

Chesapeake & Delaware LLC

SYSTEM PIPELINE STANDARDS

Effective January 2, 2019

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Purpose

The primary purpose of these Chesapeake and Delaware System Pipeline Standards (Standards) is to provide Applicants the necessary information to design and construct pipelines across and along Chesapeake and Delaware, LLC (Railroad) property.

These Standards shall apply to the design and construction of pipelines carrying flammable or nonflammable substances, as well as casings containing wires and cables, across and along Railroad Property. These Standards shall also apply to other tracks over which Railroad operates its equipment.

It is to be clearly understood that the primary purpose of Railroad Property is to operate railroads. All occupancies shall, therefore, be designed and constructed so that rail operations and facilities are not interfered with, interrupted or endangered. In addition, the proposed Facility shall be located to minimize encumbrance to the Railroad Property so that Railroad shall have unrestricted use of its Railroad Property for current and future operations.

Prior to the commencement of construction, a License Agreement must be executed between the Railroad and Applicant to address maintenance responsibilities, liability and indemnification.

The following pages in these Standards include specifications, requirements, and recommendations for the design and construction of pipelines constructed across and along Railroad Property.

Notwithstanding any specifications contained herein, all materials and work shall meet all applicable AREA Engineering Requirements and Standards, as well as any local, state and federal regulations, guidelines and mandates.

Note: These Standards are subject to revision without notice.

Definitions

APPLICANT – Individual, corporation or municipality desiring occupancy of Railroad Property.

AREMA – American Railway Engineering and Maintenance-of-Way Association.

CARRIER PIPE – Pipe used to transport Product.

CASING PIPE – The pipe through which the Carrier Pipe is installed.

FACILITY/FACILITIES – Conduit, Carrier Pipe, cables, fibers, junctions, repeaters, terminals, power sources, attachments, structures or shelters, and all other necessary and appurtenant articles of personal property connected with, necessary for or useful to the construction, installation, operation, maintenance, repair, reinstallation, replacement, relocation and removal of the aforementioned, as installed by Applicant.

PRODUCT – A substance produced during a natural, chemical, or manufacturing process.

PROFESSIONAL ENGINEER – Engineer licensed in the state where the Facility is to be constructed.

RAILROAD – Chesapeake and Delaware, LLC, or any subsidiary company of Chesapeake and Delaware, LLC.

RAILROAD PROPERTY – Applies to any property owned, or operated under lease, by Railroad.

RAILROAD PROJECT REPRESENTATIVE – The Applicant’s primary contact person for the Railroad as provided at the onset of a project.

RIGHT OF WAY – Where used on Attachments to these Standards denotes the limits of Railroad Property.

“SHALL” – Where the term “shall” appears in these Standards, it is to mean that the information following is a requirement.

“SHOULD” – Where the term “should” appears in these Standards, it is to mean that the information following is a recommendation.

Pipeline Installation Process

Overview

The typical process for the installation of a new pipeline, or the modification of an existing pipeline, is:

1. Initial discussion between Applicant and Railroad
2. Application
3. Field survey
4. Development of a site plan
5. Development and execution of a License Agreement
6. Performance construction work
7. Final inspection

Initial Discussion between Applicant and Railroad

Applicant and Railroad will discuss the project and the Applicant's needs.

Application

Applicants desiring occupancy of Railroad Property must complete, and submit to Railroad, the required application.

To obtain the application for pipeline occupancy, please visit the following:
http://www.chesapeakeanddelaware.com/RealEstate_UtilityCrossings.html

Field Survey

Applicants shall conduct a field survey to accurately identify railroad track, utilities, structures, control points and topography prior to developing a site plan. The survey shall be conducted in compliance with the Railroad's Right of Entry permitting requirements, to be advised by Railroad.

Development of a Site Plan

Applicant shall develop a site plan and present the site plan to Railroad. Unless otherwise approved by Railroad, the site plan must adhere to the requirements of these Standards.

On extensive projects that are largely located off of Railroad Property, only those site plans involving work on, or affecting, Railroad Property and operations shall be submitted. Included in such applications shall be a site plan showing the extent of the total project, upon which the portion of the project that affects Railroad is clearly defined.

Pre-plan and pre-construction site inspections for pipeline crossings are not required unless, in the opinion of Railroad, the size and location of the Facility warrant an inspection.

Development and Execution of a License Agreement

A License Agreement shall be executed between Applicant and Railroad to set forth the conditions regulating construction, liability, insurance, clearances, and other standard requirements of Railroad while clearly delineating the division of ownership and maintenance point(s) for the Applicant's Facility. Following execution, and the demonstration of all required insurance, construction may proceed.

Performance of Construction Work

Applicant shall perform all construction work. All work must be performed in accordance with the approved site plan and by the terms of the License Agreement.

Final Inspection

Applicant shall notify Railroad upon completion of all Applicant construction work. Railroad shall inspect the construction to verify compliance with the approved site plan and these Standards, and shall provide written notice of any defects.

Safety and Environmental Permitting

Safety

The Railroad's highest priority is the safety of its employees, customers and the communities served by the Railroad. **BEFORE** entering Railroad Property for any purpose—including scouting, surveying, staking out or inspecting—the Applicant shall obtain a Right of Entry Permit. While on Railroad Property, Applicant shall be responsible for adhering to Railroad requirements for worker protection, as deemed necessary by Railroad.

For more information on obtaining a Right of Entry Permit, please visit the following:
http://www.chesapeakeanddelaware.com/RealEstate_Access.html

It is to be clearly understood that the issuance of an entry permit **DOES NOT** constitute authority to proceed with any construction. Construction shall not begin until a formal agreement is executed between Applicant and Railroad and the Applicant receives permission from Railroad to proceed with the work.

Environmental Permitting

Applicant shall be responsible for all required environmental permitting and stormwater management planning for the project, including work on Railroad Property. If it is determined that wetland and/or stream delineation is required on Railroad Property for permit application(s), the Applicant *shall* contact the Railroad Project Representative *prior to the performance of the delineation*. Upon completion of any environmental field delineation, Applicant shall provide Railroad with copies of all data, notes, photographs, and/or other information related to the delineation and shall provide a copy of any draft report(s) prepared for submittal to any governmental entity, court, or third party prior to submittal for Railroad review and comment. Applicant shall maintain all information regarding such information as confidential except as required for the purpose of obtaining permit(s).

General Pipeline Requirements

Use of a Casing Pipe

A casing pipe shall be required for all pipeline crossings carrying liquid flammable or non-flammable substances under pressure.

For flammable and nonflammable gas pipelines the casing pipe may be omitted provided the carrier pipe meets the requirements provided in the AREMA manual Chapter 1, Part 5, Section 5.2.3. Railroad may require use of a casing pipe at locations where increased risks from specific site conditions (track speed, traffic density, etc.) are present.

For non-pressure sewer or drainage crossings, where the installation can be made by open cut (see “**Pipeline Construction Requirements – Method of Installation**”) the casing pipe may be omitted.

Pressure pipelines that do not cross under a track but are located within 25 feet (7.6m) of the centerline of any track, or closer than 45 feet (13.7m) to nearest point of any bridge, building or other important structure, shall be encased.

The casing pipe shall be laid across the entire width of Railroad Property, except where a greater length is required to comply with “**Pipeline Design Requirements – Casing Pipe**” of these Standards, even though such extension is beyond the Railroad Property. For non-pressure sewer or drainage crossing, where a casing is used for carrier pipe installation purposes only, the casing need only to extend from the boring pit to the receiving pit.

Location of Pipeline on Railroad Property

Pipelines laid longitudinally on Railroad Property shall be located as far as practicable from any railroad tracks or other important structures and as close to the Railroad property line as possible. Longitudinal pipelines must not be located in earth embankments or within ditches located on Railroad Property.

Pipelines shall be located, where practicable, to cross tracks at approximate right angles to the track, but preferably at not less than 45 degrees.

Pipelines shall not be placed within a culvert, under railroad bridges, nor closer than 50 feet (15.2 m) to any portion of any railroad bridge, building, or other important structure, except in special cases, and then by special design, as approved by Railroad.

Pipelines shall not be located within the limits of a turnout (switch) when crossing the track. The limits of the turnout extend from the point of the switch to the last long timber.

Pipeline installations shall not be designed as an open cut installation where the pipeline is to be located within the limits of a grade crossing. If it is shown that no other method

of installation is possible, the Applicant shall be responsible for reimbursing Railroad for all costs associated with the removal and reconstruction of the grade crossing.

Pipelines carrying liquefied petroleum gas shall, where practicable, cross Railroad where the tracks are carried on embankment.

Uncased gas pipelines must not be located within 25 feet (7.6m) of any track.

Depth of Installation

Pipelines Conveying Non-Flammable Substances

Casing/carrier pipes placed under any track(s) shall be not less than 5 1/2 feet (1.7m) from base of rail to top of pipe at its closest point. On any other portion of Railroad Property, where the pipe is not directly beneath any track, the depth from ground surface shall be 4 feet (1.2m) or from bottom of ditch to top of pipe shall not be less than 3 feet (0.9m).

Pipelines laid longitudinally on Railroad Property, 50 feet (15.2m) or less from the centerline of a track, shall be buried not less than 4 feet (1.2m) from ground surface to top of pipe. Where the pipeline is laid more than 50 feet (15.2m) from the centerline of a track, the minimum cover shall be at least 3 feet (0.9m).

Pipelines Conveying Flammable Substances

Casing pipes under any track(s) shall be not less than 5 1/2 feet (1.7m) from base of rail to top of pipe at its closest point. On other portions of Railroad Property, where the pipe is not directly beneath any track, the depth from ground surface shall be 4 feet (1.2m) or from bottom of ditch to top of pipe shall not be less than 3 feet (0.9m).

Uncased gas pipelines, under any track(s), shall not be less than 10 feet (3.0m) from the base of rail to the top of the pipe at its closest point. At all other locations where crossing Railroad Property, the minimum ground cover must be 6 feet (1.8m). Where it is not possible to obtain the above depths, use of a casing pipe shall be required.

Pipelines laid longitudinally on Railroad Property, 50 feet (15.2m) or less from centerline track, shall be buried not less than 6 feet (1.8m) from ground surface to top of pipe. Where the pipeline is laid more than 50 feet (15.2m) from the centerline of a track, the minimum cover shall be at least 5 feet (1.5m).

Pipelines Within Limits of a Dedicated Highway

Pipelines within the limits of a dedicated highway are subject to all the requirements of these Standards and must be designed and installed in accordance with them.

The limits of the dedicated highway (right-of-way) must be clearly shown on the site plan.

Modification of Existing Facility

Any replacement or modification of an existing carrier pipe and/or casing shall be considered as a new installation, subject to the requirements of these Standards.

Abandoned Facility

The Applicant of all abandoned pipeline crossings and other occupancies shall notify Railroad in writing, of the intention to abandon.

Abandoned pipelines shall be removed unless otherwise approved by Railroad.

Conflict of Standards

Where laws or orders of public authority prescribe a higher degree of protection than specified herein, then the higher degree so prescribed shall be deemed a part of these Standards.

Insulation

Pipelines and casings shall be suitably insulated from underground conduits carrying electric wires on Railroad Property.

Corrosion Protection and Petroleum Leak Prevention

Pipelines on Railroad Property that carry petroleum Product or hazardous liquids shall be designed in accordance with current federal, state and/or local regulations as they mandate leak detection automatic shutoff, leak monitoring, and sacrificial anodes and/or exterior coatings to minimize corrosion and prevent petroleum releases.

Soil Investigation

General

Test borings, or other soil investigations approved by Railroad, shall be made to determine the nature of the underlying material for all pipe crossings 60 inches (1524mm) in diameter and larger under track(s).

Test borings, or other soil investigations approved by Railroad, may be required when, in the judgment of Railroad, they are necessary to determine the adequacy of the design and construction of pipe crossings less than 60 inches (1524mm) in diameter, and for other Facilities located on Railroad Property.

Location

Borings shall be made on each side of any track(s), on the centerline of the pipe crossing, and as close to any track(s) as practicable. Test boring logs shall be accompanied with a plan, drawn to scale, showing the location of the borings in relation to any track(s) and the proposed pipe.

Sampling

Test borings shall be made in accordance with current ASTM Designation D 1586, except the sampling must be continuous from the ground surface to 5 feet (1.5m) below the proposed invert unless rock is encountered before this depth. Where rock is encountered, it is to be cored using a Series “M” double Tube Core Barrel, with a diamond bit, capable of retrieving a rock core at least 1 5/8” (41.3mm) in diameter. Individual core runs are not to exceed 5 feet (1.5m) in length.

Boring Logs

Test boring logs shall comply with *CAD Plan “Plate VIII”* and shall clearly indicate all of the following:

1. Boring number as shown on the required boring location plan.
2. Ground elevation at each boring using same datum as the pipeline construction plans.
3. Engineering description of soils or rock encountered.
4. Depth and percent recovery of all soil samples.
5. Depth from surface for each change in strata.
6. Blows for each 6 inches (152mm) of penetration for the standard penetration test described in ASTM D 1586. Blows for lesser penetrations should be recorded.
7. Percent recovery and Rock Quality Designation (RQD) for all rock cores.
8. Depth to ground water while sampling and when it has stabilized in the bore hole.

The location of the carrier pipe and/or casing pipe shall be superimposed on the boring logs before submission to Railroad.

All borings shall be sealed, for their full depth, with a 4-3-1 bentonite-cement-sand grout after accurate ground water readings have been taken and recorded.

Soil samples taken from auger vanes or return washwater are not acceptable.

Additional Information

When directed by Railroad, additional borings may be required for the purpose of taking undisturbed thinwall piston samples or Dennison type samples for laboratory testing to determine the index and engineering properties of certain soil strata.

Pipeline Design Requirements

Design Loads

General Design Load Requirements

All pipes, manholes and other similar Facilities shall be designed for the external and internal loads to which they will be subjected.

To allow for placement of additional track(s) or shifting of the existing track(s), all proposed pipelines or structures shall be designed as if a railroad loading is directly above the Facility.

Earth Load

The dead load of the earth shall be considered as 120 pounds per cubic foot (18.9 kN/m³) unless soil conditions warrant the use of a higher value.

Railroad Load (Live Load Impact)

The railroad live load used shall be a Cooper E-80 loading. This loading consists of 80 kip (356 kN) axle loads spaced 5 feet (1.5m) on centers.

An impact factor of 1.75 (multiply live load by the impact factor) shall be used for depth of cover up to 5 feet (1.5m). Between 5 and 30 feet (1.5 and 9.1m), the impact factor is reduced by 0.03 per foot (0.1 per m) of depth. Below a depth of 30 feet (9.1m), the impact factor is one.

The values shown in **Table 1** shall be used for the vertical pressure on a buried structure for the various heights of cover.

Table 1
Live loads, including impact, for various heights of cover for a Cooper E-80 loading.

Height of Cover		Load	
Feet	(meter)	lb/sq ft	(kPa)
2	(0.6)	3800	(162.8)
3	(0.9)	3150	(150.8)
4	(1.2)	2850	(136.5)
5	(1.5)	2550	(122.1)
6	(1.8)	2250	(107.7)
7	(2.1)	1950	(93.4)
8	(2.4)	1700	(81.4)
9	(2.7)	1500	(71.8)
10	(3.0)	1300	(62.2)
12	(3.7)	1000	(47.9)
14	(4.3)	800	(38.3)
16	(4.9)	625	(29.9)
18	(5.5)	500	(23.9)
20	(6.1)	400	(19.2)
25	(7.6)	250	(12.0)
30	(9.1)	150	(7.2)

To determine the horizontal pressure caused by the railroad loading on a sheet pile wall or other structure adjacent to the track, the Boussinesq analysis shall be used. The load on the track shall be taken as a strip load with a width equal to the length of the ties, 8 1/2 feet (2.6m). The vertical surcharge, q (psf), caused by each axle, shall be uniform and equal to the axle load divided by the tie length and the axle spacing, 5 feet (1.5m). For the E-80 loading results in:

$$Q = 80,000 / (8.5 \times 5) = 1882 \text{ psf.} \quad (q = 356 / (2.591 \times 1.524) = 90.1 \text{ kPa})$$

The horizontal pressure due the live load surcharge at any point on the wall or other structure is p_h and can be calculated by the following:

$$p_h = (2q/\pi) (\beta - \sin \beta (\cos 2\alpha)) \quad (\text{See CAD Plan "Plate IX"})$$

The vertical and horizontal pressures given above shall be used unless an alternate design method is approved by Railroad. Proposals to use an alternate design method must include acceptable references and a statement explaining the justification for choosing the alternate method.

Design Assumptions

To design a casing pipe or an uncased carrier pipe for the external loads on Railroad Property, the following design assumptions shall be used, unless site conditions indicate more conservative values are required:

Flexible Pipe (Steel, DIP, CMP, Tunnel Liner Plate)

Steel Pipe (Bored and jacked in place)

Spangler's Iowa formula shall be used for design with:

- | | | | |
|----------------------------------|---|-------------------------|------------|
| (a) Deflection lag factor | - | $D_f = 1.5$ | |
| (b) Modulus of soil reaction | - | $E' = 1080 \text{ psi}$ | (7.45 MPa) |
| (c) Bedding constant | - | $K_b = 0.096$ | |
| (d) Soil loading constant | - | $K_w = 0.13$ | |
| (e) Allowable deflection of pipe | - | 3% of pipe diameter | |

Ductile Iron Pipe (Open Cut)

ANSI Specification A 21.50 shall be used for design with:

- (a) Pipe laying condition = type 3 (see "**Pipeline Construction Requirements – Method of Installation**" for backfill requirements)
- (b) Earth load – ANSI A 51.50 prism method

Corrugated Steel Pipe & Corrugated Structural Steel Plate Pipe (Open Cut)

AREMA Chapter 1, Part 4, Sections 4.9 & 4.10 shall be used for design with:

- (a) Soil stiffness factor - $K = 0.33$
- (b) Railroad impact as per "**Pipeline Design Requirements – Design Loads**" of these Standards

Tunnel Liner Plate (Tunneled)

AREMA:

- (a) Soil stiffness factor - $K = 0.33$
- (c) Railroad impact as per "**Pipeline Design Requirements – Design Loads**" of these Standards

Casing Pipe

General Requirements

Casing pipe shall be so constructed as to prevent leakage of any substance from the casing throughout its length, except at ends of casing where ends are left open, or through vent pipes when ends of casing are sealed. Casing shall be installed so as to prevent the formation of a waterway under Railroad Property, and with an even bearing throughout its length, and shall slope to one end (except for longitudinal occupancy).

The casing pipe and joints shall be of steel and of leakproof construction when the pipeline is carrying liquid flammable Product or highly volatile substances under pressure.

The inside diameter of the casing pipe shall be such as to allow the carrier pipe to be removed subsequently without disturbing the casing or the roadbed. For steel pipe casings, the inside diameter of the casing pipe shall be at least 2 inches (51mm) greater than the largest outside diameter of the carrier pipe joints or couplings, for carrier pipe less than 6 inches (152 mm) in diameter; at least 4 inches (102 mm) greater for carrier pipe 6 inches (152mm) and over in diameter.

For flexible casing pipe, a maximum vertical deflection of the casing pipe of 3 percent of its diameter, plus 1/2 inch (13mm) clearance shall be provided so that no loads from the roadbed, track, traffic or casing pipe itself are transmitted to the carrier pipe. When insulators are used on the carrier pipe, the inside diameter of the flexible casing pipe shall be at least 2 inches (51 mm) greater than the outside diameter of the carrier pipe for pipe less than 8 inches (203 mm) in diameter; at least 3 1/4 inches (83 mm) greater for pipe 8 inches to 16 inches (203 mm to 406 mm), inclusive, in diameter and at least 4 1/2 inches (114 mm) greater for pipe 18 inches (457 mm) and over in diameter.

In no event shall the casing pipe diameter be larger than is necessary to permit the insertion of the carrier pipe.

Casing pipe under and across Railroad Property shall extend the **GREATER** of the following distances, measured at right angle to centerline of track:

1. Across the entire width of the Railroad Property
2. 3 feet (0.9m) beyond ditch line
3. 2 feet (0.6m) beyond toe of slope
4. A minimum distance of 25 feet (7.6m) from each side of the centerline of an outside track when casing is sealed at both ends
5. A minimum distance of 45 feet (12.7m) from the centerline of an outside track when casing is open at both ends
6. Beyond any theoretical railroad embankment line. (This line begins at a point, on existing grade, 14 feet (4.26m) horizontally from centerline track and extends downward on a 2 (H) to 1 (V) slope. (See *CAD Plan "Plate III"*) The 14 feet is measured from 19 inches below the base of the rail)

If additional tracks are constructed in the future, the casing shall be extended correspondingly at the Applicant's expense.

Steel Casing Pipe

Steel casing pipe may be installed by open cut, boring or jacking.

Chesapeake and Delaware System Pipeline Standards

Steel pipe shall have a specified minimum yield strength, SMYS, of at least 35,000 psi (241 MPa). The ASTM or API specification and grade for the pipe are to be shown on the data sheet meeting the requirements of **CAD Plan “Plate I”**.

Joints between the sections of pipe shall be fully welded around the complete circumference of the pipe.

Steel casing pipe, with a minimum cover of 5 1/2 ft. (1.7m), shall have a **MINIMUM** wall thickness as shown in **Table 2**, unless computations indicate that a thicker wall is required.

Table 2

Pipe Diameter		Coated or Cathodically Protected		Uncoated and Unprotected	
Nominal Pipe Size		Nominal Wall Thickness		Nominal Wall Thickness	
Inches	(mm)	Inches	(mm)	Inches	(mm)
10 and under	(254 & under)	0.188	(4.78)	0.188	(4.78)
12 & 14	(305 & 356)	0.188	(4.78)	0.250	(6.35)
16	(406)	0.219	(5.54)	0.281	(7.14)
18	(457)	0.250	(6.35)	0.312	(7.92)
20 & 22	(508 & 559)	0.281	(7.14)	0.344	(8.74)
24	(610)	0.312	(7.92)	0.375	(9.53)
26	(660)	0.344	(8.74)	0.406	(10.31)
28	(711)	0.375	(9.53)	0.438	(11.07)
30	(762)	0.406	(10.31)	0.469	(11.91)
32	(813)	0.438	(11.07)	0.500	(12.70)
34 & 36	(864 & 914)	0.469	(11.91)	0.532	(13.49)
38	(965)	0.500	(12.70)	0.562	(14.27)
40	(1016)	0.531	(13.49)	0.594	(15.09)
42	(1067)	0.562	(14.27)	0.625	(15.88)
44 & 46	(1118 & 1168)	0.594	(15.09)	0.657	(16.66)
48	(1219)	0.625	(15.88)	0.688	(17.48)
50	(1270)	0.656	(16.66)	0.719	(18.26)
52	(1321)	0.688	(17.48)	0.750	(19.05)
54	(1372)	0.719	(18.26)	0.781	(19.84)
56 & 58	(1422 & 1473)	0.750	(19.05)	0.812	(20.62)
60	(1524)	0.781	(19.84)	0.844	(21.44)
62	(1575)	0.812	(20.62)	0.875	(22.23)
64	(1626)	0.844	(21.44)	0.906	(23.01)
66 & 68	(1676 & 1727)	0.875	(22.23)	0.938	(23.83)
70	(1778)	0.906	(23.01)	0.969	(24.61)
72	(1829)	0.938	(23.83)	1.000	(25.40)

Coated steel pipe that is bored or jacked into place shall conform to the wall thickness requirements for uncoated steel pipe since the coating may be damaged during installation.

Smooth wall steel pipes with a nominal diameter over 72 inches (1829 mm) shall not be permitted.

Ductile Iron Casing Pipe

Ductile iron casing pipe may be used only when placed by the open cut method. Jacking or boring through a Railroad embankment is not permitted due to the bell and spigot joints.

Ductile iron pipe shall conform to the requirements of ANSI A21.51/AWWA C-151. Class 56 pipe shall be used unless computations, in accordance with “**Pipeline Design Requirements – Design Loads**” and “**Pipeline Design Requirements – Design Assumptions**”, are provided.

Table 3 is based on the design assumptions given in “**Pipeline Design Requirements – Design Assumptions**”, with a minimum cover of 5 1/2 ft. (1.7m). **Table 3** is provided for information only.

Table 3

Pipe Diameter		Thickness Class			Pressure Class		
		Wall thickness		Class	Wall thickness		Class
Inches	(mm)	Inches	(mm)		Inches	(mm)	
3	(89)	0.25	(6.35)	51	0.25	(6.35)	350
4	(114)	0.26	(6.60)	51	0.25	(6.35)	350
6	(168)	0.25	(6.35)	50	0.25	(6.35)	350
8	(219)	0.27	(6.86)	50	----	----	----
10	(273)	0.32	(8.13)	51	----	----	----
12	(324)	0.34	(8.64)	51	----	----	----
14	(356)	0.39	(9.91)	52	----	----	----
16	(406)	0.40	(10.2)	52	----	----	----
18	(457)	0.44	(11.2)	53	----	----	----
20	(508)	0.45	(11.4)	53	----	----	----
24	(610)	0.53	(13.5)	55	----	----	----
30	(762)	0.63	(16.0)	56	----	----	----
36	(914)	0.73	(18.5)	56	----	----	----
42	(1067)	0.83	(21.1)	56	----	----	----
48	(1219)	0.93	(23.6)	56	----	----	----
54	(1372)	1.05	(26.7)	56	----	----	----

The pipe shall have mechanical or restrained type joints.

Corrugated Steel Pipe and Corrugated Structural Steel Plate Pipe Casing

Corrugated steel pipe and corrugated structural steel plate pipe may be used for a casing only when placed by the open cut method. Jacking or boring through a Railroad embankment is not permitted.

Corrugated steel pipe and corrugated structural steel plate pipe may be used for a casing provided the pressure in the carrier pipe is less than 100 psi (689 kPa).

Pipe shall be bituminous coated and shall conform to the current AREMA Specifications Chapter 1, Part 4.

Corrugated steel pipe shall have a minimum sheet thickness as shown in **Table 4**. Corrugated structural steel plate pipe shall have a minimum plate thickness of 8 gage, 0.168 in. (4.27mm). If computations indicate that a greater thickness is required, the thicker sheet or plate shall be used.

Table 4

Pipe Diameter		Sheet Thickness		
Inches	(mm)	Gage	Inches	(mm)
12 to 30	(305 to 762)	14	0.079	(2.01)
36	(914)	12	0.109	(2.77)
42 to 54	(1067 to 1372)	10	0.138	(3.51)
60 to 120	(1524 to 3048)	8	0.168	(4.27)

Steel Tunnel Liner Plates

Liner plates shall be installed by the tunneling method as detailed in “**Pipeline Construction Requirements – Method of Installation**”.

Tunnel liner plates shall be galvanized and bituminous coated and shall conform to current AREMA Specification Chapter 1, Part 4, Section 4.16. If the tunnel liner plates are used only to maintain a tunneled opening until the carrier pipe is installed, and the annular space between the carrier pipe and the tunnel liner is completely filled with cement grout within a reasonably short time after completion of the tunnel, then the tunnel liner plates need not be galvanized and coated.

Tunnel liner plates are to be a minimum of 12 gage and shall be fabricated from structural quality, hotrolled, carbon-steel sheets or plates conforming to ASTM Specification A 569.

The following liner plate information must be shown on **CAD Plan “Plate I”**:

1. Number of flanges (2 or 4)
2. Width of plate

3. Type of plate (smooth or corrugated)

Concrete Encasement

At locations where the installation is by open cut and a casing pipe is required, but can not be installed due to elbows or other obstructions, concrete encasement may be used when approved by Railroad.

The concrete encasement must provide a minimum cover of 6 inches of concrete (152 mm) around the pipe. A 6 x 6 – W 2.9 x W 2.9 (152 x 152 MW 18.7 x MW 18.7) welded wire fabric shall be placed in the concrete on all sides.

Carrier Pipe

General Requirements

The pipe shall be laid with sufficient slack so that it is not in tension.

Steel pipe shall not be used to convey sewage, storm water or other liquids that could cause corrosion.

Carrier pipes located on Railroad Property shall be manufactured in accordance with the following specifications:

1. Steel Pipe – The ASTM or API specification and grade for the pipe is to shown on ***CAD Plan “Plate I”***. The specified minimum yield strength is to be at least 35,000 psi (241 MPa). Flammable substances have additional requirements as otherwise noted in these Standards.
2. Ductile Iron Pipe – ANSI A21.51/AWWA C151
3. Corrugated Metal Pipe – AREMA Chapter 1, Part 4

Carrier pipes installed within a casing pipe shall be designed for the internal pressure to which it will be subjected.

Gravity flow carrier pipes, installed without a casing pipe, shall meet the requirements, of the particular pipe material, as given in **“Pipeline Design Requirements – Casing Pipe”**.

Design computations, stamped by a Professional Engineer, must be submitted for all uncased pressure pipelines installed on Railroad Property. The pipe must be designed for the internal and external loads (see **“Pipeline Design Requirements – Design Loads”**) to which it may be subjected. The design assumptions given in **“Pipeline Design Requirements – Design Assumptions”** shall apply.

Flammable Substance Carrier Pipes

Pipelines carrying oil, liquefied petroleum gas and other flammable Product shall be of steel and conform to the requirements of the current ANSI B 31.4 Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols, and other applicable ANSI codes, except that the maximum allowable stresses for design

of steel pipe shall not exceed the following percentages of the specified minimum yield strength (multiplied by the longitudinal joint factor) of the pipe as defined in the above codes:

1. The following percentages apply to hoop stress in steel pipe within a casing under Railroad Property and longitudinally to Railroad Property:
 - a. 72% on oil pipelines.
 - b. 50% for pipelines carrying condensate, natural gasoline, natural gas liquids, liquefied petroleum gas, and other liquid petroleum Product.
 - c. 60% for installations on gas pipelines.
2. The following percentages apply to hoop stress in steel pipe laid longitudinally on Railroad Property without a casing:
 - a. 60% for oil pipelines.
 - b. 40% for pipelines carrying condensate, natural gasoline, natural gas liquids, liquefied petroleum gas, and other liquid petroleum Product.
 - c. See “**Uncased Gas Carrier Pipes**” (below) for gas pipelines.

Computations based on the above requirements, and stamped by a Professional Engineer, shall be submitted with the application occupancy.

Uncased Gas Carrier Pipes

Pipelines carrying flammable and nonflammable gas Product shall be steel and shall conform to the requirements of the current ANSI B 31.8 Gas Transmission and Distribution Piping Systems, and other applicable ANSI codes.

The minimum wall thickness for uncased carrier pipe shall be in accordance with the values provided in AREMA, Chapter 1, Part 5, Section 5.2, Tables 5.2.3 (a through j).

A durable coating, which will resist abrasion (fusion bonded epoxy or other suitable material), shall be used to protect the uncased pipeline when the boring method of installation is used.

If Railroad determines there is the potential for damage to the uncased pipeline (foreign material in the subgrade, third party damage, etc.) special protection of the pipeline shall be required. Special protection may include the use of a protection slab over the pipeline, increased depth of bury or other means.

Casing Pipe End Seals

Casings for carrier pipes of flammable and hazardous substances shall be suitably sealed to the outside of the carrier pipe. Details of the end seals shall be shown on the plans.

Casings for carrier pipes of non-flammable substances shall have both ends of the casing blocked up in such a way as to prevent the entrance of foreign material, but allowing leakage to pass in the event of a carrier break.

The ends of a casing pipe may be left open when the ends are at or above ground surface and above high water level, provided drainage is afforded in such a manner that leakage shall be conducted away from railroad tracks and structures.

Vents

Sealed casings for flammable substances shall be properly vented. Vent pipes shall be of sufficient diameter, but in no case less than two inches (51mm) in diameter, and shall be attached near each end of the casing and project through the ground surface at property lines or not less than 45 feet (13.7m), measured at right angles from centerline of nearest track.

Vent pipes shall extend not less than 4 feet (1.2m) above the ground surface. Top of vent pipe shall have a down-turned elbow, properly screened, or a relief valve. Vents in locations subject to high water shall be extended above the maximum elevation of high water and shall be supported and protected in a manner approved by Railroad.

Vent pipes shall be at least 4 feet (1.2m), vertically, from aerial electric wires or greater if required by national Electrical Safety Code (ANSI C2).

When the pipeline is in a public highway, street-type vents shall be installed.

Signs

All pipelines (except those in streets where it would not be practical to do so) shall be prominently marked at property lines (on both sides of track for crossings) by durable, weatherproof signs located over the centerline of the pipe. Signs shall show the following:

1. Name and address of owner
2. Contents of pipe
3. Pressure in pipe
4. Pipe depth below grade at point of a sign
5. Emergency telephone number in event of pipe rupture

For pipelines running longitudinally on Railroad Property, signs shall be placed over the pipe (or offset and appropriately marked) at all changes in direction of the pipeline. Such signs should also be located so that when standing at one sign the next adjacent marker in either direction is visible. In no event shall they be placed more than 300 feet (100m) apart unless otherwise specified by Railroad.

The Applicant shall maintain all signs on Railroad Property as long as the occupational agreement is in effect.

Warning Tape

All pressure pipelines installed by the trench method, without a casing, shall have a warning tape placed directly above the pipeline, 2 feet (0.6m) below the ground surface.

Shut-off Valves

Easily accessible emergency shut off valves shall be installed within effective distances on each side of Railroad Property, and at locations selected by Railroad, where hazard to life and property must be guarded against. No additional valves will be required where pipelines are provided with automatic control stations and within distances approved by Railroad.

Cathodic Protection

Cathodic protection shall be applied to all pipelines carrying flammable substances on Railroad Property.

For crossings and at other locations where the pipeline must be placed within a casing, the casing is to have Cathodic protection or the wall thickness is to be increased to the requirements of “**Pipeline Design Requirements – Casing Pipe – Steel Casing Pipe – Table 2**”.

Uncased gas carrier pipes must be coated and Cathodically protected to industry standards and test sites, for monitoring the pipeline, provided within 50 feet (15.2m) of the crossing.

Where casing and/or carrier pipes are Cathodically protected by other than anodes, Railroad shall be notified and a suitable test made to ensure that other Facilities are adequately protected from the Cathodic current in accordance with the recommendation of current Reports of Correlating committee on Cathodic Protection, published by the National Association of Corrosion Engineers.

Where sacrificial anodes are used the locations shall be marked with durable signs.

Manholes

Manholes shall not be located on Railroad Property where possible. At locations where this is not practical, including longitudinal occupancies, manholes shall be precast concrete sections conforming to ASTM Designation C 478, “Specification for Precast Concrete Manhole Sections”.

The top of manholes located on Railroad Property shall be flush with the top of ground.

The distance from centerline of adjacent track to centerline of proposed manhole shall be shown on the plans.

Box Culverts

Reinforced concrete box culverts shall conform to the requirements of AREA Chapter 8, Parts 13 and 16.

Drainage

Occupancies shall be designed, and their construction shall be accomplished, so that adequate and uninterrupted drainage of Railroad Property is maintained.

All pipes, ditches and other structures carrying surface drainage on Railroad Property shall be designed to carry the run-off from a one hundred (100) year storm. Computations indicating this design, prepared by a Professional Engineer, and suitable topographic plans, outlining the total drainage area, shall be submitted to Railroad for approval.

If the drainage is to discharge into an existing drainage channel on Railroad Property and/or through a drainage structure under Railroad Property, the computations must include the hydraulic analysis of any existing ditch and/or structure.

When calculating the capacity of existing or proposed drainage structures, under Railroad Property, the headwater at the structure shall not be greater than 1.5.

Pipe(s) used to carry surface drainage on Railroad Property shall have a minimum diameter of 36 inches.

Detention ponds must not be placed on any part of Railroad Property. Also, the railroad embankment must not be used as any part of a detention pond structure.

Formal approval of the proposed design, by the appropriate governmental agency having jurisdiction, shall be submitted with the drainage computations.

Pipelines on Bridges

Pipelines of any types shall not be installed on any bridge carrying tracks owned or operated by Railroad.

New overhead pipe bridges shall not be constructed over Railroad Property where underground installation of the pipeline is possible. Where the Applicant can show that no practicable alternative is available, this type of structure will be permitted provided the following conditions are met:

1. The vertical clearance, distance from top of rail to bottom of structure, is shown and is a minimum of 23 feet (7.01m), measured at a point 6 feet (1.83 m) horizontally from centerline track.

Chesapeake and Delaware System Pipeline Standards

2. The support bents for the overhead structure are located off of Railroad Property or a minimum clear distance of 18 feet (5.5 m) from centerline track, whichever distance is greater.
3. Support bents within 25 feet (7.6 m) of centerline track have pier protection in accordance with AREA, Chapter 8, Part 2, Section 2.1.5.
4. Complete structural plans and design computations for the structure and foundations, stamped by a Professional Engineer, are submitted with the application.
5. A fence (with barbed wire) or other measures are provided which will prevent access to the bridge by unauthorized personnel or vandals.

Pipelines carrying flammable substances or non-flammable substances, which by their nature might cause damage if escaping on or near railroad Facilities or personnel, shall not be installed on bridges over Railroad Property. In special cases when it can be demonstrated to Railroad's satisfaction that such an installation is necessary and that no practicable alternative is available, Railroad may permit the installation.

When permitted, pipelines on bridges over Railroad Property shall be so located as to minimize the possibility of damage from vehicles, railroad equipment, vandalism and other external causes. They shall be encased in a casing pipe as directed by Railroad (See ***CAD Plan "Plate VII"***).

Field Survey

Field Survey Overview

An accurate field survey is of utmost importance for the development and approval of an acceptable site plan. In particular, the following five categories are important elements of Applicant surveys:

1. Railroad track
2. Utilities
3. Structures
4. Control points
5. Topography

Railroad Track

Proper depiction of the railroad track is essential to developing a workable design on the site plan. The following items shall be located and shown on site plans:

1. Centerline of existing tracks at top of rail
2. Nearest milepost and direction of increasing mileposts

Utilities

Utilities must be accurately depicted on site plans, as missed utilities can drastically alter a project. The following utility items shall be located and shown on the drawings:

1. Aerial utility and light poles, guy wires, and guy poles
2. Natural gas line (valves, markers, and/or vents)
3. Telephone or fiber optic lines (junction boxes, or markers)
4. Water lines (taps, valves, meters, markers)
5. Sewer lines (taps, cleanouts, manholes, markers)
6. Storm water facilities (inlets, outfalls, catch basins, manholes)

Overhead wires should be surveyed for their elevation at the point at which they cross any existing tracks, if applicable. Their location and elevation should also be determined at the point of their greatest sag and referenced to the corresponding existing ground elevation along with an additional point at the centerline of all tracks.

Structures

Structures, existing and / or proposed, have the potential to adversely impact clearances and feasibility. The following items shall be shown on the plans with clearances measures to the centerline of track:

1. Doorways, sides and top
2. Corners of docks and finished floor elevations
3. Fences and gates
4. Unloading pits and scales, inside and outside walls
5. Corners/sides of buildings and finished floor elevations
6. Roadways
7. Retention pond levees and drainage structures
8. Retaining walls
9. Utility poles for side clearances
10. Overhead and under grade bridges
11. Signals and signal structures including AEI tag readers, hot box detectors, dragging equipment detectors, pedestals, signal pole lines, and bungalows
12. Other structures that might impact clearances

Control Points

All control points established or found during the course of the field survey shall be shown and labeled with description (PK nail, iron pin, survey monument, etc.) and NEZ coordinates based on the controlling datum. The controlling datum shall be identified in the corresponding NAD83, NGVD88 state plane coordinate system for the project site, allowing the Railroad to incorporate the project into the pertinent GIS database.

Real estate information, such as property pins or corners, should also be collected and shown on the plans.

Topography

Although the Railroad does not typically require submittal of complete grading plans, the collection of adequate ground shots to accurately depict the nature of the ground topography and drainage features is important. Large or sudden changes in ground topography adjacent to proposed Facilities must be measured and noted.

Site Plans

General Site Plan Information

Site plans for proposed pipeline occupancies shall be submitted to and approved by Railroad prior to Railroad issuance of a License Agreement, and prior to the start of construction.

Site plans shall be drawn to scale and shall include the pertinent Railroad Track, Utilities, Structures, Control Points and Topography information outlined in “**Field Survey**” of these Standards (also reference the attached **CAD Plan “Plates I”** through **CAD Plan “Plate VII”**).

Additional details must be shown on the site plan as follows:

1. The profile of the ground above the centerline of the pipeline from field survey showing relationship of the pipeline and/or casing pipe to the ground levels, the tracks and other Facilities (see **CAD Plan “Plate III”**). For longitudinal occupations, the top of rail profile of the adjacent track shall be shown on the pipeline profile (see **CAD Plan “Plate IV”**).
2. If the pipeline is in a public highway, the limits of the dedicated highway right-of-way, as well as the limits of any paving, sidewalks etc., shall be defined, by dimensions in feet (meters), from the centerline of the dedicated right-of-way.
3. The angle of the crossing in relation to the centerline of the tracks(s). (See **CAD Plan “Plate II”**)
4. On pipelines having valves, the distance in feet (meters) along the pipeline from the crossing to the nearest valves and/or control stations.

In all cases, the name of the State and County in which the proposed Facilities are located shall be shown. In States where Townships, Ranges and Sections are used, site plans shall show the distance in feet to the nearest Section line and identify the Section number, Township and Range.

A separate sheet meeting the requirements of **CAD Plan “Plate I”** shall be submitted for each proposed pipeline crossing.

Site plans shall be specific as to the:

1. Method of installation. (See “**Pipeline Construction Requirements – Method of Installation**”)
2. Size and material of the casing pipe. (See “**Pipeline Design Requirements – Casing Pipe**”)
3. Size and material of the carrier pipe. (See “**Pipeline Design Requirements – Carrier Pipe**”)

Note: These items **CAN NOT** have an alternative, and any application that is received that indicates options in any of the above items **WILL NOT BE PROCESSED**.

All site plans shall include a preliminary timeline for the performance of all work required to construct the Facilities described on the plan.

Once the application has been approved by Railroad, no variance from the site plans, specifications, method of installation, construction, etc., as approved in the License Agreement, will be considered or permitted without the payment to Railroad of additional fees for the re-processing of the application.

All site plans and computations associated with the work under the agreement shall be prepared by, and bear the seal of, a Professional Engineer. If not so imprinted, the application will be given no further consideration. This requirement also applies to all data submitted by any contractor of the Applicant.

Specifications

Project specifications, for all work on and affecting Railroad Property, shall be included with the submission. All pertinent requirements of this document shall be included.

Notice to Proceed

After approval of the plans and specifications, the execution of the License Agreement, and the payment of all required fees, the Applicant will be notified by Railroad. The Railroad will then coordinate all construction aspects of the project that relate to Railroad.

Railroad must be notified a minimum of fourteen (14) working days prior to desired start of construction.

Pipeline Construction Requirements

Method of Installation

General Requirements

Bored, jacked or tunneled installations shall have a bore hole essentially the same as the outside diameter of the pipe plus the thickness of the protective coating.

The use of water or other liquids to facilitate casing emplacement and spoil removal is prohibited.

If during installation an obstruction is encountered which prevents installation of the pipe in accordance with these Standards, the pipe shall be removed and the area occupied by the pipe shall be filled with grout (see “**Pipeline Construction Requirements – Grouting**”) and otherwise restored to its original condition, unless otherwise approved by Railroad. Before installation work can resume, a new installation procedure and revised plans must be submitted to, and approved by, Railroad.

Open Cut

The Applicant must request open cut approval when making application for occupancy.

Installations beneath the track by open trench methods will be permitted only after consideration by Railroad.

Installations by open cut will not be permitted under tracks owned or operated by Railroad except as specifically advised by Railroad. Open cut shall not be used within the limits of a highway/rail grade crossing or its approaches, 25 feet (7.6m) either side of traveled way, where possible.

At locations where open cut is permitted, the trench is to be backfilled with crushed stone with a top size of the aggregate to be a maximum of 2 inches (51mm) and to have no more than 5% passing the number 200 sieve. The gradation of the material is to be such that a dense stable mass is produced.

The backfill material shall be placed in loose 6 inch (152 mm) lifts and compacted to at least 95% of its maximum density with a moisture content that is no more than 1% greater than or 2% less than the optimum moisture as determined in accordance with current ASTM Designation D – 1557 (Modified Proctor). When the backfill material is within 3 feet (9.1m) of the subgrade elevation (the interface of the ballast and the subsoil) a compaction of at least 98% will be required.

All backfilled pipes laid either perpendicular or parallel to any tracks must be designed so that the backfill material will be positively drained. This may require the placement of lateral drains on pipes laid longitudinally to the track and the installation of stub-perforated pipes at the edge of the slopes.

Unless otherwise agreed by Railroad, all work involving rail, ties and other track material will be performed by Railroad at the sole expense of the Applicant.

Bore and Jack (Steel Pipe)

The bore and jack method consists of pushing the pipe into the earth with a boring auger rotating within the pipe to remove the spoil.

The boring operation shall be progressed on a 24-hour basis without stoppage (except for adding lengths of pipe) until the leading edge of the pipe has reached the receiving pit.

The front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger from leading the pipe so that no unsupported excavation is ahead of the pipe.

The auger and cutting head arrangement shall be removable from within the pipe in the event an obstruction is encountered. If the obstruction cannot be removed without excavation in advance of the pipe, the pipe shall be abandoned in place and immediately filled with grout.

The over-cut by the cutting head shall not exceed the outside diameter of the pipe by more than 1/2 inch (13mm). If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe (plus coating) by more than approximately 1 inch (25 mm), grouting (see “**Pipeline Construction Requirements – Grouting**”) or other methods approved by Railroad shall be employed to fill such voids.

The face of the cutting head shall be arranged to provide a reasonable obstruction to the free flow of soft or poor material.

Plans and description of the arrangement to be used shall be submitted to Railroad for approval and no work shall proceed until such approval is obtained.

Any method that employs simultaneous boring and jacking for pipes over 8 inches (203 mm) in diameter that does not have the above approved arrangement **WILL NOT BE PERMITTED**. For pipe 8 inches (203mm) and less in diameter, augering or boring without this arrangement may be considered for use only as approved by Railroad.

Jacking (Steel Pipe)

The jacking method consists of pushing sections of pipe into position with jacks placed against a backstop and excavation performed by hand from within the jacking shield at the head of the pipe. Ordinarily, 36-inch (914 mm) pipe is the least size that should be used, since it is not practical to work within smaller diameter pipes.

Jacking shall be in accordance with the current AREMA Specifications, Chapter 1, Part 4 “Jacking Culvert Pipe Through Fills.” This operation shall be conducted without hand

mining ahead of the pipe and without the use of any type of boring, auguring, or drilling equipment.

Bracing and backstops shall be so designed and jacks of sufficient rating used so that the jacking can be progressed on a 24-hour basis without stoppage (except for adding lengths of pipe) until the leading edge of the pipe has reached the receiving pit.

Immediately upon completion of jacking operation, the installation shall be pressure grouted as per “**Pipeline Construction Requirements – Grouting**”.

Tunneling (Tunnel Liner Plate)

This method consists of placing rings of liner plate within the tail section of a tunneling shield or tunneling machine. A tunneling shield shall be used for all liner plate installations unless otherwise approved by Railroad.

The shield shall be of steel construction, designed to support a railroad track loading as specified in “**Pipeline Design Requirements – Design Loads**”, in addition to the other loadings imposed. The advancing face shall be provided with a hood, extending no less than 20 inches (508 mm) beyond the face and extending around no less than the upper 240 degrees of the total circumference. It shall be of sufficient length to permit the installation of at least one complete ring of liner plates within the shield before it is advanced for the installation of the next ring of liner plates. The shield shall conform to and not exceed the outside dimensions of the liner plate tunnel being placed by more than 1 inch (25.4 mm) at any point on the periphery unless otherwise approved by Railroad.

The shield shall be adequately braced and provided with necessary appurtenances for completely bulkheading the face with horizontal breastboards, and arranged so that the excavation can be benched as may be necessary. Excavation shall not be advanced beyond the edge of the hood, except in rock.

Manufacturer’s shop detail plans and manufacturer’s computations showing the ability of the tunnel liner plates to resist the jacking stresses shall be submitted to Railroad for approval.

Unless otherwise approved by Railroad, the tunneling shall be conducted continuously, on a 24-hour basis, until the tunnel liner extends at least beyond the theoretical railroad embankment line (See *CAD Plan “Plate III”*).

At any interruption of the tunneling operation, the heading shall be completely bulkheaded.

The liner plates shall have tapped grout holes for no smaller than 1 1/2 inch (38 mm) pipe, spaced at approximately 3 feet (0.9 m) around the circumference of the tunnel liner and 4 feet (1.2 m) longitudinally.

Grouting behind the liner plates shall be in accordance with “**Pipeline Construction Requirements – Grouting**”.

Directional Boring / Horizontal Directional Drilling (Steel Pipe)

Method “A”

This method consists of setting up specialized drilling equipment on existing grade (launching and receiving pits are not required) and boring a small diameter pilot hole on the desired vertical and horizontal alignment, using a mechanical cutting head with a high pressure fluid (bentonite slurry) to remove the cuttings. The drill string is advanced with bentonite slurry pumped through the drill string to the cutting head and then forced back along the outside of the drill string, carrying the cuttings back to the surface for removal. When the cutting head reaches the far side of the crossing, it is removed and a reamer (with a diameter greater than the cutting head) is attached to the lead end of the drill string. The pipeline is attached to the reamer and the pilot hole is then back reamed while the pipeline is pulled into place.

This method is used to place pipelines under rivers, wetlands and other obstructions that would be difficult to cross by conventional methods. The length of the bore is generally several hundred feet in length, with installations over a thousand feet possible.

Consideration will be given where the depth of cover is greater than 10 feet (3.05 m) below the base of the rail, or the bore is in rock. Factors considered will be track usage, pipe size, contents of pipeline, soil conditions, etc.

The following preliminary information must be submitted with the request for consideration of this type of installation:

1. A site plan of the area.
2. A plan view and profile of the crossing
3. A data sheet meeting the requirements of *CAD Plan “Plate I”*
4. Several soil borings along the proposed pipeline route.
5. A construction procedure, including a general description of equipment to be used.

If Railroad determines this method of installation is acceptable, final design plans and specifications are to be prepared and submitted for approval.

The project specifications must require the contractor to submit, to Railroad for approval, a complete construction procedure of the proposed boring operation. Included with the submission shall be the manufacture’s catalog information describing the type of equipment to be used.

Method “B”

This method is used to place small diameter conduit for electric lines and other utilities. This method consists of using hydraulic jacking equipment to push a solid steel rod under the railroad from a launching pit to a receiving pit. At the receiving pit, a cone shaped “expander” is attached to the end of the rod and the conduit (casing pipe) is attached to

the expander. The rod, expander and conduit are then pulled back from the launching pit until the full length of the conduit is in place.

This method may be used to place steel conduit (casing pipe), up to and including 6 inches (152 mm) in diameter, under the railroad.

The project specifications must require the contractor to submit, to Railroad for approval, a complete construction procedure of the proposed boring operation. Included with the submission shall be the manufacture's catalog information describing the type of equipment to be used.

Grouting

For jacked and tunneled installations a uniform mixture of 1:6 (cement: sand) cement grout shall be placed under pressure through the grout holes to fill any voids that exist between the pipe or liner plate and the undisturbed earth.

Grouting shall start at the lowest hole in each grout panel and proceed upwards simultaneously on both sides of the pipe.

A threaded plug shall be installed in each grout hole as the grouting is completed at that hole.

When grouting tunnel liner plates, grouting shall be kept as close to the heading as possible, using grout stops behind the liner plates if necessary. Grouting shall proceed as directed by Railroad, but in no event shall more than 6 lineal feet (1.8 m) of tunnel be progressed beyond the grouting.

Soil Stabilization

Pressure grouting of the soils or freezing of the soils before jacking, boring, or tunneling may be required at the direction of Railroad to stabilize the soils, control water, prevent loss of material and prevent settlement or displacement of embankment. Grout shall be cement, chemical or other special injection material selected to accomplish the necessary stabilization.

The materials to be used and the method of injection shall be prepared by a Professional Engineer or by an experienced and qualified company specializing in this work and submitted for approval to Railroad before the start of work. Proof of experience and competency shall accompany the submission.

Dewatering

When water is known or expected to be encountered, pumps of sufficient capacity to handle the flow shall be maintained at the site, provided the contractor has received approval from Railroad to operate them. Pumps in operation shall be constantly attended on a 24-hour basis until, in the sole judgment of Railroad, the operation can be safely

halted. When dewatering, close observation shall be maintained to detect any settlement or displacement of Railroad Property.

Safety Requirements

All operations shall be conducted so as not to interfere with, interrupt, or endanger the operation of trains, nor damage, destroy, or endanger the integrity of Railroad Property.

All work on or near Railroad Property shall be conducted in accordance with Railroad safety rules and regulations. The contractor shall secure and comply with the Railroad safety rules and shall give written acknowledgement to Railroad that they have been received, read, and understood by the contractor and its employees.

Work on or near Railroad Property may also require worker protection. For additional information on worker protection requirements, please visit:

http://www.chesapeakeanddelaware.com/RealEstate_RWP.html

Construction operations will be subject to Railroad inspection at any and all times.

All cranes, lifts, or other equipment that will be operated in the vicinity of Railroad electrification and power transmission facilities shall be electrically grounded as directed by Railroad.

At all times when the work is being progressed, a field supervisor for the work with no less than twelve (12) months experience in the operation of the equipment being used shall be present. If boring equipment or similar machines are being used, the machine operator also shall have no less than twelve (12) months experience in the operation of the equipment being used.

Whenever equipment or personnel are working closer than 15 feet (4.6m) from the centerline of any track, that track shall be considered as being obstructed. Insofar as possible, all operations shall be conducted no less than this distance. Operations closer than 15 feet (4.6) from the centerline of a track shall be conducted only with the permission of, and as directed by, a duly qualified Railroad employee present at the site of the work, or as specifically authorized by Railroad.

Crossing of tracks at grade by equipment and personnel is prohibited except by prior arrangement with, and as directed by, Railroad.

Blasting

Blasting will not be permitted.

Protection of Drainage

If, in the course of construction, it may be necessary to block a ditch, pipe or other drainage device, temporary pipes, ditches or other drainage devices shall be installed to

maintain adequate drainage, as approved by Railroad. Upon completion of the work, the temporary devices shall be removed and the permanent drainage devices restored.

Soil erosion methods shall be used to protect Railroad Property and other drainage devices during construction on and adjacent to Railroad Property.

Support of Excavation Adjacent to Track

Launching and Receiving Pits

The location and dimensions of all pits or excavations shall be shown on the plans. The distance from centerline of any track to face of pit or excavation shall be clearly labeled. Also, the elevation of the bottom of the pit or excavation must be shown on the profile.

The face of all pits shall be located a minimum of 25 feet (7.6m) from centerline of any track, **measured at right angles to track**, unless otherwise approved by Railroad.

If the bottom of the pit excavation intersects the theoretical railroad embankment line (See *CAD Plan "Plate III"*) interlocking steel sheet piling, driven prior to excavation, must be used to protect the track stability. The use of trench boxes or similar devices are not acceptable in this area.

Design plans and computations for the pits, stamped by a Professional Engineer, must be submitted by the Applicant at time of application or by the contractor prior to start of construction. If the pit design is to be submitted by the contractor, the project specifications must require the contractor to obtain Railroad approval prior to beginning any work on or which may affect Railroad Property.

The sheeting shall be designed to support all lateral forces caused by the earth, railroad and other surcharge loads. See "**Pipeline Design Requirement – Design Loads**" for railroad loading.

After construction and backfilling, all sheet piling within 10 feet (3.0m) of the centerline of any track must be cut off 18 inches (457 mm) below final grade and left in place.

All excavated areas are to be illuminated (flashing warning lights not permitted), fenced and otherwise protected as directed by Railroad.

Parallel Trenching and Other Excavation

When excavation for a pipeline or other structure will be within the theoretical railroad embankment line (See *CAD Plan "Plate V"*) of any track, interlocking steel sheet piling shall be required to protect the track.

The design and construction requirements for this construction shall be in accordance with the requirements of "**Pipeline Construction Requirements – Support of Excavation Adjacent to Track**".

Inspection and Testing

For pipelines carrying flammable or hazardous materials, ANSI Codes, current at time of constructing the pipeline, shall govern the inspection and testing of the Facility on Railroad Property, except as follows:

1. 100% of all field welds shall be inspected by examinations, and such field welds shall be inspected for 100 percent of the circumference.
2. The proof testing of the strength of carrier pipe shall be in accordance with ANSI requirements.

Reimbursement of Railroad Costs

The Applicant shall reimburse Railroad for all Railroad costs associated with the pipe installation (inspection, flagging, track work, protection of signal cables, lost revenue, operational costs, etc.). Any Applicant-imposed requirement for an Applicant's contractor to reimburse Railroad is not acceptable.

Attachments

Plan “Plate I” – Pipe Data Sheet

Plan “Plate II” – Information for Site Plans of Right of Way Crossings

Plan “Plate III” – Pipeline Crossing

Plan “Plate IV” – Longitudinal Crossing

Plan “Plate V” – Longitudinal Occupancy

Plan “Plate VI” – Pipeline in Highway Under Railroad Bridges

Plan “Plate VII” – Pipeline on Highway Bridge Over Railroad

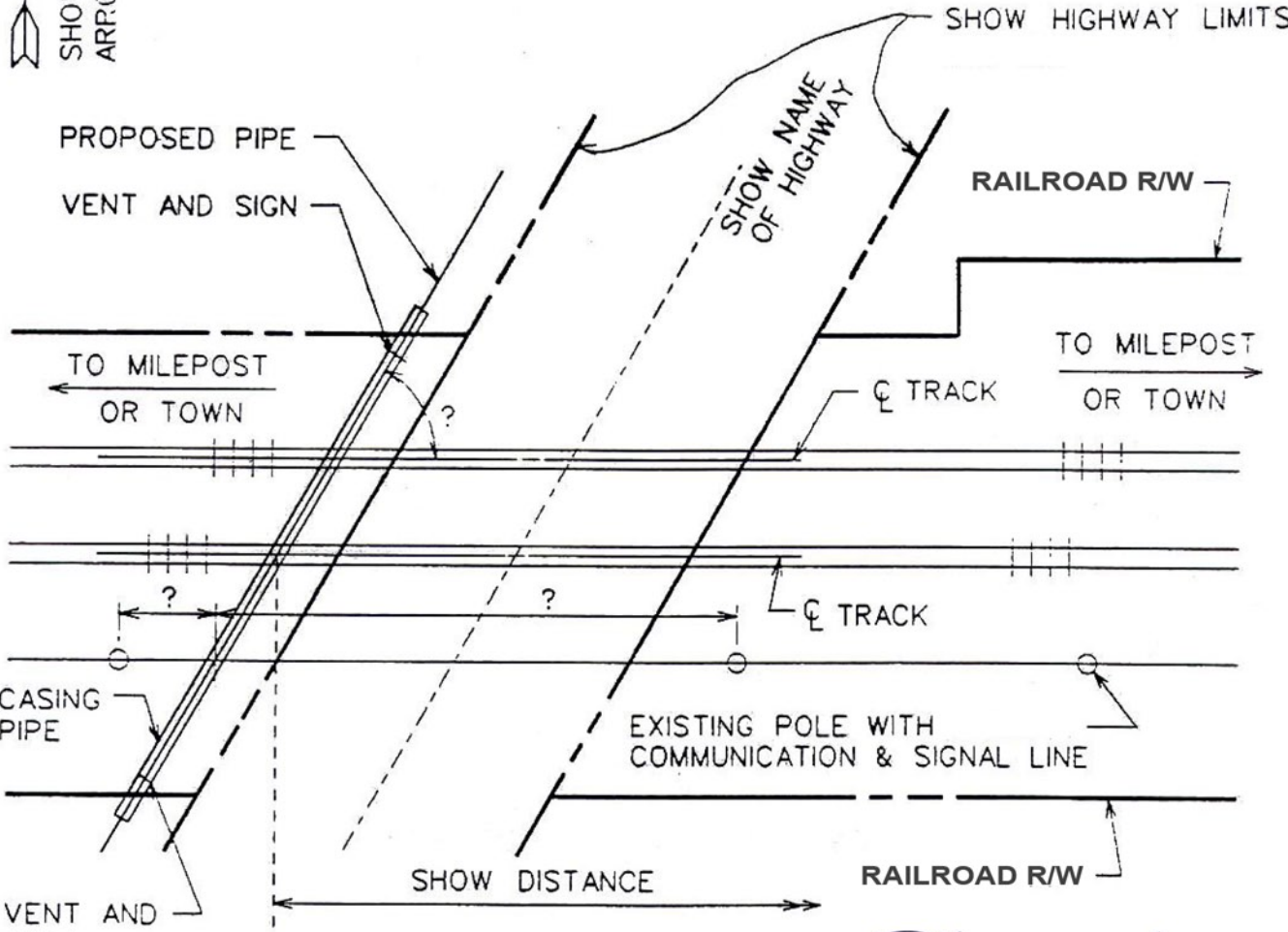
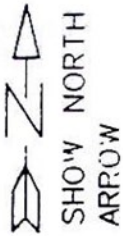
Plan “Plate VIII” – Test Boring Log

Plan “Plate IX” – Lateral Pressure Diagram

PIPE DATA SHEET

	PIPE DATA	
	CARRIER PIPE	CASING PIPE
CONTENTS TO BE HANDLED		
NORMAL OPERATING PRESSURE		
NOMINAL SIZE OF PIPE		
OUTSIDE DIAMETER		
INSIDE DIAMETER		
WALL THICKNESS		
WEIGHT PER FOOT		
MATERIAL		
PROCESS OF MANUFACTURE		
SPECIFICATION		
GRADE OR CLASS		
TEST PRESSURE		
TYPE OF JOINT		
TYPE OF COATING		
DETAILS OF CATHODIC PROTECTION		
DETAILS OF SEALS OR PROTECTION AT ENDS OF CASING		
METHOD OF INSTALLATION		
CHARACTER OF SUBSURFACE MATERIAL AT THE CROSSING LOCATION		
APPROXIMATE GROUND WATER LEVEL		
SOURCE OF INFORMATION ON SUBSURFACE CONDITIONS (BORINGS, TEST PITS OR OTHER)		

INFORMATION TO BE SHOWN ON A SITE PLAN OF DRAWINGS FOR RIGHT OF WAY CROSSINGS



Chesapeake & Delaware LLC

PLAN

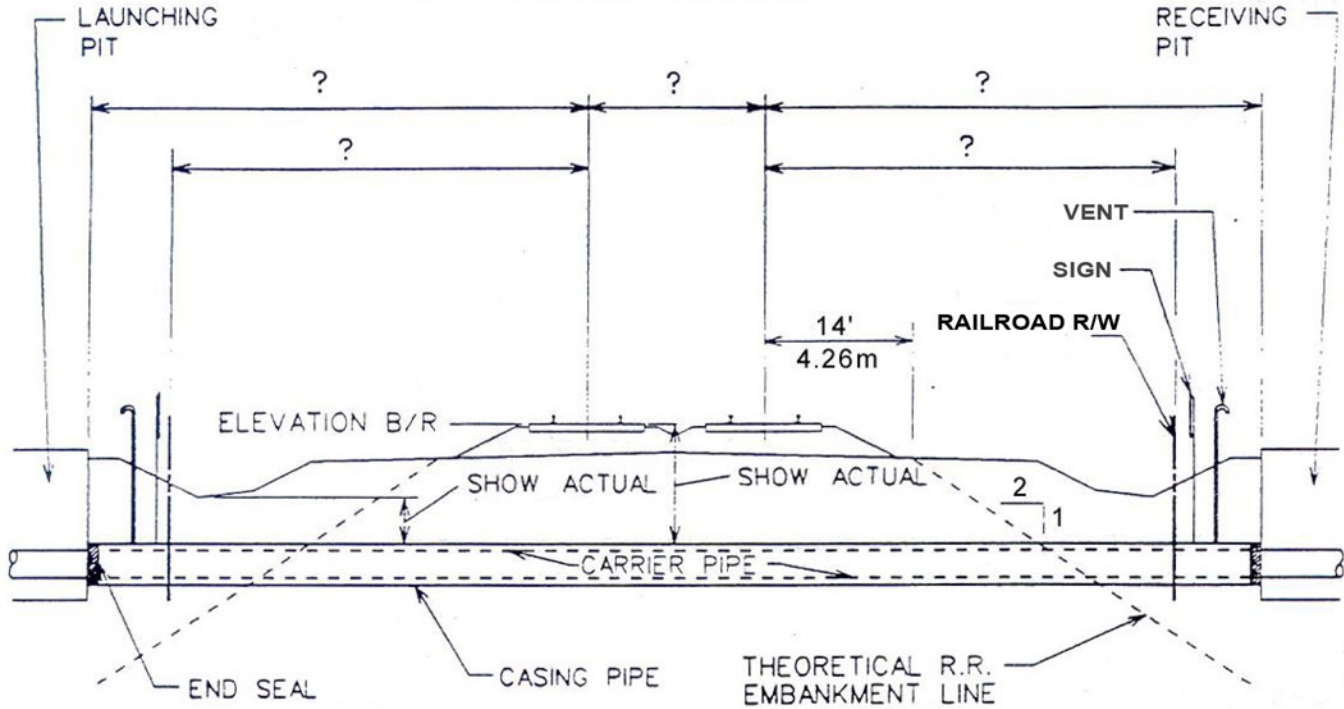
SCALE OF DRAWING TO BE SHOWN

NOTES:

IF THE PROPOSED PIPELINE IS WITHIN HIGHWAY LIMITS, THE SAME INFORMATION IS REQUIRED AS SHOWN ON THIS PLATE.

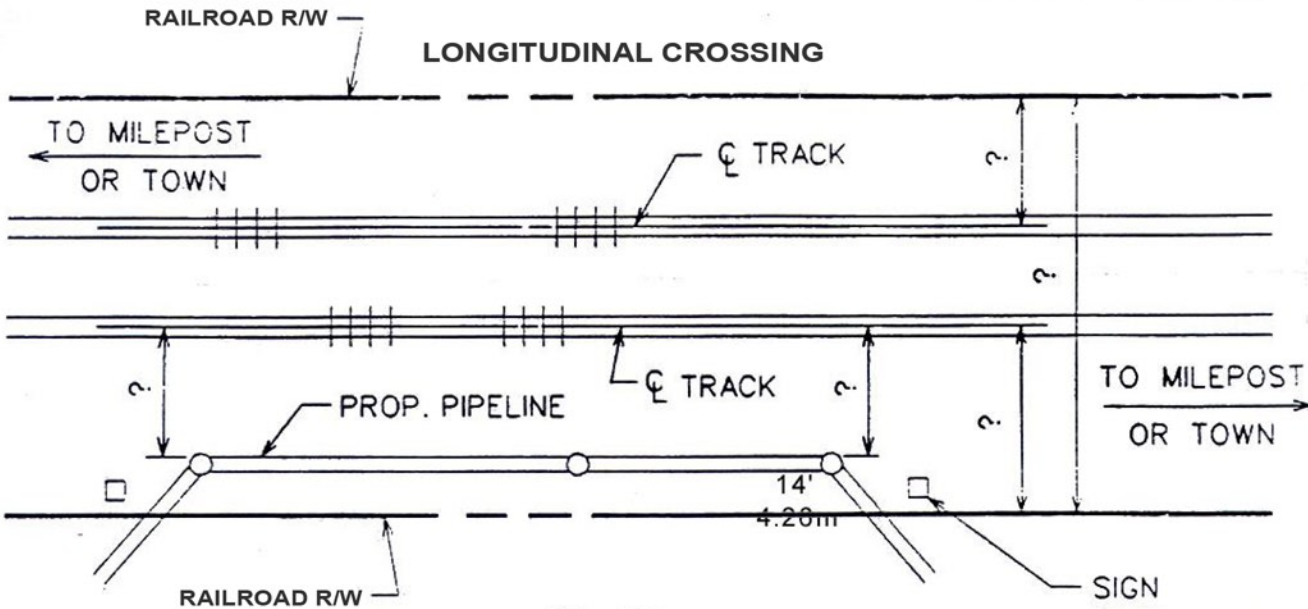
IF THE PROPOSED PIPE IS TO SERVE A NEW DEVELOPMENT, A MAP SHOWING THE AREA IN RELATION TO ESTABLISHED AREAS AND ROADS IS TO BE SENT WITH THE REQUEST.

PIPELINE CROSSING



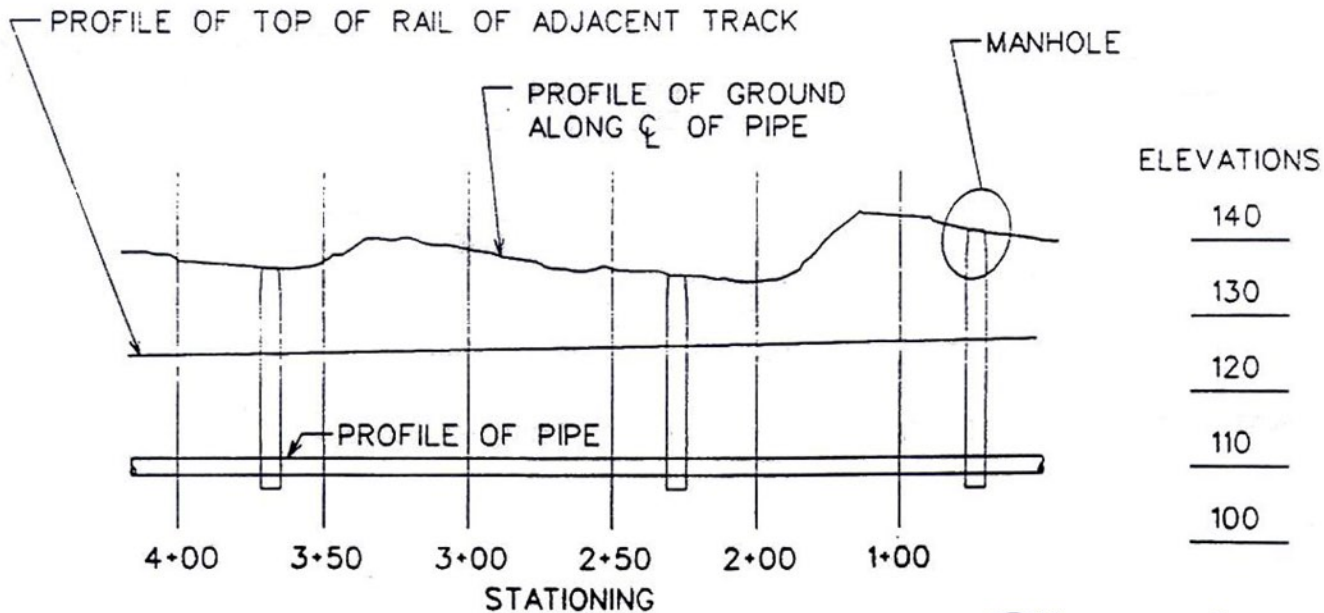
PROFILE

SCALE OF DRAWING TO BE SHOWN



PLAN

SCALE OF DRAWING TO BE SHOWN

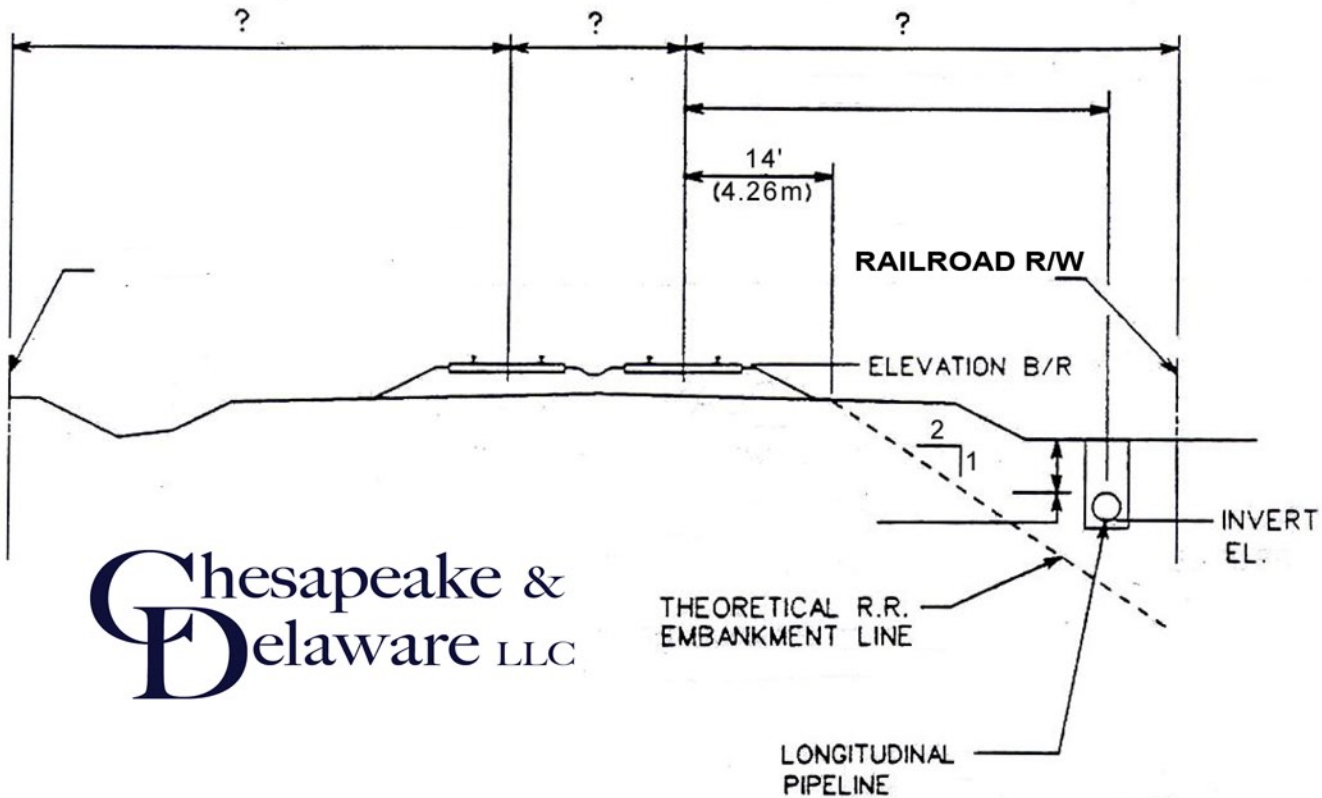


PROFILE

SCALE: HORIZ. : _____

VERT. : _____

LONGITUDINAL OCCUPANCY

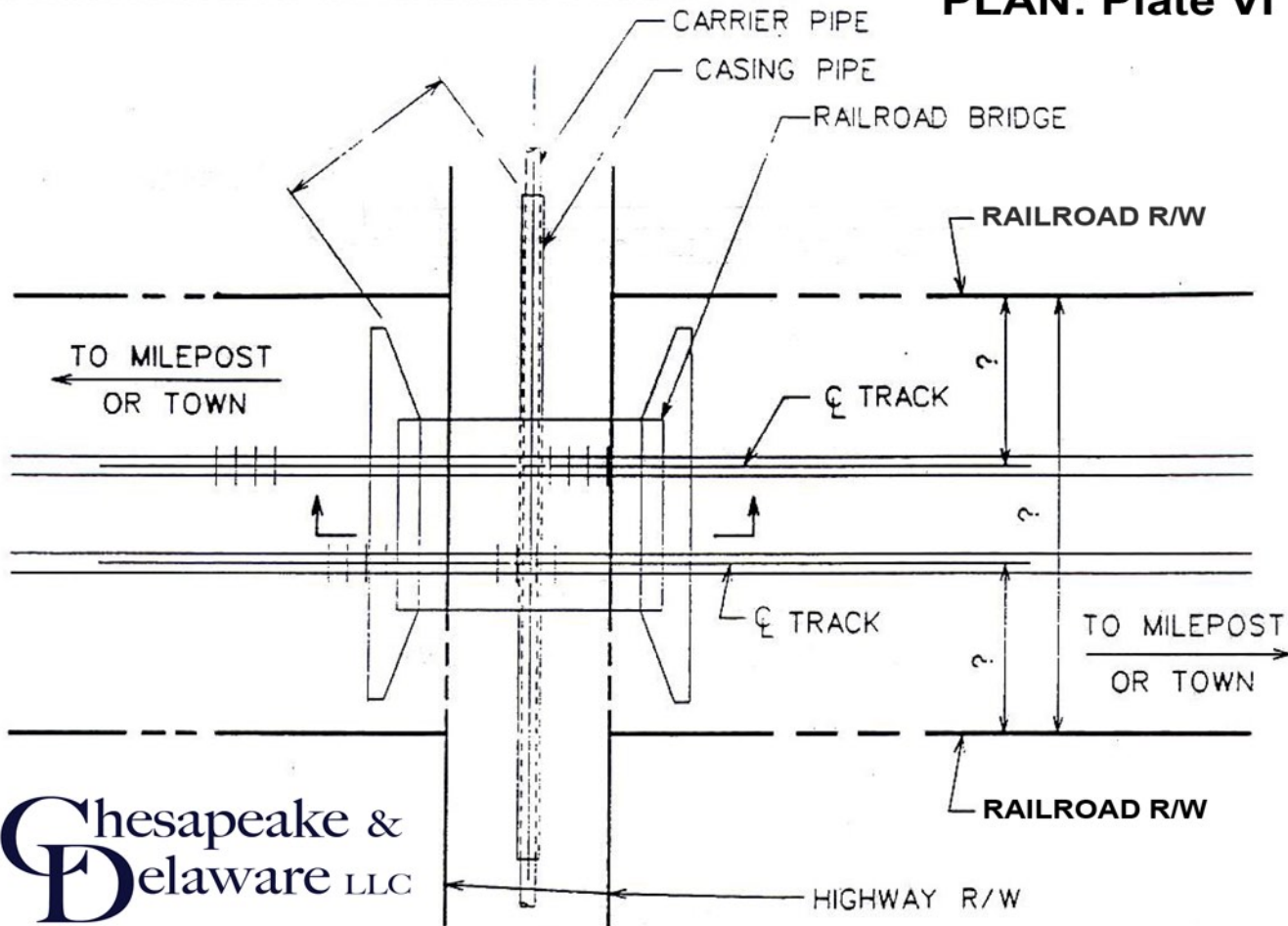


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SECTION

SCALE OF DRAWING TO BE SHOWN

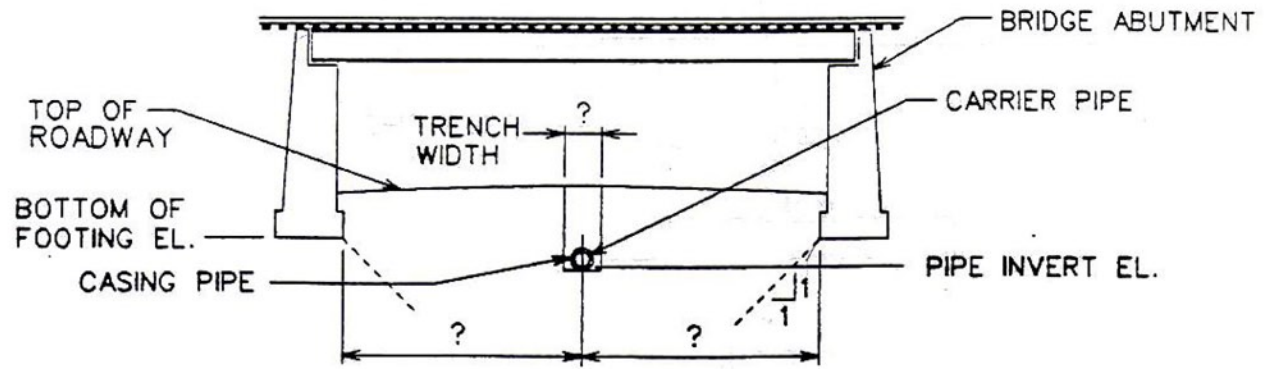
NOTE: SECTIONS TO BE TAKEN EVERY 500 FEET (152M), MAXIMUM



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PLAN

SCALE OF DRAWING TO BE SHOWN

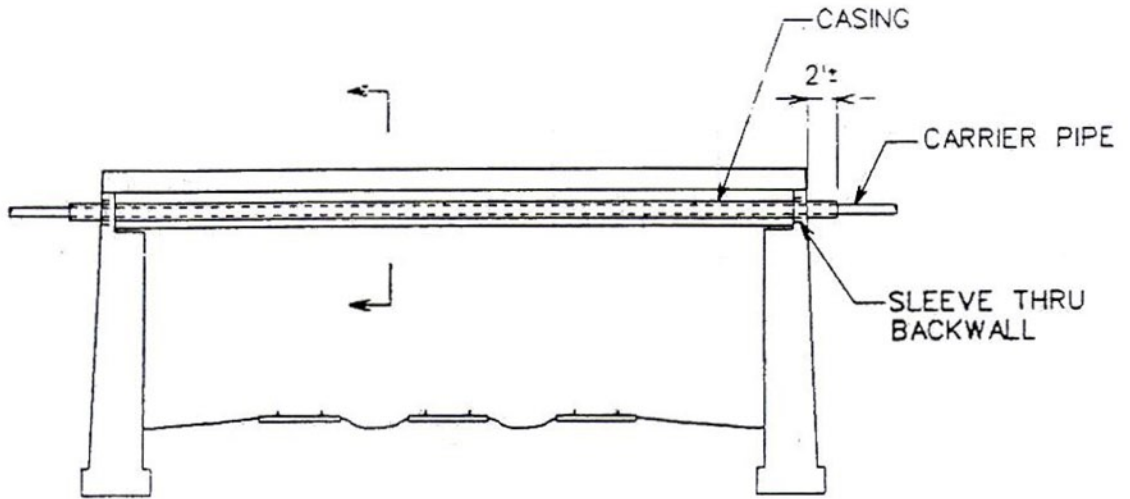


SECTION

SCALE OF DRAWING TO BE SHOWN

NOTE: PIPE OR EXCAVATION MUST NOT BE WITHIN THE 1 TO 1 SLOPE LINE THAT EXTENDS FROM BOTTOM OF FOOTING

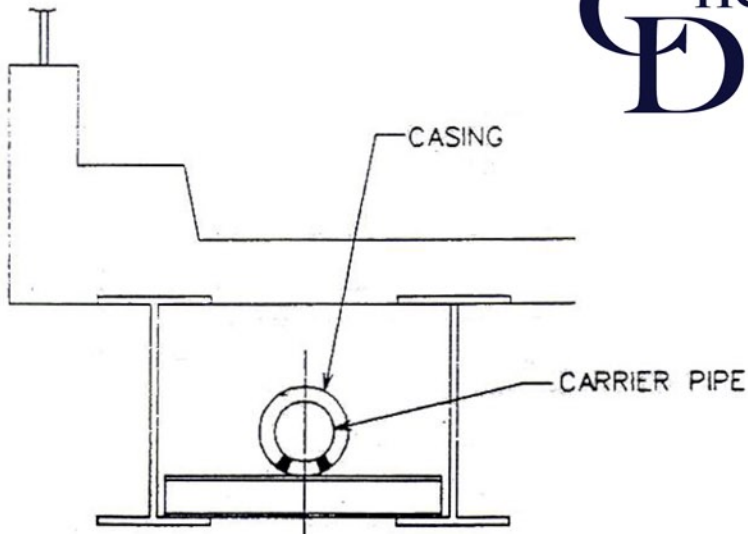
PIPELINE ON HIGHWAY BRIDGE OVER RAILROAD



ELEVATION

SCALE OF DRAWING TO BE SHOWN

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Delaware LLC



SECTION

SCALE OF DRAWING TO BE SHOWN

TEST BORING LOG

PROJECT
 LOCATION
 DATE STARTED

DATE COMPLETED

HOLE NO.
 SURF. EL.
 JOB NO.
 GROUND WATER DEPTH WHILE DRILLING
 BEFORE CASING REMOVED
 AFTER CASING REMOVED

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING
 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING
 %OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1

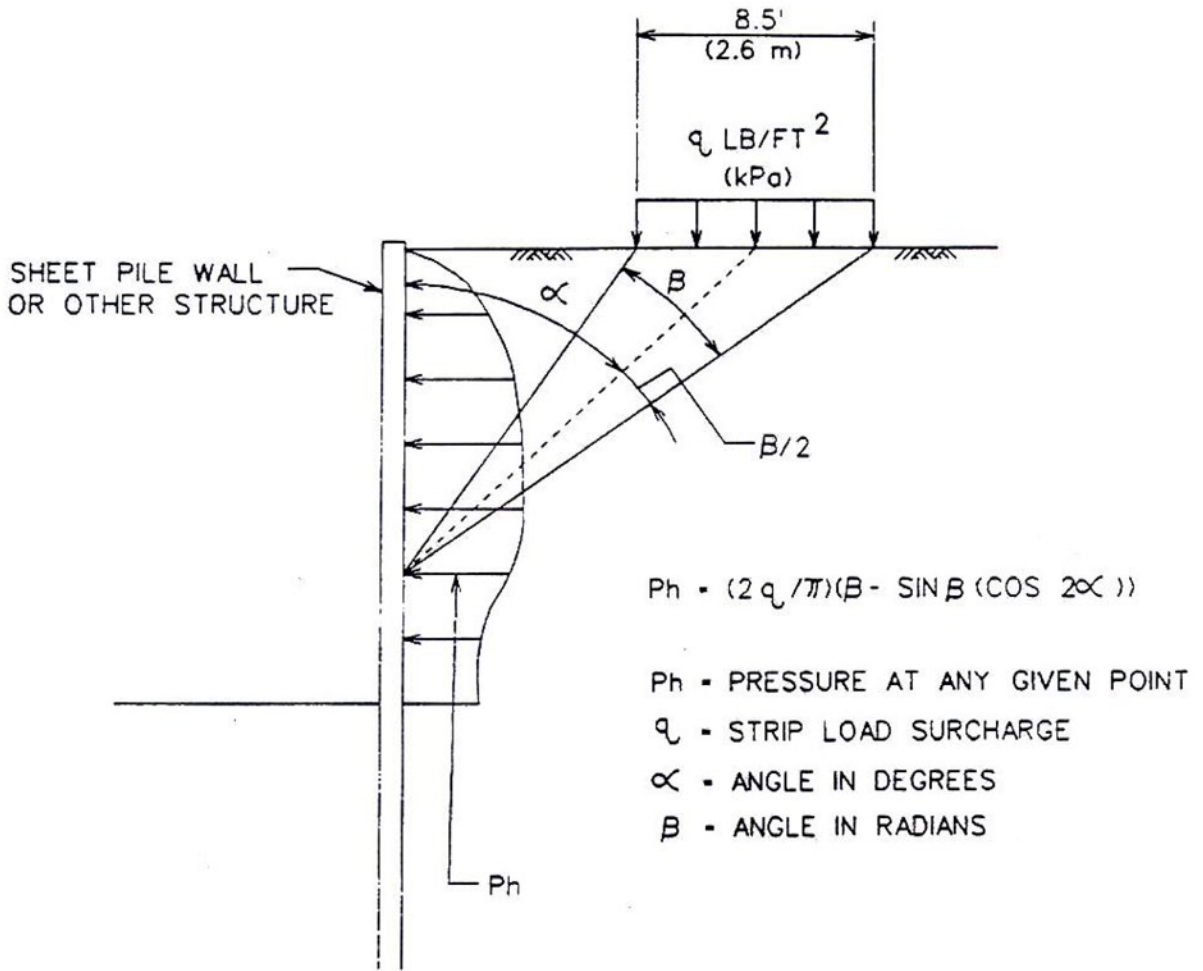
DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
5.0	0.0'-	1		6/14		Brown moist medium dense fine to coarse SAND and fine to medium GRAVEL, little silt	
	2.0'			14/19	28		
	2.0'-	2		9/15			
	4.0'			15/23	30		
	4.0'-	3		17/18			
	6.0'			11/21	29		6.0'
10.0	6.0'-	4		9/6		Brown moist stiff SILT	
	8.0'			5/7	11		8.5'
	8.0'-	5		10/12		Brown moist very stiff SILT, little fine to coarse sand, little fine gravel	
	10.0'			11/11	23		
	10.0'-	6		12/11			
	11.3'			50-.3'			12.5'
15.0	Gray dry hard silty weathered SHALE						
	Top of Rock						15.0'
20.0	15.0'-	R-1Rec	BX Core			Gray weathered steeply bedded SHALE	
	20.0'	46"	77%				
	Bottom of Boring						20.0'

Pipe Invert Elev



November 2017

LATERAL PRESSURE DIAGRAM



ELEVATION

LATERAL PRESSURE DUE TO STRIP LOAD