual or potential hazards.

Part 192 requires that each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Texas Eastern would provide the appropriate training to local emergency service personnel before the pipeline is placed in service. No additional specialized local fire protection equipment would be required to handle pipeline emergencies.

4.12.7.2 Pipeline Accident Data

Since February 9, 1970, 49 CFR Part 191 has required all operators of transmission and gathering systems to notify the DOT of any reportable incident and to submit a report on form F7100.2 within 20 days. Reportable incidents are defined as any leaks that:

- caused a death or personal injury requiring hospitalization;
- required taking any segment of transmission line out of service;
- resulted in gas ignition;
- caused estimated damage to the property of the operator, or others, or both, of a total of $5,000 or more;

- required immediate repair on a transmission line;
- occurred while testing with gas or another medium; or
- in the judgment of the operator was significant, even though it did not meet the above criteria.

The DOT changed reporting requirements after June 1984 to reduce the amount of data collected. Since that date, operators must only report incidents that involve property damage of more than $50,000, injury, death, release of gas, or that are otherwise considered significant by the operator. Table 4.12.7-1 presents a summary of incident data for the 1970 to 1984 period, as well as more recent incident data for 1986 through 2005, recognizing the difference in reporting requirements. The 14.5-year period from 1970 through June 1984, which provides a larger universe of data and more basic report information than subsequent years, has been subject to detailed analysis, as discussed in the following sections.[14]

TABLE 4.12.7-1

Natural Gas Service Incidents by Cause

Cause	Incidents per 1,000 miles of Pipeline (percentage)	
	1970-1984	1986-2005
Outside force	0.70 (53.8)	0.10 (38.5)
Corrosion	0.22 (16.9)	0.06 (23.1)
Construction or material defect	0.27 (20.8)	0.04 (15.4)
Other	0.11 (8.5)	0.06 (23.1)
Total	1.30	0.26

During the 14.5-year period, 5,862 service incidents were reported over the more than 300,000 total miles of natural gas transmission and gathering systems nationwide. Service incidents, defined as failures that occur during pipeline operation, have remained fairly constant over this period with no clear upward or downward trend in annual totals. In addition, 2,013 test failures were reported. Correction of test failures removed defects from the pipeline before operation.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 4.12.7-1 provides a percentage distribution of the causal factors as well as the annual frequency of each factor per 1,000 miles of pipeline in service.

The dominant incident cause is outside forces, constituting 53.8 percent of all service incidents. Outside forces incidents result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; weather effects such as winds, storms, and thermal strains; and willful damage. Table 4.12.7-2 shows that human error in equipment usage was responsible for approximately 75 percent of outside forces incidents. Since April 1982, operators have been required to participate in "One Call" public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines. The "One Call" program is a service used by public utilities and some private sector companies (e.g., oil pipelines and cable television) to provide preconstruction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts. The 1986 through 2005 data show that the portion of incidents caused by outside forces has decreased to 38.5 percent.

[14] Jones, D.J., G.S. Kramer, D.N. Gideon, and R.J. Eiber, 1986. "An Analysis of Reportable Incidents for Natural Gas Transportation and Gathering Lines 1970 Through June 1984." NG-18 Report No. 158, Pipeline Research Committee of the American Gas Association.

The pipelines included in the data set in table 4.12.7-1 vary widely in terms of age, pipe diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline.

TABLE 4.12.7-2

Outside Forces Incidents by Cause (1970-1984)

Cause	Percent
Equipment operated by outside party	67.1
Equipment operated by or for operator	7.3
Earth movement	13.3
Weather	10.8
Other	1.5

The frequency of service incidents is strongly dependent on pipeline age. While pipelines installed since 1950 exhibit a fairly constant level of service incident frequency, pipelines installed before that time have a significantly higher rate, partially due to corrosion. Older pipelines have a higher frequency of corrosion incidents, since corrosion is a time-dependent process. Further, new pipe generally uses more advanced coatings and cathodic protection to reduce corrosion potential.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, the older pipelines contain a disproportionate number of smaller diameter pipelines, which have a greater rate of outside forces incidents. Small diameter pipelines are more easily crushed or broken by mechanical equipment or earth movements.

Table 4.12.7-3 clearly demonstrates the effectiveness of corrosion control in reducing the incidence of failures caused by external corrosion. The use of both an external protective coating and a cathodic protection system, required on all pipelines installed after July 1971, significantly reduces the rate of failure compared to unprotected or partially protected pipe. The data shows that bare, cathodically protected pipe actually has a higher corrosion rate than unprotected pipe. This anomaly reflects the retrofitting of cathodic protection to actively corroding spots on pipes.

TABLE 4.12.7-3

External Corrosion by Level of Control (1970-1984)

Corrosion Control	Incidents per 1,000 miles per Year
None-bare pipe	0.42
Cathodic protection only	0.97
Coated only	0.40
Coated and cathodic protection	0.11

4.12.7.3 Impact on Public Safety

The service incident data summarized in table 4.12.7-1 include pipeline failures of all magnitudes with widely varying consequences. Approximately two-thirds of the incidents were classified as leaks, and the remaining third classified as ruptures, implying a more serious failure.

Table 4.12.7-4 presents the average annual fatalities that occurred on natural gas transmission and gathering lines from 1970 to 2005. Fatalities between 1970 and June 1984 have been separated into employees and nonemployees, to better identify a fatality rate experienced by the general public. Of the total 5.0 nationwide average, fatalities among the public averaged 2.6 per year over this period. The

simplified reporting requirements in effect after June 1984 do not differentiate between employees and nonemployees. However, the data show that the total annual average for the period 1984 through 2005 decreased to 3.6 fatalities per year. Subtracting two major offshore incidents in 1989, which do not reflect the risk to the onshore public, yields a total annual rate of 2.8 fatalities per year for this period.

TABLE 4.12.7-4

Annual Average Fatalities - Natural Gas Transmission and Gathering Systems a/, b/

Year	Employees	Nonemployees	Total
1970-June 1984	2.4	2.6	5.0
1984-2005 c/	-	-	3.6
1984-2005 c/	-	-	2.8 d/

a/ 1970 through June 1984 - American Gas Association, 1986.
b/ DOT Hazardous Materials Information System.
c/ Employee/nonemployee breakdown not available after June 1984.
d/ Without 18 offshore fatalities occurring in 1989 -- 11 fatalities resulted from a fishing vessel striking an offshore pipeline and 7 fatalities resulted from explosion on an offshore production platform.

The nationwide totals of accidental fatalities from various manmade and natural hazards are listed in table 4.12.7-5 in order to provide a relative measure of the industry-wide safety of natural gas pipelines. Direct comparisons between accident categories should be made cautiously, however, because individual exposures to hazards are not uniform among all categories. Nevertheless, the average 2.6 public fatalities per year is relatively small considering the more than 300,000 miles of transmission and gathering lines in service nationwide. Furthermore, the fatality rate is approximately two orders of magnitude (100 times) lower than the fatalities from natural hazards such as lightning, tornados, floods, earthquakes, etc.

TABLE 4.12.7-5

Nationwide Accidental Deaths a/

Type of Accident	Fatalities
All accidents	90,523
Motor vehicles	43,649
Falls	14,985
Drowning	3,488
Poisoning	9,510
Fires and burns	3,791
Suffocation by ingested object	3,206
Tornado, flood, earthquake, etc. (1984-93 average)	181
All liquid and gas pipelines (1978-87 average) b/	27
Gas transmission and gathering lines Nonemployees only (1970-84 average) c/	2.6

a/ All data, unless otherwise noted, reflects 1996 statistics from the U.S. Department of Commerce, Bureau of the Census, "Statistical Abstract of the United States 118th Edition."
b/ U.S. Department of Transportation, "Annual Report on Pipeline Safety - Calendar Year 1987."
c/ American Gas Association, 1986.

The available data show that natural gas pipelines continue to be a safe, reliable means of energy transportation. Based on approximately 301,000 miles in service, the rate of public fatalities for the nationwide mix of transmission and gathering lines in service is 0.01 per year per 1,000 miles of pipeline.

Using this rate, the Logan Lateral Project might result in a public fatality every 9,090 plus years. This would represent a slight increase in risk to the nearby public.

4.12.8 Additional Safety Issues Identified During Scoping

Gas Quality - Several commentors and interveners have raised LNG gas quality and interchangeability as a potential safety issue in the Crown Landing LNG Project. Crown Landing has not proposed to remove any of the heavier hydrocarbons such as ethane, butane, and propane that are present in untreated natural gas at various levels depending on the source. High amounts of the heavier hydrocarbons raise the Btu content of the natural gas. Also, the heavy hydrocarbons can potentially condense as liquids in pipelines and natural gas powered equipment causing malfunctions, reducing efficiency, or causing damage to the equipment. Crown Landing has proposed to add up to 4 percent nitrogen gas to reduce the Btu value, but has not designed gas treatment into its facility to remove the heavier hydrocarbons if present in higher quantities.

Typically, LNG suppliers do not treat the natural gas at the source to remove the heavier hydrocarbons prior to converting the gas to LNG. Crown Landing may mix LNG from different sources having varying quantities of the heavier hydrocarbons to reduce the overall heavy hydrocarbon content, although it has not specified its sources of LNG. Crown Landing has stated that it intends to comply with the gas quality provisions for each of the three pipelines it is planning to interconnect to its LNG terminal. The FERC will be considering this issue further as part of the proceedings in this project.

Previous Shipping Study – In December 1976, the FPC (FERC's predecessor) issued a Supplement to the Final Environmental Impact Statement for the Construction and Operation of an LNG Import Terminal at Raccoon Island Gloucester County, New Jersey. The study was performed at a time when the operating history of LNG vessels was very limited, and therefore was based on casualty statistics for petroleum tankers.

The knowledge and operating experience acquired during almost 30 years since the previous study shows a more accurate data set to extrapolate. During the last 40 years, LNG ships have made over 33,000 voyages around the world that has safely transported over 2.72 billion cubic meters of LNG. This includes over 1,500 voyages to or from United States ports. During the 33,000 voyages that have been completed since the inception of LNG maritime transportation, there have been only eight significant incidents involving LNG ships, none of which resulted in spills due to rupturing of the cargo tanks.

Additionally, in 1980, at the initial peak of LNG import activity in the United States, the Coast Guard published the report, *Liquefied Natural Gas and Liquefied Petroleum Gas – Views and Practices – Policy and Safety*. The report summarized the Coast Guard's extensive research into the safety hazards of LNG and its view that "...the nature of both LNG and LPG presents an acceptable risk for transportation in maritime commerce." This is due to the fact that LNG ships are well constructed, robust vessels designed to withstand low-energy type incidents that are prevalent in harbors and during docking operations. Moreover, safety measures, both equipment and training, are planned and designed into these LNG ships to prevent or control all types of potential incidents. Ship design and the operational restrictions placed on these vessels, as well as the waterways they transit are described in more detail in section 4.12.5.

The December 2004 Sandia Report estimated a range of cargo tank breach sizes for both credible accidental and intentional LNG spill events. The analysis of accidental events found that groundings and low speed collisions could result in minor ship damage but not a cargo spill; while high speed collisions with a large ship could cause a 0.5 to 1.5 square meter cargo tank breach area. The Coast Guard

requirements for one-way traffic and the moving safety and security zone around an LNG vessel will avoid the potential for a high speed collision with a large ship.

The operational restrictions to be imposed by the Delaware River Pilots on LNG vessel movements through the Delaware Bay and River, as well as the requirements that the Coast Guard would impose in its operating plan will minimize the possibility of a hazardous event occurring along the vessel transit.

Nuclear Power Plants / Risk – We received comments concerned with the proximity of the Salem 1 and 2 and Hope Creek Nuclear Power Plants to and the risks associated with LNG vessels transiting the Delaware River. The edge of the ship channel is about 6,000 feet (over 1 mile) from the power plants. In the vicinity of the power plants, the depth of water is about 30 feet outside the ship channel, thereby being too shallow for a 37-foot draft LNG vessel. The combination of distance and shallower water virtually eliminates impacts from accidental or intentional casualties of LNG vessels on the nuclear power plants.

Marcus Hook Anchorage – The COE is concerned with possible impacts from LNG vessel operations to the existing anchorage adjacent to the proposed slip. The anchorage is trapezoidal in shape with its longer edge running along the ship channel and its shorter edge running parallel to the New Jersey shoreline. The anchorage is about 0.43 mile wide with its channel side about 3.38 miles long and its shoreline side about 1.85 miles long. The overall area of the anchorage is about 720 acres. The southwestern diagonal edge leading from the shoreline side towards the channel lies just off the proposed LNG vessel slip and crosses between the slip and channel. LNG vessels would need to travel through the southwestern tip of the anchorage during docking/undocking maneuvers. In addition, possible Coast Guard safety/security zones around the slip and vessel may overlap a portion of the anchorage making it unavailable. Therefore, **we recommend that:**

- **<u>Prior to commencement of service</u>, Crown Landing should consult with the COE and Coast Guard regarding possible impacts to the Marcus Hook anchorage area from LNG vessel operations, and file the results of the consultations with the Secretary.**

4.12.9 Conclusions on Safety Issues

Much of the recent safety debate has centered on the perceived size of worst case scenarios; the distance to various thermal radiation heat levels for LNG fires; the range of potentially flammable vapors; and the population and infrastructure that are located within the various hazard areas. These are components of a consequence analysis.

However, the evaluation of safety is more than an exercise in calculating the consequences of worst case scenarios. Rather, safety is a determination of the acceptability of risk which considers: 1) the probability of events; 2) the effect of mitigation; and 3) the consequences of events.

<u>*Accidental Causes*</u> - Based on the extensive operational experience of LNG shipping, the structural design of an LNG vessel, and the operational controls imposed by the Coast Guard and the local pilots, the likelihood of a cargo containment failure and subsequent LNG spill from a vessel casualty – collision, grounding, or allision – is highly unlikely. For similar reasons, an accident involving the onshore LNG import terminal from the terminal is unlikely to affect the public. As a result, the risk to the public from accidental causes should be considered negligible.

<u>*Intentional Attacks*</u> - Unlike accidental causes, historical experience provides little guidance in estimating the probability of a terrorist attack on an LNG vessel or onshore storage facility. For a

new LNG import terminal proposal, having a large volume of energy transported and stored near populated areas, the perceived threat of a terrorist attack may be considered as highly probable to the local population.

However, at the national level, potential terrorist targets are plentiful, many having national significance, while others with a large concentration of the public (major sporting events, skyscrapers, etc.) or critical infrastructure facilities. Currently, the United States has over 500 chemical facilities operating near large populations. U.S. waterways also transport over 100,000 annual shipments of hazardous marine cargo, including LPG, ammonia, and other volatile chemicals. Many of these substances pose a similar hazard to that of LNG.

Risk Management - While the risks associated with the transportation of any hazardous cargo can never be entirely eliminated, they can be managed. For potential targets where the threat is perceived to be high, resources can be directed to mitigate possible attack paths. Such efforts may deter potential attacks on one target, but shift efforts to those that are less protected. As a result, the issue is how to best direct finite resources.

For the proposed project, it may be possible to apply risk management resources to manage realistic threats; however, an even greater level of resources may be required to manage the threats as perceived at the local level. The issue for the decision makers is whether the resources required to manage the risks are justified by the benefits, while recognizing that the risks cannot be entirely eliminated.

4.13 CUMULATIVE IMPACTS

Cumulative impact results when impacts associated with a proposed project are superimposed on, or added to, impacts associated with past, present, or reasonably foreseeable future projects within the area affected by the proposed project. Although the individual impacts of the separate projects may be minor, the effects from the projects taken together could be significant.

Existing environmental conditions in the project area have been influenced by human industry, activities, and development, which have permanently altered the natural ecosystems within the Delaware River watershed.

Table 4.13-1 provides a list of other past, present, or reasonably foreseeable future projects or activities that have impacted or may cumulatively impact resources that would be affected by construction and operation of the Crown Landing LNG and Logan Lateral Projects. These projects and activities include primarily those located in the vicinity of the proposed projects. More distant projects are not assessed because these projects generally do not have regional effects and, therefore, do not contribute significantly to cumulative impacts in the proposed project area. Potential impacts associated with the projects that are most likely to be cumulatively significant are related to aquatic resources, upland or wetland vegetation, infrastructure and public services, vehicular traffic, ship traffic, land use, and air quality and noise. Cumulative impacts that could be most directly associated with the Crown Landing LNG and Logan Lateral Projects are discussed below.

Aquatic Resources

The Delaware River aquatic ecosystem is made up of a variety of habitats including open water, soft bottoms, tidal flats, subtidal shallows, and rocky shores. The fish community within the Delaware River system includes estuarine species and coastal migrant fishes such as striped bass. The river system also provides habitat to various benthic organisms (both epifauna and infauna), including snails, amphipods, and polychaete worms.

The COE began maintaining the federal navigation channel within the Delaware River in 1896 and has maintained the river at the current depth of 40 feet since World War II to allow the safe passage of commercial and recreational boat traffic from Delaware Bay to Philadelphia. Dredging of the ship channel, marinas, and ship berths as well as associated coastal developments (e.g., piers, marinas, waterfront structures) have altered habitats within the Delaware River.

Historically, the Delaware River has been affected by various water quality problems. In the late 1970s, the COE described the water quality of the river as poor. Since that time water quality in the river has improved, although the proposed project area still does not support all of its designated uses. The impairment of water quality within the river comes from both point and non-point sources of pollution. Point sources of pollution include air deposition and industrial and municipal point sources. Non-point sources of pollution include runoff from agricultural, residential, commercial, and industrial areas. Regardless of the source, the introduction of pollutants continues to have a variety of ecosystem impacts. The presences of some pollutants create potential human health risks primarily through the consumption of contaminated seafood. Nitrogen introduced into the Delaware River can result in excessive plant growth (algal blooms). When the algae die, they are decomposed by bacteria that consume dissolved oxygen, which can suffocate fish and other organisms. Bacterial nitrification of ammonia discharged by wastewater treatment facilities can also deplete waters of dissolved oxygen.

TABLE 4.13-1

Past, Present, and Future Projects That Could Cumulatively Impact Resources of Concern Near the Crown Landing LNG and Logan Lateral Projects

		Primary Environmental Impact						
Activity/Project	Description	Aquatic Resources	Vegetation	Public Services	Vehicular Traffic	Ship Traffic	Land Use	Air Quality/Noise
Past and Present Activities/Projects								
Residential/Commercial Developments	Various developments and redevelopments in Delaware County, PA and Gloucester County, NJ.	✓	✓	✓	✓	✓	✓	✓
Commercial/Recreational Fishing	Historically, commercial fishing occurred in the Delaware River and currently some recreational fishing does occur in the river.	✓				✓		
Regional Stormwater and Sewer Systems	Stormwater outfalls discharge rainwater and sewage to the Delaware River system.	✓						
Commercial Development	The Wharf on the Boardwalk development planned near MP 4.5 of the Logan Lateral route.			✓	✓	✓	✓	✓
Maintenance Dredging	The ship channel, marinas, and industrial ship berths are periodically dredged to maintain navigational depth.	✓	✓			✓		✓
Fast Food Restaurant	Kentucky Fried Chicken restaurant planned along Edgemont Avenue adjacent to Texas Eastern's existing right-of-way.		✓	✓	✓		✓	
Proposed Activities/Projects								
Residential Development	Proposed development approximately 2 miles northeast of the LNG terminal site.		✓	✓	✓		✓	
Proposed Senior Home/Active Adult Community Development	Development planned for approximately 1,000 feet northwest of Texas Eastern's Chester Junction.		✓	✓	✓		✓	
Proposed Office Building	A 10,000 square foot office building is planned between Williamson Avenue and Edgemont Avenue in Chester, PA.			✓	✓		✓	
Business Park	Business park with nine buildings planned in Chester Township north of Concord Road encompassing 68 acres.			✓	✓		✓	
School Expansion	Chester Charter School plans an expansion of an existing unused facility on Green Avenue in Chester Township.			✓	✓		✓	
Equestrian Park	The Gloucester County Improvement Authority is planning the conversion of a dredge spoil area to an equestrian park south of Raccoon Creek and west of U.S. Route 130.	✓	✓	✓	✓		✓	

TABLE 4.13-1 (cont'd)

Past, Present, and Future Projects That Could Cumulatively Impact Resources of Concern Near the Crown Landing LNG and Logan Lateral Projects

		Primary Environmental Impact						
Activity/Project	Description	Aquatic Resources	Vegetation	Public Services	Vehicular Traffic	Ship Traffic	Land Use	Air Quality/Noise
Mercer County Airport Expansion	Mercer County has proposed a new 44,000 square foot terminal building for Trenton-Mercer Airport as well as multiple taxiway enlargements, parking facilities, road realignment, and an equipment storage building.		✓	✓	✓		✓	✓
Runway 17-35 Extension Project	Planned extension of Runway 17-35 at Philadelphia Airport.		✓		✓		✓	✓
Capacity Enhancement Program	Planned airfield redevelopment project at Philadelphia Airport.				✓		✓	✓
Delaware River Main Channel Deepening Project	The COE is planning to deepen the main channel of the Delaware River and to use portions of Raccoon Island for dredge disposal.	✓	✓			✓	✓	
Marine Terminal Logistics Distribution Center	Gloucester County Improvement Authority proposes to dredge 10 acres of nearshore habitat in the Delaware River near Paulsboro, NJ.	✓	✓			✓		
Future Road or City Street Projects	None currently documented			✓	✓			

In the foreseeable future, there will likely be other projects or activities such as the COE's proposed Delaware River Main Channel Deepening Project and the Gloucester County Improvement Authority's proposed Marine Terminal Logistics Distribution Center in Paulsboro, New Jersey that could result in additional stresses on the aquatic resources of the Delaware River. Construction of the Crown Landing LNG Project would also contribute to the adverse affects on surface water quality and biological resources within the Delaware River (see sections 4.3.2 and 4.6.2).

Specific project activities during construction and operation such as dredging, the clearing of vegetation, the grading of disturbed soils, and prop wash associated with LNG ships and/or tugs could result in a variety of impacts on aquatic resources, including:

- the loss of shallow water habitats;
- increased water turbidity and resuspension of sediments;
- surface runoff/erosion;
- disturbance to benthic substrates; and
- potential spills of hazardous substances.

Crown Landing and Texas Eastern would minimize the potential for these impacts by complying with our recommendations, the mitigation measures contained in our Plan and Procedures, and the measures proposed in their project-specific SESC Plans and onshore and offshore SPCC Plans. As discussed in section 4.6, Crown Landing would also implement specific mitigation in accordance with our recommendation to compensate for the loss of shallow water habitat. This mitigation would minimize the effect of the project on shallow water habitat and ensure that the project does not contribute to the decline of this specific habitat type in the Delaware River system.

Nevertheless, the Crown Landing LNG Project could contribute to cumulative impacts on water quality and aquatic organisms when considered in relation to past, present, and reasonably foreseeable impacts on the Delaware River, particularly if dredging occurs at the same time as other significant dredging projects (e.g., Delaware River Main Channel Deepening Project). However, we believe these impacts would primarily be short term and/or minor and would be effectively minimized through implementation of appropriate mitigation measures, including adherence to time-of-year dredging restrictions.

In comments on the draft EIS, several agencies expressed concern about the potential for long-term cumulative effects from the loss of ichthyoplankton through regular intakes of large volumes of water for ballast water along with other facilities currently withdrawing water from the Delaware River. As presented in section 4.6.2, water withdrawals for the Crown Landing LNG Project are expected to result in the loss of about 1.2 million age-1 fish annually (all species combined). Existing facilities along the Delaware River are currently estimated to be withdrawing ichthyoplankton equivalent to over 630 million age-1 fish annually. Thus, although the additional source of mortality from the proposed LNG terminal would in fact add to the losses currently occurring within the Delaware River system, estimated impacts on fishery resources from the Crown Landing LNG Project are equivalent to about 0.2 percent of the losses already occurring on the river at existing facilities. This additional source of mortality is not expected to result in population level effects on existing fishery resources.

Vegetation and Wildlife

When projects are constructed at or near the same time, the combined construction activities would have a cumulative impact on vegetation and wildlife living in the immediate area. Right-of-way clearing and grading and other construction activities associated with the Crown Landing LNG and Logan Lateral Projects along with other construction projects would result in the removal of vegetation,

alteration of wildlife habitat, displacement of wildlife, and could have other secondary effects in the project area such as increased population stress, predation, and establishment of invasive plant species. These impacts would be greatest where other projects are constructed within the same time frame and areas as the proposed facilities. Additional vegetation clearing along existing rights-of-way (electric transmission, pipeline, or railroad) can have the additive effect of creating cleared corridors of significant widths.

Construction of the proposed LNG terminal and pipeline facilities would result in the removal of vegetation and wildlife habitat, which would contribute to the cumulative impact on these resources. However, the net cumulative effect of the project on these resources would be small. Crown Landing would reduce impacts on vegetation and wildlife by locating the terminal facilities within mostly agricultural fields, which would reduce tree clearing and the long-term alteration of habitats. Crown Landing is also working with the NJDEP to develop appropriate mitigation for the habitat impacts of the project. Cumulative impacts of the pipeline on vegetation and wildlife would be reduced by Texas Eastern's proposal to locate much of the Logan Lateral within or adjacent to other existing rights-of-way or disturbed areas, which would minimize the creation of a new utility corridor (see section 4.8.1.2), and would restore the construction right-of-way to preconstruction conditions. Texas Eastern would install the pipeline across Chester Creek, Baldwin Run, Delaware River, Raccoon Creek, and Birch Creek using HDD techniques, which would minimize the clearing of riparian vegetation. Texas Eastern has also indicated that it would provide mitigation to compensate for wetland impacts.

Threatened and Endangered Species

In comments on the draft EIS, NOAA Fisheries expressed concern about the addition of vessel traffic in the vicinity of Delaware Bay and within the EEZ outside of the bay increasing the risk of vessel strikes of endangered species with specific concern regarding the North Atlantic right whale. The project could add up to 150 ships annually to the existing vessel traffic using Delaware Bay and River. This would be a minor addition to the number of vessels currently using these areas and through implementation of the appropriate conservation measures, the additional vessels are not expected to increase the frequency of vessel strikes on whales in the area.

Shortnose sturgeon could be adversely affected by several activities associated with construction and operation of the proposed LNG terminal. Some of these activities (e.g., dredging, water withdrawals) currently occur regularly in other locations in the vicinity of the project area, and may affect individual sturgeon. The proposed project could result in additional cumulative impact; however, it is unlikely that the effects of the proposed project, when added to the existing disturbances in the river, would jeopardize the population of shortnose sturgeon in the Delaware River system.

Infrastructure and Public Services

The cumulative impact of the Crown Landing LNG and Logan Lateral Projects and other projects on infrastructure and public services would depend on the number of projects under construction at one time and the specific services required for each project. The small incremental demands of several projects occurring at the same time could become difficult for police, fire, and emergency service personnel to address. This problem would be temporary and occur only for the length of construction. The operation of the proposed LNG terminal and associated facilities is not expected to have a major impact on public services since it would not result in the construction of new public roads, extensive new sewer or water systems, or significant changes in local population levels.

There is, however, a concern that an incident at the LNG terminal could exceed the current response capacity of the local fire and police departments. Although the specific details regarding the

role of the police and fire departments in the event of an incident are not available at this time, Crown Landing would coordinate with local fire departments to develop an emergency response plan to be used in the event of an incident at the LNG terminal. In addition, Crown Landing would have its own fire-fighting equipment at the facility, which would reduce the potential demand of the project on local emergency services. See section 4.12 for additional discussion of fire and public safety impacts and Crown Landing's liaison program with the area emergency response departments.

Vehicular Traffic

As discussed in section 4.9.4.1, construction and operation of the LNG terminal would increase traffic on local roads. Construction activities at the LNG terminal site are estimated to generate about 650 vehicle trips per day related to construction employees (based on the peak workforce of up to 650 workers traveling to and from the site during LNG terminal construction and dredging activities). Additionally, 20 vehicle trips per day related to construction equipment and materials delivery (including concrete) are anticipated during a normal day, with a peak of 100 trips a day during construction months 2 through 6 for the delivery of fill material. The workers and delivery vehicles would access the site via U.S. Route 130 and would also use Center Square Road within the Pureland Industrial Complex. Crown Landing has indicated that it is evaluating two mitigative measures to minimize traffic impacts during construction: 1) increase the length of the left turn lane on U.S. Route 130 into the entrance road to accommodate larger trucks and/or multiple cars; and 2) install a temporary traffic signal at the intersection of U.S. Route 130 and the entrance road to be used during peak construction periods. The increased traffic levels would be temporary and limited to the period of construction (about 3 years) and would be minimized by implementation of the mitigative measures discussed above.

During operation of the LNG terminal, up to 60 employee vehicle trips are estimated per day during average operating conditions, which would represent an increase in the existing road traffic. However, the anticipated traffic volume resulting from operation of the LNG terminal, even when considered in terms of projected future traffic volumes and in relation to reasonably foreseeable future projects, would not significantly increase the existing traffic volumes on local area roadways.

According to the NJDOT, no capital improvement projects are proposed along U.S. Route 130 adjacent to the proposed LNG facility through the year 2007. Planned and current projects along U.S. Route 130 are located more than 5 miles from the construction site. Some of these NJDOT projects could impact the daily commute of construction workers to and from the site or could be affected by the increased traffic from construction of the LNG terminal.

The Pennsylvania Department of Transportation (PADOT) currently has one project ongoing through early 2006 in the proposed project area of the Logan Lateral Project. However, construction activities, consisting of widening U.S. Route 291 to five lanes, are limited to the portion north of the Commodore Barry Bridge, approximately 3 miles from where the proposed pipeline crosses U.S. Route 291. Additionally, the future widening of U.S. Route 322, which crosses the Delaware River via the Commodore Barry Bridge is not scheduled to begin until 2008, following the scheduled completion of construction of the Logan Lateral Project. Therefore, since overlap of proposed PADOT projects and the proposed Logan Lateral Project is not likely, cumulative impacts on traffic patterns and flow are not expected.

There is potential for cumulative traffic impacts if other projects such as road improvements or in-street utility projects are scheduled to take place at the same time and in the same area as the proposed LNG and pipeline facilities. Currently, we are not aware of any other planned road improvement or utility projects that would cumulatively add to construction traffic associated with the proposed project. Moreover, several factors would minimize the potential for cumulative traffic impacts, including the area

over which the proposed project is spread and the tendency for construction workers to frequently share rides and travel to and from work during off-peak hours. The pipeline would be installed by boring beneath many of the paved roads, which would minimize impacts on traffic. Where roads must be open cut, Texas Eastern would attempt to keep at least one lane of traffic open. All open-cut road crossings would be completed as quickly possible. During the brief period when a trench is completely excavated across the road, steel plates would be available onsite to cover the open area to permit travel by emergency vehicles. Traffic lanes and home access would be maintained except for the temporary periods essential for laying the pipeline. Texas Eastern would also implement appropriate control measures such as detouring traffic where possible, signage, and flashing lights.

Due to the number of road crossings and amount of in-street work proposed along the proposed pipeline route, some traffic congestion on city streets is likely during construction. This effect, however, would be temporary and localized to the immediate construction area. Where the pipeline would be installed within or adjacent to city streets, Texas Eastern would generally use the stovepipe or drag section construction methods to minimize traffic-related impacts. Pipeline trenches in or adjacent to these streets would be backfilled or covered with steel plates daily. Impacts on local traffic would be temporary and limited to the period of construction.

Ship Traffic

Currently, commercial ship traffic entering the Delaware River averages about 3,000 ships annually. The Crown Landing LNG Project would result in one additional vessel entering the Delaware River every 2 to 3 days (an additional 100 to 150 ships per year). This would be a small addition in terms of existing ship traffic. However, security zones around LNG ships may constrain vessel movements within the Delaware River temporarily during LNG ship transits (see sections 4.9.4.2 and 4.12.5). The Delaware River Pilots manage marine traffic on the Delaware Bay and River and may be able to manage marine traffic through scheduling to minimize the impacts of the moving safety zone around the LNG ships on other marine traffic.

Land Use

There are a variety of reasonably foreseeable residential, commercial, industrial, and transportation projects in the vicinity of the proposed LNG terminal and pipeline facilities (see table 4.13-1). Although the Crown Landing LNG Project would affect existing land uses in the area, the project site is zoned for industrial use and the proposed facilities would be consistent with current land use plans and zoning ordinances. Consequently, the immediate cumulative land use effects of the project have already been considered during development of local and regional land use plans and zoning ordinances.

Air Quality/Noise

Construction of the proposed projects and some of the reasonably foreseeable projects and activities listed in table 4.13-1 would involve the use of heavy equipment that produces noise, air contaminants, and dust. Operation of the proposed LNG facility would also contribute cumulatively to air emissions and noise in the project area.

Over the long term, the proposed LNG terminal and pipeline facilities would not contribute significantly to current air pollution levels. Although the LNG terminal would emit NO_2, CO, SO_2, $PM_{10}/PM_{2.5}$, VOC, and Pb, the proposed terminal would not be a major source of air emissions under the PSD regulations (see section 4.11.1). The LNG terminal would however be subject to the nonattainment NSR regulations because emissions of NO_x and VOC associated with operation would be more than 25 tpy (see section 4.11.1) major source thresholds. The CO and NO_x emissions from the facility would be

minimized by the application of emission controls necessary to meet the NJDEP SOTA requirements. In addition, Crown Landing would need to demonstrate that the project would not have a negative effect on the local air quality. This could be done through SIP provisions, obtaining NO_x offsets, and/or dispersion modeling. NO_x and VOCs emissions from the proposed LNG terminal would contribute to regional ozone concentrations. However, these emissions would be small in comparison to the total NO_x and VOCs emitted by existing sources in the area (e.g., power plants, vehicle emissions) and the emissions anticipated from new sources. For example, the NJDEP NO_x emission budget for the 2004 ozone season included 820 tons for new source growth in the area and a budget of 6,970 tons for existing sources.

Natural gas is a relatively clean and efficient form of energy compared to other fossil fuels. By burning natural gas rather than other fossil fuels such as coal or fuel oil, it could be possible to reduce the emissions of regulated pollutants (e.g., NO_x, SO_2, and PM_{10}) or unregulated greenhouse gases (e.g., CO_2). As such, it is possible that the Crown Landing LNG and Logan Lateral Projects could cumulatively improve air quality in the region by providing a competitively priced source of natural gas that could replace the dirtier forms of energy that are currently being used.

Additional noise produced during construction of the Crown Landing LNG and Logan Lateral Projects and other projects could create short-term annoyances to nearby residences. These noise impacts would be localized and would attenuate quickly as the distance from the noise source increases. Therefore, cumulative noise impacts associated with construction would be unlikely unless one or more of the projects occur at the same time and close proximity. The operational noise generated by the LNG facility would have a predicted noise increase of approximately 0.4 dBA at the nearest residence. Such a noise increase is not perceptible by the human ear.

Reliability and Safety

Impacts on reliability and public safety would be mitigated through the implementation of applicable federal, state, and local rules and regulations for each individual project. The specific rules and regulations that apply to each individual project would ensure that the applicable design standards are implemented to protect the public and to prevent accidents and failures. The LNG terminal facilities would be sited, designed, constructed, operated, and maintained in compliance with the federal safety standards summarized in table 2.13-1. The pipelines and aboveground facilities associated with the Crown Landing LNG and Logan Lateral Projects would be designed, constructed, operated, and maintained in accordance with DOT Minimum Federal Safety Standards in Title 49 CFR Part 192.

Several of the present or reasonably foreseeable future projects, including the proposed project, would involve cargo terminals that could be expected to ship hazardous materials. Accidents involving such materials represent a potential impact on public safety. Continued growth in international commerce is likely to result in increased quantities of hazardous materials being shipped to and from the region.

It is difficult to evaluate the cumulative risk that such growth represents or has represented. In addition, it is difficult to measure the cumulative risk for an intentional attack on the Port or the LNG facility. The addition of the LNG facility and its associated LNG ships would not significantly change the risk of an intentional attack in the Delaware Bay or River. It is reasonable to assume that the rate of ship accidents (including those involving the release of hazardous materials) is likely to rise with more vessel traffic, which could cumulatively increase the risk of an accident having an impact on public safety. As previously discussed, the Delaware River Pilots manage vessel traffic to insure safe transit in the Delaware Bay and River. The Coast Guard would also enforce a moving safety zone and moored vessel security zone around LNG ships. These and other operational controls by the Coast Guard and Pilots Association for the Bay and River Delaware would minimize the risk of accidents involving LNG ships. Furthermore, the implementation of federal, state, and local rules and regulations concerning security and

the results of the WSA with its associated operations and Emergency Response Plan would minimize the risk to the LNG ship and terminal.

Emergency response time is a key aspect of public health and safety. Projects that increase traffic congestion or interfere with access are the most likely source of adverse impacts on response times. The projects identified in table 4.12-1 are not expected to cause an increase in response times for emergency services. The Traffic Management Plans to be developed by Texas Eastern would also minimize any increase in emergency response times. No significant cumulative impacts on emergency services are expected because sufficient emergency services and facilities exist in the area to accommodate the cumulative projects. No significant cumulative impacts on emergency services are expected during operation of the proposed project. Section 4.12.5 includes our recommendation that Crown Landing prepare an Emergency Response Plan and coordinate procedures with local emergency planning groups fire departments, state and local law enforcement, the Coast Guard, and other appropriate federal agencies to be used in the event of an incident. Crown Landing would be required to prepare a comprehensive plan that identifies the cost sharing mechanisms for funding these emergency response costs. With the implementation of the coordination procedures in the Emergency Response Plan and the funding of additional emergency management equipment and personnel, no cumulative impacts would be expected on emergency response services during operation of the proposed project.