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Non-Internet Public

Figure 4.11.2-1
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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. 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.

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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

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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.**

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4.12 RELIABILITY AND SAFETY

The operation of the proposed LNG terminal poses a unique 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. 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.

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. As a result, **we recommend that:**

- **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); and**

  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.**

[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."

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Crown Landing should file this review with the Secretary for review and written approval by the Director of OEP prior to construction.

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 (-260° 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 (-296° 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, 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

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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 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 facility design and construction details should be filed with the Secretary for review and approval by the Director of OEP either: prior to initial site construction;**

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prior to construction after final design; prior to commissioning; or prior to commencement of service as indicated by each specific recommendation.

- 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 prior to initial site construction.

- An evaluation of the relief and flare systems should be made and filed prior to initial site construction.

- A complete plan and list of the hazard detection equipment should be filed prior to initial site construction. 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 prior to initial site construction. 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 prior to initial site construction.

- 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 details of the LNG flow measurement system provided for the top and bottom fill to 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 ESD 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,

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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 a discretionary vent for each tank, to be operated through the DCS.

- 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 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 busting 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 recover boil-off gas, under all conditions, in the event that the send out vaporization system is not in operation.

- 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.

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- **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 for prior to and during LNG vessel unloading should be filed prior to commissioning.**

- **Operation and Maintenance procedures and manuals, as well as emergency plans, emergency evacuation plan and safety procedure manuals, should be filed prior to commissioning.**

- **Copies of the Coast Guard security plan, vessel operation plan, and emergency response 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, 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,**

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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

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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

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- 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) and other publications which are reproduced and/or summarized below for information purposes. Some of the terminology is new to the Unites States; e.g. the terms "double containment" and "full containment" are not used in any U.S. code or standard associated with LNG facilities.

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.2 Spherical storage tank

A spherical single containment system consists of an unstiffened sphere supported at the equator by a vertical cylinder. The cylinder is monolitically connected to the tank by a profile in the tank wall. Both sphere and outer shell are normally made of aluminum alloy.

For spherical onshore tanks, the lower part of the support cylinder is made of concrete and the tank is protected by a domed concrete cover (roof). The land application is shown in Figure H-2.

An aboveground spherical tank shall be surrounded by a dike wall to contain any leakage.

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.

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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 1 or 2 meters distance 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.

H.5 Membrane tank

A membrane tank should be designed and constructed so that the primary container, constituted by a membrane, is capable of containing both the liquefied gas and its vapor under normal operating conditions and the concrete secondary container, which supports primary container, should be capable of containing all the liquefied gas stored in the primary container and of controlled venting of the vapor resulting from product leakage of the inner tank.

The vapor of the primary container is contained by a steel roof liner which forms with the membrane an integral gastight containment. The action of the liquefied gas acting on the primary container (the metal membrane) is transferred directly to the pre-stressed concrete secondary container through the load bearing insulation. Examples of membrane tanks are given in Figure H.5

H.6 Cryogenic concrete tank

A cryogenic concrete tank is either a double containment tank (see H.3) or a full containment tank (see H.4). For this type of tank, the walls of the primary and secondary containers are both constructed of pre-stressed concrete. Examples of cryogenic concrete tanks are given in Figure H.6.

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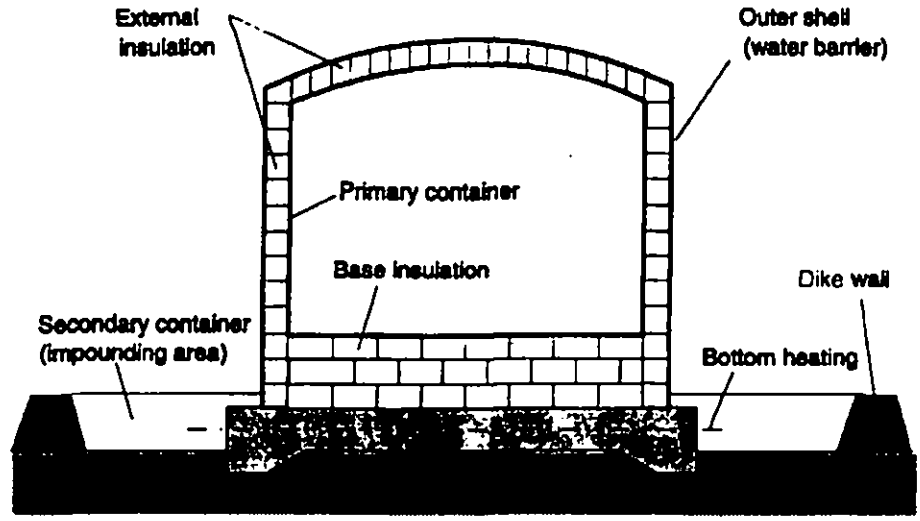

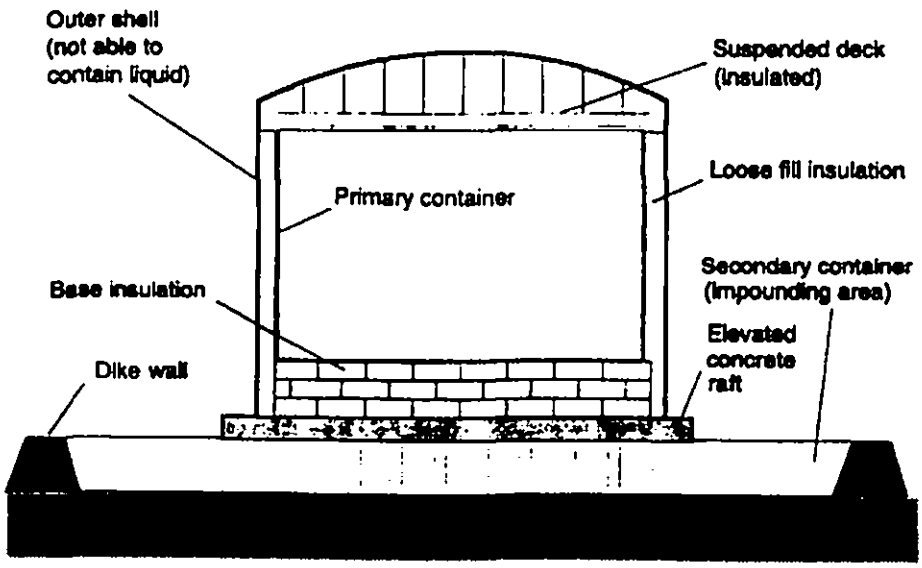

Figure H.1 Examples of single containment tanks

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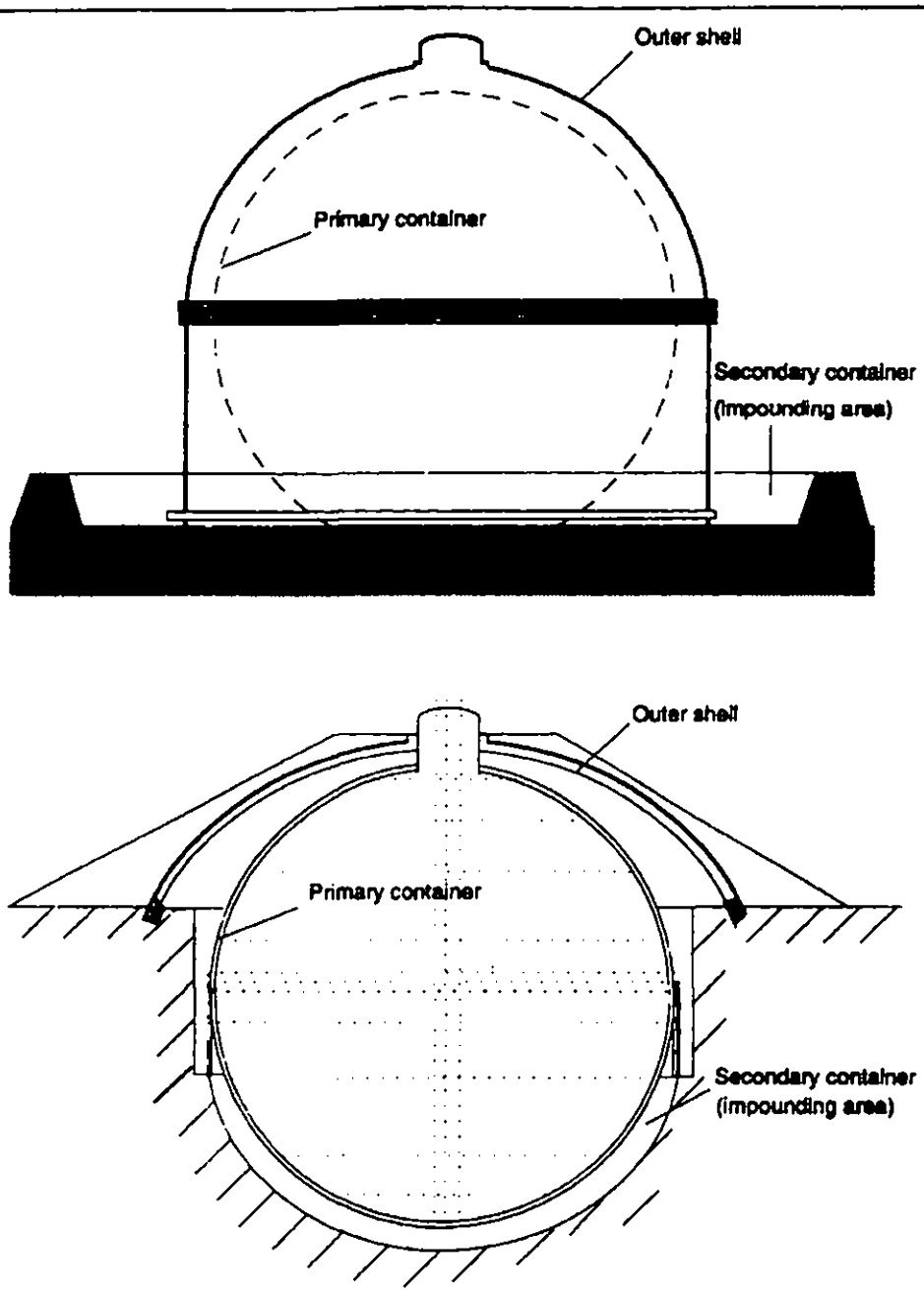

Figure H.2 Examples of spherical storage tanks

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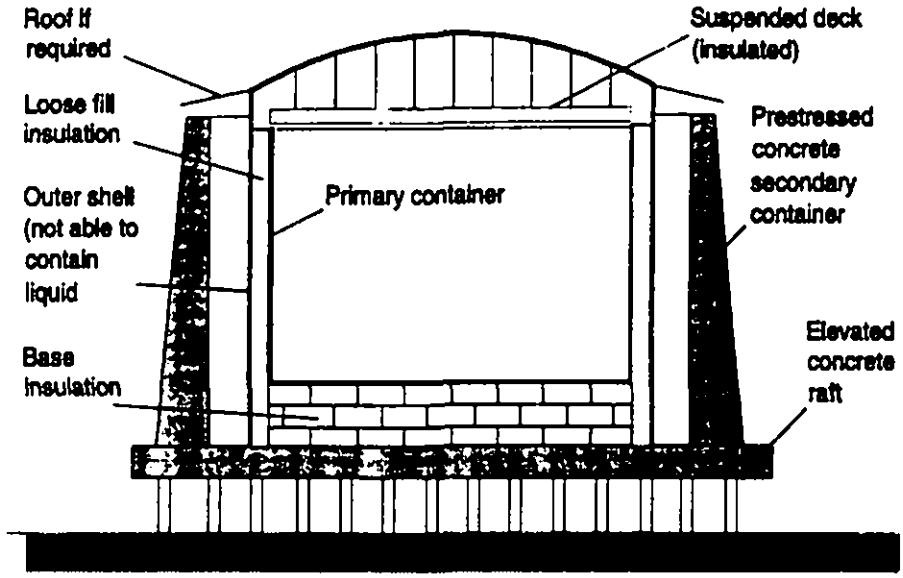

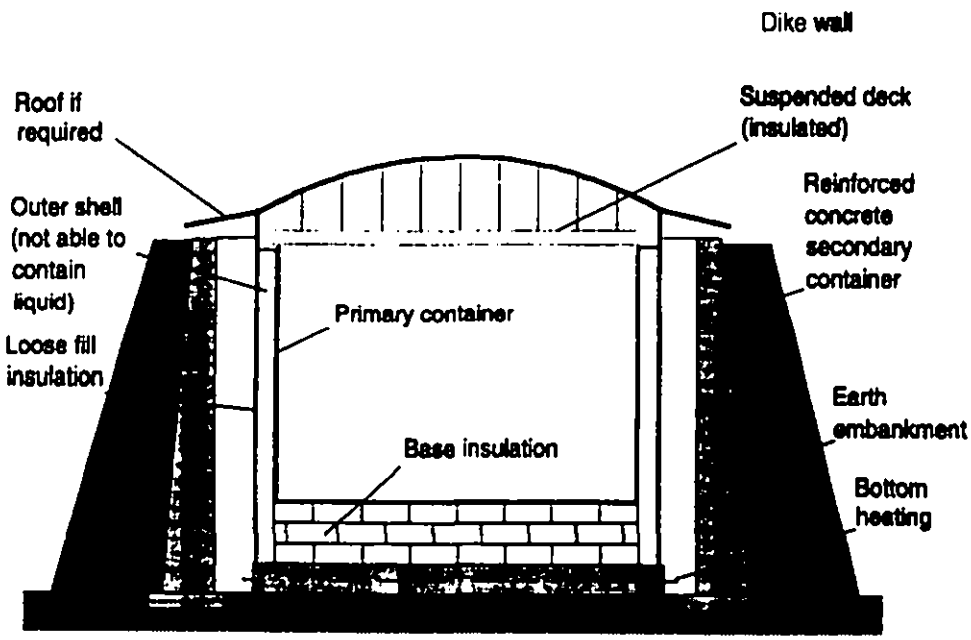

Figure H.3 Examples of double containment tanks

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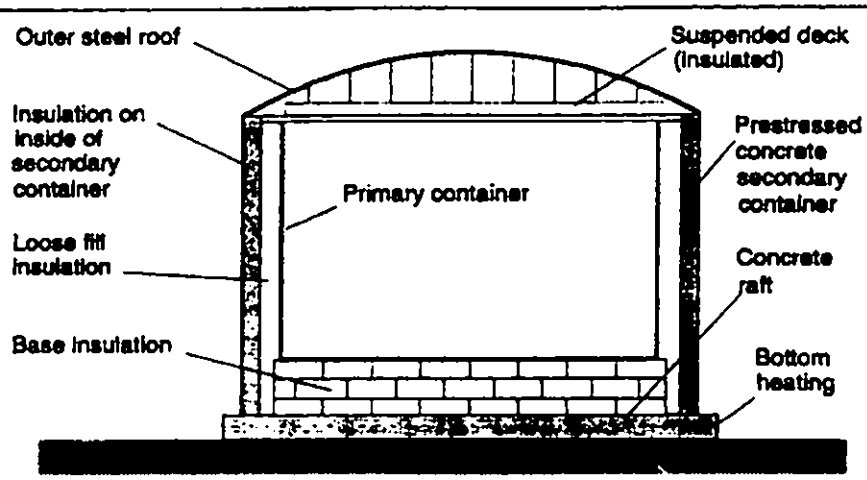

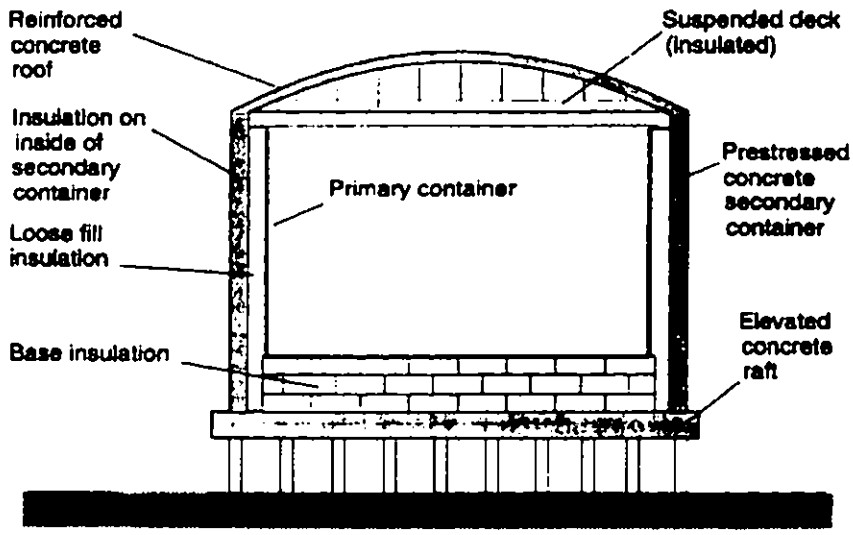

Figure H.4 Examples of full containment tanks

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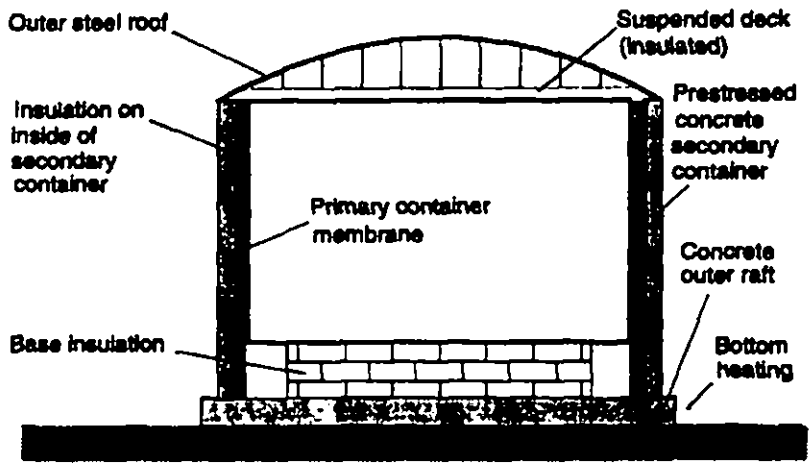

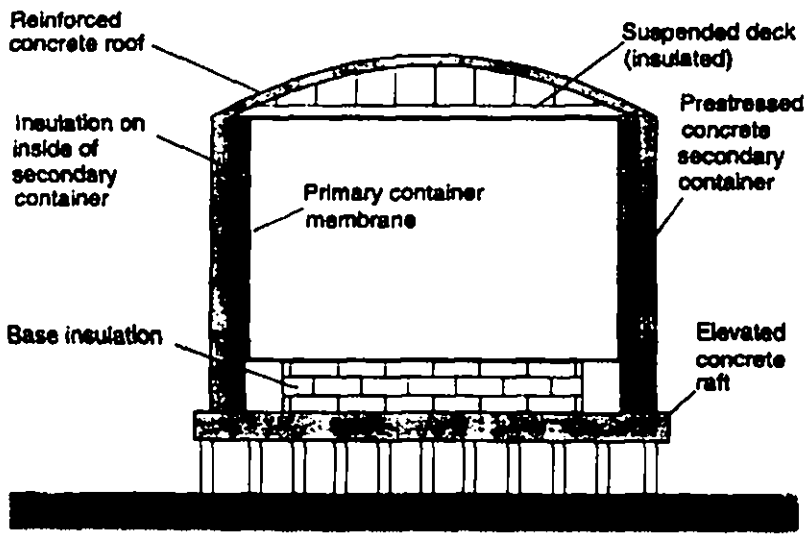

Figure H.5 Examples of membrane tanks

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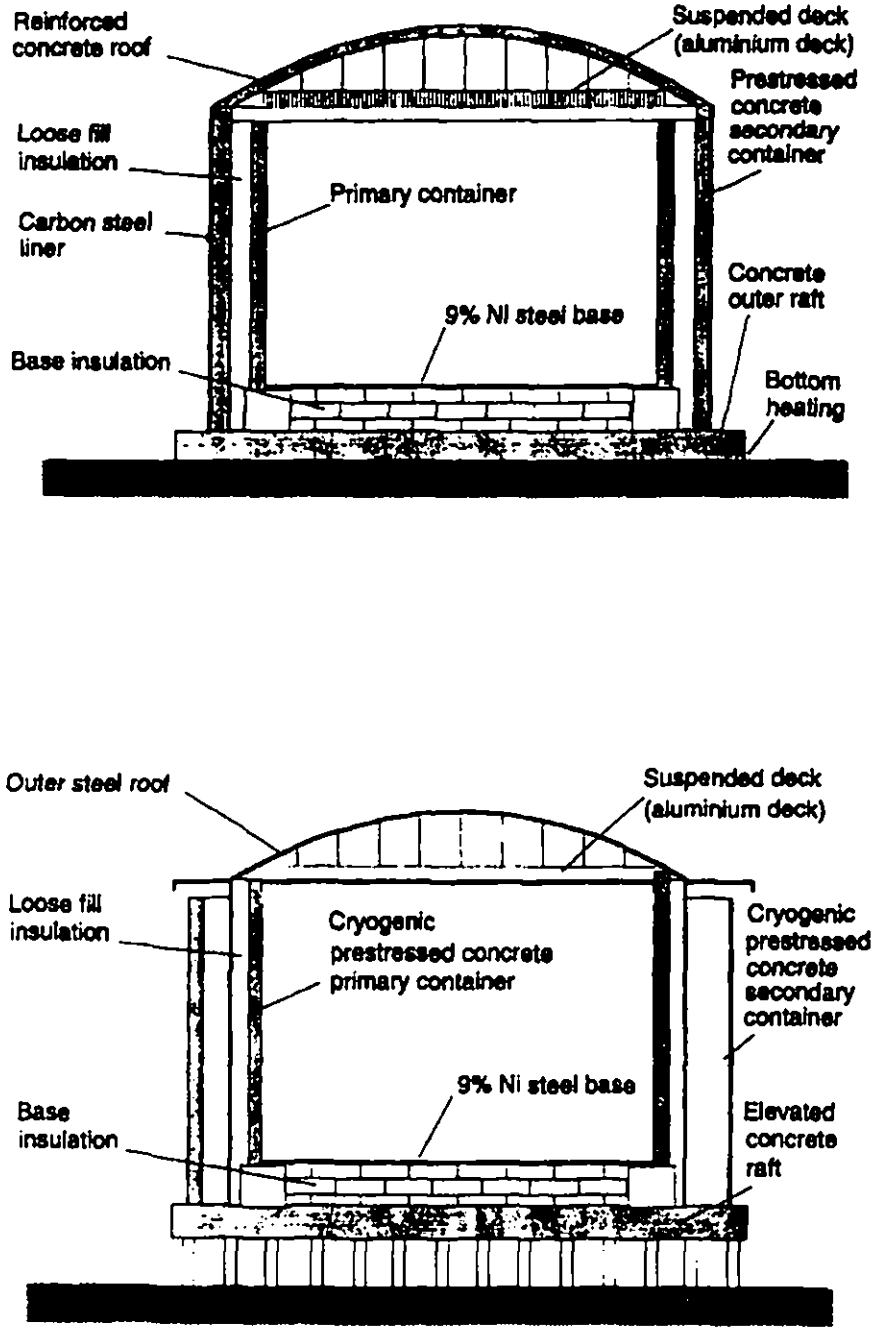

Figure H.6 Examples of cryogenic concrete tanks

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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. Although construction of full-containment tanks has not yet started in the United States, approximately 50 have been constructed world wide. 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 Office of Pipeline Safety (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.

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 193.2173. This barrier would confine LNG on the project property in the event of any hypothetical catastrophic event.

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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 5,579,717 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

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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. 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 246 feet high at the apex. The volumetric capacity of 6,250,696 ft^3 (177,000 m^3) would exceed the 110 percent requirement by 670,978 cubic feet (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 70,200,000 ft^3.

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,

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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 113,335 gallons after accounting for increased flow due to the line break. This spill would be contained in the LNG 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 each tank impoundment is the 44-inch-diameter transfer line from the marine unloading berths. The piping for the marine cargo transfer system would be contained within an impoundment trough that is sloped to a collection 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 171.2 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 process area sump to the northeast, located approximately midway between the process area and the earthen berms and inside the unloading line sump. This process area sump is 32 feet wide by 32 feet long, with a depth of 4 feet. The process area sump would have a capacity of 30,640 gallons. The design spill for the vaporizers and sendout pumps would be 21,992 gallons, a 10-minute spill of the full flow rate from a broken 1-inch-diameter pipe downstream from the booster pumps. The process area sump would accommodate this spill.

Table 4.12.4-1 presents the design spill rates and impounding areas that are used in subsequent calculations of thermal radiation and flammable vapor-gas dispersion exclusion zones.

TABLE 4.12.4-1

Impoundment Areas for LNG Spills

Source	Design Spill Size (gallons)	Impoundment System	Impoundment Size (gallons)
LNG Storage Tank	41,739,184	LNG Full Containment Dike	46,758,453
In-tank LNG Pumps	131,335	Tank Header Sump	154,600
Marine Transfer Line (44-inch line)	1,098,087	Unloading Line Sump	1,133,276
Marine Transfer Spill (1-inch line)	4,300	Dock Area Sump	4,308
Sendout Pumps and Vaporizers	18,900	Process Area Sump	30,640

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 on the both the process area and the dock area sumps.

NFPA 59A establishes certain atmospheric conditions (0 miles per hour (mph) windpseed, 70° F, and 50 percent relative humidity) which are to be used in calculating the distances. However, Part

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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: windspeed of 27 mph; ambient temperature of 18° F; and 30 percent relative humidity. These conditions yield longer distances than the 0 mph wind speed, 70° F ambient temperature, and 50 percent relative humidity specified in NFPA 59A.

The application for the proposed LNG terminal contained a thermal radiation analysis for a 10-minute design spill into the process area sump within the sub-impoundment. Crown Landing selected design spills based on an accidental release from a broken 1-inch-diameter pipe downstream of the high-pressure sendout pumps. The design spill sizes, flowing at full capacity for 10 minutes, for this accidental release would be 21,992 gallons.

However, staff performed a preliminary evaluation of any 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, and determined that a design spill from the 2-inch-diameter line downstream from the LNG booster pumps would be a more appropriate credible single accidental leakage source. However, because of Crown Landing's sump design, this accidental leakage source is still contained with the sump system. This 2-inch-diameter line leak would overflow the process area sump, but would be contained within the tank header sump.

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 full impoundment area surrounding the tank. Thermal radiation distances were also determined for 1,600 to 10,000 Btu/ft^2-hr incident flux levels centered on the both the process area and the dock area sumps.

Table 4.12.4-2 presents the calculated maximum distances for incident flux levels ranging from 1,600 to 10,000 Btu/ft^2-hr as calculated by FERC staff.

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)
Process area sump	Property line that can be built upon.	1,600	133
Dock area sump	Property line that can be built upon.	1,600	62
LNG storage tank impoundment	Outdoor assembly area occupied by 50 or more people.	1,600	428
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	933

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.

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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 the property line from a design spill into each tank impoundment. In this case, compliance with section 2.2.3.3 would also meet the requirements of section 2.2.3.4 of NFPA 59A.

According to table 2.2.3.5 of NFPA 59A, the design spill is the largest flow from the container (i.e., storage tank) withdrawal pumps for a 10-minute duration at full rated capacity. The design spill would therefore be a rupture of the 18-inch-diameter tank withdrawal line. The total amount of volume of LNG lost in the spill would be 17,557 ft^3. Assuming complete vaporization, the resulting vapor cloud would be totally contained within the earthen berm surrounding the LNG storage tank area. Therefore, the LNG tank impoundments are in compliance with 49 CFR 193.2059 by considering the provisions for containing vapors under section 2.2.3.2 of NFPA 59A.

Crown Landing's application contained a vapor dispersion analysis for the process area sump and dock area sump. An average regional temperature of 85° F, 50 percent relative humidity, and 4.5 mph wind speed were used as input conditions.

The process area sump would receive spills from the vaporizer and sendout pump area. In its application, Crown Landing selected a 1-inch-diameter pipe downstream from the booster pump as its design spill. For an accidental line break of the 1-inch-diameter line, the total volume of LNG lost would be 2,940 ft^3. Assuming complete vaporization, the volume of gas would overflow the process area sump but would still be contained by the earthen berm surrounding the LNG storage tank area.

As previously discussed, FERC staff finds that a design spill from the 2-inch-diameter pipe downstream from the LNG booster pumps would be a more appropriate credible single accidental leakage source. Based on the Crane flow through orifices formulas supplied by Crown Landing in their application, the total flow out of this source would be 9,802 ft^3. Using the same a cold vapor to liquid volumetric ratio of 1:235 as Crown Landing did, staff calculated that 2,303,470 ft^3 of cold vapor would result from the vaporization of the high-pressure sendout pump withdrawal through the 2-inch-diameter line. This vapor, however, would still be contained within the earthen berm surrounding the LNG storage tank area.

Crown Landing also modeled vapor dispersion using a flange gasket failure on the shore/pier line as the design spill. The largest diameter line on the flange is a 4-inch-diameter line. The mass flow of LNG from this leak is 5.97 pounds per second (lb/s). Using SOURCE5, FERC staff calculated a source strength of 0.44 kg/s with a pool radius of 1.12 meters. Using DEGADIS, FERC staff calculated a vapor

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cloud 22 meters wide and a distance of 60 meters from the center of the sump resulting in a vapor exclusion zone of 210 feet.

Although these impoundments technically comply with 49 CFR 193.2059, the issue of the lengthy distance from potential spill locations to the process and dock area 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 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 construction</u>.**

4.12.5 Marine Safety[8]

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 4.12.5.3). 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[9] 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.

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[8] This section was written with the cooperation and assistance of the U.S. Coast Guard, Marine Safety Office, Group Philadelphia.

[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.

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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 the LNG ship voyage from the liquefaction facility to the import terminal, disclosing the risks at each step and how they are 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:

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- 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.

LNG ships would access the proposed LNG terminal via the 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 just downstream of the Delaware Memorial Bridge. From this location, a docking pilot and tractor tug would escort the LNG ships up the Delaware River to the Marcus Hook anchorage area, where two additional tractor tugs would join the escort for docking at the proposed unloading facility.

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Non-Internet Public

Figure 4.12.5-1
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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. When leaving the berth, the bow of the LNG ship would be moved forward into the turning basin while the tugs rotate the stern to line the ship up for the exit down the Delaware River.

In addition to the Delaware River Pilots, the Coast Guard would control the transit of the LNG vessel through the harbor 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 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 requirements may include: establishment of a moving safety and security zone around the vessel while en route and 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 will be the responsibility of the facility in cooperation with other federal, state, and local agencies as described in the Facility Security Plans (see section 4.12.6).

LNG Vessel Casualties

The operational controls by the Coast Guard and the Delaware River pilots, as well as the characteristics of Delaware Bay and River, minimize the possibility of an LNG cargo spill from groundings, collisions, and allisions. The Coast Guard would enforce a moving safety and security 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 4.12.5.3). The deepwater federal navigation channel extends approximately 70 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. The navigation channel has been authorized to be deepened to 45 feet but the channel deepening project has yet to be conducted.

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 is the responsibility of the owner/operator and the master of the vessel. Security of the LNG facility is 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. The Coast Guard would establish a safety and security zone around the LNG vessels in transit and 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 prepared under 33 CFR Part 105 and approved by the Coast Guard Captain of the Port (see section 4.12.6). Some of the requirements 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;

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- 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 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:**

- **Crown Landing coordinate 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 terminal.**

A detailed evaluation of the consequences of a terrorist attack on a modern membrane LNG vessel was prepared by Lloyds Register of North America for the Weaver's Cove LNG project (see section 4.12.5.4). This analysis provides a basis for estimating the potential magnitude of a hazard from a successful terrorist attack, and for developing LNG vessel and waterfront facility security plans. In addition, the DOE released a study by Sandia National Laboratories, *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 m^2 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 m^2. In most cases, an intentional breaching scenario would not result in a nominal hole of more than 5 to 7 m^2, which is a more appropriate range to use in calculating potential hazards from spills.

The methodology described in the ABSG Consulting Inc. (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 diameter hole to range from 4,495 feet for a thermal radiation of 1,600 Btu/ft^2-hr, the level which is hazardous for persons located outdoors and unprotected, to 3,463 feet for 3,000 Btu/ft^2-hr, an acceptable level for wooden structures; and to 2,060 feet for 10,000 Btu/ft^2-hr, a level sufficient to damage process equipment for these size holes respectively.

These estimates of an average most probable "worst case" scenario provide guidance in developing the operating restrictions for LNG vessel movements through Delaware Bay and the federal

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navigation channel in the Delaware River, as well as in establishing potential impact areas for emergency response and evacuation planning. The transit within the navigation channel would pass by Delaware City, New Castle, Wilmington, and Claymont, Delaware and Pennsville and Penns Grove, New Jersey. 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 at approximately 11 knots, the adjacent communities would be exposed to a potential transient hazard for an estimated 8 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. The operational restrictions to 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 operating plan 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 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..." Typically, the manuals are prepared at the later stages of the construction process and submitted to the FERC as a requirement prior to placing the facility in service.

While the worst-case scenarios evaluated for the onshore facility in section 4.12.3 and for marine spills in 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. While recognizing that preparing emergency procedures typically occurs at the end of the construction phase rather than at the draft EIS stage, there remain a number of issues concerning the viability of emergency evacuation that have not been satisfactorily resolved. Therefore **we recommend that:**

- **Crown Landing develop emergency evacuation routes for the areas along the route of the LNG vessel transit in conjunction with the local emergency and town officials and file the routes with the Secretary for review and approval by the Director of OEP prior to construction.**

In addition, **we recommend that:**

- **Crown Landing develop an Emergency Response Plan (including evacuation) and coordinate procedures with 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;**

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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 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 approval by the Director of OEP prior to commencement of service. Crown Landing should notify FERC staff of all meetings in advance and should report progress on its Emergency Response Plan at 6-month intervals starting at the commencement of construction.

Federal Oversight

Three federal agencies share in the oversight of the safety and security of LNG import terminals: the Coast Guard, the Research and Special Programs Administration of 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. 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.

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 .

One pilot would direct the LNG ship throughout the entire 67 nautical-mile transit of Delaware Bay and River to the LNG terminal site. The LNG ships would enter the channel during a rising tide to

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ensure sufficient water depth for safe navigation. A tug would make fast to the LNG ship to aid in passage beneath the Delaware Memorial Bridge. Once the LNG ship arrives at Marcus Hook, two additional tractor tugs would escort the ship to the LNG terminal.

The three tugs would maneuver the LNG ship to the dock and assist with berthing. After the LNG is offloaded, the ship would 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. At least one tug would 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 and would 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). The majority (approximately 80 percent) of the vessels transiting to the Port of Philadelphia are 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 180 ships each year. This number of additional ships is approximately double the current number of deep draft coal ships delivering to the Logan Pier at Marcus Hook. However, even taking into account the proposed project's anticipated shipping activity, impacts on current ship traffic is expected to be minimal (see section 4.9.4.2).

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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 would enter the bay and river at high tide, as is currently the case with all deep draft vessels transiting the river.

- *Tugs* - LNG ships delivering cargo to the proposed terminal would have tug support from 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. It is anticipated that at a minimum, the regulations currently affecting vessels carrying dangerous cargoes within the Delaware River and Bay would also apply to LNG ships.

- *Reduced Visibility* – The Delaware Bay and River experiences fog mostly during spring and fall months. Vessels are not allowed transit during times when visibility is, or is expected to be, 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 given the small number of ships annually.

- *Pilotage* – 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 at the Delaware Memorial Bridge to navigate the ship upriver to the LNG terminal berth as well as navigate the ship back down river upon departure.

Additional navigational safety measures may be necessary for LNG ships based on results of a risk assessment currently being conducted by the Coast Guard.

4.12.5.2 Requirements for LNG Ship Operations

The arrival, transit, cargo transfer, and departure of LNG ships in the Delaware River would adhere to the procedures of an Operations and Emergency Manuals to be developed by Crown Landing in consultation with the Coast Guard Marine Safety Office, Group Philadelphia. These procedures would be developed to ensure the safety and security of all operations associated with LNG ship transit and unloading. The manuals 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

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Guard inspection and monitoring activities, and emergency operations. The Coast Guard Marine Safety Office, Group Philadelphia would monitor each LNG ship in accordance with these manuals.

Some of the anticipated key provisions of the manuals would be the establishment of a moving safety and/or security zone for all inbound, outbound, and moored LNG ships; the use of tugs to assist in the Delaware River and to maneuver the ship into the berth; and one tug to remain with the LNG ship while it is moored at the berth. Additional provisions may be necessary based on the results of the Coast Guard risk assessment.

The Coast Guard regulations 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 Manuals to the Captain of the Port - Group Philadelphia.

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).

In accordance with 33 CFR 127.007, Crown Landing submitted a Letter of Intent to the Coast Guard on July 30, 2004. On December 3, 2004, the Coast Guard issued a notice in the Federal Register, requesting comments on the maritime operation and waterways management aspects of the proposed LNG facility. The Coast Guard held a public meeting on January 11, 2005, which was attended by about 80 people. The Coast Guard's comment period ended on January 18, 2005. The Coast Guard is currently conducting a risk assessment to analyze navigation and waterway safety issues related to this project. Upon completion of their review, the Coast Guard will issue a Letter of Recommendation to address the suitability of the Delaware Bay and River for LNG transport with respect to the following items:

- Density and character of marine traffic;
- Locks, bridges, or other manmade obstruction;
- Depth of water;
- Tidal range;
- Protection from high seas;
- Underwater pipes and cables; and
- Distance of berthed vessels from the channel.

While the Letter of Recommendation 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 or exclusion zones would be addressed later in the development of the Coast Guard's LNG Incident Action Plan. This plan would be developed in conjunction with state and local law enforcement and emergency response communities. In addition, the

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Coast Guard would establish a safety and/or 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 the safety zone.

Impact of Vessel and Facility Security Requirements

Measures that the Coast Guard may apply to ensure the safety and security of LNG vessels in the Delaware Bay and River will be determined after a series of Coast Guard sponsored workshops are held to seek the input of port stakeholders from federal, state, local, and commercial sectors. The workshops will provide the basis for developing measures to responsibly manage the risks associated with LNG traffic. These measures complement the Maritime Transportation Security Act regulations enacted on July 1, 2004. The Coast Guard will then identify protocols to mitigate specific risks and create an Incident Action Plan, which will become the basis for appropriate security measures for each Maritime Security threat level. Although the specific requirements will not be defined until this process is complete, which is anticipated prior to the issuance of the final EIS for the Crown Landing LNG project, general requirements that may be applied can be evaluated for the potential impact on other users of the waterway and on the adjacent shoreside public.

Based on the Coast Guard's experience in controlling the movements of LPG vessels in Delaware Bay and River and LNG vessels in other ports, potential impacts can be evaluated for several general security requirements: (1) moving safety and security zones for inbound and outbound LNG vessels; (2) safety and security zones around a moored LNG vessel; and (3) other measures as deemed appropriate. Crown Landing's proposed 150 cargo deliveries per year would average about 2 to 3 per week for each inbound and outbound transit.

Applying a moving safety and security zone similar to that imposed on LPG vessels would restrict other vessels 1,000 yards ahead and behind, and 500 yards on either side of the LNG vessel. The Captain of the Port currently places these restrictions on all vessels carrying dangerous cargoes, which also applies to LNG vessels, by regulation in 33 CFR 165.510. The LNG vessels would transit the majority of the 67-nautical-mile transit from the Delaware Bay entrance, through the Delaware River to the LNG terminal at average speeds of 10.5 to 11 knots. Crown Landing anticipates that a tug would be made up to an LNG vessel at the Delaware Memorial Bridge at RM 60. Two additional tugs would be made fast as the LNG vessel approaches the LNG terminal to assist maneuvering and berthing. A 5.5-hour transit time through the Delaware Bay and River is imposed by the pilots for inbound deep draft vessels that call on Marcus Hook Berths. It is assumed that LNG vessels would have a similar transit time to the proposed Crown Landing LNG terminal.

The Coast Guard may establish safety/security zones around the Crown Landing's LNG terminal, one when an LNG vessel is docked and another when no vessel is present. There is currently a 100 yard zone for moored or anchored vessels carrying dangerous cargo (33 CFR 165.510). The Delaware River is over 3,800 feet wide at this point, allowing the passage of commercial or recreational vessels around the safety/security zone to or from upstream docks.

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 not be assumed that bridge closures would be used. Other alternatives to a complete bridge closure include closing the outboard lanes only, placing law enforcement

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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.

The moving safety and security zone, the safety and security zone at the terminal, and one-way traffic 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 and security zone may have the effect of temporarily limiting some commercial shipping routes 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 these waterways 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, as many as 120 to 180 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 Delaware Bay and River Traffic Study 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 security zones imposed by the Coast Guard as LNG ships transit the Delaware Bay and River, particularly if the width of the security 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, the security zone would be a moving zone around the ship, so these impacts would be temporary and of short duration at

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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 the security zone. To mitigate the impacts of security zones, 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 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 safety and 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 and security zone has the greatest potential to encompass the majority of the waterway width. For an LNG vessel in transit at 10 knots, recreational craft attempting to travel in the opposite direction at one of the narrow locations may need to wait up to 16 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 Delaware River in this location is about 3,100 feet wide. Recreational vessels should have ample room to pass by or have only minor delays.

The development of safety and security plans for the project has been initiated by Crown Landing and the Coast Guard. The safety and security plan development process has been divided into three sub-processes: (1) a Port and Waterway Safety Assessment Workshop (2) a Security Workshop; and (3) a Consequence Management Workshop. The results of these three workshops will facilitate the development of Operations and Emergency Manuals which the facility operator is required to submit to the Coast Guard, as well as an LNG Operations Plan which covers operational safety, security, and consequence management issues for the project and communities located along the vessel transit route.

Once these plans are finalized and the resources required to implement them have been identified, Crown Landing will be able to more specifically discuss the funding of such resources. In order to better define the potential burden on the local communities, **we recommend that:**

- **Crown Landing provide a plan identifying the mechanisms for funding project-specific security/emergency management costs that will be imposed on federal and state agencies and local communities. Crown Landing should file the plan with the Secretary no later than the comment period of the draft EIS so that the information can be included in the final EIS.**

4.12.5.3 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 450 cargoes, with volumes ranging from 60,000 to 125,000 m^3, have been delivered into the Port of Boston without incident. During 2003, a total of 506 billion cubic feet (204 cargoes) of LNG was imported into the United States. For 30 years, LNG shipping operations have been safely conducted in the United States.

The world's LNG ship fleet numbers 151, with an additional 57 ships contracted for delivery by 2006. During the last 40 years, LNG ships have made over 33,000 voyages and safely transported over

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2.72 billion cubic meters of LNG. This includes over 1,500 voyages to or from United States ports. 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 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. These 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.

- ***Mostafa Ben Boulaid*** had a check valve fail when unloading at Cove Point, Maryland, in April, 1979, releasing a small quantity of LNG onto the ship and causing some minor fracture of the deck plating. Activation of the ship's safety systems (i.e., the emergency shutdown system and water spray system), along with excellent response of the crew, kept the incident from propagating, thus minimizing any serious damage.

- ***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 Libra's*** propeller shaft fractured while the ship was en route to Japan with a full cargo in October 1980. The ship was taken under tow, and the cargo was safely transferred to another LNG ship and delivered to its 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.

- ***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.

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There have also been some incidents that involved the release of small quantities of LNG, such as minor leaks from seals and gaskets, some of which required that operations be temporarily stopped in order to rectify the malfunction.

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. Accordingly, the regulations require the use of special crack-arresting steel in strategic locations throughout the vessel's hull. 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.

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The previous FPC study estimated the additional protection afforded by the double-hull would be effective in low energy collisions, 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.

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 this case, an LNG spill would rapidly vaporize on 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.

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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.

During the past year, 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 Consultants 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. The revised methodology 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 Critical Energy Infrastructure Information (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

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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.

In December 2004, the DOE released a study by Sandia National Laboratories, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water* (Sandia Report). 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 m^2 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 m^2. In most cases, an intentional breaching scenario would not result in a nominal hole of more than 5 to 7 m^2, 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) (6,300 to 6,825 feet), but will increase the expected fire duration. Rapid phase transitions 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 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 18° 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	2.5 meters	3.0 meters	3.9 meters
Hole area	0.8 $meter^2$	5 $meters^2$	7 $meters^2$	12 $meters^2$
Spill time	94 minutes	15 minutes	10.4 minutes	6.2 minutes
Pool Fire Calculations				
Maximum pool radius	340 feet	816 feet	939 feet	1,102 feet
Fire duration	94 minutes	15 minutes	10.7 minutes	6.5 minutes
Distance to:				
1,600 Btu/ft^2-hr	2,267 feet	4,495 feet	5,020 feet	5,691 feet
3,000 Btu/ft^2-hr	1,767 feet	3,463 feet	3,861 feet	4,370 feet
10,000 Btu/ft^2-hr	1,083 feet	2,060 feet	2,286 feet	2,578 feet

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Flammable vapor dispersion calculations were based on an ambient temperature of 49 °F, 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 10,128 feet to the lower flammability limit and 13,677 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 without ignition. 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.

As mentioned previously, the LNG ships would pass by several communities along the ship route and some areas of development along the shoreline in these communities could be within a potential hazard area during the LNG ship transit. However, the adjacent communities would be exposed to a potential hazard for an estimated 8 minutes. In addition, a temporary hazard would exist around the ship unloading facility during the period when the ship is offloading LNG.

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 average most probable "worst case" scenario 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 estimated average most probable "worst case" 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).

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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 establishes 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;

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- 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 Research and Special Programs Administration's (RSPA), 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

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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.

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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.

Congress recently 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[10] is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle[11]; or
- any area in Class 1 or 2 where the potential impact circle includes an identified site[12].

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.

[10] 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.

[11] The potential impact circle is a circle of radius equal to the potential impact radius.

[12] 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.

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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.

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;

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- 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 2003, 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.[13]

TABLE 4.12.7-1

Natural Gas Service Incidents by Cause

Cause	Incidents per 1,000 miles of Pipeline (percentage)	
	1970-1984	1986-2003
Outside force	0.70 (53.8)	0.10 (38.4)
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 2003 data show that the portion of incidents caused by outside forces has decreased to 38.4 percent.

[13] 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.

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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 2003. 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

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nonemployees. However, the data show that the total annual average for the period 1984 through 2003 decreased to 3.8 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 2.9 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
1984-2003 c/	-	-	3.8
1984-2003 c/	-	-	2.9 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.

The available data show that natural gas pipelines continue to be a safe, reliable means of energy transportation. Based on approximately 306,000 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.

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 116th Edition."
b/ U.S. Department of Transportation, "Annual Report on Pipeline Safety - Calendar Year 1987."
c/ American Gas Association, 1986.

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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.

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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:**

- **Crown Landing consult with the COE and Coast Guard regarding possible impacts to the Marcus Hook anchorage area from LNG vessel operations.**

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.

Accidental Causes - 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 or LNG trucking from the terminal is unlikely to affect the public. As a result, the risk to the public from accidental causes should be considered negligible.

Intentional Attacks - 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.

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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.

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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.

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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. Expected to be completed fall 2004.			✓	✓	✓	✓	✓
Maintenance Dredging	The ship channel, marinas, and industrial ship berths are periodically dredged to maintain navigational depth.	✓	✓			✓		✓
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.			✓	✓		✓	
Fast Food Restaurant	Kentucky Fried Chicken restaurant planned along Edgemont Avenue adjacent to Texas Eastern's existing right-of-way.		✓	✓	✓		✓	
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.	✓	✓	✓	✓		✓	

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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			✓	✓			

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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.

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.

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

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would restore the construction right-of-way to preconstruction conditions. Texas Eastern would install the pipeline across Chester Creek, 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.

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 New Jersey Department of Transportation (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

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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 December of 2005 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. 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 120 to 180 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 section 4.12.5).

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.

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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 for CO only (see section 4.11.1). The LNG terminal would however be subject to the nonattainment NSR regulations because emissions associated with operation would be less than 25 tpy (see section 4.11.1). 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 obtain NO_x emission offsets or demonstrate that the project would not have a negative effect on the local air quality. This could be done through SIP provisions 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.

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5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF THE STAFF'S ENVIRONMENTAL ANALYSIS

The conclusions presented are those of the environmental staff of the FERC. The Coast Guard will present, in its Letter of Recommendation and LNG Operations Plan, its own conclusions and recommendations, prior to construction and operation. The Letter of Recommendation will address the suitability of the Delaware River for LNG ship transportation, and the Coast Guard's LNG Operations Plan will address issues related to the public impact of safety or security zones for LNG vessels. Likewise, the COE will present its own conclusions and recommendations in the dredging and wetland permits it may issue pursuant to section 10 of the River and Harbors Act and section 404 of the CWA. The EPA has the authority to review and veto the COE decisions on the section 404 permits.

We (the Commission's staff) have determined that, with the use of Crown Landing's and Texas Eastern's proposed mitigation and the addition of our recommended mitigation measures, construction and operation of the Crown Landing LNG and Logan Lateral Projects would result in limited adverse environmental impacts. Our conclusions are based on information provided by Crown Landing and Texas Eastern, and data developed from data requests; field investigations by Commission staff; literature search; alternative analyses; comments from federal, state, and local agencies; and input from public groups and individual citizens. The impacts discussed in section 4 and summarized below would be most significant during the construction period. As part of our review, we developed mitigation measures we believe would appropriately and reasonably avoid or minimize environmental impacts resulting from construction and operation of the proposed project. We are, therefore, recommending that our mitigation measures be attached as conditions to any authorization issued by the Commission.

The discussion below summarizes the environmental impacts and the proposed or recommended mitigation for each resource analyzed in this draft EIS.

Geology

Construction and operation of the proposed projects would have minimal impact on geologic and paleontologic resources in the area, and the potential for geologic hazards or other natural events to significantly impact the projects is low.

Analysis of existing geologic materials at the LNG terminal site determined that, without foundation improvement, excessive settlement would occur beneath the proposed LNG tanks and process area. To address this concern, the LNG tanks would be constructed on deep piles which would be driven to suitable soils at an approximate depth of 100 feet below the ground surface. Preliminary foundation designs for the process equipment area include mat foundations in conjunction with surcharging and piles. Crown Landing would conduct additional field tests to finalize foundation designs for the LNG tanks and other heavy loads at the site. However, 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. Preliminary engineering analysis also indicates that the stability of slopes to be created at the site can be ensured by implementing sound engineering and construction practices.

The likelihood of a major earthquake occurring in the project area during the operating life of the LNG facility is low. To mitigate the risk of damage from an earthquake, the LNG tanks would be constructed in a manner to allow for safe shutdown during an earthquake with a recurrence interval of 10,000 years, rather than 5,000 years as required by NFPA 59A. Seismically induced soil liquefaction is not expected to occur at the LNG terminal site; however, the installation of deep pile foundations beneath

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the LNG tanks and other heavy loads would further reduce any potential for liquefaction to affect those structures. Seismic hazards do not pose a significant risk to the proposed Logan Lateral Project.

The proposed LNG terminal site could be subject to flooding by tropical storm surge or high rainfall events. To mitigate this risk, most of the LNG terminal structures would be constructed on a finished grade at or above the 1,000-year flood elevation for the site. While the base of the proposed LNG tanks would be at an elevation below the 1,000-year flood elevation, the top of the earthen containment dike, which would completely surround the LNG tanks, would be approximately 6 feet above the 1,000-year flood elevation. Potential effects associated with high rainfall events during construction activities would be mitigated by implementing our Plan and Procedures and site-specific SESC Plans prepared by Crown Landing and Texas Eastern.

Soils and Sediments

Soils at the proposed LNG terminal site consist largely of dredged material that was placed onsite during dredging of the Delaware River, primarily between the 1930s and 1960s (USDA, 1962). The remaining soils on the LNG terminal site include loamy sands, sandy loam, and tidal marsh. None of the soils on the LNG terminal site are classified as prime farmland. Laboratory analyses of soils from the LNG terminal site indicate elevated concentrations of TPH, SVOCs, arsenic, and dieldrin in a few isolated areas. Only TPH and a single SVOC compound (benzo(a)pyrene) are substantially greater than the non-residential NJSCC criteria.

To minimize the risk and to protect construction workers from exposure to contaminants at the LNG terminal site, Crown Landing proposes to further delineate the extent of TPH- and SVOC-contaminated soils and excavate and dispose of the contaminated soils and 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. Because most of the existing soils in the proposed developed portion of the LNG terminal site would be buried by a significant volume of fill material (i.e., about 150,000 cubic yards) placed to raise the site grade and to create the containment berm for the storage tanks, the contaminated soils would be effectively isolated from future human exposure.

Initial site preparation (grading and other soil-disturbing activities) could increase the potential for soil erosion on the LNG terminal site and sedimentation in adjacent waterbodies and wetlands. 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. Following construction, Crown Landing would permanently stabilize disturbed soils on the site by establishing a vegetative or gravel cover and installing other appropriate landscaping.

Soils along the pipeline route would be subject to various impacts. About 10 percent of the soils that would be affected by pipeline construction are designated prime farmland (all in Pennsylvania). Most of the prime farmland soils are within or directly adjacent to commercial or residential developments and none of these soils are actively cultivated or available for farming; therefore, impacts on prime farmland would not be significant. Soil compaction and erosion impacts along the pipeline route would generally be minimal due to the limited area of soils susceptible to these impacts. Texas Eastern would control erosion and sedimentation, and minimize compaction by implementing the mitigation measures in its SESC Plan.

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About 16 percent of the soils that would be affected by pipeline construction activities exhibit poor revegetation potential. All of these soils occur in Pennsylvania. 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.

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. Crown Landing has indicated that it would develop an SPCC Plan.

Construction of the LNG terminal would require dredging about 800,000 cubic yards of sediment to create the berth area for the ship unloading facility. Based on coring research conducted for the COE from nearby locations along the Delaware River, the sediments at the LNG terminal site are probably a mixture of organic silts and interstratified sands and silty sands. Chemical analyses of the proposed dredged sediments determined that eight metal contaminants were identified at elevated concentrations. The concentrations of most metals in all samples were below the TEL criteria, 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. However, these three metals are all well below their PEL criteria, suggesting limited potential for adverse impacts.

To minimize the resuspension of sediments during dredging, Crown Landing would primarily use hydraulic cutterhead dredging to excavate the berth area. Dredged material would be transported by pipeline directly to an existing, permitted upland confined disposal facility located about 4 miles upstream of the berth area. 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.

Water Resources

Groundwater

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 set forth in our Plan and Procedures and by implementing project-specific SESC and SPCC Plans.

Shallow groundwater at the LNG terminal site contains elevated concentrations of arsenic. Crown Landing will further investigate the elevated arsenic levels and consult with the NJDEP regarding measures to mitigate the arsenic impacts. These measures could include remedial actions and/or the use of institutional controls to prevent potential exposure to the arsenic.

Contaminated groundwater could also be encountered during construction of the proposed Logan Lateral. We have recommended that Texas Eastern develop a 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 are properly managed in accordance with applicable regulations.

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It appears that one water supply well is located within the construction right-of-way of the proposed pipeline. Texas Eastern is working with the well owners to determine potential project impacts on the well and necessary mitigation measures to be implemented during construction. Six other water supply wells were identified within 150 feet of the proposed construction right-of-way. For all wells located within 150 feet of the right-of-way, Texas Eastern would provide pre- and post-construction monitoring of well yield and water quality at the landowner's request, and would return any wells to their pre-construction condition if damaged by construction activities.

Construction of the proposed LNG terminal and pipeline could affect groundwater by increasing turbidity, causing fluctuations in ground water flow, and disrupting groundwater discharge. These and other potential construction-related effects would be localized and temporary, and would not be expected to affect the deeper Potomac-Raritan-Magothy aquifer, an EPA-designated sole source aquifer. Crown Landing and Texas Eastern would avoid or minimize these impacts by implementation of our Plans and Procedures and project-specific SESC Plans. The potential for hazardous material spills to occur or affect groundwater resources would be also avoided or minimized by implementing project-specific SPCC Plans.

Surface Water

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 the appropriation and discharge of hydrostatic test water. 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 of an area; introduce organic material and/or nutrients which could lead to an increase in biological oxygen demand and reduce dissolved oxygen; and release chemicals 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 proposes to use primarily hydraulic dredging to remove approximately 800,000 cubic yards of sediment from the Delaware River. Based on computer modeling of dredging-induced sediment impacts, suspended sediment concentrations would be expected to exceed background concentrations for only several hundred feet and would be limited to bottom of the water column. The COE conducted modeling in the project area as part of a study to predict the dissolved contaminant concentration of arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc in the water column from hydraulic dredging. The model assumed that 80 percent of the sorbed metals could be dissolved in solution. Based on this conservative model, most metals were shown to be 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.

Land-disturbing activities during construction of the onshore facilities of the proposed LNG terminal could also affect water quality of the Delaware River. Stormwater runoff from the site could affect water quality in the river by increasing suspended sediment and turbidity levels. 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 construct stormwater management facilities to control and treat stormwater runoff during operations of the facility.

Construction of the Logan Lateral Project would require crossing eight perennial waterbodies, including the Delaware River and four intermittent streams. Texas Eastern proposes to install the pipeline across Chester Creek, Delaware River, Raccoon Creek, and Birch Creek using the HDD construction

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technique. The HDD construction technique is a trenchless method that avoids disturbing the bed or the banks of the waterbody. For the remaining waterbodies, Texas Eastern would install the pipeline using the open-cut construction technique. The impacts of the open-cut construction method on perennial streams would generally be localized and short term. Clearing, grading, and trenching within and adjacent to these streams would affect water quality. Sediments would be resuspended by in-stream construction activities and/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 and within 48 hours for intermediate water crossings. Other measures in specified in our Procedures and Texas Eastern's SESC Plan would minimize impacts on waterbodies crossed by the pipeline route.

Wetlands

Crown Landing designed its proposed facility to avoid wetlands located on the LNG terminal site. As a result, no wetlands would be permanently filled or drained as a result of construction of the LNG terminal. Construction of the Columbia Gas pipeline interconnect on the site would temporarily impact about 0.3 acre of palustrine emergent wetland. Following installation of this interconnect, the disturbed wetland area within the construction right-of-way would be restored to original contours and allowed to naturally revegetate.

Although construction of the LNG terminal would not permanently impact wetlands, the LNG terminal would affect approximately 5.5 acres of wetland transition area. 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. 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 mitigation. Crown Landing is evaluating three options that could be implemented to compensate for transition area impacts, including:

- planting native tree species along 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;

- restoring habitat such as planting trees along Oldmans Ditch, controlling the spread of *Phragmites australis*, and/or creating inlets to improve tidal flow and fish and wildlife habitat within adjacent wetlands; and

- purchasing land in the vicinity of the LNG terminal site and enrolling it into a conservation easement program to protect fish and wildlife habitat.

We have recommended that Crown Landing continue to consult with federal and state agencies regarding the above mitigation options and file a wetland transition area mitigation plan prior to construction.

Construction of the Logan Lateral Project would disturb about 22.4 acres of wetlands. However, no wetlands would be permanently filled or drained as a result of construction and the access roads that would be used would not affect wetlands. The primary impact of pipeline construction and right-of-way

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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. About 2.4 acres of scrub-shrub and forested wetlands in the permanent right-of-way would be permanently maintained in an herbaceous state. Pipeline construction activities could also 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 flow which could impact wetland hydrology. To minimize these impacts, Texas Eastern would adhere to the protective measures specified in our Procedures and its SESC Plan, including:

- 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 subsoil 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.

Vegetation

The proposed LNG terminal site is located on an undeveloped parcel consisting of agricultural land, emergent wetlands, and scattered areas of open, forest, and shrub lands. The LNG terminal would be primarily constructed within cropland; however, about 1.5 acres of shrub land and 1.7 acres of open land would be permanently converted to industrial uses. Following construction, portions of the site that are not developed with buildings, roads, gravel, or other hard surfaces would be restored and revegetated.

Construction of the proposed pipeline would disturb about 125.7 acres of vegetation consisting of 50.8 acres of agricultural lands, 35.0 acres of open lands, 23.4 acres of forests, and 16.5 acres of non-forested wetlands. Impacts on open lands, emergent wetlands, and agricultural areas would be temporary and short term. Impacts on trees and other woody vegetation would be longer term and about 8.5 acres of forest land on the permanent right-of-way would be permanently cleared. 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.

Following construction, the portions of the construction right-of-way that are not required for pipeline operations would be seeded and allowed to revert to their previous preconstruction condition through natural succession. The permanent right-of-way would also be restored and revegetated, and operational impacts on vegetation would be minimized by the vegetation maintenance practices specified in our Plan and Procedures and Texas Eastern's SESC Plan.

Wildlife and Aquatic Resources

Construction activities associated with the proposed LNG terminal and pipeline could affect wildlife habitat through the cutting, clearing, and/or removal of existing vegetation within the construction area. Wildlife would be temporarily displaced from these areas during construction. Other than the permanent loss of habitat at the LNG terminal site and forested habitat along the pipeline, we do

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not expect wildlife to be impacted by operation of the LNG terminal and pipeline. Crown Landing would confine its development activities primarily to an existing agricultural field. Texas Eastern would minimize permanent impacts by constructing the pipeline within or adjacent to other existing rights-of-way where possible and by implementing its SESC Plan and our Plan and Procedures.

The proposed dredging activities associated with construction and future maintenance of the ship berth would have both direct and indirect impacts on aquatic resources. Potential adverse effects on aquatic resources include impairment of water quality, destruction of benthic habitat and communities, and direct and indirect impacts to fish and their prey species. Dredging also has the potential to introduce deleterious compounds currently in the bottom sediments into the water column. Use of a hydraulic dredge would reduce turbidity, sedimentation, and the release of deleterious compounds associated with dredging. However, hydraulic dredging could entrain or impinge juvenile fish, fish larvae, and eggs during certain times of the year. To minimize this impact, Crown Landing revised its dredging schedule to avoid anadromous fish migrations and spawning periods. Crown Landing is also consulting with applicable resource agencies to develop a mitigation plan for potential impacts on shallow water habitat as the result of dredging the deeper ship berth.

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. Ballast water intakes could also entrain and/or impinge juvenile fish, fish larvae, and eggs. To avoid or minimize impacts associated with ballast water intake, we recommend that Crown Landing coordinate with appropriate resource agencies to determine the need for additional conservation measures.

Construction of the Logan Lateral Project could directly affect aquatic resources present in the waterbodies crossed by the project. An inadvertent chemical or fuel spill in or near a waterbody could release contaminants, which could adversely affect fish and other aquatic organisms. The use of the HDD method to cross select waterbodies, including the Delaware River, and the implementation of mitigative measures specified our Procedures and Texas Eastern's SESC and SPCC Plans would minimize the potential for adverse impacts on aquatic resources during construction of the pipeline facilities across or near waterbodies.

Although the proposed LNG terminal site, ship unloading facility, and pipeline crossing are north of designated EFH in the Delaware River, nine managed species with the potential to occur in the Delaware River have at least one life stage that may be found within the project area. These species include: winter flounder, windowpane flounder, American plaice, Atlantic sea herring, bluefish, butterfish, summer flounder, scup, and black sea bass. This draft EIS includes an EFH Assessment as necessary for compliance with the MSA. As a result of our analysis as presented in the EFH Assessment, we have concluded that dredging associated with the proposed project could affect open water, shallow water, and benthic EFH in the project area. Activities within the Delaware River also have the potential to affect anadromous fish, a primary prey group for managed fish species. The suspension of sediments during dredging could temporarily affect the use of the water column by managed species and their prey in the area. Dredging of the ship berth would result in permanent alteration of existing shallow water habitat to deeper water habitat within the dredging footprint. However, implementation of the conservation measures discussed in this EIS, including Crown Landing's continued coordination with the applicable resource agencies to develop appropriate mitigation for project impacts, would likely avoid or minimize adverse impacts on managed fish species and EFH.

Threatened and Endangered Species

Consultations with the FWS, NOAA Fisheries, PADEP, NJDEP, and DNREC identified 11 state and/or federally listed species that could potentially occur near the proposed project. These include the

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right whale, bald eagle, pied billed grebe, peregrine falcon, shortnose sturgeon, Atlantic sturgeon, Kemps ridley sea turtle, green sea turtle, loggerhead sea turtle, bog turtle, and red-bellied turtle.

With the exception of the bald eagle, shortnose sturgeon, and the Atlantic sturgeon, there is a low probability of these species occurring within the project vicinity and the project is not likely to adversely affect these species. Project activities would not destroy or remove any known bald eagle nests or roost trees but may disrupt bald eagles that are known to forage in the project area. Since Crown Landing has committed to providing mitigation for the permanent loss of foraging habitat, potential long-term impacts on bald eagle foraging and the impacts associated with construction would be short term and minor. Thus construction and operation of the proposed LNG terminal and pipeline *may affect* but *are not likely to adversely affect* the bald eagle.

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 individuals if present near the hydraulic dredge cutterhead. Also, the intake of ballast water during LNG offloading could also result in the entrainment, impingement, or loss of shortnose sturgeon. Therefore, the Crown Landing LNG Project *is likely to adversely affect* the shortnose sturgeon. With the issuance of this draft EIS, we are asking NOAA Fisheries to open formal consultation and issue a Biological Opinion specific to the shortnose sturgeon.

Because juvenile Atlantic sturgeons have the potential to occupy shallow water areas at the LNG site throughout the year, 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, also similar to the shortnose sturgeon, there is a potential for individuals to be adversely affected by the proposed project.

Land Use, Recreation, and Visual Resources

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.

Of the 175-acre site, about 39 acres would be permanently developed for the LNG terminal facilities. 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 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.

The Crown Landing LNG Project would also require about 29.8 acres of riverbed associated with the Delaware River for a pier (approximately 2.4 acres) and berthing facilities (approximately 27.4 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.

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),

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3.1 miles would be located within existing roadways, and 0.2 mile would be located within an existing railroad right-of-way. Texas Eastern proposes to modify and upgrade one existing aboveground facility and would construct two new aboveground facilities. Construction of the pipeline facilities would disturb a total of about 177.3 acres of land. 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.

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. Potential impacts on nearby residential and commercial areas 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. Texas Eastern's proposed construction 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) and 9 commercial/industrial structures. Texas Eastern would implement several measures to minimize construction-related impacts on residences and other structures located within 50 feet of the construction right-of-way, including the preparation of site-specific residential construction mitigation plans.

There are no planned residential, commercial, or industrial developments within 2 miles of the proposed LNG terminal site. Seven planned developments have been identified as being crossed or located within 0.25 mile of the proposed pipeline route. 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.

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, respectively; and 2) require several federal permits and approvals. Crown Landing has not yet completed the process for the federal consistency certification with either the NJDEP or DNREC and Texas Eastern has not yet completed the process with either the NJDEP or PADEP, but would need to demonstrate consistency with each state's coastal zone management program and obtain concurrence of consistency from these agencies prior to the FERC approving the start of any construction.

In a letter dated February 3, 2005 from DDNREC 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. The DNREC Decision has a 14-day appeal period, which was ongoing at the time of printing of this draft EIS. Regardless, Crown Landing would still be required to file documentation that the project is consistent with each affected states' coastal zone management program before any construction of the project could begin.

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 TPH and one site contained elevated concentrations of arsenic. No contamination was found at the remaining five of these sites. A total of 30 hazardous, potentially hazardous, and solid waste sites have been identified as being crossed or located within 0.25 mile of the proposed pipeline facilities. Construction and operation of the project facilities are not expected to significantly affect recreational activities in the project area.

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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. 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 near the LNG terminal site. While the LNG terminal would be visible and permanently impact visual resources in the area, the overall aesthetic effect would be minor.

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.

Socioeconomics

Construction and operation of the Crown Landing LNG and Logan Lateral Projects would have short- and long-term socioeconomic impacts. Construction of the projects would result in a temporary increase in population, traffic, and demand for temporary housing and public services. Due to the temporary and limited nature of these impacts, they are not considered significant. Construction and operation of the projects would have beneficial impacts on local tax revenues and economies.

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. However, fire and other emergencies at the proposed LNG terminal could require the services of local fire departments and emergency response units. Crown Landing has committed to coordinating with local emergency service providers to ensure efficient and sufficient response to potential emergencies.

The increase in vehicular traffic during construction of the proposed LNG terminal could temporarily affect traffic levels on U.S. Route 130. To minimize these impacts, Crown Landing has indicated that some construction workers would park in an offsite parking lot and be shuttled to the construction site. In addition, Crown Landing is evaluating two other mitigative measures at the site entrance to alleviate potential traffic impacts. The Logan Lateral Project could also temporarily affect traffic during construction across or within roads along the pipeline route. Texas Eastern has indicated that it would implement appropriate mitigative and traffic control measures to avoid or minimize these impacts.

Construction and operation of the proposed projects would not result in disproportionate adverse impacts on environmental justice communities. The projects are expected to generate temporary and permanent employment opportunities, taxes and other revenue streams within the project area and 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 would affect all of the communities crossed by the pipeline and would not disproportionately impact only the environmental justice areas.

Cultural Resources

Crown Landing conducted an aboveground cultural resources survey of the LNG terminal and its viewshed. The survey documented 32 built resources within the viewshed. Of these, one resource (a 1936 truss bridge) was listed in the NRHP in 1992, and another (a ca. 1900 farmstead) was recommended eligible for the NRHP. Crown Landing concluded that construction of the LNG terminal would not affect

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either resource. Each of the remaining built resources was recommended ineligible for listing in the NRHP. The New Jersey SHPO concurred with the results and recommendations of the survey.

Crown Landing also conducted a terrestrial archaeological survey of the LNG terminal and an underwater archaeological survey of the associated pier and berthing areas in the Delaware River. The terrestrial archaeological survey relocated a previously documented prehistoric site (28GL241) recommended eligible for listing the NRHP. Crown Landing subsequently redesigned its construction plans to create a no-work buffer zone within 100 feet of this site. As a result, no additional testing of the site was recommended. No sites were identified as a result of the underwater archaeological survey. The New Jersey and Delaware SHPOs concurred with the results and recommendations of the surveys.

Texas Eastern conducted an aboveground cultural resources survey of the pipeline facilities in Pennsylvania and New Jersey. One resource (a mid-nineteenth century train trestle) was identified in Pennsylvania and recommended ineligible for listing in the NRHP. The Pennsylvania SHPO concurred with the survey results and recommendation. No built resources were identified in New Jersey. The New Jersey SHPO has not yet commented on the survey results.

Texas Eastern also conducted terrestrial archaeological surveys of the pipeline facilities in Pennsylvania and New Jersey. The survey in Pennsylvania, which examined the entire pipeline corridor and an alternative, documented five archaeological sites, two of which (Sites 36DE25 and 36DE26) were recommended eligible for listing in the NRHP. Site 36DE25 contains the remains of a historic farmstead, and Site 36DE26 is a prehistoric artifact scatter. Texas Eastern concluded that both sites are located outside the construction corridor and would not be affected by construction of the pipeline facilities. No additional testing of these sites was recommended; however, installation of an avoidance fence at Site 36DE26 was recommended. The three other sites, which were identified during survey of the route alternative, were recommended ineligible for inclusion in the NRHP. The Pennsylvania SHPO concurred with the results and recommendations of the survey.

In New Jersey, the survey investigated a majority of the pipeline facilities and an alternative; however, about 1.2 miles of the pipeline facilities were not examined. Although archival research and fieldwork by Crown Landing at the LNG terminal site indicated that Site 28GL241 is located adjacent to the pipeline facilities, no sites were identified. Texas Eastern recommended the installation of an avoidance fence along the edge of the construction right-of-way in the vicinity of this site, and no additional testing was recommended. The New Jersey SHPO has not yet commented on the results and recommendations of the survey.

Texas Eastern needs to complete the survey of the pipeline facilities in New Jersey. Consequently, we have recommended that Texas Eastern defer construction of the pipeline facilities until the survey is completed, and the survey report, any required treatment plans, and the New Jersey SHPO's comments on all reports and plans are filed with the Commission for review and approval by the Director of OEP.

Air Quality and Noise

Construction and operation of the proposed LNG terminal and pipeline would result in air emissions, including fugitive dust, onshore and offshore construction equipment tailpipe emissions, LNG truck and ship emissions, tug boat emissions, and stationary source emissions (from the water/glycol heaters, flares, and reciprocating engines). These emissions would include PM_{10}, SO_2, NO_x, VOC, and CO as well as small amounts of HAPs. The fugitive dust and tailpipe emissions during construction activities would be temporary, intermittent, and vary in location over time. These emissions would not

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result in a long-term impact on air quality. Fugitive dust would be minimized using water application for dust suppression and construction equipment would be operated on an as-needed basis.

The primary pollutants emitted during operation of the LNG terminal would be NO_x and CO. The operational air emissions from the LNG terminal would be minimized by using ultra dry low NO_x burner systems on the water/glycol heaters and would meet the LAER requirement under the NSR regulations. A final LAER determination would be required from the NJDEP during the preconstruction permitting process. The NO_x emissions generated by the LNG terminal would also be required to obtain emission offsets from other sources within the air basin; thereby minimizing any air quality impacts from these stationary sources. To ensure that the low level of air emissions identified in this draft EIS are met, we have recommended that the final air emission specifications and NJDEP approval of such specifications be provided prior to commencing construction. In addition, the proposed project is subject to the general conformity determination requirements. This determination will be provided after issuance of this draft EIS and will demonstrate that the project would not delay the attainment of the ozone standard in the project area.

Noise receptors in the immediate vicinity of construction activities would experience an increase in noise levels. In most areas the increase in noise would be localized, temporary, and limited primarily to daylight hours. Noise associated with construction activities would be the most noticeable with a potential noise impact of 89 dBA under peak conditions for very short periods of time (when construction equipment is close to the residence). This noise would be limited to daylight hours. The operational noise from the LNG terminal stationary sources would be about 50.9 dBA L_{dn} at the nearest residence, which equates to a noise increase of 0.4 dBA. This noise impact is less than the FERC's 55 dBA L_{dn} and the NJDEP nighttime noise criterion of 50 dBA L_{eq}. In addition, the noise increase from the sources at the LNG terminal would not be perceptible at nearby residences.

Reliability and Safety

We evaluated the safety of both the proposed facilities and the related LNG vessel transit through the Delaware Bay and River. As part of our evaluation, we performed a cryogenic design and technical review of the proposed terminal design and safety systems. Several areas of concern were noted with respect to the proposed facility, and specific recommendations have been identified to be addressed: prior to initial site construction; prior to construction after final design; prior to commissioning; or prior to commencement of service.

Thermal radiation and flammable vapor hazard distances were calculated for an accident or an attack on an LNG vessel. For 1-, 2.5-, 3.0-, and 3.9-meter-diameter holes in an LNG cargo tank, we estimated distances to range from 2,267 to 5,691 feet for a thermal radiation level of 1,600 Btu/hr/ft^2, the level which is hazardous to unprotected persons located outdoors. 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 10,128 feet to the lower flammability limit and 13, 677 feet to one half the lower flammability limit. 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. However, the evaluation of safety is more than an exercise in calculating the consequences of worst case scenarios. Rather, it is a determination of the acceptability of risk which considers: the probability of events, the effect of mitigation, and the consequences of events. 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 is unlikely to affect the public. As a result, the risk to the public from accidental causes should be considered negligible.

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As part of our marine safety analysis, we considered how vessel security requirements for LNG ships calling on the proposed LNG terminal might affect other ship and boat traffic in Delaware Bay and River. Based on the Coast Guard's longstanding experience in controlling the movements of dangerous cargo vessels in the Delaware Bay and River and LNG vessels in other ports, potential impacts can be evaluated for several general security requirements: 1) moving safety and security zones for inbound and outbound LNG vessels; 2) safety and security zones around a moored LNG vessel; and 3) other measures as deemed appropriate. The moving safety and security zone, and the safety and security zone at the terminal, may affect other commercial, ferry, and recreational traffic using the bay and river. Based on a navigation simulation study conducted by MNI on behalf of Crown Landing, the addition of 150 LNG ships per year would have minor effect on barge traffic associated with the Logan Generating Station operations. 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.

The extent of the impact on recreational boaters would depend on the number of boats in the project area during the two to three LNG vessel transits per week when LNG ships would call on the LNG terminal, and on several other variables such as the size of the Coast Guard-imposed safety and security zone and the width of the channel at the point where a boat encounters the LNG ship. Using certain assumptions, we estimate that a recreational craft attempting to travel in the opposite direction of an LNG ship at one of the narrower locations within the navigation channel might need to wait up to 16 minutes for the LNG ship to pass. To minimize potential impacts on other marine traffic, the Coast Guard is expected to use a program of announcements to give advance notice of each safety and security zone schedule and could schedule the transit of LNG ships for times of day less likely to affect recreational boaters.

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 an LNG import terminal proposal that would involve having a large volume of energy transported and stored near populated areas, the perceived threat of a terrorist attack is a primary concern of the local population and requires that resources be directed to mitigate possible attack paths. While the risks associated with the transportation of any hazardous cargo can never be entirely eliminated, they can be managed.

An issue that has developed for several LNG terminal projects is a concern that local communities would have to bear some of the costs of ensuring the security/emergency management of the LNG facility and the LNG vessel while in transit and unloading at the dock. The potential costs will not be determined until the specific security needs have been identified, and the responsibilities of federal, state, and local agencies have been established in the Coast Guard's Incident Action Plan. Crown Landing and the Coast Guard have formally initiated the process for development of the safety and security plans for the LNG facility. This process will involve three sub-processes: 1) the Port and Waterway Safety Assessment Workshop; 2) a Security Workshop; and 3) Consequence Management Workshop. The results of these three workshops will facilitate the development of Operations and Emergency Manuals which the facility operator is required to submit to the Coast Guard, as well as an LNG Operations Plan which covers operational safety, security, and consequence management issues for the project and communities located along the vessel transit route.

Once these plans are finalized and the resources required to implement them have been identified, Crown Landing will be able to more specifically discuss the funding of such resources. In order to better define how the potential burden on local communities would be addressed, we have recommended that Crown Landing provide a plan that identifies the mechanisms for funding project-specific security/emergency management costs that would be imposed on state agencies and local communities.

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Alternatives

We evaluated the alternatives of no action or proposed action, system alternatives, alternative LNG terminal coastal areas, alternative LNG terminal sites, pier alternatives, and pipeline route alternatives.

While the no action or proposed action alternative would eliminate the environmental impacts identified in this EIS, the project objective of providing a new source of natural gas to the Mid-Atlantic market would not be met. This might lead to alternative proposals to develop natural gas delivery and storage infrastructure, increased conservation or reduced use of natural gas, and/or the use of other sources of energy.

Denying or postponing a decision on Crown Landing's and Texas Eastern's applications could limit access to new supplies of natural gas in the future, which could in turn contribute to higher natural gas prices. Higher prices could potentially result in customers conserving or reducing the use of natural gas. Although additional conservation measures may have some affect on the demand for natural gas, conservation efforts based on EIA analyses are not expected to significantly reduce the long-term requirements for natural gas or effectively exert downward pressures on gas prices. On the other hand, it seems more likely as described by Alan Greenspan in 2003 that higher natural gas prices would adversely influence the regional economy by reducing realized household incomes and business profits.

Denying or postponing a decision on Crown Landing's and Texas Eastern's applications could also force potential customers of the natural gas provided by the project to seek regulatory approval to use other forms of energy. Nuclear or renewable energies such as hydroelectric, wind, or solar are not commercially viable substitutes able to replace or significantly offset the demand for natural gas over the next 20 years. Furthermore, each of these forms of energy involves significant environmental issues such as the disposal of toxic materials, alterations to hydrological/biological systems, and visual impacts. For example, compared to other fossil fuels such as coal or oil, natural gas is a relatively clean and efficient fuel that can reduce the emission of regulated pollutants (e.g., nitrogen oxides, sulfur dioxide, and particulate matter) or unregulated greenhouse gases (e.g., carbon dioxide). Given the environmental consequences of these options (including air quality impacts), we do not believe the no action or postponed action would provide a clear environmental advantage over the proposed projects.

We considered existing LNG facilities and pipelines as alternative systems that could be used to meet the objectives of the Crown Landing LNG Project. Crown Landing is proposing a facility that would have the capabilities of unloading and storing imported LNG and delivering approximately 1.2 Bcfd of natural gas into the Mid-Atlantic region. Because the capacity of each of the existing LNG import terminals is fully committed (including their current expansion proposals), use of an existing LNG terminal to meet the proposed project objectives would not be possible without significant expansions and/or modifications to their unloading, storage, and delivery systems and possibly substantial expansion or looping of the existing sendout pipeline(s). The additional facilities required for expansion would likely result in as much if not more environmental impact as Crown Landing's proposed LNG terminal.

From a commercial perspective the best location for an LNG terminal is close to the market it is intended to serve. We determined that the great distance of the existing Southern LNG and Trunkline LNG terminals from the project area (a distance of at least 800 miles) effectively limits them from serving the Mid-Atlantic market. The existing Distrigas and Cove Point LNG terminals are closer to the proposed LNG terminal (within 200 miles). The Distrigas LNG facility, however, has physical constraints (e.g., small site size, insufficient space for additional storage tanks, etc.) that make it unsuitable to supply the natural gas volumes proposed by Crown Landing. Dominion has recently proposed an expansion of the Cove Point LNG facility that would significantly increase both the LNG storage and the natural gas

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sendout capacity of this facility. This expansion would include the construction of about 161 miles of pipeline which would result in as much if not more environmental impacts than the proposed projects. The expansion of existing pipeline systems, even if combined with the use of an existing, modified, or proposed LNG facility, would not provide a clear advantage over the Crown Landing LNG Project.

We reviewed other recently approved, proposed, or planned LNG terminals to determine if they might be environmental preferable to the proposed project. We determined that all of the recently approved and most of the proposed and planned LNG projects are too far from the Mid-Atlantic region to efficiently provide the natural gas delivery volumes proposed by Crown Landing. Additionally, the use of the Gulf Coast, Canadian, and Bahamian projects as alternatives would likely require substantial expansion of existing pipeline systems, which could have significant environmental impacts.

We examined the four closest proposed and planned projects to the Mid-Atlantic region in more detail. We determined that each of these projects has site-specific environmental issues and/or safety concerns. Moreover, we found that none of these projects would individually provide the storage or sendout capacity proposed by Crown Landing. We also concluded that although a combination of these projects could provide the sendout capacity and storage capacity proposed by Crown Landing, it seems unlikely that these projects could effectively serve the Mid-Atlantic region. Based on recent projections of natural gas demand in the New England region, by 2009 there will be an increased demand for natural gas in New England and New York above what the current infrastructure is able to provide during peak periods of use. Consequently, even if more than one of these projects are authorized and constructed, much of the capacity of these projects would likely be used to satisfy the increasing demand for natural gas in the New England and New York markets and would be unavailable for the Mid-Atlantic region.

We considered alternative locations for an LNG import terminal in the Mid-Atlantic region. We determined that while there may be some safety and environmental advantages to locating the LNG terminal offshore, there are environmental, economic, and technical factors that make an offshore LNG terminal impractical as an alternative to the facilities proposed for the Crown Landing LNG Project. We identified and evaluated seven onshore alternative LNG terminal site locations in New Jersey along the Delaware Bay and River. We concluded that all of these sites have environmental drawbacks and that none would provide a clear environmental advantage over the proposed site.

Our alternative analysis included the evaluation of pier and berth configurations and orientations that might avoid or minimize impacts associated with the construction of these facilities. We determined that locating the pier farther from shore would increase potential ship hazards. Conversely, locating the pier closer to shore would increase the amount of dredging required and would impact more shallow water habitat. We have concluded that the proposed pier configuration, which was developed after consultations with federal and state agencies, offers the best balance of increased safety and reduced environmental impacts.

Finally, to avoid or minimize environmental impacts from construction of the pipeline, we examined four major route variations and three minor route variations to the proposed pipeline route. We determined that none of the major route variations would be environmentally preferable to the proposed route. Our review of the minor route variations lead us to concur with Texas Easterns' adoption of one route variation prior to filing its application, reject one route variation, and recommend that Texas Eastern adopt the third variation (the Ward Street Variation A) between MPs 3.33 and 3.67 to avoid impacts on Veterans Memorial Park.

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5.2 FERC STAFF'S RECOMMENDED MITIGATION

If the Commission issues any authorization for the proposed project, we recommend that the Commission's Order include measures 1 through 74. We believe that these measures would further mitigate the environmental impacts associated with construction and operation of the proposed project.

1. Crown Landing, L.L.C. (Crown Landing) and Texas Eastern Transmission, L.P. (Texas Eastern) shall follow the construction procedures and mitigation measures described in their applications, supplemental filings (including responses to staff data requests), and as identified in the environmental impact statement (EIS), unless modified by the Federal Energy Regulatory Commission's (FERC or Commission) Order. Crown Landing and Texas Eastern must:

    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary of the Commission (Secretary);
    b. justify each modification relative to site-specific conditions;
    c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and
    d. receive approval in writing from the Director of the Office of Energy Projects (OEP) **before using that modification.**

2. For pipeline facilities, the Director of OEP has delegation authority to take whatever steps are necessary to ensure the protection of all environmental resources during construction and operation of the project. This authority shall allow:

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

3. For liquefied natural gas (LNG) facilities, the Director of OEP has delegated authority to take all steps necessary to ensure the protection of life, health, property, and the environment during construction and operation of the project. This authority shall include:

    a. stop-work authority and authority to cease operation; and
    b. the design and implementation of any additional measures deemed necessary to assure continued compliance with the intent of the conditions of this Order.

4. **Prior to any construction**, Crown Landing and Texas Eastern shall file an affirmative statement with the Secretary, certified by senior company officials, that all company personnel, environmental inspectors (EIs), and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs before becoming involved with construction and restoration activities.

5. The authorized facility locations shall be as shown in the EIS, as supplemented by filed alignment sheets, and shall include the staff's recommended facility locations. **As soon as they are available, and before the start of construction**, Crown Landing and Texas Eastern shall file with the Secretary revised detailed survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by this Order. All requests for modifications of environmental conditions of this Order or site-specific clearances must be written and must reference locations designated on these alignment maps/sheets.

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6. Crown Landing and Texas Eastern shall file with the Secretary detailed alignment maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage yards, new access roads, and other areas that will be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction** in or near that area.

   This requirement does not apply to route variations recommended herein or minor field realignments per landowner needs and requirements that do not affect other landowners or sensitive environmental areas such as wetlands.

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

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

7. **At least 60 days before the start of construction,** Crown Landing and Texas Eastern shall file initial Implementation Plans with the Secretary for the review and written approval by the Director of OEP describing how the companies will implement the mitigation measures required by this Order. Crown Landing and Texas Eastern must file revisions to their respective plans as schedules change. The plan shall identify:

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

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

8. Texas Eastern shall each develop and implement an environmental complaint resolution procedure. The procedure shall provide landowners with clear and simple directions for identifying and resolving their environmental mitigation problems/concerns during construction of the project and restoration of the right-of-way. **Prior to construction,** Texas Eastern shall mail the complaint resolution procedures to each landowner whose property would be crossed by the project.

a. In its letter to affected landowners, Texas Eastern shall:

i. provide a contact that the landowners should call first with their concerns; the letter should indicate how soon a landowner should expect a response;
ii. instruct the landowners that, if they are not satisfied with the response, they should call Texas Eastern's hotline; the letter should indicate how soon to expect a response; and
iii. instruct the landowner that, if they are still not satisfied with the response from Texas Eastern, they should contact the Commission's Enforcement Hotline at (888) 889-8030.

b. In addition, Texas Eastern shall include in its weekly status report a copy of a table that contains the following information for each problem/concern:

i. the date of the call;
ii. the identification number from the certified alignment sheets of the affected property;
iii. the description of the problem/concern; and
iv. an explanation of how and when the problem was resolved, will be resolved, or why it has not been resolved.

9. Crown Landing and Texas Eastern shall each employ a team of EIs. The EIs shall be:

a. responsible for monitoring and ensuring compliance with all mitigation measures required by this Order and other grants, permits, certificates, or other authorizing documents;
b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 6 above) and any other authorizing document;
c. empowered to order correction of acts that violate the environmental conditions of this Order, and any other authorizing document;
d. a full-time position, separate from all other activity inspectors;
e. responsible for documenting compliance with the environmental conditions of this Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and
f. responsible for maintaining status reports.

10. Crown Landing and Texas Eastern shall each file updated status reports prepared by the EI with the Secretary on a weekly basis until all construction and restoration activities are complete. On

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request, these status reports shall also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

a. the current construction status of the project, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally sensitive areas;
b. a listing of all problems encountered and each instance of noncompliance observed by the environmental inspector(s) during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);
c. corrective actions implemented in response to all instances of noncompliance, and their cost;
d. the effectiveness of all corrective actions implemented;
e. a description of any landowner/resident complaints which may relate to compliance with the requirements of this Order, and measures taken to satisfy their concerns; and
f. copies of any correspondence received by Crown Landing and Texas Eastern from other federal, state, or local permitting agencies concerning instances of noncompliance, and Crown Landing's and Texas Eastern's response.

11. Crown Landing and Texas Eastern must each receive written authorization from the Director of OEP before commencing service of the project. Such authorization will only be granted following a determination that rehabilitation and restoration of the right-of-way is proceeding satisfactorily.

12. **Within 30 days of placing the certificated facilities in service**, Crown Landing and Texas Eastern shall each file an affirmative statement with the Secretary, certified by a senior company official:

a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or
b. identifying which of the certificate conditions Crown Landing and Texas Eastern have complied with or will comply with. This statement shall also identify any areas along the right-of-way where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

13. Texas Eastern shall incorporate Ward Street Variation A into the proposed route. *Draft EIS section 3.5.3* [1]

14. Texas Eastern shall prepare a Plan for the Discovery and Management of Contaminated Soils and Groundwater. This Plan shall comply with applicable state and federal regulations and shall provide for management of contaminants at known sites and include procedures for the identification and management of unknown contaminants in other locations. The Plan shall be filed with the Secretary for review and approval by the Director of OEP **prior to construction**. *Draft EIS section 4.2.1*

15. Texas Eastern shall prepare a site-specific crossing plan identifying all areas that would be disturbed by construction if alternate crossing methods are proposed at Chester Creek, Delaware River, Raccoon Creek, or Birch Creek. Texas Eastern shall file this plan with the Secretary concurrent with its application to other federal and state agencies for a permit to construct using

[1] The italicized numbers at the end of a recommended measure is the section the measure appears in the EIS.

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the alternate method. The Director of OEP must review and approve this plan in writing **prior to construction**. *Draft EIS section 4.3.2*

16. Crown Landing shall continue to consult with the New Jersey Department of Environmental Protection (NJDEP), U.S. Fish and Wildlife Service (FWS), and other appropriate agencies, and prepare a wetland transition area mitigation plan. This plan shall 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 shall file the wetland transition area mitigation plan with the Secretary **prior to construction**. *Draft EIS section 4.4*

17. Texas Eastern shall consult with the U.S. Army Corps of Engineers (COE), FWS, NJDEP, and Pennsylvania Department of Environmental Protection (PADEP) and other appropriate agencies on wetland mitigation requirements. If the agencies determine that compensatory wetland mitigation is required, Texas Eastern shall prepare a wetland mitigation plan describing the type of mitigation proposed, the location and size of the mitigation site, and any monitoring requirements that would be required to ensure the successful implementation of the compensatory mitigation. Texas Eastern shall file its wetland mitigation plan with the Secretary **prior to construction**. *Draft EIS section 4.4*

18. Crown Landing shall continue coordinating with National Oceanic and Atmospheric Administration (NOAA) Fisheries and other applicable agencies in developing plans to mitigate for impacts on shallow water habitats. The plan, along with agency concurrence, shall be filed with the Director of OEP for review and approval **prior to initiating dredging activities in the Delaware River**. *Draft EIS section 4.6.2*

19. Crown Landing shall 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 shall be filed with the Secretary **prior to construction**. *Draft EIS section 4.6.2*

20. Crown Landing shall 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 shall be filed with the Secretary **prior to construction**. *Draft EIS section 4.6.2*

21. Crown Landing shall coordinate with NOAA Fisheries to determine the appropriate speed for LNG ships and file copies of related correspondence with the Secretary **prior to commencing operations**. *Draft EIS section 4.7.1*

22. Crown Landing shall continue coordinating with the FWS and NJDEP to develop appropriate plans to mitigate for potential impacts on bald eagle foraging habitat. Crown Landing shall file final mitigation plans, including copies of correspondence with applicable agencies, with the Director of the OEP for review and approval **prior to construction**. *Draft EIS section 4.7.1*

23. Crown Landing shall monitor the outlet at the dredge disposal site to determine whether sturgeon are being entrained. If monitoring indicates that sturgeon are being entrained, suspend dredging operations until NOAA Fisheries and the FERC are contacted and provide guidance on how to proceed. *Draft EIS section 4.7.1*

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24. Crown Landing shall not begin construction activities **until**:

    a. FERC staff receives comments from the FWS/NOAA regarding the proposed action;
    b. FERC staff completes formal consultation with the FWS/NOAA; and
    c. Crown Landing receives written notification from the Director of the OEP that construction may begin. *Draft EIS section 4.7.1*

25. Crown Landing and Texas Eastern shall file documentation of concurrence from the NJDEP that the projects are consistent with the New Jersey Coastal Management Program with the Secretary **prior to construction**. *Draft EIS section 4.8.3.1*

26. Crown Landing shall file documentation of concurrence from the Delaware Department of Natural Resources and Environmental Control that the project is consistent with the Delaware Coastal Management Program with the Secretary **prior to construction**. *Draft EIS section 4.8.3.2*

27. Texas Eastern shall file documentation of concurrence from the PADEP that the project is consistent with the Pennsylvania Coastal Zone Management Plan with the Secretary **prior to construction**. *Draft EIS section 4.8.3.3*

28. Texas Eastern shall defer construction of the pipeline facilities **until**:

    a. Texas Eastern files the New Jersey State Historic Preservation Officer's (SHPO) comments on the New Jersey cultural resources management report;
    b. Texas Eastern completes the outstanding cultural resources surveys of the pipeline corridor and ancillary use areas;
    c. Texas Eastern files with the Secretary all additional required cultural resources survey reports and any treatment plans, and the New Jersey SHPO's comments on all reports and plans;
    d. Texas Eastern adds the St. Regis Mohawk Tribe and Onondaga Indian Nation to the list of tribal contacts in its unanticipated finds plan; and
    e. The Director of OEP reviews and approves all cultural resources reports and plans, and notifies Texas Eastern in writing that it may proceed with treatment measures or construction.

    All material filed with the Secretary containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: **"CONTAINS PRIVILEGED INFORMATION - DO NOT RELEASE."** *Draft EIS section 4.10.4*

29. Crown Landing shall provide to the Commission a copy of the final manufacturer's guarantees and NJDEP final permit **prior to construction**. If the estimated potential to emit for carbon monoxide (CO) or volatile organic compounds (VOC) is determined to be greater than the major source threshold, additional information regarding the method of compliance demonstration shall also be provided. This may include air dispersion modeling for CO or an lowest achievable emission rate determination for VOC. *Draft EIS section 4.11.1*

30. Crown Landing shall 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 decibels of the A-weighted

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scale (dBA) day-night sound level at an NSA or the noise increase exceeds 65 dBA 24-hour equivalent sound level at a residential property line, Crown Landing shall file a report on what changes are needed and shall install additional noise controls to meet the level within 1 year of the in-service date. Crown Landing shall 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. *Draft EIS section 4.11.2*

31. Crown Landing shall 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); and
    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 shall file this review with the Secretary for review and written approval by the Director of OEP **prior to construction**. *Draft EIS section 4.12*

Crown Landing shall file facility design and construction details with the Secretary for review and approval by the Director of OEP either: prior to initial site construction; prior to construction after final design; prior to commissioning; or prior to commencement of service as indicated by each specific recommendation (conditions 32 through 64). *Draft EIS section 4.12.2*

32. Crown Landing shall develop procedures to measure, monitor and if necessary, remove water from beneath the pile cap, to prevent freezing and frost heave, during construction. Procedures shall be filed **prior to initial site construction**. *Draft EIS section 4.12.2*

33. Crown Landing shall evaluate the relief and flare systems. A report of the evaluation shall be filed with the Secretary **prior to initial site construction**. *Draft EIS section 4.12.2*

34. Crown Landing shall file a complete plan and list of the hazard detection equipment with the Director of OEP **prior to initial site construction**. The information shall include a list with the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment. Plan drawings shall clearly show the location of all detection equipment. *Draft EIS section 4.12.2*

35. Crown Landing shall file a complete plan and list of the fixed and wheeled dry-chemical, fire extinguishing, high expansion foam, hazard control equipment with the Director of OEP **prior to initial site construction**. The information shall 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 shall clearly show the planned location of all fixed and wheeled extinguishers. *Draft EIS section 4.12.2*

36. Crown Landing shall file 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 with the Director of OEP **prior to initial site construction**. *Draft EIS section 4.12.2*

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37. Crown Landing's **final design** of the hazard detection equipment shall identify manufacturer and model. *Draft EIS section 4.12.2*

38. Crown Landing's **final design** of the fixed and wheeled dry-chemical, fire extinguishing, high expansion foam hazard control equipment shall identify manufacturer and model. *Draft EIS section 4.12.2*

39. Crown Landing's **final design** shall include equipment and instrumentation for the measurement of translational and rotational movement of the inner vessel for use during and after cool down. *Draft EIS section 4.12.2*

40. Crown Landing's **final design** shall include details of the boil-off gas flow measurement system provided for each tank. *Draft EIS section 4.12.2*

41. Crown Landing's **final design** shall include details of the LNG flow measurement system provided for the top and bottom fill to each tank. *Draft EIS section 4.12.2*

42. Crown Landing's **final design** shall include a minimum of three onsite seismic instruments that would have the capability of actuating an automatic plant wide ESD in the event of seismic activity approaching the site Operating Basis Earthquake. Crown Landing shall specify the set point to be used. *Draft EIS section 4.12.2*

43. Crown Landing's **final design** shall include a reliable measurement system to monitor deflections during the hydraulic test. At a minimum, this system shall 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 shall meet or exceed the limits specified by the tank manufacturer. *Draft EIS section 4.12.2*

44. Crown Landing's **final design** shall 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. *Draft EIS section 4.12.2*

45. Crown Landing's **final design** shall include drawings and specifications of the spill protection system to be applied to the LNG tank roofs. *Draft EIS section 4.12.2*

46. Crown Landing's **final design** shall include a discretionary vent for each tank, to be operated through the DCS. *Draft EIS section 4.12.2*

47. Crowns Landing's **final design** shall include provisions to measure the discharge flow of each intank pump. *Draft EIS section 4.12.2*

48. Crown Landing's **final design** of the vaporizers shall 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 shall be automatically actuated. *Draft EIS section 4.12.2*

49. Crown Landing's **final design** shall include provisions to ensure that hot glycol/water circulation is in operation at all times 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. *Draft EIS section 4.12.2*

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50. Crown Landing's **final design** shall include detection instrumentation and shut down procedures for vaporizer tube leak, shell side overpressure, or busting disc failure. *Draft EIS section 4.12.2*

51. Crown Landing's **final design** shall include temperature measurement of the vaporizer common discharge header which shall alarm the low temperature condition. *Draft EIS section 4.12.2*

52. Crown Landing's **final design** shall include provisions to recover boil-off gas, under all conditions, in the event that the send out vaporization system is not in operation. *Draft EIS section 4.12.2*

53. Crown Landing's **final design** shall include automatic shutdown valves at the suction and discharge of the each boiloff blower and each boiloff compressor. *Draft EIS section 4.12.2*

54. Crown Landing's **final design** shall 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 shall 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. *Draft EIS section 4.12.2*

55. Crown Landing's **final design** shall 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. *Draft EIS section 4.12.2*

56. In the event that Crown Landing uses open path detectors in the final design, they shall 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. *Draft EIS section 4.12.2*

57. Crown Landing's **final design** shall include details of the shut down logic. *Draft EIS section 4.12.2*

58. Crown Landing's **final design** shall include emergency shutdown of equipment and systems activated by hazard detection devices for flammable gas, fire, and cryogenic spills, when applicable. *Draft EIS section 4.12.2*

59. Crown Landing shall file security personnel requirements for prior to and during LNG vessel unloading with the Director of OEP **prior to commissioning**. *Draft EIS section 4.12.2*

60. Crown Landing shall file Operation and Maintenance procedures and manuals, as well as emergency plans, emergency evacuation plan and safety procedure manuals, with the Director of OEP **prior to commissioning**. *Draft EIS section 4.12.2*

61. Crown Landing shall provide copies of the U.S. Coast Guard security plan, vessel operation plan, and emergency response plan to the FERC staff **prior to commissioning**. *Draft EIS section 4.12.2*

62. Crown Landing shall file the contingency plan for failure of the outer LNG tank containment with the Director of OEP **prior to commissioning.** *Draft EIS section 4.12.2*

63. Crown Landing shall notify the FERC staff of any proposed revisions to the security plan and physical security of the facility **prior to commencement of service**. *Draft EIS section 4.12.2*

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64. Crown Landing shall report progress on the proposed construction in **monthly reports** filed with the Secretary. Details shall include a summary of activities, problems encountered and remedial actions taken. Problems of significant magnitude shall be reported to the FERC within 24 hours. *Draft EIS section 4.12.2*

65. The facility shall 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 shall 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, shall be submitted. *Draft EIS section 4.12.2*

66. Crown Landing shall file semi-annual operational reports 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 shall 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 shall be reported. Reports shall 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 shall 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. *Draft EIS section 4.12.2*

67. 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, Crown Landing shall notify the Commission and specify procedures for corrective action within 24 hours. *Draft EIS section 4.12.2*

68. Crown Landing shall report to the FERC staff any 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), within 24 hours of the event. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. This notification practice shall 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;

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e. free flow of LNG for five 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 shall include investigation results and recommendations to minimize a reoccurrence of the incident. *Draft EIS section 4.12.2*

69. Crown Landing shall 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 shall file final drawings and specifications for these measures with the Secretary **prior to construction**. *Draft EIS section 4.12.4*

70. Crown Landing shall coordinate with the U.S. Coast Guard (Coast Guard) to define the responsibilities of Crown Landing's security staff in supplementing other security personnel and in protecting the LNG ships and terminal. *Draft EIS section 4.12.5*

71. Crown Landing shall develop emergency evacuation routes for the areas along the route of the LNG vessel transit in conjunction with the local emergency and town officials and file the routes with the Secretary for review and approval by the Director of OEP **prior to construction**. *Draft EIS section 4.12.5*

72. Crown Landing shall develop an Emergency Response Plan (including evacuation) and coordinate procedures with local emergency planning groups, fire departments, state and local law enforcement, and appropriate federal agencies. This plan shall include at a minimum:

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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 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 shall be filed with the Secretary for review and approval by the Director of OEP **prior to commencement of service.** Crown Landing shall notify FERC staff of all meetings in advance and shall report progress on its Emergency Response Plan at 6-month intervals starting at the commencement of construction. *Draft EIS section 4.12.5*

73. Crown Landing shall provide a plan identifying the mechanisms for funding project-specific security/emergency management costs that will be imposed on federal and state agencies and local communities. Crown Landing shall file the plan with the Secretary no later than the comment period of the draft EIS so that the information can be included in the final EIS. *Draft EIS section 4.12.5.2*

74. Crown Landing shall consult with the COE and Coast Guard regarding possible impacts to the Marcus Hook anchorage area from LNG vessel operations. *Draft EIS section 4.12.8*

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APPENDIX A

DRAFT EIS DISTRIBUTION LIST FOR THE CROWN LANDING LNG PROJECT

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APPENDIX A

DRAFT EIS DISTRIBUTION LIST

Federal Government Agencies

Advisory Council on Historic Preservation, CO
Advisory Council on Historic Preservation, DC
    Director Cultural Resources
Army Corps of Engineers, DC
        James Hand
Army Corps of Engineers, PA
        William Jenkins
    Frank Cianfrani
Center for Disease Control and Prevention, GA
    National Center for Environmental Health
        Kenneth W. Holt, MSEH
        Linda Anderson
Council on Environmental Quality, DC
Department of Agriculture, DC
    Forest Service
        Director, Environmental Coordination Staff
    Natural Resources Conservation Service
        National Environmental Coordinator
    Office of Finance and Management
Department of Agriculture, NJ
    Natural Resources Conservation Service
        Anthony Kramer, State Conservationist
Department of Agriculture, PA
    Natural Resources Conservation Services
        Robin Heard, State Conservationist
Department of Commerce, DC
    National Oceanic and Atmospheric Administration
    Director of Ecology and Conservation
Department of Commerce, MA
    National Oceanic and Atmospheric Administration - Fisheries
        Kristen Koyama, Protected Resources Division
Department of Commerce, NJ
    National Oceanic and Atmospheric Administration
        Stanley W. Gorski, Field Offices Supervisor
Department of Defense, DC
    Department of the Air Force
        Environment and Safety
Department of Energy, DC
    Office of Environmental Compliance
    Office of Intergovernmental Affairs
        Steve Lerner
Department of Homeland Security, PA
    U.S. Coast Guard
        Patrick Keffler
        LCDR Timothy E. Meyers,

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Federal Government Agencies (cont'd)

Captain John Sarubbi
Department of Housing and Urban Development, DC
Director of Environment
Department of Justice, DC
Land and Natural Resources Division
Department of Labor, DC
Office of Regulatory Economics
Department of Safety and Homeland Security, DE
Secretary James Ford, Jr.
Department of State, DC
Office of Environment/Health
Department of the Interior, DC
National Park Service
Office Environmental Policy and Compliance
Director
Department of the Interior, NJ
Fish and Wildlife Service
Steve Mars
National Oceanic and Atmospheric Administration - Fisheries
Anita Riportella
Department of the Interior, PA
Fish and Wildlife Service
Jennifer Kagel
Maria Tur
Department of Transportation, DC
Director of Environment & Policy
DOT/RSPA/Eastern Region
Alex Dankanich, CATS
Office of Pipeline Safety
Tom Fortner
RSPA/OPS/Eastern Region
William Gute, Director
Environmental Protection Agency, DC
Office of Federal Activities
Director
Environmental Protection Agency, NY
Region 2
Lingard Knutson, Environmental Scientist
Grace Musumeci, Chief - Environmental Review Section
Environmental Protection Agency, PA
Region 3
William Arguto
Kevin Magerr
Barbara Okorn
Interstate Commerce Commission, DC
Chief of Energy and Environment
Library of Congress, DC
Exchange & Gift Division, Federal Documents Section

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Federal Government Agencies (cont'd)

Nuclear Regulatory Commission, PA
Greg Smith
Senate, DC
Committee on Energy and Natural Gas

Federal Representatives and Senators

Delaware

Congressman Michael N. Castle
Kate Rohrer, Congressman Mike Castle's Office
Steve Scango, Legislative Assistant to Congressman Mike Castle

Carrie Casey, Office of Senator Carper
Jim Riley, Office of Senator Carper
Senator Joseph R. Biden
Senator Thomas Carper
Tonya Baker, Office of Senator Biden

New Jersey

Representative Robert E. Andrews

Senator Frank R. Lautenberg
Senator Jon S. Corzine

Pennsylvania

Carl Fitzgerald, Delaware County Staff Director for Congressman Robert Brady
Congressman Curt Weldon
Congressman Robert A. Brady

Senator Arlen Spector
Senator Rick Santorum

State Representatives and Senators

Delaware
Representative V. George Carey
Wayne Smith, House Majority Leader
Representative Robert J. Valihura Jr.

Senator Catherine A. Cloutier
Senator David McBride

New Jersey

Assemblyman John J. Burzichelli

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State Representatives and Senators (cont'd)

Assemblyman Douglas H. Fisher

Senator Stephen M. Sweeney

Pennsylvania

Representative Thaddeus Kirkland

Senator Dominic F. Pileggi

Native American Groups

Charles D. Enyart, Chief, Eastern Shawnee Tribe of Oklahoma, MO

Mark Gould, Nanticoke-Lenni Lenape Indian Center, NJ
Chief Roy Crazy Horse, New Jersey Commission on American Indian Affairs, NJ

Brian Patterson, Bear Clan Representative, Men's Council, Oneida Indian Nation, NY
Clint Halftown, Heron Clan Representative, Cayuga Nation, NY
Anthony Wonderley, Oneida Nation Historian, Oneida Indian Nation, NY
Leo Henry, Chief, Tuscarora Nation, NY
Irving Powless, Jr., Chief, Onondaga Indian Nation, NY
Onondaga Nation, NY
Kathleen Mitchell, THPO, Seneca Nation of Indians, Seneca-Iroquois National Museum, NY
A. Francis Boots, Historic Preservation Officer, St. Regis Mohawk Tribe, NY
Emerson Webster, Chief, Tonawanda Band of Seneca Indians, NY

Delaware Executive Committee, Delaware Nation, Oklahoma, OK
Rhonda Fair, NAGPRA Contact, Delaware Nation, Oklahoma, OK
Dee Ketchum, Chief, Delaware Tribe of Indians, OK
Jennifer Makaseah, Cultural Preservation Officer, Absentee-Shawnee Tribe of Oklahoma, OK
James Lee Edwards, Governor, Absentee-Shawnee Tribe of Oklahoma, OK
Bruce Gonzalez, Tribal President, Delaware Nation, Oklahoma, OK
David M. Scholes, M.A., NAGPRA Director, Delaware Nation, OK
Jim Rementer, NAGPRA Contact, Delaware Tribe of Indians, Oklahoma, OK
Brice Obermeyer, NAGPRA Director, Delaware Tribe of Indians, OK
Leroy Howard, Chief, Seneca-Cayuga Tribe of Oklahoma, OK

Tina Danforth, Chairperson, Oneida Tribe of Indians of Wisconsin, WI
Robert Chicks, Tribal Chairman, Stockbridge-Munsee Community of Wisconsin, WI
Stockbridge-Munsee Tribal Council, WI
Oneida Business Committee, Oneida Tribe of Indians of Wisconsin, WI
Sherry Sirgens, Cultural Preservation Officer, WI

State Government Agencies

Delaware

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Governor Ruth Ann Minner
Department of Natural Resources and Environmental Control
- Phil Cherry, Director of Policy and Planning
- John A. Hughes, Secretary
- Ben Anderson
- Robert Palmer
- Accidental Release Prevention Program
  - Bob Barrish
- Air Quality Management Section
  - Paul Foster
- Coastal Zone Act Program
  - Dennis Brown
  - Susan Love
- Division of Fish & Wildlife
  - Craig Shirey
  - Jeff Tinsman
  - Karen Bennett
- Division of Water Resources
  - Bill Moyer
  - Laura Herr

Emergency Management Agency
- James Turner III, Director

Historical Society of Delaware
Office of the Governor
- Philip Cabaud, Jr., Homeland Security Advisor

River and Bay Authority
- Lt. Jack Cawmann, Counter Terrorism Coordinator

State Historic Preservation Office
- Faye L. Stocum, Archaeologist
- Division of Historical and Cultural Affairs
  - Daniel Griffith

Tri-State Maritime Safety Association
- Doug Dillon

<u>New Jersey</u>

Governor James E. McGreevey
Chamber of Commerce
- James F. Leonard, Vice President, Gov't Relations

Department of Community Affairs
- Division of Fire Safety
  - Lawrence Petrillo, Fire Marshal

Department of Environmental Protection
  - Ken Koschek
  - Deborah Fimbel
  - Bradley Campbell, Commissioner
- Bureau of Tidelands Management
  - Rich Castagna, Commissioner
- Gary Sondermeyer, Chief of Staff
- Land Use Regulation Program

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State Government Agencies (cont'd)

Mark N. Mauriello, Director
Patricia Cluelow, Coordinator
Natural and Historic Resources, Historic Preservation Office
Dorothy Guzzo
Office of Dredging and Sediment Technology
Suzanne Dietrick, Chief
Office of Pollution Prevention
Ruth W. Foster, Ph.D.
State Historic Preservation Office
Robert C. Shinn, Jr.
Office of Counter-Terrorism
Sidney Caspersen
Soil and Water Conservation Society
Firman E. Bear Chapter
State Police
Marine Police
Lt. Dean Rainier
Office of Fire Department Preparedness
Michael Gallagher, Emergency Response and Planning Specialist
Michael Hall, Assistant Supervisor
The New Jersey Historical Society

Pennsylvania

Governor Edward G. Rendell
Department of Community and Economic Development
SE Regional Office
Department of Conservation and Natural Resources
Michael DiBerardinis, Secretary
Department of Environmental Protection
John Kennedy
Ron Drake, Program Director
Kathleen A. McGinty, Secretary
Coastal Zone Management Program
John Hines, Executive Director
SE Regional Office
Joseph A. Feola, Regional Director
Department of Health
Emergency Management Agency
Eastern Region
Tom Nervine
Historical & Museum Commission
Chan Funk
Historical and Museum Commission
Wayne S. Spilove, Chairman

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County Government Agencies

New Castle County, DE
- Chief Administrative Officer
- New Castle Historical Society
- Thomas P. Gordon, County Executive

Gloucester County, NJ
- Bill Krebs
- Charles E. Romick, Director
- Dr. Warren S. Wallace
- Frank J. DiMarco
- Gloucester County Historical Society
- Gloucester County Sheriff
- Gloucester County Soil Conservation District
- Helene M. Reed
- J. Thomas Butts, Emergency Management Coordinator
- James N. Hogan
- John H. Fisher, III
- Joseph A. Brigandi
- Margaret Miners Smith
- Robert M. Damminger, Deputy Director
- William E. Rieger, Jr.
- William Reager

Salem County, NJ
- Carl Wentzell

Delaware County, PA
- Delaware County Historical Society
- Ed Magargee
- Haverford Township Historical Society
- Joseph F McGinn, Sheriff
- Marple Newtown Historical Society
- Museum of the History of Delaware County
- The Delaware County Commerce Center
- Tim Murtaugh, Chairman of the County Council

Town Government Agencies

Erick Haley, Fire Chief, Claymont, DE

Andy Lovell, Logan EMS, Bridgeport, NJ
Art Smith, Councilperson, Logan Township, Bridgeport, NJ
David P. Fanslau, Township Administrator, Township of Logan, Bridgeport, NJ
Frank Minor, Mayor, Logan Township, Bridgeport, NJ
Gary Whalen, Executive Director, Logan Municipal Utilities Authority, Bridgeport, NJ
George Fisher, Chairman, Logan Township Planning Board, Bridgeport, NJ
Logan Township Police Department, Bridgeport, NJ

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Town Government Agencies (cont'd)

Marsha Gaventa, Councilperson, Logan Township, Bridgeport, NJ
Mayor John C. Wright, 125 Main Street, Bridgeport, NJ
Michael Smith, Chief, Logan Township Police Department, Bridgeport, NJ
Patrick Spring, Fire Chief, Bridgeport Volunteer Fire Department, Bridgeport, NJ
Phyllis Atkinson, Construction Official, Township of Logan Construction Office, Bridgeport, NJ
Veronica Bills, Councilperson, Logan Township, Bridgeport, NJ
Warren Rodgers, Deputy Mayor, Logan Township, Bridgeport, NJ
William Teter, OEM Director, Logan Township Office of Emergency Management, Bridgeport, NJ
Brian Murscell, President BFD, Bridgeport Fire Department, Swedesboro, NJ
Mayor Dave Azzari, Swedesboro, NJ
William Baitzel, Chief, Repaupo Volunteer Fire Department, Swedesboro, NJ

Mayor Ralph Garzia, Borough of Brookhaven, Brookhaven, PA
Upland Police HDQRS, Brookhaven, PA
Bill Payne, Director of City Planning, City of Chester, Chester, PA
Commissioner John Finnegan, Chester Police Department, Chester, PA
Mayor Wendell Butler, City of Chester, Chester, PA
Albert Argentine, Council President, Municipal Building, Marcus Hook, PA
Bruce A. Dorbian, Borough Manager, Municipal Building, Marcus Hook, PA
Burnie Gallows, Director Public Safety, Marcus Hook, PA
George McClure, Mayor, Municipal Building, Marcus Hook, PA
Jay Smith, Code Enforcement Officer, Marcus Hook, PA
Joseph Manerchia, Fire Chief, Marcus Hook, PA
Mervin Boyer, Council Vice President, Municipal Building, Marcus Hook, PA

Libraries

Brandywine Branch of the New Castle County Library, DE

Gloucester County Library System, NJ

Aston Public Library, PA
J. Lewis Crozer Library, PA

Media

Shawn Wagner, Newark Review, Newark, DE
The New Journal, Wilmington, DE

Adam Fifield, Philadelphia Inquirer, South Jersey Bureau, Cherry Hill, NJ
Daniele Cruz, Gloucester County Times, Woodbury, NJ
Frank Gargano, General Manager, Gloucester County Times, Woodbury, NJ
Gene Vernacchio, Courier-Post, Cherry Hill, NJ
Jeanne Ridgeway, Courier Post, Cherry Hill, NJ
Lisa Grzyboski, Courier-Post, Woodbury, NJ
WPPX-TV, Swedesboro, NJ

Chester News, Chester, PA

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Organizations and Individuals

Ruth Celler Gold, Irvine, CA
St. Francisville, LLC, Eureka, CA

Peter E. O'Rourke, Sparber and Associates, Inc., Washington, DC
Secretary of Veterans Affairs, Dept. of Veterans Affairs, Washington, DC

Ross Abson, New Castle, DE
Tom Bacon, Newark, DE
Skyla Barlow, Claymont, DE
Dr. Kenneth Bell, Dover, DE
Dick Berwick, Dover, DE
Daniel Bockover, President, Council of Civic Organizations/Brandywine Hundred, Wilmington, DE
Ms. Karen Emory Brittingham, Milford, DE
Kevin D. Brown, Claymont, DE
Eileen Butler, Delaware Nature Society, Hockessin, DE
Bruce A. Cabo, Wilmington, DE
C. Carey, Wilmington, DE
Ms. Jean Conway, Council of Civic, Wilmington, DE
Christina Cook, New Castle, DE
William L. & Eileen P. Creighton, Middletown, DE
Mt. Cuba Astronomical Observatory, Inc., Greenville, DE
Mr. Mike D'Amico, Nassau, DE
George J. Danneman, Wilmington, DE
Mrs. Mary Dantzler, Smyrna, DE
Mr. Matt Del Pizzo, President, Port Penn, DE
John L. Deming, Vice President, Gov't Relations, Ciba Specialty Chemicals, Newport, DE
Dr. Al Demio, Newark, DE
Allen A. Denio, PhD, Newark, DE
James Dennis, Dover, DE
Rev Charles Dennis, Ellendale, DE
Mr. Jim Dodd, Smyrna, DE
Mr. James Falk, College of Marine Studies, Rehoboth Beach, DE
Mr. Donald Farrell, Wilmington, DE
John Flaherty, Wilmington, DE
Ms. Lorraine Fleming, Hockessin, DE
Richard Fleming, Delaware Nature Society, Wilmington, DE
Mr. Robert Frederick, Dewey Beach, DE
Attn: Juana Fuentes-Bowles, Director, Div. of Human Relations, Dept. of State, James Wms State Service Center, Dover, DE
Richard Gardner, Dover, DE
Ms. Irene Goverts, Wilmington, DE
Ms Joanne Griffin, Wilmington, DE
Hagley Museum, Wilmington, DE
Simeon Hahn, Wilmington, DE
Dr. Bethany Hall-Long, Middletown, DE
Ms. Barbara Harbin, Claymont, DE
Mr. Holger H. Harvey, Odessa, DE
Jeremiah & Ruth Heartley, Claymont, DE
Debbie Heaton, Conservation Program Manager, Sierra Club Delaware Chapter, Wilmington, DE

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Organizations and Individuals (cont'd)

Ms. Debbie Heaton, Middletown, DE
Raymond G. Heinzelmann, Ph.D., Gahagan & Bryant Associates, Inc., Wilmington, DE
Ray Hester, Claymont, DE
Mr. Paul Hirseman, New Castle, DE
Ms. Margaret A. Ingram, Legislative Liaison, Dover, DE
Mr. Alden Jenkins, Wilmington Waterfront Watch, Wilmington, DE
Mr. Roger L. Jones, The Nature Conservancy, Delaware Chapter, Wilmington, DE
Cathe Kalisz, Motiva Enterprises, Delaware City, DE
Ms. Regina Katz, Wilmington, DE
Kent Conservation District, Dover, DE
Mr. Charles O. King, Wilmington, DE
Kathy Klein, Partnership for the Delaware Estuary, Wilmington, DE
Wallace Kremer, Wilmington, DE
Mr. Jacob Kreshtool, Wilmington, DE
Lisa & Michael Lasher, Millsboro, DE
Max M. Levy, Wilmington, DE
James Lockwood, Claymont, DE
George Losse, President, Claymont Community Coalition, Claymont, DE
June D. MacArtor, Bear, DE
Mr. Ed Malin, Bear, DE
Gerald & Colleen Manley, Claymont, DE
Mr. Mike McDowell, President, Middletown, DE
Elder L. McDuffy, Hamilton Park Advisory Council, New Castle, DE
Mary Anne McGonegal, Wilmington, DE
Ms. Meredith McGregor, Wilmington, DE
Ms Pamela Meitner, Wilmington, DE
Mr. Robert Melson, DE Academy Science, Newark, DE
Ms. Dorothy P. Miller, Newark, DE
Ms. Martha Miller, Dover, DE
Chris Motoyoshi, Executive Director, Tri-State Bird Rescue and Research, Newark, DE
Alan Muller, Executive Director, Green Delaware, Port Penn, DE
Irene Murray, Lewes, DE
New Castle Conservation Dist., Newark, DE
Mr. Tim O'Connor, Wyoming, DE
Ms. La Vaida Owens-White, Wilmington, DE
Jim Parks, Wilmington, DE
Ms. Grace Pierce-Beck, Dover, DE
John & Marie Pittenger, Env. Activities, Wilmington, DE
Ms. Til Purnell, Millsboro, DE
Michael Riska, Executive Director, Delaware Nature Society, Hockessin, DE
Ms. Leah Roedel, DE River & Bay Shrln, Wilmington, DE
Seth Ross, Delaware Nature Society, Newark, DE
Bill Satterfield, Executive Director, Delmarva Poultry Industry, Inc., Georgetown, DE
Ms. Glenda Scott, Georgetown, DE
Mr. Donald Sharp, United Auto Workers, Newark, DE
Ms. Gwynne Smith, Wilmington, DE
Mr. David Sokola, Newark, DE
Mr. Carl Solberg, Dover, DE

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Organizations and Individuals (cont'd)

Nicholas Staikos, Wilmington, DE
Sussex Conservation District, Georgetown, DE
Mr. Marvin Thomas, Wilmington, DE
Mr. Dave Timmons, Newark, DE
Mr. Stephen Tindall, Wilmington, DE
Pat Todd, Wilmington, DE
Tri-State Bird Rescue, Newark, DE
Mr. Harold Truxon, Ellendale, DE
Ms. Rita M. Vista, Wilmington, DE
Ms. Carol Walsh, Newark, DE
Wini Walton, Dover, DE
Ms. Dolores A. Washam, Urban Environmental Center, Wilmington, DE
Watch our Waterways, Dover, DE
Mr. Winston Wayne, Wilmington, DE
Lyman Welch, Wilmington, DE
Ms. Teresa Whitaker, Dover, DE
Mr. Newlin E. Wood, Jr., Wilmington, DE

Morton J. Berman, Boca Raton, FL
Eugene Mori, Miami, FL
Salvatore & Cecilia Roma, c/o Eleanor Smith, POA, Ocala, FL
Mr. Ron Spencer, Mgr. Real Estate, CSX Real Property, Jacksonville, FL

Gregory J. Bertha PE, Chicago Bridge & Iron Company, Plainfield, IL

J.D. Lormand, Executive Director, Rocky Mountain Pipeline Contractors Assoc., Lafayette, LA
Eddie Soileau, Eunice, LA

Leon Bowdoin, Fall River, MA
Gus McLachlan, Duke Energy Gas Transmission, Waltham, MA
Gene Muhlherr, Duke Energy Gas Transmission, Waltham, MA
Realty Associates Fund Vi, LP, Boston, MA

Army Corps of Engineers Baltimore, MD
Claire Filemyr, Silver Spring, MD
Jim Grant, Soil Safe, Inc., Columbia, MD
Dave Keifer, Sierra Club of Delaware, Dover, MD
Mr. Walter Kennell, Soil Safe Inc., Baltimore, MD
Susan Peterson, Elkton, MD

Randy Duncan, Natural Resource Group, Inc., Minneapolis, MN
Jeff Thommes, Natural Resource Group, Minneapolis, MN

Nancy Allen, Logan Township, NJ
John Ambrose, Ferro Plant Manager, Bridgeport, NJ
Marlene Z. Asselta, President, Southern New Jersey Development Council, Turnersville, NJ
Donald D. Bell, President, Siegfried (USA), Inc., Pennsville, NJ
Mr. Michael Bogdan, Carpenter Environmental, Ramsey, NJ
Richard and Kimberly Bond, Logan Township, NJ

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Organizations and Individuals (cont'd)

Dominick Borrelli, Logan Township, NJ
Joseph and Eleanor Borrelli, Logan Township, NJ
Joseph and Eleanor Borrelli, Pedricktown, NJ
Todd Bosco, Logan Township, NJ
Ida M. Boultinghouse, Bridgeport, NJ
Robert Cassidy, Pedricktown, NJ
David Charles, President and CEO, Revere Industries LLC, Clayton, NJ
Alfard D. Collier Jr., Swedesboro, NJ
Anthony Conte, Gibbstown, NJ
Robert Costello, Logan Township, NJ
Robert Costello, Logan Township, NJ
Romeo and Jennie Costello, Logan Township, NJ
Joanna Crane, Logan Township, NJ
Joel and Margaret Cressman, Sr., Logan Township, NJ
Brendan Daly, Swedesboro, NJ
Rakesh Darji, Remington & Vernick Engineers, Haddonfield, NJ
David Dorsey, Enterprise Transportation Co., Pedricktown, NJ
Kathleen A. Davis, Executive Vice President, Chamber of Commerce of Southern NJ, Voorhees, NJ
Elizabeth Davison Hyde, Roux Associates, Inc., West Deptford, NJ
Corby Deese, Jr., Logan Township, NJ
Debra P. DiLorenzo, President, Chamber of Commerce of Southern NJ, Voorhees, NJ
Charles Dippo, Folsom, NJ
Jennie Dobrowolski, Logan Township, NJ
Gene Dougherty, Franklinville, NJ
David Warren Dutton Sr., Logan Township, NJ
David Warren Dutton, Sr, Logan Township, NJ
Duttons, Pedricktown, NJ
Mr. Charles M. Evans, Solutia Inc. & Ferro Corp., Bridgeport, NJ
Estate of Vincent Faulls, David Faulls, Executor, Bridgeport, NJ
New Jersey Environmental Federation, Belmar, NJ
Solutia Inc. Ferro Corp., Tax Dept., Bridgeport, NJ
Willard & Dorothy Folker, Bridgeport, NJ
Bruce D. Fusello, Bridgeport, NJ
Marsha Gaverta, Logan Township, NJ
Leo & Doris Gillen, Bridgeport, NJ
Mr. Bob Golden, TRC Environmental, Lindhurst, NJ
George S. Hawkins, Chair, NJ Council of Watershed Associations, Pennington, NJ
Jerry Hernandez, Logan Township, NJ
Margaret A. Hollifred, Bridgeport, NJ
Estate of Raymond Hughes, Charles Hughes, Executor, Logan Township, NJ
David R. and Robin L. Hunt, Logan Township, NJ
Samuel and Mary Kille, Logan Township, NJ
Marcia Ledford, Soil Safe, Logan Township, NJ
James L. Lee, Thorofare, NJ
Alice L. Licciardello, MICKLETON, NJ
Logan Township Municipal Utilites Authority, Bridgeport, NJ
Beth MacWatters, Thorofare, NJ
Stephen P. Magenta, General Maintenance and Labor, Inc., Thorofare, NJ

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Organizations and Individuals (cont'd)

Josephine Magnanti, Sicklerville, NJ
James Maley, Jr. Esquire, Gloucester County Improvement Authority, Marlton, NJ
Victor M. & Zaida M. Martinez, Camden, NJ
Mr. David Meiskin, Logan 529 Group, LLC, Freehold, NJ
Rick Meng, Supervisor of Permits, New Jersey Department of Transportation, Cherry Hill, NJ
Paul and Candace Mogavero, Logan Township, NJ
Owen Morris, New Jersey Department of Transportation, Cherry Hill, NJ
Edwin Morrow, Logan Township, NJ
Pat Mulligan, President/Chairman, Oldmans Creek Watershed Association, Mullica Hill, NJ
Floyd and Josephine Muntz, Logan Township, NJ
Liz Murphy, DE River Port Authority, Camden, NJ
Mike Nichols, Woolwick Township, NJ
Margie Norton, Barnsboro, NJ
Linda Nothdurft, Logan Township, NJ
William J. O'Connor, Delaware River Port Authority, Camden, NJ
Oldmans 130 Realty LLC, HOLMDEL, NJ
Eugene N. & Linda L. Osward, Jr., BRIDGEPORT, NJ
Bob Otten, Logan Township, NJ
Keystone Urban Renl, Ltd. Partnership, Carneys Point, NJ
Gary Patterson, Commissioner, DE River Port Authority, Camden, NJ
Robert & Ruth Paz, Bridgeport, NJ
Michael F. Pesch, Vice President, Valero Paulsboro Refinery, Paulsboro, NJ
William C. Pickett, Pedricktown, NJ
Samuel A. Pignatelli, VP, South Jersey Gas Company, Folsom, NJ
Elmer F. & Steven Powell, Logan Township, NJ
David Pringle, Campaign Director, New Jersey Environmental Federation, Marlton, NJ
Manager-Corporate Properties Public Service Electric and Gas Company, Newark, NJ
Jay Rodgers, Logan Township, NJ
John M. Rowley, Vice President of Operations, Troemner, Thorofare, NJ
Mr. Mike Salvador, National Energy & Gas Transmission, Swedesboro, NJ
Mr. Richard Santo, Solutia Inc. & Ferro Corp., Bridgeport, NJ
A. & Ramos B. Santos, Logan Township, NJ
F. Savetchy, Est., C/O J. Dobrowolski, Logan Township, NJ
Mary Schubert, Bridgeport, NJ
Leakadia Sieracimski, Logan Township, NJ
New Jersey Sierra Club, Trenton, NJ
Joseph Smyk, Logan Township, NJ
Jim Sousa, Logan Power Plant Manager, Swedesboro, NJ
Tony Spadaccini, Swedesboro, NJ
William and Joan Sparks, Logan Township, NJ
Charles E. Spires, Sr., Swedesboro, NJ
William J. & Donna M. Stewart, Logan Township, NJ
Fred Sting, Westmont, NJ
Bill Sullivan, Westville, NJ
Felicia Thomas-Friel, Esq., Managing Attorney-Gas, State of New Jersey Division of Ratepayer Advocate, Newark, NJ
Kim Thompson, Logan Township, NJ
Jeff Tittle, New Jersey Sierra Club, Trenton, NJ

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Organizations and Individuals (cont'd)

Richard R. Trout, Operations Director, Johnson Matthey, West Deptford, NJ
John Tull, Logan Township, NJ
Andrew & Mary I. Valesky, Bridgeport, NJ
Charles R. Ward, Port Services, LLC, Sewell, NJ
Deborah Weiner, Swedesboro, NJ
Artis R. Williams, Plant Manager, Air Products and Chemicals, Inc., Paulsboro, NJ
Robert Winzinger, Inc., Hainesport, NJ
Madge & George Wright, C/O Doris Wright, Bridgeport, NJ
J. Wright & S. McCormick, Logan Township, NJ
Jim Wrynn, Public Service Electric and Gas Company Service Corp., Newark, NJ

Dan DuBois, Albany, NY

Transcontinental Gas Pipeline Corp., Tulsa, OK

Aaron Tabernacle Church, Bishop William Blackwell, Sr., Chester, PA
Lawrence J. Abadie, Brookhaven, PA
Shawn S. & Dolores S. Adamek, Brookhaven, PA
Capt. Greg Adams, USCG (Ret.), Maritime Consulting Solutions, Drexel Hill, PA
Felix O. Agbiro, Chester, PA
James E. Ailes, Brookhaven, PA
Michael F. Alloway, MFA Properties, LLC, Boothwyn, PA
Thomas Annas, TA Truck Sales, Chester, PA
Lawrence A. Jr. & Partricia D. April, Glen Mills, PA
Philip A. & Eileen J. Askey, Wallingford, PA
Paula Atwell, Brookhaven, PA
James J. & Eileen P. Babenko, Brookhaven, PA
John Bachle, Linwood, PA
Perry M. Rosemary Bannister, Chester, PA
Richard Banta, Boothwyn, PA
Andrew S. & Patricia L. Barolo, Brookhaven, PA
Carol L. Bedrosian, Brookhaven, PA
Edwin H. Beisel, Brookhaven, PA
Arthur Bell, Elaine Bell, Brookhaven, PA
Joseph E. Benton, McAllister Towing of Philadelphia, Philadelphia, PA
Jesse A. Berry, Gertrude Phillips, Chester, PA
Helene D. Bilson, Brookhaven, PA
Stephen H. Bixby, Wallingford, PA
John Jr. & Donna Blosinski, Gradyville, PA
Edward M. & Wanda Bogucki, Brookhaven, PA
George & Maria Borhegy, Brookhaven, PA
Victor M. & Mattie B. Bowes, Chester, PA
Lawrence Bowman, Chester, PA
Henry A. Boyd, Chester, PA
Margaret V. Boyle, Brookhaven, PA
Brandywine Conservancy, Chadds ford, PA
Brandywine Valley Association, West Chester, PA
Jason E. Breeden, Brookhaven, PA
Karen Brooks, Brookhaven, PA

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Organizations and Individuals (cont'd)

Alfred & Jeanne Brower, Brookhaven, PA
Carl T. & Debra Jean Brown, Brookhaven, PA
James T. & Josephine Brusenham, Chester, PA
Ella D. Bryant, Chester, PA
Walter M. Burch, Jr., Chester, PA
David Burk, Brookhaven, PA
James T. Jr. & Cheryl L. Burke, Brookhaven, PA
James B. & Paula M. Cadden, Brookhaven, PA
Mr. John Campanelli, Glenn Mills, PA
Anthony & Joan Canci, Brookhaven, PA
Michael D. Cannon, Wallingford, PA
Kevin Carroll, Chester, PA
Chester Township, Chester, PA
City of Chester, Veteran's Memorial Park, Chester, PA
Arthur E. Colby Jr., Brookhaven, PA
Community of Christ, Light of Hope, Rev. James Reed, Philadelphia, PA
Lou Cordivari, PennDot, Pennsylvania Department of Transportation, Media, PA
John J. Coscia, Executive Director, Delaware Valley Regional Planning Commission, Philadelphia, PA
Sophie R. & Ronald J. Crepack, Brookhaven, PA
Mr. B. Crimmins, VP Facilities, Chester Community Hospital, Brookhaven, PA
George Crum, Southwest Delaware County Municipal Authority, Aston, PA
Debra Culbert, Brookhaven, PA
William E. Dallam, Chester, PA
George H. Daly, Havertown, PA
Steve D'Angelo, Danbro L.P., Philadelphia, PA
William R. & Terry E. Davis, Chester, PA
Terence C. Davis, Donna McPartlan, E. Fallowfield, PA
Alvin D. Daviston, Jr., Chester, PA
Linda A. Dawson, Chester, PA
Dante N. Deannuntis, Media, PA
Ralph Delorenzo, Brookhaven, PA
William & Patricia DeMaio, Brookhaven, PA
James F. & Deborah A. Devlin, Brookhaven, PA
Roger Dickson, Rhonda D. Dickson, Brookhaven, PA
Joe Digulia, VP-GM Delaware County, Comcast Cablevision of Southeast PA, Inc., Wallingford, PA
Theo Dobrowolski, Brookhaven, PA
Mr. Barry Dony, American Atlantic Company, King of Prussia, PA
Michael J. & Mary Ann Dougherty, Brookhaven, PA
Don Dowd, Anthony's Home Improvement, Inc, Chester, PA
Dorothy M. Draper, Chester, PA
Nellie Duke & Fahd R. Youssef, Chester, PA
William J & Elsie G. Dunn, Brookhaven, PA
David A. & Michelle V. Duplicki, Brookhaven, PA
James, Ruth & Gilbert Emerson, Chester, PA
Gregory O. Evans, Mickael K. Evans, Chester, PA
Helen Evans, Chester, PA
Otis & Helen L. Evans et al, Chester, PA
James T. Faley, Jr., Evelyn Faley, Chester, PA

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Organizations and Individuals (cont'd)

Thomas M. Fasbinder, Brookhaven, PA
William N. Fenimore, Brookhaven, PA
Allen Egner Beers, Brookhaven, PA
Robt E. & Claire Finucane, Brookhaven, PA
Derek R. Flanagan, Brookhaven, PA
Mike Floyd, Philadelphia, PA
Joseph P. & Jean Foster, Brookhaven, PA
Maureen Patricia Gallagher, Brookhaven, PA
LTC George Gallenthin, Philadelphia, PA
Joseph & Rose Garrity, Brookhaven, PA
Mayor Ralph Garzia, Borough of Brookhaven, Brookhaven, PA
Stephen & Louise Gogatz, Brookhaven, PA
Anthony Grasso, Deccon Buildings, Drexel Hill, PA
George G. & Patricia A. Grier, Chester, PA
Thomas J. Gurick, Chairman, Delaware Valley Regional Planning Commission, The Brouse Building, Philadelphia, PA
James & Dorothy T. Hall, Chester, PA
Albert A. & Tonya D. Haman, Chester, PA
Sylvia Handy, Chester, PA
Stephen J & Gerrie L. Harman, Brookhaven, PA
Frederick & Mary J. Harmer, Brookhaven, PA
David & Marietta Harper, Chester, PA
Garrett R. & Debbie A. Hartzell, Brookhaven, PA
Marcus W. & Joanne Haseltine, Brookhaven, PA
Thomas Hemingway, Chester, PA
Donna Henry, Chester, PA
John W. Jr. & Thersa A. Henry, Brookhaven, PA
Joseph & Maxine Henson, Chester, PA
David Hessil, Brookhaven, PA
Christina Hill, Chester, PA
Robert & Sheryl Hoffman, Brookhaven, PA
Richard Holmes et ux, Brookhaven, PA
William Houpt, Jean E. Houpt, Ridley Park, PA
John Huczko, Brookhaven, PA
Housing & Urban Development, Philadephia, PA
Frank J. Huessen, McAllister Towing of Philadelphia, Philadelphia, PA
Jerry Hunt, Manager of Philadelphia Zone Operations, Frito Lay, Inc., King of Prussia, PA
Catherine R. Huppman, Brookhaven, PA
Joseph & Patricia Iacono, Brookhaven, PA
Cero & Elizabeth Iannucci, Brookhaven, PA
Samuel & Joan Impagliazzo, Brookhaven, PA
Joshua L. & Denise L. Irvan, Brookhaven, PA
Eugene J. Jablowski, Jr., Chester, PA
Raymond & Marlene Jackson, Chester, PA
William J. Jennings, Brookhaven, PA
Howard & Kathleen Johnson, Brookhaven, PA
Mae B. Johnson, Brookhaven, PA
William & Lydia Johnson, Brookhaven, PA

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Organizations and Individuals (cont'd)

Willie L. & Anna B. Johnson, Chester, PA
Edward & Lisette Jones, Brookhaven, PA
Ms. Jan Kalb, White Clay Watershed, Landenberg, PA
Patrick Killian, Executive Director, Redevelopment Authority of Delaware County, Media, PA
Cottman Kirkwood, Myrtle Starkey, Chester, PA
Andrey D. & Vera Kisha, Brookhaven, PA
Stanley Klemaszewski, Brookhaven, PA
Mahmoud Kneifati, Chester, PA
Michael Kolar, Rivertown Developers LP, Conshohocken, PA
John P. Koliba, Brookhaven, PA
Edward T. Kozlowski, Brookhaven, PA
Mr. Phil Kraus, Landenberg, PA
Jay S. & Harriet W. Kravitz, Brookhaven, PA
Donald Krupa, Chester, PA
Maya Kvan-Rossum, Delaware River Keepers, Washington Crossing, PA
Carolyn J. Langley, Brookhaven, PA
John F. & Mary L. Larison, Brookhaven, PA
Wm & Eliz C. Lawlor, Brookhaven, PA
Helen Lawrence, Chester, PA
Marcus A. & Heather J. Leclerc, Brookhaven, PA
Richard Lehr, Manager/Secretary, Aston Township, Aston, PA
Charles H. Leslie, Brookhaven, PA
Hal Lindsay, Faith Baptist Church, Wayne, PA
Hal Lindsay, Faith Community Church of Brookhaven, Wayne, PA
Hal Lindsay, Strategis Property Trust LLC, Wayne, PA
Walter A. Linewicz, Brookhaven, PA
James & Sonia Long, Wallingford, PA
Tamara Long, Wallingford, PA
Stephen M. & Nichole A. Lorenski, Brookhaven, PA
Hardy D. & Ella R. Lundy, Chester, PA
Howard W. & Christine E. Maier, Brookhaven, PA
Moses Manley, Chester, PA
Samuel Manley, Chester, PA
Paulette Mapp, West Grove, PA
Christine Margetich, Brookhaven, PA
Victor M. & Zaida M. Martinez, Brookhaven, PA
Marc Marusco, Linwood, PA
George & Olga Matuszewski, Brookhaven, PA
Robert J. & Christine May, Aston, PA
Lorena Mayer, Brookhaven, PA
Vernel Mayo, Chester, PA
John H & Ann Marie McCarthy, Brookhaven, PA
James & Judith McClain, Brookhaven, PA
Willie & Louise McClairen, Chester, PA
Mary C. & Carol A. McCloskey, Brookhaven, PA
Carl P. McCollough, Brookhaven, PA
John A. McDermott Jr., Brookhaven, PA
John M. & Bridget E. McGill, Brookhaven, PA

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Organizations and Individuals (cont'd)

Joseph & Barbara McGonigle, Brookhaven, PA
Edward J. & Doris A. McKay, Brookhaven, PA
Norfolk Southern Railway Company, c/o James McKay, DMJM+HARRIS, Harrisburg, PA
Oliver McNair, Foster H. McNair, Chester, PA
Foster McNair et al, Chester, PA
Raymond P. Meloni, Norwood, PA
Joseph R. Metzger, Jr., Joseph Skulski, Jr., Glen Mills, PA
Robert A. Michaliszyn, Brookhaven, PA
James D. Miller, West Chester, PA
Veneta N. Miller, Brookhaven, PA
Doreen Miller, Bessie White, Chester, PA
Joseph J. Monroe, Brookhaven, PA
David Montella, Brookhaven, PA
William J. Moran, Media, PA
Doug Moser, Boothwyn, PA
Kent Murphy, Exelon Business Services Company, Philadelphia, PA
Frank & Mellissa Myers, Brookhaven, PA
Ronald J. Jr. & Christine D. Probert, Brookhaven, PA
Wilfred & Doris R. Negron, Brookhaven, PA
Cary Nicholas, Executive Director, Audubon Pennsylvania State Office, Harrisburg, PA
Raymond E. Nowsatha, Brookhaven, PA
Christopher J. Oakley & Carolyn Fry, Brookhaven, PA
Alice M. Obrien, Chester, PA
Michael O'Brien, Brookhaven, PA
Bernard J. Orensky, Brookhaven, PA
Bill Orr, Real Estate Supervisor, Verizon, Upper Darby, PA
Thomas W. & Alethea Ouderkirk, Chester, PA
Michael T. Oziraky, Brookhaven, PA
Pennsylvania Department of Transportation, District 6, King of Prussia, PA
Armand C. Pace, Media, PA
Paolella Construction Company, Lawrence J. Sr. & Melinda K. Paolella, Media, PA
Shantibhai & Bhanuben S. Patel, Brookhaven, PA
William T. III & Cheryl A. Peabody, Brookhaven, PA
Nerissa Pepito, Stroehmann Bakeries, L.C., Horsham, PA
Carl A. & Mary S. Petka, Brookhaven, PA
Donald B. Phillips, Brookhaven, PA
Bill Pisarek, Township Manager, Chester Township, Chester, PA
Gerald Piscotty, Brookhaven, PA
Robert L. Polishuk, Media, PA
Jay R. Pollard, Brookhaven, PA
Mark & Cathy M. Pollock, Brookhaven, PA
Denise Poole, Brookhaven, PA
Frank Potter, Chester, PA
George R. & Blanche M. Price, Chester, PA
David Prox, Brookhaven, PA
Annette Pyatt, Chester, PA
Bill Quinn, Area Supervisor, Texas Eastern Transmission, LP, Uwchland, PA
Robert J. & Stacey L. Raker, Brookhaven, PA

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Organizations and Individuals (cont'd)

William J. & Lisa M. Ravert, Chester, PA
Stephen & Beth Ann Reinhart, Brookhaven, PA
Jacqueline L. Rinaldi, Brookhaven, PA
Heriberto & Mary Rosario, Chester, PA
Paul Royer, Duke Energy Gas Transmission, Uwchland, PA
Richard A. & Karen M. Ruark, Brookhaven, PA
Richard N. Rudolf, Chester, PA
Patricia Salvadore, Frances Brady, Brookhaven, PA
Donald R. & Caterina F. Salvino, Brookhaven, PA
Nicholas Sanbe, Ronald P. Lee, Chester, PA
Richard W. & Agnes D. Sands, Brookhaven, PA
John Savoy, SMS, Inc., Aston, PA
David Allen & Lynn M. Saxton, Brookhaven, PA
Peter C. Schlett, Chester, PA
David Scioechitti, Executive Director, Redevelopment Authority of Chester, Chester, PA
Jane Segal, Merrill Sporkin, Villanova, PA
Charles J. & Kristen D. Seitz, Brookhaven, PA
Joseph P. Shannon, Havertown, PA
Patricia J. Shober Dubolino, Brookhaven, PA
Edward J. & Nora H. Short, Chester, PA
Elizabeth Jean Shrobak, Brookhaven, PA
Edward J. Siedleski, Brookhaven, PA
Sierra Club Pennsylvania Chapter, Harrisburg, PA
Walter D. & Kathleen Siko, Brookhaven, PA
James W. & Theresa L. Silva, Brookhaven, PA
Joseph R. Simeone, Rosemary Simeone, Wallingford, PA
Larry Simmons, Brookhaven, PA
Robert C. & Elizabeth P. Singley, Brookhaven, PA
Michael & Gina Skinner, Chester, PA
John K. & Dixie Skolnicki, Brookhaven, PA
James & Ann Skulski, Brookhaven, PA
John A. & F. Kristine Skulski, Brookhaven, PA
Rodney Stark, Exelon Generating, LLC, Philadelphia, PA
Gretchen R. Starkey, Chester, PA
Mary F. Stroffolino, Brookhaven, PA
Sun Pipeline Company, Philadelphia, PA
William & Julia Tabron, Chester, PA
Delaware County Tax Claim Bureau, Media, PA
Delinquent Tax Claim Bureau, Delaware County, Media, PA
Anne Taylor, Brookhaven, PA
Bruce A. & Suzanne M. Tharp, Brookhaven, PA
Steven D. & Pamela Theisen, Boothwyn, PA
Clarence C. & Therest Thomas, Chester, PA
Robert & Clara Thomas, Chester, PA
Albert A. & Kim Y. Thompson, Chester, PA
Sylvester & Arcisa Thompson, Chester, PA
Philip M. Tigue, Aston, PA
Joseph H. Tran, Kim Nguyen, Brookhaven, PA

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Organizations and Individuals (cont'd)

Pasquale Travaglini, Brookhaven, PA
Thomas V. Travaglini, Brookhaven, PA
Michael Trout, Brookhaven, PA
James R. & Mary A. Turk, Brookhaven, PA
Robert N. Turner, Brookhaven, PA
Walter Twardowski Jr., Boothwyn, PA
McKinley & Barbara Tyler, Chester, PA
Robert & Michelle Velez, Brookhaven, PA
Daniel B. Vicario, Brookhaven, PA
Rosemarie Walls, Brookhaven, PA
Charlie L. Warren II, Chester, PA
Hector A. & Pamela D. Watson, Chester, PA
Dr. Joyce Wells, Principal, Toby Farms Elementary School, Chester, PA
Karl Westerville, Project Leader, Rivertown Developers, LP, Conshohocken, PA
A. Simeon & Victoria Whitehill, Lima, PA
Robert Wicker, Brookhaven, PA
Kimberly Wilcox, Chester, PA
Curtis Williams, Chester, PA
Thomas & Sallie Williams, c/o Richard Berry, Chester, PA
Kevin P. Williamson, Brookhaven, PA
Margaret Williamson, Chester, PA
James & Betty L. Wilson, Chester, PA
John J. Jr. & Lorraine M. Wilwert, Brookhaven, PA
Isabel Wimmer, Aston, PA
John B & Patricia A. Winters, Brookhaven, PA
Jonathan & Alana Winters, Brookhaven, PA
Charles Witomski, Bridgewater Associates, Chester, PA
Ronald & Dorothy C. Wood, Brookhaven, PA
Lloyd Yarnell, Brookhaven, PA
John E. Youngdahl, Amtrak, Philadelphia, PA
George Zagame, Jr., Brookhaven, PA
Ehab M. & Tina Zahran, Brookhaven, PA

Nell Gutierrez, Duke Energy Regulatory Affairs, Houston, TX
J. Patrick Tielborg, Pipeline Contractors Association, Dallas, TX

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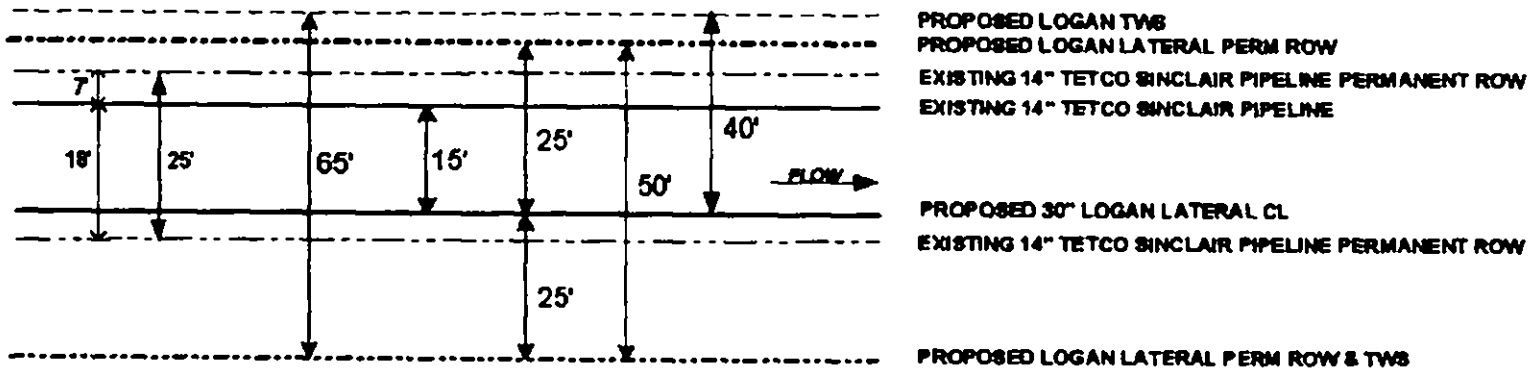
APPENDIX B

TYPICAL RIGHT-OF-WAY CROSS SECTIONS



MP 0.00 TO 0.10

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections

Configuration Parallel to Existing 14-inch Pipeline

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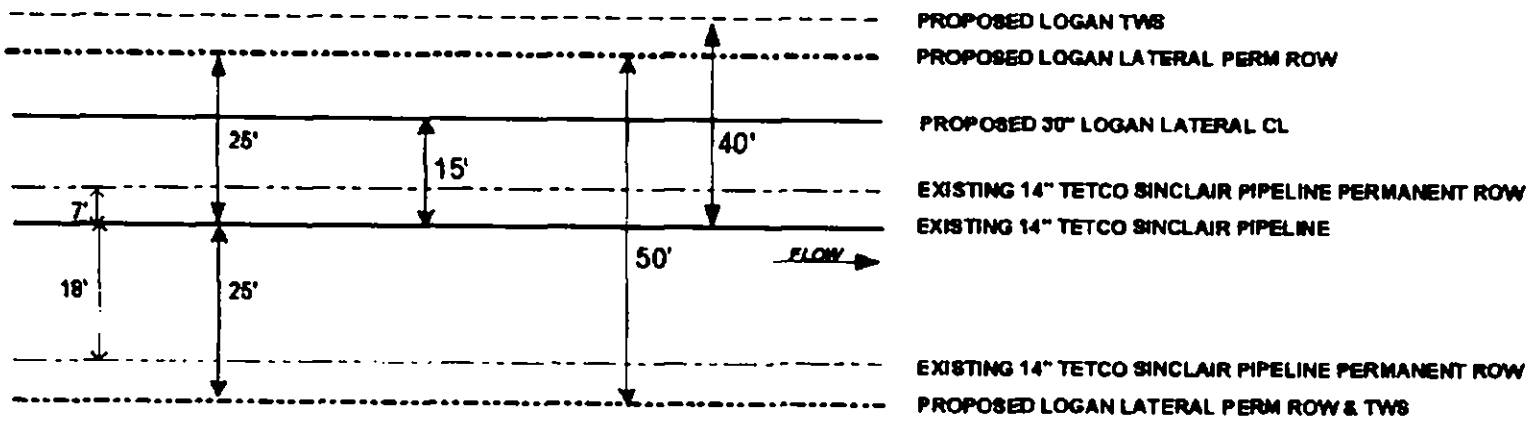

MP 0.10 TO 0.21
MP 1.21 TO 1.23

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B
Logan Lateral Project
Typical Right-of-Way Cross Sections
Configuration Parallel to Existing 14-inch Pipeline

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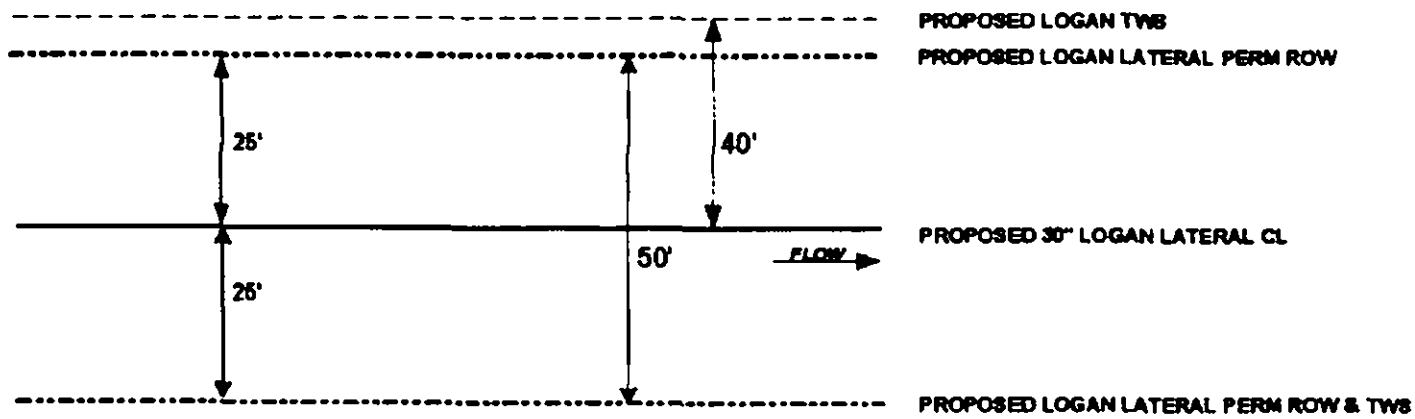

MP 0.21 TO 0.30

NOTE: PROPOSED PIPELINE ROUTED THROUGH AN EXISTING, PAVED PARKING LOT

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B
Logan Lateral Project
Typical Right-of-Way Cross Sections
Configuration of New Right-of-Way

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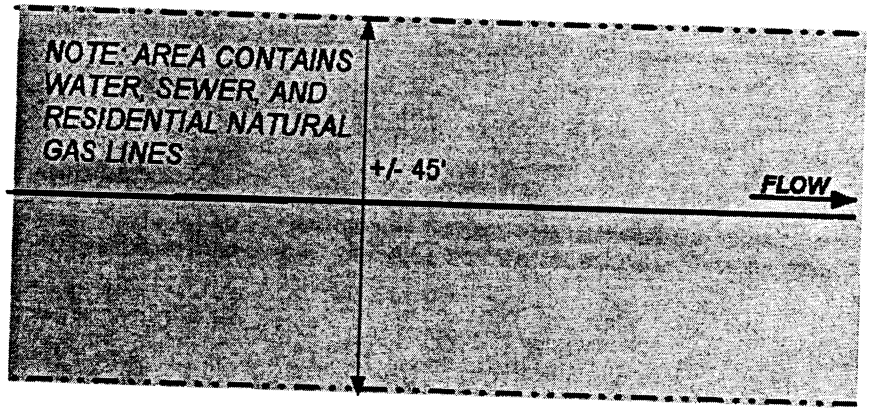

EXISTING ROAD ROW
PROPOSED LOGAN LATERAL BY PERMIT

PROPOSED 30" LOGAN LATERAL CL
30" PIPELINE TO BE PLACED WITHIN ROADWAY.
ACTUAL LOCATION WILL BE BASED ON EXISITING UTILITIES.

EXISTING ROAD ROW
PROPOSED LOGAN LATERAL BY PERMIT

MP 0.30 TO 1.19
MP 2.71 TO 2.92
MP 2.95 TO 3.15
MP 3.71 TO 4.00
MP 4.02 TO 4.20

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B
Logan Lateral Project
Typical Right-of-Way Cross Sections
Configuration through Existing Road or Railroad

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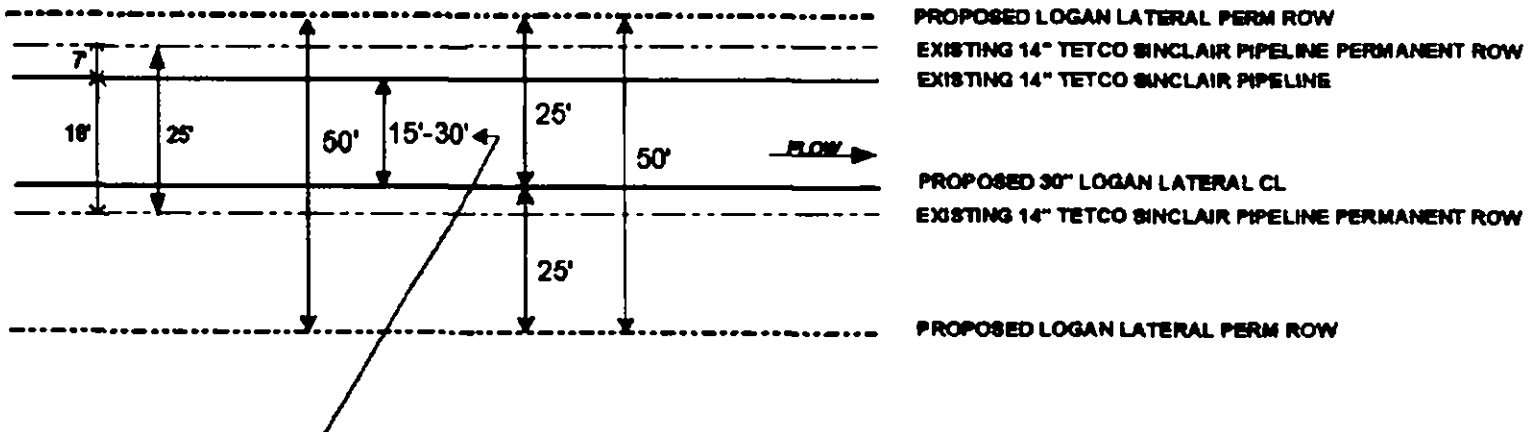

NOTE: SEPARATION BETWEEN LINES MAY CHANGE IN CONSIDERATION OF THE CONSTRUCTION METHOD SELECTED FOR THE CHESTER CREEK CROSSING

MP 1.23 TO 1.63

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections

Configuration Parallel to Existing 14-inch Pipeline

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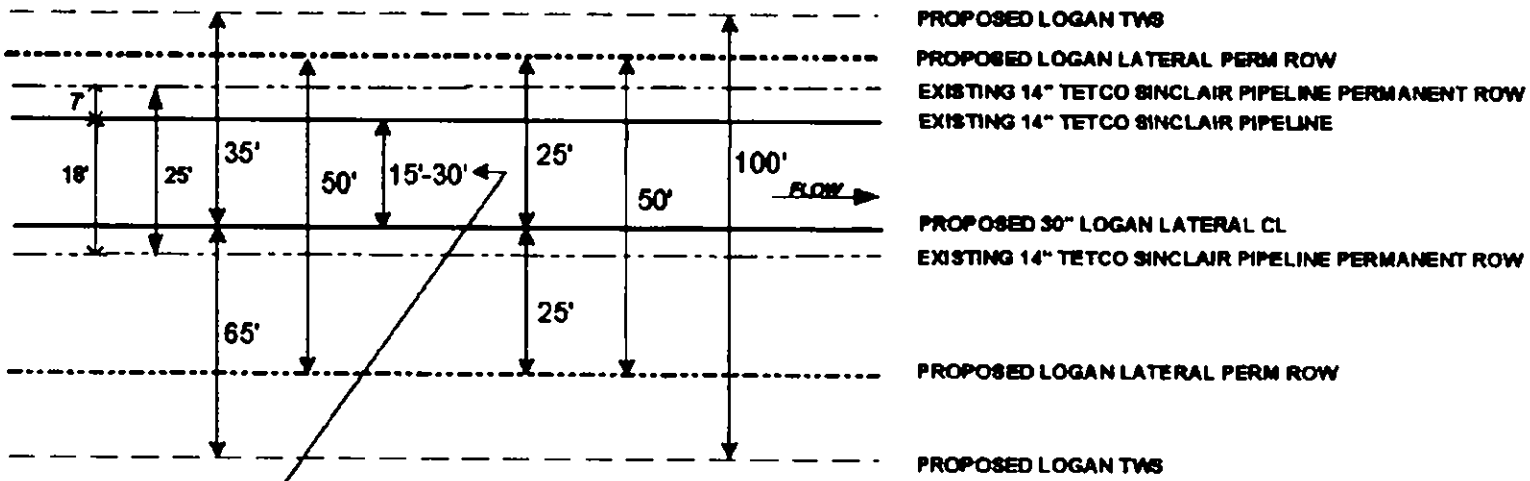

NOTE: SEPARATION BETWEEN LINES MAY CHANGE IN CONSIDERATION OF THE CONSTRUCTION METHOD SELECTED FOR THE CHESTER CREEK CROSSING

MP 1.63 TO 1.65

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections

Configuration Parallel to Existing 14-inch Pipeline

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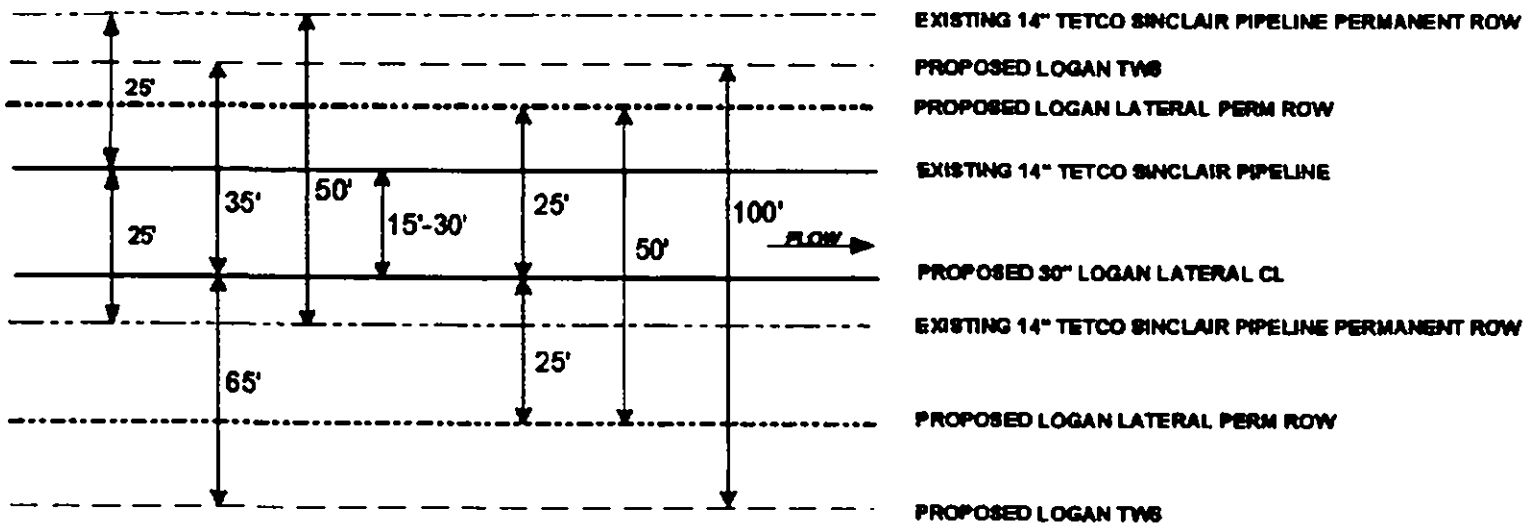


MP 1.65 TO 2.29

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

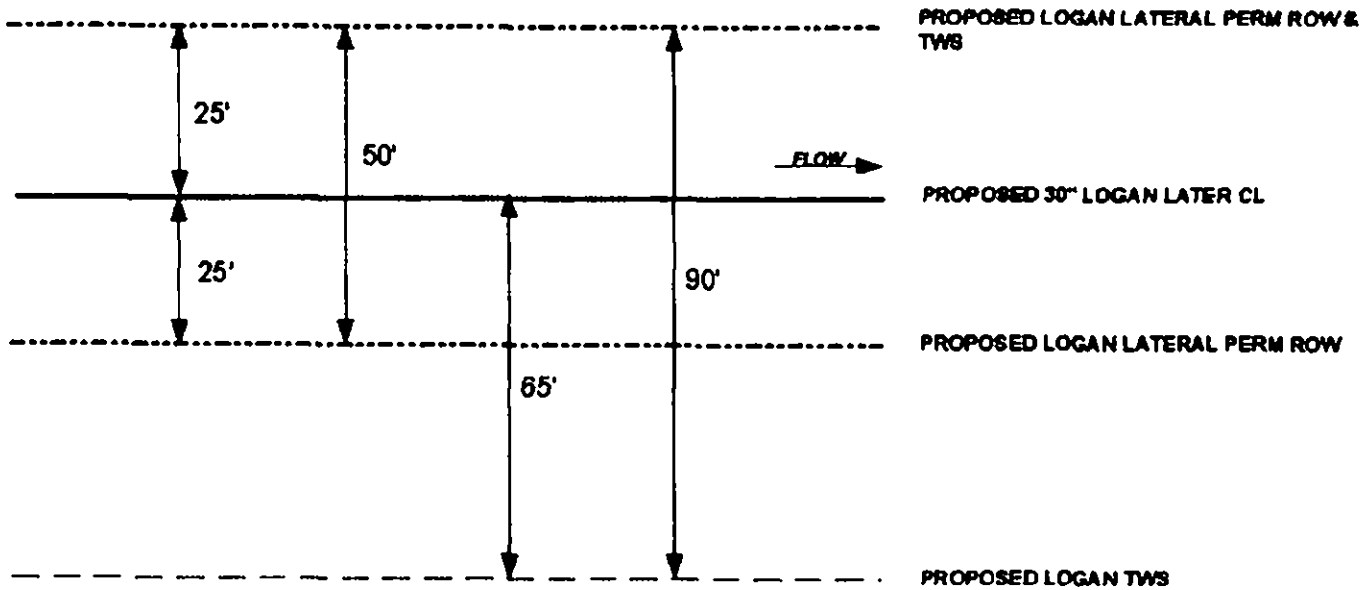
Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections

Configuration Parallel to Existing 14-inch Pipeline

Unofficial FERC-Generated PDF of 20050222-0062 Issued by FERC OSEC 02/18/2005 in Docket#: CP04-411-000



MP 2.29 TO 2.47

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

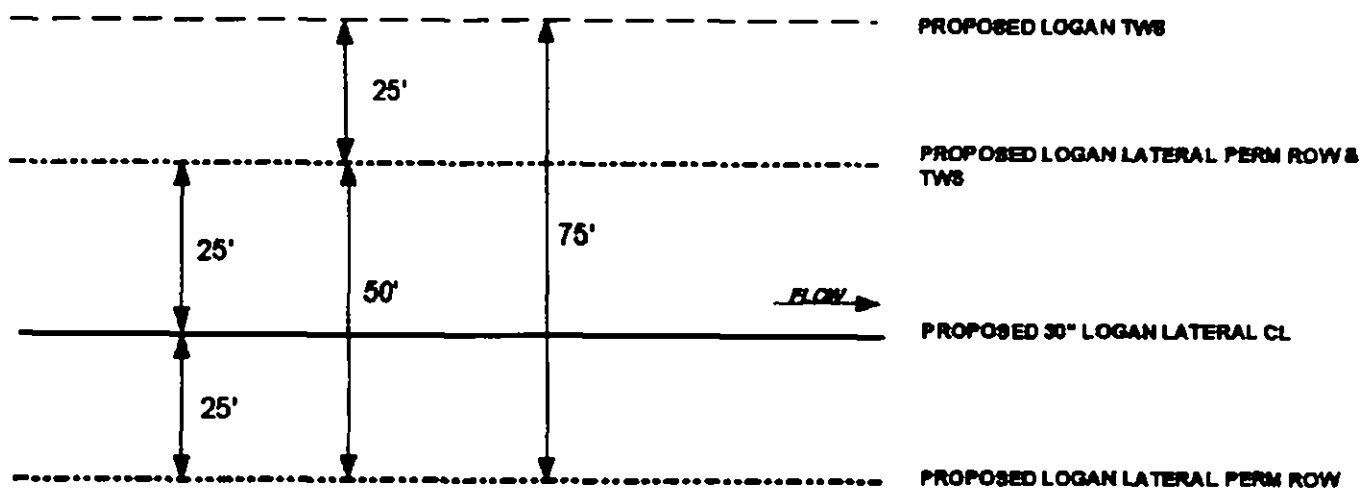
Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections

Configuration of New Right-of-Way

Unofficial FERC-Generated PDF of 20050222-0062 Issued by FERC OSEC 02/18/2005 in Docket#: CP04-411-000



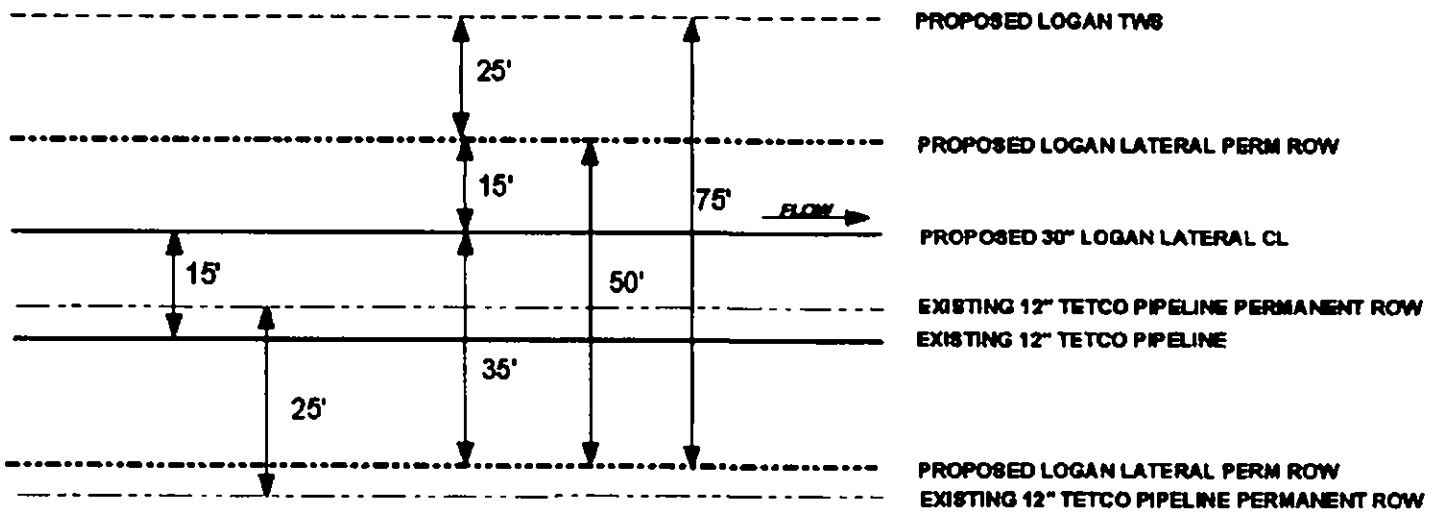
MP 2.47 TO 2.55

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B
Logan Lateral Project
Typical Right-of-Way Cross Sections
Configuration of New Right-of-Way

Unofficial FERC-Generated PDF of 20050222-0062 Issued by FERC OSEC 02/18/2005 in Docket#: CP04-411-000



MP 2.55 TO 2.71

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections

Configuration Parallel to Existing 12-inch Pipeline

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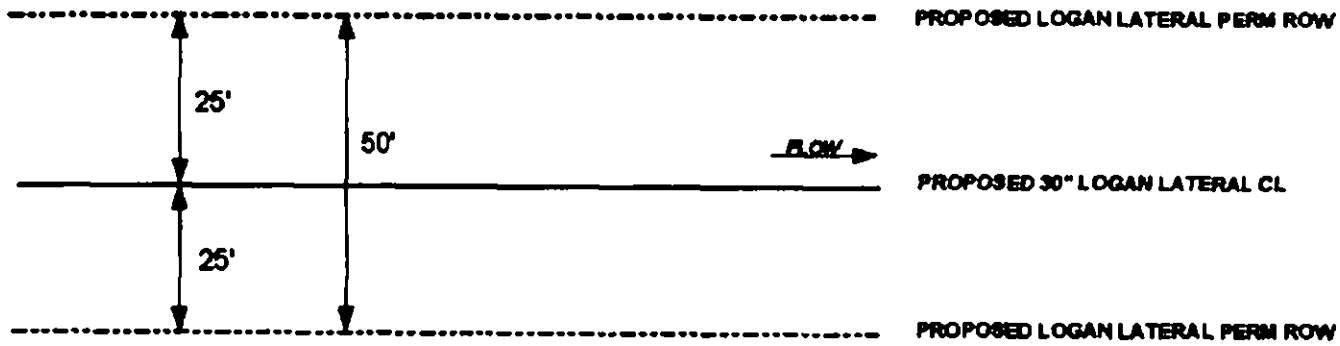

NOTE: TWS IS IRREGULARLY SHAPED. PLEASE REFER TO THE PROJECT ALIGNMENT SHEETS.

MP 2.92 TO 2.95
MP 3.44 TO 3.71
MP 4.20 TO 4.45

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B
Logan Lateral Project
Typical Right-of-Way Cross Sections
Configuration of New Right-of-Way

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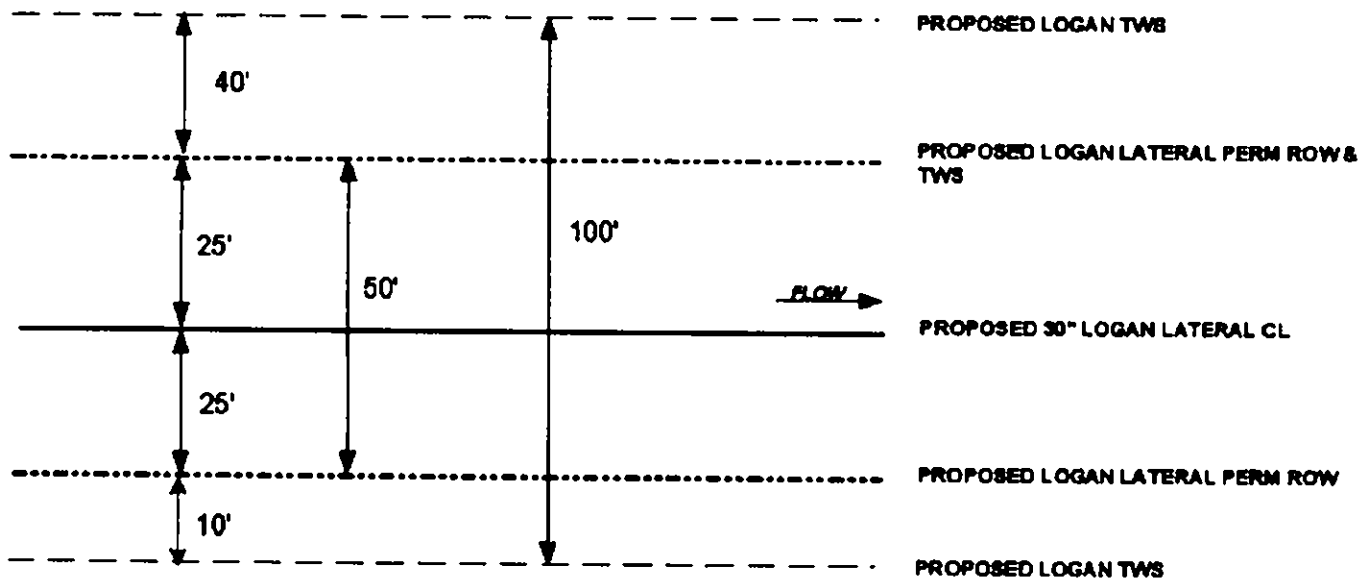

MP 3.15 TO 3.44
MP 7.35 TO 9.03

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections

Configuration of New Right-of-Way

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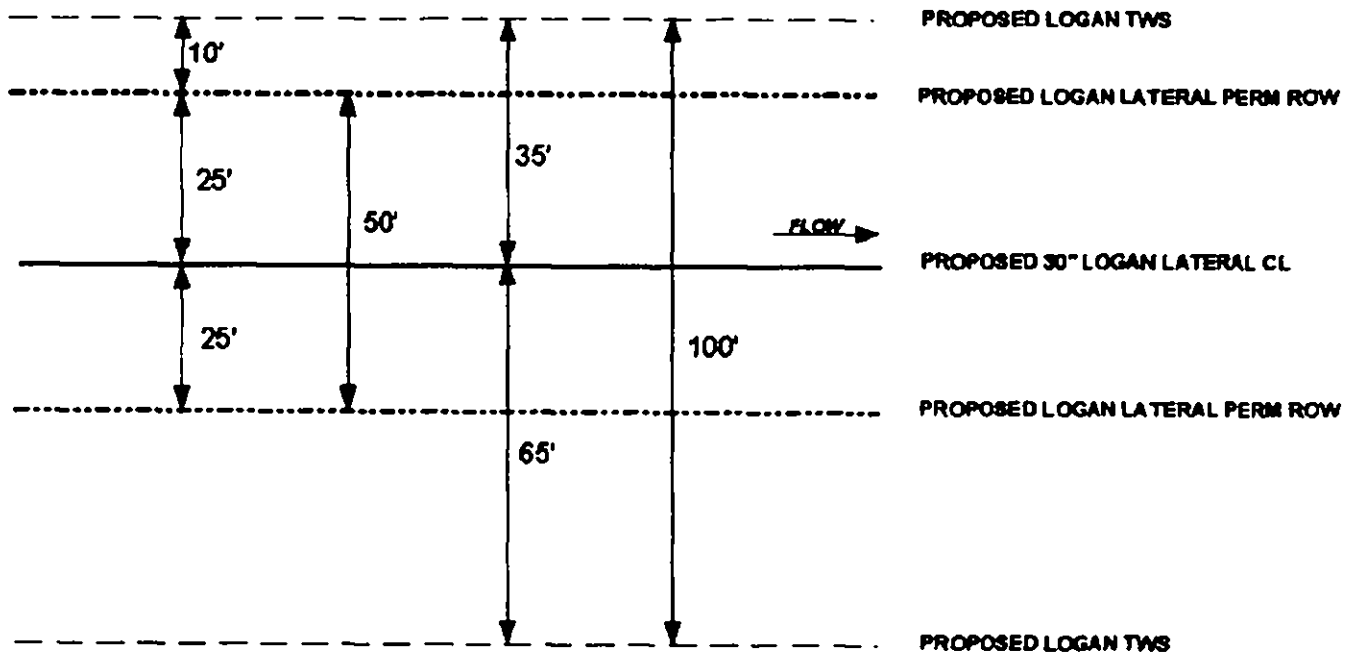

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

MP 4.00 TO 4.02

Appendix B
Logan Lateral Project
Typical Right-of-Way Cross Sections
Configuration of New Right-of-Way

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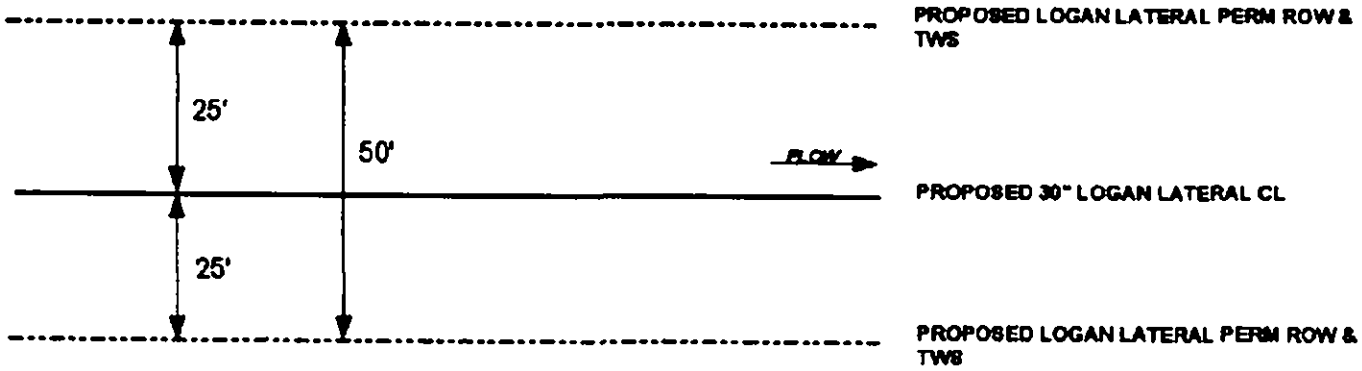

MP 1.19 TO 1.21
MP 4.45 TO 5.44
MP 6.90 TO 7.35
MP 9.03 TO 9.28

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- F PELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B
Logan Lateral Project
Typical Right-of-Way Cross Sections
Configuration of New Right-of-Way

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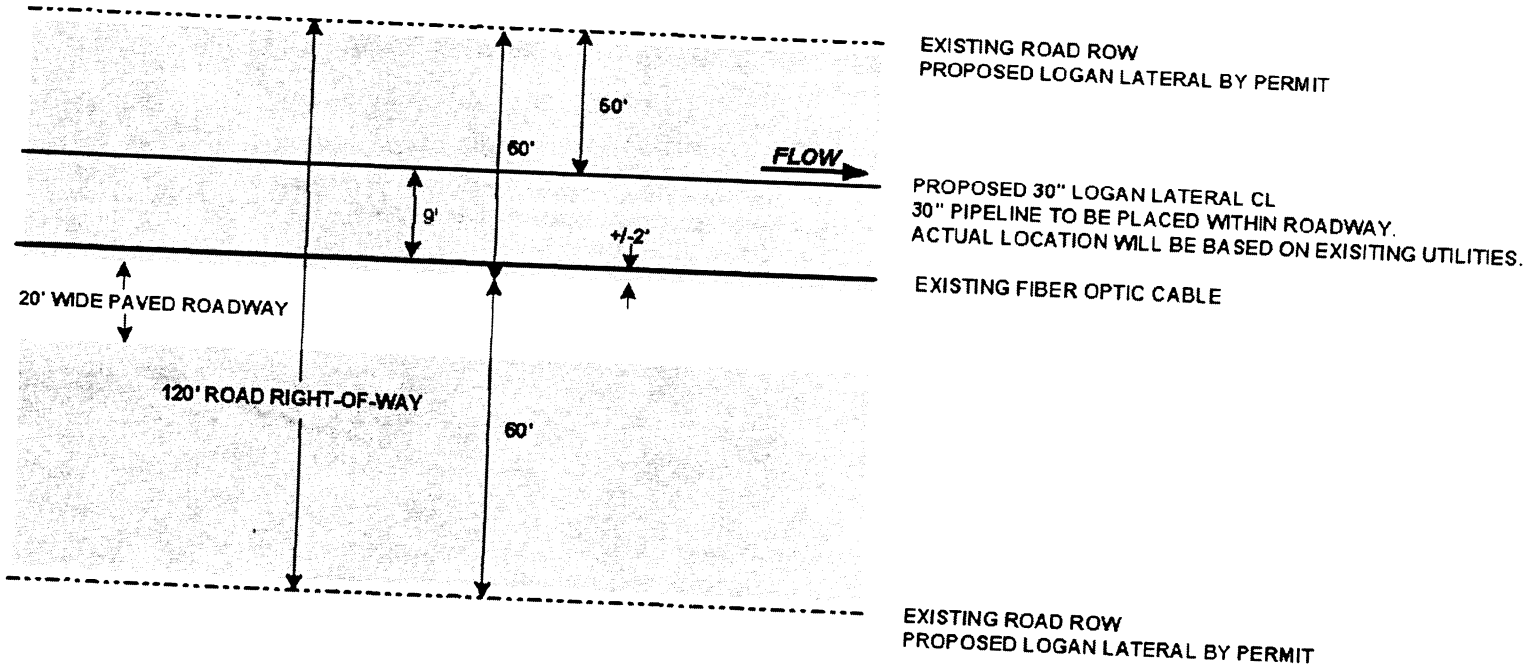

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

MP 5.44 TO 6.90

Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections
Configuration of Right-of-Way along Ferry Road

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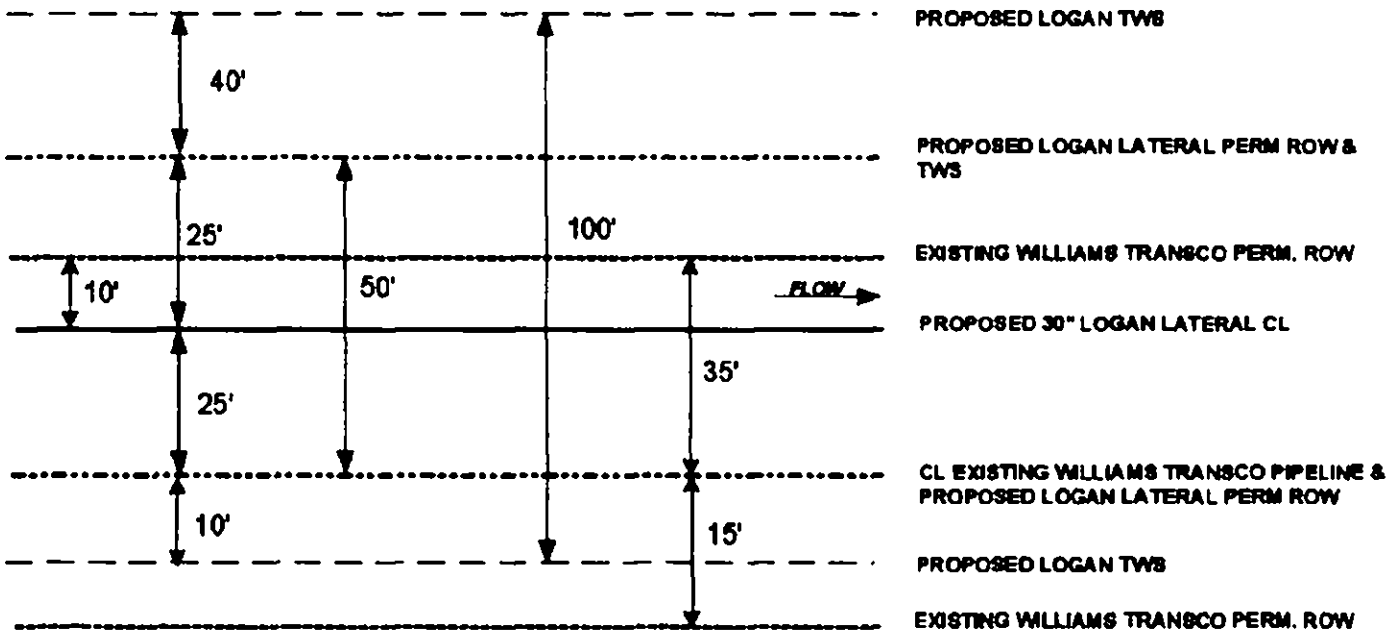

MP 9.28 TO 10.33

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections

Configuration Parallel to Existing Transco Pipeline

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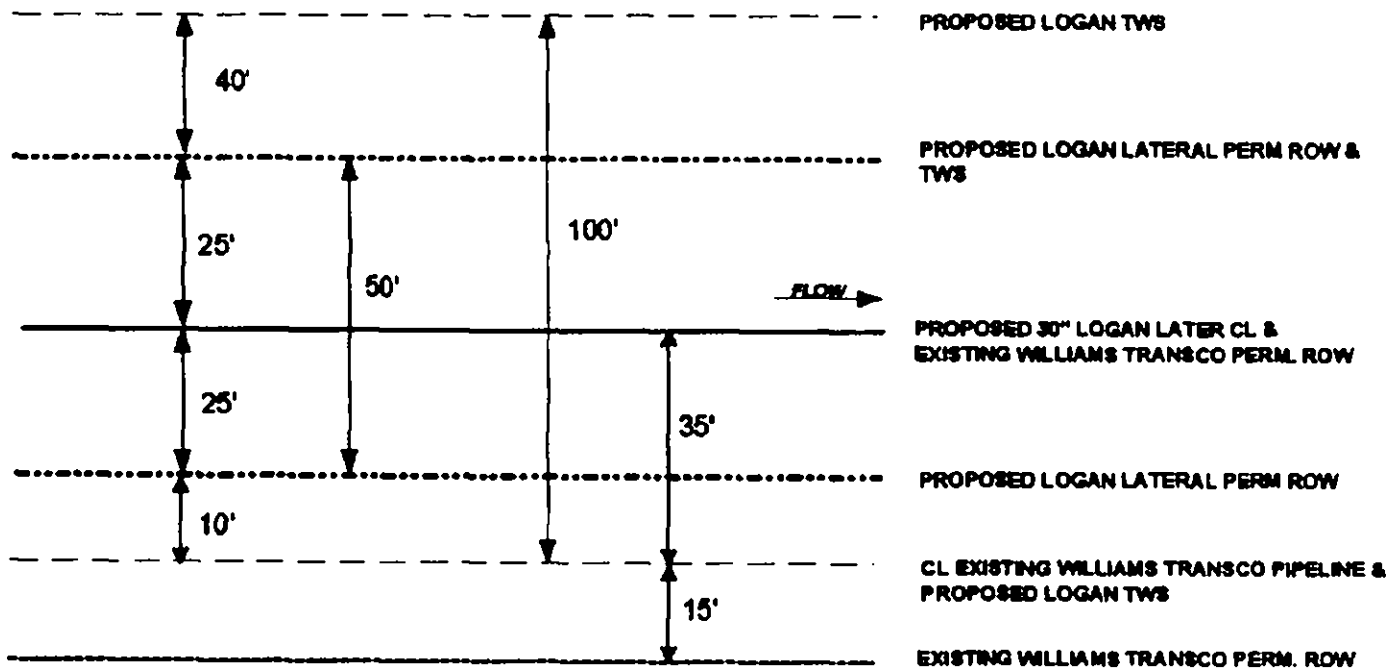

MP 10.33 TO 10.89

LEGEND

- TETCO 14' ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections

Configuration Parallel to Existing Transco Pipeline

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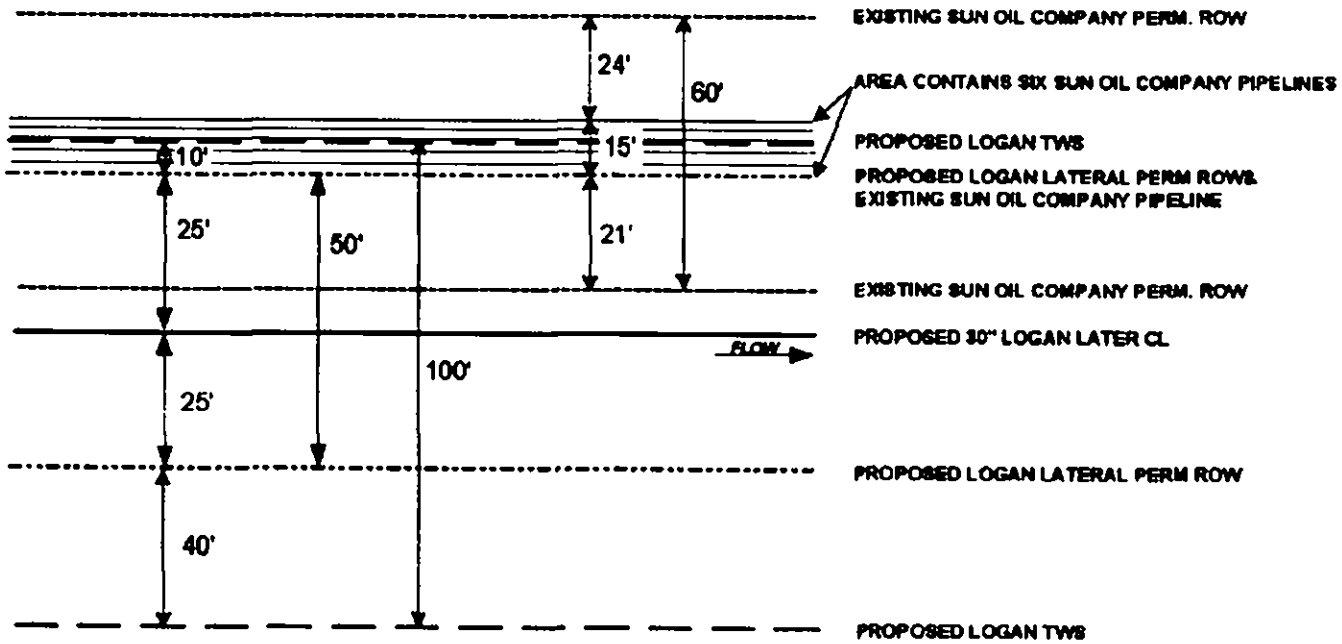

MP 10.89 TO 11.00

LEGEND

- TETCO 14" ROW
- LOGAN ROW
- PIPELINE
- LOGAN TEMPORARY WORK SPACE (TWS)

Appendix B

Logan Lateral Project

Typical Right-of-Way Cross Sections

Configuration Parallel to Existing Transco Pipeline

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APPENDIX C

TEMPORARY EXTRA WORKSPACES AND ACCESS ROADS

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TABLE C-1

Temporary Extra Workspaces Associated with the Logan Lateral Project

State	Milepost	Description	Dimensions (feet)	Acres
PENNSYLVANIA	0.00	Water source access	165x50	0.19
	0.19	Staging for road crossing	25x100	0.05
	0.28	Staging for road crossing	Irregular	0.09
	1.23	Staging for road crossing	110x300	0.68
	1.27	Staging for HDD	75x330	0.57
	1.57	Staging for HDD	100x200	0.42
	1.85	Staging for stream	35x100	0.08
	1.97	Staging for road crossing	35x135	0.10
	2.00	Staging for congestion	irregular	0.52
	2.18	Staging for congestion	irregular	0.07
	2.42	Staging for RR crossing	50x100	0.11
	2.46	Staging for RR crossing	25x100	0.05
	Off-site	Remote staging/wareyard	irregular	4.83
	2.95	Staging for road crossing	irregular	0.19
	3.01	Staging for street-lay	irregular	0.17
	3.05	Staging for street-lay	75x110	0.18
	3.06	Staging for street-lay	75x200	0.35
	3.41	Staging for street-lay	25x100	0.05
	3.44	Staging/wareyard	irregular	6.14
	3.71	Staging for RR crossing	irregular	0.55
	3.84	Staging for street-lay	75x180	0.27
	3.90	Staging for street-lay	125x130	0.37
	4.01	Staging for RR and congestion	irregular	0.39
	4.13	Staging/wareyard	irregular	5.33
	4.37	Staging for HDD	irregular	0.71
Pennsylvania Total				22.46
NEW JERSEY	5.37	Access for water source	irregular	0.22
	5.39	Staging for HDD	Irregular	0.80
	6.47	Material staging for HDD	irregular	5.26
	6.93	Staging for HDD	Irregular	2.99
	7.36	Staging for HDD	100x300	0.68
	7.38	HDD pullback area	50x1,700	1.99
	8.61	HDD material staging/contractor yard	irregular	28.75
	8.99	Staging for HDD	Irregular	0.46
	9.31	Staging for HDD	100x200	0.46
	9.54	Staging for road crossing	35x100	0.08
	9.56	Staging for road crossing	35x100	0.08
	9.73	Staging for road crossing	35x100	0.08
	9.75	Staging for road crossing	35x100	0.08
	9.86	Staging for RR crossing	35x100	0.08
	9.88	Staging for RR crossing	35x100	0.08
	10.00	Staging for road crossing	50x100	0.11
	10.03	Staging for road crossing	50x100	0.11
	10.22	Staging for waterway crossing	65x100	0.14

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TABLE C-1 (cont'd)

Temporary Extra Workspaces Associated with the Logan Lateral Project

State	Milepost	Description	Dimensions (feet)	Acres
	10.28	Staging for waterway crossing	35x100	0.08
	10.81	Staging for waterway crossing	35x350	0.28
	10.83	Staging for waterway crossing	50x100	0.11
	11.00	Staging for metering station	100x100	0.23
New Jersey Total				43.15
Project Total				65.61

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TABLE C-2

Access Roads Associated with the Logan Lateral Project

State	Milepost	Access Road #	Description a/	Width (feet)	Length (feet)	Acres
PENNSYLVANIA	0.00	PAR-0.00	Permanent access road. Existing private gravel road.	15	167	0.05
	1.66	TAR-1.66	Temporary access road. Existing private road, part paved and part gravel.	15	1,992	0.68
	2.11	PAR 2.11	Permanent access road. Existing paved parking lot and portion of new.	15	273	0.09
	2.64	TAR-2.64	Temporary access road. Existing private road.	15	333	0.11
	4.41	PAR-4.41	Permanent access road. Existing paved road.	15	350	0.12
Pennsylvania Total						1.05
NEW JERSEY	8.62	TAR-8.62	Temporary access road. Existing private dirt road.	15	3,361	1.15
	9.06	TAR-9.06	Temporary access road. Existing private road, part paved and part dirt.	15	868	0.29
	9.49	TAR-9.49	Temporary access road. Existing private dirt road.	15	70	0.02
	9.56	TAR-9.56	Temporary access road. Existing private dirt road.	15	50	0.02
	9.74	TAR-9.74	Temporary access road. Existing private paved road.	15	230	0.07
	10.02	TAR-10.02	Temporary access road. Existing private paved and dirt road.	15	5,211	1.79
New Jersey Total						3.34
Project Total						4.39

a/ *Modifications would only be made to gravel roads and would only consist of the addition of gravel.*

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APPENDIX D

TEXAS EASTERN'S SOIL EROSION AND SEDIMENTATION CONTROL PLAN

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EROSION AND SEDIMENTATION CONTROL PLAN

Company: Texas Eastern Transmission, L.P.

Project: **Logan Lateral Project**

Location: **Pennsylvania and New Jersey**

Prepared by:

Environmental Construction Permitting
5400 Westheimer Court, SP-777
Houston, Texas 77056-5310

and

ENSR International
2005 Cabot Boulevard
West Suite 100
Langhorne, Pennsylvania 19047-1810

Effective May 1, 2004

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1. INTRODUCTION

1.1 Purpose of this Plan

This Erosion and Sedimentation Control Plan (Plan) has been prepared for use by Texas Eastern Transmission, L.P. (Texas Eastern or Company) and its contractors as a guidance manual for minimizing erosion of disturbed soils and transportation of sediments off the right-of-way (ROW) and into sensitive resources (wetlands, streams, and residential areas) during natural gas pipeline construction. The procedures developed in this Plan, which represent the Company's best management practices, are designed to accommodate varying field conditions while maintaining rigid minimum standards for the protection of environmentally sensitive areas.

This Plan is designed to provide specifications for the installation and implementation of soil erosion and sediment control measures while permitting adequate flexibility to use the most appropriate measures based on site-specific conditions. The intent of this Plan is to provide general information on the pipeline construction process and to describe specific measures that will be employed during and following construction to minimize impacts to the environment along the pipeline ROW.

The goal of this Plan is to preserve the integrity of environmentally sensitive areas and to maintain existing water quality by implementing the following objectives:

- Minimize the extent and duration of disturbance;
- Protect exposed soil by diverting runoff to stabilized areas;
- Install temporary and permanent erosion control measures; and
- Establish an effective inspection and maintenance program.

1.2 Guidelines and Requirements

The measures described in this Plan have been developed based on guidelines from the Federal Energy Regulatory Commission (FERC), United States Army Corps of Engineers (COE), the United States Fish and Wildlife Service (USF&W), the United States Department of Agriculture, and the Natural Resource Conservation Service, as well as from the Company's significant experience and practical knowledge of pipeline construction and effective environmental protection measures. Lessons and insights gained during pipeline construction projects along the Company's pipeline system and comments from agency representatives are also incorporated into this Plan.

Any deviation from the placement of the structures specified in the construction drawings, or changes in the design of control measures as set forth in this Plan, must be approved by the Company's Environmental Construction Permitting Department and must have the concurrence from the appropriate permitting agency.

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1.2.1 Variance from FERC Requirements

Pursuant to changes in the FERC regulations, interstate pipeline companies are now required to comply with the FERC's Upland Erosion Control, Revegetation, and Maintenance Plan and the FERC's Wetland and Waterbody Construction and Mitigation Procedures (Plan and Procedures, 1/17/2003 Version), unless approval to deviate from the Plan and Procedures is received from the appropriate state agency.

The following identifies the differences between this Plan and the FERC's Plan and Procedures as well as the reasons behind the differences:

1. FERC Plan (Section V.C.1 and V.C.3): Perform compaction testing in residential areas disturbed by construction activities and perform appropriate soil compaction mitigation in severely compacted residential areas.

   This Plan: Compaction testing and mitigation are not required in residential areas.

   Reason to Deviate: This Plan requires that topsoil either be segregated or replaced in residential areas. Topsoil that is segregated or replaced results in little compaction and provides a suitable medium for grass. Most yard areas that are sown in grass do not require deep root penetration. In the event that the grass needs deeper root penetration, the subsequent freeze-thaw cycles of the upper portions of the subsoil will provide natural mitigation of any compacted areas of the ROW within 2-3 years. Post-construction monitoring will be conducted during this timeframe as discussed in Section 8.1.

1.2.2 Variances from State Requirements

In developing this Plan, Texas Eastern has reviewed soil and erosion controls standards established in Pennsylvania and New Jersey. For Pennsylvania, Texas Eastern has reviewed the Pennsylvania Department of Environmental Protection (PADEP), Bureau of Water Quality Protection's manual entitled "Underground Utility Line Construction, Typical Erosion and Sediment BMP's (document number 363-2134-012). For New Jersey, Texas Eastern has reviewed the New Jersey State Soil Conservation Committee's manual entitled "Standards for Soil Erosion and Sediment Control in New Jersey". Although this Plan is consistent with both states' overall erosion and sediment control programs, several variances are proposed to reflect FERC and project specific requirements. The proposed variances to the Pennsylvania and New Jersey standards are summarized in Tables 1.2.2-1 and 1.2.2-2, respectively. It should be noted that more variances to the New Jersey standards are proposed because the associated manual is not specifically tailored for utility line construction, as is the PADEP manual.

TABLE 1.2.2-1
PROPOSED VARIANCES FROM THE PADEP'S UNDERGROUND UTILITY LINE CONSTRUCTION, TYPICAL EROSION AND SEDIMENT BMP'S

No.	VARIANCE	RATIONALE
1	Subject No. 8: Maintenance of BMPs – Upon completion of earth disturbance activities on the project (or while construction on the right-of-way is halted for winter), Texas Eastern proposes to inspect BMPs weekly or after major rain events (1/2 inch rain or more).	Upon completion of the earth moving activities (either completion of construction or suspension of activity for the winter), the construction site is stabilized and will need less frequent monitoring.
2	Subject No. 10: Rock Construction Entrance – Texas Eastern proposes to use four to six inch rock *only* for rock access pad installation. No AASHTO No. 1 rock will be used (Figure 5).	Use of smaller than 4 to 6 inch rock, which may be included in the AASHTO No. 1 rock, could result in tracking of sediment/smaller stone onto roadways.
3	Subject No. 11: Access Road Crossing of Paved Road – Texas Eastern requests that the size of the flume pipe be determined by the particular situation (i.e. could be less than 12 inches in diameter, but not less than 6 inches in diameter) (Figure 25). The size of the pipe will be sufficient to prevent backwater flooding or roadway flooding.	The size of the pipe necessary to convey water in a bar ditch may impact the ability for equipment/vehicles to safely enter and exit roadways. Too large of a pipe would create a hump in the access road causing a potential impediment to continuous travel and may impact the ability for equipment/vehicles to safely enter and exit roadways.
4	Subject No. 12: Access Road Stream Crossing with Pipe Culverts – Texas Eastern proposes to use four to six inch rock *only* for access roads. No AASHTO No. 1 rock will be used. (Figure 28).	Use of smaller than 4 to 6 inch rock, which may be included in the AASHTO No. 1 rock, could result in tracking of sediment/smaller stone onto roadways.

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TABLE 1.2.2-1 (continued)
PROPOSED VARIANCES FROM THE PADEP'S UNDERGROUND UTILITY LINE CONSTRUCTION, TYPICAL EROSION AND SEDIMENT BMP'S

No.	VARIANCE	RATIONALE
5	Subject No. 12: Access Road Stream Crossing with Pipe Culverts Texas Eastern proposes that equipment bridges be optional for crossing minor (water width at the time of construction equal or less than 10 feet), non-state designated fisheries. Such waters can include intermittent drainage ditches and streams.	Texas Eastern does require equipment bridges for all state-designated fisheries and all streams regardless of fishery classification that have a water width greater than 10 feet at the time of construction.
6	Subject No. 12: Access Road Stream Crossing with Pipe Culverts – Texas Eastern proposes one pass through streams with equipment necessary for clearing and to build the equipment bridge.	Construction of an equipment bridge to support the load of the equipment utilized in this type of construction requires the clearing of banks and access to both sides of the stream to handle the bridge construction materials.
7	Subject No. 14: Swale/Ditch/Channel/Waterway Crossing – Where applicable (in areas where banks are sufficiently stable and where waterways are less than 15 feet wide), Texas Eastern proposes to use, as an option, mat bridges in lieu of flume pipes for the access road (Figure 27). All mats will be placed such that they will go from bank to bank.	For smaller waterways and channels, use of a mat bridge will result in less disruption to the waterway or channel than a flume pipe crossing.
8	Subject No. 14: Swale/Ditch/Channel/Waterway Crossing - Texas Eastern proposes the dam and pump method (Figure 31) as an alternative dry stream crossing procedure to the flume crossing.	This method is intended for use at perennial waterbodies (minor and intermediate) up to 30 feet wide and state designated fisheries. The dam and pump procedure allows for more space and flexibility during trenching and pipe installation, which shortens the duration of time spent at the waterbody.

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TABLE 1.2.2-1 (continued)
PROPOSED VARIANCES FROM THE PADEP'S UNDERGROUND UTILITY LINE CONSTRUCTION, TYPICAL EROSION AND SEDIMENT BMP'S

No.	VARIANCE	RATIONALE
9	Subject No. 15: Slope Breakers/Interceptor Dikes/Water Bars – Texas Eastern will not install permanent slope breakers in residential or cultivated areas unless specifically directed otherwise in writing by the landowner (Figures 12 and 20).	Agricultural and residential landowners often request that the slope breakers not be installed where they will be tilling or mowing.
10	Subject No. 15: Slope Breakers/Interceptor Dikes/Water Bars - Texas Eastern does not typical propose installing slope breakers/interceptor dikes in the form of silt fence and/or straw bales at railroads.	Railroads are usually crossed by boring. Regardless, Texas Eastern will install all controls as required in the crossing permit.
11	Subject No. 16: Trench Breakers/Trench Plugs – Texas Eastern proposes to allow for the use of sand bags, sakrete, *and/or* earth bags.	Table 3 of Subject No. 16 only indicates the use of sakrete on trench slopes of 100% or more. Sakrete may be required at lesser slopes. Also, for protection of the pipe coating and for providing a more stable seal, sand bags are often more effective than earth filled bags. Sand bags take less time to install than sacks filled with earth at the construction site.
12	Subject No. 17: Straw Bale Barriers -Texas Eastern proposes that each stake be installed typically 12 inches below the ground surface (Figure 8).	The 12-inch (typical) stake depth, along with the bale being anchored in 4 inches below ground, is sufficient to adequately stabilize each bale on construction right-of-way.

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TABLE 1.2.2-1 (continued)
PROPOSED VARIANCES FROM THE PADEP'S UNDERGROUND UTILITY LINE CONSTRUCTION, TYPICAL EROSION AND SEDIMENT BMP'S

No.	VARIANCE	RATIONALE
13	Subject No. 17: Straw Bale Barriers – Texas Eastern proposes to use straw bales for more than 3 months during winter stabilization.	Texas Eastern will monitor the condition of the erosion control structures at least monthly during the winter; deteriorating straw bales will be replaced, as necessary.
14	Subject No. 17: Straw Bale Barriers – Texas Eastern proposes to use straw bales for check dams in ditches and drainage swales (Figure 9).	Each check dam would consist of two rows of staked-in straw bale barriers across the channel to provide adequate support in areas of intermittent concentrated flows.
15	Subject No. 17: Straw Bale Barriers – Texas Eastern proposes that hay bales be allowed for use, in lieu of straw bales, under certain restrictions.	Hay bales would not be used for mulching and the Contractor is responsible for the removal and disposal of all hay bales.
16	Subject No. 17: Straw Bale Barriers - Texas Eastern proposes to use Commonwealth of Pennsylvania's standard spacing when using straw bales or alternate controls (ecoberm) as temporary interceptor dikes on agricultural lands, unless specifically directed otherwise in writing by the landowner.	Agricultural and residential landowners often request that the interceptor dikes not be installed where they will be tilling or mowing.
17	Subject No. 17: Straw Bale Barrier - In rock areas, Texas Eastern proposes to use native soil as backfill up-slope of the bale.	Where rock prevents the ability to drive stakes into the ground and trenching in of the bales, sand bags/sakrete can provide stabilization for the filter fabric.
18	Subject No. 18: Filter Fabric Fence – Texas Eastern proposes to typically install 3-foot long stakes 12 inches below ground (Figure 7), instead of 18 inches.	The minor difference in depths should not affect the stability of the silt fence barrier.

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TABLE 1.2.2-1 (continued)
PROPOSED VARIANCES FROM THE PADEP'S UNDERGROUND UTILITY LINE CONSTRUCTION, TYPICAL EROSION AND SEDIMENT BMP'S

No.	VARIANCE	RATIONALE
19	Subject No. 18: Filter Fabric Fence - Texas Eastern proposes that silt fence be permitted in areas where rock prevents the full and uniform depth anchoring the filter fabric, when used in conjunction with sand bags/sakrete (Figure 7).	Sand bags/sakrete can provide stabilization for the filter fabric.
20	Subject No. 19: Reinforced Filter Fabric Fence (with Straw Bale Barrier Support) – Where used in conjunction with silt fence, Texas Eastern proposes that the bales be placed upslope of the silt fence barrier and do not need to be trenched in (Figure 8).	Reinforcing the silt fence with bales is accordance with Figure 8 is only an added measure available to the Environmental Inspector. It does not allow greater spacing between barriers on a slope, as Table 5 of Subject No. 19 allows when the erosion control is installed in accordance with this state standard (bale on downslope side of silt fence and staked in).
21	Subject No. 23: Utility Line Stream Crossing with Dam and Pumping – For streams 10 feet wide or less, if rock is encountered requiring blasting or hammering, stream crossings (from clearing to completion) may require more than 72 hours.	Typically stream crossings less than 10 feet wide can be completed within the 72 hours, however, if rock is encountered additional time may be required.

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TABLE 1.2.1-2
PROPOSED VARIANCES FROM THE NEW JERSEY STATE SOIL CONSERVATION COMMITTEE'S STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY

No.	VARIANCE	RATIONALE
1	Pages 3-1: Standard for Maintaining Vegetation – Texas Eastern does not proposes to test soil for lime requirements every two to three years.	The vegetation, which permanently establishes in the construction right-of-way, is expected to be native for that area and capable of surviving in existing soil conditions. Revegetation efforts (such as fertilizing or reseeding) will continue until revegetation is successful.
2	Page 4-1: Standard for Permanent Vegetative Cover – Texas Eastern proposes to plow severely compacted soils in agricultural areas only, prior to revegetation.	Texas Eastern will segregate topsoil in all residential areas and when the construction ROW is wider than 30 feet in annual cultivated or rotated agricultural lands, cultivated pastures, hayfields, and other areas at the landowner's or land managing agency's request. The segregation of topsoil up to 12 inches depth will minimize compact.
3	Page 4-1: Standard for Permanent Vegetative Cover – Texas Eastern does not propose applying lime or fertilizer in wetland areas.	This practice is to avoid nutrient loading into wetland systems. Plus, the need for lime and fertilizer is offset by topsoil segregation in wetlands, which returns topsoil to the surface layer.
4	Page 4-1: Standard for Permanent Vegetative Cover – Texas Eastern proposes to apply lime at 4 tons per acre and fertilizer at 1000 lbs. per acre (10-20-20).	The proposed application rates are higher than those specified in the NJ standards.
5	Page 4-2: Standard for Permanent Vegetative Cover – The Plan specifies working lime and fertilizer into the top 2 inches of the soil, not 4 inches.	In practice, the difference between the Plan and state standard is negligible. The Plan requires a seedbed preparation of 4 inches.
6	Page 4-2 and Table 4-2: Permanent Vegetative Cover – Per FERC requirements, Texas Eastern proposes to seed all wetland areas with annual rye at 40 lbs. per acre. The Plan provides a recommended upland conservation seed mix in Appendix B, which does differ from the Table 4-2. However, Texas Eastern will use alternate upland seed mixes provided in writing by landowners and land management agencies.	Annual rye quickly establishes a temporary vegetative cover until native vegetation from the seedbed (re-established from topsoil segregation in wetland areas) can re-colonize the disturbed area.

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TABLE 1.2.1-2 (continued) PROPOSED VARIANCES FROM THE NEW JERSEY STATE SOIL CONSERVATION COMMITTEE'S STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY		
7	Page 4-4: Standard for Permanent Vegetative Cover – The Plan does include the use of liquid mulch binders, but excludes its use within 100 feet of wetlands and waterbodies.	This practice is to avoid nutrient loading into wetland systems.
8	Page 4-4: Standard for Permanent Vegetative Cover – Texas Eastern proposes the use of wood chips as an option for mulch cover during permanent restoration.	Wood chips can only be applied with the approval of the Chief Inspector or Environmental Inspector, and be applied no more than one (1) ton per acre with the equivalent of 11 lbs. per acre available nitrogen added.
9	Page 4-5: Standard for Permanent Vegetative Cover – Texas Eastern proposes that successful revegetation in upland areas be defined as: 1) uniform 70 percent vegetative cover in non-agricultural areas (non-mowed conditions, except for existing lawns); and, 2) crops yields are similar to adjacent undisturbed portions in the same field.	FERC requirements define successful revegetation as 70 percent uniform coverage in uplands and 80 percent uniform coverage in wetlands. Wetlands tend to revegetate quicker and more dense than uplands.
10	Page 7-1: Standard for Temporary Vegetative Cover – Texas Eastern proposes to plow severely compacted soils in agricultural areas only, prior to revegetation.	Texas Eastern will segregate topsoil in all residential areas and when the construction ROW is wider than 30 feet in annual cultivated or rotated agricultural lands, cultivated pastures, hayfields, and other areas at the landowner's or land managing agency's request. The segregation of topsoil up to 12 inches depth will minimize compact.
11	Page 7-1: Standard for Temporary Vegetative Cover – Texas Eastern proposes to apply lime at 4 tons per acre and fertilizer at 1000 lbs. per acre (10-20-20).	The proposed application rates are higher than those specified in the NJ standards.

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TABLE 1.2.1-2 (continued) PROPOSED VARIANCES FROM THE NEW JERSEY STATE SOIL CONSERVATION COMMITTEE'S STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY		
12	Page 7-2: Standard for Temporary Vegetative Cover – The Plan specifies working lime and fertilizer into the top 2 inches of the soil, not 4 inches.	In practice, the difference between the Plan and state standard is negligible. The Plan requires a seedbed preparation of 4 inches.
13	Page 7-3 and Table 7-2: Standard for Temporary Vegetative Cover – Per FERC requirements, Texas Eastern proposes to seed all wetland areas with annual rye at 40 lbs. per acre. Note: The Plan provides a recommended upland conservation seed mix in Appendix B. Texas Eastern will use alternate upland seed mixes provided in writing by landowners and land management agencies.	Annual rye quickly establishes a temporary vegetative cover until native vegetation from the seedbed (re-established from topsoil segregation in wetland areas) can re-colonize the disturbed area.
14	Page 8-2: Standard for Topsoiling – Texas Eastern does not propose hauling in topsoil to replace that which may be displaced from grading the construction ROW.	Topsoil will be segregated in residential areas, wetlands, and when the construction ROW is wider than 30 feet in annually cultivated or rotated agricultural lands, cultivated pastures, hayfield and other areas at the landowner or land managing agency's request.
15	Page 11-3: Standard for Channel Stabilization – Texas Eastern proposes to return all waterbody banks to pre-construction contours or to a stable angle of repose as approved by the Environmental Inspector in accordance with this Plan (Figures 33 and 34). No stability analysis is proposed in this Plan.	The NJ standard does not require a stability analysis for utility crossings provided the final cross sectional area of the stream remains the same. Texas Eastern intends to return stream channels to pre-project contours, however, it may be necessary to modify the channel contours to stabilize the banks.

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TABLE 1.2.1-2 (continued) PROPOSED VARIANCES FROM THE NEW JERSEY STATE SOIL CONSERVATION COMMITTEE'S STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY		
16	Page 11-5: Standard for Channel Stabilization – Texas Eastern proposes to apply rock rip-rap lining in accordance with Figure 34.	See variances proposed for the Standard for Rip-rap (Section 23).
17	Page 11-5: Standard for Channel Stabilization – Texas Eastern proposes to lime, fertilize, seed and mulch riparian areas in accordance with Appendix B of this Plan. Texas Eastern will use alternate upland seed mixes provided in writing by landowners and land management agencies.	See variances proposed for the Standard for Permanent Vegetative Cover (Section 4) and the Standard for Temporary Vegetative Cover (Section 7).
18	Page 14-1: Standard for Dewatering – Dewatering and discharge locations will not be shown on construction plans. The identification of such locations will be determined during construction. Dewatering will be done in accordance with Section 3.5.6 and Figure 15 (Filter Bag).	The Standard for Dewatering is not applicable for dewatering, as construction does not involve dewatering for "long" periods of time at any given location along the alignment. Hydrostatic intake and discharge locations will be shown on the construction plan and done in accordance with this Plan and applicable permit conditions.
19	Page 15-2 and Table 15-2: Standard for Diversions – Texas Eastern will not install permanent slope breakers in residential or cultivated areas unless specifically directed otherwise in writing by the landowner	Agricultural and residential landowners often request that the slope breakers not be installed where they will be tilling or mowing.

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TABLE 1.2.1-2 (continued) PROPOSED VARIANCES FROM THE NEW JERSEY STATE SOIL CONSERVATION COMMITTEE'S STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY		
20	Pages 15-2 & 15-6 and Table 15-2: Standard for Diversions – Texas Eastern proposes to size and space temporary and permanent diversions on the construction right-of-way in accordance with Figures 12 and 20. No drainage analysis to size the diversions are proposed.	The proposed interceptor dike/slope breaker dimensions are suitable for slowing the velocity and re-directing runoff into adjacent upland vegetated areas. The proposed size and spacing of these diversions are consistent with industry standards for pipeline construction and FERC standards. The proposed diversion requirements are also generally consistent with the PADEP erosion control requirements for utility line construction. The Environmental Inspector can require tighter spacing of diversions if field conditions warrant.
21	Page 15-9: Standard for Diversions – Texas Eastern proposes to lime, fertilize, seed and mulch diversions in accordance with Appendix B of the Plan. Texas Eastern will use alternate upland seed mixes provided in writing by landowners and land management agencies.	See variances proposed for the Standard for Permanent Vegetative Cover (Section 4) and the Standard for Temporary Vegetative Cover (Section 7).
22	Page 25-1: Standard for Sediment Barriers –Texas Eastern proposes to install sediment barriers at the base of slopes adjacent to road crossings and at all waterbody and wetland crossings.	Based on right-of-way conditions, it may not be possible to locate the sediment barrier where it is at least 30 feet up gradient is 5 percent or less slope. In areas of active construction, the sediment barriers will be inspected and maintained daily to ensure that such controls are functioning properly.

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TABLE 1.2.1-2 (continued) PROPOSED VARIANCES FROM THE NEW JERSEY STATE SOIL CONSERVATION COMMITTEE'S STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY		
23	Page 25-1: Standard for Sediment Barriers –Texas Eastern proposes to space sediment barriers in the construction right-of-way on slopes in accordance with Figure 12.	The proposed spacing of sediment barriers are suitable for slowing the velocity and re-directing runoff into adjacent upland vegetated areas. The proposed spacing is consistent with industry standards for pipeline construction and FERC standards. The proposed spacing of sediment barriers is also generally consistent with the PADEP erosion control requirements for utility line construction. The Environmental Inspector can require tighter spacing if field conditions warrant.
24	Pages 25-3 and 25-4: Standard for Sediment Barriers – Texas Eastern proposes to install silt fence and straw/hay bales in accordance with Figure 7 and Figure 8, respectively. Both figures show the stakes being driven (at a minimum) 12 inches below ground, instead of 24 inches.	The proposed minimum stake depth of 12 inches, in conjunction with the inspection and maintenance program, are sufficient to anchor the sediment barriers. The anchor depth of 12 inches in Figure 7 (silt fence) is based on a 3-foot long stake. If 4-foot long stakes are used, then the 2-foot anchor depth can be achieved.
25	Page 25-2: Standard for Sediment Barriers – Upon completion of earth disturbance activities on the project (or while construction on the right-of-way is halted for winter), Texas Eastern proposes to inspect BMPs weekly or after major rain events (1/2 inch rain or more).	Upon completion of the earth moving activities (either completion of construction or suspension of activity for the winter), the construction site is stabilized and will need less frequent monitoring.
26	Page 27-1: Standard for Slope Protection – Texas Eastern does not proposes the use of flumes for slope protection.	Texas Eastern proposes to use temporary/permanent diversion dikes and slope breakers (Figure 12 and 20). These measures are suitable for slowing the velocity and re-directing runoff into adjacent upland vegetated areas.

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TABLE 1.2.1-2 (continued)
PROPOSED VARIANCES FROM THE NEW JERSEY STATE SOIL CONSERVATION COMMITTEE'S STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY

27	Page 28-7: Standard for Soil Bioengineering – Texas Eastern proposes to lime, fertilize, seed and mulch riparian areas in accordance with Appendix B of the Plan. Texas Eastern will use alternate upland seed mixes provided in writing by landowners and land management agencies.	See variances proposed for the Standard for Permanent Vegetative Cover (Section 4) and the Standard for Temporary Vegetative Cover (Section 7).
28	Page 29-1: Stabilized Construction Access - Texas Eastern proposes to use four to six inch rock only for rock pad installation. No ASTM, size No. 2 (2 ½ to 1 ½ inch) rock will be used (Figure 5).	Use of smaller than 4- to 6-inch rock can result in tracking of sediment/smaller stone onto roadways.
29	Page 29-1: Stabilized Construction Access – Texas Eastern proposes to size and space temporary diversions on the construction right-of-way up slope of rock access pads in accordance with Figures 12 and 20. Staked straw bales or driveable berms, which are smaller versions of interceptor dikes constructed of compacted soil or sand bags, may be placed cross the width of rock pads and other entry points to the right-of-way.	The staked straw bales and/or driveable berms across pads/roads will prevent runoff from moving off-site via the rock access pad untreated.
30	Page 29-1: Stabilized Construction Access - Texas Eastern does not propose a stabilized base course of bituminous concrete underlying its rock access pads (See Figure 5) in areas greater than 5 percent slope .	The use of larger rock (4- to 6-inch rock), which are less susceptible to off-site movement, should negate the need for a bituminous concrete base.
31	Page 31-1: Standard for Temporary Stream Crossings – Texas Eastern proposes one pass through streams with equipment necessary for clearing and to build the equipment bridge.	Construction of an equipment bridge to support the load of the equipment utilized in this type of construction requires the clearing of banks and access to both sides of the stream to handle the bridge construction materials.

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TABLE 1.2.1-2 (continued)
PROPOSED VARIANCES FROM THE NEW JERSEY STATE SOIL CONSERVATION COMMITTEE'S STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY

32	Page 31-1: Standard for Temporary Stream Crossings – Texas Eastern proposes that equipment bridges be optional for crossing minor (water width at the time of construction equal or less than 10 feet), non-state designated fisheries. Such water can include intermittent drainage ditches and intermittent streams.	Equipment bridges would typically not be use for such minor waters if they have a substrate and bank capable of supporting the weight of equipment with little or no channel disturbance.
33	Pages 31-2 & 31-5: Standard for Temporary Stream Crossing – Texas Eastern proposes to use crushed stone with an average size of 4 to 6 inches (Figure 28), which is larger than the 1 ½- to 2 ½-inch stone specified by the state standard for equipment crossings using flumes.	The larger sized stone should reduce settlement and improve stability of the crossing.
34	Page 31-6: Standard for Temporary Stream Crossing – Section 5.2.1 of this Plan proposes time windows for pipeline construction in state-designated fisheries, which do vary (not significantly) from those specified on Page 31-6. Under the Plan, these time windows do not apply to the installation or removal of equipment bridges.	Equipment bridges proposed on Figures 27, 28, and 29 should not significantly impair spawning or migration. Nevertheless, Texas Eastern will adhere to permit conditions or other restrictions expressed in writing on a site-specific basis regarding in-stream work activities.
35	Page 31-6: Standard for Temporary Stream Crossing – Texas Eastern does not propose placing filter fabric on the stream bottom in association with installing an equipment bridge with clean crushed stone and flumes (Figure 28).	The larger aized rocks being proposed (4- to 6-inch) should reduce settlement into the bottom substrate and provide adequate stability.
36	Page 34-1: Standard for Floating Turbidity Barrier – Texas Eastern proposes to facilitate pipeline construction across fisheries under dry conditions by either flume crossings (Figure 30) or dam and pump crossings. (Figure 31), where conditions allow. These crossing methods separate the in-stream work area and disturbed sediments from the stream flow. No floating ing turbidity barriers are proposed.	These "dry" crossing methods are designed to maintain downstream flow at all times and to isolate the construction zone from the stream flow by channeling the water flow through a flume pipe or by damming the flow and pumping the water around the construction area. Both measures minimize the movement of sediments into downstream waters.

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Notes:

1) Not all of the standards in the NJ manual relate to the specific project location. For instance, the project area is not known to cross highly acidic soils or dunes and; therefore, this Plan does not contain measures for managing construction on these features.

2) Pipeline trenching does not involve dewatering for a long duration at any given location and; therefore, this standard is not applicable to the Project. Nevertheless, this Plan is consistent with all dewatering standards regarding the protection of wetland resources. Texas Eastern will show the intake and discharge locations for hydrostatic testing on construction plans and permit applications, as appropriate.

3) The Plan proposes to install rock access pads that are typically 50 feet in length (Figure 5), regardless of soil type. In practice, the Chief Inspector or Environmental Inspector can require a longer pad length to reflect soil conditions.

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1.3 Surveys, Permits, and Notifications

The Company shall perform the required environmental field surveys and acquire the necessary environmental permits prior to start of construction of the project. The Company shall notify the appropriate federal and state agencies prior to, during, and/or subsequent to the construction of the project, as identified in the Clearance Package/ Permit Book.

1.4 Inquiries

Inquiries regarding this Plan should be addressed to the Manager, Environmental Construction Permitting Department; shown on the front cover; P.O. Box 1642; Houston, Texas 77056. For field conditions requiring an immediate response, contact the Area Manager at the address shown on the front cover.

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2. SUPERVISION AND INSPECTION

To effectively mitigate project-related impacts, the Plan must be properly implemented in the field. Quick and appropriate decisions in the field regarding critical issues such as stream and wetland crossings, placement of erosion controls, trench dewatering, spoil containment, and other construction related items are essential.

To ensure that the Plan is properly implemented, at least one Environmental Inspector (EI) will be designated by the Company for each construction spread during active construction or restoration. The EI will have peer status with all other activity inspectors and will report directly to the Resident Engineer/ Chief Inspector who has overall authority on the construction spread. On smaller projects, the EI role may be carried out by the Resident Engineer/ Chief Inspector or a Craft Inspector, as designated by the Company. The EI will have the authority to stop activities that violate the environmental conditions of the FERC certificate (if applicable), other federal and state permits, or landowner requirements, and to order corrective action.

2.1 Responsibilities of the Environmental Inspector

At a minimum, the EI shall be responsible for:

1. Ensuring compliance with the requirements of this Plan, the construction drawings, the environmental conditions of the FERC certificate (if applicable), proposed mitigation measures, other federal or state environmental permits and approvals, and environmental requirements in landowner easement agreements;
2. Identifying, documenting, and overseeing corrective actions, as necessary to bring an activity back into compliance;
3. Verifying that the limits of authorized construction work areas and locations of access roads are properly marked before clearing;
4. Verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area;
5. Identifying erosion/sediment control and stabilization needs in all areas;
6. Identifying locations for dewatering structures and interceptor dikes to ensure they will not direct water into known cultural resources sites or locations of sensitive resources;
7. Verifying that trench-dewatering activities do not result in the deposition of sand, silt, and/or sediment near the point of discharge into a wetland or waterbody. If such deposition is occurring, the dewatering activity shall be stopped. The design of the discharge shall be changed by the EI to prevent reoccurrence;
8. Ensuring that subsoil and topsoil are tested in agricultural areas to measure compaction and determine the need for corrective action;

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9 Advising the Chief Inspector when conditions (such as wet weather) make it advisable to restrict construction activities to avoid excessive rutting;

10 Ensuring restoration of contours and topsoil;

11 Verifying that the soils imported for agricultural or residential use have been certified as free of noxious weeds and soil pests, unless otherwise approved by the landowner;

12 Determining the need for and ensuring that erosion controls are properly installed and maintained, daily if necessary; to prevent sediment flow into wetlands, waterbodies, sensitive areas, and onto roads;

13 Inspecting temporary erosion control measures at least:

a. On a daily basis in areas of active construction or equipment operation;
b. On a weekly basis in areas with no construction or equipment operation; and
c. Within 24 hours of each 0.5 inch of rainfall.

14 Ensuring the repair of all ineffective temporary erosion control measures within 24 hours of identification;

15 Identifying areas that should be given special attention to ensure stabilization and restoration after the construction phase;

16 Ensuring that the Contractor implements and complies with the Company's Spill Prevention Control and Countermeasure (SPCC) Plan; and

17 Keeping records of compliance with the environmental conditions of the FERC certificate (if applicable), proposed mitigation measures, and other Federal or state environmental permits during active construction and restoration.

2.2 Environmental Training for Construction

If required by the FERC certificate, environmental training will be given to both the Company personnel and contractor personnel whose activities will impact the environment during pipeline construction. The level of training will be commensurate with the type of duties of the personnel. All construction personnel from the chief inspector, EI, craft inspectors, contractor job superintendent to loggers, welders, equipment operators, and laborers will be given some form of environmental training. In addition to the EI, all other construction personnel are expected to play an important role in maintaining strict compliance with all permit conditions to protect the environment during construction. Training will be given prior to the start of construction and throughout the construction process, as needed, and will cover the following issues:

- The specifics of this Plan and the SPCC Plan;
- Job or activity specific permit requirements;
- Company policies and commitments;
- Cultural resource procedures and restrictions;

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- Threatened and endangered species restrictions; and
- Any other pertinent information related to the job.

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3. CONSTRUCTION TECHNIQUES FOR NATURAL GAS PIPELINES

3.1 Typical ROW Requirements

Pipeline construction workspace requirements are a function of pipe diameter, equipment size, topography, geological rock formations, location of construction such as at road crossings or river crossings, pipeline crossovers, methods of construction such as boring or open-cut construction, or existing soil conditions encountered during construction. As the diameter of the pipeline being installed increases, so does the depth of trench, excavated spoil material, equipment size, and ultimately the amount of construction work space that will be required to construct the project. All construction activities are restricted to the ROW limits identified on the construction drawings. However, in limited, non-wetland areas, the construction ROW width may be expanded by up to 25 feet without approval from the FERC for the following situations:

1. To accommodate full construction ROW topsoil segregation;

2. To ensure safe construction where topographic conditions (i.e., side-slopes) or soil limitations exist; and

3. For truck turn-arounds where no reasonable alternative access exits in limited, non-wetland or non-forested areas.

Use of these limited areas is subject to landowner approval and compliance with all applicable survey, mitigation, and reporting requirements.

The U.S. Department of Transportation (DOT) and Occupational Safety and Health Administration (OSHA) have established minimum size and area requirements for worker safety involving construction activities. See Figures 1, 2, and 3 for typical construction ROW widths. Additional construction ROW may be required at specific locations to construct a pipeline including, but not limited to, steep side or vertical slopes, road crossings, crossovers, areas requiring topsoil segregation, and staging areas associated with wetland and waterbody crossings. These locations are shown on the construction drawings.

3.2 Access Roads

All access to the construction ROW will be limited to existing roads and minimized in wetlands to the extent practical. Additional access roads to the ROW are required at various points along the project ROW where other road crossings (paved or gravel/state/local roads) do not exist. Examples of types of access used include abandoned town roads, railroad ROWs, powerline service roads, logging roads and farm roads. Improvements to access roads (i.e., grading, placing gravel, replacing/installing culverts, and trimming overhanging vegetation) may be required due to the size and nature of the equipment that would utilize the road (Figure 4).

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1. Access to the ROW during construction and restoration activities is permitted only by the new or existing access roads identified on the construction drawings.

2. Contractor shall maintain safe conditions at all road crossings and access points during construction and restoration. All access roads will be maintained during construction by grading and the addition of gravel or stone when necessary.

3. Contractor will implement all appropriate erosion and sedimentation control measures for construction/improvement of access roads.

4. Contractor shall ensure that all paved road surfaces utilized during construction are kept free of mud and debris to the extent practical.

5. If rock access pads are required by the permitting agencies in residential or active agricultural areas, rock shall be placed on nonwoven geotextile fabric to facilitate rock removal after construction (Figure 5).

6. All access roads across a waterbody must use an equipment bridge in accordance with Section 5.2.2.

7. The only access roads, unless otherwise permitted, that can be used in wetlands other than the construction ROW are those existing roads requiring no modification and no impact on the wetland.

8. Limit construction equipment operating in wetland areas to that needed to clear the ROW, dig the trench, fabricate and install the pipeline, backfill the trench, and restore the ROW. All other construction equipment shall use access roads located in upland areas to the maximum extent practical. Where access roads in upland areas do not provide reasonable access, limit all other construction equipment to one pass through the wetland using the ROW, whenever practical.

9. For access through a saturated wetland, unless otherwise authorized by agency permits, use timber mats or an equivalent (Figure 6).

3.3 Pipe and Contractor Wareyards

Pipe and contractor wareyards are required for storing and staging equipment, pipe, fuel, oil, pipe fabrication, and other construction related materials. The Contractor shall perform the following measures at pipe and contractor wareyards:

1. Strip and segregate topsoil in agricultural lands;

2. Install erosion control structures as directed by the EI, outlined in this Plan, or identified on the construction drawings, and maintain them throughout construction and restoration activities;

3. Implement and comply with the SPCC Plan; and

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4. Restore and revegetate all disturbed areas in accordance with the measures outlined in this Plan and as directed by the EI.

3.4 Off-ROW Disturbance

With certain exceptions, which are required in order to comply with FERC Plan and Procedures, all construction activities are restricted to within the limits identified on the construction drawings (exceptions include the installation of slope breakers, installation of energy-dissipating devices, installation of dewatering structures, and drain tile repair which are subject to applicable survey requirements). However, in the event that off-ROW disturbance occurs, the following measures will be implemented:

1. The EI will immediately report the occurrence to the Chief Inspector and ROW Agent;

2. The conditions that caused the disturbance will be evaluated by the Chief Inspector and the EI, and they will determine whether work at the location can proceed under those conditions; and

3. If deemed necessary by the Chief Inspector and EI, one or more of the following corrective actions will be taken: immediate restoration of the original contours, seeding and mulching of the disturbed area, and/or installation of erosion control devices. The Company's Environmental Construction Permitting Department will be notified as soon as practical.

3.5 Construction Sequence

Natural gas pipelines are installed using conventional overland buried pipeline construction techniques. These activities are necessary for the installation of a stable, safe, and reliable transmission facility consistent with DOT requirements and regulations. This section provides an overview of the equipment and operations necessary for the installation of a natural gas pipeline, describes potential impacts that may occur from each operation, and identifies the measures that will be implemented to control these potential impacts. This section also discusses in detail the erosion and sediment control techniques that apply to each construction activity including clearing, grading, trenching, lowering-in of pipe, backfilling, and hydrostatic testing. ROW restoration will be addressed in Section 3.6.

Installation of the pipeline will typically proceed from one end of the construction spread to the other in an assembly line or "mainline" fashion. The spacing between the individual crews responsible for each interdependent activity is based on anticipated rate of progress. The activities listed below are normally performed in the following sequence:

- Survey and Flag the ROW;
- Clearing the ROW;
- Installing temporary sediment barriers;
- Grading the ROW;
- Installing temporary interceptor dikes;
- Trenching/excavating the trench;
- Pipe stringing and bending;
- Welding and weld inspection;

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- Trench dewatering;
- Lowering the pipe into the trench;
- Backfilling the trench;
- Hydrostatic testing of pipe; and
- ROW restoration and clean-up.

Obstacles to the mainline technique are often encountered and are not considered to be out of the ordinary. These obstacles, which include side hill crossings, rock, wetlands, streams, roads, and residential areas, do not normally interrupt the assembly line flow.

3.5.1 Clearing

- Clearing operations will include the removal of vegetation within the construction ROW. Various clearing methods will be employed depending on tree size, contour of the land, and the ability of the ground to support clearing equipment. Vegetative clearing will either be accomplished by hand or by cutting equipment. The following procedures will be standard practice during clearing:

1. Prior to beginning the removal of vegetation, the limits of clearing will be established and identified in accordance with the construction drawings;

2. All construction activities and ground disturbance will be confined to within the ROW shown on the construction drawings;

3. Clearly mark and protect trees to be saved as per landowner requests or as otherwise required;

4. All brush and trees will be felled into the construction ROW to minimize damage to trees and structures adjacent to the ROW. Trees that inadvertently fall beyond the edge of the ROW will be immediately moved onto the ROW and disturbed areas will be immediately stabilized;

5. Trees will be chipped or cut into lengths identified by the landowner and then stacked at the edge of the ROW or removed;

6. Brush and limbs may be disposed of in one or more of the following ways depending on local restrictions, applicable permits, construction Line List stipulations, and landowner agreements:

   a. Stockpiled along the edge of the ROW;
   b. Burned;
   c. Chipped, spread across the ROW in upland areas, and plowed in; or
   d. Hauled off site.

7. Existing surface drainage patterns will not be altered by the placement of timber or brush piles at the edge of the construction ROW.

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3.5.2 Installing Temporary Sediment Barriers

Sediment barriers, which are temporary erosion controls intended to minimize the flow of sediment and to prevent the deposition of sediments into sensitive resources, shall be installed following vegetative clearing operations. They may be constructed of materials such as silt fence, staked straw bales, compacted earth (e.g., drivable berms across travel lanes), sandbags, or an equivalent material as identified by the EI (Figures 7, 8, 9, 10). Hay bales may be used in lieu of straw bales with the following restrictions – hay bales shall not be used for mulching and the Contractor is responsible for their removal and disposal.

1. Install temporary sediment barriers at the base of slopes adjacent to road crossings and at waterbody and wetland crossings in accordance with Sections 5.2.4 and 6.2.2 respectively.

2. Do not stake or trench in place straw bales used on equipment bridges or on mats across the travel lane.

3. Inspect temporary sediment barriers daily in areas of active construction to ensure proper functioning and maintenance. In other areas, sediment barriers will be inspected and maintained on a weekly basis throughout construction, and within 24 hours following storm events.

4. Maintain all temporary sediment barriers in place until permanent revegetation measures are successful or the upland areas adjacent to wetlands, waterbodies, or roads are stabilized.

5. Remove temporary sediment barriers from an area when replaced by permanent erosion control measures or when the area has been successfully restored as specified in Section 8.1.

3.5.3 Grading

The construction ROW will be graded as needed to provide a level workspace for safe operation of heavy equipment used in pipeline construction. The following procedures will be standard practice during grading:

3.5.3.1 Topsoil Segregation

Topsoil segregation methods will be used in all residential areas and when the construction ROW is wider than 30 feet in annually cultivated or rotated agricultural lands, cultivated pastures, hayfields, and other areas at the landowner's or land managing agency's request.

a. Prevent the mixing of topsoil with subsoil by stripping topsoil from either the full work area or from the trench line and subsoil storage area (ditch plus spoil side method) as stipulated in the Construction Contract or Line List (Figure 11).

b. Segregate at least 12 inches of topsoil in deep soils with more than 12 inches of topsoil. In soils with less than 12 inches of topsoil, make every effort to segregate the entire topsoil layer.

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c. Where topsoil segregation is required, maintain separation of salvaged topsoil and subsoil throughout all construction activities.

d. For wetlands, segregate the top 12 inches of topsoil within the ditchline, except in areas where standing water is present or soils are saturated or frozen.

e. Leave gaps in the topsoil piles for the installation of temporary interceptor dikes to allow water to be diverted off ROW.

f. Topsoil replacement (i.e., importation of topsoil) may be used as an alternative to topsoil segregation if approved by the landowner and Chief Inspector.

g. Never use topsoil for padding, backfill or trench plugs.

3.5.3.2 Tree Stump Removal and Disposal

a. Remove tree stumps in upland areas along the entire width of the permanent ROW to allow adequate clearance for the safe operation of vehicles and equipment. Stumps within the temporary ROW will be removed or ground to a suitable height that will allow the safe passage of equipment, as stipulated by the Chief Inspector or EI.

b. Dispose of stumps by one of the following methods, pending approval by the Chief Inspector and the landowner, and in accordance with regulatory requirements:

- Buried at a Company-approved off-site location (except in wetlands and agricultural areas);
- Burned;
- Chipped, spread across the ROW in upland areas, and plowed in; or
- Ground to grade in wetlands, excess chips will be removed for proper disposal.

c. Grading operations and tree stump removal in wetland areas will be conducted in accordance with Section 6.2.1.

3.5.3.3 Rock Disposal

Rock (including blast rock) will be disposed of in one or more of the following ways:

a. Buried on the ROW or in approved construction work areas either in the ditchline or as fill during grade cut restoration in accordance with the Construction specifications. In cultivated/ agricultural lands, wetlands, and residential areas, rock may only be backfilled to the top of the existing bedrock profile;

b. Windrowed per written landowner agreement with the Company;

c. Removed and disposed of at a Company-approved site; or

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d. Used as riprap for stream bank stabilization where allowed by an applicable regulatory agency(s) (Figure 34).

3.5.4 Installing Temporary Interceptor Dikes

1. Temporary interceptor dikes, which are temporary erosion control measures intended to reduce runoff velocity and divert water off the construction ROW, shall be installed following grading operations (Figure 12). The interceptor dikes are to be installed on all disturbed areas as necessary to avoid excessive erosion. Temporary interceptor dikes may be constructed of materials such as compacted soil, silt fence, staked straw bales, or sand bags. Hay bales may be used in lieu of straw bales with the following restrictions – hay bales shall not be used for mulching and the Contractor is responsible for their removal and disposal.

   Temporary slope breakers must be installed on slopes greater than 5 percent where the base of the slope is less than 50 feet from waterbody, wetland or road crossing at the spacing indicated below (closer spacing should be used if necessary). Where the base of the slope is equal or greater than 50 feet from a waterbody, wetland, or road crossing, install interceptor dikes at a spacing necessary to avoid excessive erosion.

Slope (%)	Spacing (feet)
<5	No Structure
5 - 15	300
> 15 - 30	200
> 30	100

2. Direct the outfall of each temporary interceptor dike to a stable, well vegetated area or construct an energy-dissipating device (silt fence, staked straw bales, erosion control fabric) at the end of the interceptor dike.

3. Position the outfall of each temporary interceptor dike to prevent sediment discharge into wetlands, waterbodies, or other sensitive resources.

4. Install temporary interceptor dikes across the entire ROW at all waterbody and wetland crossings, as well as the base of slopes adjacent to roads, when directed by the EI.

5. Drivable berms, which are smaller versions of interceptor dikes constructed of compacted soil or sand bags, may be used in place of staked straw bales at the entrances and exits of travel lanes at road crossings, waterbodies, and wetlands. They are installed the width of the travel lane at the start of the equipment crossing and made low enough to allow equipment and other vehicles to pass. Yet, they reduce and divert water runoff from sensitive environmental resources.

6. Inspect temporary interceptor dikes daily in areas of active construction to insure proper functioning and maintenance. In other areas, the interceptor dikes will be inspected and maintained on a weekly basis throughout construction, and within 24 hours following storm events.

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3.5.5 Trenching

The trench centerline will be staked after the construction ROW has been prepared. In general, a trench will be excavated to a depth that will permit burial of the pipe with a minimum of 3 feet of cover (Figure 13). Overland trenching may be accomplished using a conventional backhoe or a rotary wheel-ditching machine. In shale or rocky areas where the use of the wheel-ditching machine is limited, a tractor-drawn ripper will be employed to break and loosen hard substratum material. In areas where rock cannot be ripped, drilling and blasting may be required. A backhoe may then be used to remove rock and soil from the ditch.

The following procedures will be standard practice during ditching:

1. Flag drainage tiles damaged during ditching activities for repair; and
2. Place spoil at least 10 feet upgradient from the edge of waterbodies. Spoil will be contained with erosion and sedimentation control devices to prevent spoil materials or heavily silt-laden water from transferring into waterbodies and wetlands or off of the ROW.

3.5.5.1 Temporary Trench Plugs

Temporary trench plugs are barriers within the ditch that segment the continuous open trench. They typically consist of compacted subsoil or sandbags (soft) placed across the ditch or composed of unexcavated portions of the ditch (hard). Along steep slopes, they serve to reduce erosion and sedimentation in the trench and minimize dewatering problems at the base of slopes where sensitive environments such as waterbodies and wetlands are frequently located. In addition, they provide access across the trench for wildlife and livestock.

a. Do not use topsoil for installing temporary soft trench plugs.

b. Coordinate with the landowner to identify optimal locations for the placement of temporary hard trench plugs designed to provide access for livestock.

c. Temporary trench plugs may be used in conjunction with interceptor dikes to prevent water in the trench from overflowing into sensitive resource areas (Figure 14). Attempt to divert trench overflow to a well-vegetated off-ROW location or construct an energy-dissipating device.

3.5.6 Trench Dewatering

Trench dewatering may be periodically required along portions of the proposed pipeline prior to and/or subsequent to installation of the pipeline to remove collected water from the trench.

1. Trench dewatering will be conducted (on or off the construction ROW) in such a manner that does not cause erosion and does not result in heavily silt-laden water flowing into any waterbody or wetland.

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2. The intakes of the hoses used to withdraw the water from the trench will be elevated and screened to minimize pumping of deposited sediments.

3. Water may be discharged into areas where adequate vegetation is present adjacent to the construction ROW to function as a filter medium.

4. Where vegetation is absent or in the vicinity of waterbody/ wetland areas, water will be pumped into a filter bag (Figure 15) or through a structure composed of sediment barriers. When using filter bags, secure the discharge hose to the bag with a clamp.

5. Remove dewatering structures as soon as possible after the completion of dewatering activities.

3.5.7 Pipe Installation

3.5.7.1 Stringing and Bending

Following trench excavation, pipe sections will be delivered to the construction site by truck or tracked vehicle, and strung out along the trench. Individual pipe sections will be placed on temporary supports or wooden skids and staggered to allow room for work on the exposed ends. Certain pipe sections will be bent, as necessary, to conform to changes in slope and direction of the trench.

3.5.7.2 Welding and Weld Inspection

Once the bending operation is complete, the pipe sections will be welded together on supports using approved welding procedures that comply with Company welding specifications. After welding, the welds will be inspected radiographically or ultrasonically to ensure their structural integrity.

3.5.7.3 Lowering-in

Lowering-in consists of placing the completed pipeline sections into the trench where a tie-in weld will be made. Lowering-in is usually accomplished with two or more sideboom tractors acting in unison and spaced so as not to buckle or otherwise damage the pipe. The pipeline will be lifted from the supports, swung out over the trench, and lowered directly into the trench. The equipment uses a "leap frogging" technique requiring sufficient area to safely move around other tractors within the construction ROW to gain an advanced position on the pipe.

3.5.8 Backfilling

Backfilling consists of covering the pipe with the earth removed from the trench or with other fill material hauled to the site when the existing trench spoil is not adequate for backfill. Backfilling will follow lowering-in of the pipeline as close as is practical.

In areas where the trench bottom is irregularly shaped due to consolidated rock or where the excavated spoil materials are unacceptable for backfilling around the pipe, padding material may be

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required to prevent damage to the pipe. This padding material will generally consist of sand or screened spoil materials from trench excavation.

1. Under no circumstances shall topsoil be used as padding material.

2. Excess rock, including blast rock, may be used to backfill the trench to the top of the existing bedrock profile in accordance with Company specifications. Rock that is not used to backfill the trench will be treated as described in Section 3.5.3.3.

3. Any excess material will be spread within the ROW in upland areas and land contours will be roughed-in to match adjacent topography.

4. The trench may be backfilled with a crown over the pipe to compensate for compaction and settling. Openings will be left in the completed trench crown to restore pre-construction drainage patterns. Crowning shall not be used in wetland areas.

3.5.8.1 Permanent Trench Plugs

Permanent trench plugs are intended to slow subsurface water flow and erosion along the trench and around the pipe in sloping terrain (Figures 16, 17). Permanent trench plugs will be constructed with sand bags or an equivalent as identified in the permit requirements. On severe slopes greater than 30 percent, "Sakrete" may be used at the discretion of the Chief Inspector.

a. Topsoil shall not be used to construct trench plugs.

b. Permanent trench plugs, which are used in conjunction with interceptor dikes, shall be installed at the locations shown on the construction drawings or as determined by the EI. If not shown, use the following spacing:

Slope (%)	Spacing (feet)
<5	No Structure
5 - 15	300
> 15 - 30	200
> 30	100

c. Trench plugs shall be installed at the base of slopes adjacent to waterbodies and wetlands, and where needed to avoid draining of a resource.

3.5.9 Hydrostatic Testing

Once the pipeline is completed and before it is placed into service, it will be hydrostatically tested for structural integrity. Hydrostatic testing involves filling the pipeline with clean water and maintaining a test pressure in excess of normal operating pressures for a specified period of time (typically 8 hours). The testing procedure involves filling the pipeline with test water, performing the pressure test, and discharging the test water.

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1. The EI shall notify appropriate state agencies (as identified in the Hydrostatic Test Package) of the intent to use specific test water sources at least 48 hours before testing activities (unless waived in writing).

2. Pumps used for hydrostatic testing within 100 feet of any waterbody or wetland shall be operated and refueled in accordance with the SPCC Plan.

3. Do not use state-designated exceptional value waters, waterbodies that provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies, unless appropriate federal, state, and/or local permitting agencies grant written permission. Use only the water sources identified in the Clearance Package/Permit Book.

4. Screen the intake hose to prevent entrainment of fish and other aquatic life.

5. Maintain ambient, downstream flow rates to protect aquatic life, provide for all waterbody uses, and provide for downstream withdrawals of water by existing users.

6. Locate hydrostatic test manifolds outside wetlands and riparian areas to the greatest extent practical.

7. For an overland discharge of test water from a new pipeline, dewater into an energy dissipation device constructed of straw bales (Figures 18, 19).

8. For an overland discharge of test water from an existing pipeline, dewater into an energy dissipation device constructed of straw bales and absorbent booms (Figure 18). If required by the appropriate permitting agency, the test water may be discharged through an appropriate filtration system including frac tanks and/ or carbon filters.

9. Dewater only at the locations shown on the construction drawings or locations identified in the Hydrostatic Test Package.

10. Locate all dewatering structures in a well-vegetated and stabilized area, if practical, and attempt to maintain at least a 50-foot vegetated buffer from adjacent waterbody/wetland areas. If an adequate buffer is not available, sediment barriers or similar erosion control measure must be installed.

11. Regulate discharge rate, use energy dissipation device(s), and install sediment barriers, as necessary, to prevent erosion, streambed scour to aquatic resources, suspension of sediments, flooding or excessive stream flow.

12. Do not discharge into state-designated exceptional value waters, waterbodies which provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies, unless appropriate federal, state, and local permitting agencies grant written permission.

13. The EI shall sample and test the source water and discharge water in accordance with the permit requirements.

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3.6 ROW Restoration and Final Cleanup

Restoration of the ROW will begin after pipeline construction activities have been completed. Restoration measures include the re-establishment of final grades and drainage patterns as well as the installation of permanent erosion and sedimentation control devices to minimize post-construction erosion. Residential areas will be restored in accordance with Section 4.3.3. Property shall be restored as close to its original condition as practical unless otherwise specified by the landowner.

1. The Contractor shall make every reasonable effort to complete final cleanup of an area (including final grading and installation of permanent erosion control structures) within 20 days after backfilling the trench in that area (within 10 days in residential areas). If seasonal or other weather conditions prevent compliance with these time frames, maintain temporary erosion controls (temporary interceptor dikes and sediment barriers) until conditions allow completion of cleanup.

2. The disturbed ROW will be seeded within 6 working days of final grading, weather and soil conditions permitting.

3. If final cleanup and seeding cannot be completed and is delayed until the next recommended growing season, the winter stabilization measures in Section 3.6.4 shall be followed.

4. Grade the ROW to pre-construction contours.

5. Spread segregated topsoil back across the graded ROW to its original profile.

6. Remove excess rock from at least the top 12 inches of soil to the extent practical in all rotated and permanent cropland, hayfields, pastures, residential areas, and other areas at the landowner's request. The size, density, and distribution of rock on the construction ROW should be similar to adjacent areas not disturbed by construction. The landowner may approve other provisions in writing.

7. A travel lane may be left open temporarily to allow access by construction traffic if the temporary erosion control structures are installed, regularly inspected and maintained. When access is no longer required, the travel lane must be removed and the ROW restored.

8. Remove all construction debris (used filter bags, skids, trash, etc.) from the ROW unless the landowner or land managing agency approves otherwise. Grade or till the ROW to leave the soil in the proper condition for planting.

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3.6.1 Permanent Erosion Control

3.6.1.1 Permanent Interceptor Dikes

Permanent interceptor dikes are intended to reduce runoff velocity, divert water off the construction ROW, and prevent sediment deposition into sensitive resources (Figure 12). Permanent interceptor dikes will be constructed of compacted soil. Sand bags or some functional equivalent may be used when directed by the EI.

a. Install permanent interceptor dikes in all areas, except cultivated areas and lawns, at the locations shown on the construction drawings or as directed by the EI. If not shown, use the spacing outlined for temporary interceptor dike installation in Section 3.5.4.

b. Install permanent interceptor dikes across the entire ROW at all waterbody and wetland crossings, and at the base of slopes adjacent to roads. When the ROW parallels an existing utility ROW, permanent interceptor dikes may be installed to match existing interceptor dikes on the adjacent undisturbed pipeline ROW.

c. Construct interceptor dikes with a 2 to 8 percent outslope to divert surface flow to a stable vegetative area without causing water to pool or erode behind the interceptor dike. In the absence of a stable vegetative area, install an energy-dissipating device at the end of the interceptor dike (Figure 12).

d. Interceptor dikes may extend slightly (about 4 feet) beyond the edge of the construction ROW to effectively drain water off the disturbed area. Where interceptor dikes extend beyond the edge of the construction ROW, they are subject to compliance with all applicable survey requirements.

e. Install chevron-style interceptor dikes on slopes when directed by the EI (Figure 20).

f. Install a rock-lined drainage swale along the ROW with restricted drainage features when directed by the EI. The drainage swale is generally 8 feet wide and a maximum of 18-24 inches deep (Figure 21).

g. On slopes greater than 30 percent, install interceptor dikes with erosion control fabric on the swale side.

3.6.1.2 Erosion Control Fabric

a. Install erosion control fabric at interceptor dike outlets and drainage swales as necessary or as directed by the EI (Figure 12, 21).

b. Install erosion control fabric or matting on slopes greater than 30 percent adjacent to roads or waterbodies (Figure 22). Anchor the erosion control fabric or matting with staples or other appropriate devices in accordance with the manufacturers' recommendations.

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c. The EI will direct the installation of high-velocity erosion control fabric on the swale side of permanent interceptor dikes (Figure 23).

3.6.2 Revegetation and Seeding

Successful revegetation of soils disturbed by project-related activities is essential. Seeding will be conducted using the following requirements:

1. Fertilize and add soil pH modifiers in accordance with the recommendations in Appendix B. Incorporate recommended soil pH modifier and fertilizer into the top 2 inches of soil as soon as practical after application;

2. Seed all disturbed areas within 6 working days of final grading, weather and soil conditions permitting;

3. Prepare seedbed in disturbed areas to a depth of 3 to 4 inches to provide a firm seedbed. When hydroseeding, scarify the seedbed to facilitate lodging and germination of seed;

4. Seed disturbed areas in accordance with the seed mixes, rates, and dates in Appendix B, except in upland areas where landowners or a land management agency may request alternative seed mixes. Seeding is not required in actively cultivated croplands unless requested by the landowner.

5. Perform seeding of permanent vegetation within the recommended seeding dates as outlined in Appendix B. If seeding cannot be done within those dates, use appropriate temporary erosion control measures discussed in Section 3.5.2 and perform seeding of permanent vegetation at the beginning of the next recommended seeding season. Mulch in accordance with Section 3.6.3. Lawns may be seeded on a schedule established with the landowner;

6. Base seeding rates on Pure Live Seed (PLS). Use seed within 12 months of seed testing;

7. Treat legume seed with an inoculant specific to the species using the manufacturer's recommended rate of inoculant appropriate for the seeding method (broadcast, drill, or hydroseeding); and

8. Uniformly apply and cover seed in accordance with Appendix B. In the absence of any recommendations from the local soil conservation authorities, landowner, or land managing agency to the contrary. A seed drill equipped with a cultipacker is preferred for application, but broadcast or hydroseeding can be used at double the recommended seeding rates. Where seed is broadcast, firm the seedbed with a cultipacker or roller after seeding. In rocky soils, or where site conditions may limit the effectiveness of this equipment, other alternatives may be appropriate (e.g., use of a chain drag) to lightly cover seed after application, as approved by the EI.

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3.6.3 Mulch

Mulch is intended to stabilize the soil surface and shall consist of weed-free straw or hay, wood fiber hydromulch, erosion control fabric, or some functional equivalent as approved by the EI and Chief Inspector. Hay shall not be used for mulch.

1. Mulch **before** seeding if:

   a. Final cleanup, including final grading and installation of permanent erosion control measures, is not completed in an area within 20 days after the trench in that area is backfilled (10 days in residential areas); or

   b. Construction or restoration activity is interrupted for extended periods, such as when seeding cannot be completed due to seeding period restrictions.

   NOTE: When mulching before seeding, increase mulch application on all slopes within 100 feet of waterbodies and wetlands to a rate of 3 tons/acre of straw or equivalent.

2. Apply mulch on all slopes (except in actively cultivated cropland) concurrent with or immediately after seeding, where necessary, to stabilize the soil surface and to reduce wind and water erosion. Spread mulch uniformly over the ROW at a rate of 2 tons/acre of straw or equivalent.

3. Mulch with woodchips only under the following conditions with prior approval from the Chief Inspector or the EI:

   a. Do not use more than 1 ton/acre; and

   b. Add the equivalent of 11 lbs/acre available nitrogen (at least 50 % of which is slow release).

4. Ensure that mulch is anchored to minimize loss by wind and water. Anchoring may be achieved by wet soil conditions (when approved by the EI), mechanical means, or with liquid mulch binders.

5 When anchoring with liquid mulch binders, use rates recommended by the manufacturer. **Do not *use liquid mulch binders within 100 feet of wetlands and waterbodies.***

6. Install and anchor erosion control fabric, such as jute thatching, or bonded fiber blankets, on waterbody banks at the time of final bank recontouring. Anchor the erosion control fabric with staples or other appropriate devices.

3.6.4 Winter Stabilization

In the event that the final phases of construction occur too late in the year for cleanup activities to adequately proceed, the following procedures will be implemented along the disturbed ROW at those locations until final restoration measures can be completed. The Company will file for review and written approval from the FERC, a winterization plan if construction continues into the winter season where conditions could delay successful decompaction, topsoil replacement, or seeding until the following spring.

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1. Install permanent interceptor dikes at specified intervals on all slopes, or as directed by the EI;

2. Install temporary sediment barriers adjacent to stream and wetland crossings, as well as other critical areas;

3. Seed and mulch the ROW and seed segregated topsoil piles in accordance with Appendix B; and

4. Remove flumes from waterbody crossings to reestablish natural stream flow.

3.7 Unauthorized Vehicle Access to ROW

The Company will offer to install and maintain measures to control unauthorized vehicle access to the ROW based on requests by the manager or owner of forested lands. These measures may include:

- Signs;
- Fences with locking gates;
- Slash and timber barriers, pipe barriers, or a line of boulders across the ROW; or
- Conifers or other appropriate shrubs with a mature height of 4 feet or less across the ROW.

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4. SPECIAL CONSTRUCTION METHODS

The Company will utilize the following specialized construction procedures for agricultural areas, road crossings, and residential areas along the pipeline project. The project construction drawings, Line Lists, and Construction Contract will indicate the locations where specialized construction methods will be used.

4.1 Agricultural Areas

4.1.1 Drain Tiles

1. Attempt to locate existing drain tiles and irrigation systems.

2. Develop procedures for constructing through drain tiled areas, maintaining irrigation systems during construction, and repairing drain tiles and irrigation systems after construction.

3. Engage qualified drain tile specialists, as needed, to conduct or monitor repairs to drain tile systems affected by construction. Use drain tile specialist from the project area, if available.

4. Probe all drainage tile systems within the area of disturbance to check for damage.

5. Repair damaged drain tiles to their original condition (Figure 24). Filter-covered drain tiles may not be used unless the local soil conservation authorities and the landowner agrees in writing prior to construction.

6. Ensure that the depth of cover over the new pipeline is sufficient to avoid interference with drain tile systems (existing or proposed). For adjacent pipeline loops in agricultural areas, install the new pipeline with at least the same depth of cover as the existing pipeline(s).

4.1.2 Irrigation

1. Maintain water flow in crop irrigation systems, unless shutoff is coordinated with affected parties.

2. Repair any damage to the systems as soon as practical.

4.1.3 Soil Compaction Mitigation

1. Test topsoil and subsoil for compaction at regular intervals in agricultural areas disturbed by construction activities. Conduct tests on the same soil type under similar moisture conditions in undisturbed areas to identify approximate preconstruction conditions. Use penetrometers or other appropriate devices to conduct tests.

2. Plow severely compacted agricultural areas with a paraplow or other deep tillage implement. In areas where topsoil has been segregated, plow the subsoil before replacing the segregated topsoil. Alternatively, make arrangements with the landowner to plant and plow under a "green manure" crop, such as alfalfa, to decrease soil bulk density and improve soil structure. If subsequent construction and cleanup activities result in further compaction, conduct additional tilling.

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4.2 Road Crossings

Unpaved private and public roads supporting minimal traffic volumes are usually crossed by boring or by means of an open cut, if this method is approved by the owner or appropriate road management agency. An open cut crossing may involve closing the road to all traffic and constructing an adequate detour around the crossing area, or excavating one-half of the road at a time allowing through traffic to be maintained

(Figure 25). The trench for an open cut crossing is excavated with a backhoe or similar equipment, all backfill is compacted, and the road resurfaced. All state, national, and interstate highways as well as all railroads must be crossed by boring (Figure 26), unless the crossing permit allows an open cut crossing. Access roads shall be used in accordance with Section 3.2.

4.3 Residential Areas

4.3.1 Construction Procedures

Specialized construction procedures will be utilized in areas of heavy residential or commercial/ industrial congestion where residences or business establishments lie greater than 25 feet but less than 50 feet from the edge of the construction ROW.

1. Install safety fence at the edge of the construction ROW for a distance of 100 feet on either side of the residence or business establishment.

2. Attempt to maintain a minimum distance of 25 feet between any residence/business establishment and the edge of the construction work area for a distance of 100 feet on either side of the residence/business establishment.

3. Attempt to leave mature trees and landscaping intact within the construction work area unless the trees and landscaping interfere with the installation techniques or present unsafe working conditions.

4.3.2 Construction Techniques

In addition to the previously identified specialized procedures, smaller "spreads" of labor and equipment, operating independent of the mainline work force, will utilize either the stove pipe or drag section pipeline construction techniques in those areas of congestion where a minimum distance of 25 feet cannot be maintained between the residence(or business establishment) and the edge of the construction work area. In no case shall the temporary work area be located within 10 feet of a residence unless the landowner agrees in writing, or the area is within the existing maintained ROW. The following techniques shall be utilized for a distance of 100 feet on either side of the residence or business establishment at the locations identified in the Construction Contract and/or Line List.

1. The stove pipe construction technique is a less efficient alternative to the mainline method of construction, typically used when the pipeline is to be installed in very close proximity to an

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existing structure or when an open trench would adversely impact a commercial/industrial establishment. The technique involves installing one joint of pipe at a time whereby the welding, weld inspection, and coating activities are all performed in the open trench. At the end of each day after the pipe is lowered-in, the trench is backfilled and/or covered with steel plates or timber mats. The length of excavation performed each day cannot exceed the amount of pipe installed.

2. The drag section construction technique, while less efficient than the mainline method, is normally preferred over the stove pipe alternative. This technique involves the trenching, installation, and backfill of a prefabricated length of pipe containing several segments all in one day. At the end of each day after the pipe is lowered-in, the trench is backfilled and/or covered with steel plates or timber mats. Use of the drag section technique will typically require adequate staging areas outside of the residential and/or commercial/industrial congestion for assembly of the prefabricated sections.

4.3.3 Cleanup and Restoration

1. Reseed all disturbed lawns with a seed mixture acceptable to landowner or comparable to the adjoining lawn.

2. Landowners shall be compensated for damages to ornamental shrubs and other landscape plantings based on the appraised value as set forth in the Guide for Plant Appraisal, authored by the Council of Tree and Landscape Appraisers (CTLA), 8th Edition and published in 1992 by the International Society of Arboriculture.

3. Landowners shall be compensated for damages in a fair and reasonable manner, and as specified in the damage provision within the controlling easement on each property.

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5. WATERBODY CROSSINGS

The following section describes the construction procedures and mitigation measures that will be used for pipeline installations at waterbodies. The intent of these procedures is to minimize the extent and duration of project related disturbances within waterbodies.

5.1 Waterbody Definitions

The term "**waterbody**" as used in this Plan includes any natural or artificial stream, river, or drainage with perceptible flow at the time of crossing, and other permanent waterbodies such as ponds and lakes. In this Plan, waterbodies are characterized into three main categories depending on the width of the waterbody. The categories are as follows:

- A "**minor waterbody**" includes all waterbodies less than or equal to 10 feet wide at the water's edge at the time of construction.
- An "**intermediate waterbody**" includes all waterbodies greater than 10 feet wide but less than or equal to 100 feet wide at the water's edge at the time of construction.
- A "**major waterbody**" includes all waterbodies greater than 100 feet wide at the water's edge at the time of construction.
- A "**state designated waterbody**" includes all perennial waterbodies that support coldwater fisheries and warmwater fisheries considered significant by the state.
- A "**non-state designated waterbody**" includes intermittent drainage ditches, intermittent streams, and perennial warmwater streams not considered significant by the state.

The waterbody crossing procedures described in this Plan comply with the Section 404 Nationwide permit program terms and conditions (33 CFR Part 330).

5.2 General Waterbody Procedures

Pipeline construction across waterbody channels may result in short term water quality impacts. Decisions regarding waterbody crossing techniques will be based on agency consultations. Mobilization of construction equipment, trench excavation, and backfilling will be performed in a manner that will minimize the potential for erosion and sedimentation within the waterbody channel. Erosion control measures will be implemented to confine water quality impacts within the immediate construction area and to minimize impacts to downstream areas. The length of the crossing, the sensitivity of the area, existing conditions at the time of the crossing, and permit requirements will determine the most appropriate measures to be used.

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5.2.1 Time Window for Construction

1. Unless expressly permitted or further restricted by the appropriate state agency in writing on a site-specific basis, instream work, except that required to install or remove equipment bridges, must occur during the following time windows:
   a. Coldwater Fisheries – June 1 through September 30; and
   b. Coolwater and Warmwater Fisheries – June 1 through November 30.

5.2.2 Temporary Equipment Bridges

A temporary equipment bridge is a structure that may be installed across a waterbody to provide a means for construction equipment to cross the stream while minimizing impacts to the channel bottom or banks.

1. Until the equipment bridge is installed, only clearing equipment and equipment necessary for installation of equipment bridges may cross the waterbody and the number of crossings shall be limited to one crossing per piece of equipment, unless otherwise authorized by the appropriate permitting agency.
2. Construct equipment bridges to maintain unrestricted flow and to prevent soil from entering the waterbody. Examples of such bridges include:
   a. Equipment pads and culverts (Figure 27);
   b. Clean crushed stone and culverts (Figure 28);
   c. Flexi-float or portable bridges (Figure 29); or
   d. Equipment pads or railroad car bridges without culverts
3. Construct crossings as close to perpendicular to the axis of the waterbody channel.
4. Design and maintain each equipment bridge to withstand the highest flows that would occur. Align culverts/flumes to prevent bank erosion or streambed scour. If necessary, install energy dissipating devices downstream of the culverts.
5. Do not use soil to construct or stabilize equipment bridges.
6. Design and maintain equipment bridges to prevent soil from entering the waterbody.
7. Remove equipment bridges as soon as practical after permanent seeding unless agency permits authorized that the bridge remains in place.
8. If there will be more than 1 month between final cleanup and the beginning of permanent seeding and reasonable alternative access to the ROW is available, remove equipment bridges as soon as practical after final cleanup.

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5.2.3 Clearing and Grading

1. Confine construction activities and ground disturbance to within the ROW boundaries shown on the construction drawings.

2. Restrict extra work areas (such as staging areas and additional spoil storage areas) to those shown only on the construction drawings. All extra work areas must be located at least 50 feet away from the water's edge, except where the adjacent upland consists of actively cultivated or rotated cropland or other disturbed land. If site-specific conditions do not permit a 50-foot setback, the Company can receive written approval from the FERC to locate these extra work areas closer than 50 feet from the water's edge.

3. If the pipeline parallels a waterbody, attempt to maintain at least 15 feet of undisturbed vegetation between the waterbody (and any adjacent wetland) and the ROW except at the crossing location.

4. Clear the ROW adjacent to all waterbodies *up to the high water bank* (where discernible).

5. Immediately remove all cut trees and branches that inadvertently fall into a waterbody and stockpile in an upland area on ROW for disposal.

6. Grade the ROW adjacent to waterbodies *up to within 10 feet of the high water bank*, leaving an ungrubbed vegetative strip intact.

7. Clearing and grading operations may proceed through the 10-foot vegetative strip **only on the working side of the ROW** in order to install the equipment bridge and travel lane. Use temporary sediment barriers to prevent the flow of bank spoil into the waterbody.

8. Maintain adequate flow rates to protect aquatic life and prevent the interruption of existing downstream uses.

5.2.4 Installing Temporary Erosion and Sediment Control

1. Install sediment barriers immediately after initial disturbance of the waterbody or adjacent upland. Sediment barriers must be properly maintained throughout construction and reinstalled as necessary (such as after backfilling of the trench), until replacement by permanent erosion controls or restoration of adjacent upland areas is complete.

2. Install sediment barriers across the entire construction ROW at all waterbody crossings, where necessary to prevent the flow of sediments into the waterbody. Temporary or removable sediment barriers such as interceptor dikes or drivable berms as described in Section 3.5.4 may be used in lieu of sediment barriers in front of equipment bridges or timber mats across the travel lane. These temporary sediment barriers can be removed during the construction day, but must be reinstalled after construction has stopped for the day and/or when heavy precipitation is imminent.

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3. Install sediment barriers as necessary along the edge of the construction ROW to contain spoil and sediment within the ROW where waterbodies are adjacent or parallel to the construction ROW.

4. Use trench plugs at all waterbody crossings to prevent diversion of water into upland portions of the pipeline trench and to keep any accumulated trench water out of the waterbody. Trench plugs shall be of sufficient size to withstand upslope water pressure.

5.2.5 Various Types of Crossings

Construction at waterbodies will be conducted using two principal crossing methods, a "dry" crossing and a "wet" crossing. The "dry" crossing procedure is further divided into a flumed crossing and a dam and pump crossing. These methods are designed to maintain downstream flow at all times and to isolate the construction zone from the stream flow by channeling the water flow through a flume pipe or by damming the flow and pumping the water around the construction area. The overall objective is to minimize siltation of the waterbody and to facilitate trench excavation of saturated spoil. Unless approved otherwise by the appropriate state agency, pipeline construction and installation must occur using one of the two "dry" crossing methods for waterbodies state-designated as either coldwater or significant coolwater or warmwater fisheries. The flumed and dam and pump crossing methods are applicable to waterbodies up to 30 feet wide at the water's edge at the time of construction. The two "dry" crossings are further described below in Sections 5.2.5.2 and 5.2.5.3.

The "wet" crossing procedure involves open cutting the waterbody without isolating the construction zone from the stream flow. The objective of this method is to complete the waterbody crossing as quickly as practical in order to minimize the duration of impacts to aquatic resources. All streams, their classifications, timing windows, and crossing procedures will be identified in the Clearance Package/Permit Book and on the construction drawings. Table 6-1 outlines the general procedures to be followed at all waterbody crossings.

5.2.5.1 General Crossing Procedures

1. Dewater trench in accordance with the procedures described in Section 3.5.6.

2. For minor waterbodies:

   a. Place all spoil from the waterbody within the construction ROW at least 10 feet from the water's edge or in the extra work areas shown on the construction drawings. Use sediment barriers to prevent flow of spoil or heavily silt-laden water into the waterbody.

3. For intermediate waterbodies:

   a. Less than 30 feet in width, place all spoil from the waterbody within the construction ROW at least 10 feet from the water's edge or in the extra work areas shown on the construction drawings. Use sediment barriers to prevent flow of spoil or heavily silt-laden water into the waterbody.

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b. Greater than 30 feet in width, spoil may be temporarily sidecast into the waterbody provided that site specific approval is received from the appropriate permitting agency.

4. For major waterbodies:

   a. Place all upland bank spoil from the waterbody within the construction ROW at least 10 feet from the water's edge or in the extra work areas shown on the construction drawings. Use sediment barriers to prevent flow of spoil or heavily silt laden water into the waterbody.

   b. Sidecasting is permitted in major waterbodies upon approval from the appropriate permitting agencies.

5. Restore and stabilize the banks and channel in accordance with Section 5.2.6.

5.2.5.2 Flumed Crossing

The flumed crossing method utilizes a flume pipe(s) to transport stream flow across the disturbed area and allows trenching to be done in drier conditions (Figure 30). The flume pipe(s) installed across the trench will be sized to accommodate anticipated stream flows. This method is utilized for perennial waterbodies (minor and intermediate) up to 30 feet wide that are state designated fisheries including coldwater fisheries and warmwater fisheries considered significant by the state. Flumes are generally not recommended for use on a watercourse with a broad unconfined channel, unstable banks, a permeable substrate, excessive stream flow, or where the installation and construction of the flume crossing will adversely affect the bed or banks of the stream.

1. Cross all minor waterbodies that are state-designated fisheries, as identified in the Clearance Package/ Permit Book, using a dry crossing technique (Figures 30, 31).

2. All construction equipment must cross state-designated fisheries on an equipment bridge as specified in Section 5.2.2.

4. The flumed crossing shall be installed as follows:

   a. Install flume pipe(s) after blasting and other rock breaking measures (if required), but before trenching;

   b. Properly align flume pipe(s) to prevent bank erosion and streambed scour;

   c. Use sand bags or equivalent dam diversion structure to provide a seal at either end of the flume to channel water flow (some modifications to the stream bottom may be required to achieve an effective seal);

   d. **Do not remove flume pipe** during trenching, pipe laying (thread pipe underneath the flume pipe(s)), or backfilling activities, or initial streambed restoration efforts unless authorized by agency permits; and

   e. Remove all flume pipes and dams that are not also part of the equipment bridge as soon as final cleanup of the stream bed and bank is complete.

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5.2.5.3 Dam and Pump Crossing

The dam and pump method is presented as an alternative dry crossing procedure to the flumed crossing. The dam and pump crossing is accomplished by utilizing pumps to transport stream flow across the disturbed area (Figure 31). This method involves placing sandbags across the existing stream channel upstream from the proposed crossing to stop water flow and downstream from the crossing to isolate the work area. Pumps are used to pump the water across the disturbed area and back into the stream further downstream. This method is intended for use at perennial waterbodies (minor and intermediate) up to 30 feet wide and state designated fisheries including coldwater fisheries and warmwater fisheries considered significant by the state. The dam and pump procedure allows for more space and flexibility during trenching and pipe installation, which shortens the duration of time spent at the waterbody.

1. The dam and pump method may be used for crossings of waterbodies where pumps can adequately transfer stream flow volumes around the work area, and where there are no concerns about sensitive species passage.

2. Implementation of the dam and pump crossing method will meet the following performance criteria:

   a. Use sufficient pumps, including onsite backup pumps, to maintain downstream flows;

   b. Construct dams with materials that prevent sediment and other pollutants from entering the waterbody (e.g., sandbags or clean gravel with plastic liner);

   c. Screen pump intakes

   d. Prevent streambed scour at pump discharge; and

   e. Monitor the dam and pumps to ensure proper operation throughout the waterbody crossing.

3. The dam and pump crossing shall be installed as follows:

   a. Install and properly seal sandbags at the upstream and downstream location of the crossing;

   b. Create an in-stream sump using sandbags if a natural sump is unavailable for the intake hose;

   c. Initiate pumping of the stream around the work area prior to excavating the trench;

   d. Screen all intake hoses to prevent the entrainment of fish and other aquatic life;

   e. Direct all discharges from the pumps through energy dissipaters to minimize scour and siltation;

   f. Monitor pumps <u>at all times</u> until construction of the crossing is completed; and

   g. Following construction, remove the equipment crossing and sandbag dams.

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5.2.5.4 Wet Crossing

This construction technique is typically used to cross waterbodies that are non state-designated as well as intermediate and major waterbodies with substantial flows that cannot be effectively culverted or pumped around the construction zone using the dry crossing techniques (Figure 32). Non-state designated waterbodies include perennial warmwater streams not considered significant by the state, intermittent drainage ditches, and intermittent streams.

The wet-ditch crossing shall be installed as follows:

1. For minor waterbodies:

    a. Equipment bridges are not required at non state-designated fisheries (e.g. agricultural or intermittent drainage ditches). However, if an equipment bridge is used, it must be constructed in accordance with Section 5.2.2;

    b. Limit use of equipment operating in the waterbody to that needed to construct the crossing;

    c. Complete trenching and backfilling in the waterbody (not including blasting and other rock breaking measures) within 24 continuous hours; and

    d. If a flume is installed within the waterbody during mainline activities, it can be removed just prior to lowering in the pipeline. The 24-hour timeframe starts as soon as the flume is removed.

2. For intermediate waterbodies:

    a. Limit use of equipment operating in the waterbody to that needed to construct the crossing. All other construction equipment must cross on an equipment bridge as specified in Section 5.2.2; and

    b. Attempt to complete trenching and backfill work within the waterbody (not including blasting and other rock breaking measures) within 48 continuous hours, unless site-specific conditions make completion within 48 hours infeasible.

3. For major waterbodies:

    a. Company will develop site-specific crossing plans to be submitted for approval by the FERC and the appropriate permitting agency; and

    b. Construct the crossing in accordance with the measures contained in this Plan to the maximum extent practical.

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5.2.6 Restoration

1. Return all waterbody banks to preconstruction contours or to stable angle of repose as approved by the EI.

2. Use clean gravel or native cobbles for the upper 12 inches of trench backfill in all waterbodies identified in the Clearance Package/Permit Book as coldwater fisheries.

3. For wet crossings, stabilize waterbody banks and install temporary sediment barriers within 24 hours of completing the crossing. For dry crossings, complete bank stabilization before returning flow to the waterbody channel.

4. Limit the placement of riprap to the slopes along the disturbed waterbody crossing.

5. Install erosion control fabric along waterbodies with low flow conditions (Figure 33).

6. Revegetate disturbed riparian areas with conservation grasses and legumes in accordance with the recommended Upland Seed Mix in Appendix B. In the event that final cleanup is deferred more than 20 days after the trench is backfilled, all slopes within 100 feet of waterbodies shall be mulched with 3 tons/acre of straw.

7. Remove all temporary sediment barriers when replaced by permanent erosion controls or when restoration of adjacent upland areas is successful as specified in Section 8.1.

8. Install a permanent interceptor dike and a trench plug at the base of slopes near each waterbody crossed. Locate the trench plug immediately upslope of the interceptor dike. Permanent interceptor dikes may not be installed in agricultural areas.

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Table 5-1: General Waterbody Crossing Procedures

	WATERBODY TYPE					
	MINOR		INTERMEDIATE		MAJOR	
WATERBODY CROSSING ACTIVITIES	Non-State[1] Designated	State[2] Designated	Non-State[3] Designated	State[2] Designated	Non-State[3] Designated	State[2] Designated
Flumed Crossing (Dry) *Section 5.2.5.2, Figure 30*		X		X		
Dam and Pump Crossing (Dry) *Section 5.2.5.3, Figure 31*		X		X		
Wet Crossing *Section 5.2.5.4, Figure 32*	X		X	X	X	X
Construction timing window during the year *Section 5.2.1*		X		X		X
Time to complete construction of crossing (not including blasting)[4]	24 Hours		48 Hours			
Equipment bridge required[5]		X	X	X	X	X

[1] Includes agricultural intermittent drainage ditches, intermittent streams, and perennial warmwater streams not considered significant by the state.

[2] Includes all perennial waterbodies that support coldwater fisheries and warmwater fisheries considered significant by the state.

[3] Includes perennial warmwater streams not considered significant by the state.

[4] If a flume is installed within the waterbody during mainline activities, it can be removed just prior to lowering in the pipeline. The 24-hour timeframe starts as soon as the flume is removed.

[5] An equipment bridge may not be required for a waterbody being crossed by a horizontal directional drill.

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6. WETLAND CROSSINGS

6.1 Definition

The term "Wetland" as used in this Plan includes any area that satisfies the requirements of the current Federal methodology for identifying and delineating wetlands. Wetland areas have been delineated prior to construction and are identified on the construction drawings.

The wetland crossing procedures described in this Plan comply with the Section 404 Nationwide permit program terms and conditions (33 CFR Part 330). The requirements outlined below do not apply to wetlands in actively cultivated or rotated cropland. Standard upland protective measures including workspace and topsoiling requirements, will apply to these agricultural wetlands.

6.2 General Procedures

6.2.1 Clearing and Grading

1. Limit construction activity and ground disturbance in wetland areas to a construction ROW width of 75 feet or as shown on the construction drawings. With written approval from the FERC for site-specific conditions, construction ROW width within the boundaries of federally delineated wetlands may be expanded beyond 75 feet.

2. Wetland boundaries and buffers must be clearly marked in the field with signs and /or highly visible flagging until construction-related ground disturbing activities are complete.

3. Restrict extra work areas (such as staging areas and additional spoil storage areas) to those shown only on the construction drawings. All extra work areas must be located at least 50 feet away from wetland boundaries, except where the adjacent upland consists of actively cultivated or rotated cropland or other disturbed land. If site-specific conditions do not permit a 50-foot setback, the Company can receive written approval from the FERC to locate these extra work areas closer than 50 feet from the wetland.

4. Aboveground facilities shall not be located in any wetland, except as permitted or where the location of such facilities outside of wetlands would prohibit compliance with DOT regulations.

5. If standing water or saturated soils are present, or if construction equipment causes ruts or mixing of the topsoil and subsoil in wetlands, use low-ground-weight construction equipment or operate normal equipment on timber riprap, prefabricated equipment mats or terra mats on the working side of the ROW during clearing operations. Do not use more than two layers of timber riprap to stabilize the ROW.

6. Cut vegetation just above ground level and grind stumps to ground level, leaving existing root systems in place. Immediately remove all cut trees and branches from the wetland and stockpile in an upland area on ROW for disposal.

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7. Limit pulling of tree stumps and grading activities to directly over the trenchline. Do not grade or remove stumps or root systems from the rest of the ROW in wetlands unless the Chief Inspector and EI determine that safety-related construction constraints require removal of tree stumps from under the working side of the ROW.

8. Do not cut trees outside of the construction ROW to obtain timber for riprap or equipment mats.

9. Cleared materials (slash, logs, brush, wood chips) shall not be permanently placed within wetland areas.

6.2.2 Temporary Erosion and Sediment Control

1. Install sediment barriers immediately after initial ground disturbance at the following locations:
   a. Within the ROW at the edge of the boundary between wetland and upland;
   b. Across the entire ROW immediately upslope of the wetland boundary to prevent sediment flow into the wetland;
   c. Along the edge of the ROW, where the ROW slopes toward the wetland, to protect adjacent, off ROW wetland; and
   d. Along the edge of the ROW as necessary to contain spoil and sediment within the ROW through wetlands.

2. Maintain all sediment barriers throughout construction and reinstall as necessary (such as after backfilling of the trench) until replaced by permanent erosion controls or restoration of adjacent upland areas is complete in accordance with Section 8.1.

6.2.3 Crossing Procedure

1. Minimize the length of time that topsoil is segregated and the trench is open.

2. Do not use rock, soil imported from outside the wetland, tree stumps, or brush riprap to stabilize the ROW.

3. Perform topsoil segregation in accordance with Section 3.5.3.1 and trench dewatering in accordance with Section 3.5.6.

4. Assemble the pipeline in an upland area unless the wetland is dry enough to adequately support skids and pipe.

5. Use "push pull" or "float" techniques to place the pipe in the trench where water and other site conditions allow.

6. Install trench plugs and/or seal the trench bottom as necessary to maintain the original wetland hydrology at locations where the pipeline trench may drain a wetland.

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7. Install a permanent interceptor dike and a trench plug at the base of slopes near the boundary between the wetland and adjacent upland areas. In addition, install sediment barriers as outlined in Section 3.5.2. Permanent interceptor dikes shall not be installed in agricultural areas.

8. Restore segregated topsoil to its original position after backfilling is complete. When required, additional fill material imported from off the ROW must be approved by the EI. The original wetland contours and flow regimes will be restored to the extent practical.

6.2.4 Cleanup and Restoration

1. Revegetate the ROW with annual ryegrass at 40 lbs/acre PLS or with the recommended Wetland Seed Mix in Appendix B, unless standing water is present.

2. **Do not use lime or fertilizer in wetland areas.**

3. Mulch the disturbed ROW only when required by the appropriate land management or state agency, as identified in the Clearance Package/Permit Book.

4. In the event that final cleanup is deferred more than 20 days after the trench is backfilled, all slopes adjacent to wetlands shall be mulched with 3 tons/acre of straw for a minimum of 100 feet on each side of the crossing.

5. Remove all timber riprap and prefabricated equipment mats upon completion of construction.

6. Develop specific procedures in coordination with the appropriate land management or state agency, where necessary, to prevent the invasion or spread of undesirable exotic vegetation (such as purple loose strife and phragmites).

7. Ensure that all disturbed areas permanently revegetate in accordance with Section 8.1.

8. Remove temporary sediment barriers located at the boundary between wetland and adjacent upland areas after upland revegetation and stabilization of adjacent upland areas are successful as specified in Section 8.1.

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7. SPILL PREVENTION CONTROL

7.1 The Contractor shall adhere to the Company's SPCC Plan at all times.

1. Do not store hazardous materials, chemicals, fuels, or lubricating oils within 100 feet of any wetland, waterbody or within any designated municipal watershed area where feasible. If the 100-foot setback cannot be met, this activity can be performed within the 100-foot setback, with EI approval, if done in accordance with the SPCC Plan.

2. Refuel all construction equipment at least 100 feet from any wetland or waterbody, where feasible. If the 100-foot setback cannot be met, this activity can be performed within the 100-foot setback, with EI approval, if done in accordance with the SPCC Plan.

3. Do not perform fondu or concrete coating activities within 100 feet of any wetland or waterbody. If the 100-foot setback cannot be met, these activities can be performed within the 100-foot setback, with EI approval, if done in accordance with the SPCC Plan.

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8. POST CONSTRUCTION ACTIVITIES

8.1 Post-Construction Monitoring

All projects conducted under this Plan, with the exception of insitu pipe replacements (i.e. DOT-mandated replacements, line lowerings, and anomaly repairs), shall meet the monitoring requirements set forth in this section. Company personnel shall perform the following:

1. Establish and implement a program to monitor the success of restoration upon completion of construction and restoration activities;

2. Conduct follow-up inspections of all disturbed upland areas after the first growing season and if necessary, the second growing season (normally 3 to 9 months and 15 to 21 months after seeding, respectively) to determine the success of revegetation;

3. Revegetation in non agricultural areas shall be considered successful if the vegetative cover is sufficient to prevent the erosion of soils on the disturbed ROW and density and cover are similar to that in adjacent undisturbed area. Sufficient coverage in upland areas is defined when vegetation has a uniform 70 percent vegetative coverage. In agricultural areas, revegetation shall be considered successful if crop yields are similar to adjacent undisturbed portions of the same field. Revegetation efforts (such as fertilizing or reseeding) will continue until revegetation is successful;

4. Restoration shall be considered successful if the ROW surface condition is similar to adjacent undisturbed lands, construction debris is removed (unless requested otherwise by the land owner or land managing agency), revegetation is successful, and proper drainage has been restored;

5. Monitor and correct problems with drainage and irrigation systems resulting from pipeline construction in active agricultural areas until restoration is successful;

6. Make efforts to control unauthorized off-road vehicle use, in cooperation with the landowner, throughout the life of the project. Maintain signs, gates, and vehicle trails as necessary;

7. Monitor and record the success of wetland revegetation annually for the first 3 years (or as required by permit) after construction, or longer, until wetland revegetation is successful. Wetland revegetation will be considered successful when the cover of herbaceous and/or woody species is at least 80 percent of the type, density, and distribution of the vegetation in adjacent wetland areas that were not disturbed by construction. If revegetation is not successful at the end of 3 years, the Company shall develop and implement (in consultation with a professional wetland ecologist) a plan to actively revegetate the wetland with native wetland herbaceous and woody plant species; and

8. Inspect all temporary remaining erosion and sedimentation controls during routine patrols to ensure proper functioning. Any deficiencies found will be reported and corrected as needed. Once the area has revegetated and stabilized, the erosion controls will be removed.

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8.2 Post-Construction Maintenance

All projects conducted under this Plan, with the exception of insitu pipe replacements (i.e. DOT-mandated replacements, line lowerings, and anomaly repairs), shall meet the maintenance requirements set forth in this section. The following requirements restrict the amount of vegetation maintenance that can occur on new pipeline facilities. Where the newly established pipeline ROW is located on other existing ROWs not affiliated with the Company, the easement holder or owner will continue to maintain their ROWs using procedures specified in their vegetative management programs.

8.2.1 Uplands

Routine maintenance of the ROW is required to allow continued access for routine pipeline patrols, maintaining access in the event of emergency repairs, and visibility during aerial patrols. In upland areas, maintenance of the ROW will involve clearing the entire ROW of woody vegetation.

1. Routine vegetation maintenance clearing shall be conducted no more frequently than once every 3 years. However, to facilitate periodic corrosion and leak surveys, a 10-foot wide corridor centered on the pipeline may be maintained annually in a herbaceous state.

2. In no case shall routine vegetation maintenance clearing occur between April 15 and August 1 of any year.

8.2.2 Waterbodies and Wetlands

1. Vegetation maintenance practices on the construction ROW adjacent to waterbodies will consist of maintaining a riparian strip that measures 25 feet back from the mean high water mark. This riparian area will be allowed to permanently revegetate with native plant species across the entire ROW.

2. Vegetation maintenance practices over the full width of the construction ROW in wetlands is prohibited.

3. To facilitate periodic corrosion and leak surveys at wetlands and waterbodies, a 10-foot wide corridor centered on the pipeline may be maintained in an herbaceous state. Trees and shrubs greater than 15 feet in height that are located within 15 feet of the pipeline may be cut and removed from the ROW.

4. Herbicides or pesticides shall not be used in or within 100 feet of a wetland or waterbody, except as specified by the appropriate land management or state agency.

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8.3 Reporting

The Company shall maintain records that identify by milepost:

1. Method of application, application rate, and type of fertilizer, pH modifying agent, seed, and mulch used;
2. Acreage treated;
3. Dates of backfilling and seeding; and
4. Names of landowners requesting special seeding treatment and a description of the follow-up actions.

For the FERC-certificated projects, the Company will file quarterly activity reports documenting problems, including those identified by the landowner, and corrective actions taken for at least 2 years following construction.

A wetland revegetation monitoring report identifying the status of the wetland revegetation efforts will be filed at the end of 3 years following construction, and annually thereafter until revegetation is successful.

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APPENDIX A

FIGURES

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FIGURE NUMBER	STANDARD NUMBER	DRAWING TITLE
FIGURE #1	ES-0001	TYPICAL CONSTRUCTION WIDTHS ACQUIRING NEW PERMANENT RIGHT-OF-WAY
FIGURE #2	ES-0002	TYPICAL CONSTRUCTION WIDTHS NOT ACQUIRING NEW PERMANENT RIGHT-OF-WAY (MULTIPLE LINE SYSTEM)
FIGURE #3	ES-0003	TYPICAL CONSTRUCTION WIDTHS NOT ACQUIRING NEW PERMANENT RIGHT-OF-WAY (SINGLE LINE SYSTEM)
FIGURE #4	ES-0004	ACCESS ROAD CROSS SECTION
FIGURE #5	ES-0005	ROCK ACCESS PAD INSTALLATION AND MAINTENANCE
FIGURE #6	ES-0006	TYPICAL TEMPORARY ACCESS ROAD THROUGH WETLANDS
FIGURE #7	ES-0007	SILT FENCE INSTALLATION AND MAINTENANCE
FIGURE #8	ES-0008	STRAW BALE INSTALLATION AND MAINTENANCE
FIGURE #9	ES-0009	STRAW BALE INSTALLATION FOR A CHECK DAM IN A DRAINAGE WAY
FIGURE #10	ES-0010	STORM DRAIN INLET PROTECTION
FIGURE #11	ES-0011	R.O.W. TOPSOIL SEGREGATION TECHNIQUES
FIGURE #12	ES-0012	INTERCEPTOR DIKE INSTALLATION AND MAINTENANCE
FIGURE #13	ES-0013	TYPICAL TRENCH DETAIL
FIGURE #14	ES-0014	TEMPORARY TRENCH PLUGS
FIGURE #15	ES-0015	FILTER BAG
FIGURE #16	ES-0016	PERMANENT TRENCH PLUGS
FIGURE #17	ES-0017	TRENCH PLUG DETAIL
FIGURE #18	ES-0018	DEWATERING STRUCTURE FOR HYDROSTATIC TESTING
FIGURE #19	ES-0019	ALTERNATE DEWATERING STRUCTURE FOR HYDROSTATIC TESTING
FIGURE #20	ES-0020	CHEVRON INTERCEPTOR DIKE INSTALLATION AND MAINTENANCE
FIGURE #21	ES-0021	ROCK LINED DRAINAGE SWALE INSTALLATION AND MAINTENANCE
FIGURE #22	ES-0022	TYPICAL MATTING ON SLOPES
FIGURE #23	ES-0023	EROSION CONTROL FABRIC INSTALLATION
FIGURE #24	ES-0024	DRAIN TILE REPAIR PROCEDURE
FIGURE #25	ES-0025	TYPICAL PAVED ROAD CROSSING CONTROL MEASURES (OPEN CUT)
FIGURE #26	ES-0026	TYPICAL PAVED ROAD CROSSING CONTROL MEASURES (BORED)
FIGURE #27	ES-0027	TEMPORARY EQUIPMENT BRIDGE (EQUIPMENT PADS AND CULVERTS)
FIGURE #28	ES-0028	TEMPORARY EQUIPMENT BRIDGE (CRUSHED STONE AND CULVERTS)
FIGURE #29	ES-0029	TEMPORARY EQUIPMENT BRIDGE (FLEX-FLOAT OR PORTABLE)
FIGURE #30	ES-0030	TYPICAL FLUMED CROSSING
FIGURE #31	ES-0031	TYPICAL DAM AND PUMP CROSSING
FIGURE #32	ES-0032	TYPICAL WET CROSSING
FIGURE #33	ES-0033	TYPICAL MATTING OF STREAMBANKS
FIGURE #34	ES-0034	RIP-RAP PLACEMENT (TYPICAL)

INDEX OF FIGURES

APPENDIX A

DWG. ES-0000 REV.

LG. ES0000.DGN 01/29/2003

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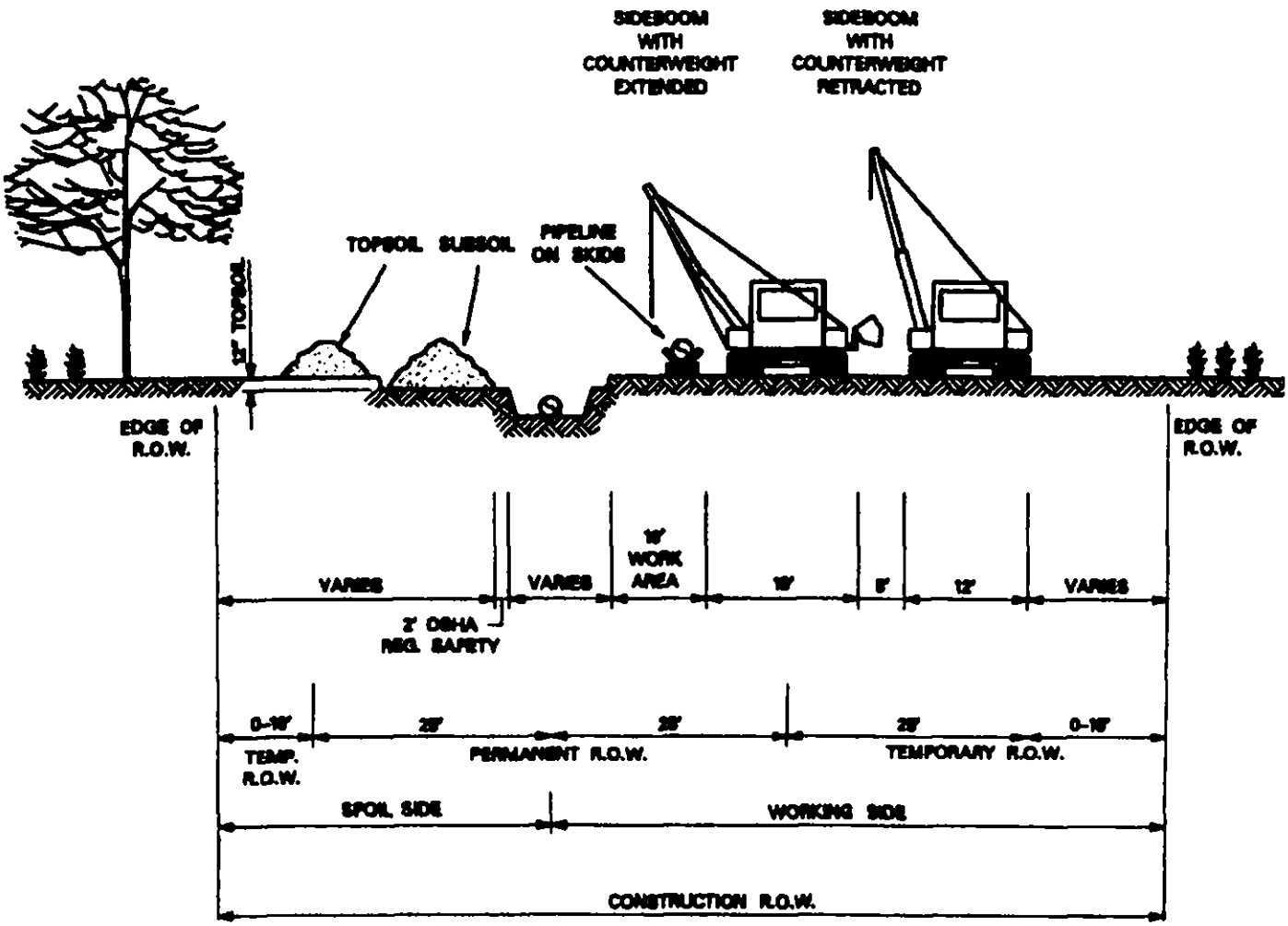

PIPE DIAMETER	SPOIL SIDE (FT.)	WORKING SIDE (FT.)	CONSTRUCTION R.O.W. (FT.)
12" OR LESS	25	50	75
14" - 36"	35	50	85
38" - 42"	35	65	100
WETLANDS	25	50	75

NOTES:

1. ALTHOUGH THE DIMENSIONS SHOWN ARE TYPICAL, SOME VARIATIONS MAY EXIST DUE TO SITE SPECIFIC CONDITIONS. UNLESS OTHERWISE INDICATED ON THE ALIGNMENT SHEETS, THE MAXIMUM WIDTH OF THE CONSTRUCTION RIGHT-OF-WAY SHALL BE AS SHOWN IN THE TABLE FOR THE APPROPRIATE PIPE DIAMETER.

2. TOPSOIL AND SUBSOIL SHALL BE SEGREGATED WITHIN WETLAND, RESIDENTIAL, AGRICULTURAL, PASTURES, HAYFIELDS, AND OTHER AREAS AT LANDOWNER'S OR LAND MANAGING AGENCY'S REQUEST.

	TYPICAL CONSTRUCTION WIDTHS ACQUIRING NEW PERMANENT RIGHT-OF-WAY	FIGURE #1	
		DWG. ES-0001	REV.

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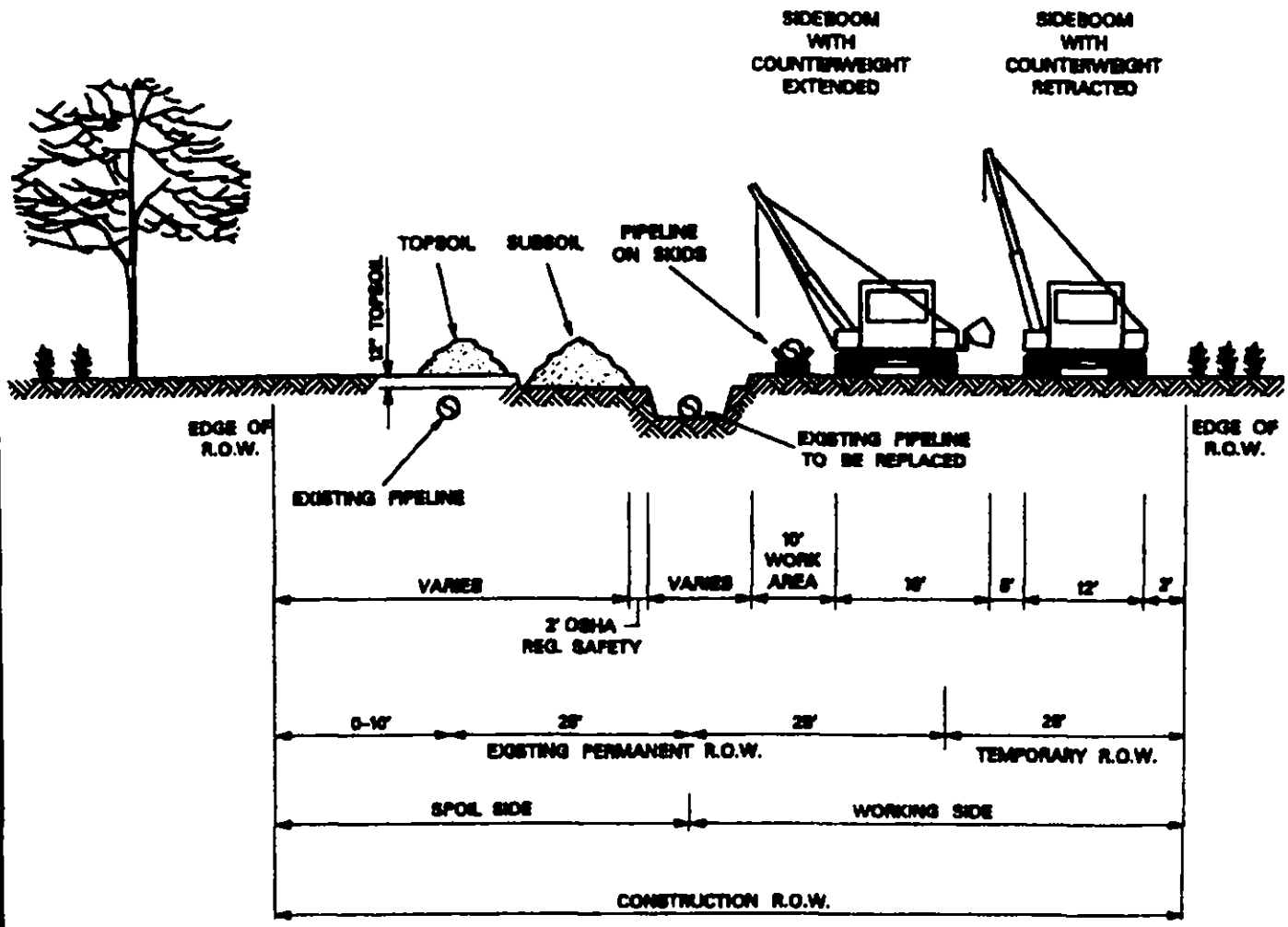

PIPE DIAMETER	SPOIL SIDE (FT.)	WORKING SIDE (FT.)	CONSTRUCTION R.O.W. (FT.)
12" OR LESS	25	50	75
14" - 30"	35	50	85
36" - 42"	35	50	85
WETLANDS	25	50	75

NOTES:

1. ALTHOUGH THE DIMENSIONS SHOWN ARE TYPICAL, SOME VARIATIONS MAY EXIST DUE TO SITE SPECIFIC CONDITIONS. UNLESS OTHERWISE INDICATED ON THE ALIGNMENT SHEETS, THE MAXIMUM WIDTH OF THE CONSTRUCTION RIGHT-OF-WAY SHALL BE AS SHOWN IN THE TABLE FOR THE APPROPRIATE PIPE DIAMETER.

2. TOPSOIL AND SUBSOIL SHALL BE SEGREGATED WITHIN WETLAND, RESIDENTIAL, AGRICULTURAL, PASTURES, HAYFIELDS, AND OTHER AREAS AT LANDOWNER'S OR LAND MANAGING AGENCY'S REQUEST.

3. IF THE WORKING SIDE MUST BE GREATER THAN 50 FEET (i.e. TEMPORARY WORKSPACE IS GREATER THAN 25 FEET), COMPANY MUST REQUEST APPROVAL FROM THE F.E.R.C.

	TYPICAL CONSTRUCTION WIDTHS NOT ACQUIRING NEW PERMANENT RIGHT-OF-WAY (MULTIPLE LINE SYSTEM)	FIGURE #2	
		DWG. ES-0002	REV.

LG. ES0002.DGN 8/17/2004

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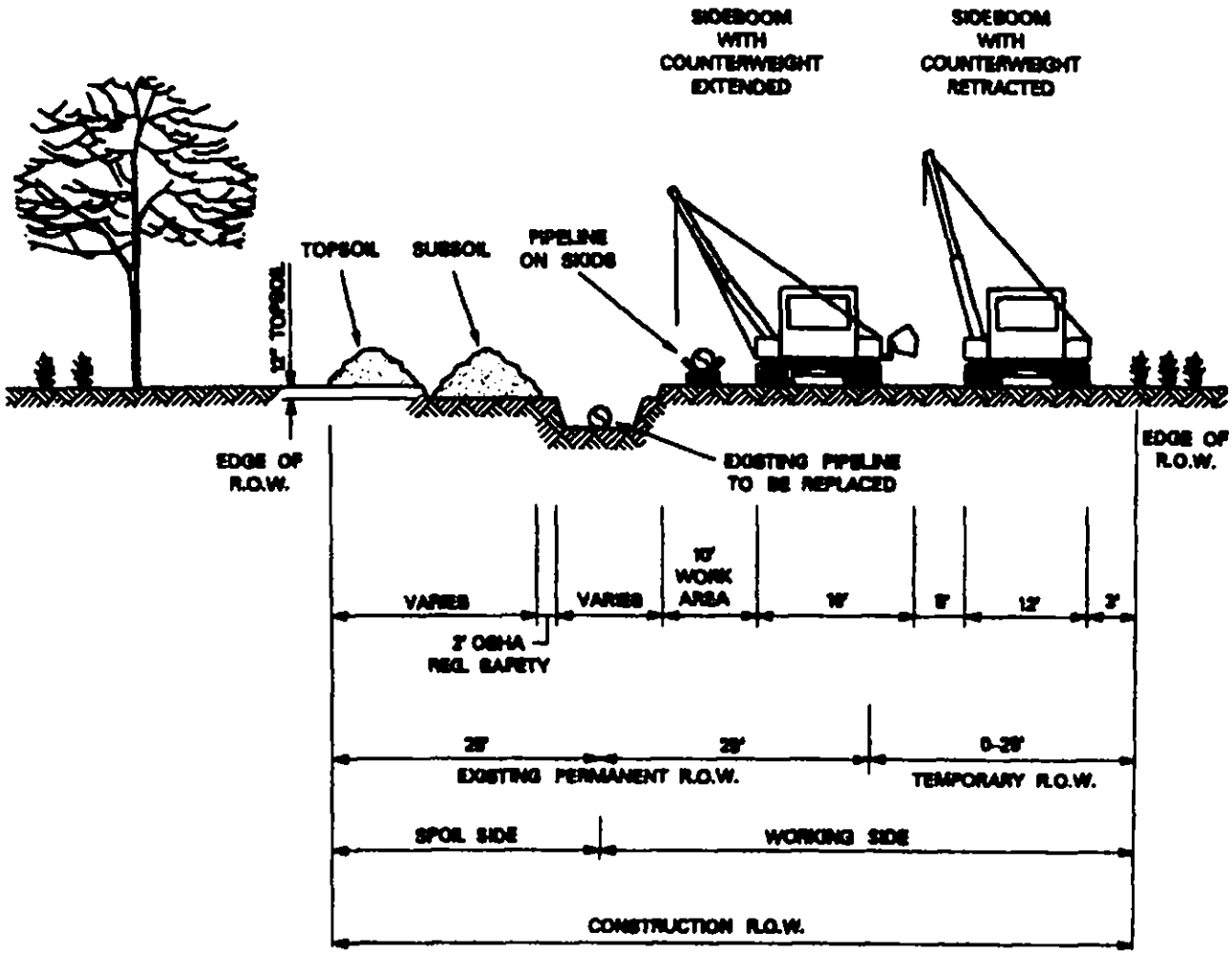

PIPE DIAMETER	SPOIL SIDE (FT.)	WORKING SIDE (FT.)	CONSTRUCTION R.O.W. (FT.)
12" OR LESS	25	25	50
14" - 36"	25	50	75
38" - 42"	25	50	75
WETLANDS	25	50	75

NOTES:

1. ALTHOUGH THE DIMENSIONS SHOWN ARE TYPICAL, SOME VARIATIONS MAY EXIST DUE TO SITE SPECIFIC CONDITIONS. UNLESS OTHERWISE INDICATED ON THE ALIGNMENT SHEETS, THE MAXIMUM WIDTH OF THE CONSTRUCTION RIGHT-OF-WAY SHALL BE AS SHOWN IN THE TABLE FOR THE APPROPRIATE PIPE DIAMETER.
2. TOPSOIL AND SUBSOIL SHALL BE SEGREGATED WITHIN WETLAND, RESIDENTIAL, AGRICULTURAL, PASTURES, HAYFIELDS, AND OTHER AREAS AT LANDOWNER'S OR LAND MANAGING AGENCY'S REQUEST.
3. IF THE WORKING SIDE MUST BE GREATER THAN THE VALUES SHOWN IN THE TABLE, COMPANY MUST REQUEST APPROVAL FROM THE F.E.R.C.

	TYPICAL CONSTRUCTION WIDTHS NOT ACQUIRING NEW PERMANENT RIGHT-OF-WAY (SINGLE LINE SYSTEM)	FIGURE #3
		DWG. ES-0003 REV.

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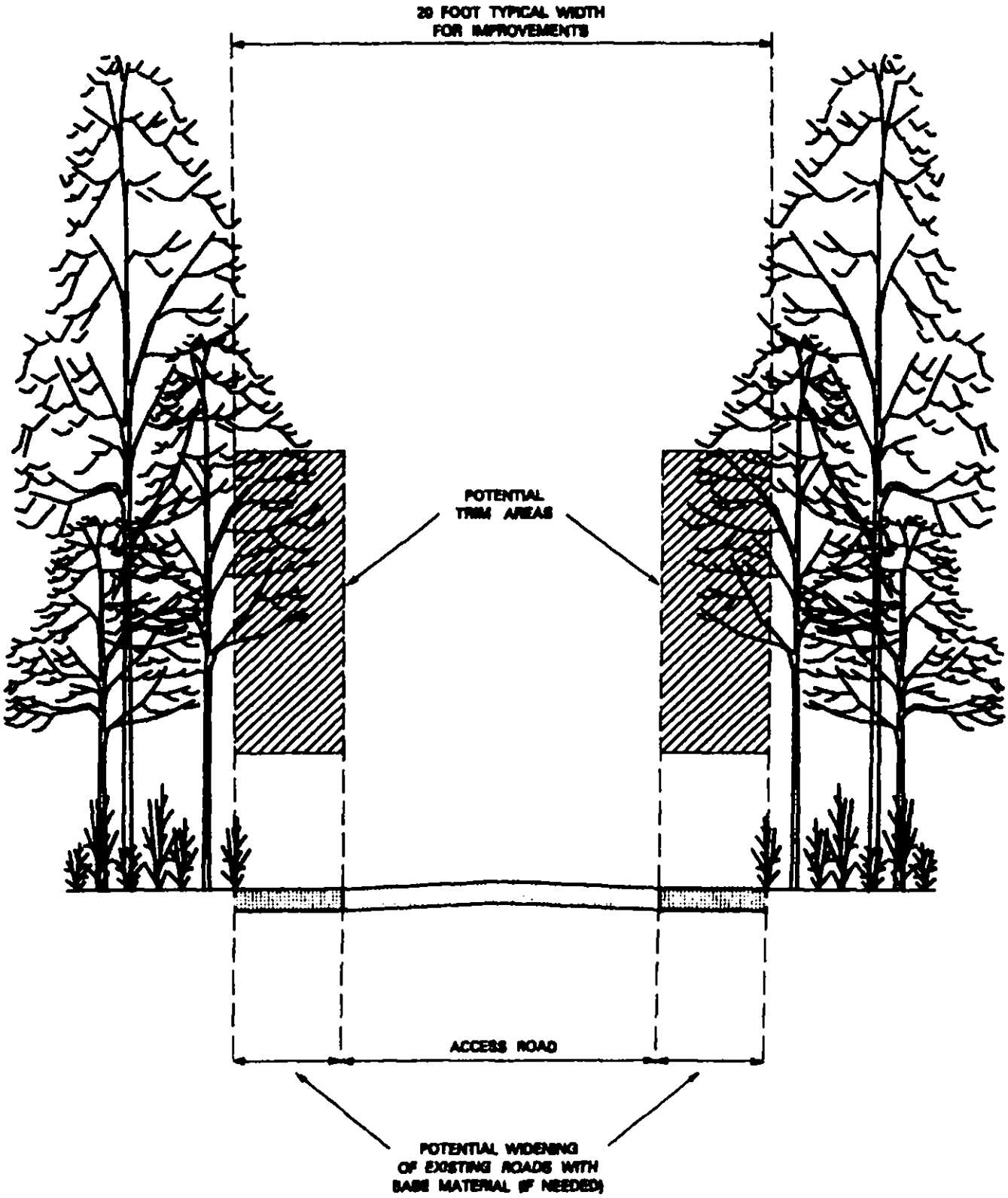

	ACCESS ROAD CROSS SECTION	FIGURE #4
		DWG. ES-0004 REV.

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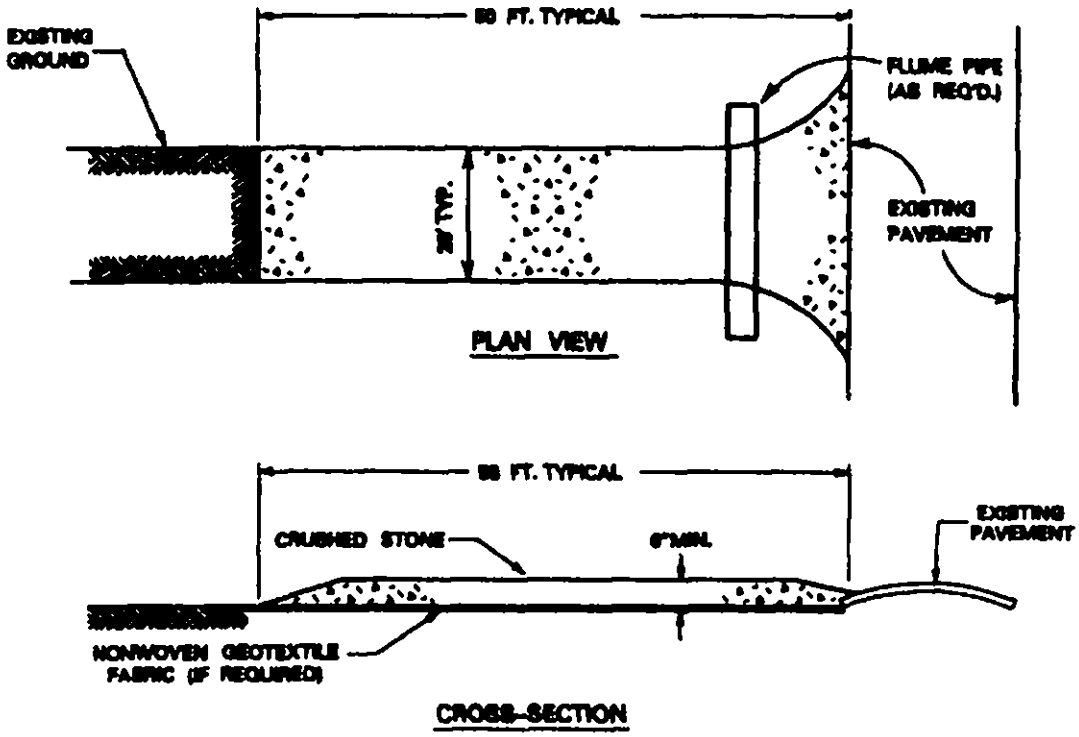

CONSTRUCTION SPECIFICATIONS:

1. STONE SIZE = 4" - 8" (AVG.) CRUSHED STONE
2. ALL STONE MUST BE PLACED ON NON-WOVEN GEOTEXILE FABRIC IF USED IN RESIDENTIAL OR ACTIVE AGRICULTURAL AREAS.
3. LENGTH = FIFTY (50) FOOT TYPICAL (IF SITE CONDITIONS ALLOW)
4. WIDTH = TWENTY (20) FOOT TYPICAL.
5. THICKNESS = SIX (6) INCHES MINIMUM.
6. ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS THE ENTRANCE. IF PIPING IS IMPRACTICAL, A DRIVEABLE BERM OR OTHER TEMPORARY EROSION CONTROL DEVICE CAN BE USED.
7. THE ENTRANCE SHALL BE PERIODICALLY INSPECTED AND MAINTAINED IN A CONDITION THAT MINIMIZES TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. MAINTENANCE MAY INCLUDE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR THE REPAIR / CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ANY SEDIMENT THAT IS SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED AS SOON AS PRACTICAL.

	ROCK ACCESS PAD INSTALLATION AND MAINTENANCE	FIGURE #5
		DWG. ES-0005 REV.

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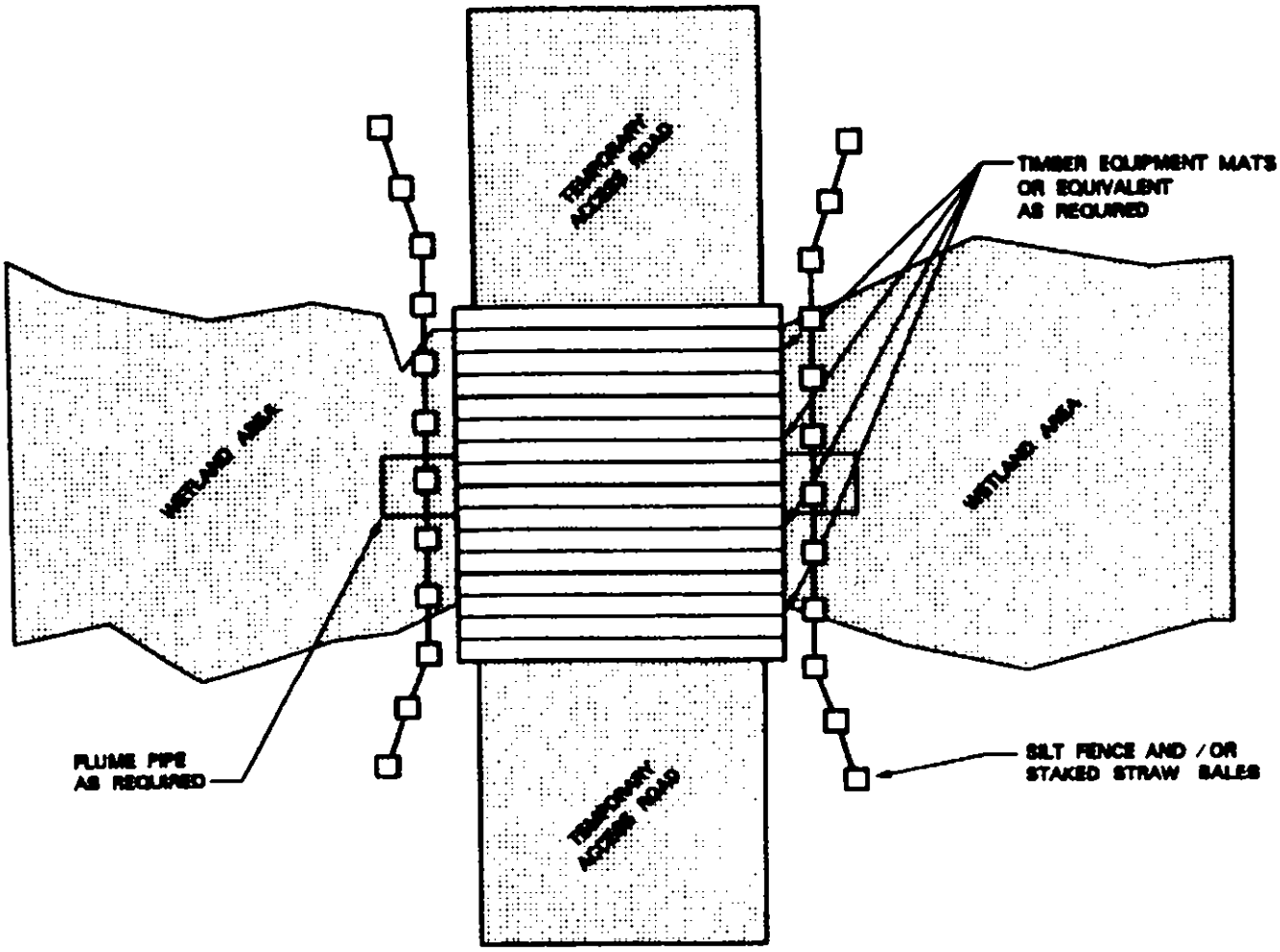

PLAN VIEW
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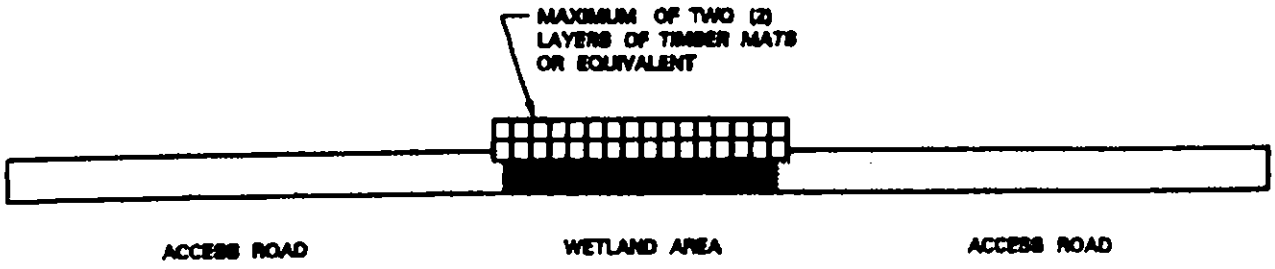

CROSS SECTION
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	TYPICAL TEMPORARY ACCESS ROAD THROUGH WETLANDS	FIGURE #6
		DWG. ES-0006 REV.

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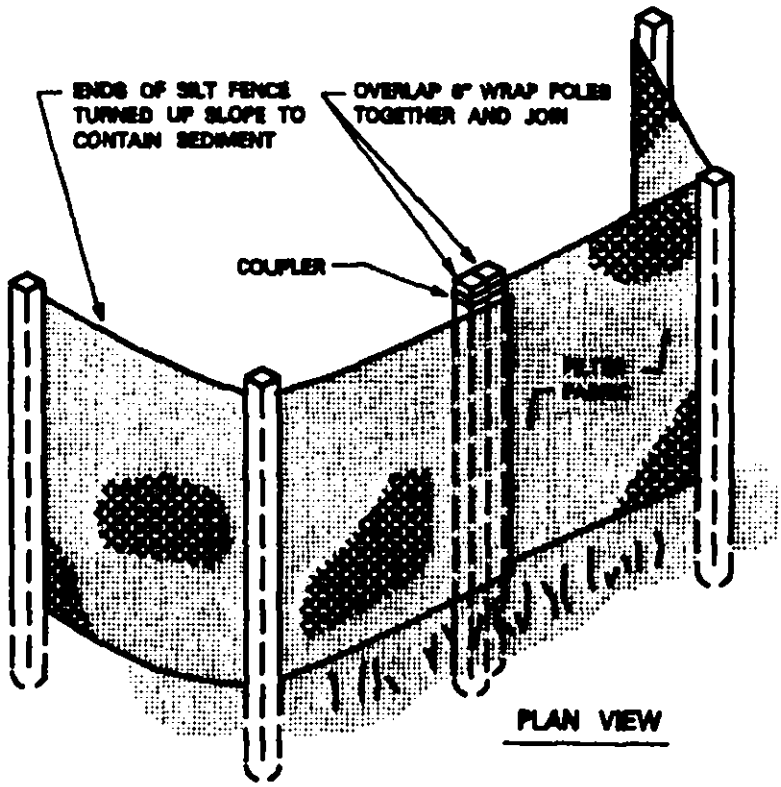

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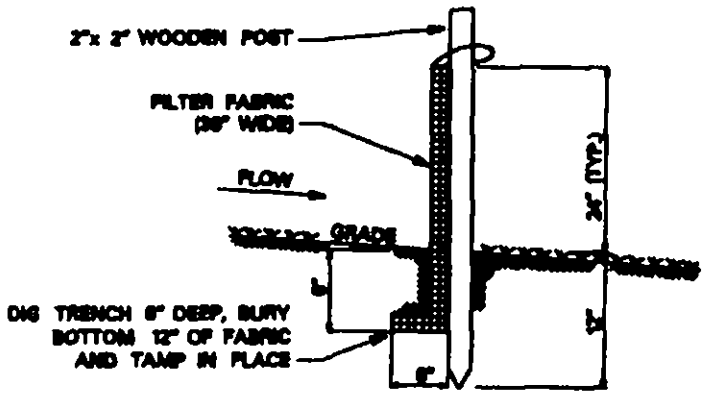

CROSS SECTION

INSTALLATION REQUIREMENTS:

- WHEN USING SILT FENCE, PLACE IT:
  - BETWEEN DISTURBED AREAS AND DOWN-SLOPE ENVIRONMENTAL RESOURCE AREAS
  - AT THE BASE OF ALL SLOPES NEXT TO WETLANDS, WATERBODIES, AND ROAD CROSSINGS
  - AT THE INLET AND OUTLET OF OPEN DRAINAGE STRUCTURES
  - APPROXIMATELY 6 FEET BEYOND THE TOE OF THE SLOPE TO GIVE THE SEDIMENT ROOM TO COLLECT
- USE SANDBAGS OR BACKFILLING TO KEY IN THE BOTTOM OF THE FABRIC WHERE IT IS NOT FEASIBLE TO TRENCH IT IN (LEDGES, ROCKY SOIL, LARGE ROOTS, ETC.)

MAINTENANCE REQUIREMENTS:

- INSPECT SILT FENCE:
  - DAILY IN AREAS OF ACTIVE CONSTRUCTION
  - WEEKLY IN AREAS WITH NO CONSTRUCTION
  - WITHIN 24 HOURS FOLLOWING EACH MAJOR STORM EVENT
- REPAIR OR REPLACE SILT FENCE AS NEEDED
- REMOVE ACCUMULATED SEDIMENTS TO AN UPLAND AREA AS NEEDED

LG. ESE0007.DGN

	SILT FENCE INSTALLATION AND MAINTENANCE	FIGURE #7
		DWG. ES-0007 REV.

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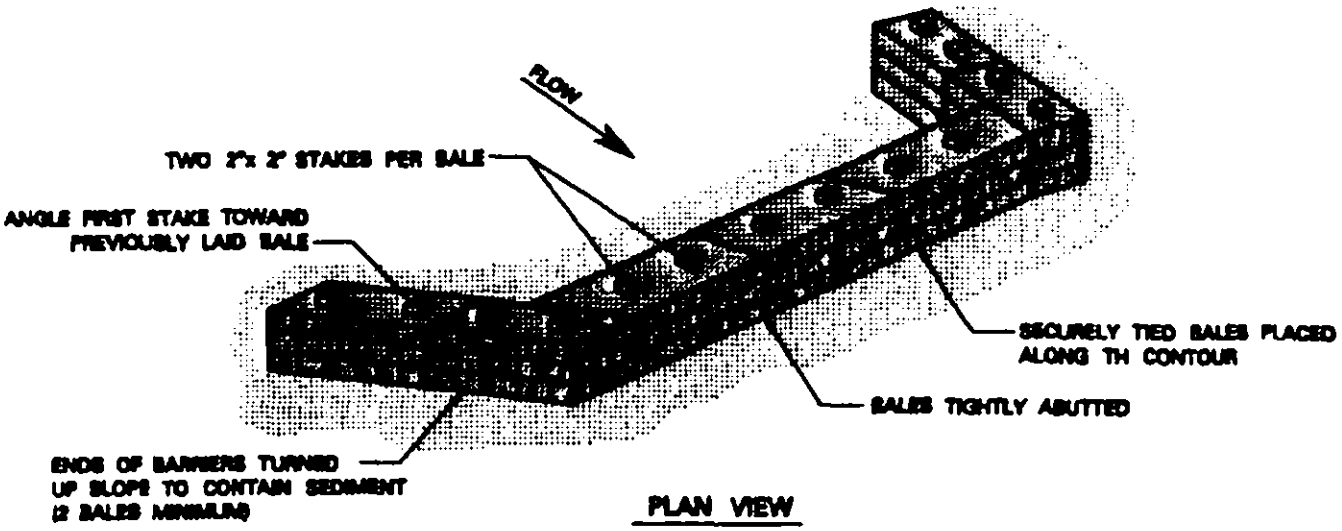
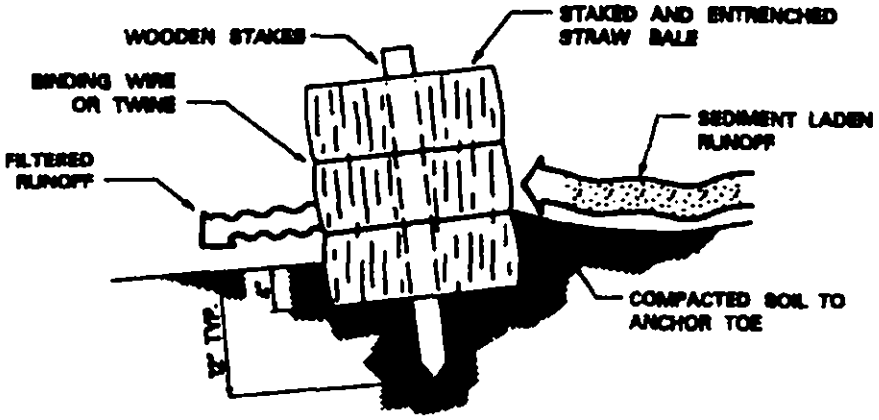


PLAN VIEW



CROSS-SECTION

INSTALLATION REQUIREMENTS:

- WHEN USING STRAW BALES, PLACE THEM:
  - WITH THEIR ENDS TIGHTLY ABUTTING AND EMBEDDED IN THE SOIL A TYPICAL OF 4".
  - BETWEEN DISTURBED AREAS AND DOWN-SLOPE ENVIRONMENTAL RESOURCE AREAS.
  - AT THE BASE OF ALL SLOPES NEXT TO WETLANDS, WATERBODIES, AND ROAD CROSSINGS
  - AT THE INLET AND OUTLET OF OPEN DRAINAGE STRUCTURES.
  - APPROXIMATELY 6 FEET BEYOND THE TOE OF THE SLOPE TO GIVE THE SEDIMENT ROOM TO COLLECT.
- KEY IN THE BOTTOM OF THE BALE. IN AREAS WHERE IT IS NOT FEASIBLE TO TRENCH IT IN (LEDGES, ROCKY SOIL, LARGE TREE ROOTS, ETC.), USE NATIVE SOIL AS BACKFILL UP-SLOPE OF THE BALE.
- IF USED IN CONJUNCTION WITH SILT FENCE, BALES ARE PLACED UPSLOPE OF THE SILT FENCE AND DO NOT NEED TO BE TRENCHED IN.

MAINTENANCE REQUIREMENTS:

- INSPECT BALES:
  - DAILY IN AREAS OF ACTIVE CONSTRUCTION.
  - WEEKLY IN AREAS WITH NO CONSTRUCTION.
  - WITHIN 24 HOURS FOLLOWING EACH MAJOR STORM EVENT.
- REPAIR OR REPLACE BALES AS NEEDED.
- REMOVE ACCUMULATED SEDIMENTS TO AN UPLAND AREA AS NEEDED.

	STRAW BALE INSTALLATION AND MAINTENANCE	FIGURE #8
		DWG. ES-0008 REV.

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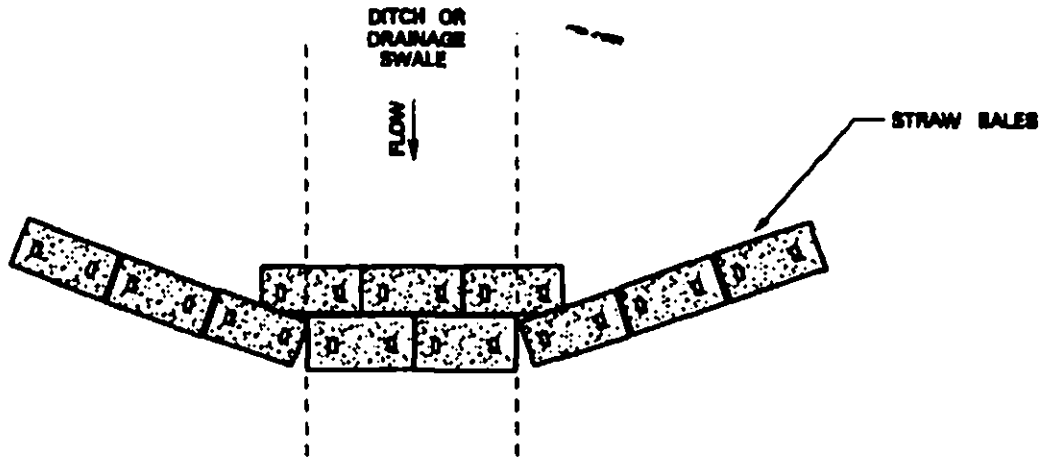

PLAN VIEW
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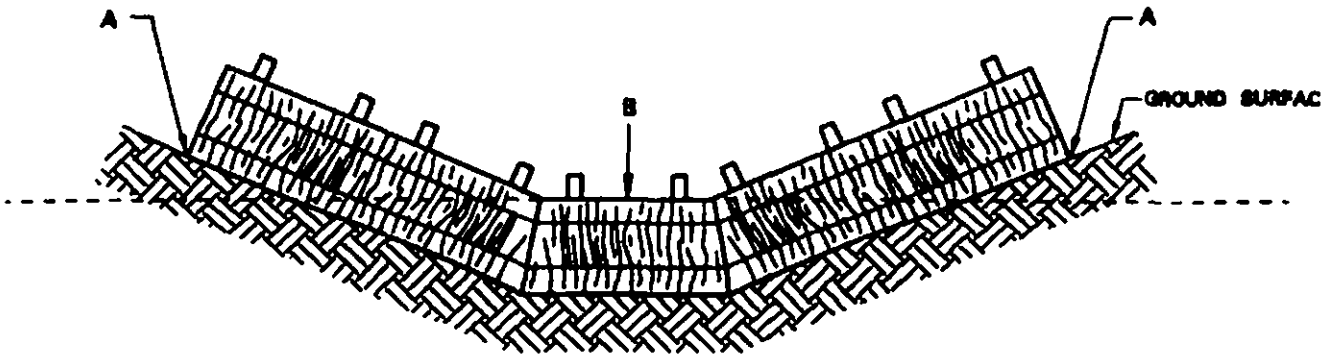

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	STRAW BALE INSTALLATION FOR A CHECK DAM IN A DRAINAGE WAY	FIGURE #9
		DWG. ES-0009 REV.

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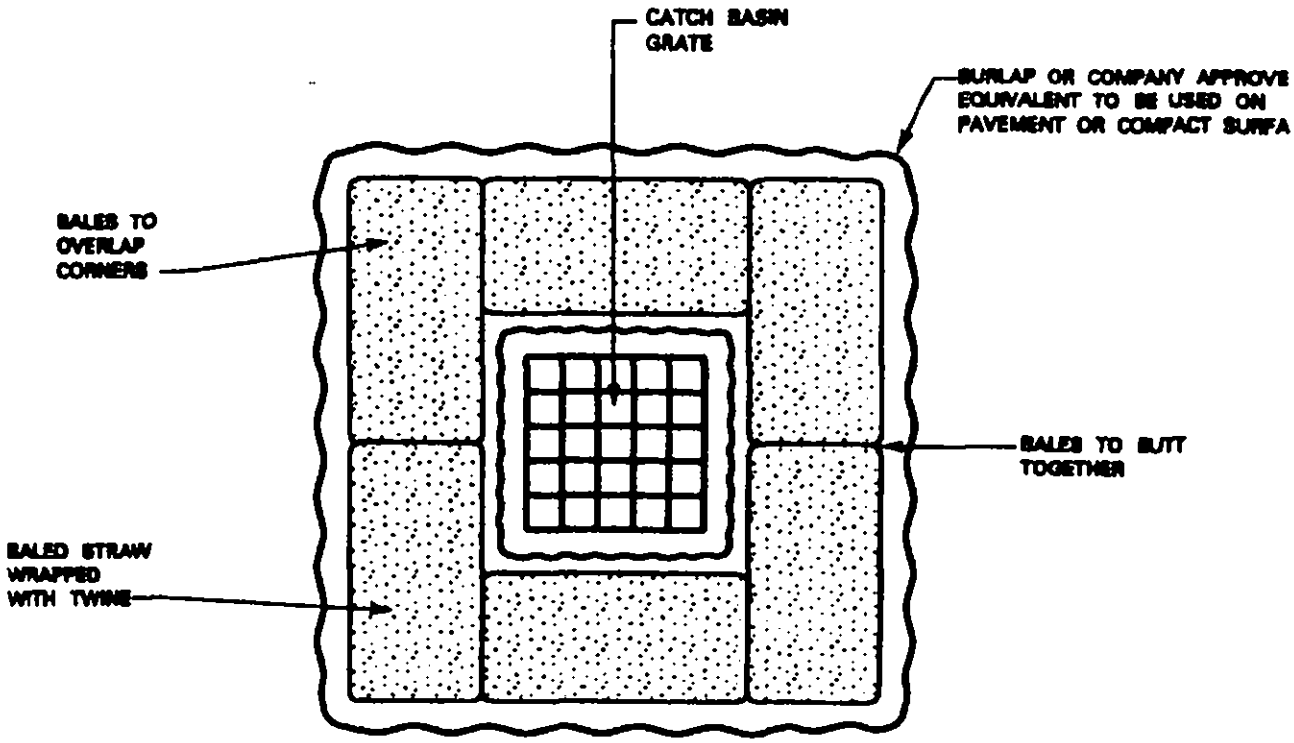

1. SURROUND STREET DRAINAGE STRUCTURE INLET WITH BALES PRIOR TO CONSTRUCTION AND MAINTAIN UNTIL CONSTRUCTION IS COMPLETED.
2. FOR BALES PLACED ON PAVEMENT (OR COMPACT SURFACES), PLACE BURLAP OR COMPANY APPROVED EQUIVALENT BETWEEN PAVEMENT AND BALE.
3. REMOVE ACCUMULATED SEDIMENT.

	STORM DRAIN INLET PROTECTION	FIGURE #10
		DWG. ES-0010 REV.

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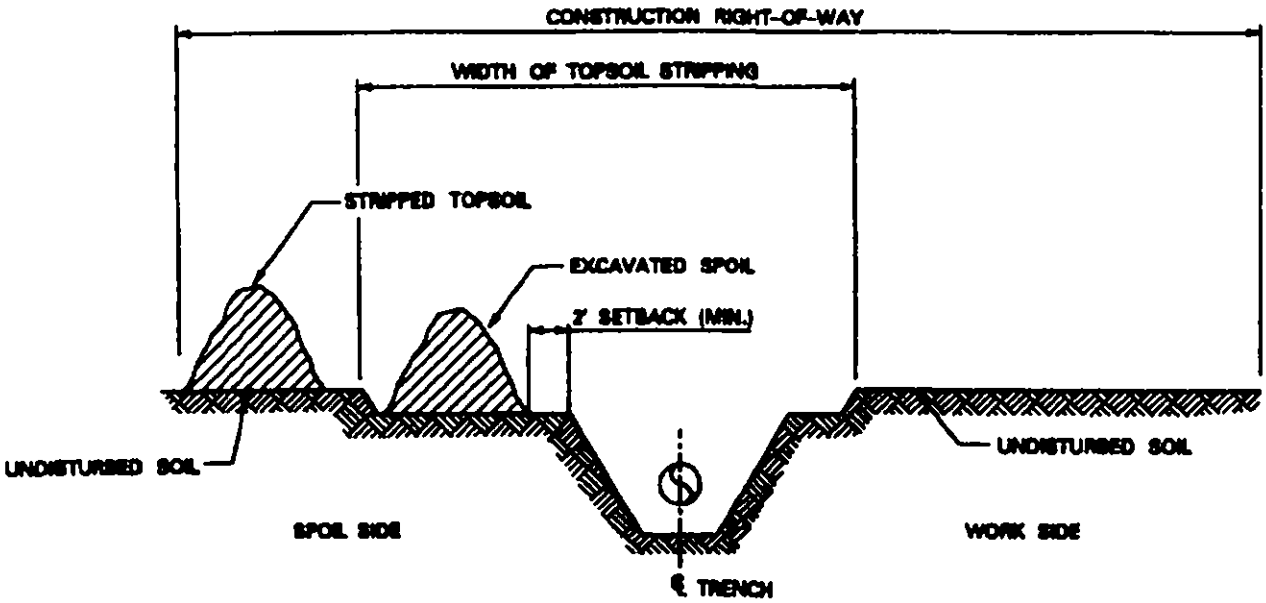
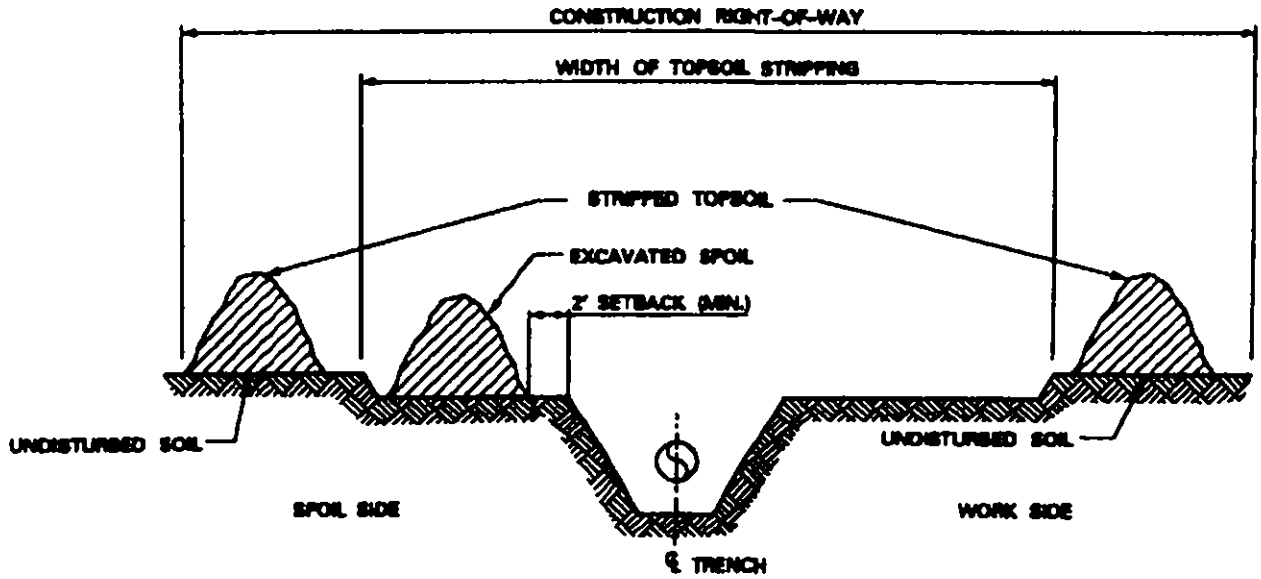


DITCH PLUS SPOILSIDE TOPSOIL SEGREGATION



FULL RIGHT-OF-WAY TOPSOIL STRIPPING

NOTES:

1. TOPSOIL MAY BE STORED IN LOCATIONS AS SHOWN ABOVE OR AT OTHER COMPANY APPROVED LOCATIONS WITHIN THE CONSTRUCTION R.O.W.
2. LEAVE GAPS IN SPOIL PILES FOR WATER RUN-OFF.
3. R.O.W. MAY BE EXPANDED UP TO 25' IN NON WETLAND AREAS FOR FULL R.O.W. TOPSOIL SALVAGE.

	R.O.W. TOPSOIL SEGREGATION TECHNIQUES	FIGURE #11
		DWG. ES-0011 REV.

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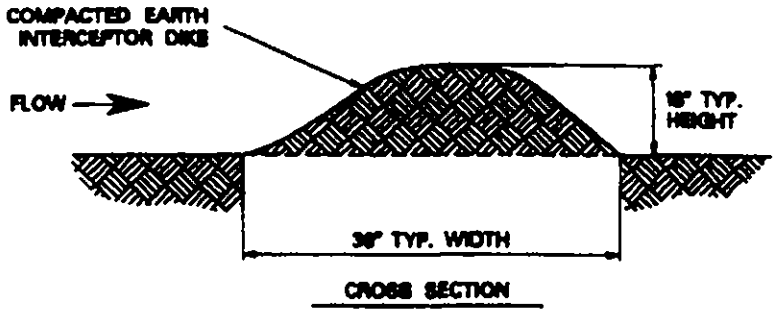

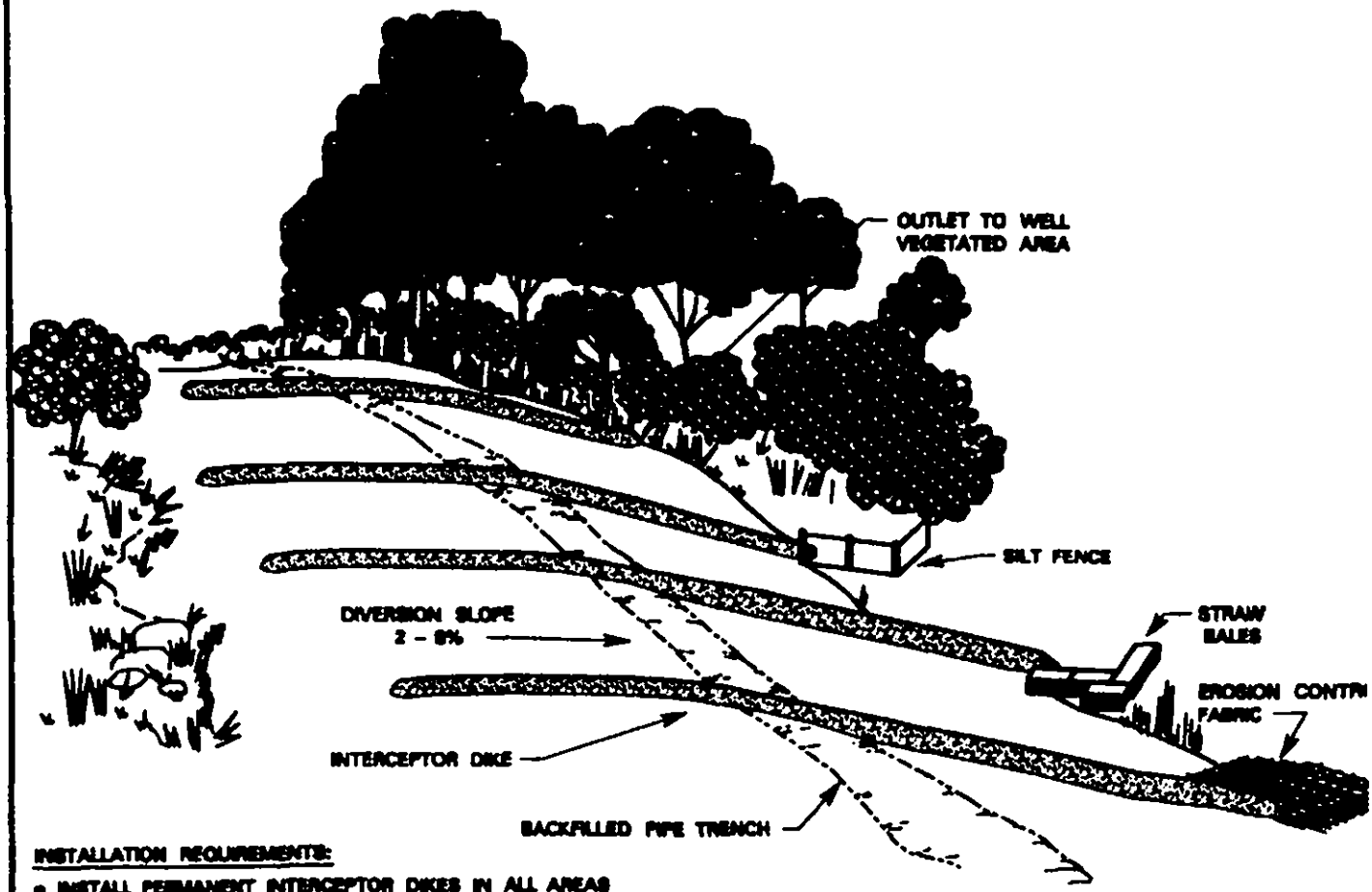

INSTALLATION REQUIREMENTS:

- INSTALL PERMANENT INTERCEPTOR DIKES IN ALL AREAS EXCEPT RESIDENTIAL OR AGRICULTURAL AS NECESSARY TO AVOID EXCESSIVE EROSION (UNLESS AUTHORIZED BY LANDOWNER OR LAND MANAGING AGENCY IN AGRICULTURAL OR RESIDENTIAL AREA).
- MUST BE INSTALLED ON SLOPES GREATER THAN 5% WHERE THE BASE OF THE SLOPE IS LESS THAN 50 FEET FROM A WATERBODY, WETLAND OR ROAD CROSSING AT THE FOLLOWING MINIMUM SPACING:

SLOPE (%)	SPACING (FT.)
5 - 15	300
>15 - 30	200
>30	100

- CONSTRUCT USING EARTH FILLED SACKS, STAKED STRAW BALES, SILT FENCE, OR SOIL FOR TEMPORARY OR COMPACTED EARTH AND ROCK FOR PERMANENT
- INSTALL WITH A 2 - 5% OUTFALL ANGLE.
- POSITION OUTFALL TO PREVENT SEDIMENT DISCHARGE INTO WETLANDS, WATERBODIES, OR OTHER SENSITIVE RESOURCES.
- FILTER RUN-OFF WATER BY CONSTRUCTING THE OUTLET IN A WELL VEGETATED STABLE AREA, OR BY USING AN ENERGY DISSIPATING DEVICE (SILT FENCE, STRAW BALES EROSION CONTROL FABRIC), AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.

MAINTENANCE REQUIREMENTS:

- INSPECT DURING AND FOLLOWING CONSTRUCTION AND MAKE REPAIRS AS NEEDED.
- KEEP THE CHANNEL FREE OF DEBRIS AND OBSTRUCTIONS.
- SEED AND MULCH PERMANENT INTERCEPTOR DIKES FOLLOWING CONSTRUCTION.

	INTERCEPTOR DIKE INSTALLATION AND MAINTENANCE	FIGURE #12
		DWG. ES-0012 REV.

LS. ES0012.DGN 02/18/2005

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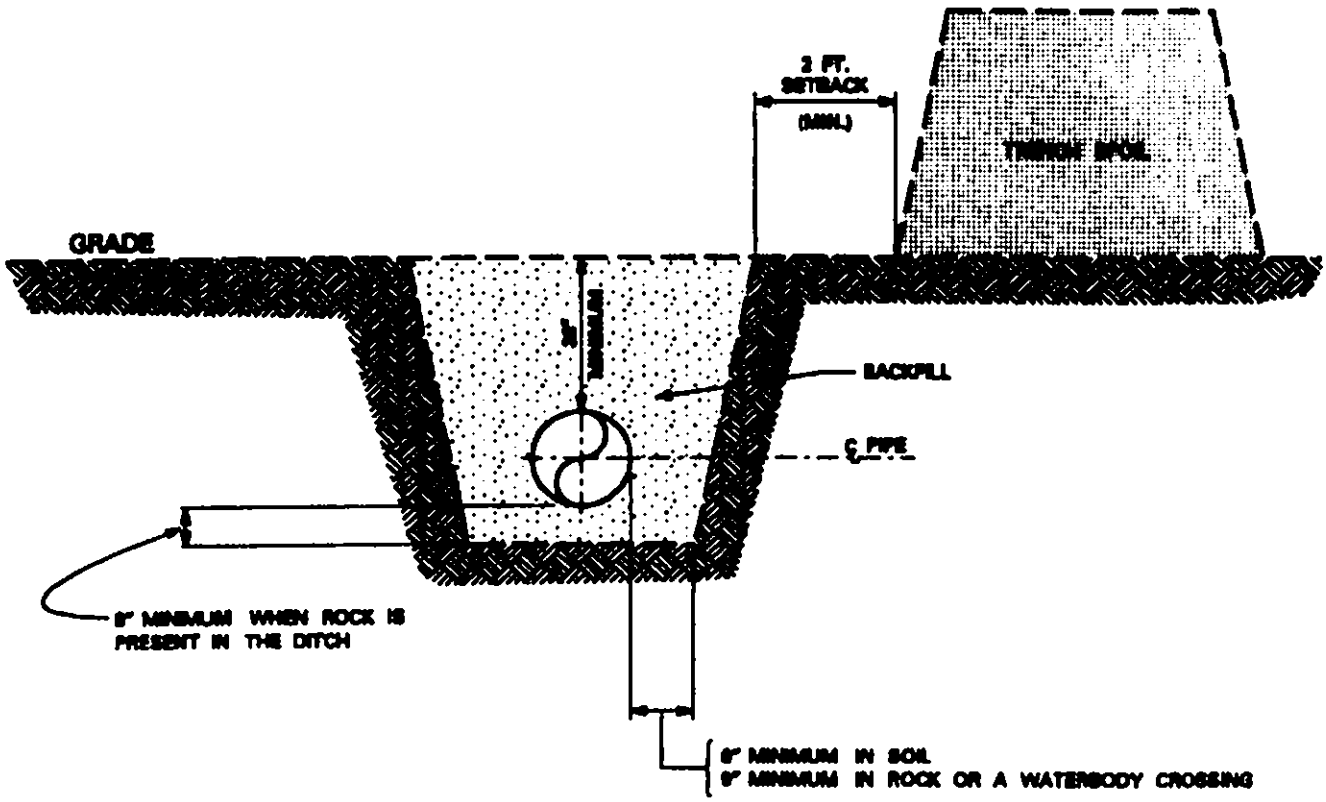

CROSS-SECTION VIEW OF TYPICAL TRENCH

NOTES:

1. ALL ORIGINAL CONTOURS WILL BE RE-ESTABLISHED UPON COMPLETION OF PIPE INSTALLATION EXCEPT IN WETLANDS. A CROWN MAY BE LEFT TO ACCOUNT FOR DITCH SETTLING, AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.

2. IN COLD WATER FISHERY STREAMS, THE TOP 12" OF THE TRENCH WILL BE BACKFILLED WITH CLEAN GRAVEL OR NATIVE COBBLES.

	TYPICAL TRENCH DETAIL	FIGURE #13
		DWG. ES-0013 REV.

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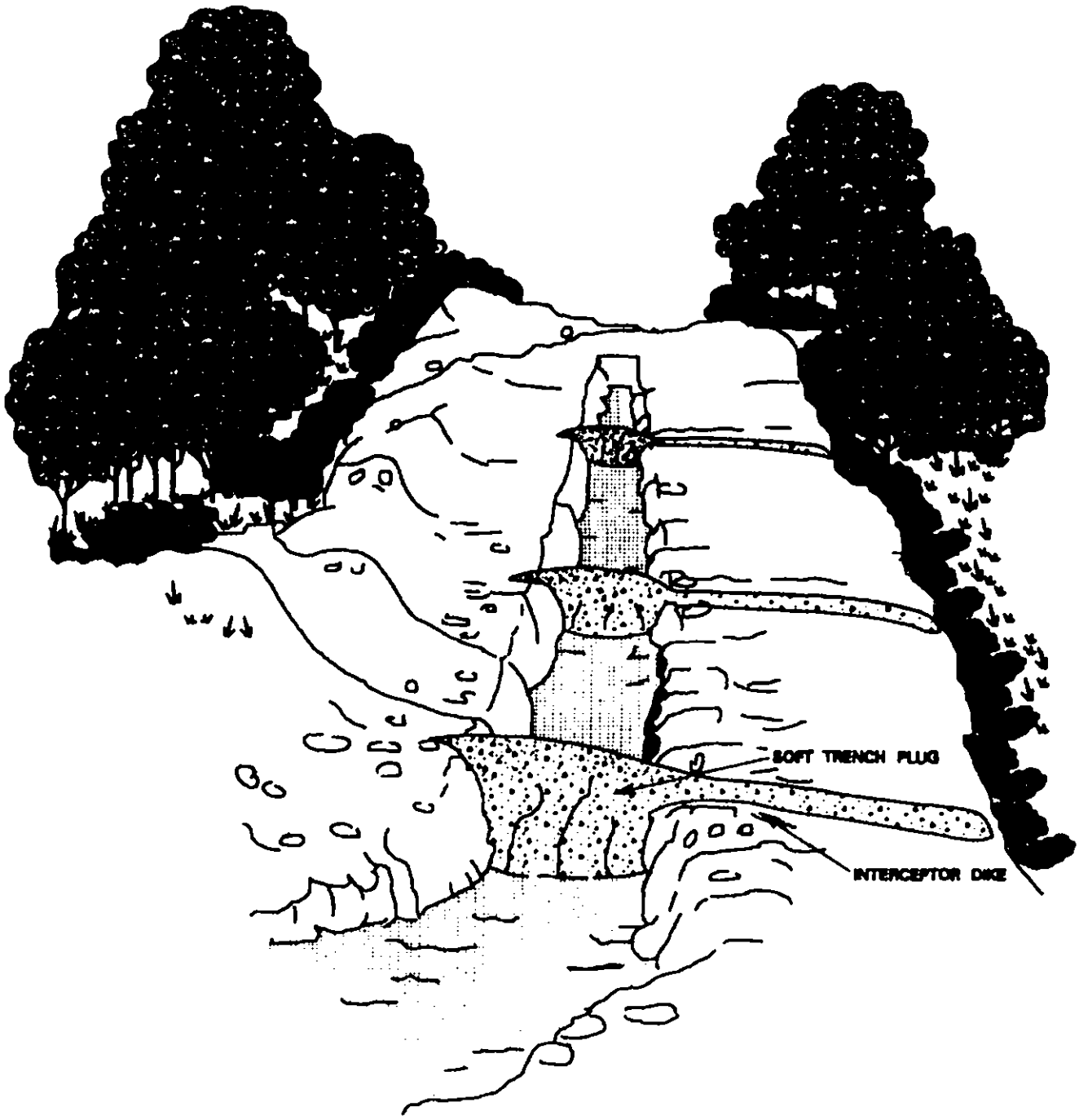

NOTES:

1. TEMPORARY TRENCH PLUGS MAY BE USED IN CONJUNCTION WITH INTERCEPTOR DIKES TO PREVENT WATER FROM OVERFLOWING INTO SENSITIVE RESOURCE AREAS.

2. DIVERT TRENCH OVERFLOW TO A WELL-VEGETATED OFF-R.O.W. LOCATION OR INSTALL APPROPRIATE ENERGY DISSIPATING DEVICE.

	TEMPORARY TRENCH PLUGS	FIGURE #14
		DWG. ES-0014 REV.

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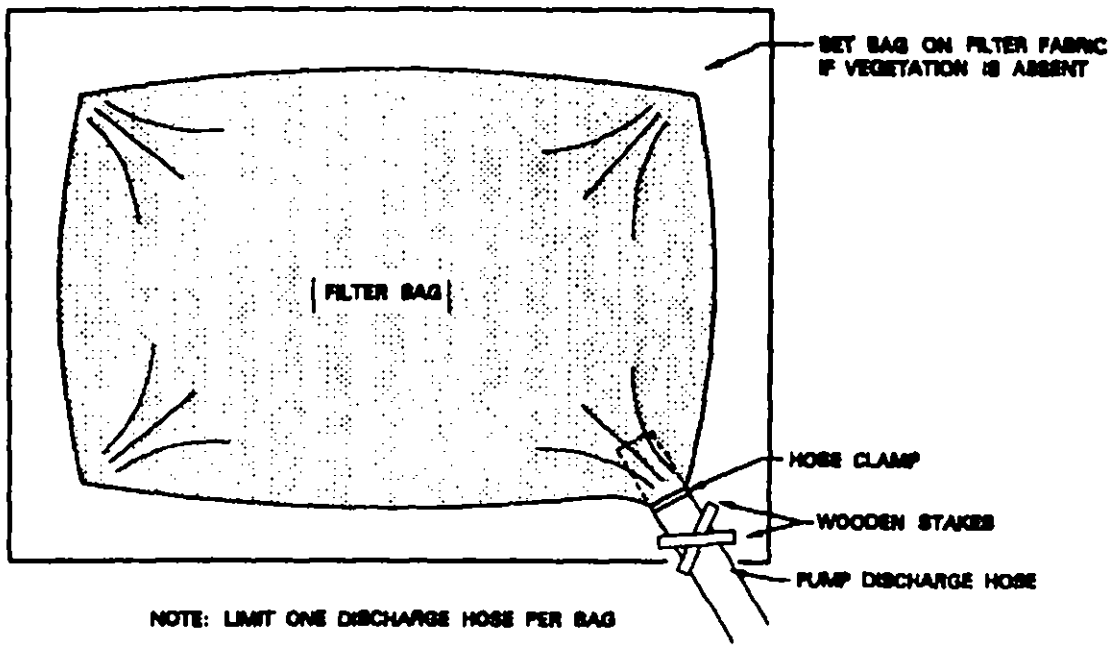
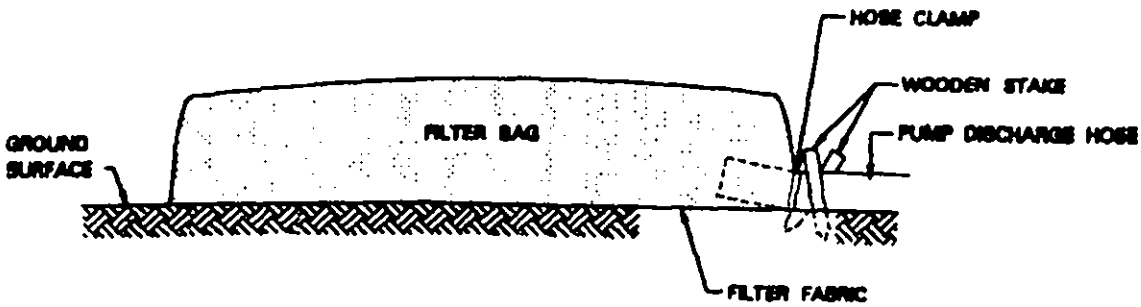


NOTE: LIMIT ONE DISCHARGE HOSE PER BAG

PLAN VIEW



CROSS-SECTION

NOTES:

1. REMOVE DEWATERING STRUCTURE AS SOON AS POSSIBLE AFTER COMPLETION OF DEWATERING ACTIVITIES.

	FILTER BAG	FIGURE #15
		DWG. ES-0015 REV.

u. ES0015. dgn

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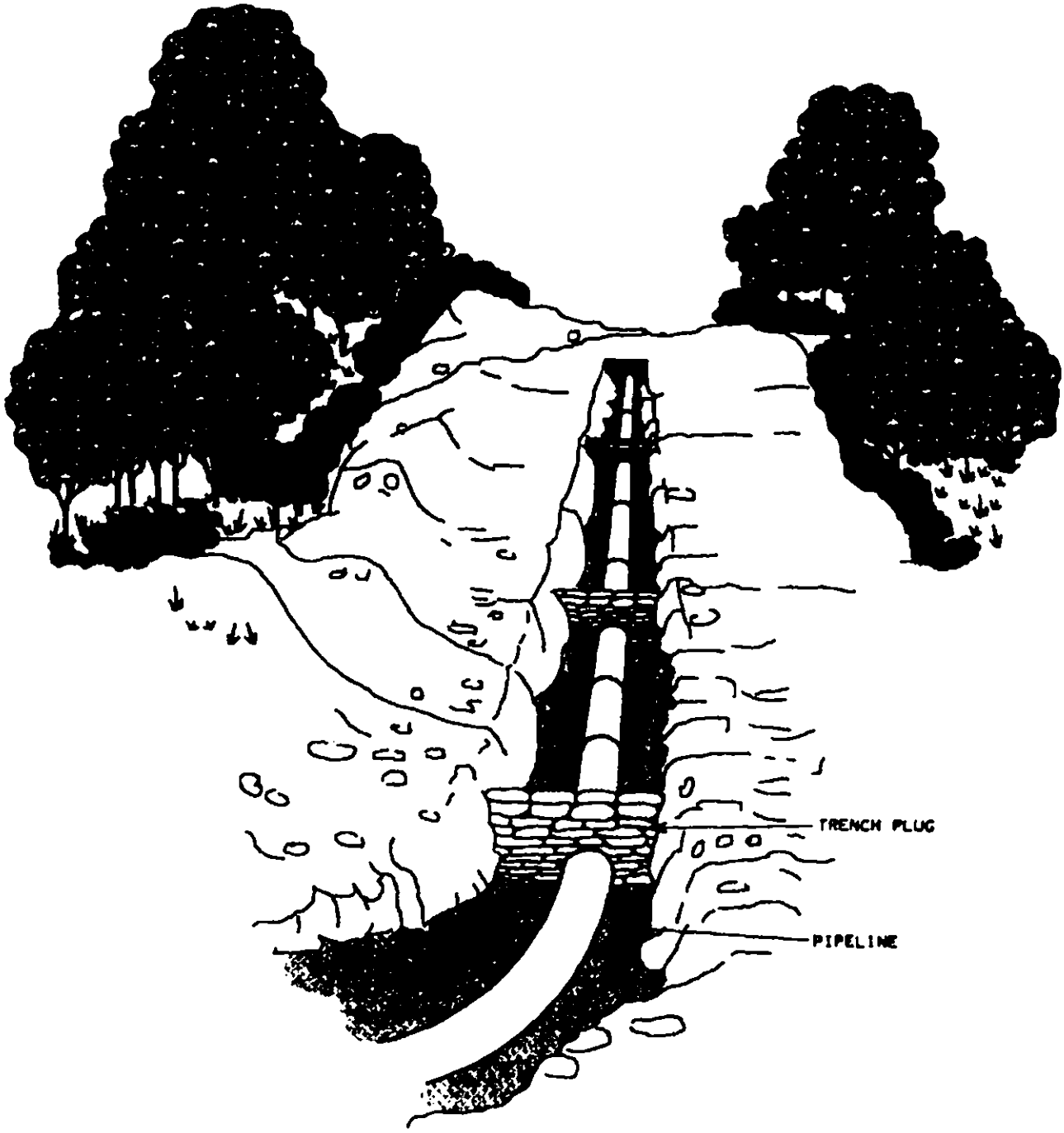

SLOPE (%)	SPACING (FT)
8-16	300
>16-30	200
>30	100

	PERMANENT TRENCH PLUGS	FIGURE #16
		DWG. ES-0016 REV.

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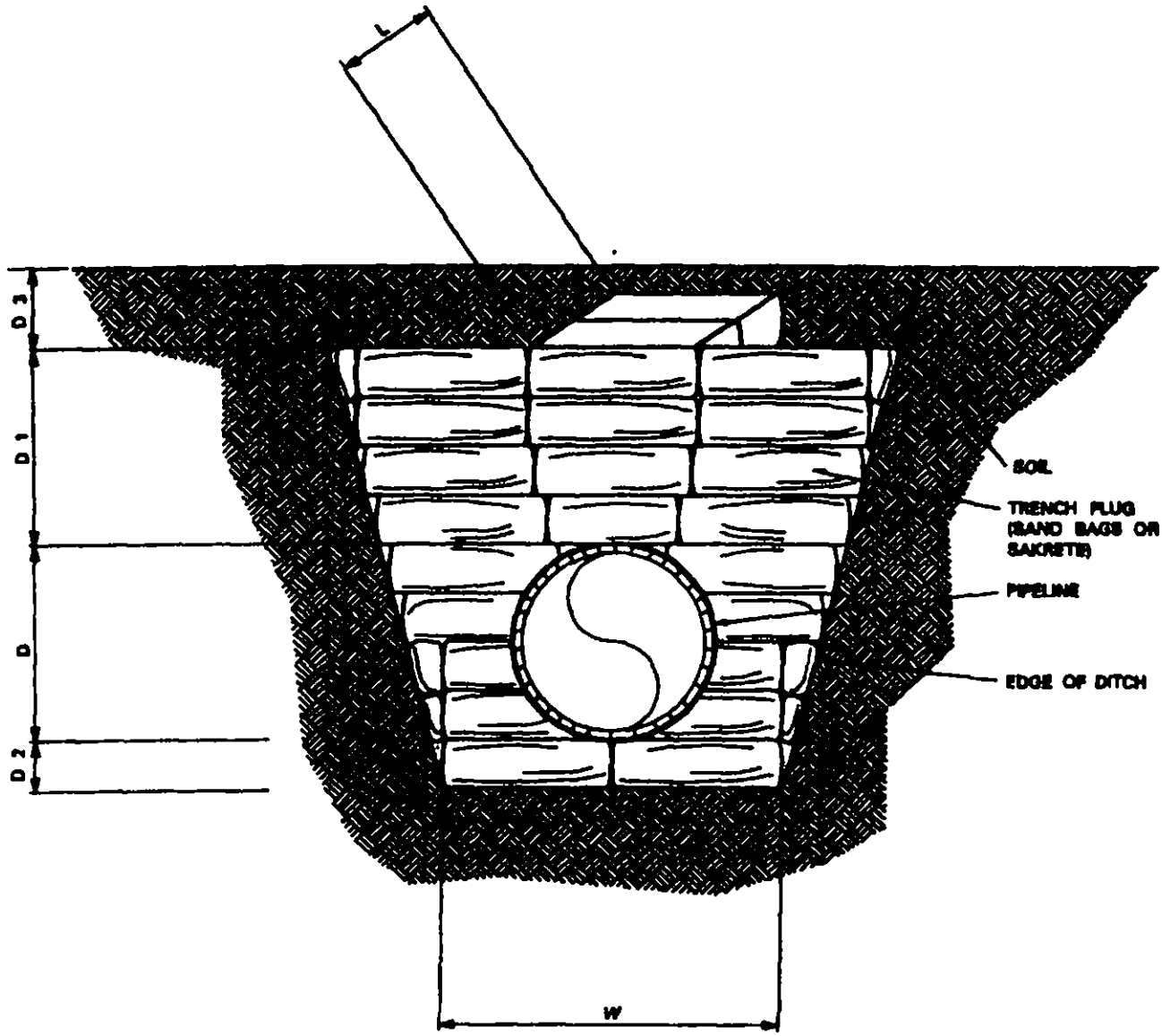

D = PIPE DIAMETER
D1 = APPROXIMATELY 24"
D2 = APPROXIMATELY 6" (8" MIN. IN ROCK)
D3 = APPROXIMATELY 12"
W = D + 2 to 4 FEET
L = APPROXIMATELY 18" - 24"
D1 + D3 = 36" MINIMUM

NOTE:

USE OF SAKRETE SHALL REQUIRE PRIOR COMPANY APPROVAL.

	TRENCH PLUG DETAIL	FIGURE #17
		DWG. ES-0017 REV.

LG. ESEC0017.DGN

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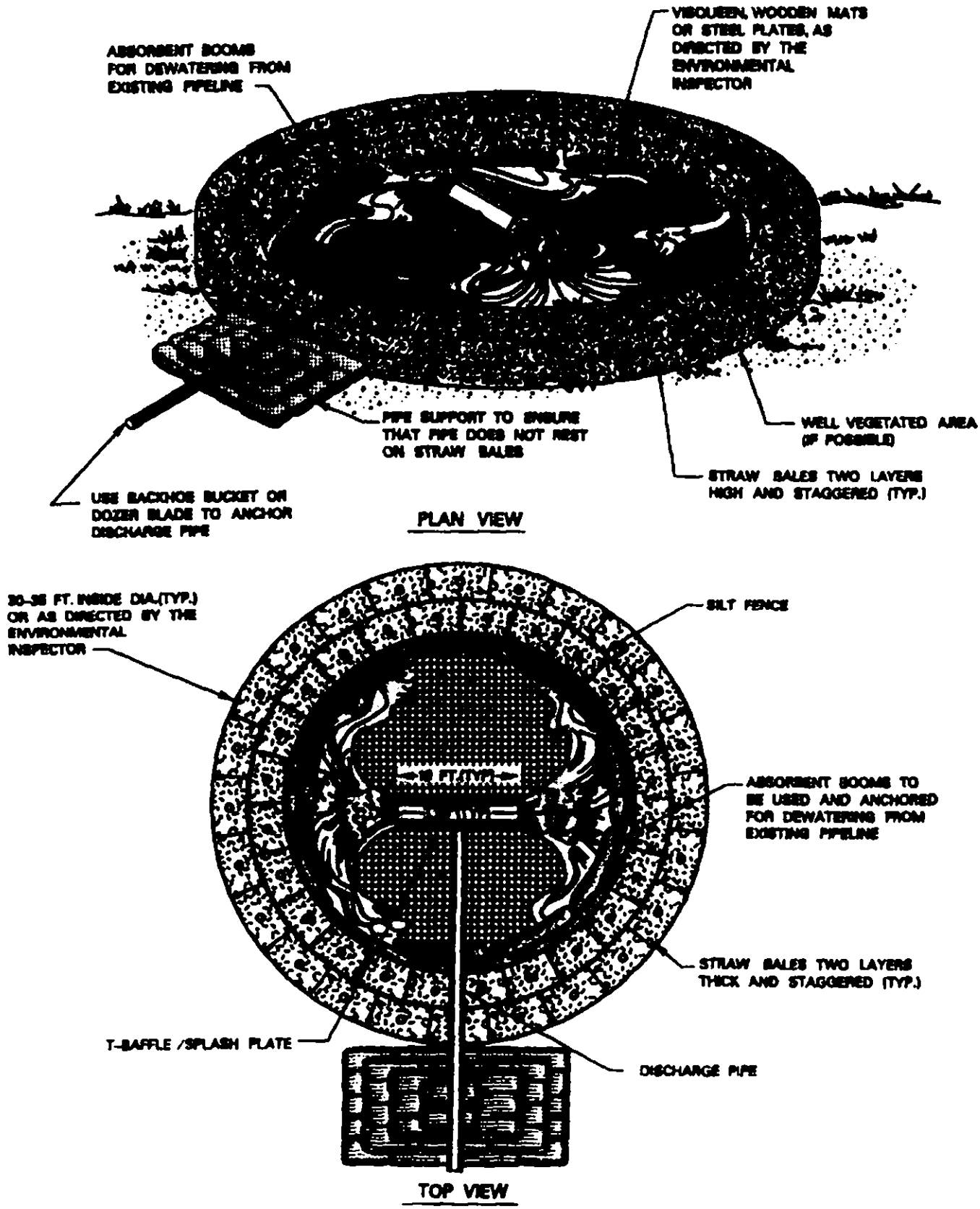

	DEWATERING STRUCTURE FOR HYDROSTATIC TESTING	FIGURE #18
		DWG. ES-0018 REV.

LG. ESE0018.DGN

USE RNAME SYLIMIT

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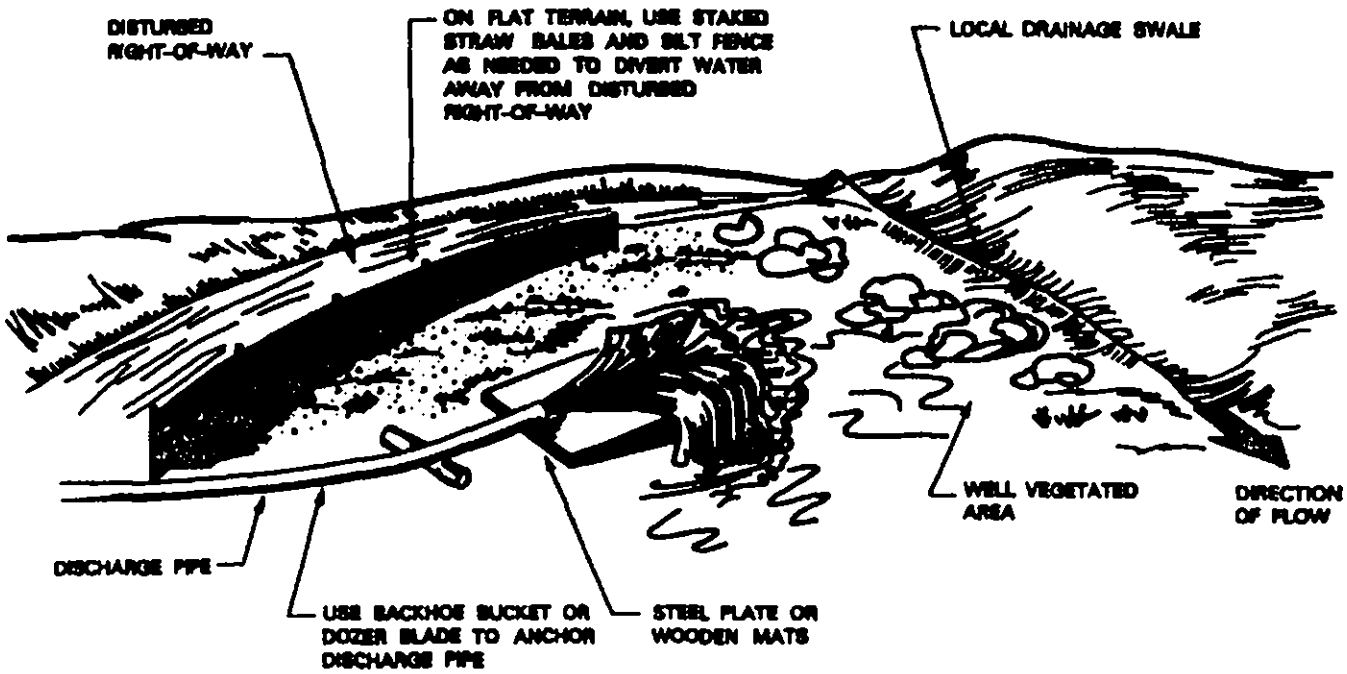

NOTE:

1. THIS DEWATERING STRUCTURE CAN ONLY BE USED FOR SMALL DISCHARGES FROM NEW PIPELINES WHEN A HYDROSTATIC TEST PACKAGE HAS NOT BEEN ISSUED. IT IS SUBJECT TO APPROVAL BY THE ENVIRONMENTAL INSPECTOR.

	ALTERNATE DEWATERING STRUCTURE FOR HYDROSTATIC TESTING	FIGURE #19
		DWG. ES-0019 REV.

LG. ESE0019.DGN

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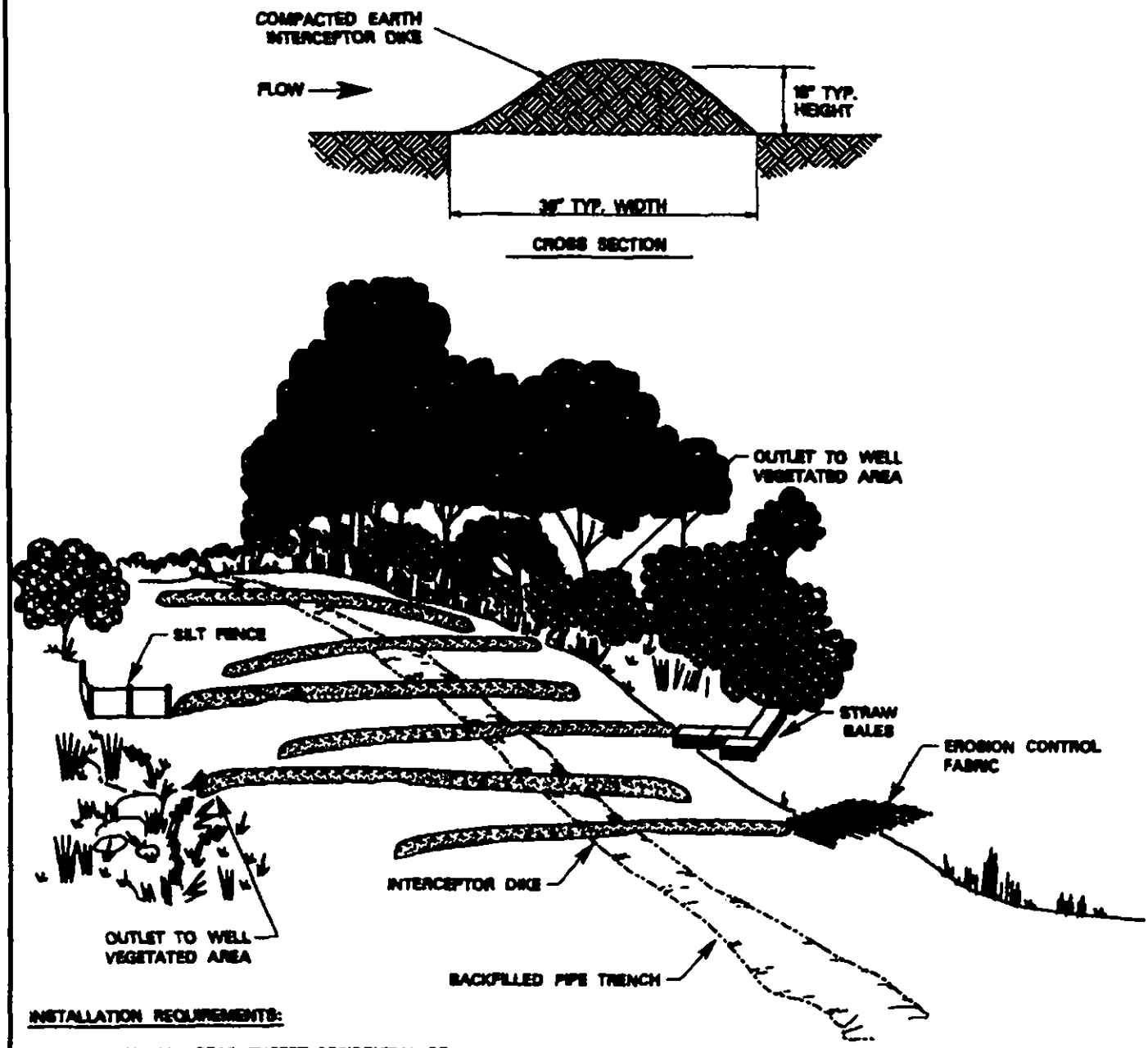

INSTALLATION REQUIREMENTS:

- INSTALL IN ALL AREAS EXCEPT RESIDENTIAL OR AGRICULTURAL (UNLESS AUTHORIZED BY LANDOWNER OR LAND MANAGING AGENCY).
- CONSTRUCT USING EARTH FILLED SACKS OR STAKED STRAW BALES FOR TEMPORARY OR COMPACTED EARTH AND ROCK FOR PERMANENT.
- INSTALL WITH A 2 - 8% OUTFALL ANGLE.
- FOR TEMPORARY CHEVRON INTERCEPTOR DIKES, POSITION OUTFALL TO PREVENT SEDIMENT DISCHARGE INTO WETLANDS, WATERBODIES, OR OTHER SENSITIVE RESOURCES.
- FILTER RUN-OFF WATER BY CONSTRUCTING AN OUTLET USING AN ENERGY DISSIPATING DEVICE (SILT FENCE, STRAW BALES, EROSION CONTROL FABRIC), AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.

MAINTENANCE REQUIREMENTS:

- INSPECT DURING AND FOLLOWING CONSTRUCTION AND MAKE REPAIRS AS NEEDED.
- KEEP THE CHANNEL FREE OF DEBRIS AND OBSTRUCTIONS.
- SEED AND MULCH PERMANENT INTERCEPTOR DIKES FOLLOWING CONSTRUCTION.

	CHEVRON INTERCEPTOR DIKE INSTALLATION AND MAINTENANCE	FIGURE #20
		DWG. ES-0020 REV.

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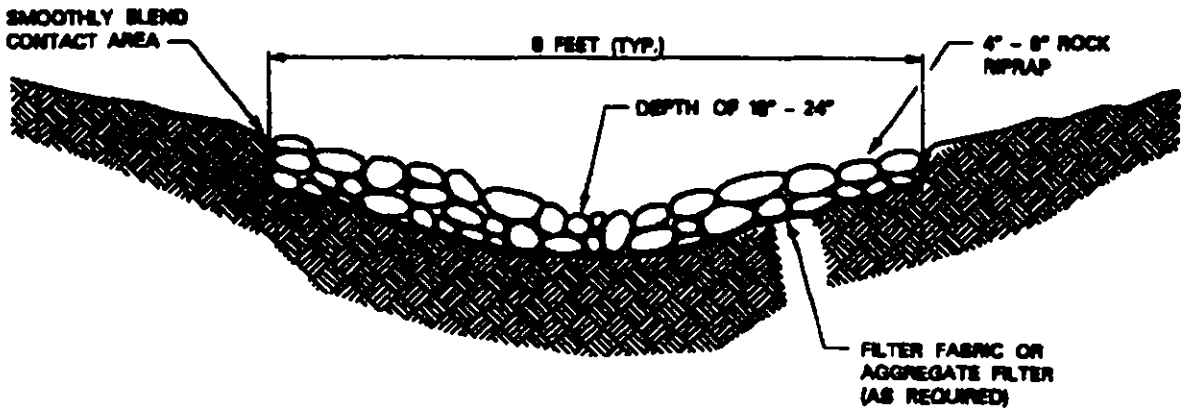

INSTALLATION REQUIREMENTS:

1. RIPRAP CHANNELS CAN BE CONSTRUCTED WITH GRASS-LINED SLOPES WHERE SITE CONDITIONS WARRANT.
2. STABILIZE CHANNEL INLET POINTS AND INSTALL OUTLET PROTECTION (AS NEEDED) DURING CHANNEL INSTALLATION.
3. INSTALL ENERGY DISSIPATING DEVICE (AS NEEDED) TO PREVENT SCOUR TO THE RECEIVING OUTLET.
4. REMOVE ALL TREES, BRUSH, AND OTHER OBJECTIONABLE MATERIAL FROM THE CHANNEL.
5. INSTALL FILTER FABRIC OR GRAVEL LAYER TO PREVENT PIPING (AS REQUIRED)

MAINTENANCE REQUIREMENTS:

1. INSPECT CHANNEL DURING AND FOLLOWING CONSTRUCTION AND MAKE REPAIRS AS NEEDED.
2. KEEP THE CHANNEL FREE OF DEBRIS AND OBSTRUCTIONS.

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SYSTIME

LG. SSBDSN.DGN

	ROCK LINED DRAINAGE SWALE INSTALLATION AND MAINTENANCE	FIGURE #21
		DWG. ES-0021 REV.

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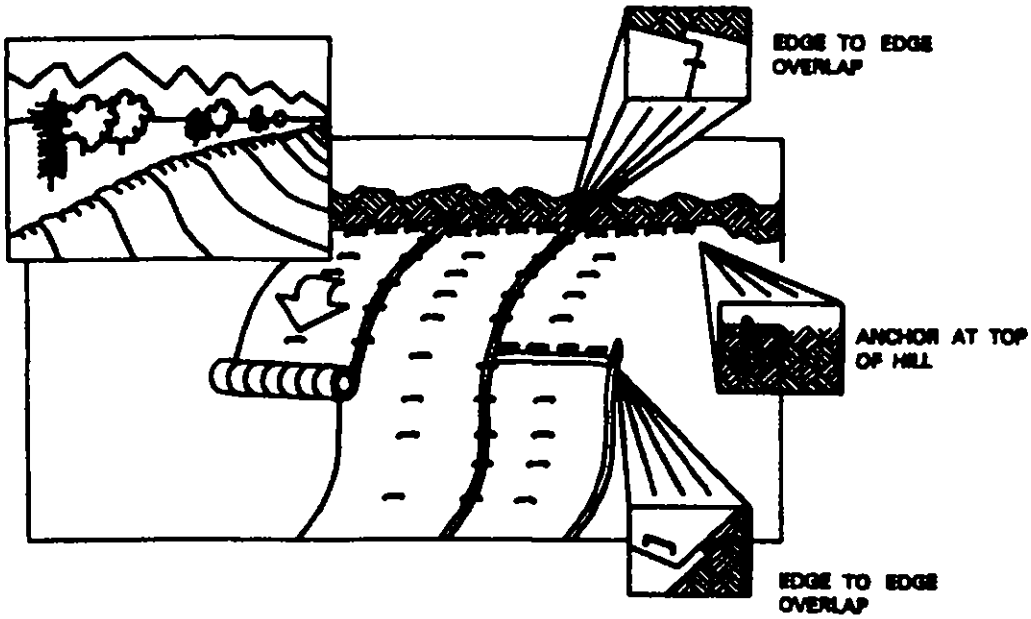

NOTES:

1. EROSION CONTROL MATTING (BLANKETS) SHALL BE USED AT LOCATIONS IDENTIFIED IN THE PLAN AND/OR AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.
2. EROSION CONTROL MATTING SHALL MEET THE REQUIREMENTS SPECIFIED IN THE PLAN AND/OR AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.
3. STAPLES SHALL BE MADE OF 11 GAUGE WIRE, U-SHAPED WITH 6" LEGS AND A 1" CROWN. STAPLES SHALL BE DRIVEN INTO THE GROUND FOR THE FULL LENGTH OF THE STAPLE LEGS.
4. MATTING SHALL BE INSTALLED ACCORDING TO MANUFACTURER SPECIFICATIONS OR AS STATED BELOW:
   - EXTEND TOP OF BLANKET 3 FEET PAST THE UPPER EDGE OF THE SLOPE.
   - ANCHOR ("KEY") THE UPPER EDGE OF THE BLANKET INTO THE SLOPE USING A 6" DEEP TRENCH AND ROLL THE BLANKET DOWN THE HILL. DOUBLE STAPLE EVERY 12" BEFORE BACKFILLING AND COMPACTING TRENCH.
   - AVOID STRETCHING EROSION CONTROL MATTING (LOOSELY) DURING INSTALLATION.
   - BRING MAT ROLL BACK OVER THE TOP OF THE TRENCH AND CONTINUE TO ROLL DOWN SLOPE. STAPLE EVERY 12" WHERE MAT EXITS THE TRENCH AT THE TOP OF THE SLOPE.
   - WHEN BLANKETS ARE SPLICED DOWN-SLOPE TO ADJOINING MATS (SLOPE OR STREAM BANK MATS), THE UPPER BLANKET SHALL BE PLACED OVER THE LOWER MAT (SHINGLE STYLE) WITH APPROXIMATELY 6" OF OVERLAP. STAPLE THROUGH THE OVERLAPPED AREA EVERY 12".
   - OVERLAP ADJACENT BLANKETS 6". STAPLE EDGES OF BLANKETS AND CENTER EVERY 36".
5. IN LIVESTOCK AREAS WHERE EROSION CONTROL MATTING IS APPLIED TO THE SLOPES, FENCING WILL BE USED IF NECESSARY TO EXCLUDE LIVESTOCK, WITH PERMISSION OF THE LANDOWNER.
6. MONITOR WASHOUTS, STAPLE INTEGRITY OR MAT MOVEMENT. REPLACE OR REPAIR AS NECESSARY.

	TYPICAL MATTING ON SLOPES	FIGURE #22
		DWG. ES-0022 REV.

LG. ES0022.DGN
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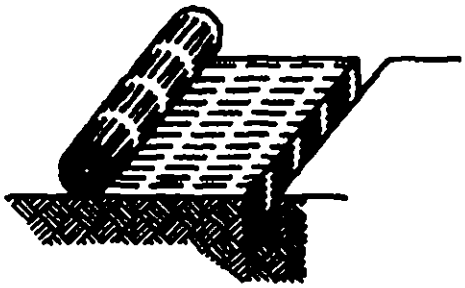
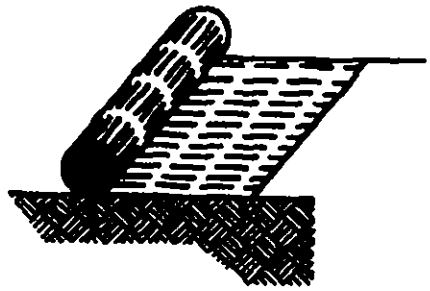
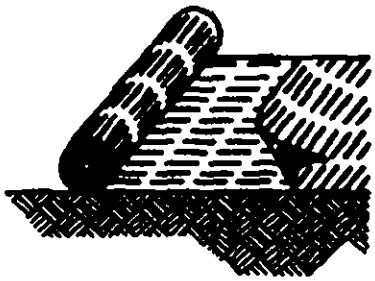
A. BURY THE TOP END OF THE JUTE STRIPS IN A 6" TRENCH (TYPICAL)



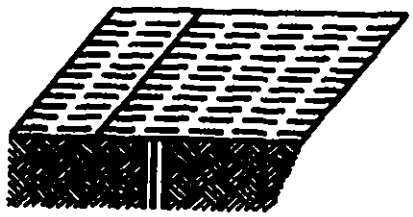
B. DOUBLE STAPLE EVERY 12" BEFORE BACKFILLING AND COMPACTING.

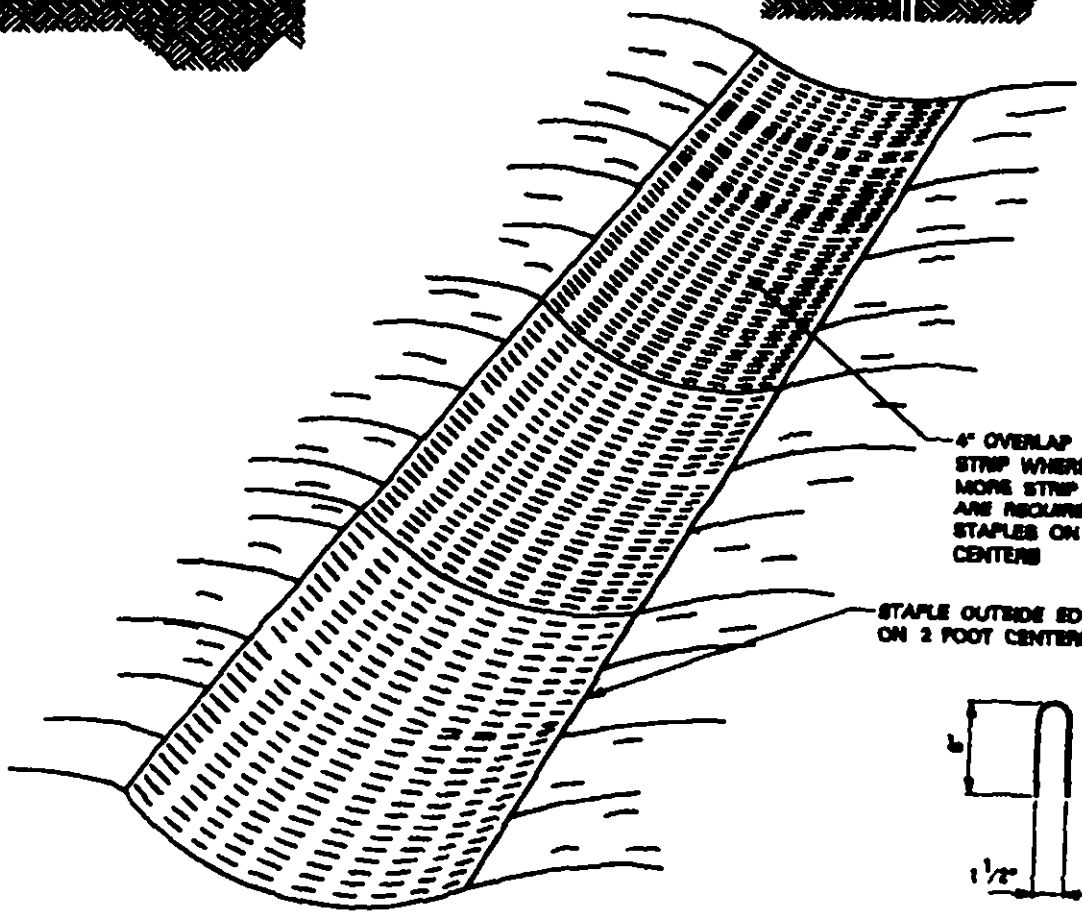


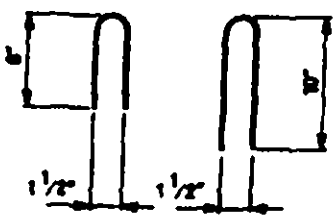
C. BURY AND TAMP UPPER END OF LOWER STRIP AS IN "A" AND "B". OVERLAP END OF TOP STRIP 4" AND STAPLE.



D. WHERE FABRIC STOPS, FOLD, BURY, AND TAMP JUTE STRIPS IN SLIT TRENCH. PROVIDE DOUBLE ROW OF STAPLES







TYPICAL STAPLES

NO. 11 GAUGE WIRE

	EROSION CONTROL FABRIC INSTALLATION	FIGURE #23
		DWG. ES-0023 REV.

LG. ESE0023. DGN

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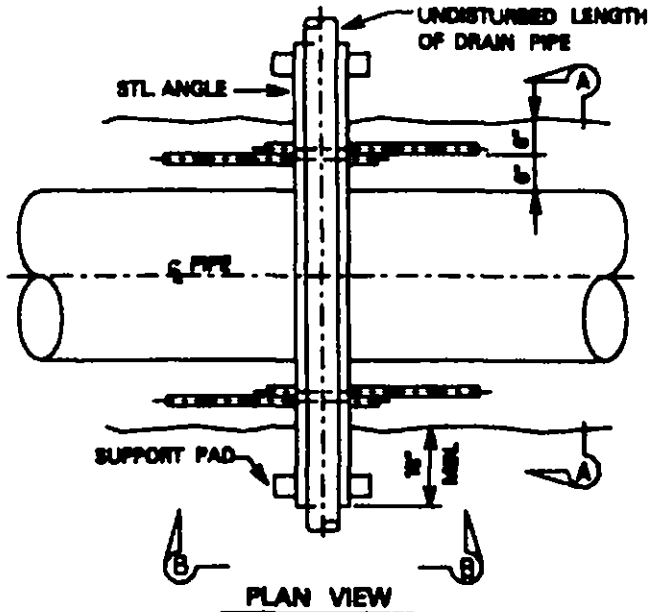
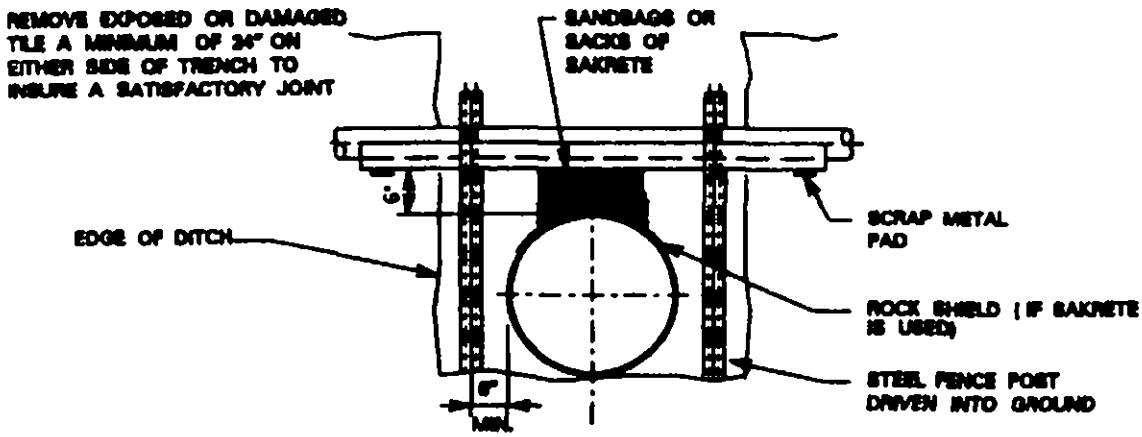


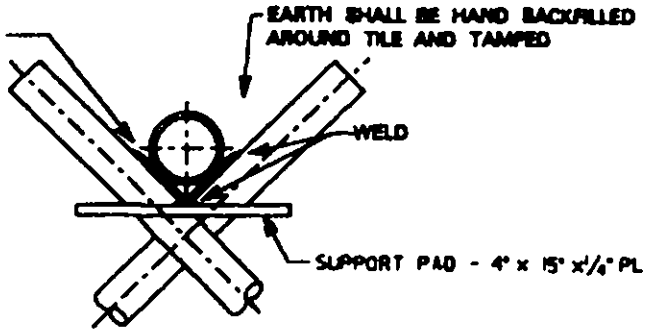
PLAN VIEW
N.T.S.



SECTION "A-A"
N.T.S.

TO SUPPORT 4" & 6" TILE USE 4" x 1/4" ANGLE

"	8" x 3/16"	
"	8" x 3/16"	
"	8" x 1/2"	
"	8" x 1/2"	



SECTION "B-B"
N.T.S.

NOTE:
USE OF SAKRETE SHALL REQUIRE PRIOR COMPANY APPROVAL.

LG. ESEC0024.DGN

	DRAIN TILE REPAIR PROCEDURE	FIGURE #24
		DWG. ES-0024 REV.

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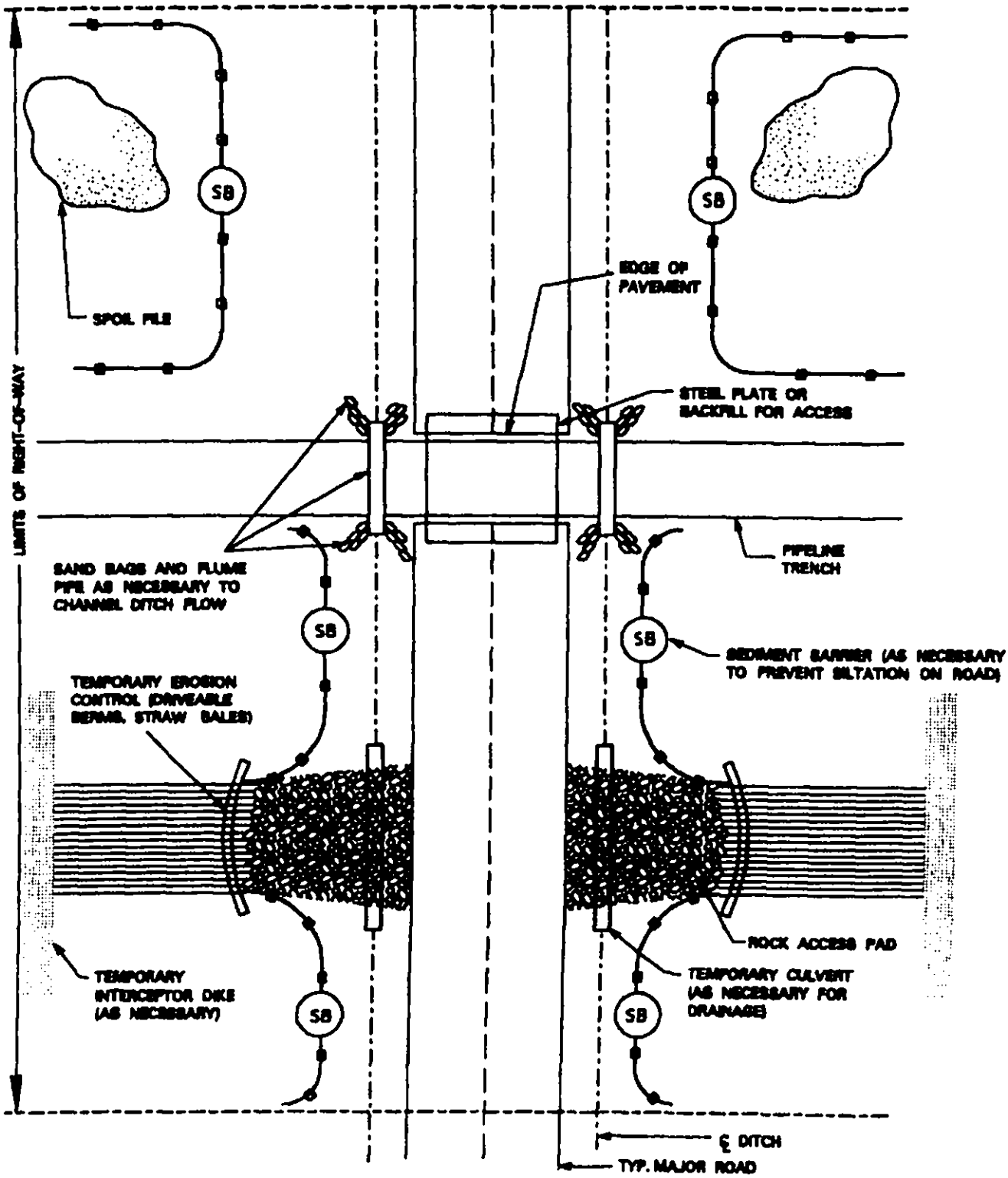

SB TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND /OR STRAW BALES

	TYPICAL PAVED ROAD CROSSING CONTROL MEASURES (OPEN CUT)	FIGURE #25
		DWG. ES-0025 REV.

LC ESE0025.DGN USERNAME SYTIME

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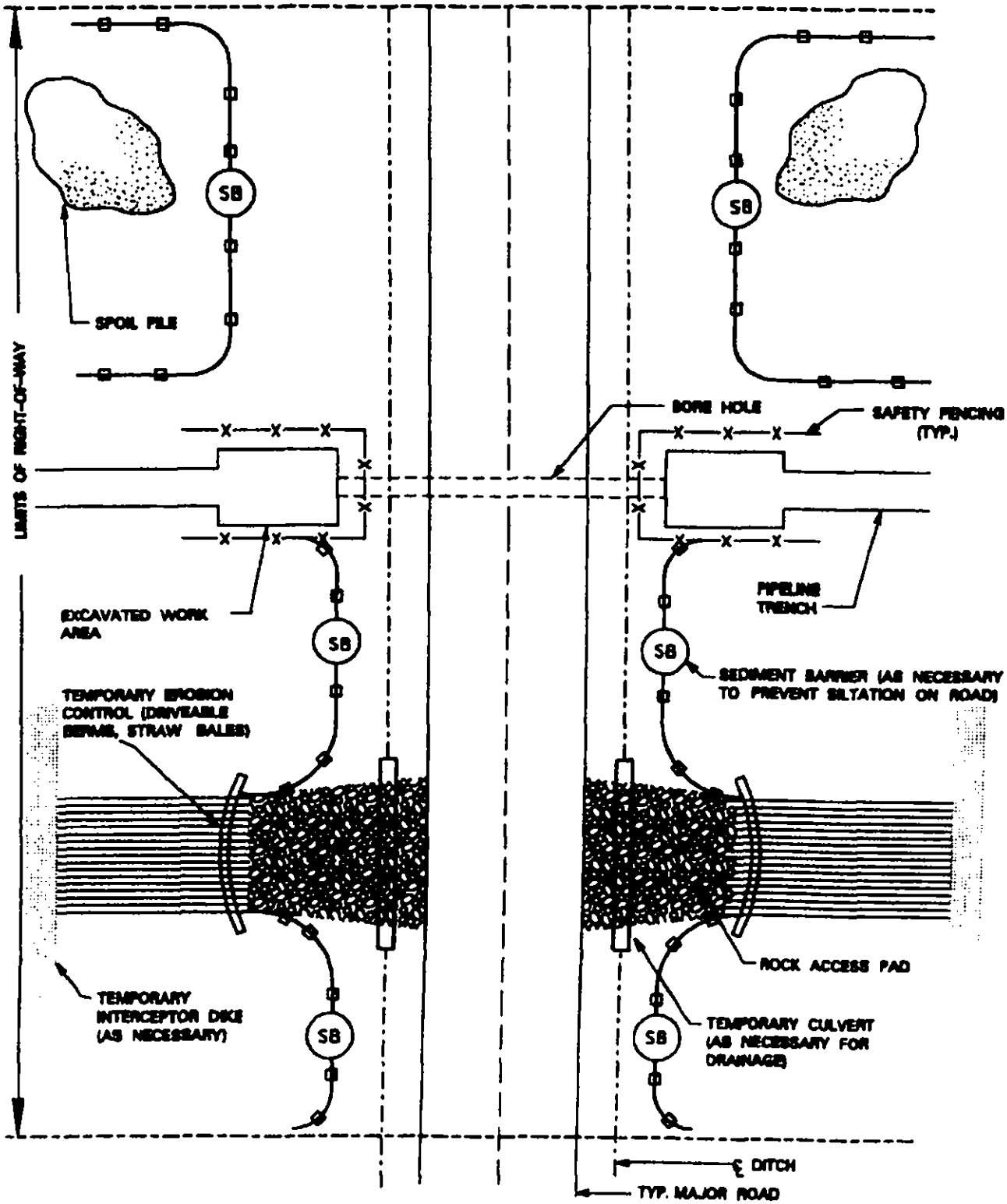

(SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND /OR STRAW BALES

LG. ESE0026.DGN

	TYPICAL PAVED ROAD CROSSING CONTROL MEASURES (BORED)	FIGURE #26
		DWG. ES-0026 REV.

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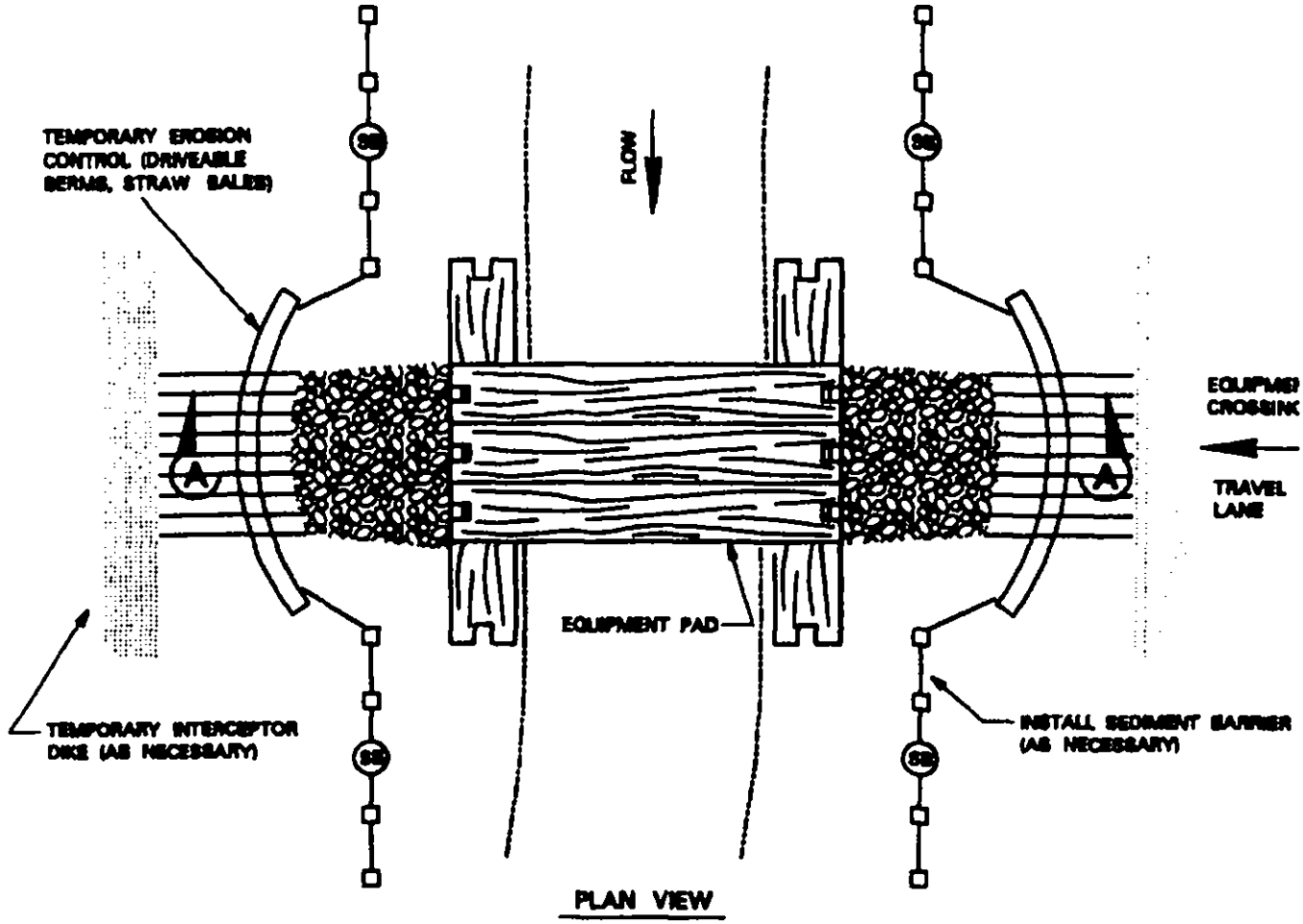
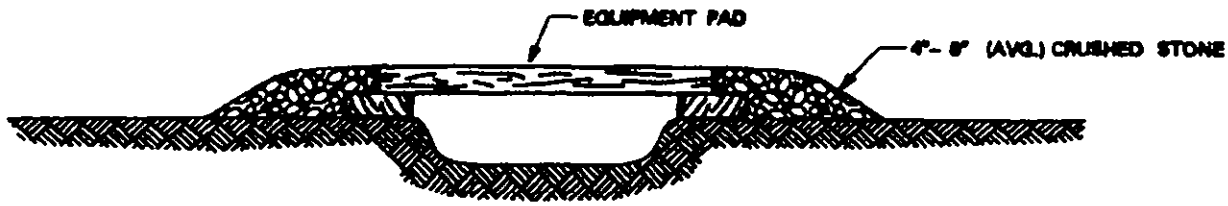


PLAN VIEW



SECTION "A-A"

NOTES:

1. (SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND/OR STRAW BALES, OR OTHER APPROPRIATE MATERIAL.
2. ADDITIONAL EQUIPMENT PADS CAN BE PUT SIDE BY SIDE IF EXTRA WIDTH IS REQUIRED.
3. EQUIPMENT PAD TYPICALLY CONSTRUCTED OF HARDWOOD; MUST ACCOMMODATE THE LARGEST EQUIPMENT USED.
4. CRUSHED STONE MUST EXTEND A MINIMUM OF 10 FEET FROM THE TOP OF THE BANK.
5. CONSTRUCT BRIDGE TO PREVENT SOIL FROM ENTERING WATERBODY.

	TEMPORARY EQUIPMENT BRIDGE (EQUIPMENT PADS AND CULVERTS)	FIGURE #27
		DWG. ES-0027 REV.

U.S. ES0027.DGN 01/22/2003

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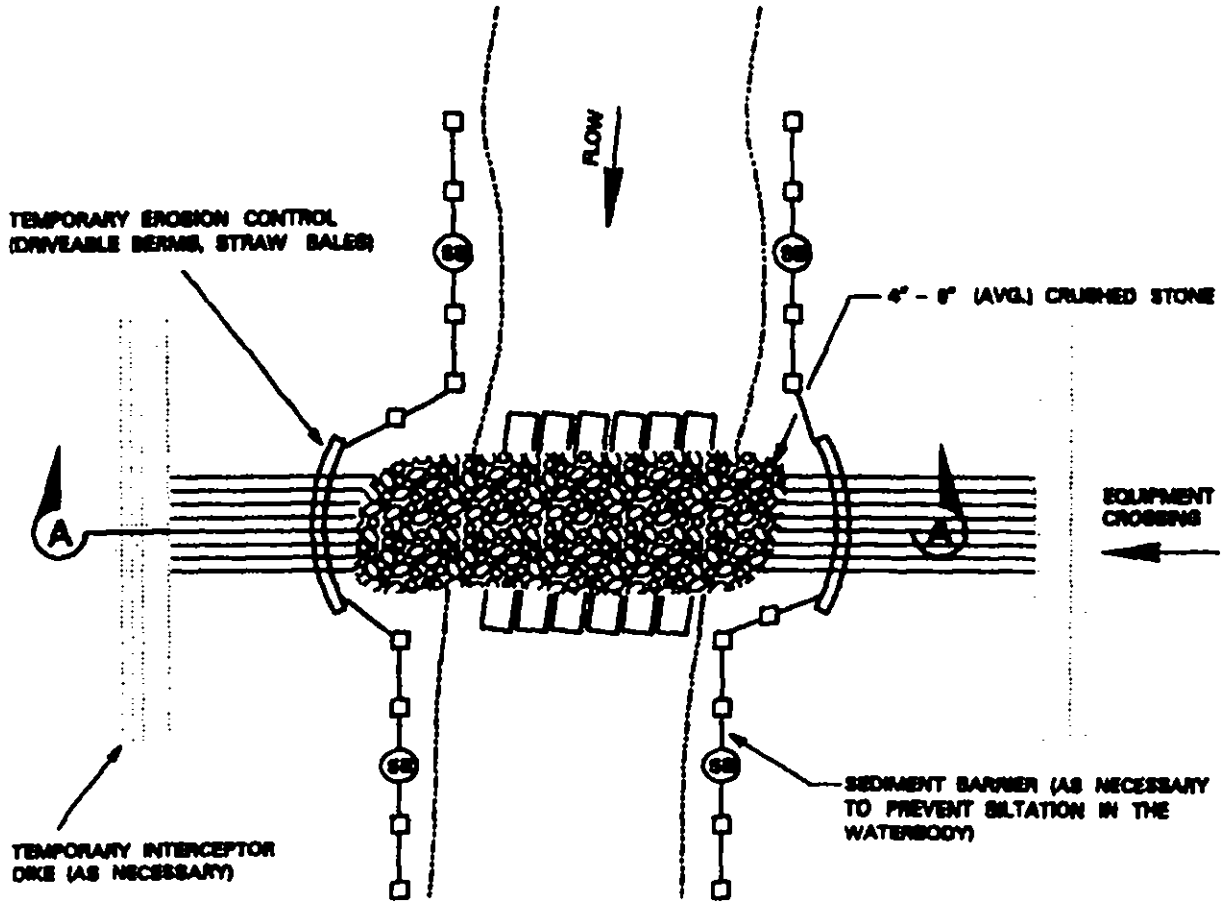
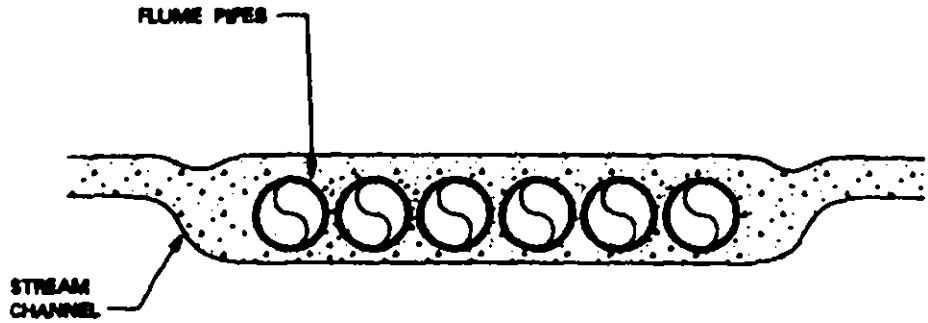


PLAN VIEW



SECTION "A-A"

NOTES:

1. ALIGN FLUME PIPES TO PREVENT EROSION AND STREAMBED SCOUR.
2. (SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCES AND/OR STRAW BALES, OR OTHER APPROPRIATE MATERIALS.

	TEMPORARY EQUIPMENT BRIDGE (CRUSHED STONE AND CULVERTS)	FIGURE #28
		DWG. ES-0028 REV.

L.G. EBEBOOB.DGN

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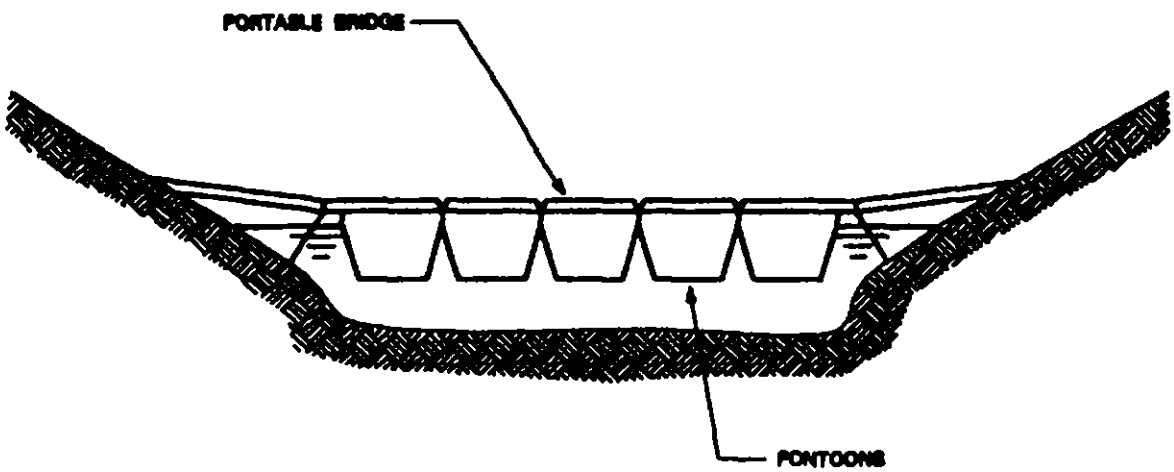

NOTES:

1. STABILIZE EDGES WITH SANDBAGS OR STONE.
2. REMOVE BRIDGE DURING CLEANUP.

	TEMPORARY EQUIPMENT BRIDGE (FLEXI-FLOAT OR PORTABLE)	FIGURE #29
		DWG. ES-0029 REV.

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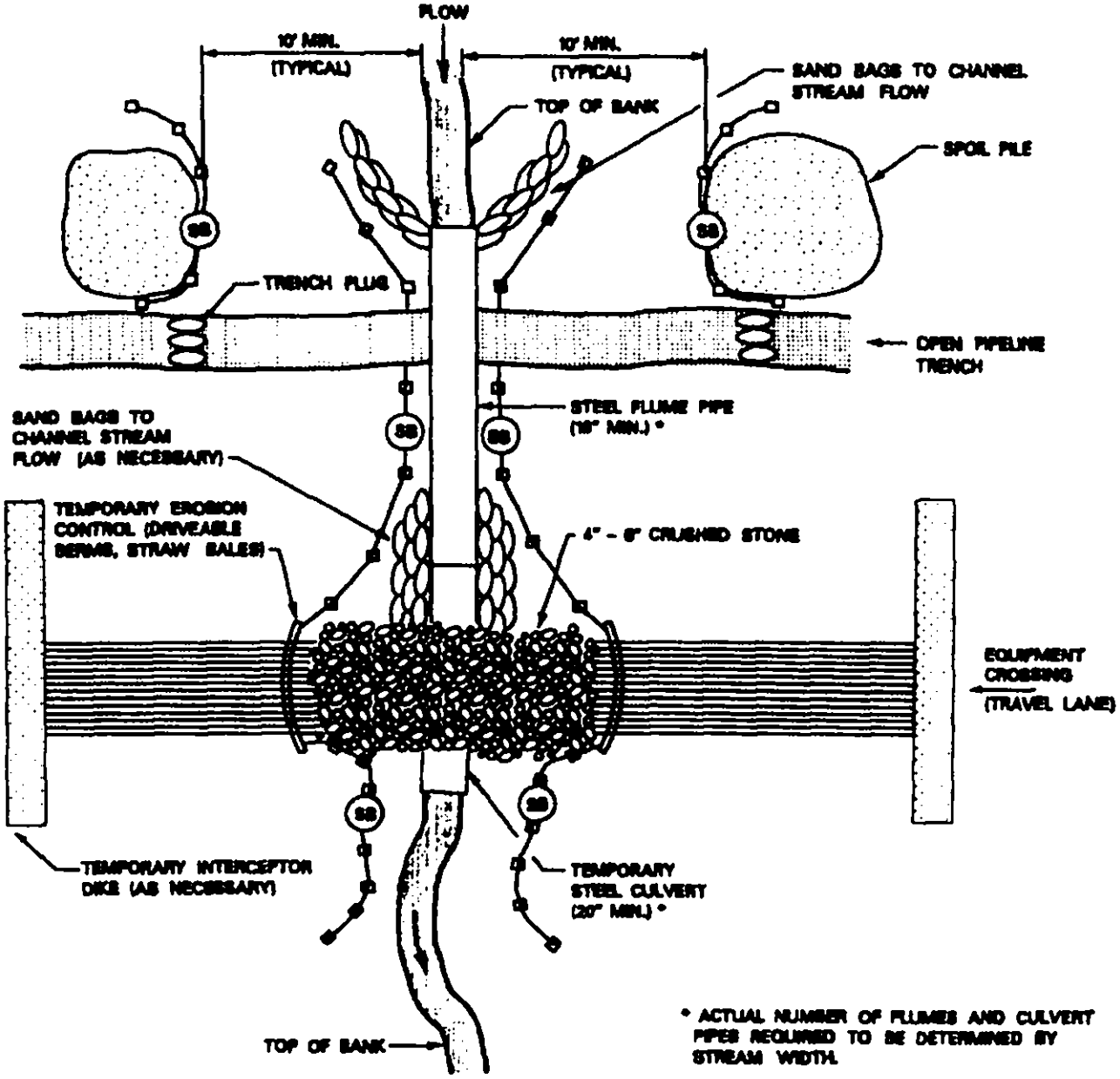

NOTES:

1. (SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND/OR STRAW BALES, OR OTHER APPROPRIATE MATERIALS.
2. SAND BAGS MUST BE FILLED WITH SAND FREE OF SILT, ORGANICS, AND OTHER MATERIAL.
3. ALIGN FLUME(S) TO PREVENT BANK EROSION AND STREAM SCOUR.
4. CONDUCT ALL IN-STREAM ACTIVITY (EXCEPT BLASTING OR OTHER ROCK BREAKING MEASURES) WITH THE FLUME(S) IN PLACE. FLUME PIPE(S) MAY NOT BE REMOVED FOR LOWERING IN OR INITIAL STREAMBED RESTORATION EFFORTS.
5. THE ENDS OF THE FLUME AND CULVERT MUST EXTEND TO AN UNDISTURBED AREA.

	TYPICAL FLUMED CROSSING	FIGURE #30
		DWG. ES-0030 REV.

LG. ES0030.DGN

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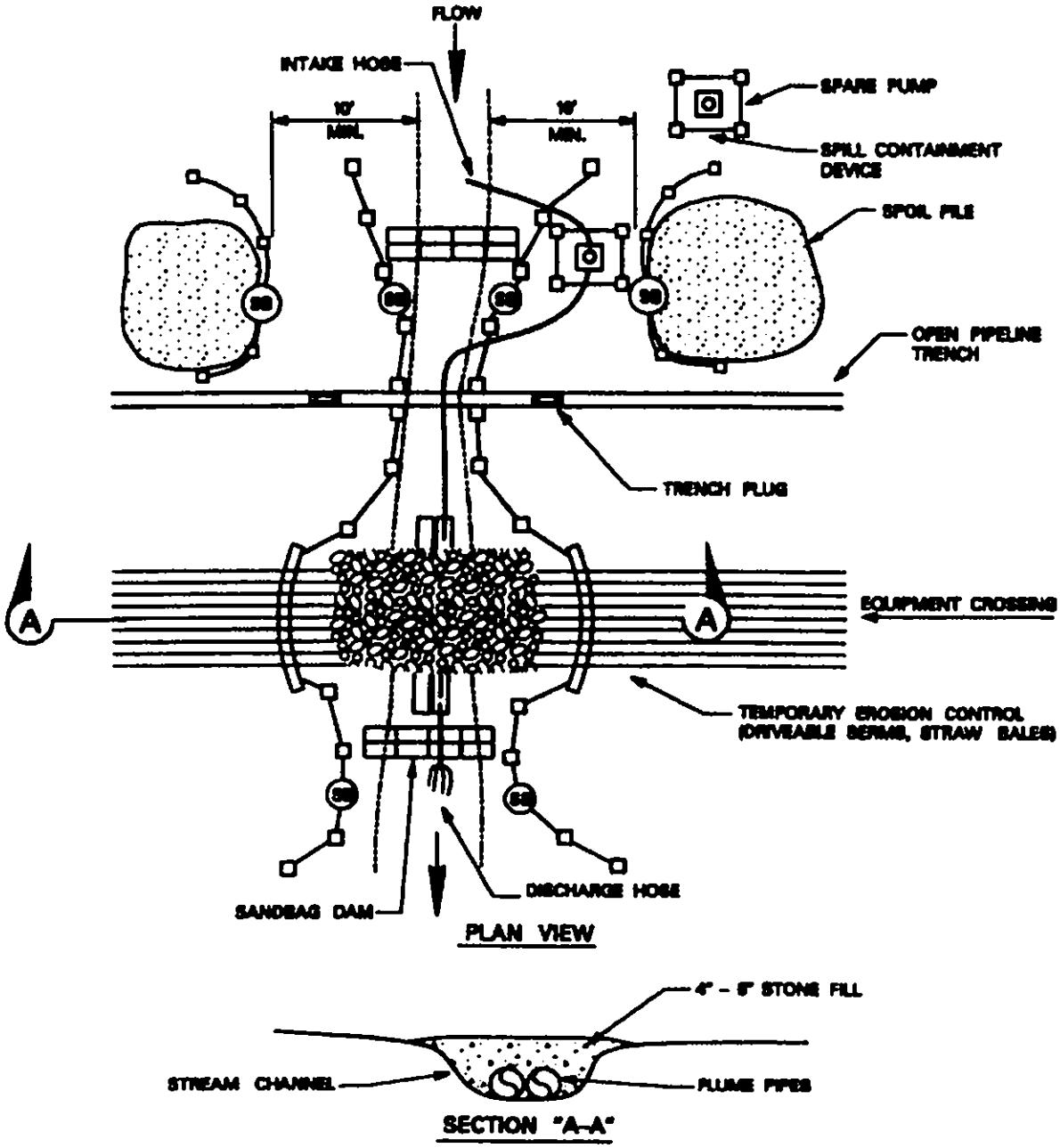

NOTES:

1. (SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND/OR STRAW BALES, OR OTHER APPROPRIATE MATERIALS
2. INSTALL AND SEAL SANDBAGS UPSTREAM AND DOWNSTREAM OF THE CROSSING.
3. CREATE AN UPSTREAM SUMP USING SANDBAGS IF NATURAL SUMP IS UNAVAILABLE FOR THE INTAKE HOSE.
4. EXCAVATE ACROSS STREAM CHANNEL FOLLOWING WATER REROUTING.
5. DO NOT REFUEL OR STORE FUEL WITHIN 100 FEET OF THE WATERBODY, WHERE FEASIBLE.
6. MONITOR PUMPS AT ALL TIMES DURING STREAM CROSSING PROCEDURE.
7. USE SUFFICIENT PUMPS, INCLUDING ONSITE BACKUP PUMPS, TO MAINTAIN DOWNSTREAM FLOW.
8. SCREEN PUMP INTAKES.
9. NUMBER OF FLUME PIPES FOR EQUIPMENT BRIDGE WILL VARY DEPENDING ON SITE CONDITIONS.

	TYPICAL DAM AND PUMP CROSSING	FIGURE #31
		DWG. ES-0031 REV.

L.C. ES-0031.DGN 07/29/2003

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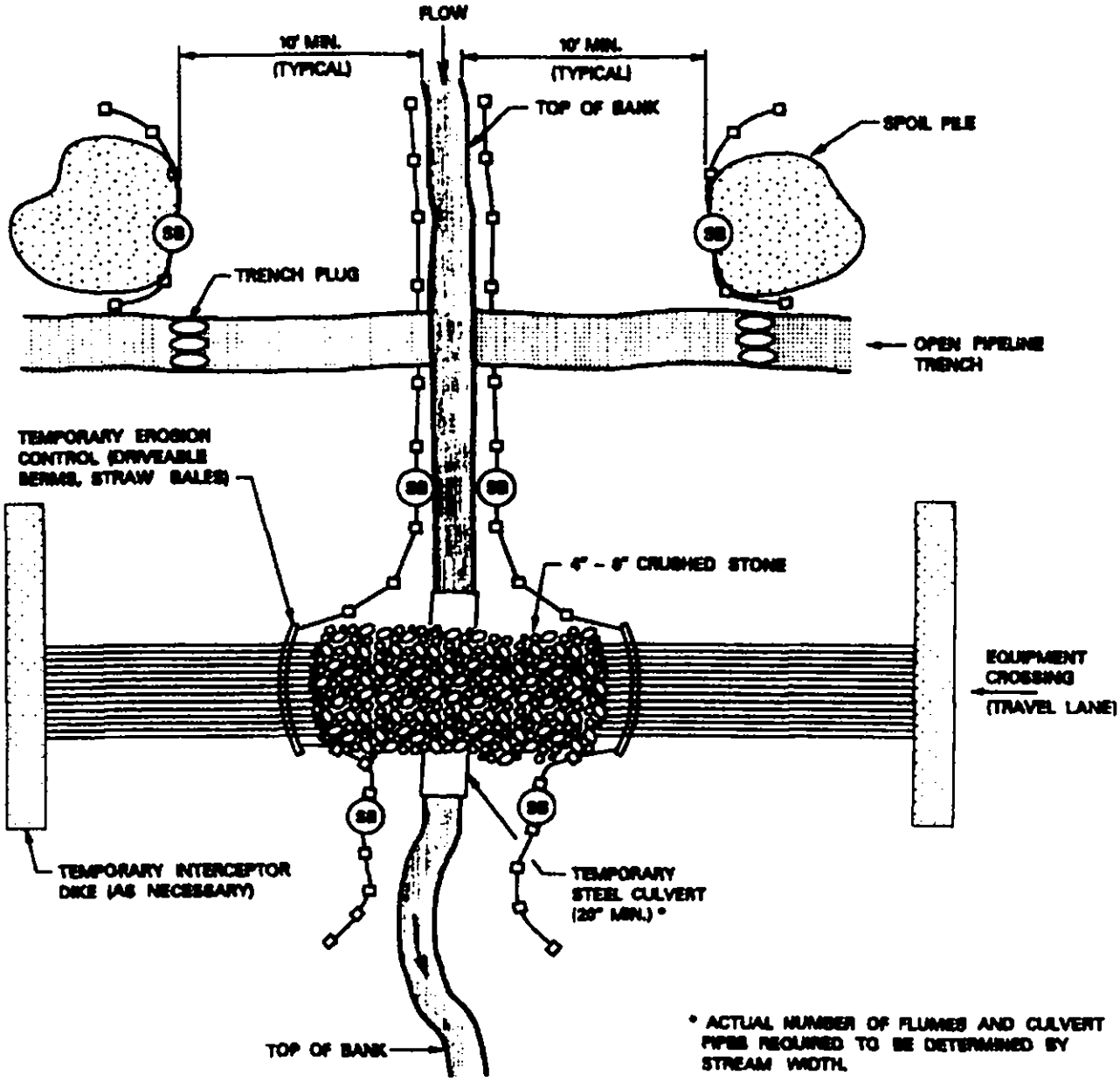

NOTES:

1. (SB) TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND/OR STRAW BALES, OR APPROPRIATE MATERIALS.
2. FOR MINOR WATERBODIES, COMPLETE TRENCHING AND BACKFILLING IN THE WATERBODY (NOT INCLUDING BLASTING OR OTHER ROCK BREAKING MEASURES) WITHIN 24 CONTINUOUS HOURS. IF A FLUME IS INSTALLED WITHIN THE WATERBODY DURING MAINLINE ACTIVITIES, IT CAN BE REMOVED JUST PRIOR TO LOWERING IN THE PIPELINE. THE 24-HOUR TIMEFRAME STARTS AS SOON AS THE FLUME IS REMOVED.
3. FOR INTERMEDIATE WATERBODIES, COMPLETE TRENCHING AND BACKFILLING IN THE WATERBODY (NOT INCLUDING BLASTING OR OTHER ROCK BREAKING MEASURES) WITHIN 48 CONTINUOUS HOURS, IF FEASIBLE.

	TYPICAL WET CROSSING	FIGURE #32
		DWG. ES-0032 REV.

L.G. ESE0032.DGN

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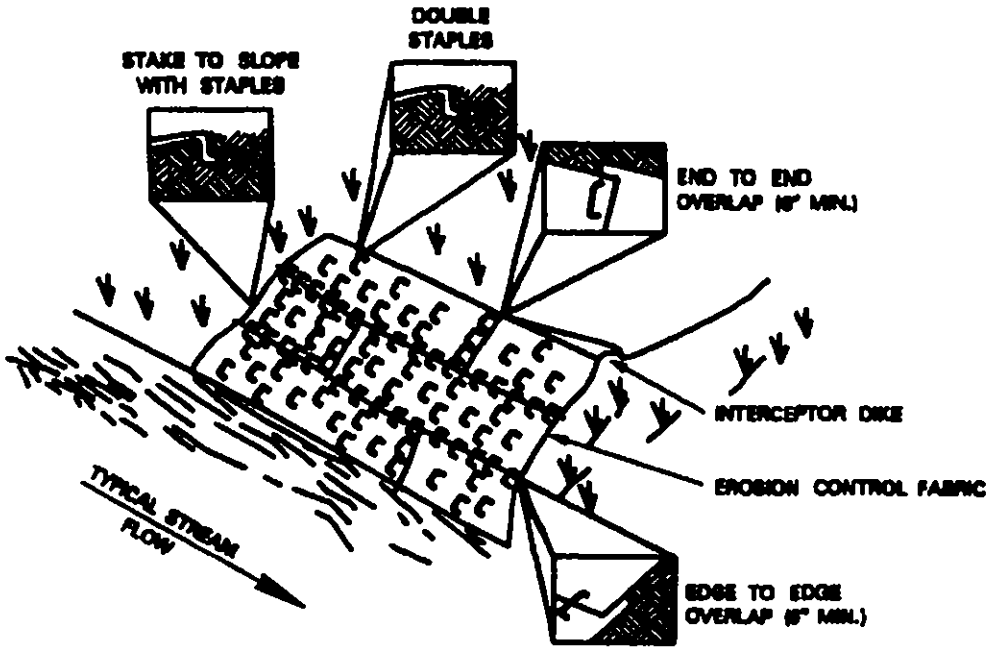

NOTES:

1. EROSION CONTROL MATTING SHALL BE PLACE ON THE BANKS OF FLOWING STREAMS WHERE VEGETATION HAS BEEN REMOVED OR AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.
2. EROSION CONTROL MATTING SHALL MEET THE REQUIREMENTS SPECIFIED IN THE PLAN AND/OR AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR.
3. STAPLES SHALL BE MADE OF 11 GAUGE WIRE, U-SHAPED WITH 6" LEGS AND A 1" CROWN. STAPLES SHALL BE DRIVEN INTO THE GROUND FOR THE FULL LENGTH OF THE STAPLE LEGS. ALTERNATELY 1" WOODEN PEGS 6" LONG AND BEVELED TO SECURE MATTING.
4. MATTING SHALL BE INSTALLED ACCORDING TO MANUFACTURER SPECIFICATIONS OR AS STATED BELOW:
   - EXTEND TOP OF BLANKET 2 FEET PAST THE UPPER EDGE OF THE HIGH WATER MARK. IF AN INTERCEPTOR DIKE IS PRESENT ON THE APPROACH SLOPE, BEGIN THE BLANKET ON THE UPHILL SIDE OF THE INTERCEPTOR DIKE.
   - INSTALL BLANKET(S) ACROSS THE SLOPE IN THE DIRECTION OF THE WATER FLOW.
   - ANCHOR ("KEY") THE UPSTREAM EDGE OF THE BLANKET(S) INTO THE SLOPE USING A 6" DEEP TRENCH. DOUBLE STAPLE EVERY 12" BEFORE BACKFILLING AND COMPACTING TRENCH
   - ANCHOR (KEY") THE UPPER EDGE OF THE BLANKET INTO THE SLOPE USING A 6" DEEP TRENCH. DOUBLE STAPLE EVERY 12" BEFORE BACKFILLING AND COMPACTING TRENCH.
   - OVERLAP THE EDGES OF PARALLEL BLANKETS A MINIMUM OF 6". PLACE THE UPPER BLANKET OVER THE LOWER BLANKET (SHINGLE STYLE) AND STAPLE EVERY 12" ALONG THE LENGTH OF THE EDGE.
   - WHEN BLANKET ENDS ARE ADJOINED, PLACE THE UPSTREAM BLANKET OVER THE DOWNSTREAM BLANKET (SHINGLE STYLE) WITH APPROXIMATELY 6" OF OVERLAP AND STAPLE THROUGH THE OVERLAPPED AREA EVERY 12".
   - STAPLE DOWN THE CENTER OF THE BLANKET(S), THREE STAPLES IN EVERY SQUARE YARD.
5. IN LIVESTOCK AREAS WHERE EROSION CONTROL MATTING IS APPLIED TO THE STREAMBANKS, FENCING WILL BE USED IF NECESSARY TO EXCLUDE LIVESTOCK, WITH PERMISSION OF THE LANDOWNER.
6. MONITOR WASHOUTS, STAPLE INTEGRITY OR MAT MOVEMENT. REPLACE OR REPAIR AS NECESSARY.

	TYPICAL MATTING OF STREAMBANKS	FIGURE #33
		DWG. ES-0033 REV.

USERNAME SYTIME
LC ES0033.DGN

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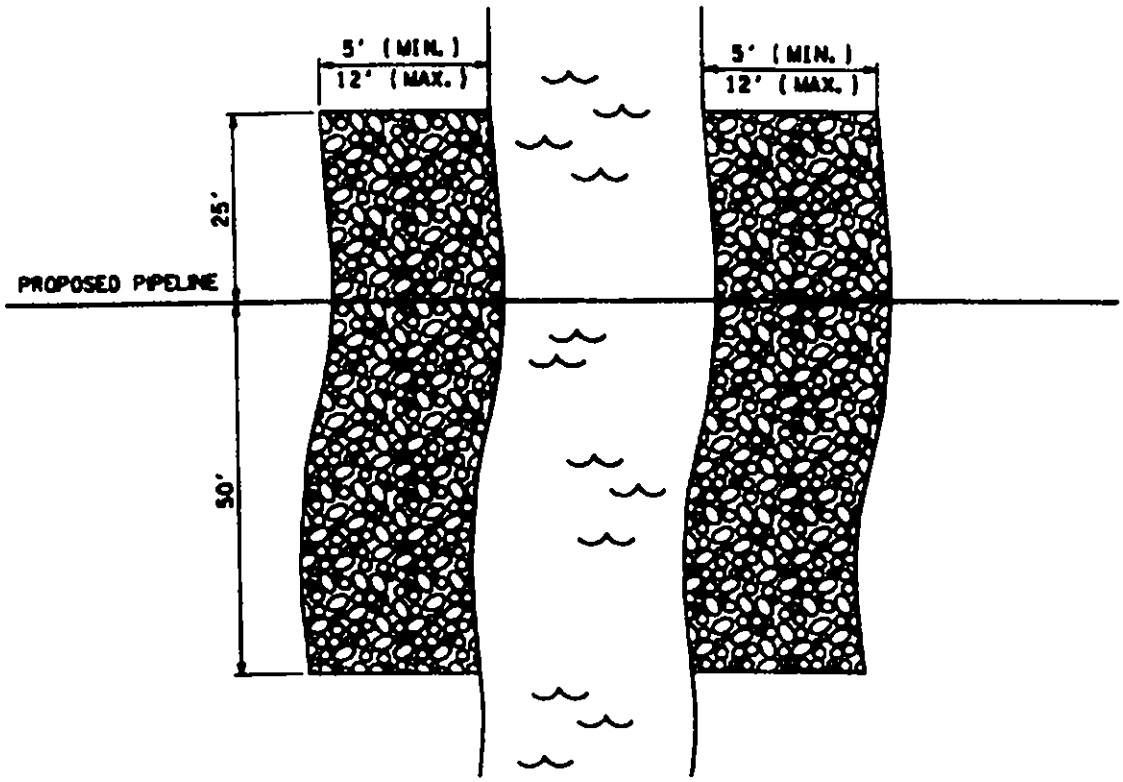
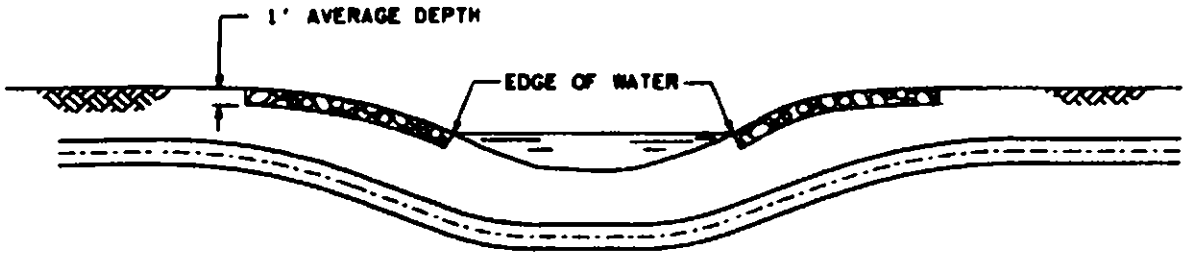


PLAN



SECTION

NOTES:

1. RIP-RAP IS LESS THAN 500 FEET IN LENGTH.
2. RIP-RAP WILL NOT EXCEED AN AVERAGE OF ONE CUBIC YARD PER RUNNING FOOT.
3. RIP-RAP INSTALLATION SHALL BE IN COMPLIANCE WITH ALL APPLICABLE PERMITS.

	RIP-RAP PLACEMENT (TYPICAL)	FIGURE #34
		DWG. ES-0034 REV.

LG. es0034. dgn

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APPENDIX B

SEED MIX RECOMMENDATIONS

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SEED MIX RECOMMENDATIONS

"NORTHERN ZONE"[1]

UPLAND AREAS

Lime	4.0 tons/acre
Fertilizer	1000 lbs./acre (10-20-20)
Mulch (Wheat Straw)	3.0 tons/acre

1. **Upland Seed Mix** — 75 lbs./acre Pure Live Seed (PLS)

Kentucky Bluegrass	20%
Red Fescue[2]	20%
Kentucky 31 Tall Fescue[2]	15%
Redtop	10%
Perennial ryegrass	20%
White clover	5%
Birdsfoot Trefoil (Minimum 20% hard seed)	10%

2. **Pasture Mix** — 20 lbs./acre PLS

(For use only in disturbed pasture areas with landowner's permission.)

Kentucky Bluegrass	31%
Medium Red clover	26%
Norcen Trefoil	17%
Poly Perennial Rye	26%

3. **Recommended Seeding Dates:**

(For the establishment of temporary or permanent vegetation.)

Spring:	March 15 - May 30
Fall:	August 1 - October 15

WINTER STABILIZATION

If restoration can not occur prior to October 15, seed the ROW with 1.5 bushels per acre of winter rye or similar variety of rye as requested by the landowner. Mulch ROW at 3.0 tons per acre with wheat straw, including areas adjacent to streams and wetland crossings. Seed segregated topsoil piles with winter rye and mulch at a rate of 3.0 tons per acre.

WETLAND AREAS

DO NOT USE LIME OR FERTILIZER !!!

Mulch (Wheat Straw)	3.0 tons/acre

1. **Wetland Seed Mix**

Annual Ryegrass	40 lbs./acre PLS

[1] The Northern Zone is generally defined as extending north from the Northern borders of Arkansas and Tennessee.

[2] Fescue must be endophyte-free.

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SEED MIX RECOMMENDATIONS

"SOUTHERN ZONE"[1]

UPLAND AREAS

Lime (agricultural limestone)	2.5 tons/acre
Fertilizer (6-12-12)	950 lbs./acre
Mulch (Oats, Wheat or Bermudagrass Straw)	3.0 tons/acre

1. **Seed Mixture**[2]

Sorghum, Sudangrass, or Sudangrass Hybrids[3]	40 lbs/acre Pure Live Seed (PLS)
Kentucky 31 Tall Fescue[4]	10 lbs/acre PLS
Big Bluestem	10 lbs/acre PLS
Indiangrass	10 lbs/acre PLS
Bermudagrass	10 lbs/acre PLS
Sericea Lespedeza[5]	10 lbs/acre PLS
White Clover[5]	5 lbs/acre PLS
Birdsfoot Trefoil[5]	10 lbs/acre PLS

2. **Recommended seeding dates:**

(For establishment of temporary or permanent vegetation.)

Spring:	March 15 - May 30
Fall:	August 1 - October 15

WINTER STABILIZATION

If restoration can not occur prior to October 15, seed the ROW with 1.5 bushels per acre of winter rye or similar variety of rye as requested by the landowner. Mulch ROW at 3.0 tons per acre with wheat straw, including areas adjacent to stream and wetland crossings. Seed segregated topsoil piles with winter rye and mulch at a rate of 3.0 tons per acre.

WETLAND AREAS

DO NOT USE LIME OR FERTILIZER !!!

Mulch (Oats, Wheat, or Bermudagrass Straw)	3.0 tons/acre

1. **Wetland Seed Mix:**

Annual Ryegrass	40 lbs/acre PLS

[1] The Southern Zone is generally defined as extending south from the Northern borders of Arkansas and Tennessee.

[2] An alternative seed mixture may be requested by the landowner(s).

[3] These species may be sold under the following trade names: DeKalb SX17, Greentreat II, Greentreat III, Tastemaker DR, Tastemaker III, FFR202, or Sordan 79.

[4] Fescue must be endophyte-free.

[5] Legumes should be treated with a species specific inoculate prior to seeding. Legume seed and soil should be scarified.

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APPENDIX C

SPILL PREVENTION CONTROL AND COUNTERMEASURE (SPCC) PLAN/ PREPAREDNESS, PREVENTION, AND CONTINGENCY (PPC) PLAN

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DUKE ENERGY GAS TRANSMISSION

SPILL PREVENTION CONTROL AND COUNTERMEASURE (SPCC) PLAN/ PREPAREDNESS, PREVENTION, AND CONTINGENCY (PPC) PLAN

Prepared By:

Environmental Construction Permitting
5400 Westheimer Court, SP-777
Houston, TX 77056-5310

Revised September 8, 2004
(for Logan Lateral Project)

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1.0 General Description

Duke Energy Gas Transmission (Company) has prepared a Spill Prevention Control and Countermeasure (SPCC) Plan which incorporates the Preparedness, Prevention, and Contingency (PPC) Plan, as well as emergency provisions. The Company's overall objective is to develop a functional contingency plan that meets all applicable federal, state, and local emergency response programs. This plan is designed to minimize hazards to human health and/or the environment from any unplanned sudden or non-sudden releases of oils, toxic, hazardous, or other polluting materials to the air, soil, surface water or groundwater. This plan also addresses unanticipated release of hydrostatic test water, especially in areas where the pipelines have been treated with mercaptan and in areas of known PCB contamination.

The Company's objective is to develop a functional contingency plan to be used on pipeline construction projects in accordance with all federal, state, and local emergency response programs. This plan was prepared to meet the requirements of the:

- Federal Water Pollution Control Act
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980
- Resource Conservation and Recovery Act
- Toxic Substances Control Act

This plan identifies:

- Type and quantity of material handled
- Measures taken for spill preparedness and prevention
- Company and Contractor emergency response procedures
- Responsibilities of designated emergency coordinators
- Emergency Evacuation Plan
- Spill incident reporting procedures
- Arrangements with local emergency response teams

2.0 Controlled Copy List of Contingency Plans

The Environmental Construction Permitting (ECP) group in Engineering Services is responsible for the accuracy of the plan related to regulatory issues, coordination and distribution of the plan, and the preparation of any necessary revisions to the plan.

A copy of the contingency plan and any revisions will be:

- Maintained at the construction field office
- Maintained by Company Emergency Coordinator (EC)
- Distributed by ECP to the engineering teams and to the transmission field offices
- Distributed by the engineering teams to the appropriate local representatives

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The controlled copy list of holders of the contingency plan representing the primary response units includes:

Department	Location
Environmental Construction Permitting	Houston
Houston Environment, Health & Safety (Houston EHS)	Houston
Engineering (Project Team Director)	Various
Transmission (Director, Technical Services)	Houston
Transmission - Division Environmental Coordinator (DEC)	Division Office
Transmission (Area Superintendent)	Area Office
Police Department	Local
Fire Department	Local
Hospital	Local
Emergency Medical Team	Local

2.1 Amendments to the Contingency Plan

The contingency plan will be amended when one of the following occurs:

- Plan proves to be ineffective in an emergency
- Material and waste inventory needs updating
- Changes to Federal or State regulations
- Changes to Local regulations where applicable

At least once every five years there will be a review, evaluation, and re-certification of the plan to be coordinated by the Manager of ECP. Portions of this plan not affecting the overall scope or design may be changed without re-certification.

3.0 Material and Waste Inventory

The Material and Waste Inventory (Appendix A, Table I) will be completed by the Contractor prior to construction. This table provides a list of chemicals used or stored at the site that have the potential of causing environmental degradation or endangerment of public health and safety through accidental releases. This list includes nutrients, such as fertilizers and sanitary wastes; solid waste, such as scrap metals, masonry products and other construction raw materials and debris; construction chemicals, such as paints, soil additives and acids for cleaning; petroleum products, such as fuels and lubricants; and other materials including concrete wash from mixers, explosives, etc.

Material Safety Data Sheets for all hazardous substances listed in Table I will be included in Appendix A and are to be provided by the contractor. Other potential waste from this site, not included in Table I, would include construction debris, rock and excess soil.

4.0 Spill and Leak Preparedness and Prevention

The purpose of this section is to demonstrate that the construction site is adequately equipped to meet preparedness and prevention requirements, as required under the Hazardous Waste Management Regulations.

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4.1 Employee Training

Contractors and company personnel are to be trained in hazardous waste management procedures that will enable them to respond effectively to emergencies by familiarizing them with emergency procedures, emergency equipment, and emergency communication systems. Personnel who handle, sample, or come in direct contact with oils or hazardous matter are to undergo basic training stressing the importance of pollution control. Spill prevention control procedures are to be thoroughly explained during the training briefings which will be conducted by the Contractor Superintendent (Contractor Emergency Coordinator) and the Company Chief Inspector (Company Emergency Coordinator) or their designated representative on the job site. The Company Emergency Coordinator (EC) is responsible for maintaining verification of the training.

Before construction, all project Chief Inspectors and Environmental Inspectors will receive a copy of this SPCC Plan and an approved list of emergency response contractors (see Table III). Inspectors will be trained regarding equipment maintenance, fuel and hazardous material handling, spill prevention procedures and spill response, as specified herein.

All personnel involved in the construction of the proposed facilities will be aware of the SPCC/PPC Plan. Regular training briefings will be conducted on an as required basis by the Contractor Superintendent and the Company Chief Inspector on the job site. These briefings shall include the following:

- Precautionary measures to prevent spills
- Potential sources of spills, including equipment failure or malfunction
- Standard operating procedures in the event of a spill
- Applicable notification requirements
- Equipment, materials and supplies available for clean-up of a spill

4.2 Security

Note: Include project site specific security information here (see Appendix A, Table V).

Hazardous wastes and waste containing PCBs greater than 50 ppm will be stored in a secured location (i.e. fenced, locked, etc.). Fuel storage areas will be located to minimize, as much as possible, tampering by unauthorized personnel during non-operational hours.

4.3 Prevention and Preparedness

It is unlikely that a discharge from the construction site into waters of the state will occur. The construction site should have onsite spill prevention and control facilities, as well as routine inspections of tank and container storage areas that help reduce the potential for oil and hazardous material releases to the soil or surface waters. In areas where hazardous materials are required to be stored or utilized within a wetland, the contractor is required to prepare and submit for approval a secondary containment plan prior to working in the wetland area.

Generally, minor spills or leaks will be contained within secondary containment areas. Areas where potential spills and leaks may occur are listed in Appendix A, Table VI (listing to be completed by Company EC).

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4.3.1 Tanks

The Contractor will take the following precautions to prevent a spill from occurring within tank storage areas:

- Operate only those tanks for fuel and material storage, which meet the approval of the Company;
- Single wall tanks shall be provided with temporary secondary containment that will hold at least 110% of the tank capacity of the largest tank inside the containment area;
- Remove any precipitation from the containment area to maintain the available containment volume at 110% of the volume of material stored. Inspect the precipitation first for evidence of oil, including a sheen, or other contaminants. If a sheen or other indicators of oil or contamination is present, collect the material for proper disposal off-site;
- Use only self-supporting tanks constructed of carbon steel or other materials compatible with the contents of each tank;
- PCB (50 ppm or greater) storage tanks shall be double-walled or have secondary containment that will hold 200% capacity of the tank;
- Elevate tanks a maximum of two (2) feet above grade;
- Tank storage shall be located in areas that are at least 100 feet from all water-bodies, wetlands, and designated municipal watershed areas; and located at least 200 feet from a private water supply well and 400 feet from a community or public water supply well. Certain exceptions as approved ECP and EHS are listed in Appendix A, Table IV;
- All tanks shall be inspected daily for leaks and deterioration by the Contractor EC or designee. The results of all inspections shall be recorded on the "Inspection Log" (Houston EHS SOP Form # 19-18). Copies of form 19-18 for unsatisfactory storage area inspections are to be distributed to Houston EHS and the project manager. Leaking and/or deteriorated tanks shall be repaired or replaced as soon as the condition is first detected;
- Keep tanks and secondary containment drains closed when not in use;
- Ensure vehicle mounted tanks are equipped with flame/spark arrestors on all vents to prevent self ignition;
- Do not store incompatible materials in sequence in tanks prior to decontamination. (A general list of potentially incompatible materials that may be used during construction are included in Appendix A, Table I);
- Decontaminate tanks used to store hazardous materials prior to use at a different construction location if there is the potential to contaminate the next material to be placed in the tank. The tanks should always be decontaminated if they are to be returned to a vendor. The tanks should also be decontaminated if they are being returned a Company yard and no immediate specific same service use is scheduled;
- If a tank contains a Hazardous Material, then transportation should follow the steps outlined in Environmental SOP Chapter 4 – Waste Transportation.

4.3.2 Containers

The Contractor will take the following precautions to prevent a spill from occurring within container storage areas:

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- For drum storage, reference Environmental SOP 3-D (Drum Specifications) and Appendix B of the SOP's (explanation of DOT Drum Markings). Company EC is to have a copy of the current Environmental SOP's;
- Ensure containers remain closed when not in use;
- All containers with a storage capacity of greater than 55 gallons shall have temporary containment (see Appendix A, Table 1 for type of temporary containment);
- Small cans of gasoline, diesel, solvents, etc., should be stored within the temporary containment or within secured trailers or vehicles when not in use;
- Do not store incompatible materials in sequence in containers prior to decontamination. (A general list of potentially incompatible materials that may be used during construction are included in Appendix A, Table I);
- Decontaminate containers used to store hazardous materials prior to use at a different construction location if there is the potential to contaminate the next material to be placed in the container. The containers should always be decontaminated if they are to be returned to a vendor. The containers should also be decontaminated if they are being returned a Company yard and no immediate specific same service use is scheduled;
- If a container contains a Hazardous Material, then transportation should follow the steps outlined in Environmental SOP Chapter 4 – Waste Transportation;
- No incompatible material shall be stored together in the same containment area;
- Leaking and/or deteriorated containers shall be replaced as soon as the condition is first detected;
- Container storage shall be located in areas that are at least 100 feet from all water-bodies, wetlands, and designated municipal watershed areas; and located at least 200 feet from a private water supply well and 400 feet from a community or public water supply well. Certain exceptions as approved ECP and EHS are listed in Appendix A, Table IV;
- All container storage and containment areas being used to store waste or products shall be per the guidelines described in SOP-10, Facility Inspections.

4.3.3 Loading/Unloading Areas

The Contractor will take the below listed precautions to prevent a spill from occurring within loading and unloading areas when those areas are located at the construction site. Company personnel shall be present during loading and unloading activities.

- Transferring of liquids and refueling shall only occur in pre-designated and pre-approved locations that are at least 100 feet from all water-bodies and wetlands; and located at least 200 feet from a private water supply well and 400 feet from a community or public water supply well. Exceptions may be approved by the Environmental Inspector if no reasonable alternatives are available and secondary containment is used. Certain exceptions are listed in Appendix A, Table IV;
- All loading/unloading areas will be closely monitored to prevent any leaks and spills;
- The area beneath loading/unloading location shall be inspected for spills before and after each use;

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- All hose connections shall utilize drip pans at the hose connections while loading/unloading liquids. If a leak or spill occurs, the loading/unloading operation will be stopped and the spill will be contained, cleaned up and collected *prior to continuing the operation*;
- All outlets of the tank trucks shall be inspected prior to leaving the loading and unloading area to prevent possible leakage from the truck while in transit;
- Each refueling vehicle shall have a sufficient number of shovels, brooms, 10 mil polyethylene sheeting, and fire protection equipment to contain a moderate *oil/fuel spill*;
- Any service vehicle used to transport lubricants and fuel must be equipped with an emergency response kit. At a minimum, this kit must include:
  - 25 lbs of granular oil absorbent
  - 10, 48" x 3" oil socks
  - 5, 17" x 17" oil pillows
  - 1, 10" x 4" oil boom
  - 20, 24" x 24" x 3/8" oil mats
  - Garden size, 6 mil, polyethylene bags
  - 10 pair of latex gloves
  - 1, 55-gallon polyethylene open-head drum;

  In addition, a smaller chemical response kit shall be available which contains:
  - 1 bag of loose chemical pulp
  - 2 to 3, 17" x 17" chemical pillows
  - 2, 48" x 3" chemical socks
  - 5, 18" x 18" x 3/8" adsorbent mats
  - garden-size, 6 mil, polyethylene bags
  - 10 pair of latex gloves,
  - 1, 30-gallon polyethylene open-head drum
  - hazardous waste labels.

4.3.4 Concrete Coating Areas for Field Joints

Concrete coating of field joints shall be performed at least 100 feet from the edge of all water-bodies; where topographic conditions and/or work space limitations necessitate application of concrete coating within 100 feet of a water-body, sufficient containment measures shall be implemented so as to eliminate the spill of any concrete coating materials into a wetland or waterbody. Containment such as the following (or equivalent as approved by Company EC in a secondary containment *plan to be submitted by the Contractor*) shall be used:

Deleted: W

- Concrete coating materials shall be temporarily stored in an earthen berm with a polyethylene underling lining of 10 mil thickness, or in a portable containment tray constructed of steel plate measuring a minimum of four (4) feet square by one (1) foot deep;
- Portable-mechanical mixing equipment, if required, shall be operated within a containment area constructed of temporary earthen berms and polyethylene underling lining a minimum of 10 mil thickness;
- Manual mixing of concrete materials in a portable container (such as a 55 gallon drum cut in half, or equivalent) shall be performed within an earthen berm with polyethylene underling lining of 10 mil thickness, or within a portable

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containment tray constructed of steel plate, measuring a minimum of four (4) feet square by one (1) foot deep.

4.4 Emergency Equipment

The construction site/contractor ware yard will have adequate manpower and equipment necessary to divert any spill from reaching water bodies and wetland areas. Emergency equipment shall include, but is not limited to shovels, backhoes, dozers, front-end loaders, oil absorbent booms, pillows, socks and/or mats, granular oil absorbent and chemical absorbent pulp. A list of emergency response equipment and personal protective equipment is provided in Appendix A, Table II.

5.0 Contingency Plan and Emergency Procedures

Emergency response procedures have been developed for this construction project to provide guidance in responding to fires, explosions, oils or hazardous waste, or hazardous waste constituents to the air, land or waters of the state regardless of the quantity involved in the incident.

For unanticipated release of hydrostatic test waters, the company will utilize Best Management Practices, as described in the Company Erosion and Sediment Control Plan as soon as possible after the release.

5.1 Responsibilities Of Company And Contractor Personnel

The Contractor and Company on-site personnel have responsibilities for spill prevention, control and countermeasures. For some projects, as specified by the Company, a Company Area Field Construction Office, staffed with appropriate environmental compliance personnel, will perform the ECP responsibilities.

If notification is given that an evacuation is necessary, all personnel will evacuate the construction area via the primary evacuation route (site specific map with evacuation route to be attached for plant projects) and await further instructions from the EC. If direct access to the primary evacuation route is restricted by fire, spill, smoke, or vapor, facility personnel will evacuate the facility via alternate evacuation routes to the nearest accessible open area.

5.1.1 First Responder

Any individual who first observes a spill or any other imminent or actual emergency situation will take the following steps:

- Assess the situation to determine if the situation poses an immediate threat to human health or the environment.
- Identify hazardous substances involved, if any.
- Report the emergency or spill to the Company and Contractor EC(s) immediately.
- Standby at a safe distance and keep others away.
- Activate emergency shutdown, if necessary.

The Contractor Superintendent will act as the EC for the Contractor. The Chief Inspector will act as the EC for the Company. The responsibilities of the EC will be as follows:

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5.1.2 Contractor EC Responsibilities

The Contractor EC will coordinate the response to all spills which occur as a result of Contractor operations. The Contractor will not coordinate the response of spills of pipeline liquids, hazardous wastes, or the unanticipated release of hydrostatic test waters, these spills will be coordinated by the Company EC.

Contractor EC Responsibilities:

- Determine any immediate threat to human health, the environment, and the neighboring community;
- Ensure personnel safety and evacuate if necessary.
- Identify source, character, amount, and extent of release;
- Determine if hazardous substances are involved;
- Inform the Company EC and follow instructions;
- Direct and document remediation efforts to contain and control spill release;
- Document remedial efforts;
- Coordinate cleaning and disposal activities;

5.1.3 Company Responsibilities

The Company EC will be responsible for coordinating the clean up of all spills of pipeline liquids, hazardous wastes, and any unanticipated release of hydrostatic test water.

5.1.4 Company EC Responsibilities

Upon notification of pipeline liquid spills, hazardous materials spills, or the unanticipated release of hydrostatic test waters:

- Assess situation for potential threat to human health, environment and the neighboring community;
- Implement evacuation, if necessary;
- Activate emergency shutdown, if necessary;
- Ensure personnel safety;
- Control source as conditions warrant;
- Notify immediately the Emergency Spill Hotline at 1-800-735-6364 (select the appropriate transmission division) and those listed in Appendix A, Table III immediately for spills that meet the following criteria:
    a. one (1) pound or more of a solid material (excluding HDD mud) spilled on land
    b. five (5) gallons or more of a liquid spilled on land
    c. creates a sheen on water
    d. unanticipated release of hydrostatic test water;
- If necessary, notify the local fire department, law enforcement authority, or health authority as appropriate. The following information should be provided:

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a. name of the caller and callback number
b. the exact location and nature of the incident
c. the extent of personnel injuries and damage
d. the extent of release
e. the material involved, and appropriate safety information;

- Ensure that waste or product which may be incompatible with a released material is kept away from the affected area;
- Keep any potential ignition source away from emergency area, if spilled material is flammable;
- Minimize affected area with appropriate containment or diking;
- Assemble required spill response equipment as required (protective clothing, gear, heavy equipment, pumps, absorbent material, empty drums, etc.)
- Place spilled material in appropriate containers, in accordance with the Environment Standard Operating Procedures;
- Label and store containers in accordance with the Environmental Standard Operating Procedures;
- Coordinate waste disposal and equipment decontamination with Houston EHS;
- Terminate response;
- Ensure that all emergency response equipment is fully functional. Any equipment that cannot be reused shall be replaced;
- For spills of PCB's, contact Houston EHS for special spill response requirements related to PCB spills;
- Assist with the coordination of cleanup and disposal activities as described in Sections 5.2, 5.3 and 5.4;
- If necessary, contact outside remediation services, in coordination with Houston EHS, to assist with clean up;
- Complete Waste Removal Storage and Disposal Record Form (WRSDR and WDR Forms to be obtained from Houston EHS) to track waste generated during this project;
- Complete Field Spill Report (Environmental SOP 19-6) and distribute accordingly;
- For unanticipated release of hydrostatic test waters, notify state contact if required by state permit in accordance with timeframes required by state permit;
- When required by permit, arrange for immediate sampling of the test water (from the pipe or a representative sample of released water where possible), or soil where the test water was released, and water from adjacent water-body if test water was released into the water-body. Analysis of the samples will be in accordance with hydrostatic test discharge permit criteria plus, where applicable, mercaptans;
- Local Right of Way agent will notify township manager and/or mayor.

5.1.5 Division Environmental Coordinator (DEC) Responsibilities

- Provide technical assistance on spill cleanup procedures
- Determine if the release requires reporting to non-project specific regulatory agencies
- Provide written and verbal reports to the above regulatory agencies

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- Contact outside remediation services through consultation with Houston EHS
- Coordinate with Houston EHS and arrange for the transport of hazardous waste and waste containing PCB's
- Coordinate with ECP relative to any project specific permit requirements

5.1.6 Environmental Construction Permitting (ECP) Responsibilities

- Determine if the release requires reporting to any project specific permitting agencies
- Provide written and verbal reports as required
- Coordinate with DEC

5.2 Spill Clean-Up/Waste Disposal Procedures

The following identifies the clean-up and control measures to be utilized in the event of a spill of oil, fuel or a hazardous substance or unanticipated release of hydrostatic test water.

5.2.1 Oil/Fuel Spills

- Ensure no immediate threat to surrounding landowners or environment;
- Remediate small spills and leaks as soon as feasible. Use adsorbent pads whenever possible to reduce the amount of contaminated articles;
- Restrict the spill by stopping or diverting flow to the oil/fuel tank;
- If the release exceeds the containment system capacity, immediately construct additional containment using sandbags or fill material. Every effort must be made to prevent the seepage of oil into soils and waterways;
- If a release occurs into a facility drain or nearby stream, immediately pump any floating layer into drums. For high velocity streams, place oil booms or hay bales between the release area and the site boundary and downstream of affected area. As soon as possible, excavate contaminated soils and sediments;
- After all recoverable oil has been collected and drummed, place contaminated soils and articles in containers;
- For larger quantities of soils, construct temporary waste piles using plastic liners placing the contaminated soils on top of the plastic and covered by plastic. Plastic-lined roll-off bins should be leased for storing this material as soon as feasible;
- Label the drum following the procedures outlined in the Company's Environmental Procedures Manual;
- Move drum to secure staging or storage area;
- Document and report cleanup activities to the Company EC as soon as feasible.
- If environmentally sensitive resources (wetlands, water-bodies) exist in the area, ensure that Best Management Practices as described in Company's E&SCP are utilized to minimize impact to these resources;

5.2.2 Hazardous Substance Releases

- Ensure no immediate threat to surrounding landowners or environment;
- Identify the material and quantity released;

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- Block off drains and containment areas to limit the extent of the spill. Never wash down a spill with water;
- Ensure that Personal Protective Equipment and containers are compatible with the substance;
- Collect and reclaim as much of the spill as possible using a hand pump or similar device. Containerize contaminated soils in an appropriate DOT container in accordance with the Company's Environmental Standard Operating Procedures Manual. (Note: Environmental SOP's are located in all division and area offices and kept by all engineering teams.) Never place incompatible materials in the same drum;
- Sample the substance for analysis and waste profiling, according to instructions from the Houston EHS;
- Decontaminate all equipment in a contained area and collect fluids in drums;
- Label the drum following Houston EHS SOP's;
- Move the drum to secure staging or storage area;
- Document and report activities to Houston EHS as soon as feasible.
- If environmentally sensitive resources (wetlands, water-bodies) exist in the area, ensure that Best Management Practices as described in Company's E&SCP are utilized to minimize impact to these resources;

5.2.3 Unanticipated Release of Hydrostatic Test Water

- Ensure no immediate threat to surrounding landowners or environment;
- If environmentally sensitive resources (wetlands, water-bodies) exist in the area, ensure that Best Management Practices as described in Company's E&SCP are utilized to minimize impact to these resources;

5.3 Disposal of Contaminated Materials/Soils

- The Contractor shall work with the Houston EHS to characterize waste generated during this project. All wastes generated, as a result of spill response activities will be analyzed to determine if hazardous, or if PCBs are greater than 1 ppm. Knowledge of the contaminant(s) may be applied to classify the waste/spill materials as determined by Houston EHS;
- The Contractor is responsible for the proper disposal of wastes generated during this project that is determined by Houston EHS to be non-hazardous and to contain PCBs less than 1 ppm. This includes obtaining applicable authorizations and registrations per Environmental SOP 1-D-3 for waste disposal;
- Houston EHS is responsible for the proper disposal of hazardous wastes and PCB wastes containing PCBs greater than 1 ppm generated during this project, including obtaining applicable EPA Identification Numbers;
- Hazardous wastes and waste containing PCBs shall be stored in a secured location (i.e. fenced, locked, etc.) until such time as this material is transported off-site. At no time will hazardous waste be stored for a period exceeding 90 days nor a waste with PCBs greater than 50 ppm be stored for a period exceeding 30 days.

5.4 Equipment Cleaning/Storage

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- Upon completion of remedial activities, the Contractor shall be responsible for decontaminating emergency response equipment used to remediate a spill resulting from their operations. The Company will be responsible if the spill is hazardous material, pipeline liquids, or hydrostatic test water;
- Waste disposal for any contaminated waste generated as a result of the decontamination process shall be the responsibility of Houston EHS.
- The Contractor shall be responsible for replacing all spent emergency response equipment prior to resuming construction activities if spill resulted from their operations;
- Reusable personal protective equipment shall be tested and inventoried by the Contractor prior to being placed back into service;

6.0 Housekeeping Program

The construction area will be maintained in a neat and orderly manner. Solid wastes, such as food wrappings, cigarette butts and packets, styrofoam cups and plates, and similar wastes will be disposed of off-site, not in the construction excavation area. Any spills or leaks will be cleaned up as expeditiously as possible. Trash will be routinely collected for off-site disposal. Container storage areas will be maintained in a neat and orderly manner.

7.0 External Factors

There will be no direct effect on the construction site due to a power outage or snowstorm. In the event of a flood or strike, all tanks and containers would be removed from the right-of-way and placed in a secure area.

8.0 Unanticipated Hazardous Material Discovery Plan

Texas Eastern is developing an Unanticipated Hazardous Material Discovery Plan for inclusion into the SPCC/PCC plans that specifies procedures for handling contaminated soil and/groundwater (both known and unanticipated) encountered during construction. The Unanticipated Hazardous Material Discovery Plan will include language that Texas Eastern will advise its Environmental Inspectors and construction contractors prior to construction on potential locations where contamination may be encountered and procedures developed to properly handle contaminated soil and/or groundwater during construction in accordance with applicable federal and state regulations. Texas Eastern proposes to submit the revised SPCC/PCC with the Unanticipated Hazardous Material Discovery Plan to the FERC for review and approval as part of the project's Implementation Plan.

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APPENDIX "A" - TABLES

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TABLE I - Material And Waste Inventory

Oil and Fuel to be used or stored on site during construction:

Commercial Chemicals to be used or stored on site during construction:

Hazardous and Non-Hazardous Wastes to be used or stored on site during construction:

Incompatible Materials to be used or stored on site during construction:

Type of Temporary Containment containers to be used:

TABLE I TO BE COMPLETED BY CONTRACTOR

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TABLE II - Emergency Response And Personal Protective Equipment

Spill Response:

Equipment	Quantity	Location

Fire Protection:

Equipment	Quantity	Location

Personnel Protection:

Equipment	Quantity	Location

TABLE II TO BE COMPLETED BY CONTRACTOR EC

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TABLE III – Key Emergency Contacts

The list of key personnel who will be contacted in the event of an emergency or spill incident include the following:

1. Company Emergency Contacts	Contact Name	Phone Number
1. Company Emergency Coordinator (within 15 minutes of incident)		
2. 24-hour spill emergency hotline (DEC Name and Division) (within 15 minutes of incident)		1-800-735-6364
3. Project Manager		
4. Project Environmental Lead (PEL) (within 60 minutes of incident)		
5. Field Construction (Houston Office)		

2. **Contractor Emergency Contact**

   1. Contractor Emergency Coordinator

3. **Local Authorities – As necessary**

Department	Number
State Police	
Local Police	
Local Fire Department	
Hospital	
Ambulance	

4. **Environmental Agencies**

   Notification to be made by DEC and PEL representative

5. **Potential Environmental Remedial Service Contractors (verify prior to issuing project specific SPCC Plan)**

   Clean Harbors Environmental Services, Inc. -Howard Alexander (800) 782-8805

   Safety-Kleen (FS), Inc. Edward A. Mitchell (281) 478-7700

   U. S. A. Environment - Cesar Garcia (713) 425-6925 or cell phone (832) 473-5354

   WRS Infrastructure and Environment Inc. Steve Maxwell Cell phone 281 731-0886

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TABLE III TO BE COMPLETED BY COMPANY EC

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TABLE IV - Tank And Container Storage Exception Areas

Tank and container storage shall be located in areas that are at least 100 feet from all water-bodies and wetlands, and at least 200 feet from a private water supply well and 400 feet from a community or public water supply well.

The below exceptions have been approved by ECP and EHS.

1.

2.

3.

4.

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TABLE V – Project Site Specific Security Information

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TABLE VI – Areas for Potential Leaks and Spills

1.

2.

3.

4.

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APPENDIX "B" - MSDS SHEETS

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APPENDIX E

ESSENTIAL FISH HABITAT ASSESSMENT FOR THE CROWN LANDING LNG PROJECT

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APPENDIX E
Essential Fish Habitat Assessment
Crown Landing LNG Project

1.0 INTRODUCTION

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) mandated the identification and protection of important marine and anadromous fisheries habitats. The regional fishery management councils, with assistance from the National Marine Fisheries Service (NMFS), are required to delineate essential fish habitat (EFH) in Fishery Management Plans and associated amendments for all federally managed fisheries. Federal agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with the NMFS.

On September 16, 2004, Crown Landing, LLC (Crown Landing) filed an application under section 3(a) of the Natural Gas Act (NGA) with the Federal Energy Regulatory Commission (FERC). In Docket No. CP04-411, Crown Landing seeks authorization to site, construct, and operate a liquefied natural gas (LNG) terminal in Logan Township, Gloucester County, New Jersey. On September 17, 2004, Texas Eastern Transmission, LP (Texas Eastern) filed an application under section 7(a) of the NGA seeking a Certificate of Public Convenience and Necessity (Certificate) to site, construct, and operate new natural gas pipelines and ancillary facilities to connect the proposed LNG terminal to its existing interstate gas transmission system (Docket No. CP04-416-000). Texas Eastern's proposed pipeline, called the Logan Lateral Project, would involve construction and operation of facilities in Gloucester County, New Jersey and Delaware County, Pennsylvania. Crown Landing's proposed LNG terminal and Texas Eastern's proposed pipeline are being evaluated together by the FERC. Because construction of the project in estuarine habitats could adversely affect EFH, the FERC is consulting with the NMFS and prepared this EFH Assessment to comply with the MSFCMA. Texas Eastern's pipeline facilities are not expected to affect EFH; therefore, although this EFH Assessment addresses the Crown Landing LNG Project, the focus is on the LNG terminal rather than the associated pipeline facilities.

Sections 2.0 through 4.0 are discussions of the proposed project as well as EFH and managed fish species found in the Crown Landing LNG Project area. Section 5.0 provides a discussion of impacts associated with the project. Additional project information to support this EFH Assessment is included in section 4.6 of the draft Environmental Impact Statement (EIS).

2.0 PROJECT DESCRIPTION

Crown Landing proposes to construct and operate an LNG import terminal consisting of facilities capable of unloading LNG ships, storing up to 450,000 cubic meters of LNG (9.2 billion cubic feet of natural gas equivalent), vaporizing LNG, and sending out natural gas at a rate up to 1.2 billion cubic feet per day. The LNG terminal facilities would consist of:

- a ship unloading facility with a single berth capable of receiving LNG ships with cargo capacities of up to 200,000 cubic meters (m^3);
- three 150,000 m^3 (net capacity) full containment LNG storage tanks;
- a closed loop shell and tube heat exchanger vaporization system; and
- various ancillary facilities, including administrative offices, warehouse/maintenance building, main control center, guardhouse, and a pier control room.

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The draft EIS includes a comprehensive discussion of the facilities as well as an evaluation of alternatives (see sections 2.0 and 3.0 of the draft EIS). See figure 2.2-1 in the draft EIS for the general project location.

Although the proposed terminal site comprises about 175 acres of land in New Jersey, the project would only affect about 39 acres of that area for terminal facilities. Additionally, about 29 acres of the Delaware River riverbed would be affected by dredging or construction of the associated marine facilities, near River Mile (RM) 78.

3.0 MANAGED FISH SPECIES

NOAA Fisheries Northeast Regional Office (NOAA Fisheries, 2004a) EFH designations tables were reviewed to identify managed species for which EFH could potentially occur within the project area. The EFH designation tables do not extend up the Delaware River past Oldmans Creek and thus EFH has not been designated north of that point. The proposed terminal site and ship unloading facility are north of Oldmans Creek and consequently outside of designated EFH. However, nine managed species with the potential to occur in the Delaware River have at least one life stage that may be found in the mixing zone between freshwater and saline waters. These species are listed in table 3-1. We also completed an additional review of the habitat requirements for those managed species occurring in the larger Delaware River estuary system to determine if habitats at the LNG terminal site have the potential to support managed fish. Through this multi-layered review, we determined that managed fish species do not have EFH designated in the project area and the likelihood of managed species occurring in the project area is low.

TABLE 3-1

Salinity Ranges for the Life Stages of Managed Fish Species Potentially Occurring in the *Mixing Zone within the Delaware River Estuary* a/

Managed Species	Typical Salinity Range of Occurrence (ppt b/)			
	Eggs	Larvae	Juveniles	Adults
Winter flounder (*Pleuronectes americanus*)	10 – 32	3.2 – 30	19 – 21	15 – 33
Windowpane flounder (*Scopthalmus aquosus*)	--	--	15 – 33	5.5 – 36
American plaice (*Hippoglossoides platessoides*)	--	--	> 32	--
Atlantic sea herring (*Clupea harengus*)	--	--	26 – 32	--
Bluefish (*Pomatomus saltatrix*)	--	--	23 – 33	> 25
Butterfish (*Peprilus triacanthus*)	--	--	3.0 – 37	--
Summer flounder (*Paralicthys dentatus*)	--	--	22 – 35	18 – 35
Scup (*Stenotomus chrysops*)	--	--	>15	--
Black sea bass (*Centropristus striata*)	--	--	> 18	--

a/ Mixing zone as defined by NOAA Fisheries (2004)
b/ ppt = parts per thousand
Note: Salinity in project area is generally less than 1 ppt.

The primary factor restricting managed species from inhabiting the project area is the low salinity. The salinity in the project area is generally less than 1 part per thousand (ppt). The U.S. Army Corps of Engineers (COE, 1997) characterized four salinity zones within the Delaware River Estuary: polyhaline with salinity levels of 18 to 30 ppt from the mouth of Delaware Bay to about RM 34; mesohaline with salinity levels of 5 to 18 ppt from about RM 34 to RM 44; oligohaline with salinity levels of 0.5 to 5 ppt from about RM 44 to RM 79; and freshwater with salinity levels of 0.5 ppt and less upstream of RM 79. NOAA Fisheries (2004b) classifies salinity zones as follows: saline zone with

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salinity levels greater than 25 ppt; mixing zone with salinity levels between 0.5 to 25 ppt; and freshwater zone with salinity levels below 0.5 ppt. Finally, EPA (1991) divided the reach of the Delaware River estuary that is tidally influenced into three zones based generally on salinity: bay (salinities more typical of marine water), transition (low saline levels, generally 0.5 to 5 ppt), and tidal fresh (salinities less than 0.5). The tidal fresh zone starts near RM 80. Thus, although it can vary with season and weather events, based on COE (1997), NOAA Fisheries (2004b), and EPA (1991), the LNG terminal site is located at the usual upstream edge of saltwater intrusion into the Delaware River and upstream of the site is considered freshwater.

Overall, managed species generally occurring in the Delaware River estuary typically occupy areas of higher salinity, including Delaware Bay and some lower stretches of the Delaware River downstream of the project area, but these species generally do not tolerate the low salinity levels found in waters at the project site (see table 3-1). Nonetheless, the project area is known to provide feeding and refuge habitat for several anadromous species that serve as prey to managed fish species during migrations. Prey for managed fish species comprise a critical component of EFH. Therefore, since impacts associated with the proposed project could indirectly affect managed species through direct impacts on prey species and their habitats, NOAA Fisheries requested that the FERC prepare an EFH Assessment.

NOAA Fisheries has also requested that this EFH Assessment be expanded to include other species for which EFH may not be designated but for species that have Fishery Management Plans and thus are either commercially important or sensitive in some other manner. Species fitting these criteria in the vicinity of the proposed LNG terminal include menhaden, blueback herring, alewife, American shad, and striped bass. Occurrence in the project area and potential impacts on these species are discussed in section 4.6.2 of the draft EIS.

4.0 ESSENTIAL FISH HABITATS

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

Although designated essential fish habitat does not extend upstream of Oldmans Creek along the Delaware River and, therefore, does not occur at the proposed LNG terminal site, aquatic habitats that would be affected by the project support prey for managed species. The primary areas inhabited by prey species near the proposed LNG terminal site include open water, shallow water, and benthic habitats. The presence of these habitats within the proposed project area and the potential impacts on them are discussed below. Also, section 4.6.2 of the draft EIS provides additional discussion on these resources and potential impacts on them from the proposed project.

4.1 OPEN WATER/SHALLOW WATER HABITAT

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 mean low water (MLW) and is characterized by turbid, low-salinity (brackish) water over a substrate of sand and mud. The open water in the vicinity

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of the proposed LNG terminal site serves as habitat for various life stages of several fish species by providing habitat for spawning, breeding, feeding, growth, and shelter.

The open water in the area of the Delaware River near the proposed LNG terminal site also supports seasonal migrations of anadromous species that are important commercial and recreational fisheries. Additionally, seasonal migrations by prey species for managed fish species occur near the proposed project area within the Delaware River.

Although the open water in the deeper portions of the Delaware River (*i.e.*, Marcus Hook Anchorage) provides habitat for many species, the nearshore shallow water habitats are typically more productive and valuable to life stages of more species and thus are more important biologically to the fish inhabiting the river. The areas between the spring high water line to a depth of 4 feet below MLW include both shallow water habitat (subtidal shallows) and those areas exposed during low tide (intertidal shallows). The subtidal shallows in the Delaware River 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 or mud substrate. In the project area, the slope and width of the subtidal and intertidal zone is relatively uniform along the Delaware River and the substrate is a mix of sand, gravel, sparse cobble, and silt. The wave action along the shoreline results in generally higher dissolved oxygen levels in the shallow water areas and thus increases the habitat value of the area to fish.

The Upper Delaware River provides key spawning and nursery habitat for the American shad along its entire length. Also, the proposed LNG terminal site is located within a section of the Delaware River considered as a critical nursery area for striped bass. 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 proposed 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. Shallow water and the lack of structure in the area also increase the vulnerability of juvenile fish to avian predators. The limited availability of food and lack of refuge habitat likely limits the value of subtidal shallows in the area as nursery habitat. Also, juveniles of several of these species are commonly found in nearshore open water and to a lesser extent deepwater, especially in the upper reaches of the Delaware River estuary, and would be likely to inhabit the area following dredging.

Effects of Dredging

Generally, migratory fish populations can be impacted by increased concentrations of suspended sediments if dredging activities occur during migratory periods. High concentrations of suspended sediment may delay or divert migratory passage and in some instances could cause total avoidance of an area by fish. These potential effects could be exacerbated if the migrating fish are in generally poor condition and under stress by other factors. Disturbance of migratory fish patterns, including the patterns of pelagic species that serve as prey to downstream managed species, could also adversely affect fish and their ability to find food resources. Decreased foraging success could have physiological effects on fish, including lowered reproductive rates, decreased competitive fitness, and increased risk of mortality.

We do not believe that the increased turbidity that would result from this project would significantly disrupt migratory fish. These fish generally ascend rivers when flows and turbidity are high and are quite tolerant of high turbidity levels. Additionally, the sediment plumes associated with the proposed hydraulic dredging would likely be restricted to the eastern half of the Delaware River near the proposed project site and would not encompass the width of the entire river. Thus migrating fish could

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and likely would avoid the plumes to reach undisturbed spawning areas upstream of the construction activities.

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 ship 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 if it occurs 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-water construction activities from March 15 to August 1.

The resource agencies have also indicated that mitigation would be necessary to offset the loss and permanent conversion of shallow water to deepwater habitat as the result of dredging a deeper ship berth. NOAA Fisheries stated that mitigation should involve creation of shallow water habitat in an area near the proposed project. Crown Landing is currently working with the applicable resource agencies to develop a mitigation plan for potential impacts on shallow water habitat. The plan may include creation of shallow water habitat near the proposed project and conducting or funding studies that would further the understanding of sensitive aquatic resources in the Delaware River.

Effects of Water Withdrawals

LNG ships would be 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/h. 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/h for a 138,000 m^3 ship and about 7,500 m^3 for a 200,000 m^3 ship. Thus the likely intake rates for the 138,000 m^3 and 200,000 m^3 ships are estimated to be about 23,000 gpm and 34,000 gpm, respectively. The total area of the two lower intake openings is 3.55 m^2. Openings are protected by bar-type grids having 4.5 mm bars spaced 25 mm apart, reducing the clear flow area to 2.36 m^2. The highest and lowest points of the openings are about 8.4 and 9.5 m below the ship's waterline, respectively.

Because LNG ships would unload LNG at the proposed terminal about 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 intakes would result in the entrainment, impingement, or loss of aquatic resources, especially larvae and eggs. The NJDFW and NOAA Fisheries have 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 marine terminal.

To assess the potential impacts of ballast water withdrawals on fish populations within the Delaware River, we reviewed data included in EPA (2002) and used in the EPA's analysis of potential

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impacts from cooling water intake structures within the Delaware River system. In the Delaware River case study (EPA, 2002), 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 north of and 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 only on volume of water and assuming 150 ships would visit the Crown Landing 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 were able to estimate annual fish losses from ballast water intakes associated with operation of the proposed LNG terminal (table 4-1).

TABLE 4-1

Estimate of Potential Impacts of Ballast Water Withdrawal by LNG Ships Using 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	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/ Assuming on average150 LNG ships would visit the proposed LNG terminal annually and that each carrier 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.

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To avoid or minimize impacts associated with ballast water intake as presented in table 4.1, we recommend in section 4.6.2 of the draft EIS that Crown Landing 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.

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.

The FERC Procedures generally prohibit the use of waterbodies like the Delaware River, which contain federally listed species, as hydrostatic test water sources 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 tanks. There would be no consumptive loss of water, as the water would be returned to the river following completion of the tests.

Water would be appropriated from the Delaware River over a 2-week period at an intake rate of approximately 2,000 to 4,000 gallons per minute (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 above for ballast water, we were able to estimate entrainment and impingement losses from hydrostatic test water withdrawals (table 4-2). Unlike ballast water withdrawals that would occur throughout the year and repeat annually, water withdrawals for hydrostatic testing of the LNG tanks would only require a withdrawal of 25 million gallons once per tank. However, since the estimates presented in table 4-2 are based on a proportion of the losses at the Logan Generating Plant 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.

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TABLE 4-2

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.

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

Effects of Pier Construction

The pier for the ship unloading facility would be supported by approximately 80 steel piles, each 3 feet in diameter and 100 to 120 feet long. Construction of the pier and breasting dolphins would result in a 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.

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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, and predators entering the area to prey on stunned fish have the potential to be stunned).

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. For example, 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.

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 five 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[1], 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.

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 these effects would substantially alter migration patterns, the relationship of predator or prey species, or their abilities to find shelter or forage, respectively. 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 addition, we recommend in section 4.6.2 of the draft EIS that

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

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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 pipe-driving activities.

4.2 BENTHIC HABITATS

Benthic habitats may consist of intertidal shallows (inundated during high tides) and subtidal substrates (permanently covered by water). Intertidal mudflats occur between spring high water line to the mean low water line and serve as important nursery and feeding areas for many bird, fish, and invertebrate species. Subtidal substrates that occur in the shallow water areas are important feeding habitats for fish and benthic species that feed on polychaete worms and mollusks inhabiting these areas. The deeper river bottom benthic substrate is comprised of sand and mud. Little to no vegetation grows in any of the benthic habitats near the project site; however, debris such as logs provide structure for invertebrates and demersal finfish.

During operations of the proposed facility, LNG ships would continue to disturb the benthic substrate during transit of the ship channel. 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. As indicated in section 4.6 of the EIS, there is no commercial shellfishery or abundance of commercially important shellfish species in the project area. Project dredging would primarily affect the Asiatic clam (*Corbicula fluminea*), 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 zones 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 zone 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 begin to 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.

5.0 CUMULATIVE IMPACTS

Cumulative impact results when impact associated with a proposed project is superimposed on or added to impact 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 might be minor, the additive effects from all the projects could be significant.

Existing environmental conditions in the project area reflect extensive changes based on past projects and activities. For example, substantial impacts have occurred and continue to occur because of water quality degradation from point and non-point source pollution along the Delaware River. Residential, commercial, and industrial developments are directly impacting EFH by dredging or by affecting the watershed. Point source discharges from industry, wastewater treatment plants, and existing power plants, combined with septic tank leachates, stormwater runoff, and oil and chemical spills have historically contributed to lower water quality and degraded fishery habitats. However, in recent years, water quality within the Delaware River has been improving.

The draft EIS provides a detailed environmental analysis of the effects of construction and operation of the LNG Project and our recommendations to mitigate environmental impacts within the

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Delaware River. The draft EIS also includes an assessment of potential impacts from construction and operation of the Logan Lateral Project. Because the Logan Lateral Project is not expected to have impacts on the aquatic resources within the Delaware River, this cumulative section only discusses the Crown Landing LNG Project.

Construction of the Crown Landing LNG Project would adversely affect surface water quality and biological resources associated with the Delaware River. Specific project activities such as dredging, prop wash, dredge disposal, hydrostatic testing, and upland clearing/grading could result in a variety of impacts related to aquatic resources that include:

- increased water turbidity and resuspension of sediments;
- surface runoff/erosion;
- loss of wetland or upland vegetation;
- noise impacts from pile driving;
- disturbance to benthic substrates;
- entrainment and impingement of aquatic organisms; and
- potential spills of hazardous substances.

Although mitigation would lessen these impacts, gradual and cumulative impacts that could result from the construction and operation of the proposed project and other projects in the area and within the near future would result in some unavoidable adverse effects on the existing environment. However, the cumulative impact of dredging and other damage to benthic habitats, when completed in accordance with Crown Landing's proposed plans and our recommendations, would be relatively minor and short term in comparison to available habitats in the Delaware River.

Operation of the proposed facility could also affect aquatic resources during ballast water intakes by LNG ships while offloading LNG at the terminal. NOAA Fisheries has expressed concern about the severity of this impact, particularly during spring, when considered with other facilities along the Delaware River. As shown in table 4-1, annual ballast water intake would impinge or entrain the equivalent of over 1,185,861 age-1 fish, would reduce fish harvest by over 33,269 pounds, and would result in over 154,286 pounds of production foregone. Although these losses would be in addition to other existing intake related losses along the Delaware River, the impacts associated with ballast water intake by LNG ships at the proposed LNG terminal are not likely to result in adverse population level effects on managed species, other recreationally important fish species, or forage species.

6.0 CONSERVATION MEASURES

Crown Landing proposes to adhere to agency-recommended timing windows for dredging activities. Avoiding dredging during critical spawning and migratory periods would avoid many of the potential direct impacts on managed species associated with the project. Use of a hydraulic dredge, as proposed, is an important measure to reduce the extent of potential impacts on habitats at the proposed project site as well as downstream of the site. The placement of dredged material in an onshore area is another important measure proposed by Crown Landing to minimize potential impacts on federally managed fish species and EFH, including prey species. Also, Crown Landing is working with the

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applicable resource agencies to develop mitigation that would compensate for the impacts on shallow water habitats from dredging.

Crown Landing's implementation of our recommendations relating to consultations with federal and state agencies on mitigative measures for the withdrawal of ballast water intake and pile-driving activities could also serve to minimize potential impacts on aquatic resources, especially eggs and larvae. These conservation measures are discussed in additional detail in section 4.6.2 of the draft EIS.

7.0 CONCLUSIONS

Dredging associated with the proposed project could affect open water, shallow water, and benthic habitats in the project area. Activities within the Delaware River also have the potential to affect anadromous fish, a primary prey groups for managed fish species. The suspension of sediments during dredging could temporarily affect use of the water column by managed species and their prey in the area. Dredging of the ship berth would result in permanent alteration of existing shallow water habitat to deeper water habitat within the dredging footprint. However, implementation of the conservation measures discussed above, including Crown Landing's continued coordination with the applicable resource agencies to develop appropriate mitigation for project impacts and implementation of our recommendations as discussed in section 4.6.2 of the draft EIS, would likely avoid or minimize adverse impacts on managed fish species and EFH. Therefore, we believe the proposed project would have negligible effects on EFH.

8.0 REFERENCES

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APPENDIX F

RESIDENCES AND OTHER STRUCTURES WITHIN 50 FEET OF THE CONSTRUCTION WORK AREA FOR THE LOGAN LATERAL PROJECT

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TABLE F-1

Residences and Other Structures Within 50 Feet of the Construction Work Area for the Logan Lateral Project

State	Milepost	Feature	Distance from Edge of Construction ROW (ft.)	Description
PENNSYLVANIA	0.00	Residence	19	House – adj. to staging
	0.00	Residence	48	House – adj. to staging
	0.03	Residence	4	House
	0.04	Residence	32	House
	0.07	Residence	14	House
	0.07	Residence	45	House
	0.14	Garage	15	Garage
	0.19	Building	0	Kentucky Fried Chicken
	0.29	Building	45	Brookhaven Shopping Center
	0.33	Residence	43	House
	0.34	Residence	44	House
	0.35	Residence	31	House
	0.35	Residence	46	House
	0.37	Residence	42	House
	0.38	Residence	38	House
	0.39	Residence	40	House
	0.40	Residence	38	House
	0.41	Residence	40	House
	0.41	Residence	38	House
	0.41	Residence	43	House
	0.42	Residence	38	House
	0.43	Residence	37	House
	0.44	Residence	38	House
	0.45	Residence	37	House
	0.46	Residence	39	House
	0.46	Residence	38	House
	0.48	Residence	38	House
	0.49	Residence	31	House
	0.51	Residence	41	House
	0.51	Residence	42	House
	0.51	Residence	42	House
	0.52	Residence	38	House
	0.52	Residence	38	House
	0.53	Residence	37	House
	0.54	Residence	37	House
	0.56	Residence	43	House
	0.57	Residence	37	House
	0.57	Residence	43	House
	0.57	Residence	40	House
	0.58	Residence	38	House
	0.59	Residence	41	House
	0.59	Residence	38	House
	0.59	Residence	43	House
	0.61	Residence	36	House
	0.61	Residence	38	House
	0.61	Residence	42	House
	0.62	Residence	38	House
	0.63	Residence	37	House
	0.63	Residence	37	House
	0.64	Residence	38	House
	0.65	Residence	41	House
	0.65	Residence	43	House
	0.66	Residence	38	House
	0.67	Residence	40	House
	0.68	Residence	40	House
	0.68	Residence	38	House
	0.70	Residence	39	House
	0.71	Residence	33	House
	0.71	Residence	39	House
	0.73	Residence	38	House
	0.73	Residence	41	House
	0.76	Residence	35	House

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TABLE F-1 (cont'd)

Residences and Other Structures Within 50 Feet of the Construction Work Area for the Logan Lateral Project

State	Milepost	Feature	Distance from Edge of Construction ROW (ft.)	Description
	0.77	Residence	41	House
	0.78	Residence	37	House
	0.81	Residence	40	House
	0.81	Residence	43	House
	0.82	Residence	39	House
	0.84	Residence	39	House
	0.85	Residence	40	House
	0.85	Residence	39	House
	0.86	Residence	46	House
	0.88	Residence	47	House
	0.89	Residence	35	House
	0.91	Residence	41	House
	0.91	Residence	41	House
	0.92	Residence	29	House
	0.93	Residence	37	House
	0.94	Residence	48	House
	0.95	Residence	41	House
	0.96	Residence	39	House
	0.97	Residence	42	House
	0.98	Residence	39	House
	0.98	Residence	41	House
	0.99	Residence	42	House
	1.00	Residence	36	House
	1.00	Residence	35	House
	1.02	Residence	41	House
	1.02	Residence	41	House
	1.04	Residence	41	House
	1.04	Residence	46	House
	1.04	Residence	40	House
	1.05	Residence	38	House
	1.05	Residence	39	House
	1.07	Residence	40	House
	1.07	Residence	43	House
	1.09	Residence	40	House
	1.09	Residence	33	House
	1.10	Residence	43	House
	1.11	Residence	38	House
	1.14	Residence	35	House
	1.15	Residence	32	House
	1.16	Residence	34	House
	1.16	Residence	33	House
	1.18	Residence	33	House
	1.22	Residence	8	House
	1.23	Garage	8	Garage
	1.23	Residence	48	House
	1.34	Building	0	Upland School Bus and Maintenance Building
	2.05	Building	10	Bakery
	2.10	Shed	23	Small Storage shed
	2.12	Building	30	Trucking Terminal
	2.18	Building	0	Verizon Building
	2.65	Building	0	Industrial Building
	2.68	Building	0	Industrial Building
	2.72	Residence	29	House
	2.74	Residence	32	House
	2.75	Residence	32	House
	2.76	Residence	30	House
	2.76	Residence	24	House
	2.77	Residence	37	House
	2.77	Residence	16	House
	2.79	Residence	38	House

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TABLE F-1 (cont'd)

Residences and Other Structures Within 50 Feet of the Construction Work Area for the Logan Lateral Project

State	Milepost	Feature	Distance from Edge of Construction ROW (ft.)	Description
	2.80	Residence	22	House
	2.82	Residence	30	House
	2.82	Residence	34	House
	2.82	Residence	30	House
	2.84	Residence	4	House
	2.86	Residence	31	House
	2.86	Residence	34	Duplex
	2.87	Residence	34	House
	2.88	Residence	20	House
	2.89	Residence	30	House
	2.90	Residence	32	House
	2.90	Residence	28	Duplex
	2.91	Residence	34	House
	2.92	Residence	0	House
	2.93	Residence	0	House
	3.03	Residence	25	House
	3.05	Residence	23	House
	3.07	Residence	17	House
	3.10	Residence	30	House
	3.15	Residence	10	House
	3.17	Residence	10	House
	3.71	Building	9	Industrial Building
	3.75	Residence	10	House
	3.78	Residence	8	House
	3.78	Residence	2	House
	3.79	Residence	7	House
	3.82	Residence	6	House
	3.82	Residence	46	House
	3.84	Residence	6	House
	3.89	Residence	8	House
	3.94	Residence	4	House
	3.96	Residence	0	House
	4.44	Residence	43	House
NEW JERSEY	7.23	Residence	10	House

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APPENDIX G

REFERENCES AND CONTACTS

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REFERENCES AND CONTACTS

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APPENDIX H

LIST OF PREPARERS

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APPENDIX H

LIST OF PREPARERS

Federal Energy Regulatory Commission

Kopka, Robert J. – Project Manager, Geology, Soils, Vegetation, Water Resources, Wetlands, Land Use, Alternatives
M.S., Soil Science, 1990, Cornell University
B.S., Agronomy, 1987, Delaware Valley College of Science and Agriculture

Boros, Laurie - Cultural Resources
B.A., Anthropology/Archaeology, 1980, Queens College, C.U.N.Y.

Thomas, Hugh V. – Reliability and Safety
M.E., Mechanical/Environmental Engineering, 1999, University of Maryland
B.S., Mechanical Engineering, 1991, University of Maryland
B.S., Physical Science, 1990, Salisbury State University

Laffoon, Danny – Fisheries, Wildlife, Threatened and Endangered Species
B.S., Fisheries and Wildlife, 2000, Virginia Polytechnic Institute and State University

Lykens, Alisa – Wildlife, Threatened and Endangered Species
B.S., Biology, 1986, Old Dominion University

Suter, Phillip – Air Quality, Noise, Reliability and Safety
B.S., Chemical Engineering, 2004, Pennsylvania State University

Zerby, Chris M. – Reliability and Safety
M.S., Civil Engineering, 1974, University of Maryland
B.S., Mechanical Engineering, 1970, Lehigh University

Natural Resource Group, Inc.

Brown, Larry – Technical Director, Alternatives
B.S., Biology, 1981, Bates College

Duncan, Randy - Project Manager, Project Description
M.S., Water Resources Management (Aquatic Biology), 1982, University of Wisconsin
B.A., Biology, 1978, Luther College

Bednarczyk, Paul – Socioeconomics
B.S., Applied Economics and Management (Environmental and Resource Economics), 2001, Cornell University

Braun, Bill - Geology, Groundwater
M.S., Course Work, Geology, 1980-1983, South Dakota School of Mines and Technology
B.A., Earth Sciences, 1980, St. Cloud State University

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Hargrove, Ross - Vegetation
B.S., Forest Resources, 2000, University of Minnesota

Jensen, Bart – Surface Water, Wetlands
B.S., Natural Resources and Environmental Studies, 1992, University of Minnesota

Lee, Jennifer - Land Use, Transportation, Recreation, Special Interest Areas, Visual Resources
B.A., Environmental Studies and Geography, 1995, University of St. Thomas

McGregor, Randy - Graphics
M.S., Geography, 1996, St. Cloud State University
B.A., International Studies, 1988, University of Washington

Mordorski, Paul - Air Quality, Noise
B.S., Chemical Engineering, 1999, University of Minnesota

Robblee, Patrick - Cultural Resources
M.A., Anthropology with a specialization in Historical Archaeology, 1995, College of William and Mary in Virginia
B.A., Anthropology, 1993, University of Massachusetts at Amherst

Thommes, Jeffrey – Deputy Project Manager, Wildlife and Aquatic Resources, Special Status Species
M.S., Zoology (Wildlife Ecology), 1994, Southern Illinois University
B.S., Zoology, 1992, Southern Illinois University

Timpson, Mike – Soils, Sediments
Ph.D., Plant and Soil Science, 1992, University of Tennessee
M.S., Soil Science, 1985, North Dakota State University
B.S., Natural Resources, 1982, University of Rhode Island

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