CONNECTICUT DEPARTMENT OF ENERGY AND ENVIORNMENTAL PROTECTION CLEAN WATER ACT SECTION 401 WATER QUALITY CERTIFICATION FOR THE NORTHEAST ENERGY DIRECT PROJECT

Submitted to:
Connecticut Department of Energy and Environmental Protection
Inland Water Resources Division
79 Elm Street
Hartford, Connecticut 06106-5127

Applicant:
Tennessee Gas Pipeline Company, L.L.C.
1001 Louisiana Street
Houston, TX 77002

November 2015

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

November 25, 2015

Central Processing Unit
Inland Water Resource Division
Connecticut Department of Energy and Environmental Protection
79 Elm Street
Hartford, Connecticut 06106-5127

Re: Section 401 Water Quality Certification Application
Northeast Energy Direct Project
Connecticut

Dear Sirs:

Attached is an application (original and five copies) of the Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") for activities within federal wetlands and waterbodies, which are necessary to construct a new natural gas pipeline. The proposed project involves the expansion and modification of Tennessee's existing pipeline system in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. The Northeast Energy Direct Project ("NED Project" or "Project") includes the following facilities:

- Approximately 41 miles of pipeline looping on Tennessee's 300 Line in Pennsylvania;
- Approximately 133 miles of new pipeline, of which 102 miles are proposed to be generally co-located with the certificated Constitution Pipeline Project ("Constitution") in Pennsylvania and New York (extending from Tennessee's existing 300 Line near Auburn, Pennsylvania to Wright, New York);
- Approximately 54 miles of pipeline generally co-located with Tennessee's existing 200 Line and an existing utility corridor in New York;
- Approximately 64 miles of pipeline generally co-located with an existing utility corridor in Massachusetts;
- Approximately 70 miles of pipeline generally co-located with an existing utility corridor in New Hampshire (extending southeast to Dracut, Massachusetts);
- Approximately 58 miles of various laterals and pipeline looping segments in Massachusetts, New Hampshire, and Connecticut to serve local markets;
- Construction of nine new compressor stations and 15 new meter stations, and modifications to an existing compressor station and 14 existing meter stations throughout the Project area; and
- Construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

The Project is needed to meet the current demand for increased natural gas in the region and is not related to or contingent upon other potential projects or expansions by Tennessee in the area. Tennessee has evaluated alternative routes to serve the increased demand for the area served by the existing pipeline network, and is proposing routes that minimize impacts to the environment. To the extent that it is practicable, feasible, and in compliance with existing law, Tennessee proposes to locate proposed pipeline facilities (either pipeline looping segments or co-located pipeline facilities) generally within or adjacent to its existing right-of-way ("ROW") associated with its existing 300 Line in Pennsylvania and Connecticut;

its existing 200 Line in New York and Massachusetts; and existing utility (pipeline and powerline) corridors in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut.

In accordance with the Federal Energy Regulatory Commission ("Commission") guidelines under the Energy Policy Act of 2005 (EPAct 2005), which requires applicants filing for a certificate from the Commission under Section 3 or 7 of the Natural Gas Act to submit all federal authorizations before or concurrently with the project's final application to the Commission, Tennessee is submitting this application to the Connecticut Department of Energy and Environmental Protection ("CTDEEP") for review for project components in Connecticut in relation to permits sought under Section 401 of the Clean Water Act. Tennessee is also submitting an application to the New England District of the United States Army Corps of Engineers ("USACE"), Baltimore District of the USACE for facilities located in Pennsylvania and the Buffalo and New York Districts of the USACE for the facilities to be built in New York. Tennessee also submitted Section 401 Water Quality Certification applications to the Pennsylvania Department of Environmental Protection ("PADEP"), New York State Department of Environmental Conservation ("NYSDEC"), Massachusetts Department of Environmental Protection ("MADEP"), and New Hampshire Department of Environmental Services ("NHDES") on November 20, 2015.

Field surveys were initiated in June 2014 and were suspended in November 2014 due to winter weather conditions. Additional field surveys re-commenced in March 2015 and are ongoing. This application presents impact information for the entire project in Connecticut, incorporating both field verified wetland delineations and data (through September 2, 2015) in areas where access permission was granted, as well as interpolated wetlands from high resolution aerial imagery and desktop data for areas where surveys have not yet been completed and in areas where access was not granted by the landowner, for use in determining approximate wetland impacts for Public Notice and mitigation purposes. This application only includes Site Specific wetland and watercourse permit drawings for those wetlands that were delineated in the field. Site Specific wetland and watercourse permit drawings are not provided for interpolated wetlands from aerial imagery. Field surveys were conducted in accordance with the USACE's *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region* (Environmental Laboratory October 2009). Supplemental data will be provided to the USACE and CTEEP as field surveys are completed in areas where survey permission was denied.

We trust you will find this package contains adequate information necessary for your initial review. If you have any questions or need additional information, please contact me at (713.420.5360) or by email at michael_letson@kindermorgan.com.

Sincerely,

Michael Letson
Project Manager, Tennessee Gas Pipeline Company, L.L.C

Encl.

Connecticut Department of Energy & Environmental Protection

CPPU USE ONLY
App #:________
Doc #:________
Check #:________
____

Permit Application Transmittal Form

Please complete this transmittal form in accordance with the instructions in order to ensure the proper handling of your application(s) and the associated fee(s). Print legibly or type.

Part I: Applicant Information:

- ***If an applicant is a corporation, limited liability company, limited partnership, limited liability partnership, or a statutory trust, it must be registered with the Secretary of State. If applicable, applicant's name shall be stated** ***exactly*** *as it is registered with the Secretary of State.*
- *If an applicant is an individual, provide the legal name (include suffix) in the following format: First Name; Middle Initial; Last Name; Suffix (Jr, Sr., II, III, etc.).*

Applicant: **Tennessee Gas Pipeline Company, L.L.C**

Mailing Address: **1001 Louisiana Street**

City/Town: **Houston** State: **Texas** Zip Code: **77002**

Business Phone: **713-420-6360** ext.:

Contact Person: **Michael Letson** Phone: **713-420-5360** ext.

E-Mail: **Michael_Letson@kindermorgan.com**

Applicant (check one): ☐ individual ☒ ***business entity** ☐ federal agency ☐ state agency ☐ municipality ☐ tribal

***If a business entity, list type (e.g., corporation, limited partnership, etc.): **Limited Liability Company**

☐ Check if any co-applicants. If so, attach additional sheet(s) with the required information as supplied above.

Please provide the following information to be used for *billing purposes only*, if different:

Company/Individual Name:

Mailing Address:

City/Town: State: Zip Code:

Contact Person: Phone: ext.

Part II: Project Information

Brief Description of Project: *(Example: Development of a 50 slip marina on Long Island Sound)*

Construction of a new 14.80 mile interstate natural gas pipeline in Connecticut (parallel and adjacent to an existing interstate natural gas pipeline)

Location (City/Town): **Farmington, West Hartford, Bloomfield, Windsor, East Granby, Avon, North Bloomfield, Milford, Easton**

Other Project Related Permits (*not* included with this form):

Permit Description	Issuing Authority	Submittal Date	Issuance Date	Denial Date	Permit #
Certificate of Public Convenience and Necessity	**Federal Energy Regulatory Commission**	**November 2015**	**Pending**	**N/A**	**Pre-file # PF14-22-000**

Clean Water Act Section 404 Permit	**USACE**	**November 2015**	**Pending**	**N/A**	**NAE-2014-644**

Part III: Individual Permit Application and Fee Information

New, Mod. or Renew	Individual Permit Applications	Initial Fees	No. of Permits Applied For	Total Initial Fees	Original + Required Copies
	AIR EMISSIONS				
	New Source Review ☐ Revision ☐ minor mod	$940.00			1 + 0
	Title V Operating Permits ☐ Revision ☐ minor mod ☐ non-minor mod	none			1 + 0
	Title IV	none			1 + 0
	Clean Air Interstate Rule (CAIR)	none			1 + 0
	WATER DISCHARGES				
	To Groundwater	$1300.00			1 + 1
	To Sanitary Sewer (POTW)	$1300.00			1 + 1
	To Surface Water (NPDES)	$1300.00			1 + 1
	INLAND WATER RESOURCES-				
	Dam Safety	none			1 + 2
	Flood Management Certification	none			1 + 1
	Inland Wetlands and Watercourses	none			1 + 5
New	Inland 401 Water Quality Certification	none	1	None	
	FERC- Hydropower Projects- 401 Water Quality Certification	none			1 +1
	Water Diversion	★			1 + 5
	OFFICE OF LONG ISLAND SOUND PROGRAMS				
	Certificate of Permission	$375.00			1 + 2
	Coastal 401 Water Quality Certification	none			1 + 2
	Structures and Dredging/and Fill/Tidal Wetlands	$660.00			1 + 2
	WASTE MANAGEMENT				
	Aerial Pesticide Application	★			1 + 2
	Aquatic Pesticide Application	$200.00			1 + 0
	CGS Section 22a-454 Waste Facilities	★			1 + 1
	Disruption of a Solid Waste Disposal Area	$0			1 + 1
	Hazardous Waste Treatment, Storage and Disposal Facilities	★			1 + 1
	Marine Terminal License	$100.00			1 + 0
	Stewardship	$4000.00			1 + 1
	Solid Waste Facilities	★			1 + 1
	Waste Transportation	★			1 + 0
		Subtotal ➡	1	New	
	GENERAL PERMITS and AUTHORIZATIONS	Subtotals Page 3 &4 ➡			
	Enter subtotals from Part IV, pages 3 - 6 of this form	Subtotals Page 5 ➡			
		Subtotals Page 6 ➡			
		TOTAL ➡	1	None	
	☐ Indicate whether municipal discount or state waiver applies. Less Applicable Discount ➡				
	AMOUNT REMITTED ➡			None	

Check # ➡

Check or money order should be made payable to:
"Department of Energy and Environmental Protection"

★ **See fee schedule on individual application.**

Part IV: General Permit Registrations and Requests for Other Authorizations Application and Fee Information

✓	General Permits and Other Authorizations	Initial Fees	No. of Permits Applied For	Total Initial Fees	Original + Required Copies
	AIR EMISSIONS				
☐	Limit Potential to Emit from Major Stationary Sources of Air Pollution	$2760.00			1 + 0
☐	Diagnostic and Therapeutic X-Ray Devices (Medical X-Ray) Registration	$190.00/Xray device			1 + 0
☐	Radioactive Materials and Industrial Device Registration (Ionizing Radiation)	$200.00			1 + 0
☐	Emergency/Temporary Authorization	★★			★★
☐	License Revocation Request	$0			★★
☐	Other, (please specify):				
	WATER DISCHARGES				
☐	Boiler Blowdown Wastewater	Expired- wastewater discharge authorized under MISC GP			
☐	Categorical Industry User to a POTW Discharges > 10,000 gpd Discharges < 10,0000 gpd	 $6250.00 $3125.00			1 + 0
☐	Domestic Sewage	$625.00			1 + 0
☐	Food Preparation Establishment Wastewater	No Registration			
☐	Food Processing Wastewater	$500.00			1 + 0
☐	Groundwater Remediation Wastewater to a Sanitary Sewer	$500.00			1 + 0
☐ ☐	Groundwater Remediation Wastewater to a Surface Water Registration Only Approval of Registration by DEEP	 $625.00 $1250.00			1 + 0
☐ ☐	Hydrostatic Pressure Testing Wastewater Registration Only Approval of Registration by DEEP (natural gas pipelines)	 $625.00 $1250.00			1 + 0
☐ ☐	Miscellaneous Discharges of Sewer Compatible Wastewater Registration Only Approval of Registration by DEEP	 $500.00 $1000.00			1 + 0
☐	Nitrogen Discharges	No Registration			
☐	Non-Contact Cooling and Heat Pump Water (Minor)	$625.00			1 + 0
☐	Photographic Processing Wastewater (Minor)	Expired- wastewater discharge authorized under MISC GP			
☐	Point Source Discharges from Application of Pesticides	$200.00			1 + 0
☐	Printing & Publishing Wastewater (Minor) Flow < 40 gpd	$500.00 $100.00			1 + 0
☐	Stormwater Associated with Commercial Activities	$300.00			1 + 0
☐	Stormwater Associated with Industrial Activities <50 employees–see general permit for additional requirements >50 employees–see general permit for additional requirements	 $500.00 $1000.00			1 + 0
☐	Stormwater & Dewatering Wastewaters-Construction Activities	★			1 + 0
☐	Stormwater from Small Municipal Separate Storm Sewer Systems (MS4)	$250.00			1 + 0

★ **See fee schedule on registration/application.**

★★ **Contact the specific permit program for this information. (Contact numbers are provided in the instructions)**

Part IV: General Permit Registrations and Requests for Other Authorizations (continued)

WATER DISCHARGES (continued)				
☐ Subsurface Sewage Disposal Systems Serving Existing Facilities	★ ★			1 + 0
☐ Swimming Pool Wastewater - Public Pools and Contractors	$500.00			1 + 0
☐ Tumbling or Cleaning of Parts Wastewater (Minor)	Expired- wastewater discharge authorized under MISC GP			
Vehicle Maintenance Wastewater ☐ Registration Only ☐ Approval of Registration by DEEP	 $625.00 $1250.00			1 + 0
☐ Water Treatment Wastewater	$625.00			1 + 0
☐ Emergency/Temporary Authorization - Discharge to POTW	$1500.00			1 + 0
☐ Emergency/Temporary Authorization - Discharge to Surface Water	$1500.00			1 + 0
☐ Emergency/Temporary Authorization - Discharge to Groundwater	$1500.00			1 + 0
☐ Other, (please specify):				
Note: Carry subtotals over to Part III, page 2 of this form. Subtotal	➡			

★ See fee schedule on registration/application.

★★ Contact the specific permit program for this information. (Contact numbers are provided in the instructions)

Part IV: General Permit Registrations and Requests for Other Authorizations (continued)

✓	General Permits and Other Authorizations	Initial Fees	No. of Permits Applied For	Total Initial Fee	Original + Required Copies
	AQUIFER PROTECTION PROGRAM				
☐	Registration for Regulated Activities	$625.00			1 + 0
☐	Permit Application to Add a Regulated Activity	$1250.00			1 + 0
☐	Exemption Application from Registration	$1250.00			1 + 0
	INLAND WATER RESOURCES				
☐	Diversion of Remediation Groundwater	No Registration			
☐	Diversion of Water for Consumptive Use: Reauthorization Categories	$1000.00			1 + 2
☐	Diversion of Water for Consumptive Use: Authorization Required	$2500.00			1 + 4
☐	Diversion of Water for Consumptive Use: Filing Only	$1500.00			1 + 4
☐	Programmatic General Permit	★			1 +3
☐	Water Resource Construction Activities	★			1 +0
☐	Emergency/Temporary Authorization	★★			★★
☐	Notice of High Hazard Dam or a Significant Hazard Dam	$0			1 +0
☐	Other, (please specify):				
	OFFICE OF LONG ISLAND SOUND PROGRAMS				
☐	4/40 Docks	$700.00			1 + 1
☐	Beach Grading	$100.00			1 + 1
☐	Buoys or Markers	No Registration			
☐	Coastal Remedial Activities Required by Order	$700.00			1 + 1
☐	Dock Reconstruction	$300.00			1 + 1
☐	Harbor Moorings	No Registration			
☐	Maintenance of Catch Basins and Tide Gates	No Registration			
☐	Marina and Mooring Field Reconfiguration	$700.00			1 + 1
☐	Minor Seawall Repair	No Registration			
☐	Non-harbor Moorings	$100.00			1 + 1
☐	Osprey Platforms and Perch Poles	none			1 + 1
☐	Pump-out Facilities (no fee for Clean Vessel Act grant recipients)	$100.00			1 + 1
☐	Programmatic General Permit	★			1 + 1
☐	Removal of Derelict Structures	$100.00			1 + 1
☐	Residential Flood Hazard Mitigation	$100.00			1 + 1
☐	Swim Floats	$100.00			1 + 1
☐	Emergency/Temporary Authorization	★★			★★
☐	Other, (please specify):				
	Note: Carry subtotals over to Part III, page 2 of this form.	Subtotal ➡			

★ See fee schedule on registration/application.

★★ Contact the specific permit program for this information. (Contact numbers are provided in the instructions)

Part IV: General Permit Registrations and Requests for Other Authorizations (continued)

✓ General Permits and Other Authorizations	Initial Fees	No. of Permits Applied For	Total Initial Fee	Original + Required Copies
WASTE MANAGEMENT				
☐ Addition of Grass Clippings at Registered Leaf Composting Facilities	$500.00			1 + 0
☐ Beneficial Use Determination	★			
Certain Recycling Facilities:				
☐ Drop-site Recycling Facility	$200.00			1 + 0
☐ Limited Processing Recycling Facility	$500.00			1 + 0
☐ Recyclables Transfer Facility	$500.00			1 + 0
☐ Single Item Recycling Facility	$500.00			1 + 0
$0 ☐ Collection and Storage of Post Consumer Paint	$0			
Contaminated Soil and/or Staging Management (Staging/Transfer)				
☐ Registration Only	$250.00			1 + 0
☐ Approval of Registration by DEEP	$1500.00			1 + 0
☐ Renewals	$750.00			
☐ Connecticut Solid Waste Demonstration Project	$1000.00			1 + 0
☐ Disassembling Used Electronics	$2000.00			1 + 0
☐ Leaf Composting Facility	none			1 + 1
☐ Municipal Transfer Station	$800.00			1 + 1
☐ One Day Collection of Certain Wastes and Household Hazardous Waste	$1000.00			1 + 0
☐ Sheet leaf Composting Notification	$0			★★
Special Waste Authorization				1 + 0
☐ Landfill or RRF Disposal	$660.00			
☐ Asbestos Disposal	$300.00			
☐ homeowner	$0			
☐ Storage and Processing of Asphalt Roofing Shingle Waste	$2500.00			1 + 0
☐ Storage and Processing of Scrap Tires for Beneficial Use	$1250.00			1 + 0
☐ Emergency/Temporary Authorization	★★			★★
☐ Other, (please specify):				
REMEDIATION				
☐ In Situ Groundwater Remediation: Enhance Aerobic Biodegradation	★			1 + 2
☐ In Situ Groundwater Remediation: Chemical Oxidation	$500.00			1 + 0
☐ Emergency/Temporary Authorization	★			★★
Note: Carry subtotals over to Part III, page 2 of this form.	Subtotal ➡			

★See fee schedule on registration/application.

★★Contact the specific permit program for this information. (Contact numbers are provided in the instructions)

Affirmative Action, Equal Employment Opportunity and Americans with Disabilities

The Connecticut Department of Energy and Environmental Protection is an Affirmative Action/Equal Opportunity Employer that is committed to complying with the requirements of the Americans with Disabilities Act (ADA). Please contact us at (860) 418-5910 or deep.accommodations@ct.gov if you: have a disability and need a communication aid or service; have limited proficiency in English and may need information in another language; or if you wish to file an ADA or Title VI discrimination complaint.

Permit Application for Programs Administered by the Inland Water Resources Division

DEP USE ONLY

Please complete this application form in accordance with the instructions (DEP-IWRD-INST-100) in order to ensure the proper handling of your application. Print or type unless otherwise noted. You must submit the *Permit Application Transmittal Form* (DEP-APP-001) and the initial fee along with this form.

Part I: Application Type

Check the appropriate box identifying the application type.

This application is for (check one):	Please identify any previous or existing permit/authorization/registration number in the space provided.
☒ A *new* application	Existing permit/authorization/registration number:
☐ A *renewal* of an existing permit	
☐ A *modification* of an existing permit	Expiration Date:

Part II: Permit Type and Fee Information

Please note: effective August 21, 2003, the application fees for the programs administered by the Inland Water Resources Division have increased as listed in the following table. The fee for municipalities is 50% of the listed rates.

Type of Permit (check *all* that apply):	Fee to submit with application:
☐ **Inland Wetlands & Watercourses** CGS Sec. 22a-36 et seq.	none
☐ **Dam Construction** *CGS Sec. 22a-403*	none
☒ **401 Water Quality Certificate** *33 U.S.C. 1341*	none
☐ **Flood Management Certification** *CGS Sec. 25-68(b) - (h)*	none
Stream Channel Encroachment *CGS Sec. 22a-342*	
☐ No change in grade and no construction of above-ground structures	$470.00
☐ A change in grade and no construction of above-ground structures	$940.00
☐ A change in grade and above-ground structures or buildings	$4,000.00
Water Diversion: Consumptive Use *CGS Sec. 22a-372(e)*	
☐ Withdrawal > 0.05 and < 0.5 mgd	$2,050.00
☐ Withdrawal ≥ 0.5 and < 2.0 mgd	$4,000.00
☐ Withdrawal ≥ 2.0 mgd	$6,250.00
Water Diversion: Nonconsumptive Use *CGS Sec. 22a-372(e)*	
☐ Watershed < 0.5 sq mi	$2,050.00
☐ Watershed ≥ 0.5 sq mi and < 2.0 sq mi	$4,000.00
☐ Watershed ≥ 2.0 sq mi	$6,250.00

Part III: Applicant Information

1. Fill in the name of the applicant(s) as indicated on the *Permit Application Transmittal Form* (DEP-APP-001):

   Applicant: **Tennessee Gas Pipeline Company, L.L.C.**

   Phone: **713-420-5360** ext. Fax:

   ☐ Check here if there are co-applicants. If so, label and attach additional sheet(s) with the required information to this sheet.

2. Applicant's interest in property at which the proposed activity is to be located:

   ☐ site owner ☐ option holder ☐ lessee

   ☒ easement holder ☐ operator ☐ other (specify):

3. List primary contact for departmental correspondence and inquiries, if different than the applicant.

   Name: **Tennessee Gas Pipeline Company, L.L.C**

   Mailing Address: **1001 Louisiana Street**

   City/Town: **Houston** State: **Texas** Zip Code: **77002**

   Business Phone: **713-420-5360** ext. Fax:

   Contact Person: **Michael Letson** Title: **Project Manager**

4. List attorney or other representative, if applicable:

   Firm Name:

   Mailing Address:

   City/Town: State: Zip Code:

   Business Phone: ext. Fax:

   Attorney:

5. Facility or Property Owner, if different than the applicant:

   Name:

   Mailing Address:

   City/Town: State: Zip Code:

   Business Phone: ext. Fax:

   Contact Person: Title:

   Home address of owner (for Inland Wetlands applications only):

   Mailing Address:

   City/Town: State: Zip Code:

   Home Phone:

Part III: Applicant Information (continued)

6. List any engineer(s) or other consultant(s) employed or retained to assist in preparing the application or in designing or constructing the activity. ☒ Check here if additional sheets are necessary, and label and attach them to this sheet.

   Name: **AECOM Environment**

   Mailing Address: **10 Orms Street, Suite 405**

   City/Town: **Providence** State: **RI** Zip Code: **02904**

   Business Phone: **401-274-5685** ext. Fax: **401-521-2730**

   Contact Person: **Mark Gardella** Title: **Vice President**

   Service Provided: **Environmental Studies**

Part IV: Site Information

1. **Site Location:**

   a. Name of facility, if applicable: **Northeast Energy Direct Project**

   Street Address or Description of Location: **Farmington, West Hartford, Bloomfield, Windsor, East Granby, Avon, Simsbury, North Bloomfield, Milford, Easton**

   City/Town: State: Zip Code:

   Project No., if applicable:

   b. Tax Assessor's Reference: Map Block Lot

   (Assessor's reference is not required if requester is an agency of the State of Connecticut.)

   c. Latitude and Longitude of the approximate "center of the site" in *degrees, minutes, and seconds*:

   Latitude: **41.816** Longitude: **-72.788**

   Method of determination (check one):

   ☐ GPS ☐ USGS Map ☒ Other (please specify): **Google Earth / GIS**

   If a USGS Map was used, provide the quadrangle name:

   d. Drainage Basin number(s) wherein the proposed activity will take place: **4100, 4300, 4403, 4404**

   e. Flood Insurance Rate Map Panel Number:

   Date of the map referenced:

   f. If applying for a SCEL permit, identify the property wherein the proposed activity will take place by indicating the following:

   SCEL Map number(s):

   Property Identifier:

   Date of the map referenced:

2. **COASTAL BOUNDARY:** Is the activity which is the subject of this application located within the coastal boundary as delineated on DEP approved coastal boundary maps? ☐ Yes ☒ No

   If yes, and this application is for a new permit or for a modification of an existing permit, you must submit a *Coastal Consistency Review Form* (DEP-APP-004) with your application as Attachment P.

   Information on the coastal boundary is available at the local town hall or on the "Coastal Boundary Map" available at DEP Maps and Publications (860-424-3555).

Part IV: Site Information (continued)

3. **ENDANGERED OR THREATENED SPECIES:** Is the project site located within an area identified as a habitat for endangered, threatened or special concern species as identified on the "State and Federal Listed Species and Natural Communities Map"? ☒ Yes ☐ No Date of Map: **December 2014**

   If yes, complete and submit a *Connecticut Natural Diversity Data Base* (CT NDDB) *Review Request Form* (DEP-APP-007) to the address specified on the form. **Please note NDDB review generally takes 4 to 6 weeks and may require additional documentation from the applicant. DEP strongly recommends that applicants complete this process before submitting the subject application.**

   When submitting this application form, include copies of any correspondence to and from the NDDB, including copies of the completed *CT NDDB Review Request Form*, as Attachment K (Environmental Report) or in Attachment Q if no environmental report is required.

   For more information visit the DEP website at www.ct.gov/dep/endangeredspecies (Review/Data Requests) or call the NDDB at 860-424-3011.

4. **AQUIFER PROTECTION AREAS:** Is the site located within a town required to establish Aquifer Protection Areas, as defined in section 22a-354a through 354bb of the General Statutes (CGS)?

   ☒ Yes ☐ No

   If yes, is the site within an area identified on a Level A or Level B map? ☐ Yes ☒ No

   To view the applicable list of towns and maps visit the DEP website at www.ct.gov/dep/aquiferprotection

   To speak with someone about the Aquifer Protection Areas, call 860-424-3020.

5. **CONSERVATION OR PRESERVATION RESTRICTION:** Is the property subject to a conservation or preservation restriction? ☐ Yes ☒ No

   If Yes, proof of written notice of this application to the holder of such restriction or a letter from the holder of such restriction verifying that this application is in compliance with the terms of the restriction, must be submitted as Attachment Q.

6. **Other Permits:** List any previous federal, state or local permits or certificates that have already been issued for the site or for the proposed activity:

Type or Nature of Permit	Permit No. Issuing Authority	Date Issued	Expiration Date	Permittee Name

Part V: Supporting Documents

Please check the attachments submitted as verification that *all* applicable attachments have been submitted with this application form. When submitting any supporting documents, please label the documents as indicated in this part (e.g., Attachment A, etc.) and be sure to include the applicant's name as indicated on the *Permit Application Transmittal Form*. The specific information required in each attachment is described in the *Instructions for Completing A Permit Application for Inland Water Resources Division Activities* (DEP-IWRD-INST-100).

☒	Attachment A:	Executive Summary
☒	Attachment B:	An 8 1/2" x 11" copy of a United States Geological Survey (USGS) Topographic Quadrangle Map (scale: 1:24,000) with the regulated activity or project site outlined or pinpointed, as appropriate.
☒	Attachment C:	*Documentation Form for: Inland Wetlands and Watercourses Permit, Stream Channel Encroachment Line Permit, and 401 Water Quality Certification* (DEP-IWRD-APP-101)

Part V: Supporting Documents (continued)

☐ Attachment D: *Documentation Form for Water Diversion Permit* (DEP-IWRD-APP-102)

☐ Attachment E: *Documentation Form for a Dam Construction Permit* (DEP-IWRD-APP-103)

☐ Attachment F: *Documentation Form for Flood Management Certification* (DEP-IWRD-APP-104) (State Agencies Only)

☒ Attachment G: Plan Sheets and Drawings

☒ Attachment H: Engineering Documentation

Part 1: *Engineering Report Checklist* (DEP-IWRD-APP-105A) and an Engineering Report

Part 2: *Hydrologic and Hydraulic Consistency Worksheet* (DEP-IWRD-APP-105B)

Section I: Floodplain Management

Section II: Stormwater Management

For state agencies only:

Section III: State Grants and Loans

Section IV: Disposal of State Land

☒ Attachment I: Flood Contingency Plan

☒ Attachment J: Soil Scientist Report (not required for Flood Management Certification)

☒ Attachment K: Environmental Report (not required for Flood Management Certification)

☒ Attachment L: Mitigation Report - wetlands and watercourses, fish and wildlife (not required for Flood Management Certification)

☒ Attachment M: Alternatives Assessment (not required for Flood Management Certification)

☒ Attachment N: *Applicant Compliance Information Form* (DEP-APP-002) (not required for Flood Management Certification or 401 Water Quality Certification Approvals)

☒ Attachment O: *Applicant Background Information Form* (DEP-APP-008) (not required for Flood Management Certification)

☐ Attachment P: *Coastal Consistency Review Form* (DEP-APP-004) (if applicable)

☒ Attachment Q: Other Information: any other information the applicant deems relevant or is required by DEP.

Number of Copies of Application:

Submit one original of all application forms, certifications, reports and supporting documents and the number of photocopies of all such materials as noted on the *Permit Application Transmittal Form*. When applying for more than one permit, you should submit the original and no more than six copies.

Part VI: Application Certification

The applicant *and* **all** individuals responsible for actually preparing the application or supporting documentation must sign this part. An application will be considered insufficient unless **all** required signatures are provided. You must include signatures of any person preparing any report or parts thereof filed in support of this application (i.e., professional engineers, surveyors, soil scientists, biologists, environmental and other consultants, etc.).

"I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify that based on reasonable investigation, including my inquiry of the individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief.

I understand that a false statement in the submitted information may be punishable as a criminal offense, in accordance with Section 22a-6 of the General Statutes, pursuant to Section 53a-157b of the General Statutes, and in accordance with any other applicable statute.

I certify that this application is on complete and accurate forms as prescribed by the commissioner without alteration of the text.

I certify that I will comply with all notice requirements as listed in Section 22a-6g of the General Statutes."

Gina B. Dorsey
Signature of Applicant

11/18/15
Date

Gina Dorsey
Name of Applicant (print or type)

Director - EHS- Project Permitting
Title (if applicable)

Ann Merry for
Signature of Preparer (if different than above)

11/18/15
Date

Mark Gardella
Name of Preparer (print or type)

Vice President
Title (if applicable)

☐ Check here if additional signatures are required.

If so, please reproduce this sheet and attach signed copies to this sheet.

Reminder: After submitting this application to DEP, except in the case of a Flood Management Certification, you must publish a notice of the application immediately and submit a certified copy of this published notice to DEP. See "Notice of Permit Application" section in the instructions (DEP-IWRD-INST-100).

List the name of the newspaper the Notice of Permit Application will be published in: **Hartford Courant**

Note: Please submit the *Permit Application Transmittal Form*, Application Form, Fee, and all Supporting Documents to:

CENTRAL PERMIT PROCESSING UNIT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
79 ELM STREET
HARTFORD, CT 06106-5127

TABLE OF CONTENTS

Attachment A

Executive Summary

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Executive Summary

1.1 Project Description

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") is filing an application seeking the issuance of a certificate of public convenience and necessity from the Federal Energy Regulatory Commission ("Commission" or "FERC") for the construction and operation of the proposed Northeast Energy Direct Project ("NED Project" or "Project"). Tennessee proposes to expand and modify its existing pipeline system in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. The NED Project is being developed to meet the increased demand in the Northeast United States ("U.S.") for transportation capacity of natural gas.

The NED Project will provide new firm natural gas transportation capacity to meet the growing energy needs in the Northeast U.S., particularly in New England. The Supply Path Component, as defined below, will transport up to 1.2 billion cubic feet per day ("Bcf/d") of natural gas, and the Market Path Component, as defined below, will transport up to 1.3 Bcf/d of natural gas.[1] For the purposes of this application, the Project volume will be referred to as up to 1.3 Bcf/d. The proposed Project involves the following facilities:

- Approximately 41 miles of pipeline looping on Tennessee's 300 Line in Pennsylvania;
- Approximately 133 miles of new pipeline, of which 102 miles are proposed to be generally co-located with the certificated Constitution Pipeline Project ("Constitution")[2] in Pennsylvania and New York (extending from Tennessee's existing 300 Line near Auburn, Pennsylvania to Wright, New York);
- Approximately 54 miles of pipeline generally co-located with Tennessee's existing 200 Line and an existing utility corridor in New York;
- Approximately 64 miles of pipeline generally co-located with an existing utility corridor in Massachusetts;
- Approximately 70 miles of pipeline generally co-located with an existing utility corridor in New Hampshire (extending southeast to Dracut, Massachusetts);
- Approximately 58 miles of various laterals and a pipe loop segment in Massachusetts, New Hampshire, and Connecticut to serve local markets;
- Construction of nine new compressor stations and 15 new meter stations, and modifications to an existing compressor station and 14 existing meter stations throughout the Project area; and
- Construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

[1] The reason for the difference in the capacity volumes of the two Project components is that Tennessee is assuming a certain amount of volumes to flow on the Market Path component facilities from sources other than the Supply Path component.

[2] On December 2, 2014, the Commission issued an Order Issuing Certificates and Approving Abandonment, Constitution Pipeline Company, LLC, 149 FERC 61,199 (2014), for the Constitution Pipeline Project, which adopted the recommendations from the Constitution "Final Environmental Impact Statement: Constitution Pipeline and Wright Interconnect Projects," FERC Environmental Impact Statement ("EIS") No. 0249F, Docket Numbers CP13-499-000, CP13-502-000, and PF12-9-000 ("Constitution Final EIS ["FEIS"]") issued October 24, 2014. Information contained within this document related to the Constitution Pipeline Project was based on routing included in the FEIS, as approved by the certificate order.

To the extent that it is practicable, feasible, and in compliance with existing law, Tennessee proposes to locate proposed pipeline facilities (either pipeline looping segments or co-located pipeline facilities) generally within or adjacent to its existing right-of-way ("ROW") associated with its existing 300 Line in Pennsylvania and Connecticut; its existing 200 Line in New York and Massachusetts; and existing utility (pipeline and powerline) corridors in Pennsylvania, New York, Massachusetts, and New Hampshire.

Pipeline loops are those pipeline segments which are laid parallel to, and connected to, another pipeline and used to increase capacity along existing pipeline facilities. These lines are connected to move larger volumes of gas through a single pipeline segment. Tennessee is proposing to minimize impacts by looping its own existing facilities in Connecticut.

Co-located pipelines are those that are laid parallel to another existing pipeline or linear utility. The current route of Tennessee's proposed NED Project, in large part, is located parallel and adjacent to, and, in many cases, overlaps existing utility easements (either pipeline or powerlines). This paralleling/overlapping of easements is commonly referred to as co-location. Refinement to the routing, of the NED Project, including locations of permanent easement and temporary construction workspaces, has occurred as the NED Project was developed during the pre-filing process and will continue as necessary through the certificate process, incorporating information gained from field surveys, and landowner and stakeholder input, including input from power companies that have existing easements in areas where Tennessee is proposing to co-locate the Project pipelines.

For areas of the NED Project pipeline alignment that are proposed to be co-located with existing powerline easements, Tennessee is proposing that the centerline of the pipeline will be installed generally five feet outside the existing powerline easement boundary. Tennessee is also proposing to minimize impacts by looping its own facilities in Pennsylvania and Connecticut.

For all areas of co-location with powerline easements, Tennessee is proposing that the permanent easement be centered generally on the proposed pipeline and that 20 feet of the proposed 50 foot permanent easement overlap the existing powerline easement. Further, Tennessee is proposing that the temporary construction workspace for the Project for these areas of co-location will overlap the existing powerline easement between 30 to 60 feet. The amount of overlap of temporary construction easements and the existing powerline easements will depend ultimately on the location of the closest powerline towers and facilities, which will dictate the amount of available space on the powerline easement.

This proposed overlap of permanent easement and temporary construction workspace with existing powerline easements will reduce environmental and landowner impacts by a commensurate width outside the powerline easement. Tennessee notes that the proposed routing of the centerline of the pipeline generally five feet outside the existing powerline easement boundaries is based on information obtained from consultation with the power companies regarding co-location and the proposed overlapping of NED Project permanent easements and temporary construction workspaces with that of existing powerline easements and these discussions are ongoing.

The Project facilities to be located in Connecticut include 14.80 miles of new 24-inch-diameter pipeline generally located within or directly adjacent to Tennessee's existing 300 Line's ROW in the Towns of Bloomfield, Avon, Simsbury, East Granby, Farmington, West Hartford, and Windsor. Approximately 1.4 miles of new pipeline will be constructed within existing powerline ROW. In addition to the new pipeline, modifications to three meter stations are proposed as part of the Project. The modified meter stations in Connecticut are as follows:

- Easton – Fairfield County, Connecticut: This project is an upgrade to an existing meter station. Modifications include the installation of a new 4 inch rotary meter in place of the existing meter by-pass run.
- North Bloomfield – Hartford County, Connecticut: This project is an upgrade to an existing meter station. Modifications include the installation of a new station tap assembly, replacement of the station inlet piping, addition of a filter-separator, replacement of the existing meter run headers, replacement and/or addition to the station metering.
- Milford – New Haven County, Connecticut: This project is an upgrade to an existing meter station. Modifications include the replacement of the station inlet piping and the replacement of an existing 2 inch turbine meter run.

1.2 Purpose and Need

Tennessee proposes to construct, install, and operate the Project facilities to meet the growing demand for natural gas transportation capacity in the Northeast U.S. and, particularly New York and New England. The Project has been designed to provide a long-term solution to the problems associated with New York and New England's high natural gas and electric prices. Current and future projected demand demonstrates that there is a genuine market need for the pipeline capacity to be created by the NED Project. Existing natural gas pipeline constraints have resulted in New England consumers paying the highest heating and electricity costs in the continental U.S., stifling economic growth and straining household budgets. These high energy costs disproportionally affect low to middle income households, small businesses, and charitable organizations and community service providers that can least afford it. The NED Project will bring needed incremental natural gas supplies to New York and New England and will do so in a cost effective, safe, and environmentally sound manner.

The Project, as described further herein, is a major new pipeline project that consists of: (1) approximately 174 miles of new and co-located pipeline and two pipeline looping segments on Tennessee's existing 300 Line in Pennsylvania, and compression facilities designed to receive gas from Tennessee's 300 Line, Iroquois Gas Transmission System, LP, and/or the Constitution Pipeline Project for deliveries to Tennessee's existing 200 Line system, Iroquois Gas Transmission System, and/or Market Path Component of the NED Project, as defined below, near Wright, New York (may be referred to as the "Supply Path Component" of the NED Project); and (2) approximately 188 miles of new and co-located pipeline facilities extending from Wright, New York, to an interconnect with the Joint Facilities of Maritimes & Northeast Pipeline System and Portland Natural Gas Transmission System ("PNGTS") ("Joint Facilities") at Dracut, Massachusetts and Tennessee's existing 200 Line near Dracut, Massachusetts (may be referred to as the "Market Path Component" of the NED Project). In addition, the Project includes: (1) the construction of nine new compressor stations, and modifications at an existing compressor station throughout the Project area; (2) construction of 15 new meter stations and modifications to 14 existing meter stations throughout the Project area; and (3) approximately 58 miles of market delivery laterals and pipeline looping segments located in Massachusetts, New Hampshire, and Connecticut.

The Project will provide up to 1.2 Bcf/day on the Supply Path Component and up to 1.3 Bcf/d on the Market Path Component of additional natural gas transportation capacity to meet the growing energy needs in the Northeast U.S., particularly in New York and New England. This includes needs of local distribution companies ("LDCs"), gas-fired power generators, electric distribution companies, industrial plants, natural gas producers, and other New England consumers. The NED Project has significant market support as evidenced by the executed precedent agreements to date with various shippers for transportation service on both the Market Path Component and Supply Path Component facilities (the "Project Shippers"). Tennessee has executed precedent agreements with four New England LDCs, two natural gas producers, a municipal light department, and a power generator for 751,650 dekatherms per day ("Dth/d") of long-term firm transportation capacity on the Supply Path Component, and has executed precedent agreements with seven New England LDCs, a municipal light department, an industrial end-user, and a holding corporation for 552,262 Dth/d of long-term firm transportation capacity on the Market Path Component.[3] Tennessee is confident that the significant demand for natural gas and pipeline capacity in the northeast U.S., particularly the demand from the electric power generation market as a result of the initiatives underway with five of the six states in New England to facilitate the ability of electric distribution companies to contract for pipeline capacity and recover the costs in their rates, will result in additional contract commitments for the full Project capacity. Tennessee is in ongoing negotiations with other additional potential Project shippers and as additional precedent agreements are executed, Tennessee will supplement the record in this proceeding.

Multiple studies have concluded that there is a critical need in the northeast U.S for additional pipeline capacity to lower energy costs, reduce volatility of natural gas and electric prices, and foster more reliable natural gas and electric service to New England consumers. As a result of the fact that current natural gas transportation infrastructure is inadequate to meet the growing demand in the New England region, gas prices in New England are the highest in the U.S.[4] Limited natural gas transportation infrastructure also has led to extremely high electricity prices in the northeast U.S., and threatens the reliability of the region's electric grid.[5] For example, National Grid received approval to increase its customers' electric rates by an average of 37 percent for winter 2014-2015 due to "continued constraints on the natural gas pipelines serving the region, which decrease natural gas availability at times of peak demand, causing some generators to buy gas on the spot market at higher prices, switch over to alternate fuels, or not run at all."[6] National Grid has applied for approval to increase its customers' electric rates by approximately 21 percent for winter 2015-2016, siting electric supply volatility due to continued gas pipeline constraints.[7]

3 Project Shippers on the Supply Path Component and Market Path Component are identified in Exhibit I to the certificate application.

4 See ISO New England, 2013 Wholesale Electricity Prices in New England Rose on Higher Natural Gas Prices: Pipeline Constraints and Higher Demand Pushed Up Prices for Both Natural Gas and Power at 1 (March 18, 2014), available at http://www.iso-ne.com/nwsiss/pr/2014/2013_price%20release_03182014_final.pdf.

5 *Id*. at 2. *See also* Massachusetts Office of The Attorney General, *Overview of Electricity & Natural Gas Rates*, available at http://www.mass.gov/ago/doing-business-in-massachusetts/energy-and-utilities/energy-rates-and-billing/electric-and-gas-rates.html.

6 National Grid, National Grid Files for Winter Rates in Massachusetts (September 24, 2014), available at https://www.nationalgridus.com/aboutus/a3-1_news2.asp?document=8764. Massachusetts DPU Docket No. 14-115, National Grid petition approved on 11/7/14. http://web1.env.state.ma.us/DPU/FileRoomAPI/api/Attachments/Get/?path=14-115%2f14115approval11072014.pdf.

7 National Grid, New England's Wiinter Electricity Supply Prices Remain Volatile (September 15, 2015), available at https://www.nationalgridus.com/masselectric/a3-1_news2.asp?document=9743. Massachusetts DPU Docket No.15-BSF-D3. http://web1.env.state.ma.us/DPU/FileRoomAPI/api/Attachments/Get/?path=15-BSF-D3%2finitial_filing.pdf.

A January 21, 2015 presentation by Gordon van Welie, President and Chief Executive Officer of ISO-New England, discussed that the New England region is challenged by a lack of natural gas pipeline infrastructure, and is losing non-gas power plants, resulting in serious threats to power system reliability. The presentation further noted that "electricity prices are on an upward trajectory until the needed energy infrastructure is added."[8]

Additional natural gas infrastructure may benefit the region in the form of lower energy costs and enhanced reliability to both the gas transmission system and the power grid, while also reducing the region's reliance on coal and oil-fired power plants with the added benefit of reducing greenhouse gas ("GHG") emissions. A recent study by the Interstate Natural Gas Association of America ("INGAA") Foundation and ICF International predicted that 6.0 Bcf/d of new natural gas pipeline capacity will be needed in the Northeast U.S. by 2020, and 10.1 Bcf/d of capacity will be needed by 2035.[9] Another recent study by the Competitive Energy Services ("CES") estimated that to provide the ISO-NE with natural gas to meet the needs of electric generators in the winter at competitive prices, New England needs an additional 2.4 Bcf/d of pipeline capacity, resulting in an annual economic value of $2.988 billion per year to the region's electricity consumers alone[10].

The New England region as a whole will benefit from the Project, as it will enable New England to sustain its electric grid and lower energy costs to compete on a more level economic playing field with other regions of the U.S. with access to low-cost gas. As part of Tennessee's fully integrated natural gas pipeline transportation system, direct access to natural gas supplies via the Project Supply Path Component and larger group of producers, the Project will provide incremental direct access to diverse and economic supplies of natural gas to customers in the New England region. As demand for natural gas in New England increases, Tennessee's LDC Project Shippers have expressed the need for additional firm transportation capacity to serve their growing residential, commercial, industrial, and power generation markets. In addition to the benefits to New England, the Project deliveries to the Iroquois Gas Transmission System and existing Tennessee system at Wright, New York will provide more supply diversity to Iroquois and Tennessee markets in New York currently served by those pipelines. These include residential, commercial, industrial, and power generation markets.

The staff of the New Hampshire Public Utility Commission ("NHPUC") released a report on September 15, 2015 analyzing the need for additional natural gas capacity and the potential for energy cost savings as a result of increased capacity. The estimates total annual average wholesale energy cost savings for the Project to range from $2.1 billion to $2.8 billion. This savings is significantly higher than other pipeline projects proposed for New England due to increased pipeline capacity delivered by the

8 van Welie, Gordon. 2015. State of the Grid: Managing a System in Transition. ISO-New England Inc., ISO on Background Informational Briefing, January 21, 2015, available at http://www.iso-ne.com/static-assets/documents/2015/01/stateofgrid_presentation_01212015.pdf

9 The Interstate Natural Gas Association of America Foundation, *North American Midstream Infrastructure through 2035: Capitalizing on Our Energy Abundance* (March 18, 2014). Available at http://www.ingaa.org/File.aspx?id=21498.

10 Silkman, Richard and Mark Isaacson. 2014. Assessing Natural Gas Supply Options for New England and their Impacts on Natural Gas and Electricity Prices (February 12, 2014). Prepared for the Industrial Energy Consumer Group. Available at: http://competitive-energy.com/docs/2014/02/CES_REPORT_NaturalGasSupply_20140131_FINAL.pdf.

NED Project.[11] In addition, the Massachusetts Department of Public Utilities ("MADPU") has indicated that electric distribution companies may enter into long-term contracts to purchase natural gas in order to reduce winter electricity price increases.
Construction of the Project will help alleviate the natural gas pipeline capacity constraints in the region by increasing capacity in high-demand markets in New York and New England. The Project will serve the emergent need for significant natural gas transportation capacity into New England by delivering sufficient incremental supplies that will, based upon basic market forces of supply and demand, put considerable downward pressure on energy commodity prices, which currently are among the highest in the U.S. The expanded natural gas pipeline transportation infrastructure will ensure greater reliability and fuel certainty in the electric generation sector. The proposed interconnection with the Joint Facilities, together with the anticipated reversal of the primary flow direction of the Joint Facilities and Maritimes & Northeast Pipeline, will potentially enable the Project to access more markets in the region, including those in New Hampshire and Maine, the Atlantic Canada region, as well as markets on Algonquin Gas Transmission's ("AGT") pipeline system through its HubLine Pipeline. Additionally, the Project significantly increases capacity via a backhaul on Tennessee's existing 200 Line system and will increase deliverability at an important supply feed to the AGT pipeline system via an existing Tennessee-AGT interconnect at Mendon, Massachusetts. Backhaul refers to transporting gas in the opposite direction from historical operation. The existing Tennessee system generally flows from west to east in New England. Bringing gas into the eastern end of the existing system via the Project will allow Tennessee to use the existing pipes to instead transport gas from east to west – first via displacement, and then if volumes become large enough via physical east to west flow.

A significant portion of the Market Path Component facilities are proposed to be co-located with existing utility corridors (i.e., generally located parallel and adjacent to, and, in certain cases, overlaps existing utility easements [pipeline or powerline]) rather than with Tennessee's existing ROW through the Commonwealth of Massachusetts. Tennessee's existing system is located in densely populated and developed parts of Connecticut and Massachusetts. When Tennessee evaluated the market need in New England, and the scope of facilities that will be required to provide the infrastructure that New England needs to reduce its high energy costs and enhance electric reliability, Tennessee conducted extensive evaluation of options to: (1) construct the pipeline along its existing 200 Line pipeline corridor in southern Massachusetts; (2) construct a new pipeline along a route across northern Massachusetts, utilizing existing utility corridors where feasible; or (3) construct a new pipeline along a route across eastern New York, western Massachusetts and southern New Hampshire, utilizing existing utility corridors where feasible. An evaluation of the alternatives that Tennessee has and continues to consider and evaluate are set forth in Attachment M of this Application. Based on an evaluation that includes environmental and landowner impacts, quickest time-to-market gas delivery, constructability, and other factors, Tennessee has selected the New York, Massachusetts, and New Hampshire route which predominantly follows the existing utility corridors for the Market Path Component of the Project.

The Project will provide the transformative solution that the northeast U.S need to reduce energy costs, enhance electric reliability, and stimulate economic growth in the New England region. It will provide the region with direct access to low-cost gas supplies, on the large scale necessary to significantly lower

[11] New Hampshire Public Utility Commission. 2015. Report on Investigation into Potential Approaches to Mitigate Wholesale Electricity Prices. (September 15, 2015) Available at: http://www.puc.state.nh.us/electric/Wholesale%20Investigation/IR%2015-124%20Staff%20Report.pdf.

energy costs to the region's homes and businesses. Tennessee's proposed route for the Project will disturb significantly fewer stakeholders and result in lower costs to consumers than it will have if Tennessee were to expand only along its existing 200 Line system corridor. The Supply Path Component involves looping of the existing 300 Line and co-location with the certificated Constitution Pipeline, to minimize impacts. Additionally, the New York, Massachusetts, and New Hampshire route of the Market Path Component, which predominantly follows existing utility corridors, will provide economic service to several geographic areas in northern Massachusetts and southern New Hampshire that are not currently served by an interstate pipeline.

In summary, the purpose of the Project, to create new natural gas transportation capacity to meet the growing demand for natural gas transportation capacity in the northeast U.S., particularly New York and New England, is clear. The new capacity created by the Project will help reduce natural gas costs for homes and businesses in the region, lower electricity prices, increase the reliability of the electric grid, and stimulate economic growth. The Project will also have ancillary environmental benefits by reducing the region's reliance on GHG-emitting coal and oil-fired power plants.

1.3 Wetland and Water Resources

The Project has taken measures to minimize or avoid adverse effects to water resources and has sited the Project within or adjacent to existing pipeline or powerline ROW to the extent practicable. In addition, appurtenant facilities and access roads have been sited in a manner to limit impacts to wetlands and watercourses to the extent practicable. The plans and drawings provided in Attachment G show the Project activities within waterbodies and wetlands (i.e., Waters of The U.S. per Sections 401/404 of the federal Clean Water Act). During construction of the Project, Tennessee will attempt to further avoid impacting these resources by using construction Project-specific Plan and Procedures, the Environmental Construction Plan ("ECP") for Connecticut, and Tennessee Best Management Practices ("BMP"s) (Attachment Q).

Access within the ROW across wetlands will only be permitted where soils are non-saturated and able to support construction equipment at the time of crossing, during frozen soil conditions (for winter tree clearing), or with the use of timber mats to avoid rutting of the wetland soil. If mats are not used, the Environmental Inspector ("EI") will record the pre- and post-construction soil density using a penetrometer to determine if the soil has been inadvertently compacted during construction or access.

All wetlands will be substantially restored to their pre-construction grades, contours, and drainage patterns. As such, the permanent impacts on wetlands associated with the Project will consist of a conversion of palustrine forested ("PFO") wetlands to palustrine scrub-shrub ("PSS") or palustrine emergent ("PEM") wetland vegetation cover types. Woody vegetation within the new permanent ROW will be allowed to regenerate within such ROW except for a 10-foot wide area centered over the pipeline that will be maintained in an herbaceous/scrub-shrub state to allow for inspection and maintenance of the pipeline once the Project is in-service. In addition, trees within 15 feet of the pipeline that could damage the pipeline coating may be selectively cut and removed from the new permanent ROW.

Tennessee's representatives submitted written consultations to the United States Fish and Wildlife ("USFWS") and National Marine Fisheries Service ("NMFS") in order to document federal listed species in the Project area. At the state level, the Connecticut Natural Diversity Database was consulted for state-listed endangered, threatened, or species of special concern, plant and animal species. Based upon the information subsequently received from these agencies, Tennessee has identified areas of the Project alignment where the potential exists for occurrence of federal- and/or state-listed threatened and endangered species. Additional information on each species identified, survey plans and/or results, and mitigation measures have been provided in Attachment K. Tennessee continues to work cooperatively with the state and federal agencies in developing approved field survey protocols to identify and document occurrences of rare plant and animal species in the Project area.

Tennessee identified, located, classified, and delineated wetland resources within and adjacent to the Project area through field surveys conducted in 2014 and 2015. Jurisdictional wetlands crossed by the Project in Connecticut were field delineated in accordance with the United States Army Corps of Engineers ("USACE") Wetlands Delineation Manual (USACE 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (USACE 2012). Tennessee intends to implement the Project-specific Procedures, incorporated into the Connecticut ECP, for any wetland area regardless of jurisdictional status, provided that the wetland area in question meets all criteria described in the USACE *Wetlands Delineation Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions* (USACE 2012).

Field surveys for the Project were initiated in June 2014 and were suspended in November 2014 due to winter weather conditions. Additional field surveys re-commenced in March 2015 and are continuing as additional survey access permissions are granted. Field surveys have included, but are not limited to, civil survey, wetland and waterbody delineations, rare species habitat assessment and presence/absence surveys, and cultural resources surveys. Completion of field surveys will be dependent upon the finalization of the Project alignment, as well as the acquisition of survey permission on all affected parcels. Supplemental data will be provided to all applicable agencies as field surveys are completed.

Biological field survey data shown on the aerial alignment sheets included in Attachment G incorporates survey data obtained through September 2, 2015. In addition, Tennessee conducted aerial flights to obtain high-resolution digital stereo aerial photography and light detection and ranging ("LiDAR") imagery. Tennessee utilized this imagery to photo-interpret wetlands and waterbody boundaries, ecological communities, and rare species habitat in areas where survey access has not been granted. The LiDAR derived 1-foot contours were overlain on project specific orthophotos to supplement the photointerpretation. Additional resources were referenced for supporting information including National Wetland Inventory ("NWI") maps, hydric soil maps, hydrology maps, topographic maps, and additional publicly available aerial photographs as needed to confirm a feature. In areas where high resolution was not collected, Tennessee utilized publically available data to identify the presence of waterbodies. Photointerpretation provides a more accurate assessment of impacts as compared to publicly available data; however, Tennessee recognizes that all resource boundaries will require field verification for the issuance of environmental permits.

During the spring of 2015, all Potential Vernal Pools ("PVP"s) were surveyed for evidence of breeding by obligate vernal pool species on parcels where access was available. Surveys included any temporarily flooded palustrine wetlands and flooded isolated depressions encountered in the field that might support vernal pool communities. Biologists followed survey and documentation procedures outlined by the USACE – New England District, "Vernal Pool Assessment Guidelines" and completed the USACE "Vernal Pool Characterization Form" for each pool encountered. A total of 103 parcels in Connecticut were surveyed for the presence of vernal pools. A total of 23 vernal pools on 12 parcels were documented. The vernal pool report is included in Attachment K. Additional vernal pool surveys are scheduled for the spring of 2016, and the results of these surveys will be communicated in subsequent submittals.

Tennessee reviewed National Flood Insurance Rate Maps ("FIRMs") issued by the Federal Environmental Management Agency ("FEMA") to identify proposed crossings of areas subject to flooding and high volume flows. The Connecticut portion of the Project crosses the flood zones of the Farmington River, Degrayes Brook, and Rippowam River. Tennessee will continue to consult with federal, state, and local agencies to identify any additional areas where flooding is a concern that may not be currently mapped by FEMA. FEMA Special Flood Hazard Areas ("SFHAs") are those areas subject to flooding by the 1 percent annual chance flood (100-year flood).

Tennessee will implement its Best Management Practices ("BMPs") for construction and restoration, as outlined in the Project-specific Plan and Procedures, Connecticut ECP and Tennessee's Construction BMPs (Attachment Q), which are intended to be used to avoid, minimize, and/or mitigate impacts from the Project. BMPs applicable to floodplains include the control of erosion and sedimentation through installation of structural erosion and sedimentation facilities within and at the limits of the Project workspace. BMPs will comply with Connecticut standards for erosion and sediment control, including specifications for flooding frequency and volume. Additionally, the amount of vegetation cleared during construction will be limited to the removal of the minimum amount necessary for safe construction. Tennessee will restore and revegetate temporary workspace ("TWS") areas to minimize impacts on vegetated areas. Restoration and revegetation will comply with state and federal regulations and monitoring requirements. The construction workspace will be restored to pre-construction contours after construction and will not result in increased flood heights or encroachment within floodways. Tennessee will apply for and obtain applicable regulatory permits and approvals related to land use regulations prior to construction of the proposed facilities. Tennessee's typical erosion and sediment control and BMP details are included in Attachment Q.

Residents in the vicinity of the Connecticut portion of the Project rely on public water supply and private wells for drinking water. Consultation with the Connecticut Department of Energy and Environmental Protection ("CTDEEP") indicated that the Project area is not located within any aquifer protection areas (Riese 2014).

Consultation with the Connecticut Department of Public Health ("CTDPH") indicated that the Project crosses several of the MDC public drinking water supply watersheds (McPhee 2015). The MDC provides potable water services to over 400,000 people in the greater Hartford area. All water company land falls under a three-tier classification system.

- Class I includes watershed land within 250 feet of high water of a reservoir or 100 feet of all watercourses and within 200 feet of groundwater wells.
- Class II land is located on a public drinking supply watershed which is not included in Class I or completely off a public drinking supply watershed, but within 150 feet of a distribution reservoir or a first-order stream tributary to a distribution reservoir.
- Class III consists the water company's land that is unimproved land off public drinking water supply watersheds and beyond 150ft from a distribution reservoir or first-order stream tributary to a distribution reservoir (CGS § 25-37c-2).

The proposed 300 Line Connecticut Loop will traverse approximately 5 miles through the watersheds of MDC Reservoirs #2, #3, #5, and #6 disturbing approximately 60 acres. The actual disturbance area will be confirmed once survey access is granted. This land is classified as Class I and Class II water company land in Connecticut and regulated by the State of Connecticut Department of Public Health (Jellison 2015).

The proposed 300 Line Connecticut Loop is located greater than 0.25 mile from Reservoir #2, #3, and #6 and over 0.5 mile from Reservoir #5. According to CGS Sections 25-32, any transfer or change of use of Class 1 or Class II water company lands requires permit approval by the Connecticut Department of Public Health ("DPH"). Tennessee is consulting with MDC to obtain access to survey the water company land in order to conduct site-specific engineering, environmental and cultural resources surveys. Tennessee is also in discussions with the MDC to determine the correct minimization and mitigation techniques best suitable for the watershed and the permit application to be filed with the DPH. Site specific plans will be developed in coordination with the MDC.

During consultation with MDC, two community wells were identified in Bloomfield, Connecticut owned by Juniper Club, Inc and the Orchard Hill Association. Collectively the wells service 36 households. The wells are located approximately 1,500 feet from the 300 Line Connecticut Loop, Segment S, approximate MP 6.2.

Tennessee will utilize BMPs outlined in Tennessee's Project-specific Plan and Procedures (Attachment Q) and Project-specific ECP for Connecticut including the Spill Prevention and Response Plan (Attachment Q) to avoid and minimize adverse effects to drinking water sources. Additionally, to ensure compliance with Tennessee's BMPs proposed for the Project, EIs will be employed during construction to oversee Tennessee's BMPs are implemented and that the Project complies with applicable regulatory permits and approval conditions. Tennessee anticipates that implementation of these BMPs will allow for construction and operation of the Project without adversely affecting any public watershed or potable surface water supply areas in Connecticut.

Table 1
Wetlands Associated With the Project in Connecticut

Facility Name	County	Town	Segment	Milepost[1]		Wetland ID[2,3]	Wetland Class[4]	State Wetland Classification[5]	Latitude	Longitude	Quadrangle	Crossing Method[6]	Wetland Impact (acres)							Crossing Length (feet)
													Construction[7]				Operation[8]			
				Begin	End								PEM	PFO	PSS	Other[10]	PFO	PSS	Other[9]	
Pipeline Facilities																				
300 Line CT Loop	Hartford	Farmington	S	0.07	0.09	WPI-3356	PFO	N/A	41° 44' 45.787" N	72° 47' 40.442" W	New Britain	Conventional Crossing	0.00	0.14	0.00	0.00	0.04	0.00	0.00	84
300 Line CT Loop	Hartford	West Hartford	S	0.34	0.35	WPI-3359	PEM	N/A	41° 45' 0.170" N	72° 47' 43.012" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Farmington	S	0.35	0.35	WPI-3359	PEM	N/A	41° 45' 0.374" N	72° 47' 43.351" W	Avon	Conventional Crossing	0.01	0.00	0.00	0.00	0.00	0.00	0.00	10
300 Line CT Loop	Hartford	Farmington	S	0.35	0.36	WPI-3359	PEM	N/A	41° 45' 0.547" N	72° 47' 43.416" W	Avon	Conventional Crossing	0.01	0.00	0.00	0.00	0.00	0.00	0.00	31
300 Line CT Loop	Hartford	West Hartford	S	0.35	0.36	WPI-3359	PEM	N/A	41° 45' 0.500" N	72° 47' 43.111" W	Avon	N/A	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Farmington	S	0.35	0.36	WPI-3360	PSS	N/A	41° 45' 0.387" N	72° 47' 43.427" W	Avon	N/A	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0
300 Line CT Loop	Hartford	Farmington	S	0.35	0.36	WPI-3361	PSS	N/A	41° 45' 0.573" N	72° 47' 43.483" W	Avon	N/A	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0
300 Line CT Loop	Hartford	Farmington	S	0.36	0.36	WPI-3362	PSS	N/A	41° 45' 0.902" N	72° 47' 43.582" W	Avon	N/A	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0
300 Line CT Loop	Hartford	Farmington	S	0.50	0.52	WPI-3365	PSS	N/A	41° 45' 7.837" N	72° 47' 46.362" W	Avon	Conventional Crossing	0.00	0.00	0.08	0.00	0.00	0.01	0.00	4
300 Line CT Loop	Hartford	West Hartford	S	0.50	0.51	WPI-3365	PSS	N/A	41° 45' 8.230" N	72° 47' 45.880" W	Avon	Conventional Crossing	0.00	0.00	0.01	0.00	0.00	0.01	0.00	23
300 Line CT Loop	Hartford	West Hartford	S	0.51	0.52	WPI-3367	PEM	N/A	41° 45' 8.443" N	72° 47' 45.534" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	0.51	0.52	WPI-3365	PSS	N/A	41° 45' 8.569" N	72° 47' 45.939" W	Avon	Conventional Crossing	0.00	0.00	0.01	0.00	0.00	0.01	0.00	19
300 Line CT Loop	Hartford	Farmington	S	0.64	0.65	WPI-3368	PSS	N/A	41° 45' 14.958" N	72° 47' 47.683" W	Avon	Conventional Crossing	0.00	0.00	0.05	0.00	0.00	0.01	0.00	20
300 Line CT Loop	Hartford	Farmington	S	0.71	0.72	WPI-3372	PEM	N/A	41° 45' 18.471" N	72° 47' 48.010" W	Avon	Conventional Crossing	0.04	0.00	0.00	0.00	0.00	0.00	0.00	21
300 Line CT Loop	Hartford	Farmington	S	0.71	0.73	WPI-3373	PFO/PSS	N/A	41° 45' 18.800" N	72° 47' 48.279" W	Avon	Conventional Crossing	0.00	0.04	0.00	0.00	0.03	0.00	0.00	93
300 Line CT Loop	Hartford	Farmington	S	0.72	0.73	WPI-3375	PEM	N/A	41° 45' 19.293" N	72° 47' 47.897" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	0.72	0.73	WPI-3372	PEM	N/A	41° 45' 19.156" N	72° 47' 47.745" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	0.72	0.74	WPI-3375	PEM	N/A	41° 45' 19.336" N	72° 47' 47.772" W	Avon	N/A	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	0.73	0.73	WPI-3373	PFO/PSS	N/A	41° 45' 19.558" N	72° 47' 47.805" W	Avon	N/A	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	1.06	1.08	WPI-3379	PEM	N/A	41° 45' 36.421" N	72° 47' 43.643" W	Avon	Conventional Crossing	0.07	0.00	0.00	0.00	0.00	0.00	0.00	73

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Facility Name	County	Town	Segment	Milepost[1]		Wetland ID[2,3]	Wetland Class[4]	State Wetland Classification[5]	Latitude	Longitude	Quadrangle	Crossing Method[6]	Wetland Impact (acres)							Crossing Length (feet)
													Construction[7]				Operation[8]			
				Begin	End								PEM	PFO	PSS	Other[10]	PFO	PSS	Other[9]	
300 Line CT Loop	Hartford	West Hartford	S	1.06	1.07	WPI-3378	PFO	N/A	41° 45' 36.322" N	72° 47' 43.968" W	Avon	N/A	0.00	0.05	0.00	0.00	0.01	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	1.07	1.23	WPI-3380	PSS	N/A	41° 45' 37.107" N	72° 47' 43.696" W	Avon	Conventional Crossing	0.00	0.00	0.43	0.00	0.00	0.03	0.00	182
300 Line CT Loop	Hartford	West Hartford	S	1.12	1.17	WPI-3382	PEM	N/A	41° 45' 39.415" N	72° 47' 43.111" W	Avon	Conventional Crossing	0.10	0.00	0.00	0.00	0.00	0.00	0.00	218
300 Line CT Loop	Hartford	West Hartford	S	1.12	1.18	WPI-3381	PFO	N/A	41° 45' 39.373" N	72° 47' 43.122" W	Avon	Conventional Crossing	0.00	0.25	0.00	0.00	0.08	0.00	0.00	47
300 Line CT Loop	Hartford	West Hartford	S	1.23	1.29	WPI-3385	Other	N/A	41° 45' 44.865" N	72° 47' 42.285" W	Avon	Conventional Crossing	0.00	0.00	0.00	0.18	0.00	0.00	0.00	183
300 Line CT Loop	Hartford	West Hartford	S	1.24	1.26	WPI-3386	PFO	N/A	41° 45' 45.654" N	72° 47' 42.243" W	Avon	Conventional Crossing	0.00	0.02	0.00	0.00	0.01	0.00	0.00	2
300 Line CT Loop	Hartford	West Hartford	S	1.24	1.30	WPI-3388	PFO/PSS	N/A	41° 45' 45.823" N	72° 47' 42.228" W	Avon	Conventional Crossing	0.00	0.24	0.00	0.00	0.07	0.00	0.00	72
300 Line CT Loop	Hartford	West Hartford	S	1.25	1.26	WPI-3387	PFO	N/A	41° 45' 45.898" N	72° 47' 42.318" W	Avon	N/A	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	1.45	1.66	WPI-3394	PEM	N/A	41° 45' 55.847" N	72° 47' 37.182" W	Avon	Conventional Crossing	0.59	0.00	0.00	0.00	0.00	0.00	0.00	987
300 Line CT Loop	Hartford	West Hartford	S	1.45	1.66	WPI-3392	PFO	N/A	41° 45' 55.707" N	72° 47' 37.605" W	Avon	N/A	0.00	0.62	0.00	0.00	0.21	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	1.65	1.71	WPI-3397	PFO	N/A	41° 46' 5.397" N	72° 47' 32.888" W	Avon	Conventional Crossing	0.00	0.54	0.00	0.00	0.16	0.00	0.00	275
300 Line CT Loop	Hartford	West Hartford	S	1.66	1.68	WPI-3396	PEM	N/A	41° 46' 6.276" N	72° 47' 34.064" W	Avon	N/A	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	1.68	1.70	WPI-3398	PEM	N/A	41° 46' 7.355" N	72° 47' 33.356" W	Avon	N/A	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	1.76	1.77	WPI-3401	PFO	N/A	41° 46' 11.303" N	72° 47' 33.271" W	Avon	N/A	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	1.76	1.78	WPI-3402	Other	N/A	41° 46' 11.407" N	72° 47' 33.298" W	Avon	Conventional Crossing	0.00	0.00	0.00	0.04	0.00	0.00	0.00	49
300 Line CT Loop	Hartford	West Hartford	S	1.78	1.85	WPI-3403	PFO	N/A	41° 46' 12.346" N	72° 47' 32.741" W	Avon	N/A	0.00	0.21	0.00	0.00	0.01	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	1.92	1.95	WPI-3405	PFO	N/A	41° 46' 20.027" N	72° 47' 32.070" W	Avon	N/A	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	2.24	2.26	WPI-3414	PFO	N/A	41° 46' 36.075" N	72° 47' 32.910" W	Avon	Conventional Crossing	0.00	0.09	0.00	0.00	0.02	0.00	0.00	33
300 Line CT Loop	Hartford	West Hartford	S	2.24	2.25	WPI-3412	PSS	N/A	41° 46' 36.060" N	72° 47' 32.966" W	Avon	N/A	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	2.25	2.26	WPI-3413	PFO	N/A	41° 46' 36.630" N	72° 47' 32.917" W	Avon	Conventional Crossing	0.00	0.02	0.00	0.00	0.02	0.00	0.00	24
300 Line CT Loop	Hartford	West Hartford	S	2.47	2.49	WPI-3416	PFO	N/A	41° 46' 48.172" N	72° 47' 34.369" W	Avon	N/A	0.00	0.05	0.00	0.00	0.01	0.00	0.00	0

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Facility Name	County	Town	Segment	Milepost[1]		Wetland ID[2,3]	Wetland Class[4]	State Wetland Classification[5]	Latitude	Longitude	Quadrangle	Crossing Method[6]	Wetland Impact (acres)							Crossing Length (feet)
													Construction[7]				Operation[8]			
				Begin	End								PEM	PFO	PSS	Other[10]	PFO	PSS	Other[9]	
300 Line CT Loop	Hartford	West Hartford	S	2.48	2.49	WPI-3419	PSS	N/A	41° 46' 48.408" N	72° 47' 34.836" W	Avon	Conventional Crossing	0.00	0.00	0.03	0.00	0.00	0.01	0.00	20
300 Line CT Loop	Hartford	West Hartford	S	2.49	2.52	WPI-3418	PFO	N/A	41° 46' 48.737" N	72° 47' 34.374" W	Avon	Conventional Crossing	0.00	0.19	0.00	0.00	0.07	0.00	0.00	99
300 Line CT Loop	Hartford	West Hartford	S	2.50	2.52	WPI-3419	PSS	N/A	41° 46' 49.633" N	72° 47' 35.218" W	Avon	Conventional Crossing	0.00	0.00	0.03	0.00	0.00	0.01	0.00	36
300 Line CT Loop	Hartford	West Hartford	S	2.51	2.53	WPI-3417	PFO	N/A	41° 46' 50.336" N	72° 47' 34.601" W	Avon	Conventional Crossing	0.00	0.03	0.00	0.00	0.02	0.00	0.00	40
300 Line CT Loop	Hartford	West Hartford	S	2.52	2.54	WPI-3420	PEM	N/A	41° 46' 50.153" N	72° 47' 35.594" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	2.64	2.66	WPI-3427	PFO	N/A	41° 46' 56.426" N	72° 47' 32.176" W	Avon	Conventional Crossing	0.00	0.03	0.00	0.00	0.01	0.00	0.00	31
300 Line CT Loop	Hartford	West Hartford	S	2.64	2.67	WPI-3426	PFO	N/A	41° 46' 56.666" N	72° 47' 32.115" W	Avon	Conventional Crossing	0.00	0.05	0.00	0.00	0.01	0.00	0.00	2
300 Line CT Loop	Hartford	West Hartford	S	2.66	2.67	WPI-3428	PEM	N/A	41° 46' 57.439" N	72° 47' 32.819" W	Avon	Conventional Crossing	0.03	0.00	0.00	0.00	0.00	0.00	0.00	30
300 Line CT Loop	Hartford	West Hartford	S	3.00	3.01	WPI-3438	PEM	N/A	41° 47' 15.356" N	72° 47' 31.588" W	Avon	N/A	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	3.01	3.04	WPI-3443	PEM	N/A	41° 47' 15.866" N	72° 47' 31.786" W	Avon	Conventional Crossing	0.05	0.00	0.00	0.00	0.00	0.00	0.00	3
300 Line CT Loop	Hartford	West Hartford	S	3.01	3.02	WPI-3439	PFO	N/A	41° 47' 15.400" N	72° 47' 31.461" W	Avon	Conventional Crossing	0.00	0.02	0.00	0.00	0.02	0.00	0.00	49
300 Line CT Loop	Hartford	West Hartford	S	3.01	3.02	WPI-3440	PFO	N/A	41° 47' 15.504" N	72° 47' 31.196" W	Avon	N/A	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	3.02	3.04	WPI-3444	PFO	N/A	41° 47' 16.146" N	72° 47' 31.527" W	Avon	Conventional Crossing	0.00	0.05	0.00	0.00	0.05	0.00	0.00	114
300 Line CT Loop	Hartford	West Hartford	S	3.04	3.15	WPI-3447	PSS	N/A	41° 47' 17.001" N	72° 47' 31.398" W	Avon	Conventional Crossing	0.00	0.00	0.47	0.00	0.00	0.13	0.00	563
300 Line CT Loop	Hartford	West Hartford	S	3.15	3.30	WPI-3453	PEM	N/A	41° 47' 22.678" N	72° 47' 30.462" W	Avon	Conventional Crossing	0.48	0.00	0.00	0.00	0.00	0.00	0.00	554
300 Line CT Loop	Hartford	West Hartford	S	3.15	3.24	WPI-3452	PFO	N/A	41° 47' 22.606" N	72° 47' 30.053" W	Avon	N/A	0.00	0.31	0.00	0.00	0.05	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	3.22	3.28	WPI-3455	PFO	N/A	41° 47' 26.046" N	72° 47' 28.882" W	Avon	Conventional Crossing	0.00	0.27	0.00	0.00	0.10	0.00	0.00	96
300 Line CT Loop	Hartford	West Hartford	S	3.27	3.30	WPI-3458	PFO	N/A	41° 47' 29.078" N	72° 47' 28.043" W	Avon	Conventional Crossing	0.00	0.17	0.00	0.00	0.06	0.00	0.00	106
300 Line CT Loop	Hartford	West Hartford	S	3.30	3.34	WPI-3459	PFO	N/A	41° 47' 30.310" N	72° 47' 27.258" W	Avon	Conventional Crossing	0.00	0.20	0.00	0.00	0.09	0.00	0.00	178
300 Line CT Loop	Hartford	West Hartford	S	3.33	3.34	WPI-3460	PFO	N/A	41° 47' 31.334" N	72° 47' 25.583" W	Avon	N/A	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0
300 Line CT Loop	Hartford	West Hartford	S	3.36	3.36	WPI-3461	PEM	N/A	41° 47' 32.170" N	72° 47' 22.623" W	Avon	N/A	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0

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													Construction[7]				Operation[8]			
				Begin	End								PEM	PFO	PSS	Other[10]	PFO	PSS	Other[9]	
300 Line CT Loop	Hartford	Bloomfield	S	4.65	4.70	WPI-3465	PFO	N/A	41° 48' 34.931" N	72° 47' 36.874" W	Avon	Conventional Crossing	0.00	0.23	0.00	0.00	0.05	0.00	0.00	76
300 Line CT Loop	Hartford	Bloomfield	S	4.67	4.82	WPI-3466	PEM	N/A	41° 48' 35.996" N	72° 47' 37.474" W	Avon	Conventional Crossing	0.60	0.00	0.00	0.00	0.00	0.00	0.00	549
300 Line CT Loop	Hartford	Bloomfield	S	4.84	4.87	WPI-3467	PSS	N/A	41° 48' 44.683" N	72° 47' 34.190" W	Avon	Conventional Crossing	0.00	0.00	0.08	0.00	0.00	0.02	0.00	83
300 Line CT Loop	Hartford	Bloomfield	S	4.86	4.89	WPI-3470	PFO	N/A	41° 48' 45.469" N	72° 47' 32.874" W	Avon	Conventional Crossing	0.00	0.09	0.00	0.00	0.03	0.00	0.00	30
300 Line CT Loop	Hartford	Bloomfield	S	4.87	4.89	WPI-3469	PSS	N/A	41° 48' 45.802" N	72° 47' 33.779" W	Avon	Conventional Crossing	0.00	0.00	0.07	0.00	0.00	0.02	0.00	71
300 Line CT Loop	Hartford	Bloomfield	S	5.67	5.74	WPI-3471	PFO	N/A	41° 49' 22.479" N	72° 47' 10.958" W	Avon	Conventional Crossing	0.00	0.50	0.00	0.00	0.18	0.00	0.00	322
300 Line CT Loop	Hartford	Bloomfield	S	5.80	5.82	WPI-3472	PFO	N/A	41° 49' 26.678" N	72° 47' 3.931" W	Avon	Conventional Crossing	0.00	0.18	0.00	0.00	0.06	0.00	0.00	107
300 Line CT Loop	Hartford	Bloomfield	S	6.56	6.57	BL-O-W001	PFO	N/A	41° 50' 2.055" N	72° 46' 55.210" W	Avon	N/A	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	6.72	6.74	BL-O-W003	PFO	N/A	41° 50' 7.603" N	72° 46' 46.972" W	Avon	Conventional Crossing	0.00	0.09	0.00	0.00	0.02	0.00	0.00	19
300 Line CT Loop	Hartford	Bloomfield	S	7.12	7.14	BL-B-W007	PEM	N/A	41° 50' 23.413" N	72° 46' 30.976" W	Avon	Conventional Crossing	0.06	0.00	0.00	0.00	0.00	0.00	0.00	25
300 Line CT Loop	Hartford	Bloomfield	S	7.28	7.28	BL-B-W006	PEM	N/A	41° 50' 31.296" N	72° 46' 26.964" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	7.28	7.40	BL-B-W006	PFO	N/A	41° 50' 31.571" N	72° 46' 26.627" W	Avon	Conventional Crossing	0.00	0.68	0.00	0.00	0.24	0.00	0.00	416
300 Line CT Loop	Hartford	Bloomfield	S	7.33	7.39	BL-B-W006	PEM	N/A	41° 50' 33.583" N	72° 46' 25.257" W	Avon	N/A	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	7.40	7.41	BL-B-W005	PEM	N/A	41° 50' 36.880" N	72° 46' 23.935" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	7.43	7.43	BL-B-W005	PEM	N/A	41° 50' 38.072" N	72° 46' 22.473" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	7.43	7.46	BL-B-W005	PFO	N/A	41° 50' 38.103" N	72° 46' 22.378" W	Avon	Conventional Crossing	0.00	0.16	0.00	0.00	0.04	0.00	0.00	68
300 Line CT Loop	Hartford	Bloomfield	S	7.44	7.44	BL-B-W005	PEM	N/A	41° 50' 38.568" N	72° 46' 21.866" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	7.46	7.51	BL-B-W005	PFO	N/A	41° 50' 38.857" N	72° 46' 20.167" W	Avon	Conventional Crossing	0.00	0.37	0.00	0.00	0.13	0.00	0.00	224
300 Line CT Loop	Hartford	Bloomfield	S	7.49	7.50	BL-B-W005	PEM	N/A	41° 50' 40.332" N	72° 46' 19.702" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	7.63	7.78	BL-B-W004	PFO	N/A	41° 50' 43.154" N	72° 46' 10.276" W	Avon	Conventional Crossing	0.00	1.08	0.00	0.00	0.43	0.00	0.00	751
300 Line CT Loop	Hartford	Bloomfield	S	7.63	7.64	BL-B-W004	PFO	N/A	41° 50' 42.750" N	72° 46' 9.981" W	Avon	N/A	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0

Table 1
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Facility Name	County	Town	Segment	Milepost[1]		Wetland ID[2,3]	Wetland Class[4]	State Wetland Classification[5]	Latitude	Longitude	Quadrangle	Crossing Method[6]	Wetland Impact (acres)							Crossing Length (feet)
													Construction[7]				Operation[8]			
				Begin	End								PEM	PFO	PSS	Other[10]	PFO	PSS	Other[9]	
300 Line CT Loop	Hartford	Bloomfield	S	7.96	8.00	BL-B-W002	PEM	N/A	41° 50' 58.991" N	72° 46' 5.607" W	Avon	N/A	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	7.96	7.98	BL-B-W002	PEM	N/A	41° 50' 58.991" N	72° 46' 5.607" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	7.96	7.98	BL-B-W005	PEM	N/A	41° 50' 58.991" N	72° 46' 5.607" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	7.97	7.98	BL-O-W005	PEM	N/A	41° 50' 59.941" N	72° 46' 5.758" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	7.98	7.98	BL-B-W005	PEM	N/A	41° 51' 0.121" N	72° 46' 5.657" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	8.03	8.06	BL-B-W002	PEM	N/A	41° 51' 2.759" N	72° 46' 5.369" W	Avon	N/A	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	8.07	8.13	BL-B-W002	PEM	N/A	41° 51' 4.845" N	72° 46' 4.817" W	Avon	N/A	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	8.13	8.17	WPI-3484	PFO	N/A	41° 51' 7.772" N	72° 46' 2.963" W	Avon	Conventional Crossing	0.00	0.25	0.00	0.00	0.08	0.00	0.00	109
300 Line CT Loop	Hartford	Bloomfield	S	8.47	8.61	BL-B-W001	PEM	N/A	41° 51' 22.168" N	72° 45' 49.743" W	Avon	Conventional Crossing	1.19	0.00	0.00	0.00	0.00	0.00	0.00	725
300 Line CT Loop	Hartford	Bloomfield	S	8.47	8.48	BL-B-W001	PFO	N/A	41° 51' 21.633" N	72° 45' 49.058" W	Avon	N/A	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	8.49	8.54	BL-B-W001	PFO	N/A	41° 51' 22.491" N	72° 45' 47.868" W	Avon	N/A	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	8.61	8.62	BL-B-W001	PEM	N/A	41° 51' 28.366" N	72° 45' 44.880" W	Avon	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	8.63	8.63	BL-B-W001	PFO	N/A	41° 51' 28.739" N	72° 45' 43.546" W	Avon	N/A	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	8.67	8.74	BL-P-W002	PEM	N/A	41° 51' 30.900" N	72° 45' 42.256" W	Avon	Conventional Crossing	0.12	0.00	0.00	0.00	0.00	0.00	0.00	28
300 Line CT Loop	Hartford	Bloomfield	S	8.67	8.67	BL-P-W002	PFO	N/A	41° 51' 30.880" N	72° 45' 42.257" W	Avon	N/A	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	8.74	9.01	BL-P-W001	PEM	N/A	41° 51' 33.900" N	72° 45' 40.364" W	Avon	Conventional Crossing	2.41	0.00	0.00	0.00	0.00	0.00	0.00	1,415
300 Line CT Loop	Hartford	Bloomfield	S	9.01	9.02	BL-P-W001	PEM	N/A	41° 51' 47.488" N	72° 45' 33.586" W	Avon	Conventional Crossing	0.03	0.00	0.00	0.00	0.00	0.00	0.00	38
300 Line CT Loop	Hartford	Bloomfield	S	9.03	9.06	BL-P-W001	PEM	N/A	41° 51' 48.678" N	72° 45' 34.023" W	Avon	Conventional Crossing	0.21	0.00	0.00	0.00	0.00	0.00	0.00	113
300 Line CT Loop	Hartford	Bloomfield	S	9.05	9.52	BL-P-W001	PFO	N/A	41° 51' 49.295" N	72° 45' 32.523" W	Avon	Conventional Crossing	0.00	4.20	0.00	0.00	1.39	0.00	0.00	2,424
300 Line CT Loop	Hartford	Bloomfield	S	9.51	9.68	BL-P-W001	PEM	N/A	41° 52' 11.071" N	72° 45' 18.808" W	Avon	Conventional Crossing	1.46	0.00	0.00	0.00	0.00	0.00	0.00	864
300 Line CT Loop	Hartford	Bloomfield	S	9.55	9.56	BL-P-W001	PFO	N/A	41° 52' 12.816" N	72° 45' 17.369" W	Avon	N/A	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0

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													Construction[7]				Operation[8]			
				Begin	End								PEM	PFO	PSS	Other[10]	PFO	PSS	Other[9]	
300 Line CT Loop	Hartford	Bloomfield	S	9.68	9.68	WPI-3504	PEM	N/A	41° 52' 19.243" N	72° 45' 16.141" W	Avon	Conventional Crossing	0.01	0.00	0.00	0.00	0.00	0.00	0.00	13
300 Line CT Loop	Hartford	Bloomfield	S	9.68	9.69	BL-P-W005	PFO	N/A	41° 52' 19.521" N	72° 45' 16.128" W	Avon	Conventional Crossing	0.00	0.03	0.00	0.00	0.02	0.00	0.00	30
300 Line CT Loop	Hartford	Bloomfield	S	9.70	9.89	NWI-1176	PFO	N/A	41° 52' 20.244" N	72° 45' 16.094" W	Avon	Conventional Crossing	0.00	1.66	0.00	0.00	0.67	0.00	0.00	1,024
300 Line CT Loop	Hartford	Bloomfield	S	9.70	9.72	BL-P-W005	PFO	N/A	41° 52' 20.513" N	72° 45' 16.081" W	Avon	N/A	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	9.89	9.90	NWI-1176	PFO	N/A	41° 52' 29.994" N	72° 45' 14.417" W	Tariffville	Conventional Crossing	0.00	0.07	0.00	0.00	0.03	0.00	0.00	42
300 Line CT Loop	Hartford	Bloomfield	S	9.92	10.00	NWI-1176	PFO	N/A	41° 52' 31.451" N	72° 45' 13.414" W	Tariffville	Conventional Crossing	0.00	0.43	0.00	0.00	0.09	0.00	0.00	145
300 Line CT Loop	Hartford	Bloomfield	S	10.01	10.10	BL-P-W005	PFO	N/A	41° 52' 34.982" N	72° 45' 9.043" W	Tariffville	Conventional Crossing	0.00	0.25	0.00	0.00	0.07	0.00	0.00	101
300 Line CT Loop	Hartford	Bloomfield	S	10.03	10.03	BL-P-W005	PFO	N/A	41° 52' 35.831" N	72° 45' 8.611" W	Tariffville	N/A	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	10.10	10.14	BL-P-W005	PFO	N/A	41° 52' 38.909" N	72° 45' 6.892" W	Tariffville	N/A	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	10.12	10.14	BL-P-W005	PFO	N/A	41° 52' 39.815" N	72° 45' 6.587" W	Tariffville	N/A	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Bloomfield	S	10.16	10.18	BL-P-W005	PFO	N/A	41° 52' 41.732" N	72° 45' 5.941" W	Tariffville	Conventional Crossing	0.00	0.11	0.00	0.00	0.05	0.00	0.00	68
300 Line CT Loop	Hartford	Bloomfield	S	10.17	10.19	BL-P-W006	PFO	N/A	41° 52' 42.375" N	72° 45' 5.410" W	Tariffville	Conventional Crossing	0.00	0.06	0.00	0.00	0.04	0.00	0.00	70
300 Line CT Loop	Hartford	Bloomfield	S	10.19	10.21	BL-P-W006	PEM	N/A	41° 52' 43.130" N	72° 45' 4.854" W	Tariffville	Conventional Crossing	0.04	0.00	0.00	0.00	0.00	0.00	0.00	29
300 Line CT Loop	Hartford	Bloomfield	S	10.24	10.31	BL-P-W006	PEM	N/A	41° 52' 45.327" N	72° 45' 3.075" W	Tariffville	Conventional Crossing	0.41	0.00	0.00	0.00	0.00	0.00	0.00	223
300 Line CT Loop	Hartford	Bloomfield	S	10.29	10.36	BL-P-W006	PEM	N/A	41° 52' 46.154" N	72° 45' 0.000" W	Windsor Locks	Conventional Crossing	0.57	0.00	0.00	0.00	0.00	0.00	0.00	320
300 Line CT Loop	Hartford	Bloomfield	S	10.98	11.00	BL-N-W006	PEM	N/A	41° 53' 14.754" N	72° 44' 32.433" W	Windsor Locks	Conventional Crossing	0.05	0.00	0.00	0.00	0.00	0.00	0.00	47
300 Line CT Loop	Hartford	Bloomfield	S	10.98	11.00	BL-N-W006	PFO	N/A	41° 53' 14.489" N	72° 44' 32.004" W	Windsor Locks	Conventional Crossing	0.00	0.03	0.00	0.00	0.01	0.00	0.00	17
300 Line CT Loop	Hartford	Bloomfield	S	11.12	11.14	BL-N-W007	PEM	N/A	41° 53' 18.351" N	72° 44' 24.165" W	Windsor Locks	Conventional Crossing	0.06	0.00	0.00	0.00	0.00	0.00	0.00	50
300 Line CT Loop	Hartford	Bloomfield	S	11.12	11.14	BL-N-W007	PEM	N/A	41° 53' 18.506" N	72° 44' 23.754" W	Windsor Locks	Conventional Crossing	0.04	0.00	0.00	0.00	0.00	0.00	0.00	10
300 Line CT Loop	Hartford	Windsor	S	11.28	11.36	BL-N-W003	PFO	N/A	41° 53' 22.641" N	72° 44' 14.454" W	Windsor Locks	Horizontal Directional Drill	0.00	0.50	0.00	0.00	0.27	0.00	0.00	394
300 Line CT Loop	Hartford	Windsor	S	11.29	11.34	BL-N-W003	PFO	N/A	41° 53' 21.250" N	72° 44' 10.895" W	Windsor Locks	N/A	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0

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													Construction[7]				Operation[8]			
				Begin	End								PEM	PFO	PSS	Other[10]	PFO	PSS	Other[9]	
300 Line CT Loop	Hartford	Windsor	S	11.40	11.41	BL-N-W002	PFO	N/A	41° 53' 27.306" N	72° 44' 10.013" W	Windsor Locks	Horizontal Directional Drill	0.00	0.06	0.00	0.00	0.03	0.00	0.00	50
300 Line CT Loop	Hartford	Windsor	S	12.50	12.51	WPI-3514	PFO	N/A	41° 54' 17.466" N	72° 43' 41.845" W	Windsor Locks	Conventional Crossing	0.00	0.06	0.00	0.00	0.02	0.00	0.00	37
300 Line CT Loop	Hartford	Windsor	S	12.87	12.95	WPI-3516	PEM	N/A	41° 54' 35.368" N	72° 43' 33.052" W	Windsor Locks	Conventional Crossing	0.44	0.00	0.00	0.00	0.00	0.00	0.00	364
300 Line CT Loop	Hartford	Windsor	S	12.90	12.92	WPI-3517	PEM	N/A	41° 54' 36.842" N	72° 43' 31.951" W	Windsor Locks	N/A	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Windsor	S	12.92	12.93	WPI-3517	PEM	N/A	41° 54' 37.539" N	72° 43' 31.047" W	Windsor Locks	N/A	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Windsor	S	12.94	12.97	WPI-3520	PFO	N/A	41° 54' 38.793" N	72° 43' 31.166" W	Windsor Locks	N/A	0.00	0.09	0.00	0.00	0.01	0.00	0.00	0
300 Line CT Loop	Hartford	Windsor	S	12.95	12.97	WPI-3519	PEM	N/A	41° 54' 38.726" N	72° 43' 30.187" W	Windsor Locks	Conventional Crossing	0.07	0.00	0.00	0.00	0.00	0.00	0.00	88
300 Line CT Loop	Hartford	Windsor	S	12.95	12.98	WPI-3518	PEM	N/A	41° 54' 38.896" N	72° 43' 30.007" W	Windsor Locks	Conventional Crossing	0.06	0.00	0.00	0.00	0.00	0.00	0.00	29
300 Line CT Loop	Hartford	Windsor	S	12.97	13.00	WPI-3521	PFO	N/A	41° 54' 39.711" N	72° 43' 29.707" W	Windsor Locks	Conventional Crossing	0.00	0.25	0.00	0.00	0.09	0.00	0.00	156
300 Line CT Loop	Hartford	Windsor	S	13.04	13.06	WPI-3522	PFO	N/A	41° 54' 43.268" N	72° 43' 27.996" W	Windsor Locks	N/A	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0
300 Line CT Loop	Hartford	Windsor	S	13.61	13.70	WPI-3525	PSS	N/A	41° 55' 11.199" N	72° 43' 17.401" W	Windsor Locks	N/A	0.00	0.00	0.41	0.00	0.00	0.01	0.00	0
300 Line CT Loop	Hartford	Windsor	S	13.97	13.99	WI-P-W001	PEM	N/A	41° 55' 29.604" N	72° 43' 12.466" W	Windsor Locks	Conventional Crossing	0.08	0.00	0.00	0.00	0.00	0.00	0.00	22
300 Line CT Loop	Hartford	Windsor	S	14.11	14.20	EG-P-W001	PFO	N/A	41° 55' 35.832" N	72° 43' 7.633" W	Windsor Locks	Conventional Crossing	0.00	0.79	0.00	0.00	0.27	0.00	0.00	470
300 Line CT Loop	Hartford	East Granby	S	14.19	14.23	EG-P-W001	PFO	N/A	41° 55' 39.621" N	72° 43' 4.167" W	Windsor Locks	Conventional Crossing	0.00	0.26	0.00	0.00	0.07	0.00	0.00	121
300 Line CT Loop	Hartford	East Granby	S	14.22	14.26	EG-P-W001	PFO	N/A	41° 55' 40.338" N	72° 43' 2.532" W	Windsor Locks	Conventional Crossing	0.00	0.09	0.00	0.00	0.02	0.00	0.00	37
Pipeline Subtotal													**9.84**	**16.66**	**1.72**	**0.22**	**5.61**	**0.30**	**0.00**	**16,785**
Aboveground Facilities																				
North Bloomfield (204523)	Hartford	Bloomfield	S	10.86	10.86	WPI-3511	PFO	N/A	41° 53' 10.814" N	72° 44' 40.269" W	Windsor Locks	N/A	0.00	0.01	0.00	0.00	0.00	0.00	0.00	N/A
Aboveground Facilities Subtotal													**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**
Contractor Yards																				
N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Contractor Yards Subtotal													**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**

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													Construction[7]				Operation[8]			
				Begin	End								PEM	PFO	PSS	Other[10]	PFO	PSS	Other[9]	
Access Roads																				
NED-TAR-S-0100	Hartford	West Hartford	S	0.07		WPI-3358	PSS	N/A	41° 44' 57.908" N	72° 47' 41.411" W	New Britain	Timber Mats	0.00	0.00	0.03	0.00	0.00	0.00	0.00	108
NED-TAR-S-0100	Hartford	West Hartford	S	0.07		WPI-3364	PSS	N/A	41° 45' 8.423" N	72° 47' 44.669" W	Avon	Timber Mats	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0
NED-TAR-S-0100	Hartford	West Hartford	S	0.07		WPI-3366	PSS	N/A	41° 45' 8.519" N	72° 47' 44.689" W	Avon	Timber Mats	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0
TGP-TAR-S-0100	Hartford	West Hartford	S	0.70		WPI-3392	PFO	N/A	41° 46' 4.475" N	72° 47' 36.025" W	Avon	Timber Mats	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
TGP-TAR-S-0100	Hartford	West Hartford	S	0.70		WPI-3392	PFO	N/A	41° 46' 6.265" N	72° 47' 35.571" W	Avon	Timber Mats	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
TGP-TAR-S-0100	Hartford	West Hartford	S	0.70		WPI-3392	PFO	N/A	41° 46' 7.995" N	72° 47' 34.909" W	Avon	Timber Mats	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
TGP-TAR-S-0100	Hartford	West Hartford	S	0.70		WPI-3392	PFO	N/A	41° 46' 8.113" N	72° 47' 34.819" W	Avon	Timber Mats	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
TGP-TAR-S-0100	Hartford	West Hartford	S	0.70		NWI-1419	PFO	N/A	41° 46' 39.315" N	72° 47' 29.021" W	Avon	Timber Mats	0.00	0.13	0.00	0.00	0.00	0.00	0.00	282
TGP-TAR-S-0100	Hartford	West Hartford	S	0.70		WPI-3460	PFO	N/A	41° 47' 30.023" N	72° 47' 24.517" W	Avon	Timber Mats	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
TGP-TAR-S-0200	Hartford	Bloomfield	S	7.43		BL-O-W004	PEM	N/A	41° 50' 37.538" N	72° 46' 20.170" W	Avon	Timber Mats	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
TGP-TAR-S-0200	Hartford	Bloomfield	S	7.43		BL-O-W004	PEM	N/A	41° 50' 37.558" N	72° 46' 19.972" W	Avon	Timber Mats	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
TGP-TAR-S-0200	Hartford	Bloomfield	S	7.43		BL-B-W005	PFO	N/A	41° 50' 37.751" N	72° 46' 20.034" W	Avon	Timber Mats	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
TGP-TAR-S-0200	Hartford	Bloomfield	S	7.43		BL-B-W005	PFO	N/A	41° 50' 37.751" N	72° 46' 19.829" W	Avon	Timber Mats	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
TGP-TAR-S-0300	Hartford	Bloomfield	S	9.02		BL-P-W001	PEM	N/A	41° 51' 48.579" N	72° 45' 34.820" W	Avon	Timber Mats	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0
Access Roads Subtotal													**0.03**	**0.20**	**0.05**	**0.00**	**0.00**	**0.00**	**0.00**	**390**
Connecticut Total[12]													**9.87**	**16.87**	**1.77**	**0.22**	**5.61**	**0.30**	**0.00**	**17,175**

Table 1
Wetlands Associated With the Project in Connecticut

Facility Name	County	Town	Segment	Milepost[1]		Wetland ID[2,3]	Wetland Class[4]	State Wetland Classification[5]	Latitude	Longitude	Quadrangle	Crossing Method[6]	Wetland Impact (acres)							Crossing Length (feet)
													Construction[7]				Operation[8]			
				Begin	End								PEM	PFO	PSS	Other[10]	PFO	PSS	Other[9]	

Source: The data sets utilized for wetlands is a combination of field surveyed data, photo interpreted LiDAR data, and publically available data. Field surveyed data was used wherever there was parcel access, photo interpreted LiDAR data was used where there was no parcel access, and publically available data was used where there was no parcel access and no photo interpreted aerial coverage. The publically available data is from the USFWS - NWI (2014).
1 Mileposts for Contractor Yards and Access Roads are given as nearest MP, which indicates the point at which the Access Road or Contractor Yard connects with the pipeline construction ROW, or closest MP to the construction ROW if there is no direct connection.
2 Wetland ID in the form of NWI-XXX are USFWS-NWI wetlands and wetland ID in the form WPI-XXX are photo interpreted wetlands. All other wetland ID's are surveyed wetlands.
3 Wetlands identified as "Unnamed" are wetlands delineated by AECOM that have yet to be assigned a unique Wetland ID.
4 Wetland classification is in accordance with Cowardin et al 1979: PEM = Palustrine Emergent Wetland; PSS = Palustrine Scrub-Shrub; PFO = Palustrine Forested Wetland; PUB = Palustrine Unconsolidated Bottom; Other = accommodates all other wetland class types.
5 Connecticut Inland Wetland and Watercourses Act (Section 22a-36 through 45 of the Connecticut General Statue) does not provide specific state wetland classifications.
6 Crossing methods for wetlands are described in Section 2.3.6; I = standard crossing; II = conventional crossing; III = push/pull crossing; IV = Horizontal Directional Drill; V = Timber mats will be used to cross wetlands for Contractor Yards and Access Roads; N/A = wetland not crossed by pipeline.
7 Construction Acreage = all workspace during construction activities (TWS, ATWS, and permanent easement) that impacts wetlands. Workspace was laid out to maintain a 75 foot construction ROW through wetlands. Any construction ROW impacts greater than 75 feet are detailed in the Project-specific ECP.
8 Operation Acreage = 10-foot wide corridor permanently maintained in herbaceous vegetative cover through PSS wetlands, and 30-foot wide corridor permanently maintained through PFO wetlands where trees taller than 15 feet that could damage the pipeline coating will be selectively cut and removed. The permanently maintained corridors represent a change in cover type from PFO to PSS and PEM or PSS to PEM; there is no operation impact on PEM wetlands, since there is no change in pre- and post-construction wetland vegetation cover type. Operational acreage represents areas of new permanent easement and does not include overlap with TGP's existing pipelines. The existing permanent easement for TGP's existing pipelines are not included in the operational wetland impacts.
9 Wetland type not classified by NWI as PEM, PSS, or PFO
10 The totals shown in this table may not equal the sum of addends due to rounding.

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Table 2
Waterbodies Associated With the Project in Connecticut

Facility Name	County	Town	Segment	Nearest Milepost[1]	Waterbody ID[2]	Waterbody Name[3]	Latitude	Longitude	Quadrangle	Type[4]	FERC Class[5]	Water Quality Designation / Fishery Classification[6]	Timing Restriction[7]	Crossing Method[8,9]	Crossing Length[10] (feet)	Crossing Length[10] (square feet)
Pipeline Facilities																
300 Line CT Loop	Hartford	Farmington	S	0.35	SPI-798	UNT to Trout Brook	41° 45' 0.524" N	72° 47' 43.457" W	Avon	I	MI	A		II	5	245
300 Line CT Loop	Hartford	Farmington	S	0.36	SPI-798	UNT to Trout Brook	41° 45' 0.870" N	72° 47' 43.560" W	Avon	I	MI	A		II	3	856
300 Line CT Loop	Hartford	West Hartford	S	0.50	SPI-800	UNT to Trout Brook	41° 45' 8.450" N	72° 47' 44.675" W	Avon	I	MI	A		N/A	0	4
300 Line CT Loop	Hartford	West Hartford	S	0.50	SPI-800	UNT to Trout Brook	41° 45' 8.308" N	72° 47' 45.492" W	Avon	I	MI	A		N/A	0	1,556
300 Line CT Loop	Hartford	West Hartford	S	0.51	SPI-799	UNT to Trout Brook	41° 45' 8.604" N	72° 47' 44.460" W	Avon	I	MI	A		N/A	0	4
300 Line CT Loop	Hartford	Farmington	S	0.67	SPI-803	UNT to Trout Brook	41° 45' 16.484" N	72° 47' 48.341" W	Avon	I	I	A		II	16	1,203
300 Line CT Loop	Hartford	Farmington	S	0.68	SPI-804	UNT to Trout Brook	41° 45' 17.266" N	72° 47' 48.575" W	Avon	I	MI	AA		II	8	688
300 Line CT Loop	Hartford	West Hartford	S	0.69	SPI-805	UNT to Trout Brook	41° 45' 17.616" N	72° 47' 47.160" W	Avon	I	MI	A		N/A	0	2
300 Line CT Loop	Hartford	West Hartford	S	0.95	SPI-807	UNT to Trout Brook	41° 45' 30.682" N	72° 47' 45.735" W	Avon	P	I	AA		II	14	2,007
300 Line CT Loop	Hartford	West Hartford	S	1.13	SPI-809	UNT to Trout Brook	41° 45' 39.706" N	72° 47' 43.716" W	Avon	P	MI	A		N/A	0	5
300 Line CT Loop	Hartford	West Hartford	S	1.13	SPI-809	UNT to Trout Brook	41° 45' 39.906" N	72° 47' 43.727" W	Avon	P	MI	AA		N/A	0	1,520
300 Line CT Loop	Hartford	West Hartford	S	1.63	SPI-811	UNT to Trout Brook	41° 46' 5.120" N	72° 47' 36.146" W	Avon	I	MI	A		N/A	0	1,352
300 Line CT Loop	Hartford	West Hartford	S	1.68	SPI-811	UNT to Trout Brook	41° 46' 7.532" N	72° 47' 35.421" W	Avon	I	MI	A		N/A	0	230
300 Line CT Loop	Hartford	West Hartford	S	1.69	SPI-812	UNT to Trout Brook	41° 46' 8.082" N	72° 47' 34.843" W	Avon	I	MI	A		N/A	0	13
300 Line CT Loop	Hartford	West Hartford	S	2.25	SPI-814	UNT to Trout Brook	41° 46' 36.572" N	72° 47' 32.734" W	Avon	I	I	AA		II	10	1,348
300 Line CT Loop	Hartford	West Hartford	S	2.25	SPI-814	UNT to Trout Brook	41° 46' 36.907" N	72° 47' 32.800" W	Avon	I	MI	AA		II	8	448
300 Line CT Loop	Hartford	West Hartford	S	2.51	SPI-815	UNT to Trout Brook	41° 46' 49.999" N	72° 47' 35.108" W	Avon	I	MI	A		II	3	223
300 Line CT Loop	Hartford	West Hartford	S	2.52	SPI-815	UNT to Trout	41° 46' 50.434" N	72° 47' 35.260" W	Avon	I	I	A		II	15	993

Table 2
Waterbodies Associated With the Project in Connecticut

Facility Name	County	Town	Segment	Nearest Milepost[1]	Waterbody ID[2]	Waterbody Name[3]	Latitude	Longitude	Quadrangle	Type[4]	FERC Class[5]	Water Quality Designation / Fishery Classification[6]	Timing Restriction[7]	Crossing Method[8,9]	Crossing Length[10] (feet)	Crossing Length[10] (square feet)
						Brook										
300 Line CT Loop	Hartford	West Hartford	S	2.66	SPI-818	UNT to Trout Brook	41° 46' 57.536" N	72° 47' 32.625" W	Avon	I	I	A		II	15	1,176
300 Line CT Loop	Hartford	West Hartford	S	3.00	SPI-819	UNT to Tumble Brook	41° 47' 15.361" N	72° 47' 31.392" W	Avon	I	MI	A		II	6	461
300 Line CT Loop	Hartford	West Hartford	S	3.02	SPI-820	UNT to Tumble Brook	41° 47' 15.904" N	72° 47' 31.504" W	Avon	I	I	A		II	24	1,960
300 Line CT Loop	Hartford	West Hartford	S	3.27	SPI-822	UNT to Tumble Brook	41° 47' 28.899" N	72° 47' 27.934" W	Avon	I	I	A		II	20	3,772
300 Line CT Loop	Hartford	West Hartford	S	3.30	SPI-822	UNT to Tumble Brook	41° 47' 30.014" N	72° 47' 27.196" W	Avon	I	I	A		II	33	2,216
300 Line CT Loop	Hartford	West Hartford	S	3.34	SPI-822	UNT to Tumble Brook	41° 47' 31.881" N	72° 47' 25.957" W	Avon	I	MI	A		II	8	587
300 Line CT Loop	Hartford	West Hartford	S	3.36	SPI-823	UNT to Tumble Brook	41° 47' 32.943" N	72° 47' 25.410" W	Avon	P	I	A		II	10	933
300 Line CT Loop	Hartford	West Hartford	S	3.39	SPI-824	UNT to Tumble Brook	41° 47' 34.743" N	72° 47' 24.500" W	Avon	I	I	A		II	15	1,134
300 Line CT Loop	Hartford	West Hartford	S	4.27	SPI-825	UNT to Tumble Brook	41° 48' 16.331" N	72° 47' 39.532" W	Avon	I	I	A		II	10	729
300 Line CT Loop	Hartford	Bloomfield	S	4.34	SPI-826	UNT to Tumble Brook	41° 48' 19.628" N	72° 47' 41.902" W	Avon	P	I	A		II	17	1,575
300 Line CT Loop	Hartford	Bloomfield	S	4.87	SPI-827	UNT to Tumble Brook	41° 48' 45.697" N	72° 47' 33.475" W	Avon	P	MI	AA		II	5	630
300 Line CT Loop	Hartford	Bloomfield	S	5.73	SPI-828	UNT to Tumble Brook	41° 49' 24.316" N	72° 47' 7.192" W	Avon	I	I	A		II	15	1,612
300 Line CT Loop	Hartford	Bloomfield	S	5.79	SPI-829	UNT to Tumble Brook	41° 49' 26.547" N	72° 47' 4.052" W	Avon	I	I	AA		II	17	1,341
300 Line CT Loop	Hartford	Bloomfield	S	5.82	SPI-829	UNT to Tumble Brook	41° 49' 27.395" N	72° 47' 2.882" W	Avon	I	I	AA		II	26	2,015
300 Line CT Loop	Hartford	Bloomfield	S	6.57	BL-O-S001	UNT to Tumble Brook	41° 50' 1.900" N	72° 46' 54.973" W	Avon	I	MI	A		N/A	0	363
300 Line CT Loop	Hartford	Bloomfield	S	7.07	BL-P-S004	UNT to Tumble Brook	41° 50' 21.553" N	72° 46' 32.671" W	Avon	E	I	A		II	31	1,803
300 Line CT Loop	Hartford	Bloomfield	S	7.08	BL-P-S004	UNT to Tumble Brook	41° 50' 21.781" N	72° 46' 32.106" W	Avon	E	MI	A		N/A	0	12
300 Line CT Loop	Hartford	Bloomfield	S	7.09	BL-P-S004	UNT to Tumble Brook	41° 50' 22.005" N	72° 46' 31.895" W	Avon	E	MI	A		N/A	0	24

Table 2
Waterbodies Associated With the Project in Connecticut

Facility Name	County	Town	Segment	Nearest Milepost[1]	Waterbody ID[2]	Waterbody Name[3]	Latitude	Longitude	Quadrangle	Type[4]	FERC Class[5]	Water Quality Designation / Fishery Classification[6]	Timing Restriction[7]	Crossing Method[8,9]	Crossing Length[10] (feet)	Crossing Length[10] (square feet)
300 Line CT Loop	Hartford	Bloomfield	S	7.09	BL-P-S004	UNT to Tumble Brook	41° 50' 22.176" N	72° 46' 31.798" W	Avon	E	MI	A		N/A	0	225
300 Line CT Loop	Hartford	Bloomfield	S	7.45	BL-B-S003	UNT to Tumble Brook	41° 50' 37.567" N	72° 46' 19.882" W	Avon	NF	MI	A		N/A	0	26
300 Line CT Loop	Hartford	Bloomfield	S	7.46	BL-P-S003	UNT to Tumble Brook	41° 50' 39.225" N	72° 46' 20.611" W	Avon	P	MI	A		II	5	371
300 Line CT Loop	Hartford	Bloomfield	S	7.71	BL-P-S002	UNT to Tumble Brook	41° 50' 46.502" N	72° 46' 7.493" W	Avon	NF	MI	A		N/A	0	1,325
300 Line CT Loop	Hartford	Bloomfield	S	8.73	BL-P-S001	UNT to Wash Brook	41° 51' 33.744" N	72° 45' 40.880" W	Avon	E	MI	A		N/A	0	56
300 Line CT Loop	Hartford	Bloomfield	S	9.69	BL-P-S005	UNT to Wash Brook	41° 52' 19.843" N	72° 45' 16.444" W	Avon	P	I	A		II	64	2,493
300 Line CT Loop	Hartford	Bloomfield	S	9.70	NHD-743	UNT to Wash Brook	41° 52' 20.487" N	72° 45' 16.413" W	Avon	P	I	A		II	90	9,600
300 Line CT Loop	Hartford	Bloomfield	S	10.18	BL-P-S007	UNT to Wash Brook	41° 52' 42.913" N	72° 45' 4.862" W	Tariffville	E	MI	A		II	3	97
300 Line CT Loop	Hartford	Bloomfield	S	11.14	BL-P-S009	UNT to Farmington River	41° 53' 19.245" N	72° 44' 23.576" W	Windsor Locks	I	MI	A		II	4	362
300 Line CT Loop	Hartford	Windsor	S	11.35	BL-P-S010	UNT to Farmington River	41° 53' 25.434" N	72° 44' 11.786" W	Windsor Locks	P	MI	A		IV	1	43
300 Line CT Loop	Hartford	Windsor	S	11.41	BL-P-S008	UNT to Farmington River	41° 53' 27.882" N	72° 44' 9.962" W	Windsor Locks	P	MA	A		IV	277	12,883
300 Line CT Loop	Hartford	Windsor	S	11.46	SPI-835	Farmington River	41° 53' 30.272" N	72° 44' 8.180" W	Windsor Locks	P	I	B		IV	13	2,157
300 Line CT Loop	Hartford	Windsor	S	11.46	SPI-836	Farmington River	41° 53' 29.063" N	72° 44' 5.071" W	Windsor Locks	P	MI	B		N/A	0	136
300 Line CT Loop	Hartford	Windsor	S	12.30	SPI-837	West Brook	41° 54' 7.650" N	72° 43' 46.965" W	Windsor Locks	I	I	A		II	28	2,773
Pipeline Subtotal															**819**	**67,587**
Aboveground Facilities																
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aboveground Facilities Subtotal															**0**	**0**
Contractor Yards[12]																

Table 2
Waterbodies Associated With the Project in Connecticut

Facility Name	County	Town	Segment	Nearest Milepost[1]	Waterbody ID[2]	Waterbody Name[3]	Latitude	Longitude	Quadrangle	Type[4]	FERC Class[5]	Water Quality Designation / Fishery Classification[6]	Timing Restriction[7]	Crossing Method[8,9]	Crossing Length[10] (feet)	Crossing Length[10] (square feet)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
														Contractor Yard Subtotal	**0**	**0**
Access Roads[12]																
TGP-TAR-S-0100	Hartford	West Hartford	S	0.70	NHD-887	UNT to Wash Brook	41° 47' 24.080" N	72° 47' 20.879" W	Avon	P	MI	A		N/A	3	61
TGP-TAR-S-0100	Hartford	West Hartford	S	0.70	NHD-888	UNT to Trout Brook	41° 46' 39.480" N	72° 47' 30.274" W	Avon	P	MI	AA		N/A	3	69
NED-TAR-S-0900	Hartford	East Granby	S	14.80	NHD-910	DeGrayes Brook	41° 56' 42.068" N	72° 42' 24.417" W	Windsor Locks	P	MI	A		N/A	3	90
														Access Road Subtotal	**9**	**220**
														Total Crossing Length	**828**	**67,807**

Source: The data sets utilized for waterbodies is a combination of field surveyed data, photo interpreted LiDAR data, and publically available data. Field surveyed data was used wherever there was parcel access, photo interpreted LiDAR data was used where there was no parcel access, and publically available data was used where there was no parcel access and no photo interpreted aerial coverage. The publically available data is from the USGS-NHD 2015.

1 Nearest Milepost for access roads indicates the point at which the access road connects with the pipeline ROW, or closest milepost to ROW if there is no direct connection.

2 Waterbody ID in the form of NHD-XXX and NHD-R-XXX are USGS-NHD waterbodies, and waterbody ID in the form SPI-XXX are photo interpreted waterbodies. All other waterbody ID's represent field surveyed data.

3 Unnamed tributary; waterbody is not mapped as a tributary on available GIS data layers; tributary name was identified based on review of USGS topographical mapping.

4 P = Perennial; I = Intermittent; E = Ephemeral; NF = No Flow; AP = Artificial Path; C = Connector

5 MI = Minor (<10 feet); I = Intermediate (10 - 100 feet); MA = Major (>100 feet).

6 Water quality classification was identified through a desktop review of available GIS datalayers.

7 Consultation with CTDEEP is ongoing. CWFs timing restrictions is based on FERC Plan and Procedures recommendations.

8 I = Conventional, Wet Crossing Method; II = Dry Crossing Method including Flume and Dam and Pump; III = Conventional Bore; IV = Horizontal Directional Drill; N/A = waterbody not crossed by the pipeline. Intermittent streams containing discernable flow at the time of construction will be crossed using a dry crossing method.

9 Crossing methods for each waterbody are still being evaluated. Tennessee intends to implement a dry-crossing construction technique on all waterbody crossings with discernible flow (with the exception of roadside swales and ditches) at the time of construction unless an alternative crossing method is approved by the state agencies, USACE, and Commission.

10 For non-surveyed waterbodies shown as a single line feature on the Project alignment sheets, the stream crossing length was determined from a desktop analysis using Google Earth and/or ArcGIS. A crossing length of 0 feet indicates that a waterbody is within the construction workspace limits, but does not cross the pipeline. N/A = Not Applicable. The Project will not cross waterbodies at aboveground facilities or contractor yards, however number of stream crossing indicated reflect streams on the entire parcel that will be avoided through final design of the aboveground facility or contractor yard. Access to aboveground facilities that require linear crossings of streams is accounted for in the AR line item and crossing length.

11 Existing waterbodies will not be impacted. Any improvements to existing culverts will be permitted as necessary.

1.4 Impact Evaluation

Tennessee has taken measures to minimize or avoid adverse effects from the Project to water resources. The proposed new pipeline in Connecticut has been sited parallel and adjacent to existing permanent pipeline and powerline ROW to the extent practicable to minimize impacts. As discussed herein, the Project facilities are proposed to cross wetlands and waterbodies. In the majority of these locations, the effects of the construction of Project facilities on wetlands and watercourses will be temporary.

Tennessee has identified access roads for use during construction and operations and is in the process of obtaining permission for the use of private access roads ("ARs"). Although public roads and the construction ROW will be used for primary access to the pipeline segments during construction, non-public ARs have been identified for potential use during construction of the Project as well. ARs identified include temporary roads that have been previously utilized on former Tennessee projects, those approved for use during construction of the Constitution Pipeline Project, and additional ARs identified by Tennessee. Tennessee has sited these facilities outside of sensitive resources to the extent practicable.

Along the proposed Project, vegetation removal and tree clearing will be required for temporary workspace to install the pipeline facilities. As a result, trees within forested wetlands along new ROW areas will be removed. In temporary workspace areas, trees will be allowed to regrow and return to forested wetlands following construction. In forested wetlands, Tennessee will minimize tree clearing to the maximum extent practicable while maintaining safe construction conditions. Following construction, tree clearing within wetlands during operation of the new pipeline will be limited to selectively clearing trees with roots that could compromise the integrity of the pipeline coating within 15 feet centered on the pipe. Tennessee will also maintain a 10-foot corridor, centered on the new pipeline, in herbaceous cover to allow for annual pedestrian walkover surveys that would convert scrub-shrub to herbaceous cover type. These maintenance procedures will result in forested wetlands being converted to scrub-shrub and scrub-shrub to emergent marsh wetland types. This will not create a loss of overall wetland habitat, but rather a long-term change in habitat type, from forested to scrub-shrub and emergent marsh. Tennessee will develop in-situ restoration plans for the forested wetland areas. Additional details regarding wetland construction and mitigation activities are provided in Attachment K.

Access within the ROW across wetlands will only be permitted where soils are non-saturated and able to support construction equipment at the time of crossing, during frozen soil conditions (for winter tree clearing), or with the use of timber mats to avoid rutting of the wetland soil. If mats are not used, the EI will record the pre- and post-construction soil density using a penetrometer to determine if the soil has been inadvertently compacted during construction or access.

Impacts to wetlands will be minimized by segregating up to the top 12 inches of soil from the area disturbed by trenching activities, except in super saturated areas or when soils are frozen. The topsoil will be restored to its original location immediately after backfilling is complete to preserve the existing seedbank and promote revegetation of the disturbed area. Seed mixes spread on the restored topsoil for temporary stabilization will include annual rye grass (*Lolium multiflorum*) at a rate of 40 pounds per acre (unless standing water is present) or appropriate mixes recommended by the landowner, state agency, or regional conservation districts. The use of fertilizers will not be permitted. Mulch will only be used within wetlands as required by state agencies. Utilizing recommended seed mixes containing native plants will control the import of invasive and/or exotic plant species to the site. Erosion controls, including silt fence and/or staked hay bales, also will be installed to protect wetlands from sediment disturbed in adjacent uplands during construction. Post-construction, the disturbed area will be monitored to ensure long-term stabilization of the site.

Tennessee will protect and minimize potential adverse impacts to wetlands by expediting construction in and around wetlands, by restoring wetlands to their original configurations and contours, by segregating topsoil during excavation, by permanently stabilizing upland areas near wetlands as soon as possible after backfilling, by inspecting the ROW periodically during and after construction, and by repairing any erosion control or restoration features until permanent revegetation is successful. Tennessee will comply with the applicable permit conditions issued by federal, state, and local permitting agencies with respect to construction and operation of the Project facilities within wetlands.

The general procedures for pipeline construction that will be followed for the Project are described in this section. Tennessee will use conventional techniques for buried pipeline construction and will follow the requirements set forth in Tennessee's Project-specific ECP for Connecticut (Attachment Q) to ensure safe, stable, and reliable transmission facilities consistent with the Commission and USDOT specifications. At a minimum, Tennessee will perform the following procedures:

- Marking the corridor;
- Clearing and grading;
- Trenching;
- Stringing;
- Pipe preparation (bending, welding, X-ray, weld coating, and coating repair) and lowering in;
- Backfilling and grade restoration;
- Hydrostatic testing and tie-ins; and
- Cleanup and restoration.

The above-listed procedures will typically follow in the sequence listed. Areas requiring special construction techniques include road or utility crossings, waterbodies and wetlands, unusual topographies such as unstable soils and trench conditions, residential or urban areas, agricultural areas, areas requiring rock removal, and permanent recreation facilities.

The proposed pipeline will cross the Farmington River in the Town of Windsor, Connecticut. The proposed crossing method at this location is Horizontal Directional Drill ("HDD"). The use of HDD at this crossing will avoid direct impacts from pipeline construction. The volume and source of water for the HDD are being evaluated. The preliminary estimates of the required volume for an HDD at this location is 500,000 gallons. Tennessee is currently evaluating potential sources for this water, including the Farmington River, municipal supplies, or off-site sources that would be transported via truck.

HDD is an advanced, controllable trenchless boring method of installing underground pipes, conduits, and cables in an arc along a predetermined bore path. HDD will be used in areas where trenching or excavating is not practical. The decision to install waterbody crossings by HDD instead of by conventional means, at specific locations on the Project, will depend on the following:

- Crossing location;
- Environmental sensitivity and associated constraints;
- Geotechnical concerns;

- Substrate composition; and
- Hydrological data.

The HDD process consists of drilling a pilot hole with a cutting head along the predetermined path and then enlarging the pilot hole with a larger cutting tool (back reamer) to the diameter required to install the casing, pipe, or conduit. The HDD process is done with the help of a viscous fluid known as drilling fluid. The fluid generally consists of a mixture of water and usually bentonite. The fluid is pumped through holes in the cutting heads to facilitate the removal of cuttings, stabilize the bore hole, cool the cutting head, and lubricate the passage of the pipe. The fluid is recycled throughout the drilling process.

This method of installation will require a large amount of additional temporary workspace (“ATWS”) and is only used in areas where boring and conventional open cut methods are not suitable. The large amount of TWS is directly related to the required drilling fluid pits and pipe stringing corridor. The pipe stringing corridor is required to pre-connect the pipe so that it can be pulled through the bore hole in one piece. Pulling the pipe in one piece greatly increases the probability of a successful HDD. Site specific crossing plans are provided in Attachment G.

Protecting the natural features of each waterbody and the associated wildlife habitat is the highest priority for each stream crossing. Application of Tennessee’s BMPs at each crossing will ensure that the selected construction contractor will protect the waterbodies during construction and provide a stable post-construction environment. Revegetation of trees and shrubs in areas adjacent to these waterbodies which currently support forested wetland, outside of the 30-foot corridor directly along the pipe, will further contribute to restoring riparian habitat values along the waterbodies.

The effects from the Project on air quality in the area will be short-term and minimal, occurring only during construction activities. Construction of the Project may cause a temporary reduction in the local ambient air quality due to fugitive dust and emissions generated by construction equipment. These effects will only occur in the vicinity of the construction activity. The emissions from vehicles and equipment will have minimal effects on the air quality of the region. Once construction activities are completed, emissions will subside and ambient air quality will return to pre-construction levels.

1.5 Hydrostatic Test Water

In compliance with United States Department of Transportation (“USDOT”) specifications, Tennessee will conduct hydrostatic testing on all pipeline segments prior to placing them in service. Preliminary sources and volumes of hydrostatic test water for the Connecticut portion of the pipeline are provided below in Table 3. Upon completion of the hydrostatic tests, the water will be discharged to an upland area through a dewatering structure consisting of an energy dissipation device and water filtration structure. Environmental impacts from withdrawal and discharge of test water will be minimized by utilizing the measures outlined in the Tennessee’s Project-specific Plan and Procedures and incorporated into the Project-specific ECP for Connecticut, as well as by complying with all applicable state and federal permit requirements.

Tennessee anticipates filing all applications with the CTDEEP, as necessary, for hydrostatic testing water uptake and discharge. Tennessee does not anticipate the use of any additives within the hydrostatic test water. Should it be determined that additives are necessary based on the source and composition of the test water, Tennessee will submit detailed information on any chemicals to the Commission and all applicable agencies for review and approval prior to use.

Based on the preliminary calculations for hydrostatic test water withdrawal and CTDEEP requirements, Tennessee does not believe a Water Diversion Permit is required for this withdrawal. If Tennessee determines through continued planning and/or consultations with the CTDEEP that a water withdrawal permit would be required, all required attachments and forms will be submitted to the CTDEEP.

Table 3
Potential Sources of Hydrostatic Pressure Test Water for the Project in Connecticut

Potential Water Source[1]	Segment	Approximate Milepost	Fill / Discharge Location	Water Quantity (gallons)
Farmington River	S	11.40	11.40	998,894

1 Fire Hydrants may be utilized as a potential water source and are located adjacent to the project pipeline in the following locations: West Hartford, Bloomfield, Windsor, and East Granby, CT.

1.6 Types of Material Being Discharged

Construction of the Project will require both temporary and permanent discharges of materials to Waters of the United States ("U.S."). Discharges will result from temporary stockpiling of soils in wetlands and from installation of the new pipeline and the placement of temporary timber construction mats to serve as construction workspace in wetlands and floodplains. The types of materials that would be discharged include trench spoil, rock or gravel for permanent access road improvements, and wood matting for temporary access roads or work areas (e.g. temporary workspace or contractor yards). Table 4 summarizes the estimated cubic yards of materials being discharged.

Table 4
Estimated Material Being Discharged for the Project in Connecticut

Project Activity	Estimated Volume of Temporary Discharge[2] (cubic yards)	Estimated Volume of Permanent Discharge[3] (cubic yards)
Pipeline Workspace[1,4]	48,386	0
Aboveground Facilities[1]	16	0
Access Roads[1]	460	0
Contractor Yards[1]	0	0
Stream Bed (linear feet crossed)[5]	819	0
Total	**48,862**	**0**

[1] For the purposes of calculating cubic yards of discharge from pipeline workspace, aboveground facilities, access roads, stream beds and contractor yards, a depth of 1 foot was assumed to all stream and wetlands. Temporary swamp mats are considered temporary discharge.
[2] Estimated Volume of Temporary Discharge was calculated using the construction impacts to wetlands and waterbodies.

[3] Estimated Volume of Permanent Discharge represent wetlands that will be permanently filled.

[4] The pipeline workspace does not take into consideration the 15 Horizontal Directional Drills (HDDs) for the project that will reduce impacts to several wetlands and waterbodies.

[5] Stream Bed (linear feet crossed) is the length of pipeline crossing wetlands.

No upland spoils generated during construction will be deposited or stored in wetlands. In wetlands, up to the top 12 inches of the wetland topsoil over the trenchline will be segregated from subsoil, unless saturated according to the Project-specific Plan and Procedures. Trench spoil will be temporarily stockpiled along the pipeline trench. Construction mats, whether wood or other material, will be removed and the disturbed area restored, as close as practicable, to pre-construction conditions. If shallow groundwater is encountered during excavation, dewatering would be performed in accordance with local permit conditions and/or construction BMPs. Such practices typically include pumping the water into a temporary sediment filter device such as a hay-bale corral or filter bag in an adjacent upland area to minimize sediments from entering wetlands and waterbodies (see Tennessee Construction BMPs and the Connecticut ECP in Attachment Q).

Table 5 below provides a summary of impacts by wetland type in each municipality in Connecticut. Detailed summaries of the temporary (construction) and permanent (operation) impacts to each wetland along the pipeline loop are presented in Table 1. Detailed site specific permit drawings for field verified wetlands and watercourses are provided in Attachment G. Table 6 lists all wetlands confirmed during field surveys performed in spring 2015 that contain vernal pool and/or amphibian breeding habitat.

A general sequencing of pipeline construction methods is provided above and also in Attachment K. Soil erosion and sediment control procedures, including the basic measures to be used to minimize erosion and sedimentation into Waters of the U.S., are included in Attachment Q.

In summary, the Project has implemented measures to avoid and minimize adverse impacts to water resources. The Project has been sited parallel and adjacent to existing pipeline and powerline ROWs that have been periodically cleared of vegetation and maintained since installation. All Project appurtenant facilities including MLVs and pig facilities have been sited outside of Waters of the U.S. The Project will result in temporary direct wetland impacts totaling 28.45 acres during construction and 5.91 acres of impacts during operation (i.e., vegetative maintenance). No permanent direct wetland filling impacts from the Project have been identified in Connecticut to date. Mitigation for these wetland impacts is being proposed in the form of in-situ restoration, including re-establishment of existing grades and hydrology, replacement of wetland topsoils, and revegetation with a wetland seed mix and/or plantings of wetland woody vegetation (trees and shrubs). Additional information on the construction and mitigation proposed for the Project is provided in Attachment K. The conceptual mitigation plan submitted to the USACE is provided in Attachment L. Accordingly, it is believed that the Project has and will continue to effectively avoid and minimize impacts to Waters of the U.S., and will adequately mitigate for any unavoidable adverse impacts.

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Table 5
Summary of Temporary and Permanent Impacts by Municipality for Connecticut

Municipality	Pipeline Impacts (acres)		Aboveground Facility Impacts (acres)		Contractor Yard Impacts (acres)		Access Roads in Wetlands (acres)		Wetland Vegetation Removal (acres)[2]		Non-wetland Tree Removal (acres)[3]	
	Temporary	Permanent[1]	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent
Farmington	0.42	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.12	7.51	1.73
West Hartford	6.29	1.31	0.00	0.00	0.00	0.00	0.23	0.00	4.76	1.31	40.71	13.87
Bloomfield	18.36	3.69	0.01	0.00	0.00	0.00	0.05	0.00	10.85	3.69	48.15	19.51
Windsor	3.02	0.70	0.00	0.00	0.00	0.00	0.00	0.00	2.33	0.70	20.77	9.05
East Granby	0.35	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.09	5.86	1.13
Avon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00
Connecticut Total[4]	**28.44**	**5.91**	**0.01**	**0.00**	**0.00**	**0.00**	**0.28**	**0.00**	**18.64**	**5.91**	**123.46**	**45.29**

*Note: Impact areas are of federal wetlands and do not include impacts to the state-regulated upland review areas, buffer areas or floodplains.

[1] - These impacts include numbers of acres converted from forested wetland to scrub-shrub or emergent wetland and from scrub-shrub to emergent during operation of the pipeline.

[2] - These impacts represent the number of acres of wetland forest and scrub-shrub impacted during construction and operation. These wetland forest and scrub-shrub impacts are a total of all Project facilities (pipeline, access roads, contractor yards) constructed and operated as part of the Project.

[3] - These impacts represent numbers of acres of secondary upland impacts due to vegetation removal.

[4] - Minor apparent discrepancies between totals and sums of individual impacts are a result of rounding.

Table 6
Potential Impacts to Wetlands Providing Vernal Pool Habitat in Connecticut

Vernal Pool ID	Wetland ID[1]	Wetland Type[2]	Municipality	Type of Impact to Surrounding Wetland (square feet)		Type of Impact to Vernal Pool (square feet)	
				Construction[3]	Operation[4]	Construction[3]	Operation[5]
BL-AC3-VP003, BL-AC3-VP004	BL-B-W001	PFO	Bloomfield	2,980	330	0	0
BL-AC3-VP005, BL-AC3-VP006, BL-AC3-VP007, BL-AC3-VP008, BL-AC3-VP009, BL-AC3-VP010, BL-AC3-VP011	BL-P-W001	PFO	Bloomfield	183,388	60,548	0	0
BL-AC3-VP012, BL-AC3-VP013	BL-P-W005	PFO	Bloomfield	20,473	6,534	0	0
BL-AC3-VP014	NWI-1176	PFO	Bloomfield	94,090	34,412	0	0
EG-AC3-VP001, EG-AC3-VP002, WI-AC3-VP001, WI-AC3-VP002, WI-AC3-VP003, WI-AC3-VP004	EG-P-W001	PFO	East Granby, Windsor	49,658	15,681	0	0

Table 6
Potential Impacts to Wetlands Providing Vernal Pool Habitat in Connecticut

Vernal Pool ID	Wetland ID[1]	Wetland Type[2]	Municipality	Type of Impact to Surrounding Wetland (square feet)		Type of Impact to Vernal Pool (square feet)	
				Construction[3]	Operation[4]	Construction[3]	Operation[5]

Source: The data sets utilized for wetlands and vernal pools is a combination of field surveyed data, photo interpreted LiDAR data, and publically available data. Field surveyed data was used wherever there was parcel access, photo interpreted LiDAR data was used where there was no parcel access, and publically available data was used where there was no parcel access and no photo interpreted aerial coverage. The publically available data for wetlands is from the USFWS - NWI (2014).

1 Wetland ID in the form of NWI-XXX are USFWS-NWI wetlands, and WPI-XXX are photo interpreted wetlands. All other wetland ID's are surveyed wetlands.

2 Wetland classification is in accordance with Cowardin et al 1979: PEM = Palustrine Emergent Wetland; PSS = Palustrine Scrub-Shrub; PFO = Palustrine Forested Wetland.

3 Construction Acreage = all workspace during construction activities (TWS, ATWS, and permanent easement) that impacts wetlands or vernal pools.

4 Operation Acreage (for wetlands) = 10-foot wide corridor permanently maintained in herbaceous vegetative cover through PSS wetlands, and 30-foot wide corridor permanently maintained through PFO wetlands where trees taller than 15 feet that could damage the pipeline coating will be selectively cut and removed. The permanently maintained corridors represent a change in cover type from PFO to PSS and PEM or PSS to PEM; there is no operation impact on PEM wetlands, since there is no change in pre- and post-construction wetland vegetation cover type. Operational acreage represents areas of new permanent easement and does not include overlap with TGP's existing pipelines. The existing permanent easement for TGP's existing pipelines are not included in the operational wetland impacts.

5 Operation Acreage (for vernal pools) = impacts to vernal pools within the new permanent easement. The existing permanent easement for TGP's existing pipelines are not included in the operational vernal pool impacts.

Attachment B

USGS Topographic Maps of the Project

Attachment C

Documentation Form for 401 Water Quality Certification (DEP-IWRD-APP-01)

Attachment C: Documentation Form for the Following Permits:

- **Inland Wetlands and Watercourses Permit (CGS Section 22a-39)**
- **Stream Channel Encroachment Line Permit (CGS Section 22a-342 through 22a-349)**
- **401 Water Quality Certification Inland Waters (33 U.S.C. 1341)**

All applicants should review the application instructions (DEP-IWRD-INST-100). Applicants for an Inland Wetlands and Watercourses Permit should review CGS Sections 22a-36 through 22a-45 and RCSA Sections 22a-39-1 through 22a-39-15. Applicants for a Stream Channel Encroachment Line Permit should review CGS Section 22a-342. Applicants for 401 Water Quality Certification should review Section 401 of the Federal Water Pollution Control Act (33 U.S.C. 1341) and Connecticut's Water Quality Standards.

If more space is needed for your response, duplicate the form and attach additional pages to the form. If additional pages are attached, they should be numbered and titled to correspond to the specific number and title of the request for information on the application form.

1. Applicant Name: **Tennessee Gas Pipeline Company, L.L.C**
   (as indicated on the *Permit Application Transmittal Form*)

2. Check the permit(s) being requested in this application (check all that apply):
   - ☐ Inland Wetlands & Watercourses
   - ☐ Stream Channel Encroachment Lines
   - ☒ Water Quality Certification

3. If applying for a SCEL permit, indicate the SCEL Map number(s) wherein the proposed activity will take place, the property identifier and the date of the map referenced:

   SCEL Map number(s)

   Property Identifier:

   Date of the map referenced:

4. Name of wetland(s) and watercourse(s) involved:

   Please refer to Attachment A, Executive Summary

Attachment C: Documentation Form (continued)

5. Describe the purpose and need for the proposed project.

   Please refer to Attachment A, Executive Summary

☐ Check here if additional sheets are necessary, and label and attach them to this sheet.

Attachment C: Documentation Form (continued)

6. *Description of the Regulated Activity:*

6a. Indicate the area, in acres and volume in cubic yards, of any fill, excavation, or other alterations of wetlands, watercourses and floodplains.
28.73 acres **48,862** cubic yards

6b. Describe all proposed regulated activities in and affecting wetlands, watercourses and floodplains. Include all discharges of dredged or fill material and storm waters incidental to the construction and/or operation of the proposed project.

Please refer to Attachment A, Executive Summary

☐ Check here if additional sheets are necessary, and label and attach them to this sheet.

Attachment C: Documentation Form (continued)

7. *Description of Site* - Describe all natural and man-made features at the property at which the regulated activity is proposed to be conducted.

   Please refer to Attachment K, Environmental Report

   ☐ Check here if additional sheets are necessary, and label and attach them to this sheet.

8. *Disposal of Excess Material* - State the type and quantity of excess material anticipated from the project and where such material will be disposed.

   All excavated material will either be reused on-site to backfill the pipeline trench or disposed of off-site in accordance with applicable requirements.

   ☐ Check here if a disposal plan is included as Attachment C8.

Attachment C: Documentation Form (continued)

9. *Inland Wetlands and Watercourses Applications Only*:

   a. Is the project located in a public water supply watershed? ☐ Yes ☐ No

   If Yes, the applicant must give written notice to the water company of the filing of this application in accordance with CGS Section 22a-42f.

   If Yes, include a copy of that notice as Attachment C9a.

   b. Is any portion of an inland wetland or watercourse in which the regulated activity is proposed located within 500 feet of an another municipality? ☐ Yes ☐ No

   If Yes, the applicant must give written notice to the inland wetlands agency of such municipality of the filing of this application in accordance with CGS Section 22a-42c.

   If Yes, include a copy of that notice as Attachment C9b.

   c. Is the owner of the subject property different than the applicant? ☐ Yes ☐ No

   If Yes, the owner must give written consent to the proposed activity in accordance with RCSA Section 22a-39-5.2.

   If Yes, include a copy of that consent as Attachment C9c.

10. *Inland Wetlands and Watercourses Applications Only*:

    List the names and addresses of the current owners of record of land abutting the site of the proposed regulated activity.

Name:

Address:

City/Town: State: Zip Code:

Mailing address, if different than above:

Mailing Address:

City/Town: State: Zip Code:

Name:

Address:

City/Town: State: Zip Code:

Mailing address, if different than above:

Mailing Address:

City/Town: State: Zip Code:

Name:

Address:

City/Town: State: Zip Code:

Mailing address, if different than above:

Mailing Address:

City/Town: State: Zip Code:

☐ Check here if additional sheets are necessary, and label and attach them to this sheet.

Attachment C: Documentation Form (continued)

11. *Section 401 Water Quality Certification Applications Only:*

In order to obtain a Section 401 Water Quality Certification from the DEP, you must have applied for a federal license or permit for an activity which may result in a discharge into the waters of the United States, including wetlands.

a. Has an application for a federal license or permit been submitted to the Army Corps of Engineers or other federal agency? ☒ Yes ☐ No

If Yes, include a complete copy of the application form and plans as Attachment C11a.

b. If the Section 401 Water Quality Certification application is for an activity authorized by an individual or programmatic general permit issued by the Army Corps of Engineers under section 404 of the federal Clean Water Act, identify such permit by name and application or file number.

Permit Name: **U.S. Army Corps of Engineers (USACE) Section 404 Permit**

Application or File Number: **NAE-2014-644**

12. Summary of Documents submitted with Attachment C: Check each document being submitted under Attachment C as verification that all applicable documents have been submitted.

☐ Attachment C8: Disposal Plan

☒ Attachment C9a: If the project is located in a public water supply watershed, provide a copy of the written notice sent to the water company of the filing of this application in accordance with CGS Section 22a-42f.

☐ Attachment C9b: If any portion of an inland wetland or watercourse in which the regulated activity is proposed to be located is within 500 feet of an another municipality, provide a copy of the written notice sent to the inland wetlands agency of such municipality of the filing of this application in accordance with CGS Section 22a-42c.

☐ Attachment C9c: If the owner of the subject property is different than the applicant, provide a copy of the owner's written consent to the proposed activity in accordance with RCSA Section 22a-39-5.2.

☒ Attachment C11a: *Section 401 Water Quality Certification Applications Only*: a complete copy of the application form and plans submitted to a federal agency for a federal license or permit.

☐ Other, please specify:

Attachment D

Documentation Form for Water Diversion Permit (DEP-IWRD-APP-102)

***Not required as part of this application.**

Attachment E

Documentation Form for Dam Construction Permit (DEP-IWRD-APP-103)

***Not required as part of this application.**

Attachment F

Documentation Form for Flood Management Certification Permit (DEP-IWRD-APP-104)

***Not required as part of this application.**

Attachment G

Plan Sheets and Drawings

Attachment G1

Site-Specific Wetland and Waterbody Drawings in Connecticut

TENNESSEE GAS PIPELINE COMPANY, L.L.C.

NORTHEAST ENERGY DIRECT PIPELINE - WETLANDS & WATERBODIES

PENNSYLVANIA, NEW YORK, MASSACHUSETTS, NEW HAMPSHIRE, CONNECTICUT

DRAWING PACKAGE:

- COVERSHEET
- GENERAL NOTES
- INDEX OVERVIEW
- SITE SPECIFIC DRAWINGS

GRAPHIC SCALE

20 10 0 20 MILES

REVISIONS					
NO.	REVISIONS	DATE	DRAWN	CK	APPR

PREPARED FOR

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

PREPARED BY

Hatch Mott MacDonald

NORTHEAST ENERGY DIRECT PROJECT

COVERSHEET

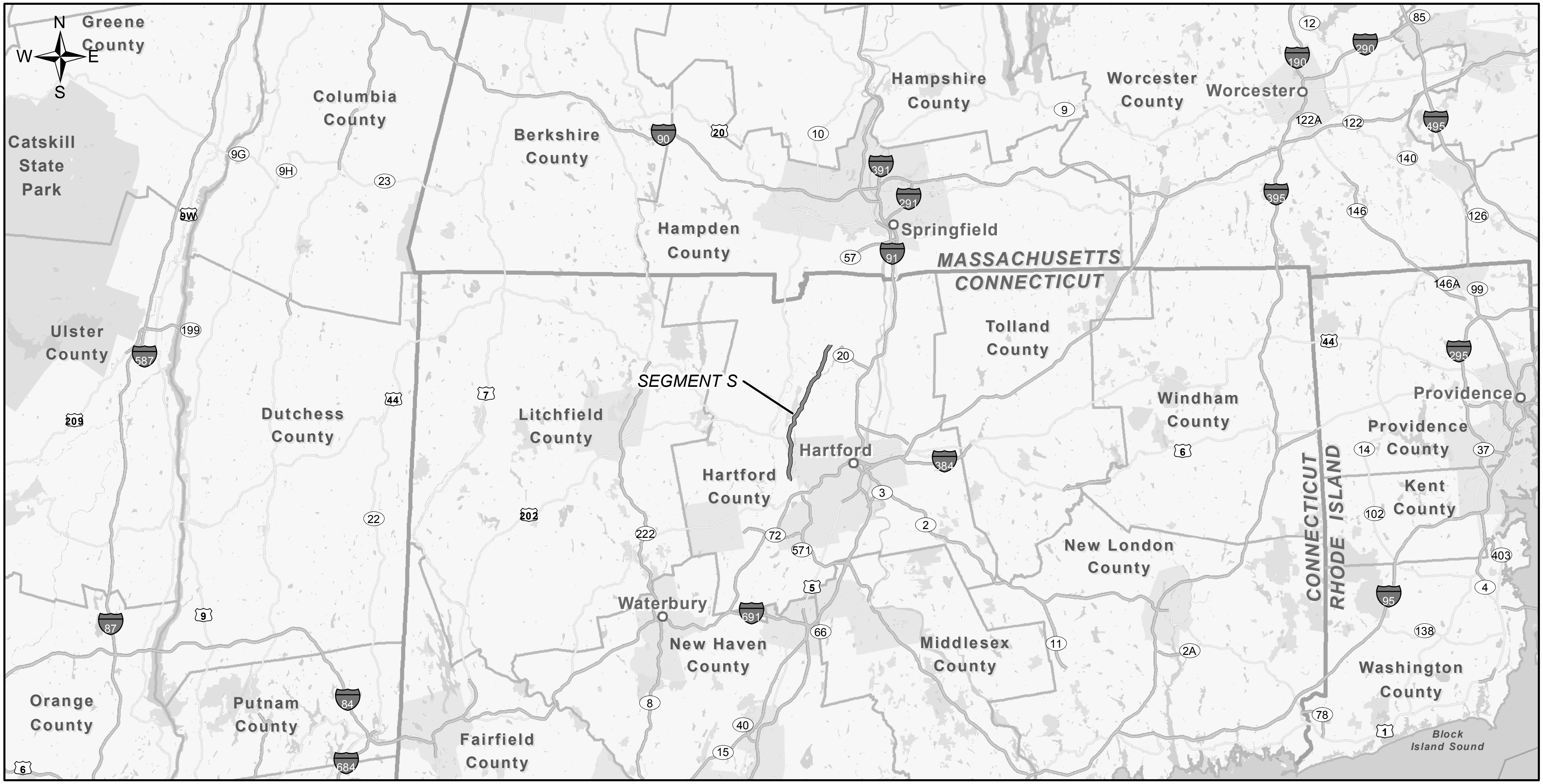
NORTHEAST ENERGY DIRECT PIPELINE
OVERALL PROJECT

SCALE	DRAWING NO.	REVISION
AS SHOWN	COVERSHEET - OVERALL	

TENNESSEE GAS PIPELINE COMPANY, L.L.C.

NORTHEAST ENERGY DIRECT PIPELINE - WETLANDS & WATERBODIES

CONNECTICUT



DRAWING PACKAGE:

- COVERSHEET
- GENERAL NOTES
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- SITE SPECIFIC DRAWINGS

GRAPHIC SCALE

7.5 3.75 0 7.5 MILES

REVISIONS					
NO.	REVISIONS	DATE	DRAWN	CK	APPR

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Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

PREPARED BY

Hatch Mott MacDonald

NORTHEAST ENERGY DIRECT PROJECT

COVERSHEET

NORTHEAST ENERGY DIRECT PIPELINE
CONNECTICUT
SEGMENT S

SCALE	DRAWING NO.	REVISION
AS SHOWN	COVERSHEET - CT	

TENNESSEE GAS PIPELINE COMPANY, L.L.C.

NORTHEAST ENERGY DIRECT PIPELINE - WETLANDS & WATERBODIES

GENERAL NOTES

1. Source: Wetland & waterbody field delineation completed by Tennessee Gas Pipeline Company's consultants where parcel access was available.
2. The overall project consists of multiple segments labeled as A, B, C, D, E, F, G, H, I, J, K, L, N, O, P, Q and S. Each segment is associated with its own set of mileposts beginning at MP 0.00. Segment breaks typically occur at state lines.
3. Sheet numbering is based on the sheet location along the pipeline alignment. Therefore, sheet numbering is not in sequence.
4. Title Blocks are labeled with Segment, Milepost Range of the sheet, a list of wetland and waterbody feature designations, township, county and state of the crossing location.
5. Mileposts are not shown on the alignment to avoid clutter. The milepost range of each sheet is shown in the title block.
6. Some wetlands and waterbodies are shown on more than one sheet. In these cases, each sheet will have the total impact shown for each feature.
7. Definitions:
   a. INDEX – Sequential numbering of wetland and waterbody features. Index numbers are placed on the map near the westerly edge of the feature where it is first impacted by the workspace. Index numbers begin again at "1" on each individual sheet.
   b. FEATURE – The assigned designation of the wetland or waterbody feature.
   c. LENGTH FT – Crossing length of feature in feet. For waterbodies, a crossing length of 0 feet indicates that the waterbody is within the construction workspace limits, but does not cross the pipeline. For wetlands, crossing lengths of 0 feet indicate that a wetland is impacted by only workspace (not the pipeline centerline).
   d. CONSTR ACRES – Construction Acreage = all workspace during construction activities (TWS, ATWS, and permanent easement) that impacts wetlands. Workspace was laid out to maintain a 75 foot construction ROW through wetlands with the exception of certain site-specific areas. Stream acreage impacts were not calculated and are designated as NC – Not Calculated and will be provided in subsequent submissions.
   e. OPER ACRES – 10-foot wide corridor permanently maintained in herbaceous vegetative cover through PSS wetlands, and 30-foot wide corridor permanently maintained through PFO wetlands where trees taller than 15 feet that could damage the pipeline coating will be selectively cut and removed. The permanently maintained corridors represent a change in cover type from PFO to PSS and PEM or PSS to PEM; there is no operation impact on PEM wetlands, since there is no change in pre- and post-construction wetland vegetation cover type. Operational acreage represents areas of new permanent easement and does not include overlap with TGP's existing pipelines. The existing permanent easement for TGP's existing pipelines are not included in the operational wetland impacts.
   f. Stream acreage impacts were not calculated and are designated as NC – Not Calculated.
   g. CROSSING METHOD – Method of wetland/waterbody crossing.
      - Wetlands Crossing Techniques: I = standard crossing; II = conventional crossing; III = push/pull crossing; IV = Horizontal Directional Drill; V = Timber mats will be used to cross wetlands for Contractor Yards and Access Roads; N/A = wetland not crossed by pipeline.
      - Waterbodies crossing techniques: I = Conventional, Wet Crossing Method; II = Dry Crossing Method including Flume and Dam and Pump; III = Conventional Bore; IV = Horizontal Directional Drill; N/A = waterbody not crossed by the pipeline. Intermittent streams containing discernable flow at the time of construction will be crossed using a dry crossing method.
   h. TYPE – Wetland or Waterbody Type. Wetland classification is in accordance with Cowardin et al 1979.
      i. PEM – Palustrine Emergent Wetland
      ii. PSS - Palustrine Scrub Shrub
      iii. PFO - Palustrine Forested Wetland
      iv. Other - All other wetland class types
      v. P = Perennial Stream
      vi. I = Intermittent Stream
      vii. E = Ephemeral Stream
      viii. NF = No Flow Stream
      ix. AP = Artificial Path Stream
      x. C = Connector Stream
      xi. RUB = Riverine Unconsolidated Bottom
      xii. UNK – Unknown Stream Type
   i. DEG USE – Water Quality Designation / Fishery Classification as identified through a review of publically available data. The definitions vary by state as presented below.
      Pennsylvania: N/A = Not Applicable, no state fishery classification; TS = Trout stocked; PA Fishery Classifications: Approved trout waters (PFBC 2015a, 2015f); Natural Trout Reproduction (PFBC 2015b, 2015c).
      New York: Class A, A-Special, AA, and AA-Special surface waters. Waters with classifications A, B, and C also may have a standard of (T), indicating that they may support trout populations; or (TS), indicating that they may support trout spawning (TS).
      Massachusetts: Class A: These waters include waters designated as a source of public water supply and their tributaries. Class B: These waters are designated as a habitat for fish; other aquatic life, and wildlife, including reproduction, migration, growth, and other critical functions; and for primary and secondary contact recreation. Class C: These waters are designated as a habitat for fish; other aquatic life and wildlife, including reproduction, migration, growth and other critical functions; and for secondary contact recreation. HQ-High Quality. CFR - Coldwater Fishery Resource.
      New Hampshire: CWF = Cold Water Fishery, A= Class A, B= Class B
      Connecticut: Class AA: Existing or proposed drinking water supplies; habitat for fish and other aquatic life and wildlife; recreation; and water supply for industry and agriculture. Class A: Habitat for fish and other aquatic life and wildlife; potential drinking water supplies; recreation; navigation; and water supply for industry and agriculture. Class B: Habitat for fish and other aquatic life and wildlife; recreation; navigation; and industrial and agricultural water supply.

DRAWING PACKAGE:

- COVERSHEET
- GENERAL NOTES
- INDEX OVERVIEW
- SITE SPECIFIC DRAWINGS

REVISIONS

NO.	REVISIONS	DATE	DRAWN	CK	APPR

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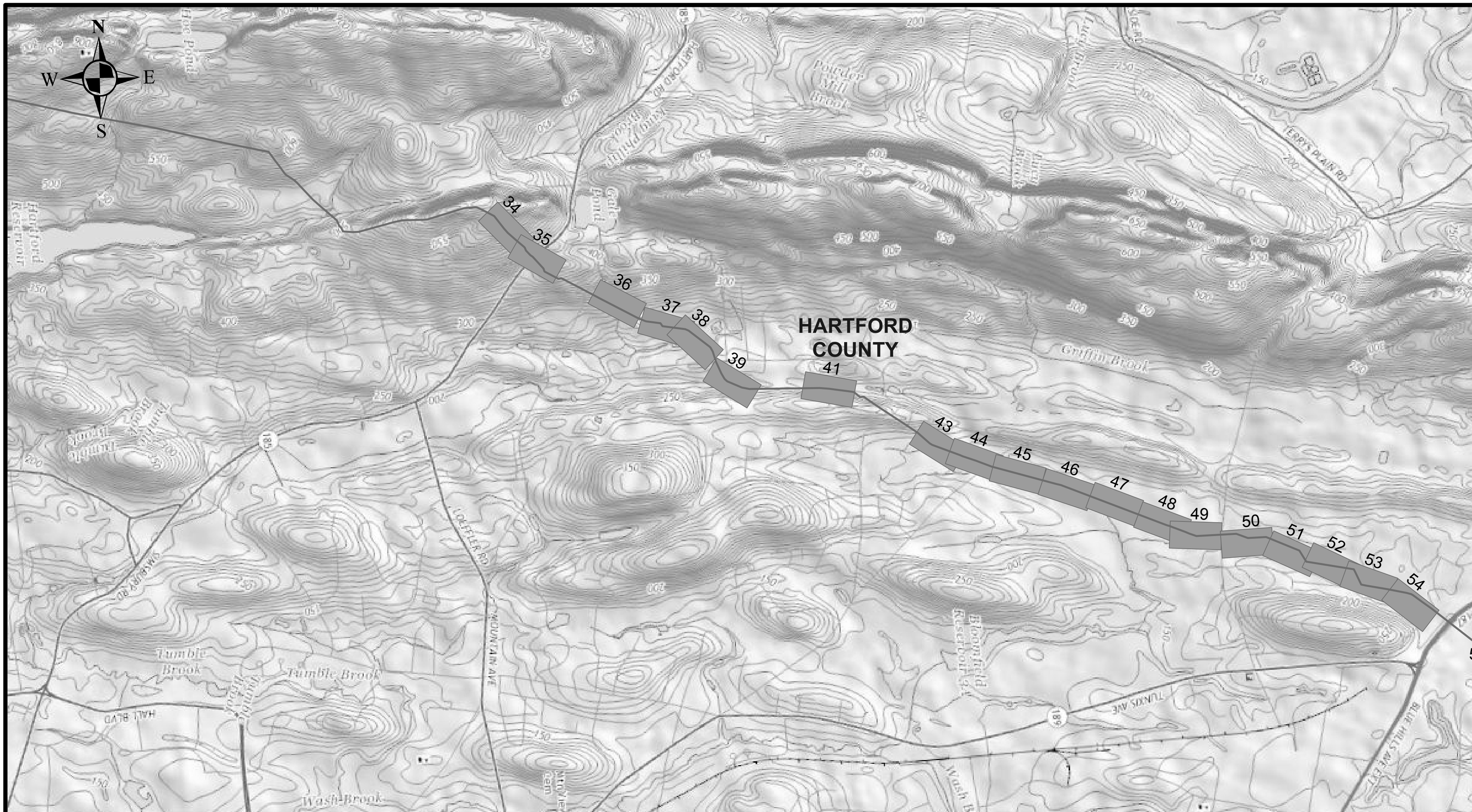
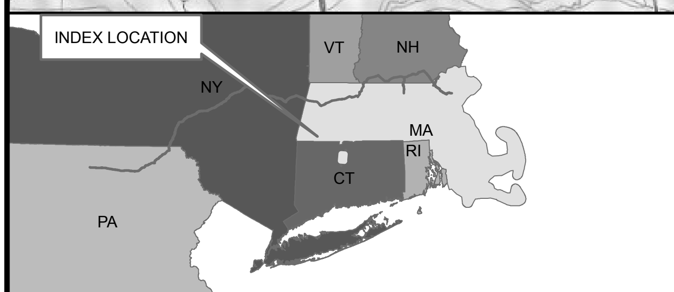
NORTHEAST ENERGY DIRECT PROJECT

COVERSHEET
NORTHEAST ENERGY DIRECT PIPELINE
GENERAL NOTES

SCALE	DRAWING NO.	REVISION
	COVERSHEET - NOTES	



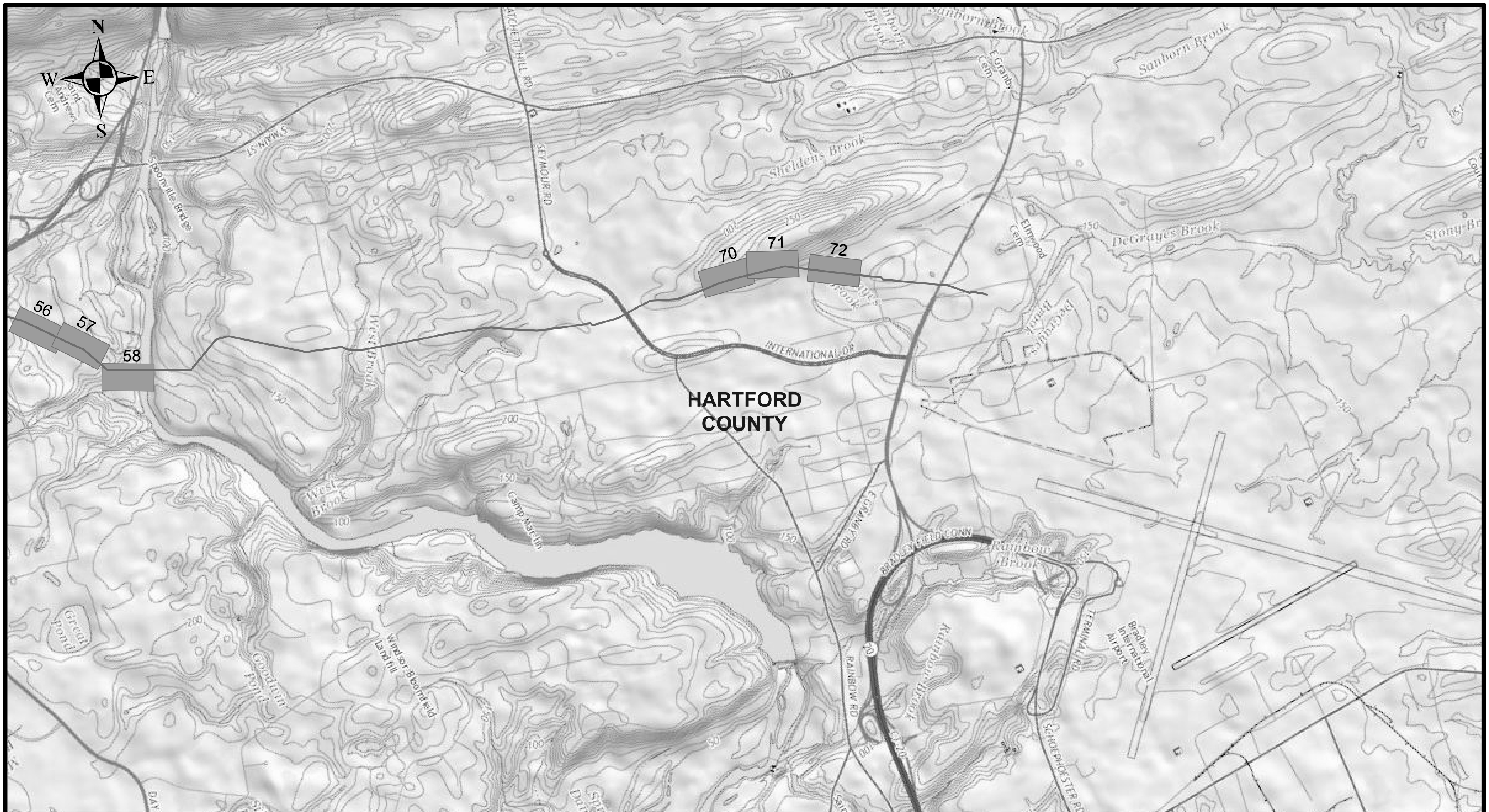


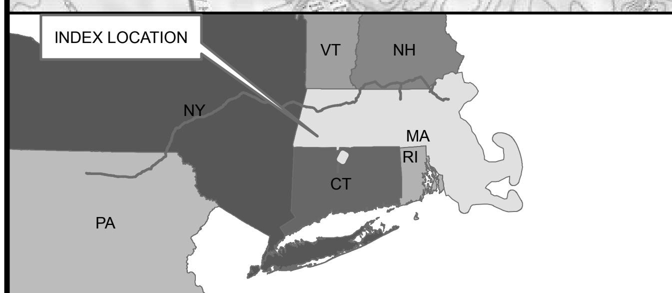
NED ENVIRONMENTAL IMPACT SHEET INDEX

SHEET 001 OF 2 IN SEGMENT "S"

FROM MP 4.4 TO MP 10.8

HARTFORD COUNTY, CONNECTICUT



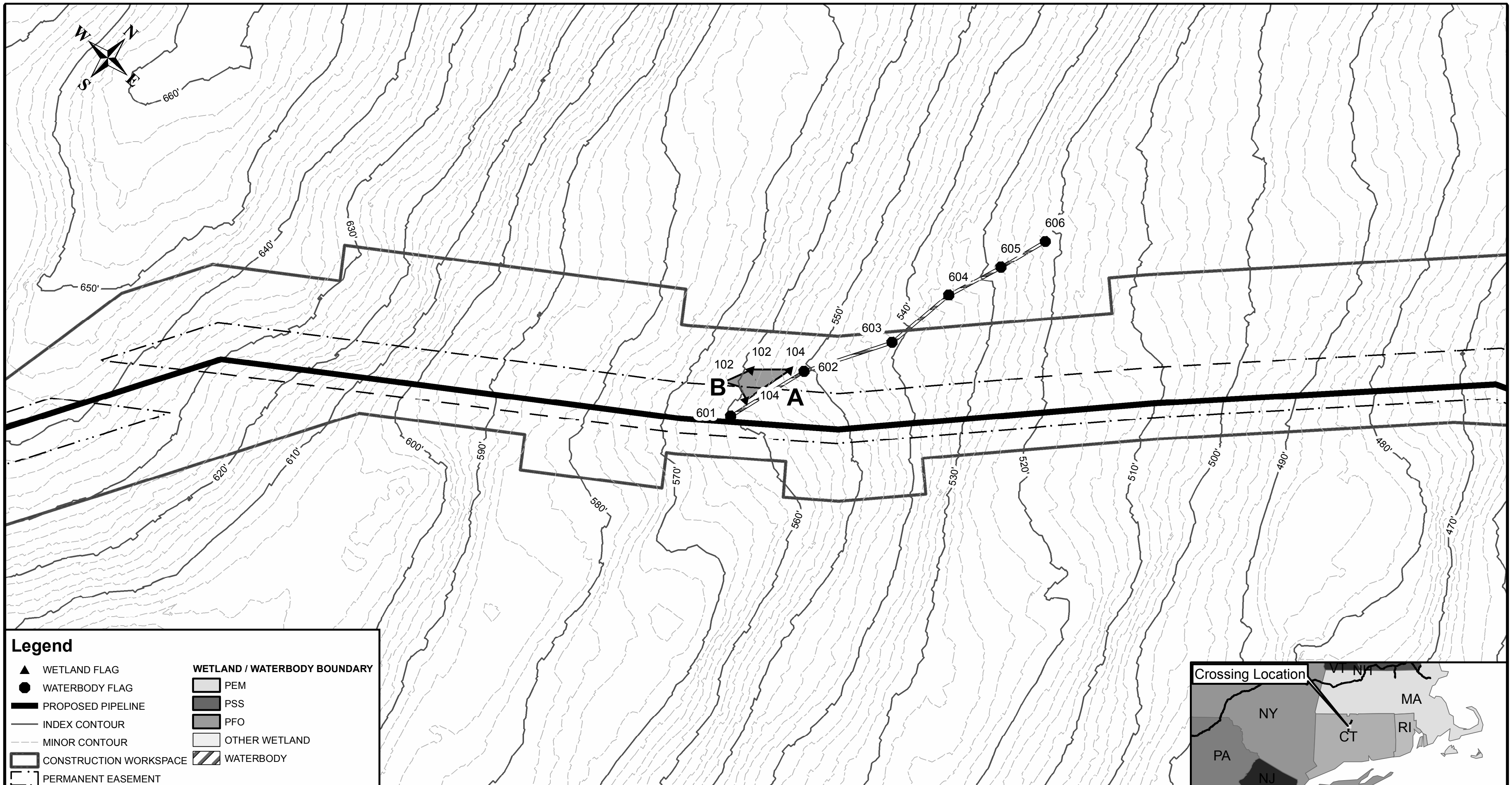


NED ENVIRONMENTAL IMPACT SHEET INDEX

SHEET 002 OF 2 IN SEGMENT "S"

FROM MP 10.8 TO MP 14.8

HARTFORD COUNTY, CONNECTICUT



Legend

- WETLAND FLAG
- WATERBODY FLAG
- PROPOSED PIPELINE
- INDEX CONTOUR
- MINOR CONTOUR
- CONSTRUCTION WORKSPACE
- PERMANENT EASEMENT

WETLAND / WATERBODY BOUNDARY

- PEM
- PSS
- PFO
- OTHER WETLAND
- WATERBODY

Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 50' 1.900" N	72° 46' 54.973" W	BL-O-S001	0	0	0	N/A	I	A	UNT TO TUMBLE BROOK
B	41° 50' 2.055" N	72° 46' 55.210" W	BL-O-W001	0	0.01	0	N/A	PFO		

1 inch = 100 Feet 0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP6.5 TO MP6.6
BL-O-S001
BL-O-W001

BLOOMFIELD, HARTFORD COUNTY, CT

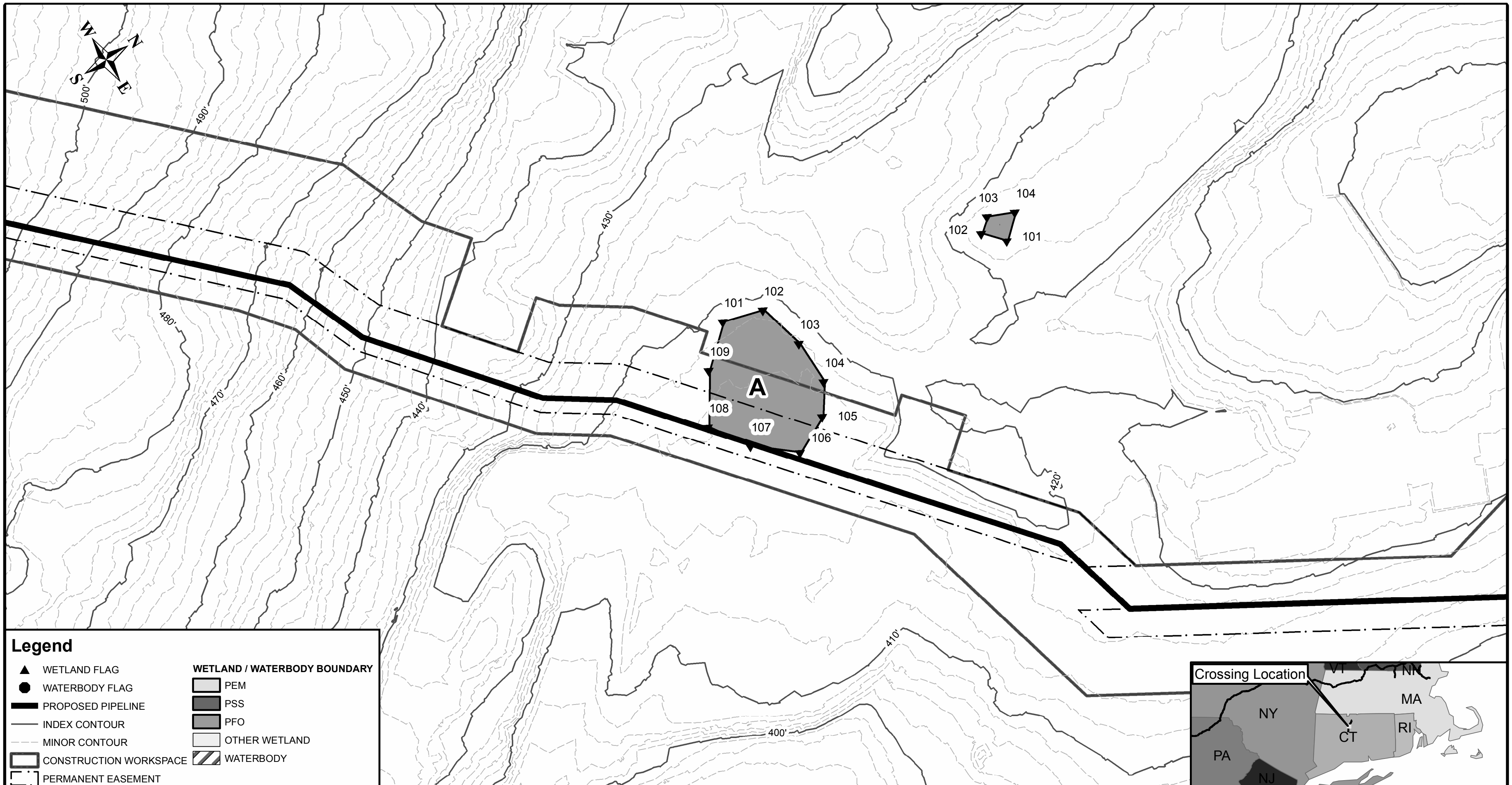
TE-SEG-S-ENV- 034

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 50' 7.603" N	72° 46' 46.972" W	BL-O-W003	19	0.09	0.02	II	PFO		

1 inch = 100 Feet 0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP6.6 TO MP6.8
BL-O-W002
BL-O-W003

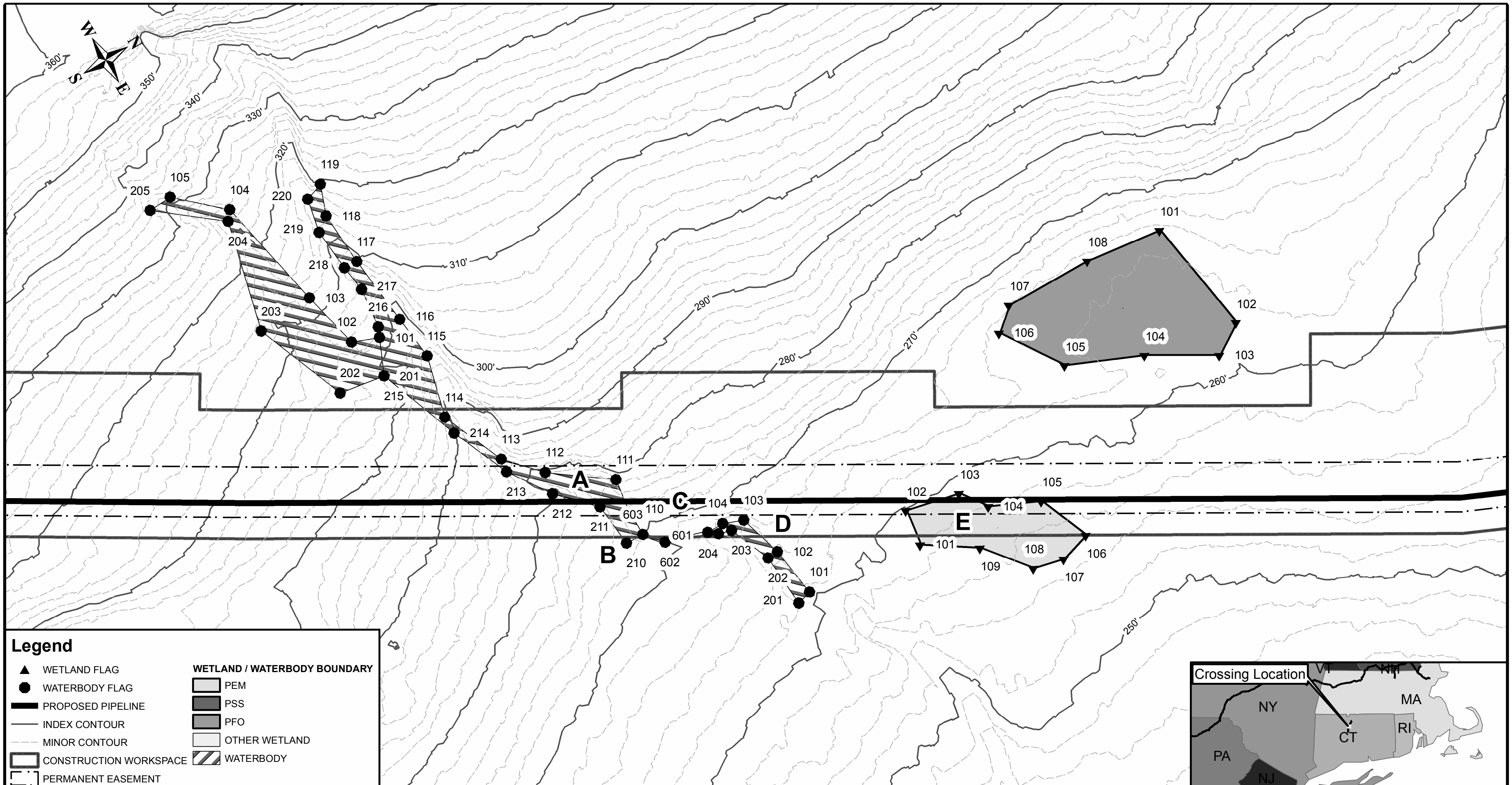
BLOOMFIELD, HARTFORD COUNTY, CT

TE-SEG-S-ENV- 035

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald
Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 50' 21.553" N	72° 46' 32.671" W	BL-P-S004	31	0	0	II	E	A	UNT TO TUMBLE BROOK
B	41° 50' 21.781" N	72° 46' 32.106" W	BL-P-S004	0	0	0	N/A	E	A	UNT TO TUMBLE BROOK
C	41° 50' 22.005" N	72° 46' 31.895" W	BL-P-S004	0	0	0	N/A	E	A	UNT TO TUMBLE BROOK
D	41° 50' 22.176" N	72° 46' 31.798" W	BL-P-S004	0	0	0	N/A	E	A	UNT TO TUMBLE BROOK
E	41° 50' 23.413" N	72° 46' 30.976" W	BL-B-W007	25	0.06	0	II	PEM		

1 inch = 100 Feet 0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP7.0 TO MP7.2

BL-B-W007
BL-P-S004
BL-P-S004A
BL-P-W003

BLOOMFIELD, HARTFORD COUNTY, CT

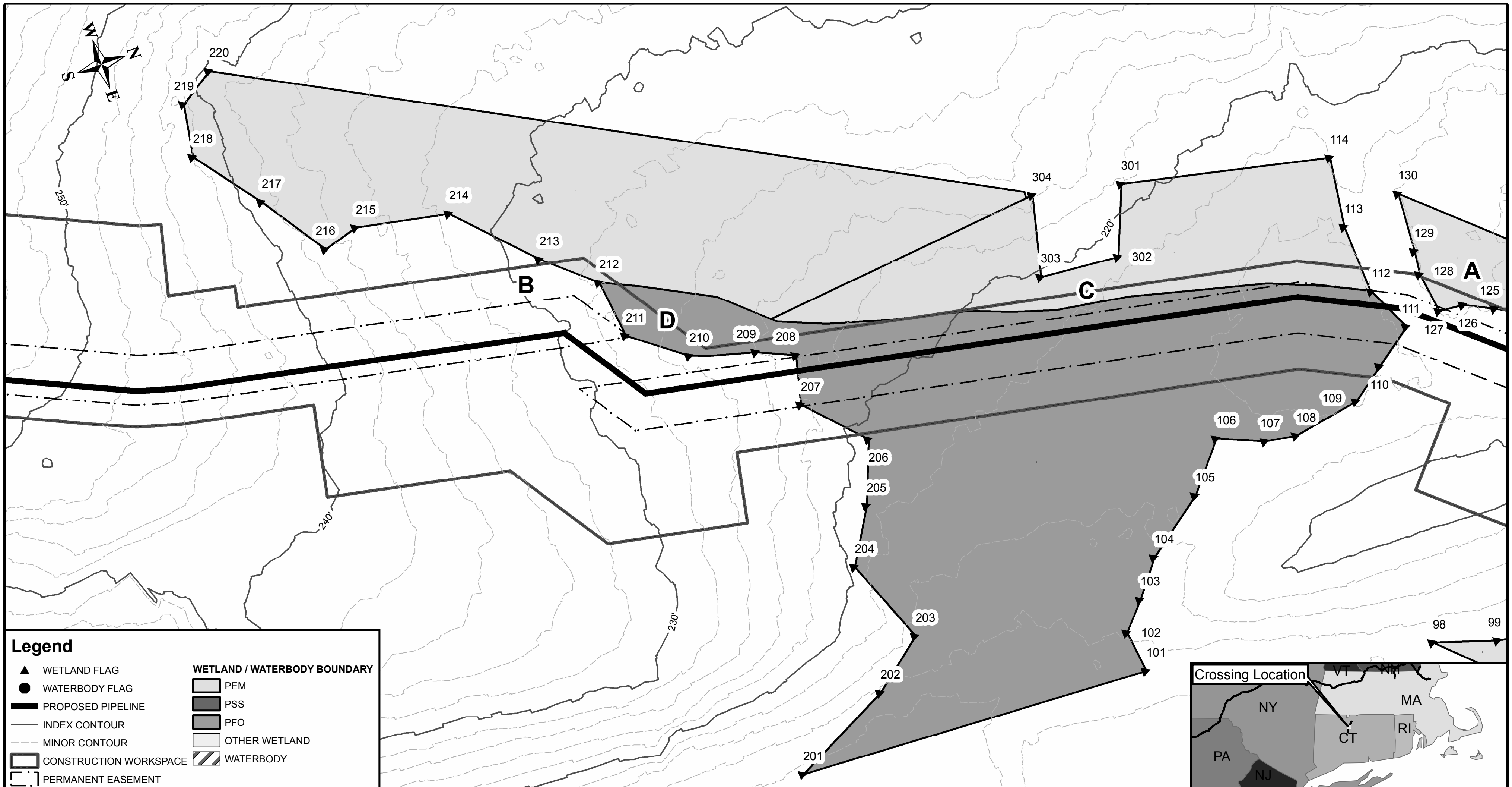
TE-SEG-S-ENV- 036

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 50' 36.880" N	72° 46' 23.935" W	BL-B-W005	0	0.01	0	N/A	PEM		
B	41° 50' 31.296" N	72° 46' 26.964" W	BL-B-W006	0	0.01	0	N/A	PEM		
C	41° 50' 33.583" N	72° 46' 25.257" W	BL-B-W006	0	0.06	0	N/A	PEM		
D	41° 50' 31.571" N	72° 46' 26.627" W	BL-B-W006	416	0.68	0.24	II	PFO		

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.

2. THE IMPACT TABLE SHOWS ENTIRE AREA FOR EACH WETLAND OR WATERBODY IMPACT LISTED, EVEN IF IT CONTINUES ON TO AN ADJACENT SHEET.

1 inch = 100 Feet 0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP7.2 TO MP7.4
BL-B-W005
BL-B-W006
BL-O-W004

BLOOMFIELD, HARTFORD COUNTY, CT

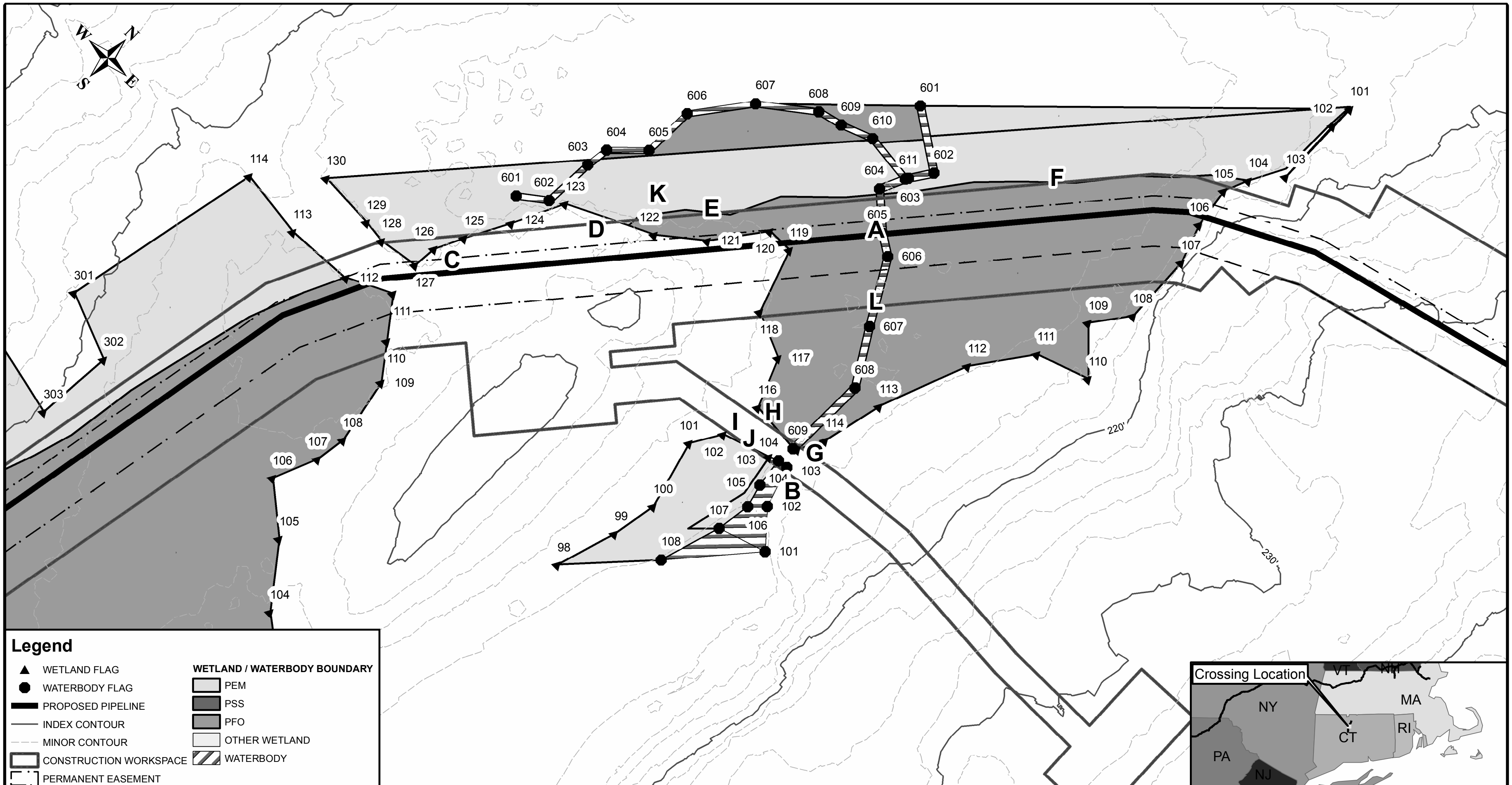
TE-SEG-S-ENV- 037

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 50' 39.225" N	72° 46' 20.611" W	BL-P-S003	5	0	0	II	P	A	UNT TO TUMBLE BROOK
B	41° 50' 37.567" N	72° 46' 19.882" W	BL-B-S003	0	0	0	N/A	NF	A	UNT TO TUMBLE BROOK
C	41° 50' 36.880" N	72° 46' 23.935" W	BL-B-W005	0	0.01	0	N/A	PEM		
D	41° 50' 38.072" N	72° 46' 22.473" W	BL-B-W005	0	0.01	0	N/A	PEM		
E	41° 50' 38.568" N	72° 46' 21.866" W	BL-B-W005	0	0.01	0	N/A	PEM		
F	41° 50' 40.332" N	72° 46' 19.702" W	BL-B-W005	0	0.01	0	N/A	PEM		
G	41° 50' 37.751" N	72° 46' 19.829" W	BL-B-W005	0	0.01	0	V	PFO		
H	41° 50' 37.751" N	72° 46' 20.034" W	BL-B-W005	0	0.01	0	V	PFO		
I	41° 50' 37.538" N	72° 46' 20.170" W	BL-O-W004	0	0.01	0	V	PEM		
J	41° 50' 37.558" N	72° 46' 19.972" W	BL-O-W004	0	0.01	0	V	PEM		
K	41° 50' 38.103" N	72° 46' 22.378" W	BL-B-W005	68	0.16	0.04	II	PFO		
L	41° 50' 38.857" N	72° 46' 20.167" W	BL-B-W005	224	0.37	0.13	II	PFO		

Impact Table

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.

2. THE IMPACT TABLE SHOWS ENTIRE AREA FOR EACH WETLAND OR WATERBODY IMPACT LISTED, EVEN IF IT CONTINUES ON TO AN ADJACENT SHEET.

1 inch = 100 Feet 0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP7.4 TO MP7.6

BL-B-S003
BL-B-W005
BL-B-W006
BL-O-W004
BL-P-S003
BL-P-S003A

BLOOMFIELD, HARTFORD COUNTY, CT

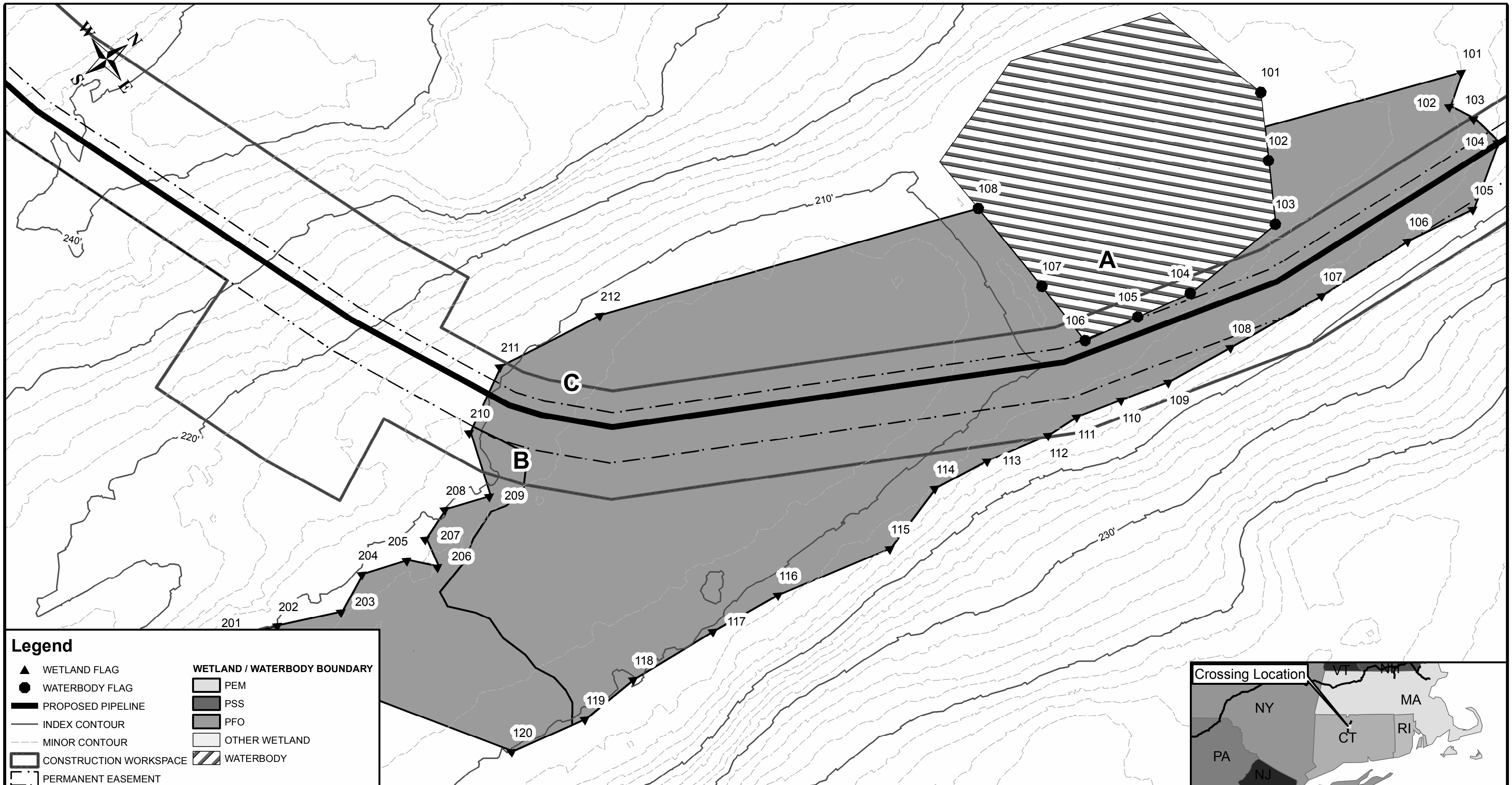
TE-SEG-S-ENV- 038

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C. a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 50' 46.502" N	72° 46' 7.493" W	BL-P-S002	0	0	0	N/A	NF	A	UNT TO TUMBLE BROOK
B	41° 50' 42.750" N	72° 46' 9.981" W	BL-B-W004	0	0.02	0	N/A	PFO		
C	41° 50' 43.154" N	72° 46' 10.276" W	BL-B-W004	751	1.08	0.43	II	PFO		

1 inch = 100 Feet 0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP7.6 TO MP7.8
BL-B-W004
BL-P-S002

BLOOMFIELD, HARTFORD COUNTY, CT

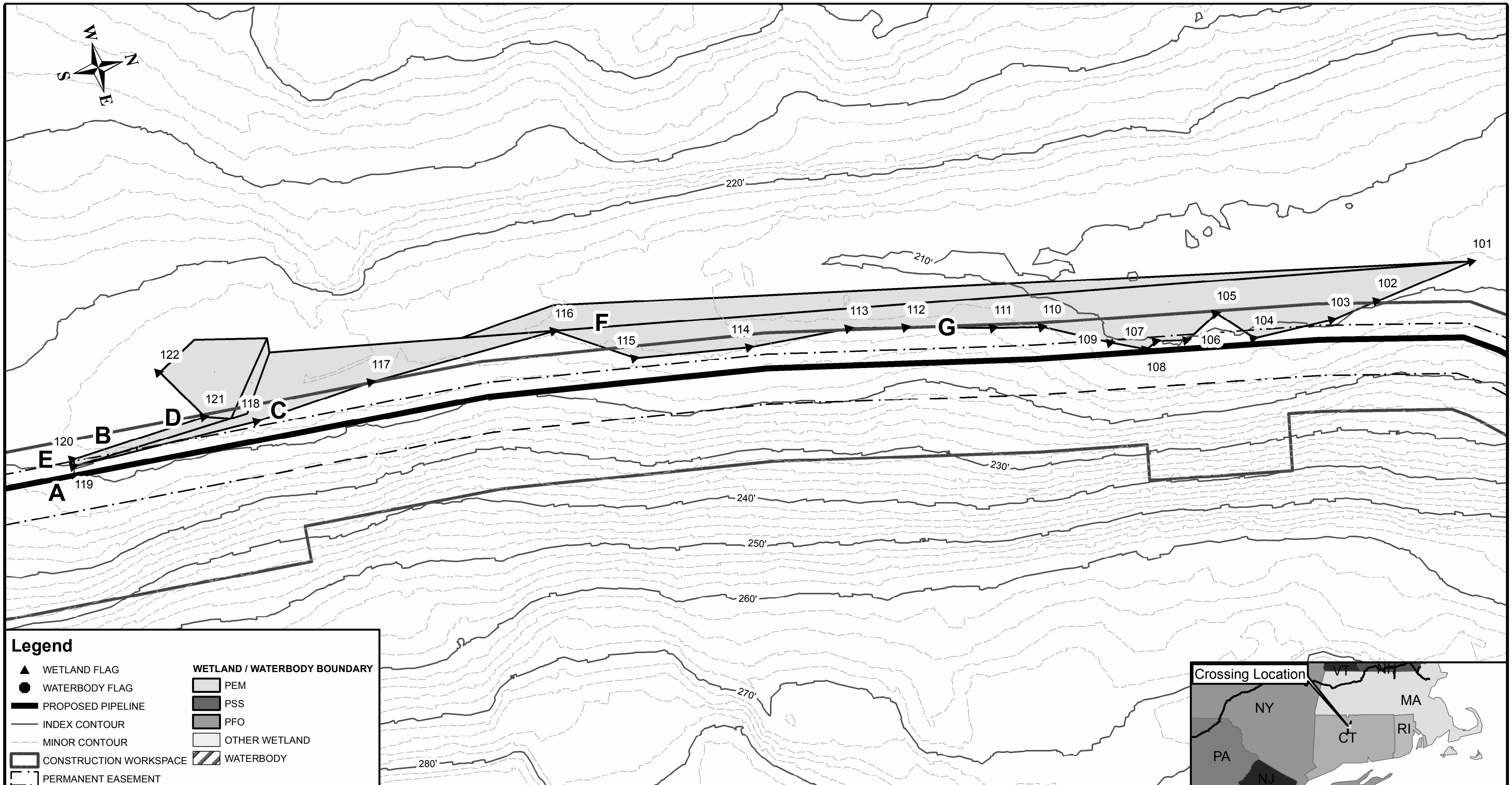
TE-SEG-S-ENV- 039

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 50' 58.991" N	72° 46' 5.607" W	BL-B-W002	0	0.01	0	N/A	PEM		
B	41° 50' 58.991" N	72° 46' 5.607" W	BL-B-W005	0	0.01	0	N/A	PEM		
C	41° 51' 0.121" N	72° 46' 5.657" W	BL-B-W005	0	0.01	0	N/A	PEM		
D	41° 50' 59.941" N	72° 46' 5.758" W	BL-O-W005	0	0.01	0	N/A	PEM		
E	41° 50' 58.991" N	72° 46' 5.607" W	BL-B-W002	0	0.02	0	N/A	PEM		
F	41° 51' 2.759" N	72° 46' 5.369" W	BL-B-W002	0	0.03	0	N/A	PEM		
G	41° 51' 4.845" N	72° 46' 4.817" W	BL-B-W002	0	0.07	0	N/A	PEM		

1 inch = 100 Feet 0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP7.9 TO MP8.1
BL-B-W002
BL-B-W005
BL-O-W005

BLOOMFIELD, HARTFORD COUNTY, CT

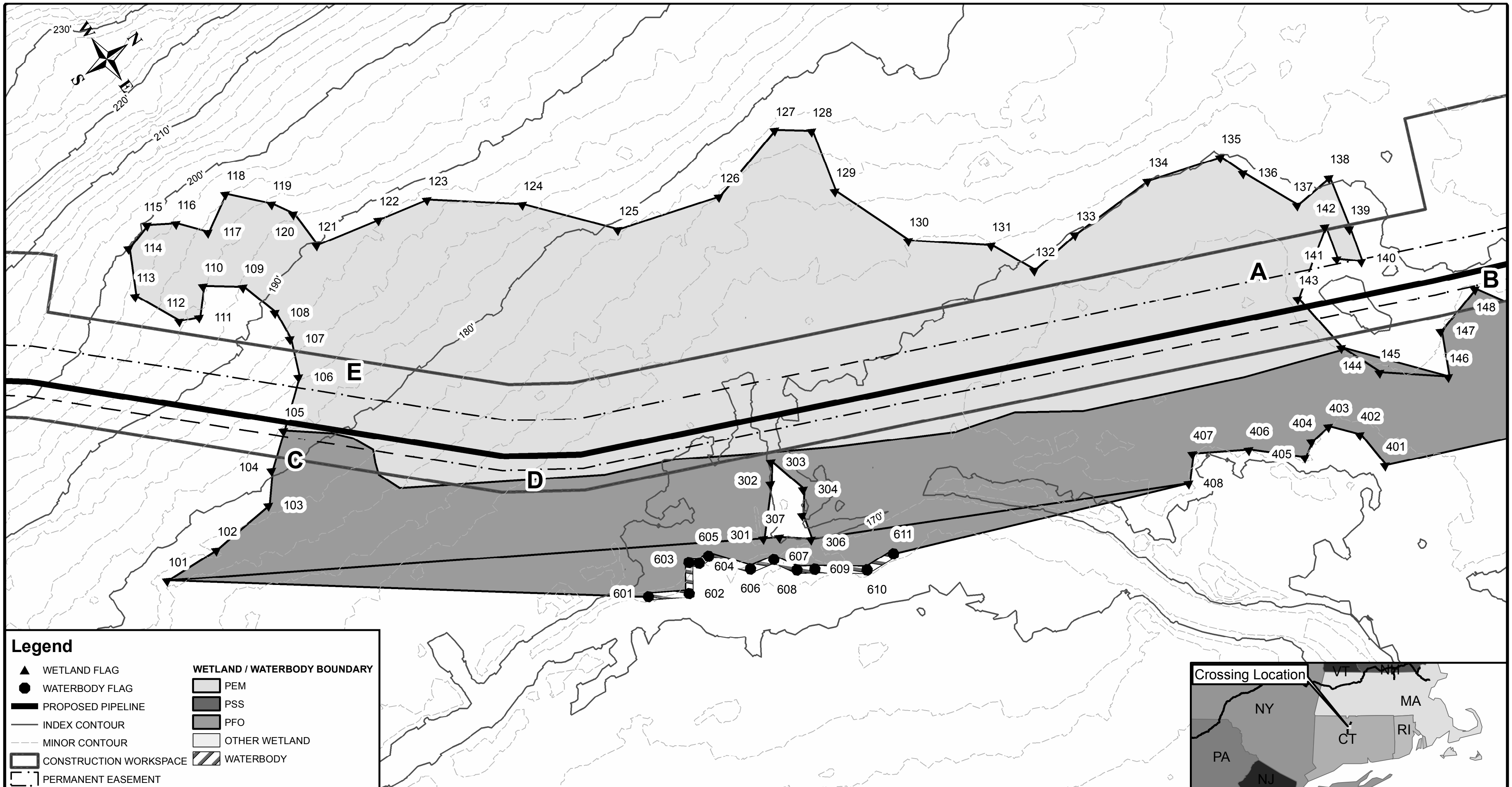
TE-SEG-S-ENV- 041

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 51' 28.366" N	72° 45' 44.880" W	BL-B-W001	0	0.01	0	N/A	PEM		
B	41° 51' 28.739" N	72° 45' 43.546" W	BL-B-W001	0	0.01	0	N/A	PFO		
C	41° 51' 21.633" N	72° 45' 49.058" W	BL-B-W001	0	0.03	0.01	N/A	PFO		
D	41° 51' 22.491" N	72° 45' 47.868" W	BL-B-W001	0	0.03	0	N/A	PFO		
E	41° 51' 22.168" N	72° 45' 49.743" W	BL-B-W001	725	1.19	0	II	PEM		

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.

2. THE IMPACT TABLE SHOWS ENTIRE AREA FOR EACH WETLAND OR WATERBODY IMPACT LISTED, EVEN IF IT CONTINUES ON TO AN ADJACENT SHEET.

1 inch = 100 Feet

0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP8.4 TO MP8.6
BL-B-S002
BL-B-W001

BLOOMFIELD, HARTFORD COUNTY, CT

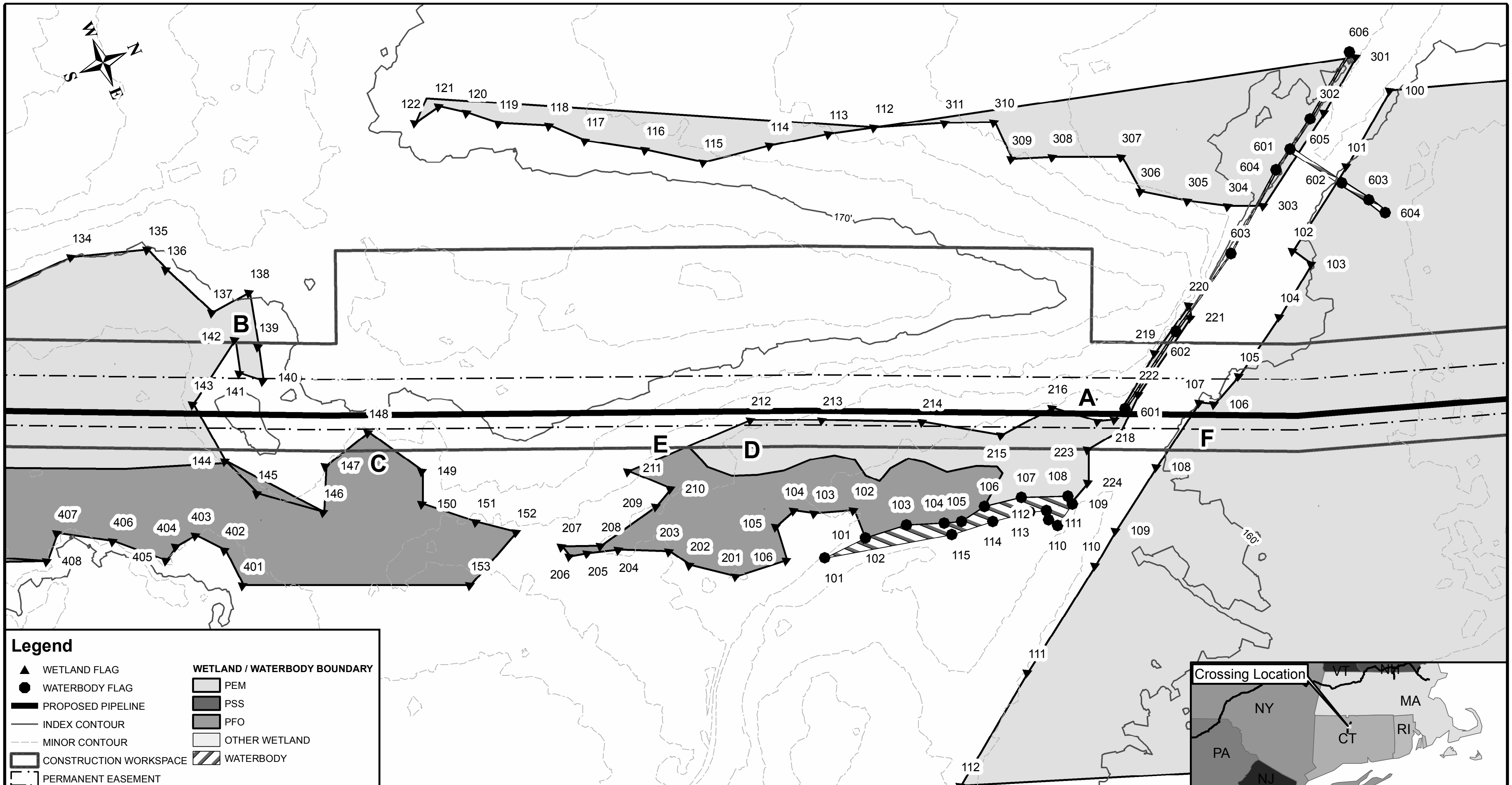
TE-SEG-S-ENV- 043

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 51' 33.744" N	72° 45' 40.880" W	BL-P-S001	0	0	0	N/A	E	A	UNT TO WASH BROOK
B	41° 51' 28.366" N	72° 45' 44.880" W	BL-B-W001	0	0.01	0	N/A	PEM		
C	41° 51' 28.739" N	72° 45' 43.546" W	BL-B-W001	0	0.01	0	N/A	PFO		
D	41° 51' 30.880" N	72° 45' 42.257" W	BL-P-W002	0	0.01	0	N/A	PFO		
E	41° 51' 30.900" N	72° 45' 42.256" W	BL-P-W002	28	0.12	0	II	PEM		
F	41° 51' 33.900" N	72° 45' 40.364" W	BL-P-W001	1415	2.41	0	II	PEM		

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP8.6 TO MP8.8

BL-B-S001
BL-B-W001
BL-P-S001
BL-P-S001A
BL-P-W001
BL-P-W002
BL-P-W003

BLOOMFIELD, HARTFORD COUNTY, CT

TE-SEG-S-ENV- 044

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

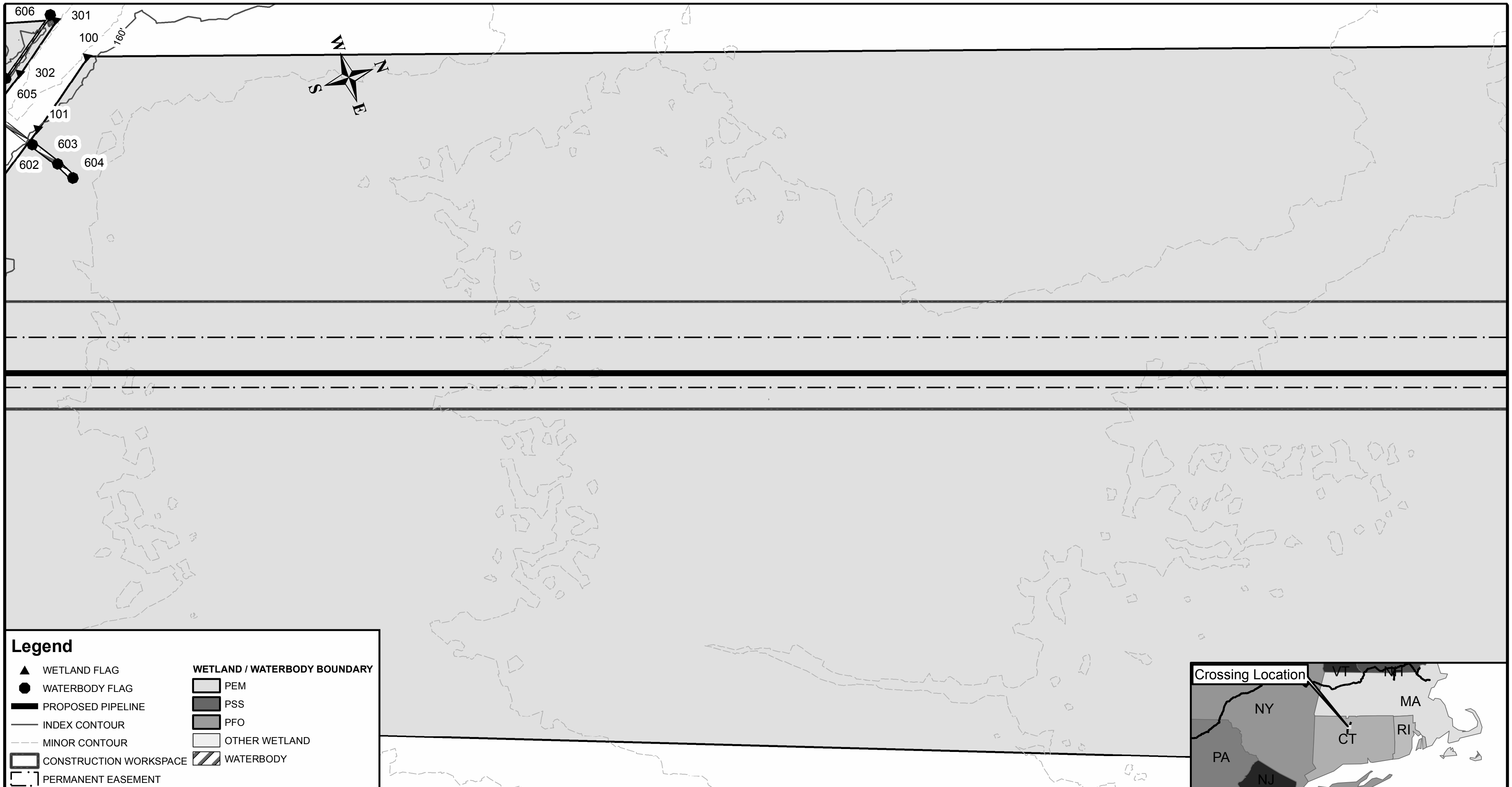
Hatch Mott MacDonald

Drawing Date: 11/16/2015

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.
2. THE IMPACT TABLE SHOWS ENTIRE AREA FOR EACH WETLAND OR WATERBODY IMPACT LISTED, EVEN IF IT CONTINUES ON TO AN ADJACENT SHEET.

1 inch = 100 Feet

Feet 0 25 50 100



Legend

- ▲ WETLAND FLAG
- ● WATERBODY FLAG
- PROPOSED PIPELINE
- INDEX CONTOUR
- MINOR CONTOUR
- CONSTRUCTION WORKSPACE
- PERMANENT EASEMENT

WETLAND / WATERBODY BOUNDARY

- PEM
- PSS
- PFO
- OTHER WETLAND
- WATERBODY

Impact Table

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP8.8 TO MP9.0

BL-P-S001
BL-P-S001A
BL-P-W001
BL-P-W003

BLOOMFIELD, HARTFORD COUNTY, CT

TE-SEG-S-ENV- 045

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.

2. THE IMPACT TABLE SHOWS ENTIRE AREA FOR EACH WETLAND OR WATERBODY IMPACT LISTED, EVEN IF IT CONTINUES ON TO AN ADJACENT SHEET.

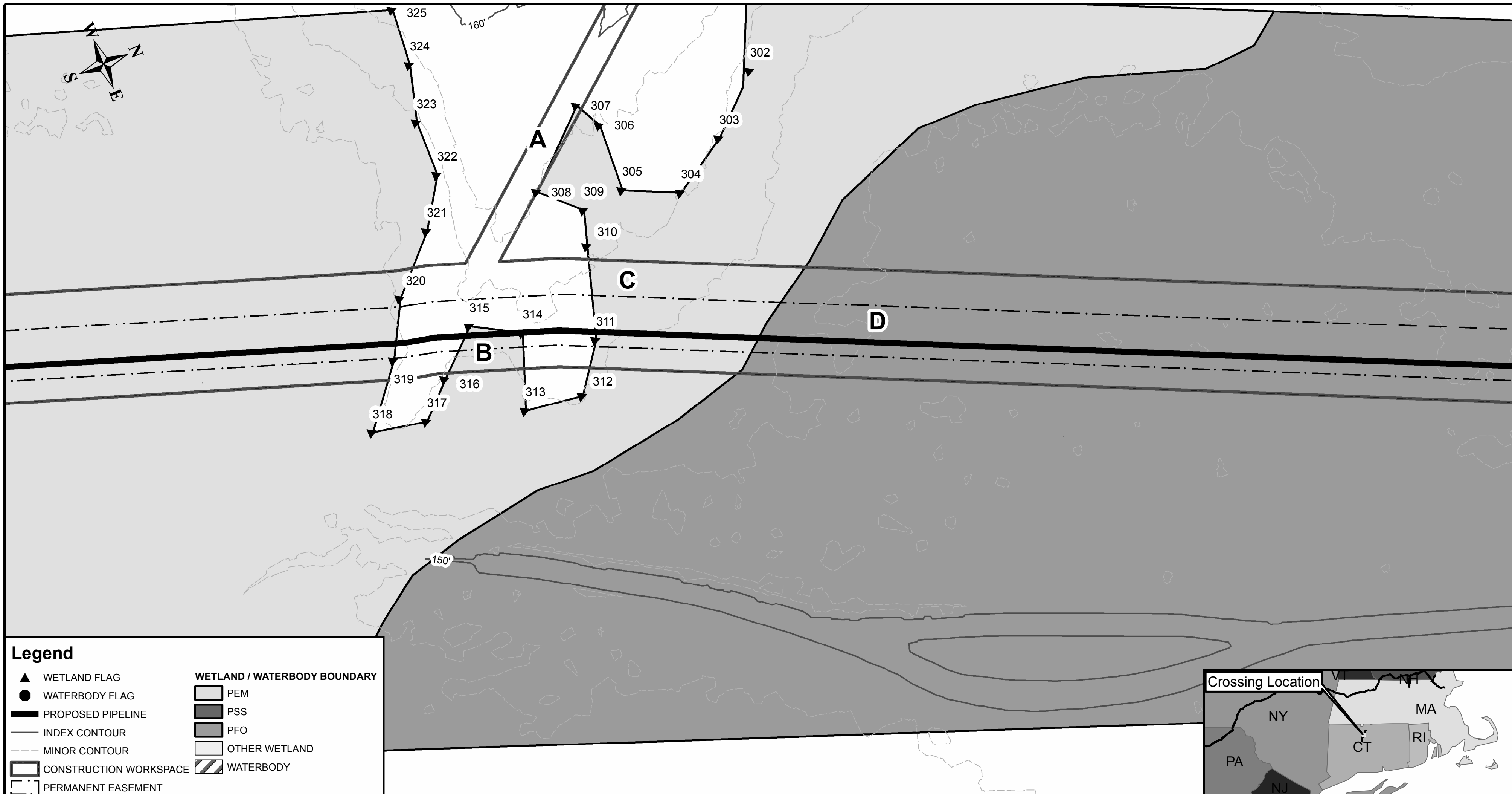
1 inch = 100 Feet

0 25 50 100 Feet

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 51' 48.579" N	72° 45' 34.820" W	BL-P-W001	0	0.01	0	V	PEM		
B	41° 51' 47.488" N	72° 45' 33.586" W	BL-P-W001	38	0.03	0	II	PEM		
C	41° 51' 48.678" N	72° 45' 34.023" W	BL-P-W001	113	0.21	0	II	PEM		
D	41° 51' 49.295" N	72° 45' 32.523" W	BL-P-W001	2424	4.2	1.39	II	PFO		

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.

2. THE IMPACT TABLE SHOWS ENTIRE AREA FOR EACH WETLAND OR WATERBODY IMPACT LISTED, EVEN IF IT CONTINUES ON TO AN ADJACENT SHEET.

1 inch = 100 Feet 0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP9.0 TO MP9.2
BL-P-W001

BLOOMFIELD, HARTFORD COUNTY, CT

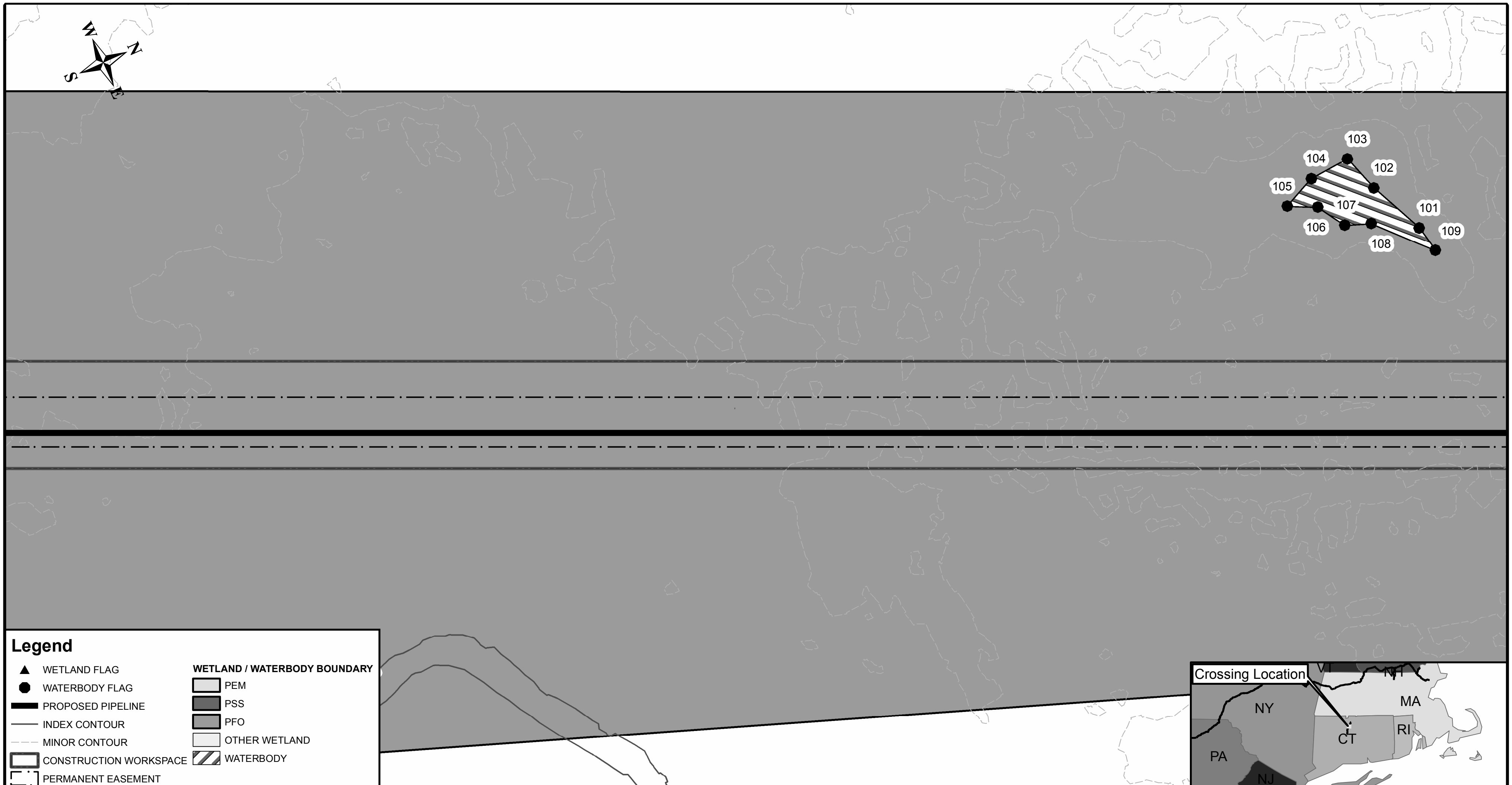
TE-SEG-S-ENV- 046

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Legend

- ▲ WETLAND FLAG
- ● WATERBODY FLAG
- PROPOSED PIPELINE
- INDEX CONTOUR
- MINOR CONTOUR
- CONSTRUCTION WORKSPACE
- PERMANENT EASEMENT

WETLAND / WATERBODY BOUNDARY

- PEM
- PSS
- PFO
- OTHER WETLAND
- WATERBODY

Impact Table

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP9.2 TO MP9.3
BL-P-S005
BL-P-W001

BLOOMFIELD, HARTFORD COUNTY, CT

TE-SEG-S-ENV- 047

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

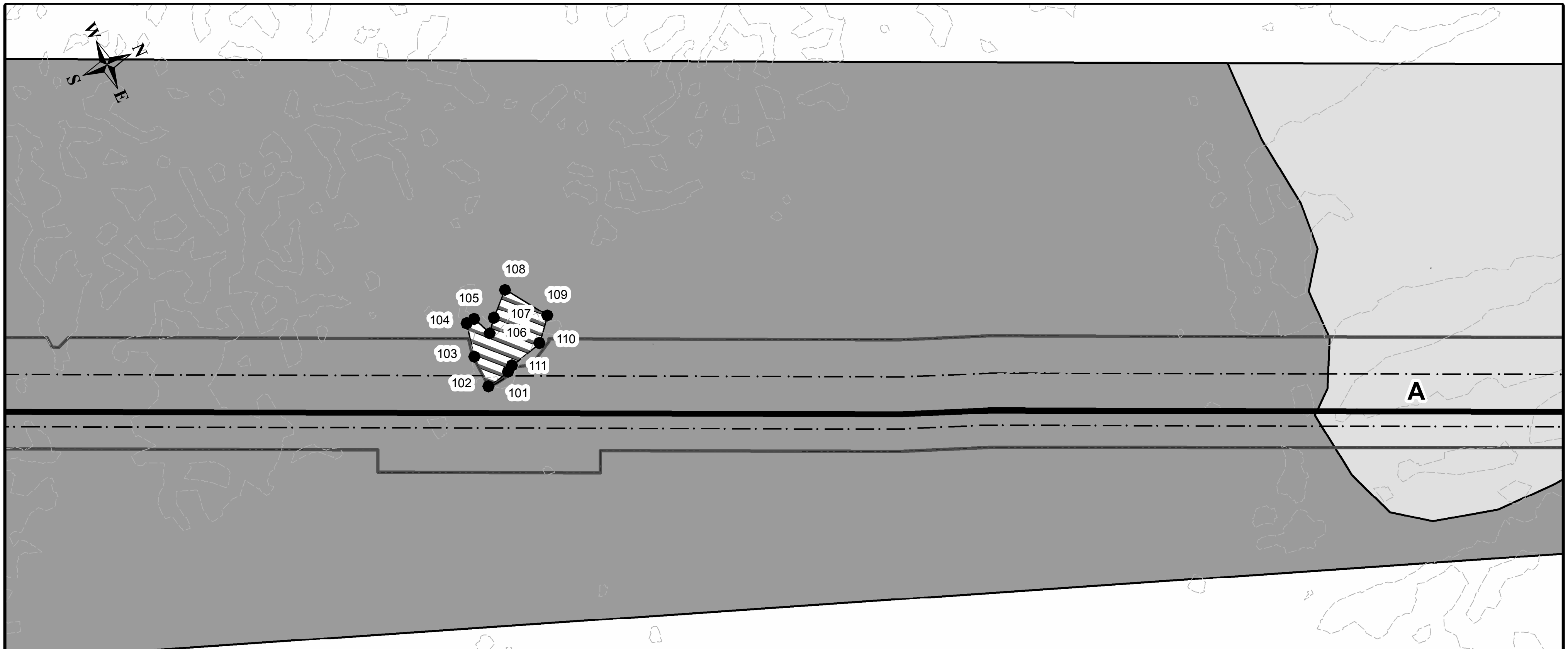
Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.
2. THE IMPACT TABLE SHOWS ENTIRE AREA FOR EACH WETLAND OR WATERBODY IMPACT LISTED, EVEN IF IT CONTINUES ON TO AN ADJACENT SHEET.

1 inch = 100 Feet 0 25 50 100 Feet

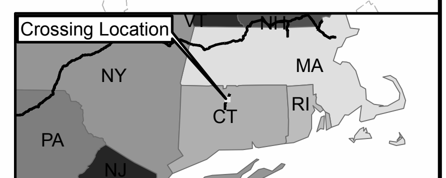


Legend

- ▲ WETLAND FLAG
- ● WATERBODY FLAG
- PROPOSED PIPELINE
- INDEX CONTOUR
- MINOR CONTOUR
- CONSTRUCTION WORKSPACE
- PERMANENT EASEMENT

WETLAND / WATERBODY BOUNDARY

- PEM
- PSS
- PFO
- OTHER WETLAND
- WATERBODY



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 52' 11.071" N	72° 45' 18.808" W	BL-P-W001	864	1.46	0	II	PEM		

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.

2. THE IMPACT TABLE SHOWS ENTIRE AREA FOR EACH WETLAND OR WATERBODY IMPACT LISTED, EVEN IF IT CONTINUES ON TO AN ADJACENT SHEET.

1 inch = 100 Feet 0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP9.3 TO MP9.5
BL-B-S004
BL-P-W001

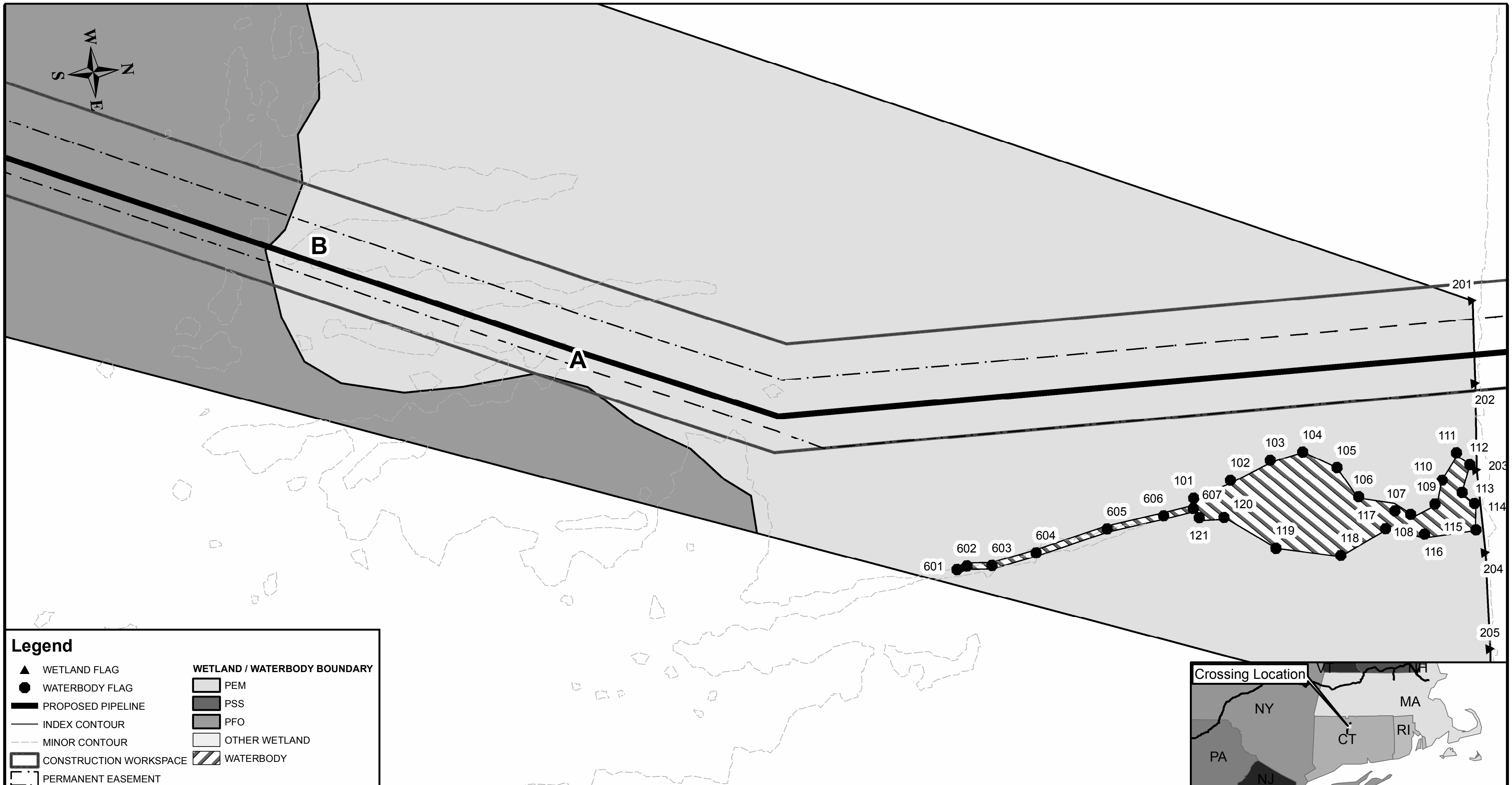
BLOOMFIELD, HARTFORD COUNTY, CT

TE-SEG-S-ENV- 048

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald
Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 52' 12.816" N	72° 45' 17.369" W	BL-P-W001	0	0.01	0	N/A	PFO		
B	41° 52' 11.071" N	72° 45' 18.808" W	BL-P-W001	864	1.46	0	II	PEM		

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP9.5 TO MP9.7
BL-B-S006
BL-B-S006A
BL-P-W001

BLOOMFIELD, HARTFORD COUNTY, CT

TE-SEG-S-ENV- 049

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

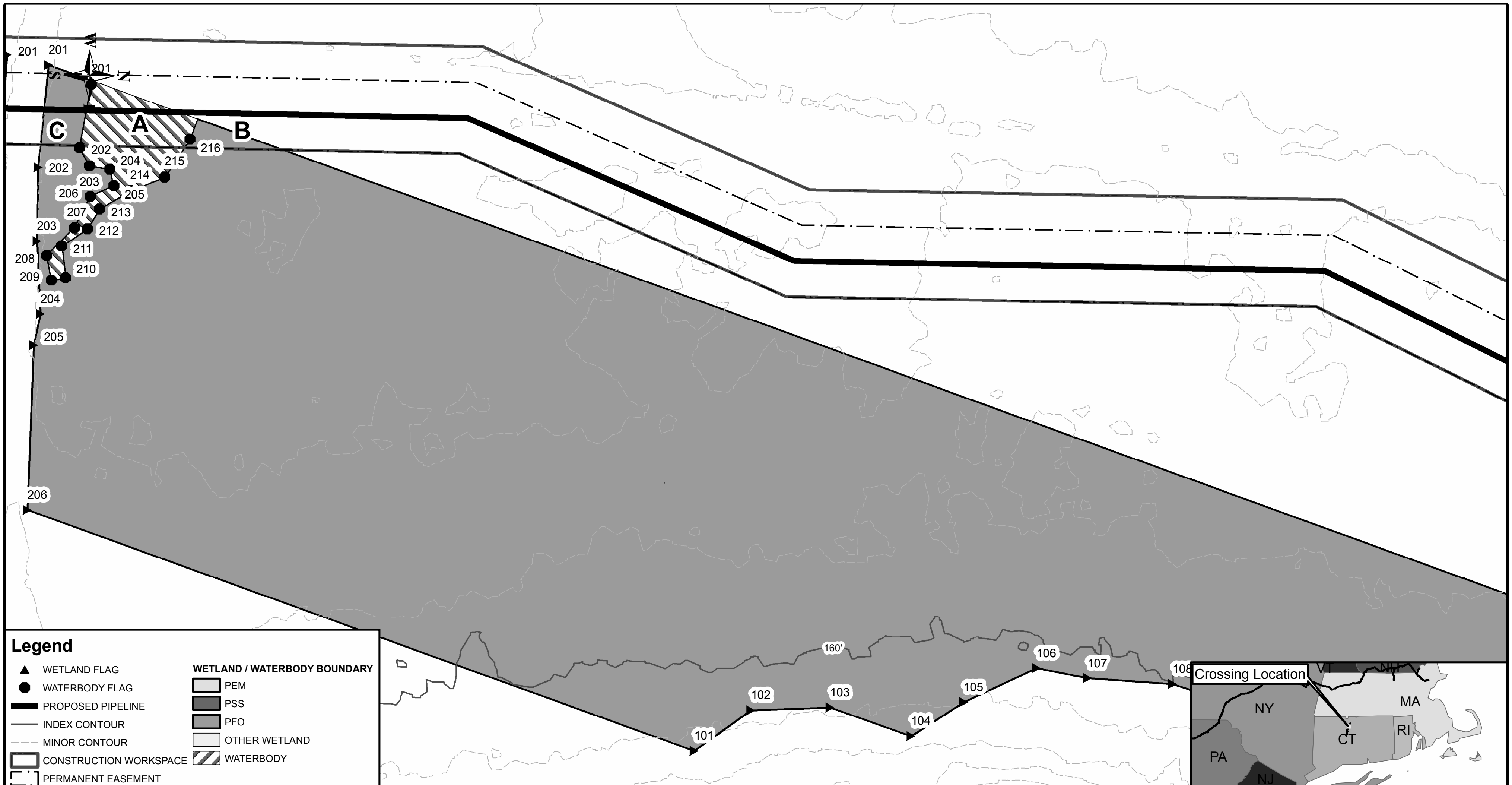
Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald
Drawing Date: 11/16/2015

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.
2. THE IMPACT TABLE SHOWS ENTIRE AREA FOR EACH WETLAND OR WATERBODY IMPACT LISTED, EVEN IF IT CONTINUES ON TO AN ADJACENT SHEET.

1 inch = 100 Feet

Feet 0 25 50 100



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 52' 19.843" N	72° 45' 16.444" W	BL-P-S005	64	0	0	II	P	A	UNT TO WASH BROOK
B	41° 52' 20.513" N	72° 45' 16.081" W	BL-P-W005	0	0.02	0.01	N/A	PFO		
C	41° 52' 19.521" N	72° 45' 16.128" W	BL-P-W005	30	0.03	0.02	II	PFO		

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP9.7 TO MP9.9

BL-P-S005
BL-P-S006
BL-P-W001
BL-P-W005

BLOOMFIELD, HARTFORD COUNTY, CT

TE-SEG-S-ENV- 050

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
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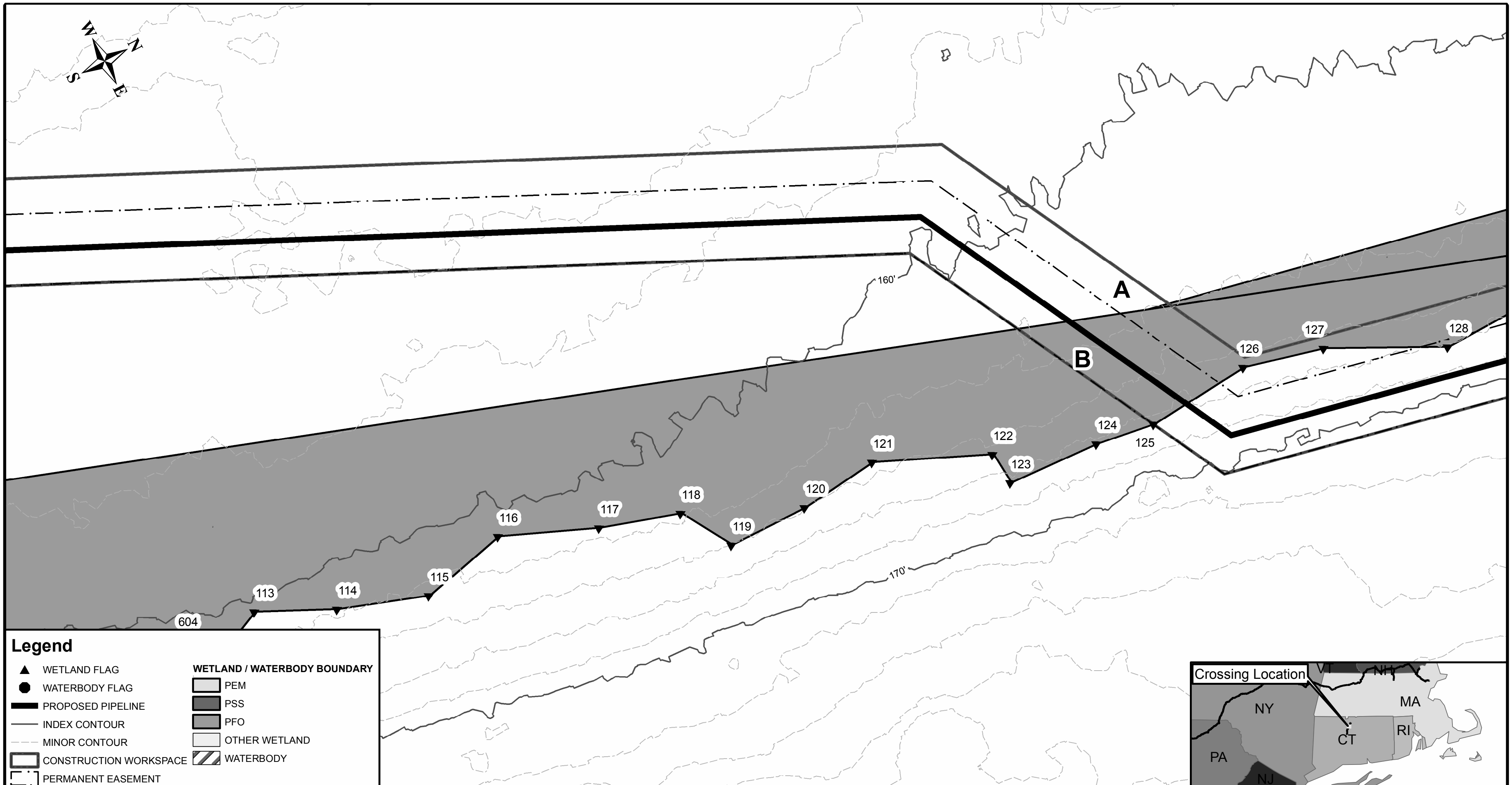
1 inch = 100 Feet

Feet 0 25 50 100



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 52' 35.831" N	72° 45' 8.611" W	BL-P-W005	0	0.01	0	N/A	PFO		
B	41° 52' 34.982" N	72° 45' 9.043" W	BL-P-W005	101	0.25	0.07	II	PFO		

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP9.9 TO MP10.1
BL-P-S006
BL-P-W005

BLOOMFIELD, HARTFORD COUNTY, CT

TE-SEG-S-ENV- 051

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
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Drawing Date: 11/16/2015

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.
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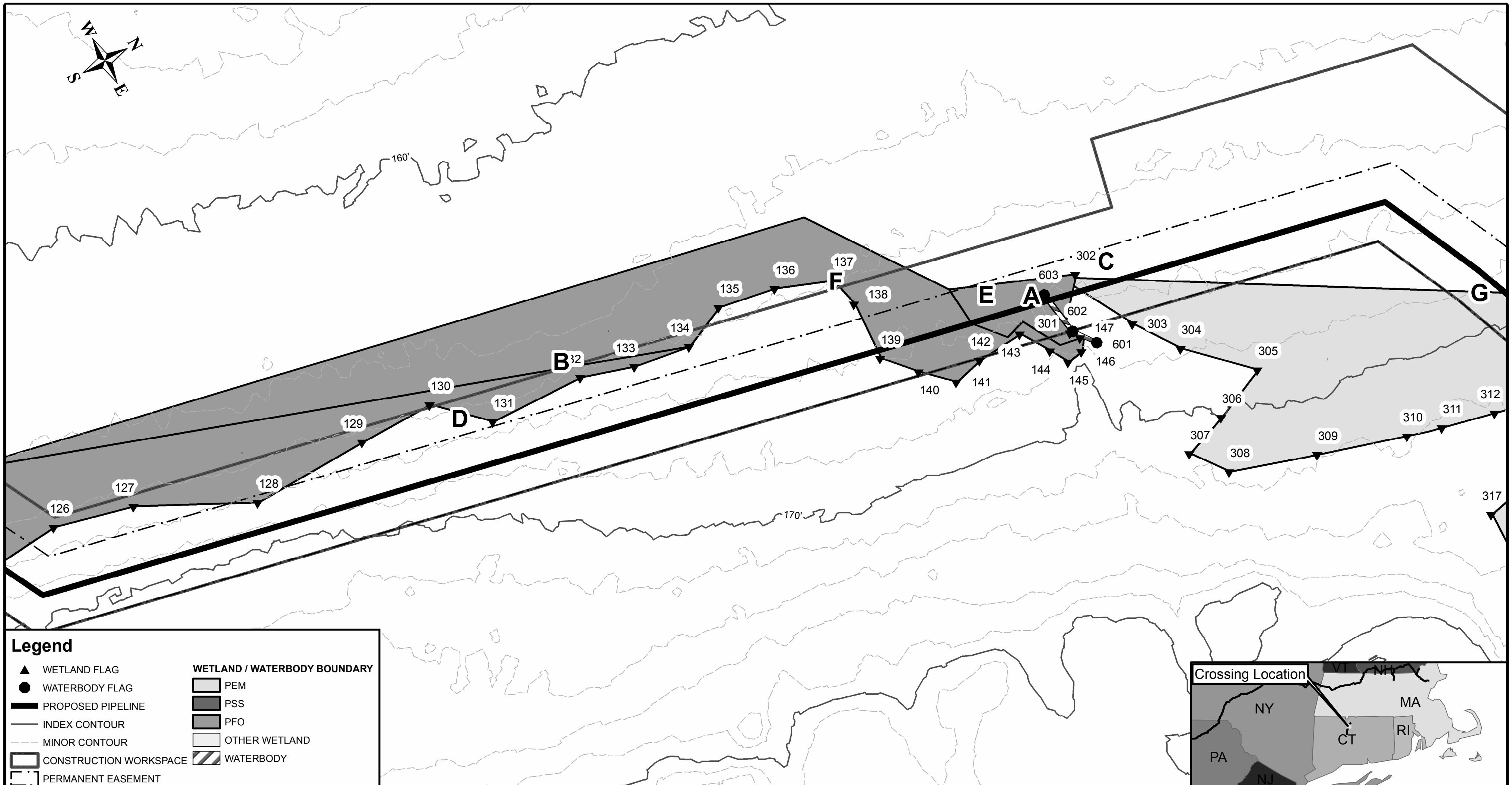
1 inch = 100 Feet 0 25 50 100 Feet



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 52' 42.913" N	72° 45' 4.862" W	BL-P-S007	3	0	0	II	E	A	UNT TO WASH BROOK
B	41° 52' 39.815" N	72° 45' 6.587" W	BL-P-W005	0	0.01	0	N/A	PFO		
C	41° 52' 43.130" N	72° 45' 4.854" W	BL-P-W006	29	0.04	0	II	PEM		
D	41° 52' 38.909" N	72° 45' 6.892" W	BL-P-W005	0	0.04	0	N/A	PFO		
E	41° 52' 42.375" N	72° 45' 5.410" W	BL-P-W006	70	0.06	0.04	II	PFO		
F	41° 52' 41.732" N	72° 45' 5.941" W	BL-P-W005	68	0.11	0.05	II	PFO		
G	41° 52' 45.327" N	72° 45' 3.075" W	BL-P-W006	223	0.41	0	II	PEM		

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.

2. THE IMPACT TABLE SHOWS ENTIRE AREA FOR EACH WETLAND OR WATERBODY IMPACT LISTED, EVEN IF IT CONTINUES ON TO AN ADJACENT SHEET.

1 inch = 100 Feet

0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP10.1 TO MP10.2

BL-P-S007
BL-P-W005
BL-P-W006

BLOOMFIELD, HARTFORD COUNTY, CT

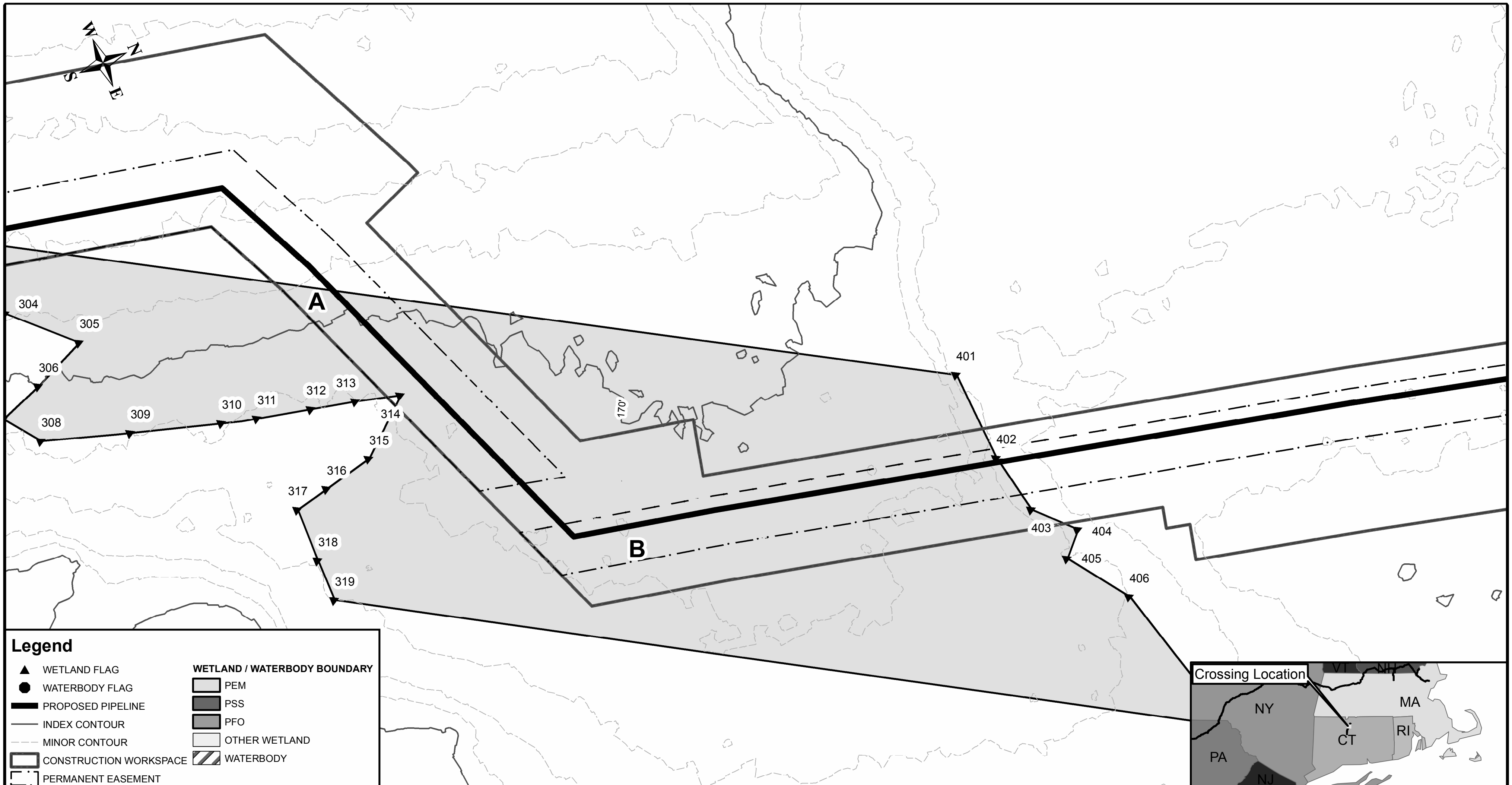
TE-SEG-S-ENV- 052

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 52' 45.327" N	72° 45' 3.075" W	BL-P-W006	223	0.41	0	II	PEM		
B	41° 52' 46.154" N	72° 45' 0.000" W	BL-P-W006	320	0.57	0	II	PEM		

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP10.2 TO MP10.4
BL-P-W006

BLOOMFIELD, HARTFORD COUNTY, CT

TE-SEG-S-ENV- 053

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald
Drawing Date: 11/16/2015

NOTES: 1. THE WETLAND OR WATERBODY SHOWN ON THIS SHEET CONTINUES. SEE ADJACENT SHEETS.
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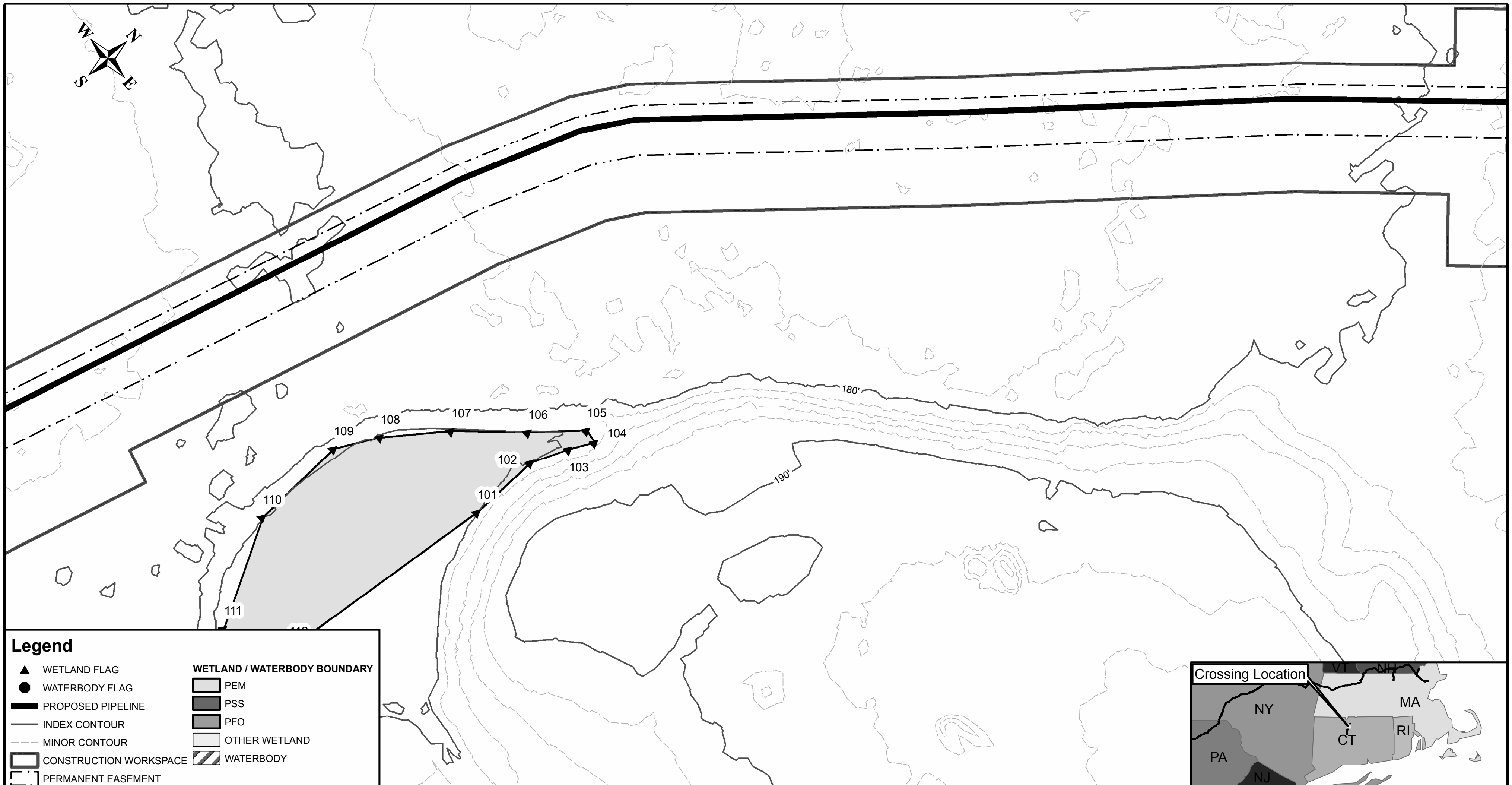
1 inch = 100 Feet
Feet 0 25 50 100



Impact Table

1 inch = 100 Feet

Feet 0 25 50 100

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP10.4 TO MP10.6
BL-N-W001

BLOOMFIELD, HARTFORD COUNTY, CT

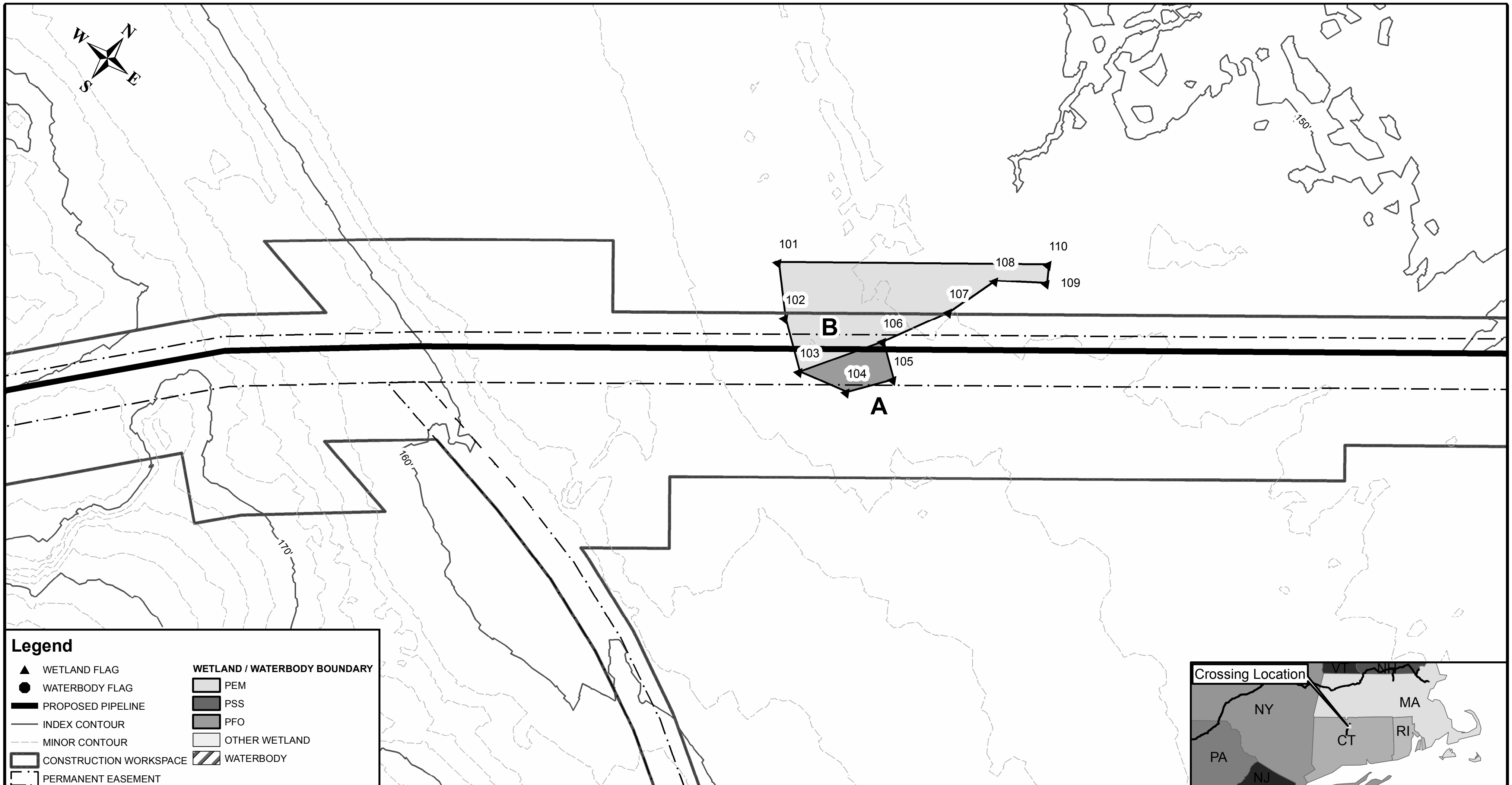
TE-SEG-S-ENV- 054

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 53' 14.489" N	72° 44' 32.004" W	BL-N-W006	17	0.03	0.01	II	PFO		
B	41° 53' 14.754" N	72° 44' 32.433" W	BL-N-W006	47	0.05	0	II	PEM		

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP10.9 TO MP11.1
BL-N-W006

BLOOMFIELD, HARTFORD COUNTY, CT

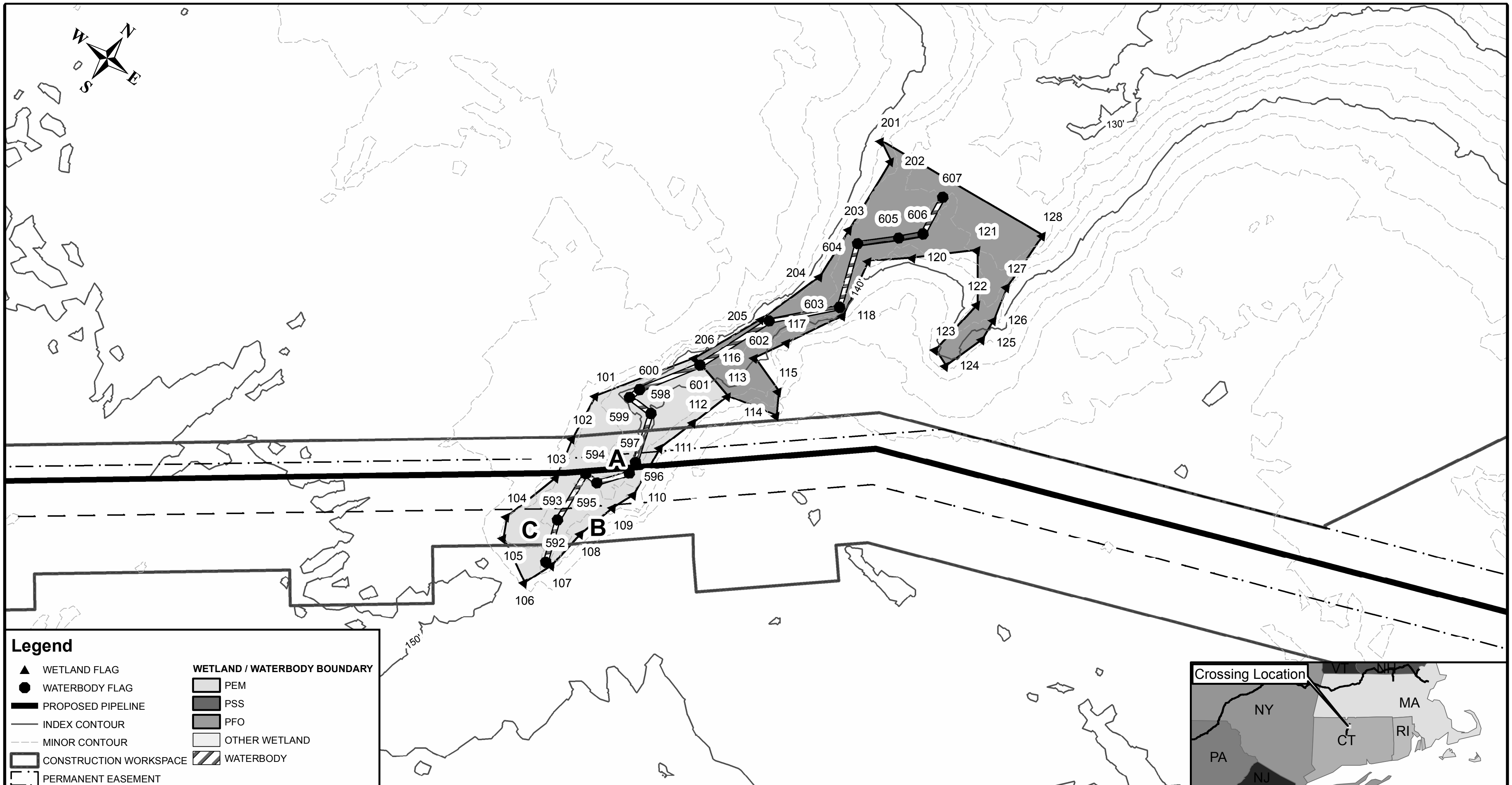
TE-SEG-S-ENV- 056

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 53' 19.245" N	72° 44' 23.576" W	BL-P-S009	4	0	0	II	I	A	UNT TO FARMINGTON RIVER
B	41° 53' 18.506" N	72° 44' 23.754" W	BL-N-W007	10	0.04	0	II	PEM		
C	41° 53' 18.351" N	72° 44' 24.165" W	BL-N-W007	50	0.06	0	II	PEM		

1 inch = 100 Feet

0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP11.1 TO MP11.3

BL-N-W005
BL-N-W007
BL-P-S009

BLOOMFIELD, HARTFORD COUNTY, CT
WINDSOR, HARTFORD COUNTY, CT

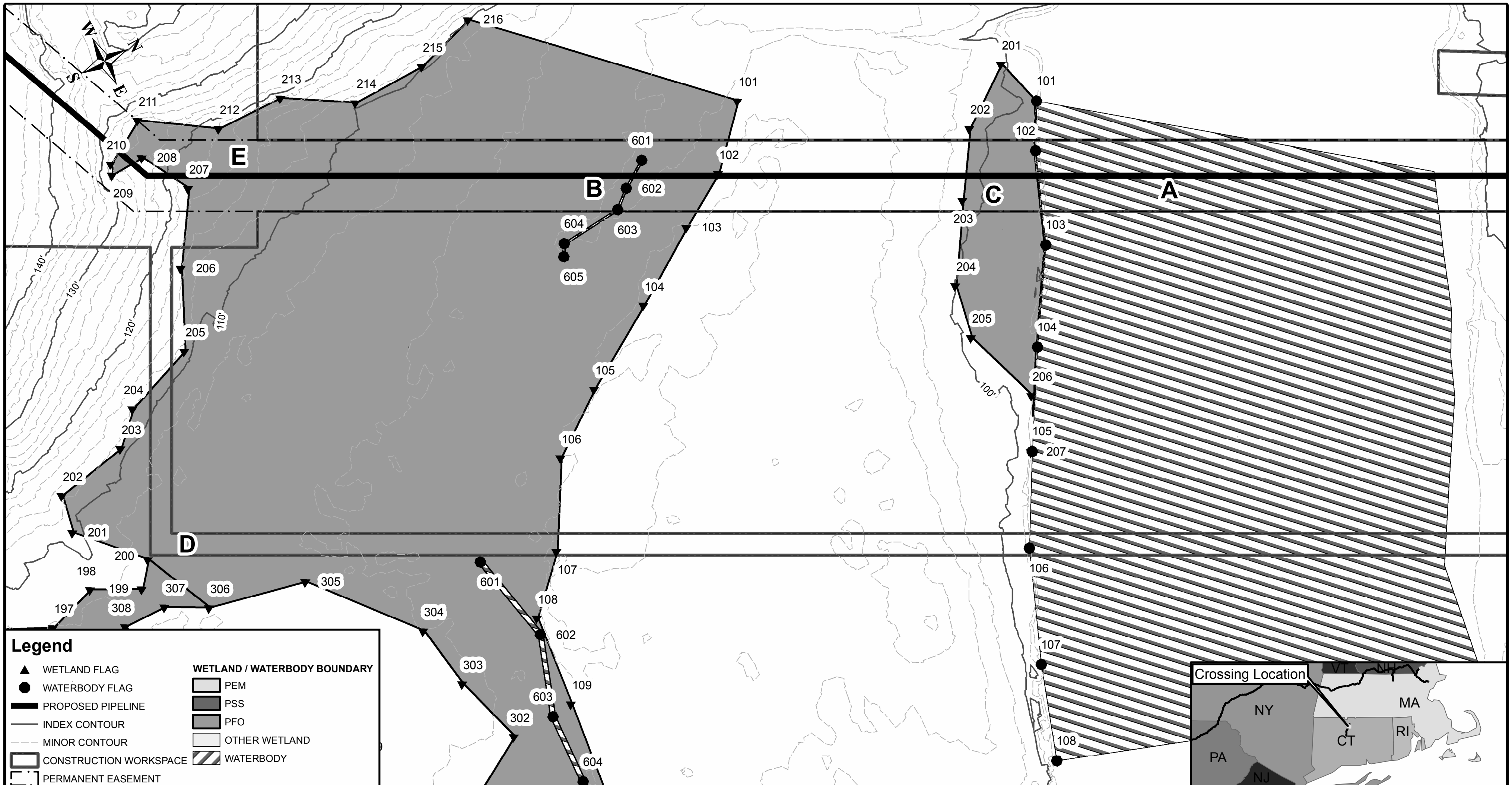
TE-SEG-S-ENV- 057

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015



Impact Table

INDEX	LATITUDE	LONGITUDE	FEATURE	FEET	CST AC	OP AC	CROSSING METHOD	TYPE	DESIG USE	WATERBODY NAME
A	41° 53' 27.882" N	72° 44' 9.962" W	BL-P-S008	277	0	0	IV	P	A	UNT TO FARMINGTON RIVER
B	41° 53' 25.434" N	72° 44' 11.786" W	BL-P-S010	1	0	0	IV	P	A	UNT TO FARMINGTON RIVER
C	41° 53' 27.306" N	72° 44' 10.013" W	BL-N-W002	50	0.06	0.03	IV	PFO		
D	41° 53' 21.250" N	72° 44' 10.895" W	BL-N-W003	0	0.14	0	N/A	PFO		
E	41° 53' 22.641" N	72° 44' 14.454" W	BL-N-W003	394	0.5	0.27	IV	PFO		

1 inch = 100 Feet 0 25 50 100 Feet

WETLAND & WATERBODY SITE SPECIFIC DWG
NED SEGMENT "S" MP11.3 TO MP11.5

BL-N-W002
BL-N-W003
BL-P-S008
BL-P-S010
BL-P-S010A

WINDSOR, HARTFORD COUNTY, CT

TE-SEG-S-ENV- 058

NO	DATE	BY	REVISION DESCRIPTION
1	11/13/15	HMM	ISSUED FOR PERMIT

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

Hatch Mott MacDonald

Drawing Date: 11/16/2015

Attachment H

Engineering Documentation

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Attachment H

Part 1-Engineering Report Checklist (DEP-IWRD-APP-105A)

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Attachment H: Engineering Documentation

Part 1: Engineering Report Checklist

The following is a checklist of requirements that need to be completed, included and submitted as part of the Engineering Report. Please complete this checklist by identifying where each requirement listed is addressed in the Engineering Report (report title and page numbers). If an item is not applicable, place "NA" in the box. Attach the completed checklist as the cover sheet to engineering reports, as applicable, which fully describe the design of the proposed facilities or other actions and the hydraulic and hydrologic effects thereof. The application instructions (DEP-IWRD-INST-100) should be consulted for a complete description of each item listed. This checklist is required to be signed and sealed by a professional engineer licensed in the State of Connecticut.

Stormwater Management

Location of Item	Item Description
H pg 2	Description of the design storm frequency intensity, volume and duration
G	Watershed maps, existing and proposed
H Pg 3	Computations for Tc
H APP. A	Imperviousness calculations
N/A	NRCS runoff curve numbers, volumetric runoff coefficients
H APP. A, B	Computations used to determine peak runoff rates, and velocities for each watershed area (24-hour storm): • Stream Channel Protection: 2-year frequency (“over-control” of 2-year storm) • Conveyance Protection: 10-year frequency • Peak Runoff Attenuation: 2-year, 10-year, and 100-year frequency • Emergency Outlet Sizing: safely pass the 100-year frequency or larger storm
N/A	Hydrograph routing calculations
H 5-9, APP. A,B	Description, schematics, and calculations for drainage and stormwater management systems, bridges and culverts
N/A	Infiltration rates
N/A	Documentation of sources
N/A	Computer disk containing input and output data and the associated program for all computer models used in the analyses
APP. A,B	Hard copy of input and output data including input/output tables
N/A	Detention basin analysis including timing and duration of expected outflow, stream stability analysis and hydrograph summation

Flood Plain Assessment

Location of Item	Item Description
N/A	Description or simulation of existing and proposed conditions upstream and downstream of the proposed activity
N/A	(For SCEL applications only) A determination of the effect of the proposed activity on flooding and flood hazards together with an equivalent encroachment on the opposite bank for the flood event establishing the encroachment lines
N/A	For any bridge or culvert placement or replacement with a drainage area of 100 acres or more, plan sheets showing the existing and proposed inundation area for the 2, 10, 25, 50, and 100 year discharges, carried to convergence
N/A	A description and analysis of the floodplain modifications required to restore any flood conveyance and flood storage capacity
N/A	Demonstration that backwater from the proposed activity will not impact an existing dam, dike, or similar structure
N/A	Backup data and complete hydraulic analysis for proposed modifications to the floodplain including location plan and plot for sections, profile sheet, summary sheet

Dams, Dikes, Diversion Channels, Similar Structures

Location of Item	Item Description
N/A	Primary and emergency spillway and outlet structure erosion protection
N/A	Dam breach analysis
N/A	Geotechnical evaluation
N/A	Construction Specifications for foundation preparation, embankment material, outlet structure, and construction inspection

Soil Erosion and Sediment Control Plan

Location of Item	Item Description
H PG 1	Narrative
G	Drawings
Q	Details
H APPENDIX B	Calculations for Engineered Measures

Professional Certification

For any Engineering Report submitted as part of the IWRD permit application, the following certification must be signed and sealed by a professional engineer licensed to practice in Connecticut and submitted with the Engineering Report Checklist and Report.

"I certify that in my professional judgement, each requirement listed in the Engineering Report Checklist has been addressed in the Engineering Report submitted as part of the IWRD permit application as Attachment H, Part 1 and that the information is true, accurate and complete to the best of my knowledge and belief.

This certification is based on my review of the Engineering Report.

I understand that a false statement made in the submitted information may, pursuant to Section 22a-6 of the General Statutes, be punishable as a criminal offense under Section 53a-157b of the General Statutes, and may also be punishable under Section 22a-438 of the General Statutes."

Signature of Applicant	Date
Name of Applicant (print or type)	Title (if applicable)
Signature of Professional Engineer	Date
Name of Professional Engineer (print or type)	P.E. Number (if applicable)

Affix P.E. Stamp Here
(if applicable)

Hatch Mott
MacDonald

Northeast Energy Direct Project

Connecticut Pipeline

Design of Best Management Practices (BMPs) Along the Connecticut Pipeline and Associated Access Roads

November 2015

Table of Contents

1.0 INTRODUCTION

The attached hydrologic and hydraulic calculations were performed for the areas within the limits of disturbance, including areas adjacent to the pipeline alignment and along the project access roads for the Northeast Energy Direct pipeline project (NED Project) along the Connecticut Pipeline (CT Pipeline) segment. This report summarizes the evaluation of the potential environmental impacts to adjacent lands due to the construction of the pipeline. This segment of the NED project consists of installing approximately 14.8 Miles of 24-inch Pipeline in Connecticut. There will be approximately 196 acres of land within the proposed limits of disturbance. The primary objective of the attached calculations was to evaluate and systematically address the runoff generated due to the construction of the pipeline and associated access roads and to provide an effective soil erosion and sediment control plan.

The Connecticut Pipeline includes 13 access roads along the pipeline alignment to aid in the construction process as well as to provide access to the pipeline alignment post installation. Nine new access roads are proposed for the NED project, whereas four access roads are existing and were used on a previous project. The 13 access roads require varying degrees of modifications to suit the needs of the current project based on existing use of the lands. Only one of the access roads requires no modifications because an existing roadway is to be used for access. The remaining 12 access roads require varying degrees of modifications based on existing coverage and current use of the lands. Increased stormwater runoff due to construction of access roads is summarized below, in **Table 6**, and the calculations are summarized in **Appendix A**.

As a result of the proposed land disturbance activities, the installation of several types of soil erosion mitigation measures is proposed within the project limits. These measures will mitigate environmental impacts until the disturbed land is stabilized and re-established with vegetation. Proposed Best Management Practices (BMPs) along with their locations along the alignment are shown on the erosion and sediment control plans and are summarized in **Appendix B**. The project will proceed as described in the Project Sequence and Schedule Notes as shown on the soil erosion and sediment control plans, and are included in **Appendix C** of this report.

2.0 DESIGN CRITERIA AND METHODOLOGY

Hydrologic runoff calculations were performed using the Rational Method. The estimated flows were developed for existing and proposed conditions and varied based on parameters such as drainage areas, slopes, and ground cover type. The Rational Method Equation is detailed below, **Equation 1**.

$$Q = CC_fIA \qquad \textbf{Eqn. 1}$$

- Q = flow (cubic feet per second)
- C = runoff coefficient. The runoff coefficients used herein were taken from Tables 6-3, 6-4, and 6-5 from the Connecticut DOT Drainage Manual. For the purposes of this analysis, conservative runoff coefficients were chosen.
- C_f = Frequency factor to adjust the rational formula for higher intensity storms (25-year or greater). Refer to **Table 2**, below.
- I = rainfall intensity (inches per hour – in/hr). The rainfall intensities used herein were taken from the Rainfall Intensity table found in Appendix B of the ConnDOT Drainage Manual. Refer to **Table 1**, below, for the rainfall intensities used for each of the design storms analyzed.

Table 1 – Rainfall Intensities

Storm Frequency (Years)	Rainfall Intensity (in/hr)
2	3.6
10	4.8
25	5.5
50	6
100	6.5

*Rainfall intensities are based on a 10-minute duration

- A = Drainage Area (acres). The drainage area considers applicable areas with contributory runoff.

- All Times of Concentration for the analysis used a conservative minimum value of 10 minutes.

Table 2 – Frequency Factors for Rational Formula

Storm Frequency (Years)	C_f
2	1.0
10	1.0
25	1.1
50	1.2
100	1.25

Using the parameters above, Excel spreadsheets were developed for the design of standard BMPs and the determination of access road runoff. The spreadsheets allow the user to enter the location-specific variables for use in the Rational Method calculations of runoff. The flow determinations were used to determine impacts of the proposed construction and to design applicable erosion and sediment control measures to mitigate adverse environmental impacts throughout the project limits. The spreadsheets utilize peak runoff for return periods consistent with the Connecticut Guidelines for Soil Erosion and Sediment Control.

3.0 ACCESS ROAD IMPACTS

The access roads were analyzed for a range of return periods ranging from the 1-year to the 100-year storm events. Runoff coefficients were determined by considering land cover and slope and were based on an assumed "B" hydrological soil group. Access road design implemented conservative, low runoff coefficients for the existing conditions to predict the maximum perceived impacts, in terms of increases in stormwater runoff, for impervious and semi-impervious proposed conditions. Refer to **Table 3**, below, for the coefficients used in the analysis. The drainage areas used for the analysis of the impacts due to the proposed construction are equal to the areas of the roads themselves. Since the typical access road extends several thousand feet, the spreadsheet compares the existing and proposed peak runoff rates per 100 feet of road length. This analysis expresses the proposed increases in runoff in more realistic terms considering that the roads will promote sheet flow and will not tend to have one point of discharge. The pre- and post-development peak runoff rates were estimated, and compared, for each storm analyzed and it has been determined that the increases in runoff are minimal and will not result in an adverse impact to the downstream properties or to public water resources. The results of the analysis for the access roads are summarized in **Table 6**, below. The locations and routes of the access roads are each clearly shown in the soil erosion and sediment control plans.

Table 3 – Access Road Runoff Coefficients

Cover Type	Slope Range	Hydrological Soil Group	Runoff Coefficient
B Flat, 0-1	0% - 1%	B	0.07
B Avg. 2-6	>1% - 6%	B	0.12
B Steep, 6+	>6%	B	0.18
Gravel, 0-3		B	0.7
Paved*		B	0.76

*Paved Runoff Coefficient designed to equal 0.95 during 100 year storm.

4.0 PIPELINE ALIGNMENT

The proposed pipeline installation will include the disturbance of 14.8 miles of lands along the project alignment. Throughout the duration of the project, from initial land clearance through final soil stabilization and revegetation, Kinder Morgan's Construction Standards shall be implemented **(See Appendix D).** In order to mitigate adverse environmental impacts during construction, the adjacent lands will be protected through the implementation of soil erosion and sediment control measures designed in accordance with the Connecticut Guidelines for Soil Erosion and Sediment Control, 2002. See section **5.0 Design of Soil Erosion & Sediment Control Measures**, below, for a detailed review of the design approach for selected project BMPs. The project limits of disturbance along the pipeline alignment will be stabilized and revegetated so that the post-development conditions result in no net increases in stormwater runoff. Post-construction sediment loading of local waterbodies will mimic pre-construction conditions in that the extent of sediment runoff will consist of natural erosive processes independent of the proposed construction.

5.0 DESIGN OF EROSION & SEDIMENT CONTROL MEASURES

Design of erosion and sediment control measures employed a conservative runoff coefficient from the Connecticut DOT Drainage manual that acts to ensure that drainage structures and measures will perform appropriately. In determining the Rational Runoff Coefficient, a hydrologic soil group of 'C' with steep terrain was chosen. This Runoff Coefficient of 0.31 will ensure that erosion and sediment control devices will be able to perform their intended purpose. The conservative runoff coefficient in addition to the chosen time of concentration of 10 minutes acts to ensure that BMPs will perform during design storms specified in the CT Guidelines for each measure. A summary of selected BMPs follows:

Water Bars:
Water bars are a channel with a supporting berm on the down slope side which will be constructed across the pipe alignment. The purpose of the water bars is to minimize the concentration of sheet flow across the pipe alignment area. In accordance with the CT Guidelines, no engineering design is required for water bars, however they may only be used under certain circumstances. For example, the water bars may be constructed only when the contributing drainage areas are less than 1 acre and channel slopes are 2% or less. The maximum vertical distance measured from the bottom of the channel to the top of the berm is 18 inches, the side slopes must be 2:1 or flatter, and the minimum base width of the berm shall be 6 feet. The water bars shall extend across the entire length of the pipe alignment and will discharge to a stabilized outlet consisting of existing vegetated areas or appropriate j-hook measures as required dependent upon existing site-specific conditions. For a complete description of the dimensions and design parameters for water bars, refer to page 5-7-6 of the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control (CT Guidelines).

Diversions:

Temporary diversions are a temporary channel with a berm of tamped or hand compacted soil placed in such a manner so as to divert flows. The purpose of the diversions is to divert water away from areas with disturbed soils where construction activity is taking place and to fragment disturbed areas to reduce the velocity and prevent concentrated runoff from causing erosion. When the existing site topography runs parallel to the construction, diversions are used to divert flow around the exposed soil in order to prevent erosion. No engineering design is required for a temporary diversion if the contributing drainage area is 1 acre or less. If the contributing area to a temporary diversion is greater than 1 acre, but less than 5 acres, an engineering design will be required per the Permanent Diversion standards for the 2-yr design storm.

For this project, the diversion swales were sized for the 10-year storm event using FlowMaster which uses Manning's equation. To simplify the construction documents, a typical swale size was developed for all of the proposed diversions, except for the two diversions located at stations 282+24 through 283+00 and 283+00 through 284+50 which both required a greater design due to higher flows. The typical swale will have a 1 foot bottom width, 3:1 side slopes, a 1 foot channel depth, and a 9 inch berm on the downslope side. The two diversions at stations 282+24 to 283+00 and 283+00 to 284+50 will have a 2 foot bottom width, 3:1 side slopes, and an 18" channel depth with a 9 inch berm. All diversions will be installed with erosion control matting and vegetated for stabilization.

Temporary Pipe Slope Drain:

Pipe slope drains are a flexible or rigid pipe used to convey water from the top of a slope to the toe of the slope. Pipe slope drains are typically used in conjunction with a diversion structure and outlet protection. The purpose of the pipe slope drains is to convey water over excessive grade changes without causing erosion problems. The size of the pipe slope drain is based on the contributing drainage area and ranges from 12 inch to 24 inch diameter pipe. For a complete description of the design criteria and installation requirements, refer to the CT Guidelines, page 5-5-23.

Level Spreader:

A level spreader is a form of outlet protection for diversions or other water conveyance systems. The purpose of the level spreaders is to reduce the depth and velocity of concentrated runoff by releasing it uniformly as sheet flow onto a larger, stabilized area. The water bars constructed for this project will not generate erosive velocities and will either discharge onto stable areas if available, or will discharge into either silt fence or a hay bale barrier, and therefore will not require engineered outlet protection devices. All temporary diversions not conveying runoff to a pipe slope drain will include a level spreader as outlet protection. The level spreaders will be designed in accordance with the recommendations of the CT Guidelines, pages 5-10-2, and will typically be 10 feet long, with an entrance width of 10 feet, downstream width of 6 feet, and a depth of 6 inches. The spreaders will include a vegetated lip at the downstream end unless the discharge exceeds 4 cfs in which case the spreader will include a rigid lip.

Pipe slope drains will utilize **conduit level spreaders** for outlet protection. The conduit level spreaders consist of riprap outlet protection and will be designed in accordance with the recommendations of the CT Guidelines, pages 5-10-2. The conduit level spreaders will be sized based on the diameter of the discharge pipes of the pipe slope drains and will be sized for apron length, width, depth, and riprap stone size. For a complete description of the design criteria and installation requirements for level spreaders, refer to the CT Guidelines, page 5-10-2. The construction details are included with the Erosion and Sediment Control Drawing set.

Silt Fence:

Silt fence will be installed in order to intercept and retain sediment from disturbed areas and to decrease the velocity of sheet flows and low volume concentrated flows before leaving the limits of disturbance. The CT Guidelines only mention standard geotextile silt fence, however reinforced silt fence and super silt fence will also be used on this project on an as-needed basis. Silt fence will be installed along the limits of disturbance on the downslope side of construction and on either side of access roads before final stabilization has been accomplished.

As per the Connecticut Guidelines for Soil and Sediment Control (2002, section 5-11-35), silt fencing placement is applicable in small disturbed areas where the contributing drainage areas area is less than 1 acre. The maximum slope length for standard and 20" reinforced silt fence is tabulated in **Table 4**, below.

Table 4 – Maximum Allowable Slope Steepness for Standard & Reinforced Silt Fence

Slope Steepness	Slope Steepness (%)	Maximum Slope Length (ft)
2:1 to 3:1	50 to 33	25
3:1 to 4:1	33 to 25	50
4:1 to 5:1	25 to 20	75
5:1 or flatter	20 or less	100

When either the maximum slope steepness or slope length is exceeded, the use of super silt fence shall be implemented as shown in **Table 5**, below.

Table 5 – Access Road Runoff Coefficients

Maximum Slope Length (ft) Above Fence*		
Slope Steepness	Slope Steepness (%)	Super Silt Fence
2:1	50	50
-	45	60
-	40	75
-	35	85
-	30	100
4:1	25	135
5:1	20	175
-	15	215
10:1	10	325
20:1	5	500
50:1	2	1000

*This table is based on Table 4.4 Maximum Slope Length for Silt Fence of the PA DEP Erosion and Sediment Pollution Control Manual, 2012, page 76.

Locations where contributing slope steepness or slope lengths are exceeded as noted in the above tables, a diversion and pipe slope drain will be utilized to intercept runoff up gradient of the construction area thereby directing the flow around the construction area to a preferred down gradient location without eroding exposed soils. Silt fence will be installed where indicated on the construction plans and as specified in the construction details.

Dewatering:

In the event that trench dewatering is required during the course of construction, dewatering practices shall abide by chapter 5-13 of the CT Guidelines. Where applicable, dewatering operations will follow the standard details included with the Soil Erosion and Sediment Control Plans. These practices may employ any or all of the following details on an as needed basis. Pump Intake and Outlet Protection, Pumping Settling Basin, Trench Dewatering, Dewatering of Earth Materials, Compost Sock Sediment Trap, and Well Point / Sump Pit.

Construction details for all proposed BMPs are included in the soil erosion and sediment control plan set of standard construction details. These BMP measures shall be maintained as specified in the Connecticut Guidelines, as applicable. If the employed bmp is not specified in the CT Guidelines, then it will be maintained as specified on the standard construction details. Additionally, bmp measures shall be inspected and maintained after each major rain event of 1" or greater.

6.0 SUMMARY AND CONCLUSIONS

The Connecticut Pipeline includes a total of 345 water bars, 112 temporary diversions and 57 temporary pipe slope drains along the pipe alignment. The diversion swales and pipe slope drains are sized according to the recommendations in the CT Guidelines and the outlet protection measures are designed appropriately for the analyzed storm events. The outlet protection measures act to mitigate erosive velocities as well as allow for suspended sediments to settle out prior to flowing offsite. This acts to protect adjacent downslope properties and water resources from adverse environmental impacts. In addition, erosion control blankets within the swales and on exposed steep slopes will be implemented to protect the exposed soils from erosion while vegetation is being re-established. Once established, the vegetation will protect the swales from erosion. Upon project completion, the entire limits of disturbance will be re-vegetated with permanent seeding and mulching measures as detailed in the Connecticut Guidelines. Standard seeding details are included with the Erosion and Sediment Control Drawings. Once the project's limits of disturbance are re-vegetated, no permanent stormwater management systems will be required. The spreadsheets in **Appendix B** summarize the results of the analysis and design of the standard BMPs.

The access roads are designed to allow access to the pipeline Right of Way (ROW) for maintenance, servicing, and construction. For the proposed access roads, the hydrology is not significantly altered by the construction of the roadways. The proposed access roads result in minimal increases in flow which will be distributed over large areas. Silt fence on either side of the roads will prevent concentrated flows from releasing sediment laden water into the environment throughout construction and re-vegetation of any disturbed areas adjacent to the roadways. **Table 6**, below, highlights the results of the access road analysis. Refer to **Appendix A** for additional access road calculations as well as supporting data and results.

Table 6 – Summary of Results

Access Road Designation	100-yr Flow Increase , cfs per 100 feet of Road Length
NED-TAR-S-0100	0.216
NED-TGP-S-0100	0.194
NED-TAR-S-0101	0.074
TGP-TAR-S-0200	0.050
NED-TAR-S-0300	0.049
TGP-TAR-S-0300	0.039
TGP-TAR-S-0400	0.039
NED-TAR-S-0400	0.097
NED-TAR-S-0500	0.194
NED-TAR-S-0600	0.028
NED-TAR-S-0700	0
NED-TAR-S-0800	0.097
NED-TAR-S-0900	0.144

APPENDIX A – Access Road Impacts

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Rational Method = Q = C*i*A
Use for up to 200 acres in drainage area

**Input Cells in Green

**Access Road Identification is the station(s) where the access road attaches to the alignment workspace
**Avg. Road width is 20 feet

Runoff coefficient Adjustments:	
2-yr	1.00
10-yr	1.00
25-yr	1.10
50-yr	1.20
100-yr	1.25

	Slope		
Cover type	Min %	Max %	Runoff Coefficient
Paved			0.76
B Flat, 0-1	0	1	0.07
B Avg. 2-6	>1	6	0.12
B Steep, 6+	>6		0.18
Gravel, 0-3	0	3	0.7

Access Road Indentification	Runoff (cfs) Existing Flow	Proposed Flow	Return Period
0.07	0.54	3.13	2-yr
	0.64	3.74	10-yr
NED-TAR-S-0100	0.90	5.26	25-yr
	1.07	6.26	50-yr
Dirt	1.21	7.06	100-yr

100-yr flow increase (cfs) per 100 feet road length 0.2163

Tc (min)	Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product	Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
10	Paved	0.76	0		0.000	0	Paved	0.76		0.000	0
	B Flat, 0-1	0.07	0		0.000	0	B Flat, 0-1	0.07		0.000	0
	B Avg. 2-6	0.12	2706	54100	1.242	6492	B Avg. 2-6	0.12		0.000	0
	B Steep, 6+	0.18	0		0.000	0	B Steep, 6+	0.18		0.000	0
	Gravel, 0-3	0.7	0		0.000	0	Gravel, 0-3	0.7	54100	1.242	37870
		sum	2706	54100	1.242	6492			54100	1.242	37870
		Aggregate Runoff Coefficient				0.12		Aggregate Runoff Coefficient			0.7

Intensity (in/hr) 2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification	Runoff (cfs) Existing Flow	Proposed Flow	Return Period
0.7	27.15	43.19	2-yr
	32.43	51.59	10-yr
TGP-TAR-S-0100	45.63	72.59	25-yr
	54.30	86.39	50-yr
Dirt / Gravel	61.28	97.48	100-yr

100-yr flow increase (cfs) per 100 feet road length 0.1941

Tc (min)	Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product	Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
10	Paved	0.76	0		0.000	0	Paved	0.76		0.000	0
	B Flat, 0-1	0.07	0		0.000	0	B Flat, 0-1	0.07		0.000	0
	B Avg. 2-6	0.12	0		0.000	0	B Avg. 2-6	0.12		0.000	0
	B Steep, 6+	0.18	9327	373309.2	8.570	67195.656	B Steep, 6+	0.18		0.000	0
	Gravel, 0-3	0.7	9327	373309.2	8.570	261316.44	Gravel, 0-3	0.7	746618.4	17.140	522632.88
		sum	18654	746618.4	17.140	328512.096			746618.4	17.140	522632.88
		Aggregate Runoff Coefficient				0.44		Aggregate Runoff Coefficient			0.7

Intensity (in/hr) 2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification	Runoff (cfs) Existing Flow	Proposed Flow	Return Period
3.62	1.05	1.66	2-yr
	1.25	1.99	10-yr
NED-TAR-S-0101	1.76	2.80	25-yr
	2.09	3.33	50-yr
Dirt / Gravel	2.36	3.75	100-yr

100-yr flow increase (cfs) per 100 feet road length 0.0743

Tc (min)	Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product	Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
10	Paved	0.76	0		0.000	0	Paved	0.76		0.000	0
	B Flat, 0-1	0.07	0		0.000	0	B Flat, 0-1	0.07		0.000	0
	B Avg. 2-6	0.12	0		0.000	0	B Avg. 2-6	0.12		0.000	0
	B Steep, 6+	0.18	938.5	14374.8	0.330	2587.464	B Steep, 6+	0.18		0.000	0
	Gravel, 0-3	0.7	938.5	14374.8	0.330	10062.36	Gravel, 0-3	0.7	28749.6	0.660	20124.72
		sum	1877	28749.6	0.660	12649.824			28749.6	0.660	20124.72
		Aggregate Runoff Coefficient				0.44		Aggregate Runoff Coefficient			0.7

Intensity (in/hr) 2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification	Runoff (cfs) Existing Flow	Proposed Flow	Return Period
7.43	0.41	0.50	2-yr
	0.49	0.60	10-yr
TGP-TAR-S-0200	0.69	0.85	25-yr
	0.82	1.01	50-yr
Dirt / Gravel	0.93	1.14	100-yr

100-yr flow increase (cfs) per 100 feet road length 0.0499

Tc (min)	Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product	Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
10	Paved	0.76	0		0.000	0	Paved	0.76		0.000	0
	B Flat, 0-1	0.07	0		0.000	0	B Flat, 0-1	0.07		0.000	0
	B Avg. 2-6	0.12	0		0.000	0	B Avg. 2-6	0.12		0.000	0
	B Steep, 6+	0.18	105.75	2178	0.050	392.04	B Steep, 6+	0.18		0.000	0
	Gravel, 0-3	0.7	317.25	6534	0.150	4573.8	Gravel, 0-3	0.7	8712	0.200	6098.4
		sum	423	8712	0.200	4965.84			8712	0.200	6098.4
		Aggregate Runoff Coefficient				0.57		Aggregate Runoff Coefficient			0.7

Intensity (in/hr) 2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification	Runoff (cfs) Existing Flow	Proposed Flow	Return Period
7.8	0.49	0.61	2-yr
NED-TAR-S-0300	0.59	0.73	10-yr
	0.83	1.02	25-yr
	0.99	1.21	50-yr
Dirt / Gravel	1.12	1.37	100-yr

100-yr flow increase (cfs) per 100 feet road length 0.0485

Tc (min)	Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product
10	Paved	0.76	0		0.000	0
	B Flat, 0-1	0.07	0		0.000	0
	B Avg. 2-6	0.12	0		0.000	0
	B Steep, 6+	0.18	131.25	2625	0.060	472.5
	Gravel, 0-3	0.7	393.75	7875	0.181	5512.5
		sum	525	10500	0.241	5985
		Aggregate Runoff Coefficient				0.57

Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
Paved	0.76		0.000	0
B Flat, 0-1	0.07		0.000	0
B Avg. 2-6	0.12		0.000	0
B Steep, 6+	0.18		0.000	0
Gravel, 0-3	0.7	10500	0.241	7350
		10500	0.241	7350
Aggregate Runoff Coefficient				0.7

Intensity (in/hr) 2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification	Runoff (cfs) Existing Flow	Proposed Flow	Return Period
9.02	0.95	1.12	2-yr
TGP-TAR-S-0300	1.13	1.33	10-yr
	1.60	1.87	25-yr
	1.90	2.23	50-yr
Gravel road widening	2.14	2.52	100-yr

100-yr flow increase (cfs) per 100 feet road length 0.0388

Tc (min)	Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product
10	Paved	0.76	0		0.000	0
	B Flat, 0-1	0.07	0		0.000	0
	B Avg. 2-6	0.12	0		0.000	0
	B Steep, 6+	0.18	0	3856	0.089	694.08
	Gravel, 0-3	0.7	964	15424	0.354	10796.8
		sum	964	19280	0.443	11490.88
		Aggregate Runoff Coefficient				0.596

Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
Paved	0.76		0.000	0
B Flat, 0-1	0.07		0.000	0
B Avg. 2-6	0.12		0.000	0
B Steep, 6+	0.18		0.000	0
Gravel, 0-3	0.7	19280	0.443	13496
		19280	0.443	13496
Aggregate Runoff Coefficient				0.7

Intensity (in/hr) 2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification	Runoff (cfs) Existing Flow	Proposed Flow	Return Period
10.71	1.50	1.76	2-yr
TGP-TAR-S-0400	1.79	2.11	10-yr
	2.52	2.96	25-yr
	3.00	3.53	50-yr
Gravel	3.39	3.98	100-yr

100-yr flow increase (cfs) per 100 feet road length 0.0389

Tc (min)	Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product
10	Paved	0.76	0		0.000	0
	B Flat, 0-1	0.07	0		0.000	0
	B Avg. 2-6	0.12	0		0.000	0
	B Steep, 6+	0.18		6098.4	0.140	1097.712
	Gravel, 0-3	0.7	1520	24393.6	0.700	17075.52
		sum	1520	30492	0.700	18173.232
		Aggregate Runoff Coefficient				0.596

Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
Paved	0.76		0.000	0
B Flat, 0-1	0.07		0.000	0
B Avg. 2-6	0.12		0.000	0
B Steep, 6+	0.18		0.000	0
Gravel, 0-3	0.7	30492	0.700	21344.4
		30492	0.700	21344.4
Aggregate Runoff Coefficient				0.7

Intensity (in/hr) 2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification	Runoff (cfs) Existing Flow	Proposed Flow	Return Period
11.72	3.23	5.14	2-yr
NED-TAR-S-0400	3.86	6.14	10-yr
	5.43	8.64	25-yr
	6.46	10.28	50-yr
Dirt / Gravel	7.29	11.60	100-yr

100-yr flow increase (cfs) per 100 feet road length 0.0970

Tc (min)	Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product
10	Paved	0.76	0		0.000	0
	B Flat, 0-1	0.07	0		0.000	0
	B Avg. 2-6	0.12	0		0.000	0
	B Steep, 6+	0.18		44431.2	1.020	7997.616
	Gravel, 0-3	0.7		44431.2	2.040	31101.84
		sum	4444	88862.4	2.040	39099.456
		Aggregate Runoff Coefficient				0.44

Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
Paved	0.76		0.000	0
B Flat, 0-1	0.07		0.000	0
B Avg. 2-6	0.12		0.000	0
B Steep, 6+	0.18		0.000	0
Gravel, 0-3	0.7	88862.4	2.040	62203.68
		88862.4	2.040	62203.68
Aggregate Runoff Coefficient				0.7

Intensity (in/hr) 2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification	Runoff (cfs) Existing Flow	Proposed Flow	Return Period
13.21	0.31	1.21	2-yr
NED-TAR-S-0500	0.37	1.45	10-yr
	0.52	2.04	25-yr
	0.62	2.43	50-yr
Dirt	0.70	2.74	100-yr

100-yr flow increase (cfs) per 100 feet road length 0.1940

Tc (min)	Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product
10	Paved	0.76	0		0.000	0
	B Flat, 0-1	0.07	0		0.000	0
	B Avg. 2-6	0.12	0		0.000	0
	B Steep, 6+	0.18	1048	20960	0.481	3772.8
	Gravel, 0-3	0.7	0		0.000	0
		sum	1048	20960	0.481	3772.8
		Aggregate Runoff Coefficient				0.18

Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
Paved	0.76		0.000	0
B Flat, 0-1	0.07		0.000	0
B Avg. 2-6	0.12		0.000	0
B Steep, 6+	0.18		0.000	0
Gravel, 0-3	0.7	20960	0.481	14672
		20960	0.481	14672
Aggregate Runoff Coefficient				0.7

Intensity (in/hr) 2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification: 13.39 — NED-TAR-S-0600 — Paved / Gravel

Runoff (cfs)

Existing Flow	Proposed Flow	Return Period
1.13	1.26	2-yr
1.35	1.51	10-yr
1.90	2.12	25-yr
2.26	2.52	50-yr
2.55	2.85	100-yr
100-yr flow increase (cfs) per 100 feet road length	0.0279	

Tc (min): 10

Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product
Paved	0.76		9000	0.207	6840
B Flat, 0-1	0.07	0		0.000	0
B Avg. 2-6	0.12	0		0.000	0
B Steep, 6+	0.18	151	3020	0.069	543.6
Gravel, 0-3	0.7		9000	0.207	6300
	sum	1051	21020	0.483	13683.6
			Aggregate Runoff Coefficient		0.650980019

Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
Paved	0.76	9000	0.207	6840
B Flat, 0-1	0.07		0.000	0
B Avg. 2-6	0.12		0.000	0
B Steep, 6+	0.18		0.000	0
Gravel, 0-3	0.7	12020	0.276	8414
		21020	0.483	15254
		Aggregate Runoff Coefficient		0.72568982

Intensity (in/hr)

2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification: 14.49 — NED-TAR-S-0700 — Existing Paved Road

Runoff (cfs)

Existing Flow	Proposed Flow	Return Period
2.44	2.44	2-yr
2.91	2.91	10-yr
4.09	4.09	25-yr
4.87	4.87	50-yr
5.50	5.50	100-yr
100-yr flow increase (cfs) per 100 feet road length	0.0000	

Tc (min): 10

Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product
Paved	0.76	1794	38768.4	0.890	29463.984
B Flat, 0-1	0.07	0		0.000	0
B Avg. 2-6	0.12	0		0.000	0
B Steep, 6+	0.18	0		0.000	0
Gravel, 0-3	0.7			0.000	0
	sum	1794	38768.4	0.890	29463.984
			Aggregate Runoff Coefficient		0.76

Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
Paved	0.76	38768.4	0.890	29463.984
B Flat, 0-1	0.07		0.000	0
B Avg. 2-6	0.12		0.000	0
B Steep, 6+	0.18		0.000	0
Gravel, 0-3	0.7		0.000	0
		38768.4	0.890	29463.984
		Aggregate Runoff Coefficient		0.76

Intensity (in/hr)

2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification: 14.8 — NED-TAR-S-0800 — Paved / Dirt

Runoff (cfs)

Existing Flow	Proposed Flow	Return Period
0.19	0.29	2-yr
0.22	0.35	10-yr
0.31	0.49	25-yr
0.37	0.58	50-yr
0.42	0.65	100-yr
100-yr flow increase (cfs) per 100 feet road length	0.0970	

Tc (min): 10

Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product
Paved	0.76		2400	0.055	1824
B Flat, 0-1	0.07	0		0.000	0
B Avg. 2-6	0.12	0		0.000	0
B Steep, 6+	0.18	120	2400	0.055	432
Gravel, 0-3	0.7			0.000	0
	sum	240	4800	0.110	2256
			Aggregate Runoff Coefficient		0.47

Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
Paved	0.76	2400	0.055	1824
B Flat, 0-1	0.07		0.000	0
B Avg. 2-6	0.12		0.000	0
B Steep, 6+	0.18		0.000	0
Gravel, 0-3	0.7	2400	0.055	1680
		4800	0.110	3504
		Aggregate Runoff Coefficient		0.73

Intensity (in/hr)

2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

Access Road Indentification: 14.8 — NED-TAR-S-0900 — Paved / Dirt

Runoff (cfs)

Existing Flow	Proposed Flow	Return Period
0.88	1.37	2-yr
1.05	1.63	10-yr
1.48	2.30	25-yr
1.76	2.73	50-yr
1.99	3.08	100-yr
100-yr flow increase (cfs) per 100 feet road length	0.1442	

Tc (min): 10

Cover Type	Runoff Coefficient	Road Length	Runoff Area Existing (ft²)	Area (Acres)	Product
Paved	0.76		11325.6	0.260	8607.456
B Flat, 0-1	0.07	0		0.000	0
B Avg. 2-6	0.12	0		0.000	0
B Steep, 6+	0.18	566	11325.6	0.260	2038.608
Gravel, 0-3	0.7			0.520	0
	sum	762	22651.2	0.520	10646.064
			Aggregate Runoff Coefficient		0.47

Cover Type	Runoff Coefficient	Runoff Area Proposed (ft²)	Area (Acres)	Product
Paved	0.76	11325.6	0.260	8607.456
B Flat, 0-1	0.07		0.000	0
B Avg. 2-6	0.12		0.000	0
B Steep, 6+	0.18		0.000	0
Gravel, 0-3	0.7	11325.6	0.260	7927.92
		22651.2	0.520	16535.376
		Aggregate Runoff Coefficient		0.73

Intensity (in/hr)

2-yr	10-yr	25-yr	50-yr	100-yr
3.6	4.3	5.5	6	6.5

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APPENDIX B – BMP Design

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	Station Start	Station End	BMP class	Drainage Area (SF)	Acres	Channel Grade	Rat'l C	Design Storm Duration (min)	10-yr Design Storm intensity	Design Flow (cfs)	Pipe Diam. (in)	Level Spreader				
												Length	Entrance Width	End Width	Depth (ft)	Lip Material (Rigid/ Vegetated, or Riprap size)
Diversion	1100	1230	TD	84661	1.944	0.04545	0.31			0						
Conveyance / SS /	1100		pipe slope drain	84661	1.944						18					
Outlet/trap/treat methodology	1100		Conduit Level Spreader	84661	1.944		0.31	say 10	4.8	2.892		14.68	4.5	19.18	0.5	0.36
Diversion	1550	1727	TD	153056	3.514	0.03571										
Conveyance / SS /	1550		pipe slope drain	153056	3.514						24					
Outlet/trap/treat methodology			Conduit Level Spreader	153056	3.514		0.31	say 10	4.8	5.2284		19.14	6	25.14	0.5	0.72
Diversion	1805		TD	103438	2.375	0.01481										
Outlet/trap/treat methodology			Level Spreader	103438	2.375		0.31	say 10	4.8	3.5334		10	10	6	0.5	Vegetated
Diversion	2019		TD			0.04587										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	2390	2574	TD	55122	1.265	0.02041										
Conveyance / SS /	2400		Pipe Slope Drain	55122	1.265						18					
Outlet/trap/treat methodology			Conduit Level Spreader	55122	1.265		0.31	say 10	4.8	1.883		13.74	4.5	18.24	0.5	0.20
Diversion	2574	2788	TD	143989	3.306	0.03365										
Conveyance / SS /	2574		Pipe Slope Drain	143989	3.306						24					
Outlet/trap/treat methodology			Conduit Level Spreader	143989	3.306		0.31	say 10	4.8	4.9186		18.96	6	24.96	0.5	0.66
Diversion	2788	2951	TD	108731	2.496	0.08571										
Conveyance / SS /	2788		Pipe Slope Drain	108731	2.496						18					
Outlet/trap/treat methodology			Conduit Level Spreader	108731	2.496		0.31	say 10	4.8	3.7142		15.44	4.5	19.94	0.5	0.50
Diversion 1	2951	3226	TD	113673	2.61	0.09677										
Diversion 2	3226	3317	TD	62396	1.432	0.07865										
Conveyance / SS /	3226		Pipe Slope Drain	176069	4.042						24					
Outlet/trap/treat methodology			Conduit Level Spreader	176069	4.042		0.31	say 10	4.8	6.0145		19.61	6	25.61	0.5	0.86
Diversion	3317	3548	TD	188241	4.321	0.05217										
Conveyance / SS /	3317		Pipe Slope Drain	188241	4.321						24					
Outlet/trap/treat methodology			Conduit Level Spreader	188241	4.321		0.31	say 10	4.8	6.4303		19.86	6	25.86	0.5	0.95
Diversion	3584		TD			0.20548										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	3620	3764	TD	57036	1.309	0.07143										
Conveyance / SS /	3720		Pipe Slope Drain	57036	1.309						18					
Outlet/trap/treat methodology			Conduit Level Spreader	57036	1.309		0.31	say 10	4.8	1.9483		13.8	4.5	18.30	0.5	0.21
Diversion	3900	3942	TD	58108	1.334	0.04444										
Conveyance / SS /	3900		Pipe Slope Drain	58108	1.334						18					
Outlet/trap/treat methodology			Conduit Level Spreader	58108	1.334		0.31	say 10	4.8	1.985		13.84	4.5	18.34	0.5	0.22

Diversion	3942	4237	TD	181970	4.177	0.12143										
Conveyance / SS /	3950		Pipe Slope Drain	181970	4.177						24					
Outlet/trap/treat methodology			Conduit Level Spreader	181970	4.177		0.31	say 10	4.8	6.2161		19.74	6	25.74	0.5	0.90
Diversion 1	4237	4412	TD	129596	2.975	0.0226										
Diversion 2	4412	4540	TD	35545	0.816	0.08661										
Conveyance / SS /	4412		Pipe Slope Drain	165141	3.791						24					
Outlet/trap/treat methodology			Conduit Level Spreader	165141	3.791		0.31	say 10	4.8	5.6412		19.39	6	25.39	0.5	0.79
Diversion 1	4720	4862	TD	72033	1.654	0.0407										
Diversion 2	4862	4997	TD	35773	0.821	0.10667										
Conveyance / SS /	4862		Pipe Slope Drain	107806	2.475						18					
Outlet/trap/treat methodology			Conduit Level Spreader	107806	2.475		0.31	say 10	4.8	3.6826		15.41	4.5	19.91	0.5	0.50
Diversion	5064		TD	10421	0.239	0.06838										
Outlet/trap/treat methodology			Level Spreader	10421	0.239		0.31	say 10	4.8	0.356		10	10	6	0.5	Vegetated
Diversion	5300	5551	TD	10421	0.239	0.05578										
Conveyance / SS /	5300		Pipe Slope Drain	10421	0.239						12					
Outlet/trap/treat methodology			Conduit Level Spreader	10421	0.239		0.31	say 10	4.8	0.356		8.605	3	11.61	0.5	0.03
Diversion	5554		TD			0.12										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	5600		TD			0.0225										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	8120	8474	TD	210971	4.843	0.00833										
Conveyance / SS /	8120		Pipe Slope Drain	210971	4.843						24					
Outlet/trap/treat methodology			Conduit Level Spreader	210971	4.843		0.31	say 10	4.8	7.2067		20.33	6	26.33	0.5	1.10
Diversion	8474	8670	TD	199066	4.57	0.01667										
Conveyance / SS /	8670		Pipe Slope Drain	199066	4.57						24					
Outlet/trap/treat methodology			Conduit Level Spreader	199066	4.57		0.31	say 10	4.8	6.8001		20.09	6	26.09	0.5	1.02
Diversion	9038		TD			0.02247										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	9370	9608	TD	185498	4.258	0.01674										
Conveyance / SS /	9364		Pipe Slope Drain	185498	4.258						24					
Outlet/trap/treat methodology			Conduit Level Spreader	185498	4.258		0.31	say 10	4.8	6.3366		19.81	6	25.81	0.5	0.93
Diversion	9608	9898	TD	71975	1.652	0.05172										
Conveyance / SS /	9608		Pipe Slope Drain	71975	1.652						18					
Outlet/trap/treat methodology			Conduit Level Spreader	71975	1.652		0.31	say 10	4.8	2.4587		14.28	4.5	18.78	0.5	0.29
Diversion 1	9898	10064	TD	114187	2.621	0.03614										
Diversion 2	10064	10176	TD	97198	2.231	0.00901										
Conveyance / SS /	10064		Pipe Slope Drain	211385	4.853						24					

Outlet/trap/treat methodology			Conduit Level Spreader	211385	4.853		0.31	say 10	4.8	7.2209		20.34	6	26.34	0.5	1.10
Diversion	10176	10727	TD	131219	3.012	0.01815										
Conveyance / SS /	10176		Pipe Slope Drain	131219	3.012						24					
Outlet/trap/treat methodology			Conduit Level Spreader	131219	3.012		0.31	say 10	4.8	4.4824		18.69	6	24.69	0.5	0.59
Diversion	10848		TD	46430	1.066	0.01878										
Outlet/trap/treat methodology			Level Spreader	46430	1.066		0.31	say 10	4.8	1.586		10	10	6	0.5	Vegetated
Diversion	11938		TD			0.12222										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	11968	12280	TD	214274	4.919	0.04516										
Conveyance / SS /	12000		Pipe Slope Drain	214274	4.919						24					
Outlet/trap/treat methodology			Conduit Level Spreader	214274	4.919		0.31	say 10	4.8	7.3196		20.4	6	26.40	0.5	1.12
Diversion	12280	12647	TD	173423	3.981	0.04865										
Conveyance / SS /	12280		Pipe Slope Drain	173423	3.981						24					
Outlet/trap/treat methodology			Conduit Level Spreader	173423	3.981		0.31	say 10	4.8	5.9241		19.56	6	25.56	0.5	0.85
Diversion	12647	13080	TD	151860	3.486	0.02309										
Conveyance / SS /	13064		Pipe Slope Drain	151860	3.486						24					
Outlet/trap/treat methodology			Conduit Level Spreader	151860	3.486		0.31	say 10	4.8	5.1875		19.12	6	25.12	0.5	0.71
Diversion	13393		TD			0.02941										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	13951		TD	8690	0.199	0.03883										
Outlet/trap/treat methodology			Level Spreader	8690	0.199		0.31	say 10	4.8	0.2968		10	10	6	0.5	Vegetated
Diversion	14106		TD			0.03175										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	14309	14638	TD	34489	0.792	0.01534										
Conveyance / SS /	14625		Pipe Slope Drain	34489	0.792						18					
Outlet/trap/treat methodology			Conduit Level Spreader	34489	0.792		0.31	say 10	4.8	1.1781		13.09	4.5	17.59	0.5	0.11
Diversion	14882	15000	TD			0.07563										
Conveyance / SS /	14882		Pipe Slope Drain								12					
Outlet/trap/treat methodology			Conduit Level Spreader	say	1		0.31	say 10	4.8	1.488		10.53	3	13.53	0.5	0.17
Diversion 1	15000	15093	TD			0.02198										
Diversion 2	15093	15200	TD			0.05505										
Conveyance / SS /	15093		Pipe Slope Drain								12					
Outlet/trap/treat methodology			Conduit Level Spreader	say	1		0.31	say 10	4.8	1.488		10.53	3	13.53	0.5	0.17
Diversion	15200	15488	TD			0.0692										
Conveyance / SS /	15483		Pipe Slope Drain								12					
Outlet/trap/treat methodology			Conduit Level Spreader	say	1		0.31	say 10	4.8	1.488		10.53	3	13.53	0.5	0.17

Diversion	15834		TD			0.02667										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	16312		TD	104687	2.403	0.03604										
Outlet/trap/treat methodology			Level Spreader	104687	2.403		0.31	say 10	4.8	3.5761		10	10	6	0.5	Vegetated
Diversion	16438		TD	90626	2.08	0.04294										
Outlet/trap/treat methodology			Level Spreader	90626	2.08		0.31	say 10	4.8	3.0958		10	10	6	0.5	Vegetated
Diversion	16522		TD	83172	1.909	0.0708										
Outlet/trap/treat methodology			Level Spreader	83172	1.909		0.31	say 10	4.8	2.8411		10	10	6	0.5	Vegetated
Diversion	16654		TD	116769	2.681	0.01299										
Outlet/trap/treat methodology			Level Spreader	116769	2.681		0.31	say 10	4.8	3.9888		10	10	6	0.5	Vegetated
Diversion	17663		TD			0.04478										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	17706		TD			0.06061										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	17903		TD			0.09174										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	17990		TD			0.03015										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	20865	21450	TD	69614	1.598	0.03813										
Conveyance / SS /	20865		Pipe Slope Drain	69614	1.598						18					
Outlet/trap/treat methodology			Conduit Level Spreader	69614	1.598		0.31	say 10	4.8	2.378		14.2	4.5	18.70	0.5	0.28
Diversion 1	21450	21554	TD	14426	0.331	0.06838										
Diversion 2	21554	21791	TD	14852	0.341	0.0431										
Conveyance / SS /	21554		Pipe Slope Drain	29278	0.672						18					
Outlet/trap/treat methodology			Conduit Level Spreader	29278	0.672		0.31	say 10	4.8	1.0001		12.93	4.5	17.43	0.5	0.09
Diversion	22064	22435	TD	83839	1.925	0.01351										
Conveyance / SS /	22435		Pipe Slope Drain	83839	1.925						18					
Outlet/trap/treat methodology			Conduit Level Spreader	83839	1.925		0.31	say 10	4.8	2.8639		14.65	4.5	19.15	0.5	0.35
Diversion	22500		TD			0.03191										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion 1	23100	23694	TD	105563	2.423	0.02813										
Diversion 2	23694	23885	TD	60102	1.38	0.02151										
Conveyance / SS /	23694		Pipe Slope Drain	165665	3.803						24					
Outlet/trap/treat methodology			Conduit Level Spreader	165665	3.803		0.31	say 10	4.8	5.6591		19.4	6	25.40	0.5	0.80
Diversion	24008		TD	71164	1.634	0.03763										
Conveyance / SS /			N/A	71164	1.634						N/A					

Outlet/trap/treat methodology			Level Spreader	71164	1.634		0.31	say 10	4.8	2.4309		10	10	6	0.5	Vegetated
Diversion	25589		TD		0	0.10891										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	25814		TD		0	0.12069										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	25958	26369	TD	100235	2.301	0.03398										
Conveyance / SS /	26369		Pipe Slope Drain	100235	2.301						18					
Outlet/trap/treat methodology			Conduit Level Spreader	100235	2.301		0.31	say 10	4.8	3.424		15.17	4.5	19.67	0.5	0.45
Diversion	26369	26820	TD	188588	4.329	0.05543										
Conveyance / SS /	26820		Pipe Slope Drain	188588	4.329						24					
Outlet/trap/treat methodology			Conduit Level Spreader	188588	4.329		0.31	say 10	4.8	6.4421		19.87	6	25.87	0.5	0.95
Diversion	27365		TD	42054	0.965	0.0355										
Outlet/trap/treat methodology			Level Spreader	42054	0.965		0.31	say 10	4.8	1.4366		10	10	6	0.5	Vegetated
Diversion	27612		TD	120163	2.759	0.11565										
Outlet/trap/treat methodology			Level Spreader	120163	2.759		0.31	say 10	4.8	4.1047		10	10	6	0.5	Vegetated
Diversion 1	28224	28288	TD	464721	12.68											
Diversion 2	28288	28450	TD	552357	10.67											
Conveyance / SS /	28245		Pipe Slope Drain	1017078	23.35	0.042	0.31		4.8	34.743	24					
Conveyance / SS /	28278		Pipe Slope Drain								24					
Conveyance / SS /	28289		Pipe Slope Drain								24					
Conveyance / SS /	28300		Pipe Slope Drain								24					
Conveyance / SS /	28366		Pipe Slope Drain								24					
Outlet/trap/treat methodology			Conduit Level Spreader	1017078	23.35		0.31	say 10	4.8	7		7	6	13.00	0.5	1.06
Diversion	28642	28900	TD	49808	1.143	0.01432										
Conveyance / SS /	28648		Pipe Slope Drain	49808	1.143						18					
Outlet/trap/treat methodology			Conduit Level Spreader	49808	1.143		0.31	say 10	4.8	1.7014		13.57	4.5	18.07	0.5	0.18
Diversion	28900	29073	TD	28234	0.648	0.01225										
Conveyance / SS /	29034		Pipe Slope Drain	28234	0.648						18					
Outlet/trap/treat methodology			Conduit Level Spreader	28234	0.648		0.31	say 10	4.8	0.9645		12.89	4.5	17.39	0.5	0.08
Diversion	29915		TD			0.01333										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	30260	30437	TD	47973	1.101	0.025										
Conveyance / SS /	30298		Pipe Slope Drain	47973	1.101						18					
Outlet/trap/treat methodology			Conduit Level Spreader	47973	1.101		0.31	say 10	4.8	1.6387		13.52	4.5	18.02	0.5	0.17
Diversion	30437	30564	TD	9293	0.213	0.04324										
Conveyance / SS /	30564		Pipe Slope Drain	9293	0.213						12					
Outlet/trap/treat methodology			Conduit Level Spreader	9293	0.213		0.31	say 10	4.8	0.3174		8.54	3	11.54	0.5	0.02

Diversion	30761		TD			0.02857										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	33230	33414	TD	7629	0.175	0.03261										
Conveyance / SS /	33235		Pipe Slope Drain	7629	0.175						12					
Outlet/trap/treat methodology			Conduit Level Spreader	7629	0.175		0.31	say 10	4.8	0.2606		8.443	3	11.44	0.5	0.02
Diversion 1	33414	33757	TD	15036	0.345	0.05143										
Diversion 2	33757	33891	TD	8515	0.195	0.02759										
Conveyance / SS /			Pipe Slope Drain	23551	0.541						18					
Outlet/trap/treat methodology			Conduit Level Spreader	23551	0.541		0.31	say 10	4.8	0.8045		12.74	4.5	17.24	0.5	0.07
Diversion 1	33891	34105	TD	22370	0.514	0.07981										
Diversion 2	34105	34300	TD	30651	0.704	0.02062										
Conveyance / SS /	34105		Pipe Slope Drain	53021	1.217						18					
Outlet/trap/treat methodology			Conduit Level Spreader	53021	1.217		0.31	say 10	4.8	1.8112		13.68	4.5	18.18	0.5	0.19
Diversion 1	35667	35840	TD	27035	0.621	0.03509										
Diversion 2	35840	35950	TD	75228	1.727											
Conveyance / SS /	35840		Pipe Slope Drain	102263	2.348						18					
Outlet/trap/treat methodology			Conduit Level Spreader	102263	2.348		0.31	say 10	4.8	3.4933		15.23	4.5	19.73	0.5	0.46
Diversion	35961	36062	TD	17585	0.404	0.04808										
Conveyance / SS /	36062		Pipe Slope Drain	17585	0.404						12					
Outlet/trap/treat methodology			Conduit Level Spreader	17585	0.404		0.31	say 10	4.8	0.6007		9.021	3	12.02	0.5	0.05
Diversion	36156		TD	49280	1.131	0.01408										
Outlet/trap/treat methodology			Level Spreader	49280	1.131		0.31	say 10	4.8	1.6834		10	10	6	0.5	Vegetated
Diversion	37260		TD		0	0.02034										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	37412		TD		0	0.0375										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	38553		TD		0	0.02										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	39064		TD		0	0.02703										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	39239		TD		0	0.01235										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	39647		TD		0	0.05263										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	40289		TD		0	0.01299										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated

Diversion	41057		TD		0	0.04824										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	41090	41630	TD	133723	3.07	0.02752										
Conveyance / SS /	41158		Pipe Slope Drain	133723	3.07						24					
Outlet/trap/treat methodology			Conduit Level Spreader	133723	3.07		0.31	say 10	4.8	4.5679		18.75	6	24.75	0.5	0.60
Diversion 1	41630	41994	TD	69356	1.592	0.04155										
Diversion 2	41994	42263	TD	66093	1.517	0.02583										
Conveyance / SS /	41994		Pipe Slope Drain	135449	3.109						24					
Outlet/trap/treat methodology			Conduit Level Spreader	135449	3.109		0.31	say 10	4.8	4.6269		18.78	6	24.78	0.5	0.61
Diversion 1	42263	42737	TD	110610	2.539	0.0305										
Diversion 2	42737	42795	TD	13007	0.299	0.01639										
Conveyance / SS /	42737		Pipe Slope Drain	110610	2.838						24					
Outlet/trap/treat methodology			Conduit Level Spreader	110610	2.539		0.31	say 10	4.8	3.7784		18.27	6	24.27	0.5	0.47
Diversion 1	42795	42911	TD	20946	0.481	0.0339										
Diversion 2	42911	43200	TD	53268	1.223	0.09934										
Conveyance / SS /	42911		Pipe Slope Drain	74214	1.704						18					
Outlet/trap/treat methodology			Conduit Level Spreader	74214	1.704		0.31	say 10	4.8	2.5351		14.35	4.5	18.85	0.5	0.30
Diversion	43650		TD		0	0.11429										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	44679		TD		0											
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	53021	53272	TD	205045	4.707	0.00738										
Conveyance / SS /	53021		Pipe Slope Drain	205045	4.707						24					
Outlet/trap/treat methodology			Conduit Level Spreader	205045	4.707		0.31	say 10	4.8	7.0043		20.21	6	26.21	0.5	1.06
Diversion	53272	53445	TD	152338	3.497	0.01765										
Conveyance / SS /	53445		Pipe Slope Drain	152338	3.497						24					
Outlet/trap/treat methodology			Conduit Level Spreader	152338	3.497		0.31	say 10	4.8	5.2038		19.13	6	25.13	0.5	0.71
Diversion	53445	53600	TD	150820	3.462	0.00641										
Conveyance / SS /	53600		Pipe Slope Drain	150820	3.462						24					
Outlet/trap/treat methodology			Conduit Level Spreader	150820	3.462		0.31	say 10	4.8	5.152		19.1	6	25.10	0.5	0.70
Diversion	53600	53758	TD	148407	3.407	0.00625										
Conveyance / SS /	53758		Pipe Slope Drain	148407	3.407						24					
Outlet/trap/treat methodology			Conduit Level Spreader	148407	3.407		0.31	say 10	4.8	5.0696		19.05	6	25.05	0.5	0.69
Diversion	53872		TD	159564	3.663	0.01796										
Outlet/trap/treat methodology			Level Spreader	159564	3.663		0.31	say 10	4.8	5.4507		10	10	6	0.5	Rigid
Diversion	63549	63714	TD	23807	0.547	0.00667										
Conveyance / SS /	62549		Pipe Slope Drain	23807	0.547						18					
Outlet/trap/treat methodology			Conduit Level Spreader	23807	0.547		0.31	say 10	4.8	0.8132		12.75	4.5	17.25	0.5	0.07

Diversion	63714	64102	TD	80421	1.846	0.00541										
Conveyance / SS /	64102		Pipe Slope Drain	80421	1.846						18					
Outlet/trap/treat methodology			Conduit Level Spreader	80421	1.846		0.31	say 10	4.8	2.7472		14.54	4.5	19.04	0.5	0.34
Diversion	64102	64660	TD	155438	3.568	0.00714										
Conveyance / SS /	64660		Pipe Slope Drain	155438	3.568						24					
Outlet/trap/treat methodology			Conduit Level Spreader	155438	3.568		0.31	say 10	4.8	5.3097		19.19	6	25.19	0.5	0.73
Diversion	64872		TD	30995	0.712	0.04494										
Outlet/trap/treat methodology			Level Spreader	30995	0.712		0.31	say 10	4.8	1.0588		10	10	6	0.5	Vegetated
Diversion	65005		TD	21013	0.482											
Outlet/trap/treat methodology			Level Spreader	21013	0.482		0.31	say 10	4.8	0.7178		10	10	6	0.5	Vegetated
Diversion	67962		TD		0	0.10078										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated
Diversion	73939		TD		0	0.04444										
Outlet/trap/treat methodology			Level Spreader	say	1		0.31	say 10	4.8	1.488		10	10	6	0.5	Vegetated

Worksheet for 28224 to 28300

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.04200	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	18.87	ft^3/s

Results

Normal Depth	0.74	ft
Flow Area	3.10	ft^2
Wetted Perimeter	6.65	ft
Hydraulic Radius	0.47	ft
Top Width	6.42	ft
Critical Depth	0.92	ft
Critical Slope	0.01655	ft/ft
Velocity	6.09	ft/s
Velocity Head	0.58	ft
Specific Energy	1.31	ft
Froude Number	1.55	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.74	ft
Critical Depth	0.92	ft
Channel Slope	0.04200	ft/ft

Worksheet for 28224 to 28300

GVF Output Data

Critical Slope	0.01655	ft/ft

Worksheet for 28300 to 28450

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.04200	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	15.88	ft³/s

Results

Normal Depth	0.68	ft
Flow Area	2.73	ft²
Wetted Perimeter	6.28	ft
Hydraulic Radius	0.43	ft
Top Width	6.06	ft
Critical Depth	0.84	ft
Critical Slope	0.01694	ft/ft
Velocity	5.82	ft/s
Velocity Head	0.53	ft
Specific Energy	1.20	ft
Froude Number	1.53	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.68	ft
Critical Depth	0.84	ft
Channel Slope	0.04200	ft/ft

Worksheet for 28300 to 28450

GVF Output Data

Critical Slope	0.01694	ft/ft

Worksheet for 53021 to 53272 (Maximum Design Check)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00738	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	7.00	ft³/s

Results

Normal Depth	0.81	ft
Flow Area	2.79	ft²
Wetted Perimeter	6.13	ft
Hydraulic Radius	0.45	ft
Top Width	5.87	ft
Critical Depth	0.66	ft
Critical Slope	0.01889	ft/ft
Velocity	2.51	ft/s
Velocity Head	0.10	ft
Specific Energy	0.91	ft
Froude Number	0.64	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.81	ft
Critical Depth	0.66	ft
Channel Slope	0.00738	ft/ft

Worksheet for 53021 to 53272 (Maximum Design Check)

GVF Output Data

Critical Slope	0.01889	ft/ft

Worksheet for 53021 to 53272 (Maximum Design Check)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00738	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	7.00	ft^3/s

Results

Normal Depth	0.81	ft
Flow Area	2.79	ft^2
Wetted Perimeter	6.13	ft
Hydraulic Radius	0.45	ft
Top Width	5.87	ft
Critical Depth	0.66	ft
Critical Slope	0.01889	ft/ft
Velocity	2.51	ft/s
Velocity Head	0.10	ft
Specific Energy	0.91	ft
Froude Number	0.64	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.81	ft
Critical Depth	0.66	ft
Channel Slope	0.00738	ft/ft

Worksheet for 53021 to 53272 (Maximum Design Check)

GVF Output Data

Critical Slope	0.01889	ft/ft

APPENDIX C – Project Sequence and Schedule

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1.1 CONSTRUCTION PROCEDURES

The Project facilities will be designed, constructed, tested, operated, and maintained to conform with applicable federal, state, and local requirements, including USDOT regulations at 49 CFR Part 192, "Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards", and Commission regulations at 18 CFR Section 380.15, "Siting and Maintenance Requirements". In addition, Tennessee will implement the Commission's "Upland Erosion Control, Revegetation and Maintenance Plan" ("Plan", May 2013 version) and the Commission's "Wetland and Waterbody Construction and Mitigation Procedures" ("Procedures", May 2013 version), with the exception of any modifications of the Plan and Procedures requested by Tennessee and granted by the Commission, incorporated in Tennessee's Plan and Procedures with Project-specific modifications. Requested Project-specific modifications to the Plan and Procedures are detailed in Section 1.3.2.9, including justifications for the requested modifications. Additionally, Tennessee will implement Tennessee's Project-specific ECP for Connecticut. This ECP details additional guidance including, but not limited to, typical construction drawings, Spill Prevention and Response Plan ("SPRP"); Waste Management Plan; Horizontal Directional Drill Contingency Plan; Plan for Unanticipated Discoveries of Cultural and Paleontological Resources and Human Remains; Unanticipated Discovery of Contamination Plan; Blasting Management Plan; Invasive Species Management Plan; Soil Protection and Subsoil Decompaction Mitigation Plan; Organic Farm Protection Plan; and Winter Construction Plan.

1.1.1 Pipeline Construction

The general procedures for pipeline construction that will be followed for the Project are described in this section. Tennessee will use conventional techniques for buried pipeline construction and will follow the requirements set forth in Tennessee's Project-specific ECP for Connecticut to ensure safe, stable, and reliable transmission facilities consistent with the Commission and USDOT specifications. At a minimum, Tennessee will perform the following procedures:

- Marking the corridor;
- Clearing and grading;
- Trenching;
- Stringing;
- Pipe preparation (bending, welding, X-ray, weld coating, and coating repair) and lowering in;
- Backfilling and grade restoration;
- Hydrostatic testing and tie-ins; and
- Cleanup and restoration.

The above-listed procedures will typically follow in the sequence listed. Areas requiring special construction techniques include road or utility crossings, waterbodies and wetlands, unusual topographies such as unstable soils and trench conditions, residential or urban areas, agricultural areas, areas requiring rock removal, and permanent recreation facilities.

1.1.1.1 Marking the Corridor

Land survey crews will mark the centerline of Tennessee's pipeline mainline, looping segments, and laterals with stakes prior to construction. The centerline will be marked at frequent intervals as well as at known crossings of foreign lines and utilities, at road crossings, and at points of inflection. Additionally, avoidance areas including wetland boundaries, cultural resource sites, and rare species habitat, as applicable, will be marked with appropriate fencing, signage, and/or flagging, based on environmental and archaeology surveys and environmental permit conditions, prior to construction.

1.1.1.2 Erosion and Sediment Control

Temporary soil erosion and sediment control measures will be installed along the proposed construction ROW, ATWS areas, ARs, and other work areas, as applicable, in accordance with Tennessee's Project-specific ECP for Connecticut. Typically, staked straw bales and/or silt fence barriers are positioned along the limit of wetland boundaries within the construction workspace. To ensure that appropriate erosion and sediment control measures are maintained until the construction workspace is fully stabilized, full-time Environmental Inspectors ("EIs") will be assigned to the Project and will inspect all disturbed areas of the construction spread(s) (e.g., construction ROW and contractor yards) that have not been permanently stabilized in accordance with the following schedule: (1) on a daily basis in areas of active construction; (2) on a weekly basis in areas with no construction or equipment operation; or (3) within 24 hours of the end of a storm event that produces 0.5-inch or greater of precipitation.

1.1.1.3 Clearing, Grading, and Fencing

The construction corridor will be cleared and graded to remove brush, trees, roots, and other obstructions such as large rocks and stumps. Non-woody vegetation may be mowed to ground level. Temporary fences and gates will be installed as needed. No cleared material will be placed within wetland areas.

Tennessee anticipates disposal of trees cleared from the ROW using several different methods. Trees, if suitable, may be taken off-site by the clearing contractor and used for timber unless alternate arrangements have been made with the landowner. Trees and stumps may be chipped on-site and removed. Chipped material not removed may be spread across the ROW within upland areas in a manner that does not inhibit revegetation. Wood chips will not be left within agricultural lands, wetlands, or within 50 feet of wetlands. Wood chips will not be stockpiled in a manner that they may be transported into a wetland.

Grading activities will be scheduled to minimize the time between initial clearing operations and the actual installation of pipe. Access to the construction corridor will normally be obtained via public roads that intersect the ROW. Permission will be obtained from landowners for the use/upgrade of ARs across their property to the construction corridor. At the request of a landowner, Tennessee will erect temporary gates along ARs where necessary.

Grading of the construction workspace will allow for the movement of heavy equipment and the safe passage of work crews. Grading will include removing rock outcrops, tree stumps, ridges, and topographic irregularities. Generally, machinery will operate on one side of the trench (working side) with excavated materials stockpiled on the other (non-working side).

As appropriate, the clearing and grading operations will incorporate special construction procedures to minimize the amount of vegetation removed from stream banks and slopes, prevent undue disturbance of the soil profile, restore the original contours of the natural ground, and prevent topsoil erosion. To minimize impact to the soil profile on agricultural lands, up to 12 inches of topsoil will be segregated from subsoil during trenching and will remain segregated during construction to avoid loss due to mixing with subsoil material. Tennessee will utilize either full ROW topsoil segregation or ditch plus spoil side topsoil segregation, as requested by the landowner, as required by the applicable U.S. Department of

Agriculture ("USDA") National Resource Conservation Service ("NRCS") District or County Conservation District ("CCD"), or as appropriate based upon site-specific conditions. Upon completion of backfilling operations, the topsoil will be properly replaced over the graded area. Grading activities will be scheduled to minimize the time between initial clearing operations and the actual installation of pipe.

1.1.1.4 Trenching

In most areas characterized by normal soils, the trench for the pipeline is excavated by crawler-mounted, rotary wheel-type trenching machines, or track–mounted excavators. The trench generally will be approximately 12 inches wider than the diameter of the pipe and of sufficient depth to allow for the minimum cover requirements to the top of the pipe in accordance with USDOT regulations pursuant to the Natural Gas Pipeline Safety Act of 1968, as amended. Landowner requests or permitting requirements may dictate greater depth.

Except as depicted on site-specific plans, the depth of cover for the proposed pipeline facilities, as well as the depth of cover for other, non-typical conditions, such as HDD, will be in accordance with Tennessee's minimum specifications, as set forth in Table 1.3-1. Scour analysis and the potential for external damage may increase these depths. In actively cultivated agricultural lands, Tennessee plans to install the pipeline with 36 inches of cover, except where rock prevents this depth. Rock excavation is any excavation that requires blasting or removal by equivalent means. In these cases, Tennessee's minimum specifications for depth of cover will be used.

Table 1.3-1
Tennessee's Minimum Specifications for Depth of Cover

Location[1]	**Normal Soil (inches)**	**Consolidated Rock (inches)**
USDOT Pipeline and Hazardous Materials Safety Administration ("PHMSA") Class 1	36	24
USDOT PHMSA Classes 2, 3, and 4	36	24
Land in agriculture	48	24
Drainage ditches of public roads or railroad crossings	36	24
Navigable river, stream, or harbor	60	24
Minor stream crossings[2]	60	24

1 As defined by USDOT PHMSA at 49 CFR 192.5.
Class 1: offshore areas and areas within 220 yards of a pipeline with ≤10 buildings intended for human occupancy.
Class 2: areas within 220 yards of a pipeline with >10 but <46 buildings intended for human occupancy.
Class 3: areas within 220 yards of a pipeline with >46 buildings intended for human occupancy and areas within 100 yards of either a building or a small, well defined outside area (such as a playground, recreation area, outdoor theater, or other place of public assembly) that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12-month period.
Class 4: areas within 220 yards of a pipeline where buildings with four or more stories are prevalent.
2 Minor streams are defined by FERC as less than 10 ft wide.

Crossing of foreign pipelines will generally require the pipeline to be buried at greater depths depending upon the depth of the foreign pipeline. A minimum of 12 inches of clearance will be maintained when crossing foreign pipelines, utilities, or other structures as required by USDOT. Pipeline burial depths in areas requiring special construction techniques through rock will be in accordance with USDOT requirements, 49 CFR Part 192. Prior to the commencement of construction activities, the following will be contacted to have underground utilities and foreign pipelines identified and marked: (1) the "Call Before You Dig" system for Connecticut; and (2) the National "811" call system. Trenching in the vicinity of any foreign utilities will begin only after completing the appropriate notification procedures.

In accordance with Tennessee's Project-specific ECP for Connecticut, measures will be employed to minimize erosion during trenching operations and construction activities. Measures also will be taken to minimize the free flow of water into the trench and through the trench into waterbodies. Compacted earth for temporary trench breakers and sandbags or foam for permanent trench breakers may be installed within the trench to reduce erosion.

1.1.1.5 Pipe Stringing

The stringing operation involves moving the pipe into position along the prepared ROW. Pipe will be delivered to the Project area's pipeline storage areas typically by truck and will then be moved by truck from the pipeline storage areas to the construction zone, where it will be placed along the ROW in a continuous line in preparation for subsequent lineup and welding operations. Individual joints of pipe will be strung along the ROW parallel to the centerline and arranged so they are easily accessible to construction personnel. The amount of pipe necessary for stream or road crossings will be stockpiled in pipeline storage areas in the vicinity of each crossing. Stringing activities will be coordinated with the advance of the trenching and pipe laying crews to minimize the potential impact to the resources.

1.1.1.6 Pipe Bending

The pipe will be delivered to the Project site in straight sections. However, bending of the pipe will be required to allow the pipeline to follow natural grade changes and direction changes of the ROW. For this purpose, prior to line-up and welding, selected joints will be field-bent by track-mounted hydraulic bending machines. For larger horizontal changes of direction, manufactured induction bends may be used.

Pipe bending in the field will be utilized for turns involving slight deflections and/or large radii. For turns involving larger deflections and/or small radii, often related to spatial limitations due to easement and topographic constraints, prefabricated elbow fittings will be utilized, rather than pipe bending on-site.

1.1.1.7 Pipe Assembly and Welding

Following stringing and bending, the joints of pipe will be placed on temporary supports adjacent to the trench. The ends will be carefully aligned and welded together using multiple passes for a full penetration weld. Only welders qualified according to applicable American National Standards Institute ("ANSI"), American Society of Mechanical Engineers ("ASME"), and American Petroleum Institute ("API") Standards will be permitted to perform the welding. A Tennessee-approved welding inspector will conduct the welder qualification testing and document all test results. A welder failing to meet acceptance criteria of the Kinder Morgan Company[1] Standard Welder Qualification Test – API1104 will be disqualified. Bending, welding, and coating in the field will comply with USDOT regulations, 49 CFR Part 192.

It has not been determined if automated welding will be implemented during pipe assembly. Tennessee believes that automated welding may be appropriate for portions of the proposed route, although the use of automated welding may prove impractical for steep construction areas. Tennessee and the construction contractors will jointly determine whether automated welding is appropriate for portions of the Project.

1.1.1.8 X-Ray and Weld Repair

To ensure that the assembled pipe meets or exceeds the design strength requirements and to ensure weld quality and integrity, the welds will be inspected visually and tested non-destructively using radiographic (x-ray) or another approved test method, in accordance with API Standards. Welds displaying inclusions (void spaces) or other defects will be repaired if out of code, or they will be cut out (removed) and new welds installed and retested.

1.1.1.9 Coating Field Welds, Inspection and Repair

Following welding, the previously uncoated ends of the pipe at the joints will be field-coated per Tennessee coating specifications. Prior to lowering the pipe into the trench, the coating on the entire pipe section will be visually inspected and jeeped using a holiday detector (inspection of pipe coating using electronic equipment). Damaged areas will be repaired per Kinder Morgan's coating repair specifications.

1.1.1.10 Pipe Preparation and Lowering-In

Once the pipeline has been welded together, coated, and inspected, the pipe is lowered into the trench. If the bottom of the trench is rocky, methods to protect the pipe will be used, including the possible use of sandbags or support pillows at designated intervals along the trench. Rock shield will be installed as needed to protect the pipe coating. Trench dewatering may be required in certain locations to prevent the pipe from floating and to perform certain limited activities in the trench. Trench dewatering will be performed in accordance with Tennessee's Project-specific ECP for Connecticut.

1.1.1.11 Tie-Ins

At select locations, such as waterbody crossings, road crossings, and terrain changes along the pipeline system, the pipe will be lowered into the trench in segments. The segments then will be welded together or tied-in prior to backfilling. A crew will be assigned to make these tie-ins at designated locations ahead of the backfill operations.

At certain connections to Tennessee's existing system there may be a need to remove asbestos pipe coating. At any location where asbestos must be removed Tennessee will implement measures to ensure safety of all personnel on-site as follows:

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[1] Tennessee is an indirect wholly-owned subsidiary of Kinder Morgan, Inc. ("Kinder Morgan") and is a member of Kinder Morgan's natural gas pipeline group.

- Before starting work, plastic sheeting will be laid beneath the work area to catch all debris. When joining sheeting, taped seams will be overlapped a minimum of 18 inches. Sheeting will be secured with weights.
- Pipe coating will be pounded with hammers or scraped with razor scrapers, allowing the material to fall onto plastic liner beneath pipe. Debris will be kept wet.
- When pipe is clear of coating, edges of cleaned area will be trimmed with razors, re-wet and then the surfaces will be wet wiped. Asbestos contaminated rags will be disposed of in waste disposal bags.
- Tools will be rinsed/cleaned over a waste bag and then removed from the work area. Waste material will be bagged and sealed.

If wind or other conditions carry debris off the drop cloth, the following steps, in addition to the preceding work procedures, will be implemented:

- The shroud fabric will be soaked in amended water and draped over the pipe where coating is to be disturbed. The shroud and pipe surfaces will be kept wet at all times.
- Pipe coating will be pounded through the shroud until it falls on plastic liner. When appropriate, the shroud will be dropped onto the liner and a new shroud applied as needed until scraping/cleaning is completed.

All waste products will be disposed of in accordance with applicable regulations.

1.1.1.12 Backfilling and Grade Restoration

After lowering the pipe into the trench, the trench will be padded and backfilled. Backfill usually consists of the material originally excavated from the trench; however, in some cases, additional backfill from other sources may be required. Any excess excavated materials or materials unsuitable for backfill will be handled, as approved by the landowner or land management agency, and disposed of in accordance with applicable regulations. In areas where topsoil has been segregated, the subsoil will be placed in the trench first and then the topsoil placed over the subsoil. Backfilling will occur to approximate grade. However, a soil crown may be placed above the trench at the discretion of the Tennessee inspector to accommodate any future soil settlement.

1.1.1.13 Clean-up and Restoration

After the completion of backfilling, disturbed areas will be graded, and any remaining trash and debris will be properly disposed of in compliance with federal, state, and local regulations. The construction corridor will be protected through the implementation of erosion control measures, including site-specific contouring, permanent slope breakers, mulching, and reseeding or sodding with soil-holding vegetation.

Tennessee proposes to restore the construction ROW to original contours as closely as possible. This cannot always be achieved due to severity of slope, rock bluffs, etc., however, these areas will be restored to original contour or slope where successful restoration can be achieved. Erosion control methods, such as water bars and erosion control matting, will be installed to help achieve successful restoration. If additional material is needed, displaced material from other Project locations may be imported or local area supplies may be used as necessary.

In order to avoid allowing backfilled rock to directly contact the pipe, padding of the ditch and the pipe with select fill, in accordance with construction and backfill specifications, will be required. Also, during detailed design, additional methods of preventing rocks from contacting the pipe will be evaluated. These methods may include the use of rock shield or concrete coating.

Tennessee will restore the construction workspace in accordance with Project-specific ECP for Connecticut, applicable seed mix requirements from the NRCS or applicable CCDs and relevant landowner agreements.

1.1.1.14 Hydrostatic Testing and Tie-Ins

Hydrostatic testing procedures will be described in Tennessee's Project-specific ECP for Connecticut. Tennessee will seek coverage under the Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut state-required hydrostatic test water discharge permits. If the proposed discharge location(s) do not allow for discharges covered under a General Permit, Tennessee will seek coverage under an individual permit. Hydrostatic test water will be discharged within an upland area through a filter structure.

The pipeline will be tested hydrostatically in accordance with the USDOT's regulations, 49 CFR Part 192. The pipeline will be filled with water and maintained at a test pressure and duration in compliance with Kinder Morgan's engineering standards and applicable federal regulations. After the completion of a satisfactory test, water will be discharged to the ground through a containment structure in a vegetated upland area. In general, Tennessee will not discharge directly into a waterbody unless regulating agencies allow such a discharge. Tennessee plans to locate suitable upland locations for discharge. The discharge rate of the test water will be regulated using values and energy dissipation devices to prevent erosion. Tie-in locations will be cleaned and restored after hydrostatic testing. Tennessee does not intend to add chemicals to hydrostatic test water at this time. Attachment A provides additional information regarding hydrostatic pressure testing of the pipeline, including anticipated water volumes for each pipeline.

1.1.1.15 Alternating Current Mitigation and Cathodic Protection

As determined by Tennessee's technical services group and cathodic protection consultant, field work has been conducted to determine if soil conditions may affect the need for AC mitigation measures. Specifically, soil resistivity, AC/DC voltage measurements have been obtained at various locations along the proposed pipeline routes where access is available in the vicinity of existing transmission lines. Additionally, information about the adjacent powerlines has been obtained from the applicable utility company including voltage levels, available fault current, and the location of transformers. Special software modeling techniques were then be applied to predict potential induced voltages and determine mitigation measures needed for safety and cathodic protection.

Cathodic protection equipment needed for the pipeline facilities will consist of test leads and stations, rectifiers, anode beds, and AC mitigation devices. Rectifiers and anode beds are routinely located outside the permanent ROW of the pipeline, and impacts associated with those areas are included in Table 1.2-1. AC mitigation devices are located within the permanent ROW of the pipeline. Tennessee will continue to evaluate the need for cathodic protection and AC mitigation devices as additional survey access becomes available and will seek the appropriate approvals from landowners, regulatory agencies, and the Commission for all cathodic protection facilities located outside the permanent ROW of the pipeline.

1.1.2 Specialized Construction Procedures

Dependent upon site conditions, Tennessee may implement the following special pipeline construction methods in residential, agricultural, and environmentally sensitive areas.

1.1.2.1 Rugged Topography

Rugged topography may be present along portions of several pipeline sections to be installed. Permanent trench breakers consisting of sandbags or foam will be installed in the ditch over and around the pipe in areas of slopes with high erosion potential. Trench breakers will be used to isolate wet areas and minimize channeling of groundwater along the ditch line. Attachment K identifies areas along the proposed pipeline facilities where slopes (15 to 30 percent and greater than 30 percent) are encountered.

In the areas of construction where the slope exceeds 30 percent, a special means of manipulating the construction equipment must be utilized. The preferred method will be "winching" the equipment. This process consists of placing and anchoring a tractor at the top of the slope and using a winch to manipulate the equipment up and down the slope. Attachment K identifies areas along the proposed pipeline facilities where slopes greater than 30 percent are encountered and the specialized construction techniques noted above may be implemented.

In areas along the ROW where steep side slopes are encountered, the two-tone cut and fill construction methods will be utilized for equipment and/or personnel safety considerations. ATWS will be needed at these locations to accommodate excavated material from the temporary cut and fill areas, while allowing for the temporary storage of trench spoil, excess rock material, cut timber, and, in some cases, salvageable topsoil. When side slopes that require special construction are encountered, the two-tone construction technique will be employed, which entails benching into the side-slope to provide a level work surface. During grade restoration of side slope locations, the spoil will be placed back in the cut and compacted. Any springs or seeps found in the cut will be carried down-slope through polyvinyl chloride ("PVC") pipe and/or gravel French drains installed as part of the cut restoration. Tennessee will install slope breakers, erosion matting, geotextile fabric, gabion baskets, rip-rap, etc., dependent on site-specific conditions, local requirements, and landowner requests, to prevent post-restoration slips and landslides in steep terrain.

Tennessee will attempt to retain all soil and/or rock on the construction ROW in rugged topography using fencing, haybales or other containment materials, such as timber mats. In the event that soil and/or rock does exit the ROW, Tennessee will retrieve the material as soon as practical either by hand or using equipment to reach out and retrieve the material. No ground disturbance will be allowed outside the certificated ROW without the necessary agency approvals. If the material has, or has the potential to, impact sensitive features, Tennessee will contact the applicable agency to determine the most appropriate course of action.

In areas of rugged topography, ROW restoration will begin within 20 days of final pipeline installation to minimize potential erosion and sedimentation control problems, where weather and access issues allow. Tennessee will restore workspace locations within rugged terrain to pre-construction grades and contours. Excavated locations will be backfilled with the original substrate material and if necessary, permanent erosion control devices will be installed following site grading. To facilitate revegetation of the ROW, restored workspace locations will be seeded, fertilized, and mulched in accordance with Tennessee's Project-specific ECP for Connecticut.

1.1.2.2 Residential Areas

Temporary construction impacts on residential areas could include inconvenience caused by noise and dust generated by construction equipment, personnel, and trenching of roads or driveways; ground disturbance of lawns; removal of trees, landscaped shrubs, or other vegetative screening between residences; potential damage to existing septic systems or wells; and removal of aboveground structures such as fences, sheds, or trailers from the ROW. Open burning will be prohibited along the ROW.

Construction through or near residential areas will be done in a manner to ensure that all construction activities minimize adverse impacts on residences and that cleanup is prompt and thorough. Affected landowners will be notified at least five days before construction commences, unless more advance notice is required pursuant to a landowner agreement. Access to homes will be maintained, except for the brief periods essential for laying the new pipeline. Landowners will be advised of any temporary access limitations. Tennessee will implement general measures to minimize construction-related impacts on all residences and other structures located within 50 feet of the construction ROW, including:

- Attempt to maintain, where feasible, a minimum distance of 25 feet between any residence and the edge of the construction work area;
- Install a safety fence at the edge of the construction ROW for a distance of 100 feet on either side of the residence;
- Fence the boundary of the construction work area to ensure that construction equipment and materials, including the spoil pile, remain within the construction work area;
- Attempt to leave mature trees and landscaping intact within the TWS, unless the trees and landscaping interfere with the installation techniques or present unsafe working conditions;
- Ensure piping is welded and installed as quickly as reasonably possible to minimize the amount of time a neighborhood is affected by construction;
- Backfill the trench within 10 days after the pipe is laid or temporarily place steel plates over the trench during non-working hours; and
- Complete final cleanup, grading, and installation of permanent erosion control devices within 10 days after backfilling the trench, weather and access permitting.

To ensure that the trench is backfilled within 10 days after pipeline installation, Tennessee will use a typical pipeline construction sequence in which the pipeline installation crew is followed by a separate backfill crew. Tennessee will require its contractor, by contractual agreement, to backfill trenches in residential areas as soon as practicable after installation of the pipeline. The minimal length of each construction spread will not require construction crews to be separated by significant distances during pipeline construction. Pipeline construction crews will be in close proximity to each other and will be able to efficiently communicate during the entire construction phase of the Project.

Topsoil in landscaped lawns will be segregated and replaced or topsoil will be imported. Immediately after backfilling, residential areas will be restored and all construction debris removed. Compaction testing will be performed and soil compaction mitigation will be performed in severely compacted areas. Lawns will be raked, topsoil added as necessary, and restored per landowner agreements.

Private property such as mailboxes, fences, gates, and other structures that have been removed will be restored, unless alternate plans have been made with the landowner. Sidewalks, driveways, and roads disturbed by pipeline construction will be restored to their original condition upon completion of construction activities. Additionally, Tennessee is planning to test water wells within 200 feet of the construction workspace along the ROW, both before and after construction, for water quantity and quality parameters. In order for a landowner or resident to immediately qualify for post-construction testing, they must allow Tennessee access to property on which such water wells are located to conduct a pre-construction test. Tennessee will conduct testing of all wells within the proposed area as referenced above, both pre- and post-construction, unless otherwise prohibited by the resident or landowner. Tennessee will similarly, at the request of a landowner, sample developed springs used for drinking water pre- and post-construction within the area referenced above. Water quality parameters for testing of both wells and springs will include: yield, pH, petroleum based hydrocarbons, total suspended solids, total dissolved solids, nitrates, nitrites, arsenic, iron, manganese, lead, copper, and total coliform bacteria. oil/grease, pH, flow, turbidity, and total suspended solids. For wells identified close to a septic system, testing will also include fecal coliform. After restoration is complete, a Tennessee representative will contact landowners to ensure that conditions of all agreements have been met and that the landowner has been compensated for damage incurred during construction.

If the construction ROW crosses a road or driveway, Tennessee will maintain existing access, or provide alternative access so residents have ingress/egress to their homes. If the road is open cut, one lane will remain open during construction or traffic will be detoured around the work area through the use of adjacent roadways. Traffic safety personnel will be present during construction periods, and signage and safety measures will be developed in compliance with applicable state and local roadway crossing permits. Tennessee will coordinate with state and local agencies to avoid or minimize impacts to roadways and traffic patterns and will comply with all applicable permits. Construction contractors will be responsible for obtaining and complying with any town-required road use agreements and/or traffic plans. Tennessee will conduct a pre-construction road assessment of pre-existing conditions, which may include video documentation and photographs. Tennessee will also conduct a post-construction evaluation to identify any damage caused by the Project. Tennessee will be responsible for repairs of any damage as determined through discussions with local agencies. To the maximum extent practicable, Tennessee will schedule work within roadways to minimize commuter traffic and impacts on school bus schedules.

In general, Tennessee will implement the following practices during construction within residential areas, where necessary to minimize impact.

1.1.2.2.1 Stove-Pipe Construction Method

The stove-pipe construction method is typically used in areas where the pipeline is to be installed in very close proximity to an existing structure and an open trench will have an adverse impact, i.e. heavily congested urban areas. The technique involves installing one joint of pipe at a time in which the welding, weld inspection, and coating activities are all performed in the open trench, thereby reducing the width of the construction ROW. At the end of each day, the trench is backfilled and/or covered with steel plates or timber mats, or protected by fencing. The length of excavation performed each day will typically not exceed the amount of pipe installed.

1.1.2.2.2 Drag-Section Method

The drag-section construction method is another method used in areas of reduced ROW access and is normally preferred over the stove-pipe method. This technique involves the trenching, installation, and backfilling of a prefabricated length of pipe containing several segments, all done in one day. As in the stove-pipe method, the trench is backfilled and/or covered with steel plates or timber mats or protected by fencing at the end of each day after the pipe is lowered in, as necessary to ensure safety.

1.1.2.3 Agricultural Lands

To preserve soil productivity in agricultural lands, up to 12 inches of topsoil will be segregated and stored separately from subsoil during construction. Tennessee will utilize the full ROW topsoil segregation, as required by landowner agreements, or as required by the NRCS or CCD, or as appropriate based upon site-specific conditions. Rock will be removed from the top 12 inches (topsoil layer) or to the existing subsoil horizon during initial clean-up to a level such that the construction ROW is similar to surrounding areas. During the backfilling and restoration phases, topsoil will be replaced, and any rock uncovered during construction will be returned to the construction work area similar to that of adjacent areas not disturbed by construction. Tennessee's construction contractors will utilize rock rakes or rock hounds to remove excess 4-inch or larger rock from agricultural spoils before final site restoration, unless the agricultural resource is substantially composed of 4-inch and larger rock before construction. Any drain tiles damaged during construction will be repaired or replaced.

1.1.2.4 Road and Railroad Crossings

Prior to construction, Tennessee will locate all existing underground utilities and make provisions for traffic management in work areas as necessary. The majority of road crossings will be completed using standard open cut or conventional boring methods. Conventional boring entails drilling a hole beneath travel arteries through which the pipe will pass. Tennessee intends to utilize non-cased crossings at roads and railroads. Additionally, any railroad alignments without rails in which the easement is no longer valid will be open cut.

1.1.2.5 Trenchless Construction Methods

1.1.2.5.1 Conventional Bore

Conventional boring consists of creating a shaft/tunnel for a pipe or conduit to be installed to minimize surface disturbance. This is done by first excavating a bore pit and receiving pit. The bore pit is excavated to a depth slightly deeper than the depth of the associated trench and is graded such that the bore will follow the proposed angle of the pipe. A boring machine is then lowered to the bottom of the bore pit to tunnel using a cutting head mounted on an auger. The auger rotates through a bore tube, both of which are pushed forward as the hole is cut. The pipeline is then installed through the bored hole and welded to the adjacent pipeline; the bore tube is removed. The typical workspace configurations required for boring operations consist of staging areas (50 feet x 100 feet) for boring machine setup, cuttings/return settlement and storage pits, pipe storage, entrance and exit pit spoil storage, and construction equipment necessary to support the operation.

Major factors limiting the success of a boring operation include the crossing distance, subsurface soil and geologic conditions, and existing topography. Boring operations typically occur over a crossing distance of 50 to 60 feet. The maximum length a bore will achieve in ideal soil conditions typically does not exceed 400 feet. Subsurface soil and geologic conditions must be conducive to establishing and maintaining a safe bore pit excavation, as well as provide the capabilities for the boring equipment to conduct a successful bore. Loose packed sediment, free of rock material, is preferred when conducting boring operations. The topographic conditions at a site may also limit the use of this method, as preferred locations are generally consistent with level or moderately convex terrain, such that the depth of the bore pit does not present concerns relative to constructability or safety constraints. Most roads along the proposed pipeline facilities are expected to be crossed via conventional bore.

1.1.2.5.2 Horizontal Directional Drilling

HDD is a trenchless method of installing pipelines in areas where traditional open cut excavations are not feasible due to sensitive resource areas or logistical reasons. The greatest advantage of the HDD crossing technique is that open cut trenching and equipment disturbance within sensitive resource areas are not necessary, and, as a result, environmental impacts on sensitive resource areas are minimized. However, a greater amount of equipment staging is required for HDD than for the open cut crossing method, and typical installation of an HDD segment generally occurs at durations two to three times slower than a conventional open cut crossing.

A minimum workspace footprint of 200 feet wide by 250 feet long is required at the entry and exit points to support the drilling operation. The amount of workspace required can vary significantly from site to site based on site-specific conditions. The entry-side equipment and operations typically will include the drilling rig and entry hole, control cab, drill string pipe storage, site office, tool storage trailers, power generators, bentonite storage, bentonite slurry mixing equipment, slurry pump, cuttings separation equipment, cuttings return/settlement pit, water trucks and water storage, and the heavy construction equipment necessary to support the operation.

Exit-side equipment and operations typically will include the exit point and slurry containment pit, cuttings return/settlement pit, cuttings separation and slurry reclamation equipment, drilling string pipe storage, and the heavy construction equipment necessary to support the operation. In addition to the drilling operations to be conducted within this workspace footprint, ATWS, will be required along the working side ROW. ATWS in the form of a “false” ROWs may be required to provide a straight corridor for handling pipe at HDD locations where the ROW changes direction, in which to prefabricate the pipeline into one continuous section in preparation for the pull-back. Because this “false” ROW must be relatively straight to accommodate a long section of pipe before it is pulled through the annulus, a significant area of ATWS will be required outside of the standard pipeline construction workspace. Once assembled, the pipeline will be placed on pipe rollers so that it may be conveyed into the drill hole during the pull-back operation.

Locations of proposed HDDs are included in Table 1.3-2. There are risks associated with HDD, including inadvertent returns during drilling operations and inaccessibility for visual inspection of the pipe and repairs post-construction. Tennessee has developed an HDD Contingency Plan as part of the Project-specific ECP for Connecticut. This Plan outlines protocols for handling unanticipated releases of drilling mud.

Each proposed HDD crossing will be analyzed to confirm feasibility, including geotechnical core borings at proposed locations. At this time, Tennessee is evaluating each proposed HDD crossing. Geotechnical investigation must be completed for each HDD; however, for some locations, lack of landowner access has hindered the geotechnical investigations. Therefore, the crossing designs for each HDD have not been finalized to determine the need for false ROWs for pullback sections. For crossings where an HDD is determined to not be feasible, Tennessee will propose an alternative construction method at those crossings.

Table 1.3-2
Horizontal Directional Drill Crossings for the Project

Facility Name	County	Township/Town	Segment	Milepost[1]		Comment	Approx. Length (feet)[2,3]
				Begin	End		
Connecticut							
300 Line CT Loop	Hartford	Windsor	S	11.29	11.59	Crossing of Farmington River	1,570
						Connecticut Subtotal	**1,570**
						Project Total	**44,540**

1 Begin/End MPs are at the approximate locations of HDD entry/exit pits.
2 Lengths represent horizontal distance and are approximate and subject to field verification.
3 For exact lengths refer to the Site-Specific Horizontal Directional Drill Plan.

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1.1.2.5.3 Direct Pipe®

Direct Pipe® is a trenchless method that combines advantages of the established pipeline installation methods of microtunnelling and HDD. A single continuous working operation allows the trenchless installation of pre-fabricated pipeline and the simultaneous development of the required bore hole. Earth excavation is performed with a microtunnelling machine (equipped with a cutterhead) which is navigable and uses a flushing circuit (pipes) method to transport earthen materials to the surface. Modern and proven controlled pipe jacking techniques ensure accurate measurement of the current pipe position along the intended route. The axial force that is necessary for the boring process is transferred along the installed pipeline from the pipe thruster or hydraulic jacking system at entry of the cutterhead.

Direct Pipe® installations may be much shorter and shallower than HDD installations because the excavation is continuously cased, reducing the risk of hole collapse and subsequent settlement. Additionally, the external fluid pressures of the excavation slurry system and bentonite lubrication system are much lower than a typical HDD, thereby reducing the relative risk of hydraulic fracture and inadvertent returns. The length limitation for the Direct Pipe® technology (for a 30-inch pipe) is approximately 900 feet due to the requirements of the hydraulic motors in the smaller diameter tunneling machines. Soils with abundant, strong, and/or abrasive boulders or other large obstructions present risk to the Direct Pipe® method.

Direct Pipe® can be more sensitive to soil conditions than HDD, as the cutterhead cannot tunnel through rocky substrate. Direct Pipe® also requires construction personnel to periodically enter the pipe to monitor and adjust settings underground. This presents additional safety risks, and requires a specialized team of individuals to always be on-site in the event that an incident occurs. While Direct Pipe® has been used overseas, this trenchless installation method is relatively new to the U.S. Also, Direct Pipe® is typically used for much larger diameter facilities, (42-inches and larger). The equipment associated with this method has undergone recent modification to allow for smaller diameters drills (30-inches or less) but this diameter is not common with use of the majority of Direct Pipe® applications. Tennessee has not identified any areas where Direct Pipe® will be utilized; however, Tennessee continues to evaluate geotechnical information to determine the feasibility of using the Direct Pipe® method.

1.1.2.6 Rock Removal

Rock encountered during trenching will be removed using one of the techniques detailed below.

Techniques include:

- Conventional excavation with a backhoe;
- Ripping with a bulldozer followed by backhoe excavation;
- Hammering with a pointed backhoe attachment or a pneumatic rock hammer, followed by backhoe excavation;
- Blasting followed by backhoe excavation; or
- Blasting surface rock prior to excavation.

While some of this rock may be rippable by conventional excavation equipment, some of it may require blasting. The determination of construction method in rocky areas is based on site-specific conditions and cannot be determined until construction. Blasting will generally be limited to areas of consolidated rock. All blasting activity will be performed according to strict guidelines designed to control energy release. Proper safeguards will be taken to protect personnel and property in the area. The ECP for Connecticut in

Attachment Q contains details relative to blasting. Methods will be employed to prevent the scattering of rock and debris. Tennessee will attempt to avoid all karst areas during the routing and construction phases of the Project. Blasting may be required in areas of limestone and/or karst geology. If voids or sinkholes are discovered during blasting or excavation, measures in the Karst Mitigation Plan will be followed. The Project-specific ECP for Connecticut includes measures for preserving karst geology in the event they are encountered. Tennessee will strictly adhere to all applicable local, state, and federal regulations applicable to controlled-blasting and blast vibration limits with regard to structures and underground utilities while performing these activities. Special care will be taken to monitor and assess blasting within 200 feet of dwellings and private or public water supply wells.

Tennessee has developed a Project-specific Blasting Management Plan that establishes procedures and safety measures that Tennessee's Contractor will be required to adhere to while implementing blasting activities along the pipeline ROW during the Project. Tennessee will also obtain all the necessary federal, state, or local blasting permits prior to construction. Tennessee's construction contractor will be required to submit a detailed Blasting Specification Plan to Tennessee that is consistent with the provisions of the Blasting Plan and Kinder Morgan Construction Specifications. The construction contractor's plan, when approved by Tennessee, will be incorporated into the construction contractor's scope of work. Tennessee's Blasting Plan will be provided in Tennessee's Project-specific ECP for Connecticut.

Excess rock is defined as all rock that cannot be returned to the existing rock profile in the trench or graded cuts or is not needed to restore the ROW surface to a condition comparable to that found adjacent to the ROW. Excess rock will be hauled off the ROW and disposed of at an approved landfill or recycling facility unless approved for use as slope stabilization, windrowing, or some other use on the construction work areas as approved by the landowner or land managing agency.

1.1.2.7 Wetland Crossing Construction

Wetland locations along the pipeline segments are shown on the aerial alignment sheets included in the Connecticut ECP in Attachment Q. Site-specific wetland plans are provided in Attachment G. Pipeline construction across wetlands will be performed in accordance with Tennessee's Project-specific ECP for Connecticut. Tennessee is evaluating additional locations for proposed HDD crossings, some of which may be used to cross wetland areas. Final decisions on which wetlands will be traversed using HDDs will be made once all access to the ROW has been obtained. Limited landowner access has hindered Tennessee's ability to assess large wetland areas for HDD installation.

Tennessee will utilize one of the following methods for installing the pipeline within wetlands during construction. The construction methods include:

- Standard pipeline;
- Conventional wetland;
- Conventional bore;
- Direct Pipe®;
- HDD; and
- Push-pull technique.

These wetland crossing techniques are described in detail in Attachment K. Crossing methods are provided in Attachment A and Attachment K and typical drawings depicting these construction methods are provided in the ECP for Connecticut in Attachment Q. The wetland impact summary tables are located in Attachment A.

1.1.2.8 Waterbody Crossing Construction

Waterbody locations along the pipeline segments are described in Attachments A and K and shown on the aerial alignment sheets included in the ECP for Connecticut in Attachment Q. Site-specific waterbody plans are provided in Attachment G. Pipeline construction across waterbodies will be performed in accordance with Tennessee's Project-specific ECP for Connecticut and with applicable permit conditions. It is not anticipated that any crossings will take place outside of the timeframes outlined in Tennessee's Project-specific ECP for Connecticut. If any crossings are required to take place outside of the specified timeframes, Tennessee will consult with the applicable state agencies to obtain concurrence to proceed with construction outside of the specified timeframes. Waterbodies crossed by the Project are included in Attachment A and shown on the aerial alignment sheets. Crossing methods are provided in Attachment A and typical drawings depicting these crossing techniques are provided in the ECP for Connecticut in Attachment Q.

Tennessee will utilize one of the following methods for installing the pipeline across waterbodies:

- Wet open cut;
- Dry crossing;
  - Flume crossing;
  - Dam and pump;
  - Cofferdam; and
  - Dry open cut (conventional trenching waterbodies that are dry or frozen at the time of crossing during periods of no flow);
  - Direct Pipe®;
- Conventional bore; and
- HDD. Tennessee is evaluating additional waterbodies to be crossed using HDD methods. Limited ROW access in certain areas has hindered Tennessee's ability to assess each waterbody crossing to determine the appropriate crossing method. Tennessee will continue negotiations with federal and state agencies to determine the appropriate crossing methods for streams greater than 30 feet wide, and those containing sensitive species.

These waterbody crossing techniques are described in detail in Attachment K. The waterbody impact summary tables with proposed crossing technique for each waterbody are located in Attachment A.

1.1.2.9 Project Specific Alternative Measures or Modifications to Commission's Plan and Procedures

Proposed modifications to the Commission's Plan and Procedures (which are incorporated in the Project's Plan and Procedures) are listed below. These proposed modifications, if approved by the Commission, will be incorporated in the Project-specific ECP for Connecticut.

1.1.2.9.1 <u>Upland Erosion Control, Revegetation, and Maintenance Plan</u>

One Project-wide modifications to the Commission's Plan is proposed:

1. Silt fence, staked hay, straw bales and sandbags will not be used to construct temporary slope breakers in upland areas, as these barriers are not intended to convey concentrated flow, only minimal sheet flow. This provides more appropriate resource protection and supercedes the Commission's Plan (Section IV.F.1.a).

State regulatory requirements dictate several state-specific modifications as outlined below and described in greater detail in the Connecticut ECP.

1.1.2.9.2 Wetland and Waterbody Construction and Mitigation Procedures

Project-wide modifications to the Commission's Procedures include:

1. Tennessee will cross streams with discernible flow at the time of construction via fluming or dam and pump, regardless of fisheries or critical habitat designation, unless otherwise approved by applicable federal and/or state regulatory agencies. This is more restrictive than the Commission's Procedure's requirements (Section V.B.6).
2. Tennessee acknowledges that the Project will require certain ATWS to be located within 50 feet of waterbodies and wetlands.
3. Areas of workspace greater than 75 feet wide within wetlands are identified in Attachment K. Justification for including workspace greater than 75 feet within wetlands is also provided in the table per Commission's Procedure (Section VI.A.3).
4. Tennessee proposes that permanent slope breakers may not always be appropriate for installation at wetland boundaries. At the discretion of the EI, Lead Environmental Inspector ("LEI"), and Tennessee's contractor, permanent slope breakers that may alter the permanent overland flow characteristics, consequently altering the wetland's characteristics, will not be installed. Tennessee proposes the use of hay/straw bales as temporary slope breakers at the wetland boundaries until restoration is complete to ensure the wetland characteristics will remain intact in situations where permanent slope breakers are not used. This exception applies only to the use of a permanent slope breaker per Commission's Procedures (Section VI.C.3).

1.1.3 Meter Stations and Appurtenant Facilities

The new and modified meter stations, and appurtenant facilities, including pig facilities, will be constructed in accordance with industry standards. Construction of these facilities will coincide with construction of the pipeline facilities. Certain of the appurtenant facilities may require cathodic protection (as determined by cathodic protection pre-and post-surveys).

1.1.3.1 Clearing and Grading

The sites for the aboveground facilities will be cleared of vegetation and graded as necessary to create level surfaces for the movement of construction vehicles on the sites and to prepare the areas for the building foundations, where required for specific aboveground facilities. Tennessee will install silt fence and/or hay bales around disturbed areas, as appropriate to the land, soil, and weather conditions, to minimize the potential for erosion and impacts to off-site wetlands and waterbodies. Tennessee will consider additional BMPs such as super silt fence in locations where necessary to protect features either within the ROW or along the ROW. Furthermore, Tennessee will abide by state erosion and sedimentation permit requirements during construction, thus using the most stringent BMPs to protect sensitive features either along or within the ROW. Erosion and sediment controls will conform to Tennessee's Project-specific ECP for Connecticut.

1.1.3.2 Foundations

Where required, building foundations are likely to be constructed of poured reinforced concrete. Topsoil, if present, will be stripped from the area of the building foundations. Such soil may be used on-site either for landscaping or to provide soil cover for the septic system leach field, if acceptable. Additional soil or subsurface materials may be imported from approved sources to achieve the desired site/foundation grade.

1.1.3.3 Building Design and Construction

No compressor stations are proposed for Connecticut

For the meter stations, it is anticipated that the buildings housing meter runs, regulators/control valves, EGM, communications, etc. shall be pre-fabricated off-site and delivered to the site for final installation during construction. The construction for the pre-fabricated buildings shall be consistent with the standard Kinder Morgan details.

1.1.3.4 High Pressure Piping

Tennessee proposes to design and construct the high pressure station piping in the new meter stations and modified stations to meet the requirements of the USDOT, 49 CFR Part 192. Tennessee proposes to coat the station piping for protection against corrosion.

1.1.3.5 Pressure Testing

Prior to placing each of the meter stations (whether new or modified) in-service, Tennessee proposes to conduct pressure testing of the piping system. Tennessee proposes to conduct this testing in accordance with applicable state and local codes or regulatory requirements.

1.1.3.6 Infrastructure Facilities

The installation of the infrastructure facilities includes the various compressors and auxiliary equipment, piping, and other electrical and mechanical systems. These systems have been previously installed at the existing compressor station and meter station sites where modifications are planned. The exception will be Market Path Tail station which will tie into adjacent to municipal water and sewer. No communication towers are anticipated to be installed at new meter stations or MLV sites as part of the Project; communication towers in-service will be utilized at existing meter stations where modifications are proposed.

1.1.3.7 Control Checkout and Startup

Before the compressor appurtanances are put into service at the new and modified compressor stations, Tennessee will develop and implement station commissioning and startup plans. These plans will include the checking and testing of controls and safety features, including the venting silencers, relief valves, gas and fire detection facilities, ESD Controls, over-speed, vibration, and other on- and off-engine protection and safety devices.

1.1.3.8 Final Grading and Landscaping

Prior to construction, Tennessee will develop plans for the final grading and landscaping of the areas that will be disturbed during construction. These final grading and landscaping plans will be consistent with Tennessee’s Project-specific ECP for Connecticut for the restoration of uplands.

1.1.3.9 Erosion Control Procedures

During the construction of the new and modified meter stations, and other aboveground facilities, Tennessee will adhere to the applicable provisions of Tennessee's Project-specific ECP for Connecticut. As set forth in the referenced documents, Tennessee proposes to install appropriate erosion controls (e.g., silt fence and/or hay bales) to minimize the potential for erosion from construction of the facilities.

1.1.4 Timeframe for Construction

Construction of the Project will commence after ROWs (private, federal, and state) and applicable regulatory permits and clearances have been acquired for the Project. Tennessee requests issuance of a certificate of public convenience and necessity by fourth quarter of 2016. Certain aspects of construction, including winter tree clearing to avoid Indiana bat and other endangered species breeding periods, compliance with the Migratory Bird Treaty Act ("MBTA"), installation of HDD segments, and contractor yard preparation, are planned to begin in the first quarter of 2017. The 2017 construction activities for the mainline and facility scope of work are scheduled to commence in the spring of 2017, pending specific construction windows imposed on the Project. Winter tree clearing for the 2018 construction activities is scheduled to commence in October 2017, with the 2018 construction activities for the mainline scheduled to commence in the spring of 2018. It is anticipated that installation of the HDD segments and facility scope of work will continue year-round once started. All Project facilities are anticipated to be placed in-service by November 2018 (with the exception of one proposed pipeline looping segment in Connecticut which will be placed in service by November 1, 2019).

Tennessee estimates that twelve construction spreads will be required for the pipeline construction portion of the Project. Each spread will consist of approximately 400-1,000 personnel depending upon the pipeline facility, and each spread will take approximately 9 months to 1 year to complete, depending upon site-specific conditions for each pipeline facility.

Construction of the new and modified meter station facilities will require approximately 2 months to 6 months to complete and will each require up to 20-40 construction workers, depending on the facility.

Tennessee anticipates there will be a need for additional permanent staff for operation of the new Project facilities. The required additional permanent staff will be stationed at existing Station 319 and new offices will be located at the new Project compressor stations. Two new district offices are planned for these new facilities. One of which will be located in Franklin County, New York at the Supply Path Mid Station. The other district office will be at Market Path Mid Station 4 in New Ipswich, New Hampshire. Tennessee anticipates the need for approximately 26 additional full time employees for operation of the Project facilities.

1.1.5 Supervision and Inspection

Tennessee will use a minimum of one qualified, full-time EI for each pipeline spread during Project construction, as well as a minimum of one LEI to oversee the EI staff. The EIs assigned to oversee construction for the individual pipeline spreads will also oversee the construction of the new and modified meter stations, and appurtenant facilities in the area. Tennessee conducts in-house EI training to ensure that the EIs will be able to carry out their duties as described in this document and that construction activities will be in compliance with the Project-specific ECP requirements for Connecticut, requirements of applicable federal, state, and local environmental permits and approvals. and environmental requirements in landowner easement agreements. Additionally, Tennessee will conduct environmental training in advance of construction, and the EIs will perform all duties as specified in Tennessee's Project-specific ECP for Connecticut. The level of training will be commensurate with the type of duties of the Project personnel. Further details concerning environmental training is provided in Tennessee's Project-specific ECP for Connecticut.

Tennessee will fund a third-party compliance program to operate at the direction of the Commission to ensure the compliance to Project-specific ECP as well as the requirements of applicable federal, state, and local environmental permits and approvals.

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APPENDIX D – Kinder Morgan Construction Standards

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Kinder Morgan
Construction Standards

Table of Contents

1. Scope

1.1. Contractors and/or Subcontractors are referred to as 'Contractor' in these standards. The authorized Company Representative is referred to as 'Company Representative' in these standards.

1.2. These standards shall govern construction and/or modification of natural gas pipelines, compressor stations, and facilities. All construction shall be performed in conformance with safe professional construction techniques, the Company **Contractor Environmental/Safety Manual**, the Company Construction Standards, Scope of Work, associated drawings, and contract requirements.

1.3. The project and work to be performed comprise all work necessary to complete construction and/or modification of natural gas transmission pipelines within the construction schedule.

1.4. In case of conflict between the Contract, Appendices, codes, regulations, and permit conditions, the more stringent shall apply as determined by the Company, so long as the more stringent complies with applicable regulations and permit conditions. In case of an omitted Specification, the work shall be performed as specified by the Company Representative. In the event of conflict between the drawings, Engineering and Construction Standards, the contractor shall notify the company representative, who shall then notify the Contractor (in writing) of the approved changes to resolve the issue.

2. Compliance with All Authorities

2.1. Contractor shall comply with all regulations, codes and laws of local, county, State and Federal government and other bodies having jurisdiction over operations and utilities such as environmental, health and safety (EHS) practices, blasting, roads, waterways, underground facilities, railways and others that may be encountered in the course of the work.

2.2. Adhering to these statutes and standards shall be mandatory in and around all Company work places, including areas outside of the right-of-way (ROW) that Contractor sets up as part of the overall project encompassed by the Scope of Work.

2.3. Contractor shall comply with all Federal, State, county and local fire regulations pertaining to burning permits and prevention of uncontrolled fires. Contractor shall also be responsible for supplying and maintaining (in working order) an adequate supply of fire extinguishers and fire fighting equipment for each crew.

2.4. Contractor shall comply with current edition of Company's **Contractor Environmental/Safety Manual**.

2.5. Local agencies may have additional or more stringent permit requirements. Contractor shall comply with all permit requirements, even where more stringent than this standard.

3. General Conditions

3.1. Contractor is required to notify Company before commencing any phase of the work as detailed in these standards. Contractor shall also inform Company daily regarding all work-crew locations, and shall immediately notify Company of work stoppages or shutdowns. For typical pipeline construction sequence refer to **Construction Drawing CST-P-1000-B060 – Typical Pipeline Construction Sequence**.

3.2. In certain localized areas, Contractor may be required to modify its operations to control noise levels. Such areas and conditions will be defined in the Scope of Work or ROW document.

3.3. At its option and cost, Company may obtain the services of specialists to supervise or assist in construction or use of any Company-furnished equipment and material. When such specialists are employed, they shall act on behalf of and to the extent authorized by the Company Representative.

3.4. Contractor shall prevent litter, construction debris, and construction chemicals from becoming a pollutant source.

3.5. Alcohol, weapons, fireworks, pets, and illegal substances shall not be allowed on Company worksites.

4. Traffic Control

4.1. Contractor shall provide qualified flag persons. Contractor shall supply, install, and maintain all temporary signs and other devices necessary to warn road users of construction activities. Such signs and devices and their placement shall conform to permits and standards of agencies having jurisdiction over affected crossings. In addition, Contractor shall comply with any applicable State and Federal regulations requiring such warning devices.

4.2. Contractor shall obtain all permits required during construction, such as, but not limited to, those required for moving loads on public roads.

5. Safety Procedures for Damage Prevention

5.1. At certain locations, Contractor may be working close to existing pipelines, foreign structures, and/or other utility lines (e.g. phone cables, electric lines, etc.). Contractor shall note locations of undercrossings and overcrossings (on drawings) where work must be performed under or over existing operating pipelines. Contractor shall ensure that safety procedures (outlined in this Standard, the **Contractor Environmental/Safety Manual**, and all applicable Federal, State, county, and local statutes) are strictly adhered to during the entire construction period, including final cleanup.

5.2. Contractor shall make all required 'One-Call' notifications prior to commencement of work at the site. Contractor shall not commence on-site activities until One-Calls and subsequent notifications and location markings are complete. In addition, Contractor shall give advance notification of all work to be performed within 25 feet of Company's pipelines or facilities, so that site preparation and inspection can be provided. Contractor shall assume full responsibility for identifying, exposing, and protecting all underground facilities encountered in performing the work.

5.3. Contractor shall exercise extreme caution when working or moving equipment across difficult ROW areas located close to operating pipelines or facilities. Should a machine bog down, slide into, or come to rest on top of (or dangerously close to), such facilities, the machine shall be immediately shut down, and the Company Representative notified. No attempt shall be made to move or extricate such machinery without the approval of Company Representative.

5.4. All accidents shall be reported to the Company Representative immediately and Contractor shall complete an Injury/Accident Report in conformance with the **Contractor Environmental/Safety Manual**. Contractor shall correct any damage its personnel or operations cause to Company facilities. However, repairs or replacement shall not be initiated until authorized by the Company Representative. All repairs or replacements shall conform to Company Standards, as approved by the Company Representative.

5.5. Company shall review and authorize/deny the use of any heavy equipment above company pipelines or other buried facilities. Company shall also review and authorize/limit the use of explosives near adjacent facilities. Refer to **Construction Standard C1030 - Blasting**.

5.6. Contractor shall maintain awareness of, and take precautions to mitigate hazards associated with construction at, or close to, foreign utilities and facilities (e.g., high voltage power lines and pipelines operating under pressure) and other construction operations (e.g., blasting and strength testing).

5.7. Contractor shall permit only those employees qualified, by training or experience, to operate equipment and machinery as required by 49CFR 192 and 49CFR 195. Using any machinery, tool, material, or equipment that does not comply with OSHA 29 CFR Part 1910 or 1926 is prohibited.

5.8. Contractor shall designate a competent person or persons to conduct daily work-area safety and environmental inspections.

6. Work Area Activities

6.1. Pipeline construction activities shall be confined to the ROW, temporary and additional workspace, storage areas, and approved access routes. Contractor transport and service vehicles parked along the ROW shall not impede work progress or ROW access.

6.2. At compressor stations or plants, Contractor's employees shall use designated parking, entrances, and routes to proceed directly to job sites and avoid passing through operating locations. Contractor may be required to sign in and out when working at Company facilities (to provide traffic, security and personnel control in operating areas).

6.3. The Company shall control and monitor the use of all natural gas and power sources as required during various construction phases.

6.4. Contractor shall provide dust control as required by Company bid documents and applicable agency regulations.

6.5. Traveled surfaces of roads, streets, highways, etc. (and railways when applicable) shall be cleaned of mud, dirt, or any debris immediately after equipment traverses the roads or exits from the ROW and deposits such material.

6.6. Smoking areas shall be designated by company representative.

Table of Contents

1. Scope

This document defines requirements for site preparation including, but not limited to: work site access, clearing, grading, fencing, soil conservation, roadway construction, etc. For Projects subject to FERC regulation, additional requirements may apply, and shall supercede the basic requirements contained herein.

2. General Conditions

2.1. The Company will provide a permanent right-of-way (ROW) within which the pipeline system shall be located and installed. For Contractor's construction operations, Company may provide additional, temporary work-space as specified in the ROW list, Scope of Work, or Construction Drawings.

2.2. Contractors shall not make direct agreements with landowners. Company shall negotiate and approve any additional workspace adjacent to Company's ROW (access roads, stockpile sites, etc.).

2.3. Company shall determine that no environmental, archeological, or landowner considerations are jeopardized.

2.4. The ROW line list provides detailed instructions concerning access, ROW clearing and restoration. Contractor shall be controlled and bound by all provisions or instructions contained in the ROW line list and permit requirements.

2.5. Before starting any excavation, Contractor shall contact the local 'One-Call' services in conformance with regional requirements. Contractors shall be required to perform visual observation and run-line detection surveys to detect if there are unmarked lines and/or underground utility installations in the area that do not participate in One-Call. Utility lines or cables shall be located and flagged before excavation. Contractor shall provide spotters to hand-excavate as needed to locate lines or cables and maintain visual contact with these lines or cables until excavation is completed. Contractor shall provide temporary support for lines or cables as needed.

2.6. Company shall mark its existing pipelines on the construction site using visible markers. Using equipment and/or excavating around said pipeline shall be in conformance with Company standards, and in the presence of the Company Representative. Contractor shall exercise extreme caution while excavating near high-pressure pipelines; and may not do so without prior approval of Company Representative.

2.7. Contractor shall preserve (without damage) all roads, poles, lawns, stone walls, ditches, canals and similar property, as well as trees (in farm yards, groves orchards, and windbreak area), shrubs and similar desirable growths to the fullest extent consistent with ROW line list and contract documents.

2.8. Prior to starting any excavation, Contractor shall provide Company Representative with copies of all Contractor-supplied permits necessary to perform construction detailed in the Scope of Work.

2.9. Contractor may be required to clear the entire area (involved in the work on plant sites) for facilities such as compressor stations, dehydration plants and meter stations. For pipeline construction, Contractor shall clear the ROW only to a width sufficient for constructing the line and within the ROW limits furnished by Company.

2.10. A Company surveyor shall visibly mark all construction site corners and ROW limits unless otherwise specified in the Scope of Work. Contractor shall take care during construction to ensure that markers are not disturbed or removed until permanent markers or fences are installed. Company shall supply a contour map of the construction site if the site is sufficiently rough or on a hillside. Contractor shall be responsible for establishing all necessary benchmarks used during construction. Such benchmarks shall be referenced on construction drawings.

2.11. Contractor shall immediately stop activity and notify Company Representative in the event any cultural or paleontologic resource or human remains are exposed.

2.12. Exposure or contact of any metallic structure can represent a potential hazard. Where the pipe-to-foreign structure voltage exceeds 15V (RMS), pipe grounding shall be implemented.

3. Access Roads and Work-spaces

3.1. Contractor shall be responsible for preparing the permanent ROW, any temporary work-space, and any site access for construction. This preparation includes, but is not limited to: clearing brush, grading where required, erecting temporary fences, gaps and barricades, installing ramps, culverts, erosion and sediment control structures, etc.

3.2. Contractor shall note that work-space may be limited where there are physical barriers (trees, buildings, ponds, above grade structures, etc.) or in sensitive areas as included in the Scope of Work, the ROW line list and drawings. Contractor shall allow for such partial restrictions and plan operations accordingly.

3.3. Contractor shall prepare and maintain all public and private access roads and routes and additional sites. Contractor shall restore access roads and additional sites to their original condition. This work shall comply with requirements of permits and approval of Company Representative.

3.4. Contractor shall use only such access roads through farms or other lands as designated and approved by the Company. Access roads shall be maintained in good condition at all times but may not be expanded unless authorized by Company.

3.5. Contractor shall adhere to all commitments made by the Company to all applicable agencies regarding access over watercourses and across wetlands. Where wetlands are encountered, every effort shall be made to minimize the extent of work-space used (through the wetlands) to minimize natural habitat disruption.

3.6. Contractor shall notify the Company where ramps across railways will be required for construction access. Application procedures for necessary permits will differ depending on the railway owner. At no time shall Contractor contact railway companies directly without first notifying the Company.

3.7. Contractor shall use the least amount of temporary work-space practical. At construction outset, before work commences in each particular area, Contractor shall provide Company Representative a description of work-space requirements for that area. Only after Company Representative approves the plan may work space disturbance commence.

3.8. Contractor shall ensure that construction through agricultural areas is completed in a manner that minimizes interference or inconvenience to landowners/tenants and their agricultural operations. Landowner/tenant access to their property shall be maintained at all times, including opening up topsoil- and spoil-piles and installing ditch plugs across the trench at various locations.

4. Clearing and Grading Facility Sites

4.1. Construction site shall be cleared of trees, stumps, rocks and other obstructions as required on the drawings and as required by the Company Representative. All debris shall be disposed of as directed by the Company Representative.

4.2. Burning of trees, stumps, and/or other debris on the construction site or near gas pipelines is not permitted. All large obstructions such as boulders, concrete, etc. shall be removed using heavy equipment, jackhammers or blasting. All blasting shall be done in conformance with **Construction Standard C1030 – Blasting**.

4.3. Contractor shall provide adequate temporary or permanent protection to all significant above grade or below grade items such as landmarks, pipelines, historical sites, or markers, etc., that could be damaged or destroyed during construction.

4.4. Before grading and leveling, topsoil shall be removed and stored in locations approved by the Company Representative. Topsoil may be used as final ground cover after leveling is completed.

4.5. Fill-soil shall be free of rocks and other debris and approved by Company Representative before use. Removed soil shall be disposed of as directed by the Company Representative.

4.6. BMP must be placed after clearing and grating. Refer to **Construction Standard C1260 – Environmental Requirements. Section 3**.

5. Fences and Gates

5.1. Contractor shall confirm with Company that permission has been secured from property owners for fencing crew entry. Contractor shall furnish gates in fences that the pipeline route crosses. Contractor shall brace, cut, dismantle, remove, relocate, modify, replace, and restore all existing fences and gates for accessing the site and temporary work-space. Before cutting fences to make gates, fences shall be braced on both sides of the ROW to prevent fence damage. Gates or gaps shall be constructed so that they can be securely closed. Contractor shall be responsible for all damages and negligence of employees failing to keep gates closed at all times.

5.2. Contractor shall install all temporary fences required to prevent unauthorized access to the work site (at road crossings or across access roads) and to delineate and protect sensitive sites, including approaches to water crossings and cultural resource sites.

5.3. Where necessary, Contractor shall construct temporary fences (other than those noted above) to prevent livestock from entering or leaving the site, and/or to protect livestock and people from accidents that could result from construction activities. Contractor shall provide personnel to patrol the pipeline and check gates and fences during the project. Contractor shall be obligated to aid in recovering livestock allowed to escape by virtue of inadequate fencing or gates left opened.

5.4. Contractor shall maintain all temporary fences and gates. Contractor shall also be responsible for dismantling and restoring all fencing at existing Company facilities such as compressor stations and valve locations.

5.5. Following completion of pipeline construction, temporary gates shall be removed and fences restored. Contractor shall replace removed sections of existing fences and gates with new fence materials and gates as required by the Company Representative. Contractor shall also supply and install any additional lengths of fencing needed because of replacing or relocating existing fences.

6. Clearing of Pipeline ROW

6.1. Contractor shall obtain Company approval before commencing any clearing operations, to ensure that work-space clearing is consistent with terms of all landowner agreements. Contractor shall provide personnel and surveying instruments necessary to ensure exact elevations. Before clearing operations commence, Contractor shall be familiar with all special provisions relating to Company-secured ROW and shall comply with these provisions as outlined in the ROW line list and site-specific environmental requirements.

6.2. Contractor shall protect Company's survey stakes (while clearing and thereafter) as long as they are useful. Contractor shall be responsible for all re-survey and re-staking work necessary due to disturbing of construction survey stakes.

6.3. In clearing ROW, and performing work under the ROW line list provisions, Contractor shall consider landowners' and tenants' interests and property and perform its work in a manner that causes minimum inconvenience, injury, or damage.

6.4. Where ROW passes through environmentally sensitive property, Contractor shall comply with terms of all permits.

6.5. In all construction phases, measures shall be taken to prevent and/or control fire and other hazards.

6.6. To prevent damage outside the approved ROW and temporary work-space limits, brush and trees shall be felled within staked limits. Care shall be exercised when removing branches overhanging the ROW. Primary branch cuts shall be made only at branch intersections using a chain saw or handsaw. Stumps and other loose debris from the ROW shall be cleared a sufficient distance from the ditch line (so spoil banks from ditching operations will not fall on foreign matter or become mixed with excavated soil).

6.7. All treetops, limbs, stumps, and brush cleared from the ROW shall be disposed of as required by the Company Representative.

6.8. All timber (salable or otherwise) less than 6-inches in diameter shall be cut within 3-inches of the natural grade, and felled on the ROW so as not to damage trees intended to remain standing.

6.9. Contractor shall remove all stumps in timbered areas (including those from trees felled by bulldozers) in a strip 20-feet wide along the working side of the trench. In marsh construction, Contractor shall only remove stumps in the ditch line.

7. Swamps and Wetlands

7.1. Where removal is necessary in swamp areas, trees shall be cut flush with the terrain surface and stumps left in place (except at the ditch line) to avoid creating bog holes. Removing trees to accommodate future operations shall be avoided and the number of trees removed kept to a minimum.

7.2. Temporary erosion and sediment control structures shall be placed as necessary to protect these areas from runoff. Refer to Construction Drawings **CST-P-1260-A380.1 – Typical Wetland Crossing**, **CST-P-1260-A380.2 – Typical Wetland Crossing**, **CST-P-1260-A390.1 – Typical Push Pull Wetland Crossing**, and **CST-P-1260-A390.2 – Typical Push Pull Wetland Crossing**.

8. Grading of Pipeline ROW

8.1. Grading shall be performed to the extent necessary to accommodate bending limits and to provide a safe, level working surface for construction equipment. The extent of grading shall be restricted where the safety of existing facilities is jeopardized.

8.2. Grading shall not be detrimental to natural drainage and slope stability. Spoil from grading shall be stockpiled to avoid blocking drainage ditches and to minimize erosion. Spreading spoil into tree or crop areas is not permitted.

8.3. The extent of grading shall comply with approval of Company Representative in all cases. Slopes subject to erosion shall be temporarily protected after grading.

8.4. Cuts for grade shall not be closer than 5 feet to any existing parallel pipeline unless otherwise specified by Company.

8.5. Contractor shall grub or otherwise remove all stumps from the ditch line and space required for spoil storage. Stumps shall be disposed of by chipping or as specified in the ROW line list or Scope of Work.

8.6. Contractor shall minimize blading to leave existing vegetation root structure in place where possible.

9. Road Ditch Crossings

9.1. Where Contractor is required to cross road ditches to access the ROW, Contractor shall supply any required temporary culverts and cover them with material as required by local regulation or Company Representative. Contractor shall be responsible for maintaining the ditch in good condition during construction and for cleaning up and removing all materials after construction.

10. Soil Conservation

10.1. Through cultivated and improved lands, Contractor shall remove topsoil over areas to be graded or excavated unless directed otherwise by the Company Representative. Topsoil shall be removed to its actual depth or a maximum depth as required by permits, landowner agreements, or bid documents. Topsoil shall be salvaged and piled separately from spoil banks in conformance with the drawings or as directed by the Company Representative. Under no circumstances shall topsoil be used for padding or backfilling the trench. Equipment for stripping and replacing topsoil shall be subject to approval of the Company Representative.

10.2. Where grade cuts result in additional spoil, it may be stored on either side of the working area. In such cases, topsoil shall be stripped from the entire work-space so that subsoil cannot be mixed with, or stored upon, topsoil. Contractor shall be responsible for grading, removing topsoil, and restoration work.

10.3. Topsoil shall not be stored in a manner that increases its water content. Topsoil or subsoil storage piles shall not block drains and ditches.

10.4. Soil conservation requirements listed above shall apply for all construction work where excavations are necessary.

10.5. Refer to Construction Drawings **CST-P-1260-A250 – Typical Full Topsoil Separation Side Hill Construction**, **CST-P-1260-A255 – Typical Topsoil Separation Trench and Spoilside Method**, **CST-P-1260-A260 – Typical Topsoil Separation Trench Plus 4' Method**, **CST-P-1260-A265 – Typical Topsoil Separation Blade Width**, and **CST-P-1260-A270 – Typical Full Topsoil Separation Side Hill Construction Spoilside Travel Lane**.

11. Construction of Roadways and Parking Areas

11.1. Locations of roads and parking areas will be designated in the ROW line list, on drawings, in the Scope of Work, or determined by the Company Representative. The Contractor is responsible for supplying all labor, material, and equipment to complete roadway and parking area construction as designated in the Scope of Work.

11.2. Contractor shall install culverts as required for water drainage from surrounding terrain, as shown on drawings or as directed by the Company Representative. Culverts shall be installed at intersections of all Company roads and/or access/public roads. Such installations shall be in conformance with applicable State, County, or local specifications.

Contractor shall replace any culvert damaged, lost, or rendered unusable during facility installation or construction.

12. Fill Work and Compaction

12.1. Contractor shall make all required earth fills by depositing earth materials in layers 6- to 8-inches deep. When required by the Scope of Work, Contractor shall compact earth fills by wetting and tamping or rolling each layer.

12.2. All fill material for subgrades and base materials shall be thoroughly compacted in approximately 6- to 8-inch layers to the density specified in the Scope of Work. Contractor shall supply all water required for compacting and ground wetting. Company Representative shall have the right to reject any fill material considered unsuitable for base material or specified compaction.

12.3. Clods or lumps of material shall be broken and mixed by blading or similar methods so that uniform density is attained in each compaction layer.

12.4. Contractor shall wet construction area to prevent blowing and shifting soil as directed by the Company Representative. Contractor shall comply with all environmental codes and permit conditions for fugitive dust emissions.

13. Grading and Excavating

13.1. Grading and excavating shall include all work necessary to provide elevations, gradients, or coverages; and shall include cutting, removing, transporting, and compacting in its various forms.

13.2. Contractor shall remove the following from excavation surfaces: stumps, roots, rocks, boulders, and any other foreign material. Contractor shall perform all excavation necessary (including hand excavation, where required) for parts of structures below grade.

13.3. Contractor shall take necessary precautions to protect excavations from cave-in until backfilling operations commence. Sides of all excavations over 4-feet deep shall be dug, stair stepped, sloped, or shored at all times to provide safe work areas for personnel in conformance with OSHA requirements and **Contractor Environmental/Safety Manual**. On a daily basis, Contractor shall document that a designated competent person has inspected all excavations prior to use.

13.4. Any surplus topsoil or subsoil material (resulting from grading, trenching, or excavating operations) shall be disposed of by Contractor by hauling and spreading to areas approved by the Company Representative.

13.5. In some instances, final grading and leveling will be completed after construction has been completed. Contractor shall not start final grading without prior approval of the Company Representative. Grade elevations shall be maintained as indicated on the drawings.

13.6. Excavation in rock shall be carried 6-inches below the bottom of lines.

13.7. Contractor shall install temporary slope breakers and other erosion control structures as required by permit conditions or the Company Representative.

Table of Contents

1. Scope

This document defines Company requirements and standards for Construction of Ditching, including, but not limited to: Ditching Procedures, Topsoil Separation, Drainage Tiles, etc. For Projects subject to FERC regulation, additional requirements may apply, and shall supercede the basic requirements contained herein.

2. General

2.1. All below grade facilities within 25-feet of mechanical excavation shall be located and staked/identified. Contractor shall continually check cover around buried facilities by probing and removing soil by hand. Buried facilities shall remain visible to the equipment operator at all times and hand-removing soil shall keep pace with progress of mechanical equipment. When excavating, passing an equipment bucket over exposed pipeline shall be minimized to the extent possible. Mechanical excavation shall terminate no less than 24-inches from above grade facilities.

2.2. Any liabilities incurred by Contractor because of damage to below grade facilities shall be promptly settled to satisfaction of the facility owner.

2.3. Where other pipelines, drainpipes, telephone conduits, and/or other foreign lines are to be crossed, new pipeline shall be installed with a minimum of 24-inches clearance (reference **Construction Standard C1005 – Construction near Company Facilities**.) Additional clearance may be specifically defined by the owner/operator or contract documents. Refer to Construction Drawings **CST-P-1000-A315 – Typical Buried Cable Crossing** and **CST-P-1000-A325 – Crossing Foreign Pipelines**.

2.4. Contractor shall clearly identify all above grade facilities within 25 feet of work site with flagging material before any mechanical excavation commences. Contractor shall protect above grade facilities within 10 feet of the excavation with barriers.

2.5. In certain site-specific cases where shrubbery, tree, or salable timber are encountered in the right-of-way (ROW), or where the use of trenching equipment could result in unnecessary damage or injury to property (crossed by the ROW), Company Representative may require hand trench excavation. Such areas shall be delineated in the drawings, ROW line list, and/or Scope of Work.

2.6. Heavy equipment will be permitted over operating pipelines only after the affected pipeline owner has analyzed the stress loading and granted approval. Existing backfill shall be modified, and/or temporary ramps or mats shall be constructed, as shown in **Construction Drawing CST-P-1000-A330 – Typical Temporary Crossing Ramp Over Existing Pipelines**, or in conformance with requirements of the pipeline owner. Contractor shall provide pipeline owner with 48 hours advance notice, as well as parameters of heavy equipment, prior to equipment use.

3. Ditching Requirements

3.1. Ditch width requirements:

3.1.1. For steel lines 4-inch and larger the ditch shall be excavated to a width that provides a minimum of 6-inches clearance on either side of pipe to be placed therein. Additional clearance requirements shall be noted in the Scope of Work.

3.1.2. For plastic lines and steel lines less than 4-inch the ditch width shall be wide enough to accomidate placement of pipe or as directed by Company Representative.

3.2. The ditch shall be cut to a uniform grade and to a depth specified on construction drawings and in **Major Design Installation E0100 – Pipelines (Onshore)**. Depth of cover shall be measured from the top of pipe and or concrete, or set on weights to the lowest shoulder of the ditch. The finished ditch shall be excavated along a Company-marked route and shall be free of clods, rocks, debris, protruding roots, or any such materials or objects that may damage pipe coating. Deviation from the Company-marked route shall not be allowed without approval from the Company Representative.

3.3. Cover for pipe installed across roads, creeks, streams or riverbeds will be measured at its lowest point. Refer to Typical Drawings **TYP-P-0100-A041 – Typical Minor Waterway Crossing**, **TYP-P-0100-A005**, **TYP-P-0100-A010 – Typical Uncased Open Cut Road Crossing** and **TYP-P-0100-A015 – Typical Cased Road Crossing** for road and stream crossings that are not specifically designed.

3.4. Excavated dirt or spoil bank shall be placed a minimum of 24-inches from ditch edge. Where necessary, spoil bank will be opened to prevent impounding water.

3.5. Contractor shall provide temporary crossings over ditches that are at least 10-feet wide, with dirt plugs at convenient locations to permit livestock and farm machinery passage. Spoil banks shall be opened at all gates to ensure access.

3.6. Slick-boring foreign line crossings, as shown in historical Standard Drawings **STD-14-E2 – Miscellaneous Foreign Line Crossing Details** and **STD-EN-A04 – Topsoil Separation at Bored Crossings** (New drawings will be developed in the future as needed), are permitted with approval of the Company.

3.7. If additional ditch depth is necessary to accommodate present or future land use, Company will designate depth and length. Where it is required to deepen the ditch to accommodate bending and the approach to other line(s), road, railroad, water bodies, bores, etc., undercrossings shall not be considered as extra depth.

3.8. All ditches shall be graded so that over-bends ride high and maintain required minimum cover. Coverage at any particular point shall be measured from top of pipe to the average level of natural ground on both sides of the trench.

3.9. At improved public roads, pipeline cover in the road borrow ditch shall be as specified in **Major Design Installation E0100 – Pipelines (Onshore)**. All roads with normal grades, with or without borrow ditches, shall be dug to give a minimum cover of 36-inches over the pipeline. Refer to Typical Drawings **TYP-P-0100-A005 – Typical Uncased Bored Road Crossing**, **TYP-P-0100-A010 – Typical Uncased Open Cut Road Crossing** and **TYP-P-0100-A015 – Typical Cased Road Crossing**.

3.10. The maximum length of open ditch allowed during construction shall be assigned by the Scope of Work.

3.11. Contractor shall provide and maintain adequate pumps and other equipment for removing and disposing of surface and groundwater entering trench. Any water discharge shall be in conformance with jurisdictional agency permits.

3.12. Trench shall be excavated to reduce angularity of bends and conform to pipe. Irregularity in the pipe bottom gradient (after trenching) shall be corrected by filling trench with loose materials not to exceed 4-inches. Filling the trench under bends is prohibited.

3.13. Contractor shall comply with all OSHA, Federal, State, county, and local trenching regulations. It is Contractor's responsibility to maintain current copies of applicable trenching regulations.

4. Topsoil Separation

4.1. Where the Scope of Work and permits require topsoiling or double ditching, topsoil shall be removed and kept separate from remaining excavated material. The topsoil shall be kept segregated in its original uncontaminated state and at no time shall be allowed to become contaminated with foreign material.

4.2. As specified by ROW easements or the Company Representative, Contractor shall remove topsoil from trench line or excavated area as a separate operation. Contractor shall segregate topsoil and subsoil when removed so that each can be replaced in the trench or excavation without mixing (and return each to its original relative position). In areas where ROW requires grading, topsoil shall be separated across the entire width of the grading cut, as described in **Construction Standard C1010 - Clearing, Grading, and Site Preparation**.

4.3. Removed subsoil shall be returned to the trench or excavation to a thickness that permits all topsoil to be placed over returned subsoil so that the upper portion of the trench (or excavation and the crowned surface) shall contain only originally removed topsoil.

4.4. Any surplus subsoil that cannot be returned to the trench or excavation shall be hauled away and disposed of at locations approved by Company Representative.

5. Drainage Tiles

5.1. Contractor may cut through all drainage tiles with trenching machine except in locations where such cutting is prohibited (Company-marked with flagging or noted on the ROW line list).

5.2. When tile lines are cut during any trenching operations, Contractor shall:

- Mark drain tile locations immediately and maintain markers until tile lines are repaired.
- Make temporary repairs immediately, if required by Company Representative, until permanent repairs can be made after pipe is lowered into the trench.
- Permanently repair or replace all damaged drain tiles as required by Company Representative.

5.3. Contractor shall install pipeline at sufficient depth at undercrossing points so that no interference will occur between repaired section of drainage tile and pipeline. Contractor shall be responsible for any property damage caused by improper drainage due to inadequate temporary or permanent tile repairs.

5.4. Whenever pipeline crosses drain tile, trench shall be completed so that top of pipeline meets minimum clearance below tile bottom or as required in the Scope of Work or project drawings (after drain tile is restored in accordance with this section). Contractor may elect to bend pipe to go under tile line and avoid undue excavation or to excavate trench to required depth with appropriate gradient.

5.5. Contractor shall repair damaged drain tile as shown on **Construction Drawing CST-P-1000-A305 – Typical Undercrossing of Tile Drainlines** and in the following manner:

5.5.1. When drainage tile is cut, Contractor shall carefully cover open ends on the drainage tiles to prevent ingress of dirt or rock.

5.5.2. All broken tile shall be removed and replaced. Where drainage tile is composed of corrugated-plastic drainage tubing, all crushed and stretched tubing shall be removed and replaced. All reusable tiles shall be thoroughly cleaned.

5.5.3. Replacement tile shall be laid on both sides of trench so it crosses pipeline at an angle not less than 45° to pipe axis.

5.5.4. Contractor shall provide corrugated plastic drainage tubing for replacement unless otherwise specified. Such tubing shall be of a quality at least equal to existing materials and acceptable to landowner/tenant and Company Representative. Where specified, knitted filter-covered, corrugated plastic tubing may be used in lieu of standard drainage tubing.

5.5.5. Excavation for drainage tile repair shall be made through the pipeline (compacted) backfill. Care shall be taken to avoid disruption of topsoil separation.

5.5.6. A segmented sewer-rod (fitted with a plug not more than 15% smaller than internal tile diameter) shall be inserted into open tile ends far enough to ascertain that traffic on ROW has not damaged or displaced tiles. Contractor shall provide and place sacks of earth or sand (free of rock or gravel) along both sides of replaced or repaired tile line to prohibit lateral displacement during backfilling operations.

5.5.7. Drainage tile shall be replaced so that its former gradient and alignment are restored. Contractor shall fabricate support material to fully support tile.

5.5.8. In cases where tile line closely parallels pipeline being installed, tile line shall be re-laid on both sides of trench, for a distance determined by the Company Representative, so that it crosses pipeline at an angle greater than 45°.

5.5.9. To minimize settling and crushing of restored tile, granular material shall be placed in the pipeline trench and around drainage tile to a depth sufficient to cover tile.

5.5.10. Backfill material shall be carefully placed in 6-inch lifts and compacted using a power-driven vibrator-type tamper.

5.6. Spoil banks from ditching operations shall not be placed where drainage will be affected unless such placement conforms to the ROW line list and applicable Federal, State, county, or local regulations. Contractor shall ensure that all drainage ditches and watercourses are kept open and functional. Spoil banks from ditching operations shall not be allowed to fall on any loose debris or foreign matter that might mix with soil excavated from trench.

6. Trench Sheeting and Bracing

6.1. If required (to protect pavement, utilities and other facilities, and other than for Contractor's convenience), Contractor shall provide and install suitable sheeting and ditch bracing to prevent caving of trench walls where adequate bank slopes cannot be obtained.

6.2. Contractor is solely responsible for determining whether trench sheeting or bracing is necessary. Contractor shall also determine location, type, and amount of such sheeting and bracing. Contractor shall inform Company Representative about, and provide justification for, sheeting and bracing prior to installation.

Table of Contents

1. Scope

This document defines Company requirements for all Blasting and Blasting-related operations. For Projects subject to FERC regulation, additional requirements may apply, and shall supercede the basic requirements contained herein.

2. General Conditions

2.1. Blasting-related operations (including, but not limited to: obtaining, transporting, storing, handling, loading, detonating, and disposing of blasting material, as well as drilling and ground-motion monitoring) shall comply with permit requirements and all applicable Federal, State, and local regulations.

2.1.1. Company may specify locations (foreign line crossings, near-by structures, etc.) where consolidated rock shall be removed by approved mechanical equipment such as rock-ditching machines, rock saws, hydraulic rams or jack hammers in lieu of blasting. Blasting for grade or ditch excavation shall be utilized only after all other reasonable means of excavation have proven unsuccessful.

2.1.2. Blasting shall be done only when a Company Representative is present, and when Company Representative approves to proceed, prior to each blast. Company Representative's approval does not relieve Contractor from responsibility or liability.

2.1.3. Contractor shall acquire all required Federal, State, and local permits relating to transportation, storage, handling, loading, and detonation of explosives. Blasting operations shall be conducted by or under the direct and constant supervision of experienced personnel, legally licensed and certified to perform blasting operations in the jurisdiction where blasting is required. Prior to starting any blasting activities, Contractor shall provide Company with evidence of experience, licenses, certifications, and permits as required from the State in which work is being performed.

3. Blasting Procedure

3.1. Contractor shall submit a detailed Blasting Procedure to the Company for approval before commencing any blasting operations. Company's acceptance of Blasting Procedure shall not relieve Contractor of liability for harmful consequences of Contractor's blasting operations.

3.2. Contractor's blasting and staging procedure shall provide for all aspects of blasting process with documented emphasis on noise, vibration, and air blast.

3.3. The Blasting Plan shall, at a minimum, include the following:

- Explosive type, product name and size, weight per unit, and density.
- Delay type, sequence, and delay (ms).
- Initiation method (detonating cord, blasting cap, or safety fuse).
- Stemming material and tamping method.
- Hole depth, diameter, and pattern.
- Explosive depth, distribution, and maximum weight per delay.
- Number of holes per delay.
- Distance and orientation to nearest above grade structure and pipeline.
- Procedure for storing handling, transporting, loading, and firing explosives, fire prevention, inspections after each blast, misfires, flyrock and noise prevention, stray-

current accidental-detonation prevention, sign and flagmen, warning signals prior to each blast, notification prior to blasting, and disposal of waste blasting material.

- Seismograph company, name, equipment and sensor location, if required.
- Copies of all required Federal, State, and local permits.
- Blaster's name, company, copy of license, and statement of qualifications.
- Magazine type and locations for explosives and detonating caps.
- Typical rock type and geology structure (solid, layered, or fractured).

3.4. Contractor shall give Company Representative, jurisdictional authorities, and owners or operators of potentially-affected facilities, a minimum advance notice of 48 hours (or as required by Federal, State, county, or local authority) before detonating explosives near existing facilities. Existing facilities may include pipelines, dwellings, structures, overhead or below grade utilities, farm operations, or public crossings.

3.5. At all times, Contractor shall protect workers and the public from any injury or harm potentially arising from drilling (e.g. dust) and/or the use of explosives.

3.6. When working near power, telephone, or fiber optic lines, existing pipeline facilities, structures, water wells, springs, buildings, or where directed by Company, Contractor shall conduct fully Controlled Blasting.

3.7. Flyrock shall be controlled near residences, cottages, highways, railways, utilities, structures and throughout improved woodlots and cultivated lands. Flyrock shall be contained by a combination of blast design, collaring, and matting, including, but not limited to, supplying and installing fabricated mats, over-burden, and sand-pad matting. Flyrock shall not be permitted to leave the right-of-way (ROW).

3.8. Contractor shall maintain an inventory and use-record for all explosives and detonating caps, which shall be reconciled at the end of each working day. The use-record shall include the number of misfires and their disposition. The inventory and use-record shall be available for review by the Company Representative and jurisdictional authority inspection at all times. No explosives or blasting agents shall be abandoned on the ROW. Contractor shall not allow explosive-loaded holes to be left unattended or unprotected. Explosive-loaded holes shall not be staged overnight under any circumstances. Explosives shall be primed only immediately before use.

3.9. Personnel involved in blasting operations shall thoroughly review the **Contractor Environmental/Safety Manual**, the Blasting Plan, and any other attachments or procedures stated herein before commencing any drilling or blasting operations.

3.10. Company Representative shall notify all landowners, residents along the adjacent ROW, and owners of adjacent facilities (pipelines, power lines, buildings, etc.) before blasting operations commence.

3.11. Contractor shall comply with 'One-Call' notification requirements prior to blasting.

3.12. Blasting in or near environmentally-sensitive areas (such as streams and wildlife areas) may include additional restrictions as described in the ROW line list and permit requirements.

3.13. Smoking, firearms, matches, open flames, non-intrinsically safe electronic devices, and heat-and-spark-producing devices shall be prohibited in or near explosive magazines or where explosives are being handled, transported, or used. No explosive material shall be located where it may be exposed to flame, excessive heat, sparks, or impact.

3.14. Contractor shall post warning signs at all points of access to blasting area in conformance with the Blasting Plan.

3.15. Where pipeline route parallels or crosses an electrical transmission corridor, Contractor shall use approved blasting procedures and methods to minimize the potential hazard of induced currents and premature detonation. Contractor may specify using non-electric blasting methods.

3.16. Contractor shall immediately discontinue all operations and move workers to secure positions when worksite is threatened by an electrical storm. Work at the site shall not resume until the storm has passed.

3.17. If loose rock is scattered outside of ROW, Contractor shall commence pick-up and disposal of such rock within 24 hours, to a location approved by Company Representative.

3.18. Contractor shall report the lineal-footage of removed rock to the Company Representative daily. Contractor and Company Representative shall sign and date the report on the day rock is removed.

3.19. Finished ditch in excavated rock shall provide a minimum cover in conformance with 49CFR 192. Finished ditch excavated in solid rock shall have a 6-inch earth or sand padding for pipe to rest on and shall be backfilled with the same material to 6-inches above the top and along both sides of pipe. When required, Contractor shall provide for additional padding at the work location.

3.20. All refuse from dynamite containers and cartridges shall be disposed of as directed by the Company Representative. In no case shall refuse from dynamite containers and cartridges be disposed of in backfill dirt.

3.21. Contractor assumes sole liability for property damage or injuries/fatalities (to people and livestock) caused by blasting operations. When blasting in the proximity of pipelines, buildings, bridges, and other structures or facilities (subject to damage by blasting vibrations), Contractor shall take precautions to minimize stresses caused by ground-transmitted blasting vibrations.

3.22. Contractor shall make necessary arrangements, as required by Company Representative, to prevent damage to any vessels (moored or underway), buildings, or structures and to protect crews or occupants from injury resulting from Contractor's operations.

3.23. Blasting shall be done during daylight hours or as defined in the Blasting Plan.

Table of Contents

1. Scope

This document defines Company requirements and standards for Backfilling, including, but not limited to: Padding Procedures, Rock Removal, Breakers/Trench Plugs, Crossings, and Facility Backfilling. For Projects subject to FERC regulation, additional requirements may apply, and shall supercede the basic requirements contained herein. Refer to **Construction Standard C1260 – Environmental Requirements**, for additional requirements.

2. General Requirements

2.1. Contractor shall notify Company Representative before starting any backfill work. Contractor shall perform all backfilling across drainage ditches, irrigation ditches, terraces, drainage districts, railroads, public highways, private drives, trails or roads, rivers and streams. Work shall be done in conformance with environmental specifications, permit requirements, right-of-way provisions, and all applicable Federal, State, or local regulations.

2.2. The Project Manager shall specify when plastic warning tape shall be installed (24-inches above Company's pipeline) in open-cut road and foreign line crossings.

2.3. Backfilling shall closely follow pipe lowering-in. All backfilling operations shall utilize methods approved by the Company Representative (to minimize damage to pipeline, coating, or adjacent facilities).

2.4. Rock, gravel, or frozen material shall not be backfilled directly onto pipe. Where such materials are encountered, Contractor shall provide earth or sand to form a minimum 6-inch thick pad or cushion above pipe. Portions of ditch shall be left open or backfilled (using selected backfill) to accommodate testing operations and the installation of appurtenances.

2.5. Foreign material (such as containers, welding rod, refuse, timber, stumps, slash, brush, trash, or rubbish) shall not be disposed of in backfill.

2.6. Loose dirt shall be filled into trench and compacted. Remaining backfill material shall be placed over ditch and dressed with a crown as specified in Scope of Work or line list. Topsoil segregated and replaced across cultivated lands shall be free of rock and/or shall meet requirements specified in Scope of Work or line list.

2.7. Contractor shall achieve soil compaction as specified on Construction drawings. Company may require testing to verify soil compaction.

2.8. All ditches and trenches inside station fences shall be compacted during backfill operations. Acceptable compaction methods may include mechanical compaction at 6- to 8-inch lift intervals (while maintaining optimum moisture content for soils), and water packing soils during backfill operation. The Company Representative shall designate compaction method (based upon project-specific requirements, including anticipated vehicle or equipment traffic and personnel access).

2.9. Where trench or excavation has been backfilled with frozen earth, Contractor shall, if initial backfill is not approved by Company Representative, rework and re-dress backfill and right-of-way (ROW) cuts as soon as ground conditions permit.

2.10. ROW cuts shall be backfilled as much as is practical with material removed from the cut and crowned with surplus earth in amounts necessary to compensate for settlement. Earth shall be replaced to restore natural ground contours and normal surface area drainage. In the event backfill depth exceeds 6 feet at any point, dirt shall be deposited in increments not exceeding 3 feet in thickness (loose measure) and each increment shall be compacted over the entire area.

2.11. Where required by the Company Representative, the crown shall be left in a condition that does not interfere with prevailing land use. Remaining topsoil, if any, shall be uniformly spread over ROW or removed, as directed by the Company Representative.

2.12. When specified in the Scope of Work, Contractor shall use a disc, harrow, and/or subsoil tool to break up and scarify hard, underlying soil in the ROW, exercising caution to prevent damaging tile lines. Company Representative shall designate type of tools to be employed.

2.13. Terraces, levees, ditches, and banks shall be restored to their original condition to function as originally intended. Trench breakers shall be installed at terraces where specified by the Company Representative. Backfill shall be solidly compacted at points of trench intersection with terraces and drainage ditches (to prevent erosion).

3. Padding Procedure

3.1. The Company Representative may require padding before or after lowering-in and before backfilling, or both, if backfill material contains rock or other matter injurious to pipeline/equipment coating.

3.2. Backfill material is suitable for padding if stone size is approximately 1-inch or smaller and surrounding earth content is approved for backfill by the Company Representative.

3.3. Contractor shall conduct a thorough inspection before placing any padding to ensure existence of bottom and side clearance. Installing additional support pillows may be required by the Company Representative, particularly at side-bends or sags and over-bends (to prevent pipeline from contacting rock). When pipeline is satisfactorily supported, padding material may be placed directly onto pipe and allowed to pour under pipeline, completing bottom and top padding in one operation. Contractor shall provide under-padding, probing, and compacting as necessary to achieve a firm under-padding completely free of voids. Finished padding surface shall be a minimum of 6-inches above pipe and level across trench.

3.4. With the exception of spoil banks, earth from the ROW shall not be used for padding. Under no circumstances shall topsoil be used for padding. Surplus padding material shall be placed in the trench or removed to a Company-approved disposal site, and shall not be left on the ROW.

3.5. Contractor shall adhere to the following padding procedures:

3.5.1. Before Lowering-In Pipe

3.5.1.1. Padding material shall be:

- Composed of soil, sand, or a combination thereof.
- Free of rock.
- Subject to approval of the Company Representative.
- Secured from sources approved by the Company Representative.

3.5.1.2. Padding under pipe shall be placed across the full trench width to a level of 4-inches below pipe.

3.5.2. After Lowering-In Pipe

3.5.2.1. If specified in the Scope of Work, Contractor shall use mechanical padding machines to maximize use of native backfill material.

3.5.2.2. When the pipe is lowered onto sandbags, closed-cell polyurethane foam, or manufactured plastic support pillows of sufficient size to maintain 6-inches of clearance between pipe, trench bottom, and each side. Pipeline shall be uniformly supported throughout its length at all times. Contractor shall supply hoisting equipment (capable of safely repositioning pipe) and/or pillows as required (to achieve in-trench alignment). Refer to **Construction Drawing CST-P-1000-A290 – Typical Pipeline Support Pillows of Sandbags or Polyurethane Foam**.

3.5.2.3. Installing sandbag and foam pillow supports shall always be followed by padding placement (compacted where necessary) to provide uniform support along the pipe underside. Under no circumstances shall support pillows be used alone as pipe support except for lowering-in.

3.5.2.4. Foam pillow support spacing shall be adjusted within limits specified by the Company Representative. Contractor shall ensure that pillows do not split or compress to below 6-inch minimum clearance under pipe during lowering-in.

3.5.2.5. Padding over pipe shall be placed across the full trench width to a level of 6-inches before backfilling trench.

3.6. Contractor shall leave the pipeline uncovered at cathodic protection test station sites until test wires are attached and coated.

4. Rock Removal

4.1. Unless otherwise directed by the Scope of Work or Company Representative, rock, boulders, or stones shall be disposed of as follows:

4.1.1. Rock or boulders 12-inches or more in diameter shall be disposed of in areas approved by Company Representative.

4.1.2. Rock or stones larger than 1-inch and up to 4-inches in diameter may be disposed of in the partially backfilled trench (ensuring that rock or stone lies a minimum of 6-inches above the lowered pipeline and 1 foot below normal ground surface.

5. Breakers/Trench Plugs

5.1. Contractor shall install sandbag or approved foam trench breakers in the trench and as directed by the Company Representative. Breakers shall be earth-filled sacks as shown on **Construction Drawing CST-P-1260-A200 – Typical Trench Breaker** or polyurethane foam as described below.

5.2. Contractor shall furnish all sacks, foam, or other materials and all labor and equipment necessary to install breakers in trench, under, over, and around pipe (to provide full protection against padding or backfill material washout and changes in natural drainage pattern). Sandbags and or foam plugs shall be used as breakers when directed by the Company Representative.

5.3. Company may specify polyurethane foam for trench breakers. Polyurethane foam shall be an HCFC-based, two-component system, and must be approved for use in the State where work is performed. The foam's base materials shall be mixed and applied in conformance with the Manufacturer's recommendations (so that at least 4 cubic yards can be applied in a single pass without risk of exothermic combustion). Polyurethane foam breakers shall have a minimum density of 2 lb./cu. ft. and closed cell content of 90% or greater.

6. River Crossings and Wetland Areas

6.1. Contractor shall backfill trench to prevent pipe from floating, should the trench become flooded. Where required, wetland areas shall be crossed with concrete-coated pipe or a Company-approved weight system. Refer to **Typical Drawing TYP-P-0100-A220 – Typical Pipeline Set-On Type Concrete Weight**.

6.2. All excavations across streambeds shall be filled to restore streambed to its original contour. Sag bends shall be backfilled first. Backfilling shall be done with particular care to restore natural ground contour and normal area surface drainage.

6.3. Special or specific backfilling requirements shall be completed as specified in the line list or permit condition.

6.4. On high banks of all stream crossings and in other areas where required or requested by the Company Representative, Contractor shall construct cross drains or diversion terraces across and along pipeline route (to prevent erosion of backfill material).

7. Road Crossings

7.1. Contractor is responsible for backfill and restoration work of all roads as required by applicable jurisdictional agencies and the Company Representative.

7.2. Primary Roads shall conform to the following requirements:

7.2.1. For open-cut crossings of primary roads, the excavated trench (across the road between the outside shoulder edges) shall be backfilled as specified by permit requirements and repaired to original condition unless specified otherwise by jurisdictional agencies.

7.2.2. The degree of compaction shall conform to jurisdictional agency requirements. Contractor shall add water to backfill material where necessary to obtain required compaction.

7.2.3. Surfaces of all open-cut paved highways shall be replaced with new paving material (as specified by jurisdictional agencies) or to meet minimum specifications of the surface originally removed. Pavement shall not be cut beyond required trench width. Adjacent roadway and shoulders shall be cleaned of all mud and debris before repaving. All surface courses shall be thoroughly compacted and blended with adjacent roadway to form a uniform surface (free from bumps or depressions) as specified in the permit.

7.2.4. Unless otherwise specified, Contractor shall supply and install all material required as specified above for each open-cut road crossing, including that necessary for trench sloping per regulations. Where required and specified, Contractor shall supply and install sand padding around pipe.

7.3. Secondary Roads shall conform to the following requirements:

7.3.1. For open-cut crossings of secondary roads, excavated trench (across the road between the outside shoulder edges) shall be backfilled as specified by permits and repaired to original condition unless specified otherwise by jurisdictional agencies.

7.3.2. The degree of compaction shall conform to jurisdictional agency requirements. Contractor shall add water to backfill material where necessary to obtain required compaction.

7.3.3. Surfaces of all open cut roadways shall be replaced with new material (as specified by jurisdictional agencies) or to meet minimum specifications of that originally removed. Roadway shall not be cut beyond required trench width. Roadway and shoulders shall be cleaned of all mud and debris. All surface courses shall be thoroughly compacted and blended with adjacent roadway to form a uniform surface (free from bumps or depressions) as specified in the permit.

7.3.4. Unless otherwise specified, Contractor shall supply and install all material required as specified above for each open-cut road crossing, including that necessary for trench sloping per regulations. Where required and specified, Contractor shall supply and install sand padding around pipe.

7.4. Unimproved Roads shall conform to the following requirements:

Unless otherwise specified, natural backfill material shall be used for all unimproved road crossings. While backfill requirements are not stringent at these crossings, backfill material (free of stones and boulders) shall be approved by the Company Representative. Material shall be compacted to ensure that trench area is compatible with adjacent roadway, and free from bumps or depressions. Where required, Contractor shall supply and install granular topping equal to existing road conditions.

7.5. Private Roads

Unless otherwise noted, crossings of private driveways, roadways and access roads shall be repaired according to line list.

8. Facility Backfilling Procedure

Where concrete foundations are installed (tie-ins, mainline valve assemblies, etc.), Contractor shall ensure that all backfill consists of native clay soils or other Company-approved material (free of topsoil, vegetation, debris or other refuse). The uppermost soil cap (3 feet) shall be uniformly placed and compacted in 6- to 8-inch lifts, each compacted to approximate original soil conditions. Finished grade shall establish drainage away from facilities.

Table of Contents

1. Scope

This document defines the Company's requirements for Cleanup, including, but not limited to: Roadways, Parking and Yard Areas, Roadways, Walks, and Fences. For Projects subject to FERC regulation, additional requirements may apply, and shall supercede the basic requirements contained herein.

2. Cleanup - General

2.1. Contractor shall keep all working areas clear and free from daily accumulation of refuse material for the duration of the project. Contractor shall accumulate, segregate, and dispose of all such material in locations approved by the Company Representative.

2.1.1. Contractor's crews shall keep all working areas completely clear and free from refuse and debris resulting from their particular operations and shall immediately dispose of discarded welding rod, pipe trimmings, paint containers or any other similar material.

2.1.2. Open burning of organic material shall only be performed when allowed by permit.

2.1.3. Non-organic material shall not be buried and covered as a means of disposal, except as allowed by permit.

2.1.4. As part of the work, Contractor shall dispose of any excess material, debris, trees, stumps, or vegetation from the right-of-way (ROW) as directed by the Company Representative.

2.1.5. Contractor shall not dispose of anything in any water body.

2.1.6. Contractor shall clean up the construction ROW according to line list and permit requirements. Contractor shall clean up access roads, pipe yards, additional staging areas, warehouse sites, and any adjoining areas used by Contractor.

2.1.7. Clean up work shall begin as soon as practical after backfilling and shall continue until clean up has been completed.

2.2. Subsoil surface preparation shall include leveling subsoil and breaking up any remaining lumps prior to topsoil redistribution. As general cleanup is completed, Construction ROW areas shall be de-compacted and topsoil shall be replaced according to line list or permit requirements.

2.3. In improved and cultivated areas, ROW shall be cleared of stones and rocks greater than 4-inches in any dimension to a depth of 12-inches. Post-cleanup soil condition shall match pre-construction soil condition (where existing fields are cleared of all rock and stones to a smaller size and/or a lower rock-to-soil ratio than lands adjacent to the right-of-way). A mechanical stone rake and/or picker may be used; however, removing stone by hand may also be necessary. Stone removal shall follow tilling.

2.4. In unimproved areas, rock distribution will blend in with adjacent areas.

2.5. Unless directed otherwise by the Company Representative, Contractor shall restore to original profile and condition all roads, hillsides, creek banks, dikes, and other places where earth has been moved to facilitate moving or operating Contractor's equipment. Contractor shall also level and contour piles of extraneous material at Company-approved dumping/ stockpiling locations and blend said material with surrounding environment. Terracing may be required on hillsides when directed by the Company Representative (to prevent construction-related washouts). Refer to **Construction Standard C1100 - Backfilling (Subsection 2.13)**.

2.6. Contractor shall restore all damaged property, including, but not limited to: buildings, fences, hedges, survey monuments, roads, railways, bridges, culverts, drainage ditches, terraces, drainage tile systems, creeks, dikes, and rivers occupied or crossed during construction. Any property damaged in executing the work shall be restored to its original condition (before work commenced).

2.7. Upon work completion, unless approved otherwise by the Company Representative, Contractor shall immediately restore any areas disturbed by Contractor's activities to original condition, including roadways, walks, yard, and gravel areas.

2.8. Contractor shall clean up any and all pollution caused by Contractor in the course of construction.

2.9. Upon completing all backfill and ROW cleanup, Contractor shall make permanent repairs to all fences using either original or equivalent material similar to existing fences.

2.10. Upon completing backfill and cleanup, Contractor shall install pipeline markers at all road, railroad, fence, waterway crossings, major pipeline direction changes and along line of sight where land use permits and in conformance with construction drawings. All pipeline markers, including markers on navigable waterways, shall be installed by Contractor directly over the pipeline according to construction drawings. Refer to **Standard Drawing STD-P-0100-A200 – Standard Pipeline Markers for NGPL, KMTP, & Tejas**, and **Standard Drawing STD-P-0100-A205 – DRV Composite Marker**.

2.11. Contractor shall perform all required re-vegetation and sloping work as described in **Construction Standard C1260 - Environmental Requirements**.

3. Roadways, Parking and Yard Areas – Company Facilities

3.1. All roadways and parking areas previously prepared shall be finished to the final grade. Additional gravel or crushed stone shall be applied to maintain the finished elevation shown on drawings or otherwise specified in the Scope of Work, or as directed by the Company Representative. All roadways and parking areas shall be clearly defined to prevent unnecessary travel on finished yard areas.

3.2. Yard areas shall be thoroughly cleaned of all debris before final landscaping is started. Property outside fence lines shall be returned to the natural state of surrounding terrain. Property within fence lines shall be graded and seeded, covered with gravel/crushed stone, or returned to a natural state as defined on drawings or otherwise specified in the Scope of Work.

4. Crushed Stone Roadways and Walks – Company Facilities

4.1. Contractor shall install and compact crushed stone in layers of 4-inches maximum thickness over previously prepared subgrade.

4.2. Crushed stone shall match existing material or consist of similar or equivalent particles that are reasonably free of soft and unsound material. If stone is being installed on soft subsoil or areas that tend to subside, large crushed rock (3- to 4-inches diameter) shall be used as a base layer as determined by the Company Representative. Crushed stone for roadways shall be Grade 8 and shall conform to the following sieve analysis:

Size Criteria	Percentage
Percent passing 1-inch	100%
Percent passing 1/2-inch	60 to 90%
Percent passing # 4 sieve	40 to 60%
Percent passing # 8 sieve	25 to 50%
Percent passing # 16 sieve	20 to 40%
Percent passing # 200 sieve	5 to 15%

Table C1120 / 4.2 – Crushed Stone Sieve Analysis

4.3. All earth fills required in subgrade shall be made in conformance with the Scope of Work and **Construction Standard C1010 - Clearing, Grading, and Site Preparation**.

4.4. Rock shall be placed and spread in a uniform layer without segregating size, to such loose depth that stone will be 4-inches thick when compacted, or as specified on Construction drawings or the Scope of Work. Roadways and other unobstructed areas shall be compacted in a manner approved by the Company Representative.

4.5. During construction period, Contractor shall maintain a smooth surface on roadways and work areas.

5. Bituminous (Asphalt) Roads

5.1. All work shall conform to Good Construction Practices as adopted by the Asphalt Institute.

5.2. At least 15 workdays before priming and surfacing roads, Contractor shall submit to Company Representative samples of any bituminous materials proposed for use. The Company Representative shall submit the samples to a testing laboratory, which must approve the samples before Contractor may commence priming and surfacing operations.

5.3. Company Representative shall furnish Contractor the mixing formula for binder and surface courses determined by the testing laboratory.

5.4. If specified material is not available within a reasonable distance of the job site, Contractor shall qualify its proposal to reflect a substitution. All substitutions are subject to prior approval of the Company Representative.

5.5. The crushed stone base course shall be graded to conform to the cross section shown on drawings. If insufficient stone is available from pavement edges, additional Grade 8 stone shall be added in low areas. Material shall be compacted until stone no longer creeps ahead of the roller. The compacted base density shall be in excess of 95% of maximum density.

5.6. Contractor shall remove all loose material, dirt, clay, or other foreign material from surface immediately before applying the prime coat.

5.7. Asphalt primer material shall be applied so that uniform distribution is obtained over the entire surface to be treated. Prime coat shall be applied in conformance with Manufacturer's specifications. Asphalt primer shall not be applied when the atmospheric temperature is below 60° F unless pre-approved by the Company Representative.

5.8. Contractor shall deliver and distribute asphalt primer using a Company-approved pressure distributor or other Company-approved means. Asphalt primer shall be MC-30 and shall be applied at the rate of approximately 0.25 to 0.3 gallons per square yard of surface. The surface shall be allowed to dry for not less than 48 hours or such additional time as needed to allow volatiles to evaporate from primer materials.

5.9. Contractor shall keep base clean and as free from traffic as possible before surface course mixture is delivered. Bituminous mixture shall be RC-3000. Mixture shall be delivered at a temperature of 250° F and shall be placed only when weather conditions are dry and favorable. Asphaltic concrete shall be laid in an even surface for a compacted thickness of 2-inches or as specified on Construction drawings or in the Scope of Work.

5.10. Asphaltic concrete surface course shall be laid and rolled in one course in a continuous sheet with a mechanical spreading, tamping, leveling, and finishing machine. While still hot, the surface course shall be uniformly compressed by power-driven tandem or 3-wheeled roller weighing at least 10 tons.

5.11. After compression, final surface shall be smooth and true to the established crown and grade. Joints between finishing machine parallel passes shall provide a proper bond with the new surface mixture.

6. Fences

6.1. Contractor shall close all gaps in hedges with fence as designated in the line list or Scope of Work.

6.2. Contractor shall remove all temporary fencing and dispose of all reclaimed material in a manner and at locations approved by the Company Representative.

6.3. Contractor shall replace all disturbed stiles and/or markers in original fences.

6.4. All fence repairs shall conform to line list and requirements of the Company Representative. Refer to Constuction Drawings **CST-P-1000-A005 – Typical Permanent Barbed Wire Fence**, **CST-P-1000-A010 – Typical Permanent Right of Way Fence Gates**, **CST-P-1000-A015 – Typical Temporary Fence Gate (offset)**, **CST-P-1000-A020 – Typical Fence Cut and Restoration**, and **CST-P-1000-A025 – Typical Permanent Right of Way Double Fence Gate**.

Table of Contents

1. Scope

This document defines Company requirements for Hydrostatic and Pneumatic Pressure Testing of new and existing pipeline as well as facilities piping. These requirements also apply to pre-testing pipe section for pipeline crossings at roadways and waterways. For Projects subject to FERC regulation, additional requirements may apply, and shall supersede the basic requirements contained herein.

2. Pressure Testing Steel Pipe – General

2.1. As specified by the Scope of Work, Contractor shall prepare, and submit for Company approval, a detailed pressure test plan.

2.2. In addition to the requirements of this document, Contractor shall perform pressure testing in conformance with Company **Construction Standard C1135 – Strength and Leak Testing**, and conform to specific requirements defined in **Construction Standard C1260 – Environmental Requirements**. For testing plastic pipe, refer to **Construction Standard C1240 – PE Plastic Pipe Installation**.

2.3. The Company Representative shall review, approve, and be present during all testing operations. The Company Representative shall review and approve proposed deviations to Contractor's test plan and/or pressure test results.

2.4. If the Company applies for permits, the Company shall provide Contractor with a copy of the withdrawal/discharge permit for hydrostatic test water. If Company employs a third-party Contractor to apply for permits, said Contractor shall provide Company with copies of approved permits. Contractor shall keep water withdrawal/discharge permit on site at all times during testing operations.

2.5. Any water obtained or discharged shall comply with permit requirements. Contractor shall not discharge water to any locations other than those approved by permits.

2.6. Contractor shall notify Company of any schedule changes as soon as such changes are known, and not less than 72 hours before commencement of tests.

2.7. Contractor shall provide all labor, equipment, material, services, and supervision to perform complete pressure testing, including, but not limited to:

- High volume pumps capable of filling pipeline with water at a rate that prevents inclusion of air in the test section.
- A variable speed, positive displacement pressure pump capable of pumping and pressuring line to a minimum of 200 psi in excess of maximum specified endpoint test pressure. Pump shall be capable of maintaining a constant and uniform pressurization rate. Pump shall be equipped with a solenoid-type stroke counter or meter to measure the amount of test liquid added during pressuring or removing from pipeline.
- A flow-meter sized to measure maximum test water fill rate. Flow-meter shall be of a type and capacity to measure water volumes to within ±0.5% of Manufacturer's specifications.
- Company approved deadweight (electronic or hydraulic), including back-up unit(s), with individual weights for measuring up to the specified endpoint test pressures in maximum increments of 1 psi.

- Pressure recorders covering a minimum 24-hour range with an 8-inch minimum diameter chart size, 8-inch minimum chart width for strip recorders, or company approved graph. Pressure recorders shall be capable of measuring a 0- to 3,000-psi range (or range designated by the Company Representative). Company may approve use of other Pressure measurement devices/methods at a later date.
- 6-inch minimum diameter Bourdon pressure gauges with marked pressure increments, capable of measuring the full range of specified test pressures.
- Temperature recorders and thermometers covering a minimum 24-hour range and capable of measuring temperatures from 0 to 150° F.
- Electronic temperature measuring devices (i.e., multimeters, digicators, thermoelectric pyrometers, thermocouples, resistance temperature detectors, thermistors, etc.) to attach to the pipeline during hydrostatic testing when required by Company Representative. These devices shall be capable of measuring temperature to the nearest 0.5° F.
- Air compressors capable of propelling cleaning, dewatering, and drying pigs at recommended rates that will clean the pipeline. Compressors shall be capable of overcoming static head pressures during dewatering and transfer operations.
- Strainers/filters for use in the water supply line intake with 100-mesh screen and/or cartridge (to prevent pumping foreign materials into pipeline).
- Test header/receiver designs as pre-approved by the Company Representative.
- Cleaning, filling, and dewatering pigs in conformance to the specifications in the Scope of Work.
- Splash plates and/or energy diffusers for disposal lines. Refer to **Construction Drawing CST-P-1000-A160 – Typical Splash Pup for Test Water Discharge**.
- Temporary piping, fittings, valves, flanges, gaskets, bolts, and all other test apparatus required for temporary water lines for fill and/or disposal.
- Clean water transfer tanks (for flushing and discharging water) which hold water volumes capable of avoiding shut-down of water pumps between water load deliveries.
- Clean tank trucks or vessels to transport source water to the test site (to prevent source water contamination)
- Victaulic / invasion pipe shall not be used for dewatering.

2.7.1. The Environmental Inspector or other Company Representative shall inspect test water for sheen and sediment before it is removed from the trucks.

2.8. When required by the Company Representative or as specified in the Scope of Work, Contractor shall provide an enclosed, lighted, heated, and/or air-conditioned shelter sized to house pressure recorders, approved deadweight (electronic or hydraulic), and test personnel at the data procurement site of each test section (during complete cleaning, filling, pressuring, testing, and water disposing operations). Contractor shall provide Company-approved lighting for otherwise non-illuminated areas with operating compressors, pumps, shelters, and test manifolds connected to pumps or compressors (during all cleaning, filling, pressuring, testing, water disposing, and drying operations).

2.9. During hydrostatic test operations, Contractor shall provide for the safety of the public and all pipeline construction personnel with the following measures:

- Placing warning signs in or near populated areas.
- Restricting access to the immediate hydrostatic test areas (test shelters, manifolds, pressure pumps, instruments, etc.) only to personnel engaged in testing operations. While pipeline facilities are being pressurized and during testing, all personnel not required for test operations (checking for leaks, tightening gaskets, checking valve status, operating pumps, recording data, etc.) shall be restricted from pipeline testing area.
- Prohibiting major pipeline work around pipeline sections being tested when such work is not directly associated with test operations.
- Providing and maintaining reliable transportation and communication systems during test operations whereby all personnel (directly involved in testing) may communicate during testing.
- Checking all hoses, fittings, connectors, and valves for proper pressure rating.

- Restraining and securing fill and discharge lines and hoses.
- When required, informing State and local agencies, and/or people living or working within 100 feet of the pipeline, before starting the test. (Responsibility for notifications remains with Company, though Company may designate Contractor to assist in making notifications when specified in the Scope of Work or required by the Company Representative).
- If required by the Company Representative, conducting inspections of all temporary welds (subject to hydrostatic test pressure) using a Company-approved radiographic Contractor.

2.10. Hydraulic deadweight test equipment shall have been certified for accuracy within the prior 6 months by an independent test lab. Electronic deadweight test equipment shall have been certified for accuracy within the prior 6 months by either the original equipment manufacturer or a test lab authorized by the original equipment manufacturer. Certifications of said test equipment shall be provided to Company Representative a minimum of 72 hours prior to commencing hydrostatic testing operations. Company retains the right to reject use of any equipment that appears subject to improper handling or that is not functioning correctly.

2.11. A 24-hour pressure recorder and pressure gauge shall be manifolded and installed at the shelter (described in paragraph 2.8 (above)), the pressure site, or other areas designated by the Company Representative. At the pressuring site, approved deadweight (electronic or hydraulic) shall be included in the manifold. Manifolds shall be installed so that each instrument may be isolated from other instruments.

2.12. Temperature recorders shall be located at the shelter area (described in paragraph 2.8 (above)), the pressure site, or other areas designated by the Company Representative. Recorders shall be located to avoid effects of ambient temperatures or changes in injection fluid temperature (due of proximity of injection pump).

2.13. Externally mounted temperature bulbs (for pipeline test sections) shall be secured directly to the lower half of exposed pipe and insulated from weather elements before the line is filled with water.

2.14. Unless otherwise specified in the Scope of Work, Contractor shall provide, inspect, repair, and maintain all test heads as outlined below:

2.14.1. Prior to commencing hydrostatic testing operations, the Company Representative and Contractor shall inspect test heads to confirm all components are in good condition and meet working pressure requirements.

2.14.2. Before each hydrostatic test, Contractor shall inspect test heads/manifolds to ensure that no components (including gaskets, O-rings, fittings, and valves) will leak or cause loss of test water and that all components conform to specified safety requirements.

2.14.3. Unless otherwise specified, Contractor shall provide detailed drawings and material specifications (for each test header) to Company Representative for review no less than 72 hours before use.

2.15. Pipeline shall be hydrostatically tested in conformance with **Construction Standard C1135 – Strength and Leak Testing**. Test pressures shall be provided in the Scope of Work or drawings.

2.16. Contractor shall complete all test records, charts, instrument certifications, and related forms. Both Contractor and Company Representative shall sign all test records, charts, instrument certifications, and related forms.

2.17. Contractor shall ensure water used for testing does not freeze.

3. Initial Testing Procedure

3.1. The Company Representative and Contractor shall review and approve test pressure and elevation data before start of test operations. If actual elevations do not match supplied data, test pressures shall be adjusted. In any case, test pressure shall not drop below minimum test pressure nor exceed maximum test pressure specified on the Construction drawings.

3.2. Before start of test operations, Contractor shall submit a Test Plan for review and approval of the Company Representative. The Test Plan shall outline specific procedures for cleaning, filling, testing, dewatering, drying, and tying-in test sections. The Test Plan shall also include:

- Names of Contractor personnel conducting the test
- Testing timetable
- Specific equipment locations
- Water sources and analysis
- Fill points
- Temporary fill line locations
- Discharge points
- Fill and discharge rates
- Test points
- Filtration equipment
- Disposal plan
- Dispersion equipment
- Recording charts
- Reporting forms
- Other equipment to be used for test

3.3. Contractor's work shall not deviate from approved Test Plan and shall conform to minimum requirements of this Document. Upon test completion, test section shall be slowly depressurized with Company-approved dissipation devices.

3.4. Paddle flanges/skillets may only be used if they are stamped with specifications/pressure ratings. Before using blank plates, Contractor shall perform and provide engineering calculations to prove compatibility of plate with test to be performed.

3.5. Contractor shall not test through equipment or against closed valves, unless specifically pre-approved by the Company Representative.

3.6. Under no circumstances shall an alternate water source be used without prior authorization from the Company Representative.

3.7. Prior to any filling operations, the Company Representative shall obtain any required water samples from each source to allow time for lab analysis. Contractor shall contact Company Representative at least one day before obtaining and discharging water. Contractor shall provide Company Representative access to test water for obtaining samples.

3.8. Hydrostatic test water shall be discharged within the same major drainage basin from which it was withdrawn (i.e., no inter-basin disposal shall occur), unless otherwise authorized by permit. Company shall provide or approve discharge locations for hydrostatic test water disposal at various overland discharge locations.

3.9. Staging and manifold areas for filling pipeline (with water) shall be located a minimum of 50 feet from water's edge. If topographic conditions allow, such areas shall also be located 10 feet beyond the high bank (to prevent runoff toward the water body).

3.10. Construction equipment refueling shall be conducted at a minimum distance of 100 feet from any water body unless spill containment countermeasures are in place. Contractor shall install temporary sediment filter devices adjacent to all streams that may encounter runoff. Refer to **Construction Standard C1260 – Environmental Requirements, Sub-Section 9**.

3.11. As defined by Scope of Work, Contractor shall clean pipeline by running Company-approved cleaning pigs (propelled by compressed air). Pigs shall be run completely through pipeline test section. Additional cleaning pig runs shall be repeated as required until cleanliness of the test section is approved by the Company Representative.

3.12. Unless approved otherwise by the Company Representative, Contractor shall run brush pigs and squeegees continuously through the pipeline until all solids, dust and mill scale are removed. After the final brush pig run, foam squeegees shall be run to enhance removal of dust and mill scale. Contractor shall continue to run brush and foam squeegees until cleanliness of the test section is approved by the Company Representative.

3.13. If a cleaning pig becomes lodged in the line, pressure shall not be increased beyond 50 psig unless higher pressures are approved by the Company Representative. If the presence of water is determined to be the cause of stoppage, Company Representative may authorize higher pressures to facilitate water movement. In such cases, Company Representative may require pressure to be released and a dewatering line installed at the downstream receiver, as required by permit. When cleaning pigs cannot be dislodged, Contractor shall:

- Locate lodged pig(s) within the pipeline.
- Obtain Company Representative's approval to remove lodged pig(s).
- Cut out affected section of pipeline.
- Rejoin/repair cut-out section of pipeline.

3.14. Upon completion of the cleaning operation, the temporary launcher and receiver for pigging shall be removed. Pipeline section ends shall be sealed by installing Company-approved hydrotest headers or Company-approved caps supported/braced to ensure safety of testing personnel. Pipeline test section shall be sealed to prevent dust, water, or foreign substances from entering, and to preserve internal pipeline cleanliness until filling and pressure testing operations commence. Contractor shall tie-in cleaned pipeline sections as required to complete test sections and shall exercise care in tie-in operations to maintain internal pipeline cleanliness.

4. Filling the Pipeline

4.1. After final pipe positioning, Contractor shall fill the pipeline with water. Pipe ends shall not be restrained during filling. Before filling a test section with water, Contractor shall make a final check to verify:

- Valve body drain plugs have been removed, carefully cleaned, taped (Teflon), and replaced.
- All valves are in open position.
- Valves have been greased, stroked, and have had the packing tightened.
- All pipe and bolt connections are tight.
- Test manifolds are fabricated and installed in compliance with Construction Drawings.
- Pumps and compressors are in good working condition.
- Instruments are ready for use (proper charts installed, ink pens filled, clocks wound, correct calibration, etc.)
- Pigs are installed.

4.2. Contractor shall monitor each Company-required pressure recorder along with ambient water temperatures during fill operation. These records shall be delivered to Company Representative after completion of pressure test.

4.3. All mainline valves within the fill section must be open for fill pig passage, after which valves shall be closed halfway to fill the body cavity.

4.4. Contractor shall install a connection from pipe test section to body bleed valve on gate valves supplied in the full open position (no gearing) to equalize pressure across valve seat.

4.5. Contractor shall insert fill pig into test head immediately ahead of the water column (to prevent air pockets from forming). The travel rate of fill pigs shall be controlled:

- To prevent acceleration during filling of downhill test section portions.
- To ensure the water column behind the fill pig is not broken during filling operations.

4.6. The fill pig travel rate shall be controlled by maintaining air backpressure on the fill pig (based upon test section elevation profile) to prevent breaking the fill water column (by venting air in test section as fill pig progresses). Contractor is responsible for controlling fill pig velocity and ensuring water fill. Company shall approve pigs and placement in temporary launchers and test headers.

4.7. Fill pumps shall be set in a catch pan (sized to contain all leaking lubricants or fuel and prevent them from entering the water source). When water source is a stream, suction inlet shall be placed in a 100-mesh screened enclosure. Enclosure shall be placed at a depth that prevents air from being drawn in with the water. Enclosure may require a rock-lined sump to prevent intrusion of sediment. Disturbance of the stream channel will require a permit.

4.8. If requested by Company Representative, Contractor shall provide a back-flushing or cartridge-type filter with 100-mesh (or alternate size designated by Company Representative) screen. If a cartridge-type filter is used, additional cartridges shall be kept on hand at filter location (to replace dirty filters). Contractor shall install filter between low head and high fill pumps. Contractor is responsible for keeping the filter back-flush valve closed during filling operations. Contractor is responsible for properly disposing of materials back-flushed from filter or filter cartridges. Contractor shall not back-flush the filter into stream or other water source.

4.9. During pipeline water filling, Contractor shall use fill pumps capable of injecting water into the pipeline at a rate specified in the Scope of Work. Generally, fill rates range from 1400 – 2200 GPM. Contractor shall measure water volumes added to, or removed from, the pipeline.

4.10. Contractor shall increase pressure in the pipeline to maximum fill pump capability. After completion of the filling operation, pipeline water temperature and water turbulence shall be allowed to stabilize. Contractor shall check the pressure on each test section end and compare with calculated pressures to confirm the specified test pressure for the section.

5. Testing the Pipeline

5.1. After completion of the filling operation, Contractor shall install blind flanges and bull plugs on all fill connections not in use.

5.2. Contractor shall perform and record the pressure test in conformance with **Construction Standard C1135 – Strength and Leak Testing**.

5.2.1. Contractor shall maintain radio communications with the Company Representative at Company-designated locations during the test (i.e., road crossings, valve sites, etc.).

5.2.2. Contractor shall perform testing using test durations and pressures specified on Construction Drawings. Contractor shall adjust test pressures for elevation in consideration of grade profiles and approved deadweight (electronic or hydraulic) elevation. Pressure at the lowest elevation shall not exceed maximum allowable test pressure. Pressure at the highest elevation shall not drop below minimum allowable test pressure. Contractor shall limit each test section to a pressure decay of 15 psig or as specified on Construction Drawings.

5.2.3. Contractor shall not test through equipment or against a fully-open or closed valve unless pre-approved by the Company Representative.

5.2.4. Whenever testing at pressures of 50% specified minimum yield stress (SMYS) or higher, Contractor shall make every effort to keep non-test-related personnel off the right-of-way (ROW) and away from test area. Contractor shall check all above grade pipe and fittings for leaks.

5.2.5. When test section is at a pressure of 85% SMYS, Contractor shall maintain a static test pressure for a minimum of 30 minutes. Contractor shall check all above grade pipe and fittings for leaks.

5.2.6. If requested by the Company, Contractor shall produce a pressure-volume plot (where the test pressure will result in a hoop stress in excess of mill test pressure at the low point or exceeding 90% of the SMYS). For practical reasons, yield plots shall not be required on any test section less than 1,000 feet in length. The pressure-volume plot shall be initiated at 85% of SMYS and consist of a graph showing water volume (gallons) added versus pressure (at 10-psi intervals or at intervals sufficient to show any deviation). The graph shall be plotted by hand. The scale for plotting the pressure-volume curve shall be selected to place the plotted data between 45° and 75° from the horizontal. A constant pumping rate shall be maintained during pressurization. Sufficient water shall be provided to complete the plot without stopping until full test pressure is reached.

5.2.7. When test pressure (adjusted for elevation) is reached, Contractor shall shut-in the test section for one hour. For the duration of this one-hour test:

5.2.7.1. Contractor shall record pressure readings from the approved deadweight (electronic or hydraulic) at a minimum of every 10 minutes.

5.2.7.2. Contractor shall not re-pressure the test.

5.2.7.3. Pressure may be bled off so that maximum pressure (adjusted for elevation) is not exceeded. If pressure drops below the minimum during this hour, Contractor shall repair leaks and begin a new hour-long test until pressure is held between the specified limits.

5.2.8. After a successful one-hour shut-in period, Contractor shall re-pressure test section to the required test pressure (adjusted for elevation).

5.2.9. During the following 7 hours, Contractor shall maintain pressure between the maximum and minimum allowable test pressures. Contractor shall record pressure readings from the approved deadweight (electronic or hydraulic) every 30 minutes and before and after each re-pressuring or bleed down period.

5.3. Contractor shall provide all labor and equipment required to locate and repair any leak or rupture, as determined by the Company Representative.

5.4. If a failure occurs in a pipe seam, the entire joint shall be removed from pipeline. For other leaks, Contractor shall mark with a paint stick and remove pipe as a cylinder containing the defective area. The Company Representative shall determine actual pipe length(s) to be removed. Removed piece(s) of pipe shall be marked for orientation (with respect to the pipeline position) and with the alignment sheet station number of the defect location. Contractor shall not cut on or damage the failed pipe edge during removal, transit, or unloading at the Company's designated storage location. All cut-out sections of pipe shall be provided to the Company Representative.

5.5. The Company shall be responsible (to Contractor) for delays, leaks, or failures only when caused by defective Company-supplied material. The Contractor shall be responsible for delays, leaks, or failures caused by, but not limited to, any of the following:

- Girth welds and flanged connections installed by Contractor.
- Construction damage (such as dents and gouges in piping) caused by Contractor.
- Test head malfunction.
- Unavailability or malfunction of Contractor-supplied materials and equipment.
- Labor problems.
- Faulty installation of Company-supplied equipment.
- Performance of any Contractor-supplied pigs.
- Freezing water in the test section, fill lines, or instrument lines.
- Excessive or inadequate test pressures, including those due to temperature changes.
- Malfunctioning valves or other pipeline components (Company-supplied or otherwise) where Contractor could have prevented said malfunctions through timely action (e.g. tightening bolts or other fasteners, replacing gaskets or rubbers, inserting sealant, etc.).
- Contractor's failure to comply with any specification or condition contained in the Scope of Work, drawings, permits or other relevant construction documents.

5.6. Test information shall be entered onto all test charts (for all tests, successful or not) as specified in Company **Construction Standard C1135 – Strength and Leak Testing**. Contractor shall sign pressure/temperature charts or graphs and pressure test reports after successful test completion. At completion of test, all test charts, data logs, and information regarding leaks or breaks shall be delivered to the Company Representative

5.7. Contractor shall prepare a test report for every pressure leak test. Contractor shall also submit the following completed forms to the Company Representative at the completion of tests:

- Field Pressure and Test Report
- Test Section Fill Log
- Test Section Data and Log
- Pressure – Volume Data
- Test Section Plan and Profile Sketch
- Pressure Test Failure Report, when applicable

6. Dewatering the Pipeline

6.1. As soon as possible after Company Representative's test acceptance, Contractor shall reduce pipeline pressure at a limited rate (to avoid development of vibrations). Contractor shall exercise extreme caution throughout depressurizing process. Valves shall be opened and closed slowly to protect assembly from shock loading.

6.2. Prior to beginning any dewatering activities, Contractor shall ensure that all mainline valves have been returned to the full open position.

6.3. Once test section is prepared for dewatering, a squeegee or polyethylene pig shall be run to dewater pipeline. Pigs shall be run as many times as necessary to remove free water as required by the Company Representative.

6.4. If the adjacent test section is to be filled from or through a prior test section, a bleed-down shall be performed into the section to be filled. Contractor shall provide air pressure behind a pig to displace water from test section. Extreme caution shall be used to prevent air lock in the test section to be dewatered.

6.5. Contractor is responsible for disposing of test water in conformance with governing permits or Company requirements. Contractor shall provide and install an energy-absorbing diffuser, as approved by the Company Representative (to prevent erosion, scour, or damage to vegetation).

6.6. Dewatering lines shall be securely supported and tied down at discharge end (to prevent uncontrolled movement during dewatering). Victaulic / invasion pipe shall not be used.

6.7. To reduce discharge velocity, Contractor may use the following energy-dissipating devices:

6.7.1. Splash Pup. Refer to **Construction Drawing CST-P-1000-A160 – Typical Splash Pup for Test Water Discharge**.

6.7.2. Splash Plate. Refer to **Construction Drawing CST-P-1000-A160 – Typical Splash Pup for Test Water Discharge**.

6.7.3. Plastic Liner

6.7.4. Straw Bale Dewatering Structure. Refer to **Construction Drawing CST-P-1000-B170 – Typical Straw Bale Dewatering Structure Large Volume**.

6.7.5. Company-Approved Filter Bags. Refer to **Construction Drawing CST-P-1000-A165 – Typical Geotextile Filter Bag for Dewatering**.

The Company shall make final selection and/or approval of energy-dissipating devices. Contractor shall install devices as specified in water discharge permit. Contractor shall install alternate devices only when pre-approved by the Company Representative.

6.8. When a booster compressor is used to provide compressed air for dewatering, Contractor shall install an after-cooler and scrubber between booster discharge and test head.

6.9. Contractor shall control the system backpressure and discharge volume of the water. Discharge rates shall be followed as specified in governing permits. In addition, the volume discharged shall be controlled to prevent erosion damage at discharge point.

6.10. After test section has been dewatered, all valve body drain plugs shall be removed, carefully cleaned, taped (Teflon), and replaced (after the valve body is drained).

6.11. Contractor shall repair ROW and/or adjacent property damage caused by test section dewatering as directed by Company Representative.

7. Drying

After dewatering is complete, an adequate number of drying pigs shall be run to obtain a dew point of negative 38.5 degrees Fahrenheit or as otherwise required in the project scope of work to meet gas quality specifications. Deviations from this specification shall be discussed and agreed on with the respective Division Director of Operations.

8. Equipment

8.1. Company approved deadweight (electronic or hydraulic) includes:

8.1.1. Deadweight testers with NIST traceable certification

8.1.2. Crystal Engineering © nVision Reference Pressure Recorder with NIST traceable certification

(a) nVision Reference Pressure Recorder configuration requirements

(1) (1) 0-3000 pressure module (3KPSI)

(2) Pressure recorded in PSIG

(3) Maximum logging interval = 30 seconds

(4) Temperature recorded in degrees Fahrenheit

Table of Contents

1. Scope

This document defines Company requirements and standards for Construction of Railway, Highway, and Road Crossings.

2. General

2.1. Railway, highway, and road crossings shall be installed in conformance with Construction drawings and jurisdictional authority requirements. Contractor shall provide all equipment and personnel necessary for installing crossings.

2.2. Contractor is responsible for:

- Moving its vehicles and equipment across railroads, highways, or roads.
- Obtaining permissions from railroad, highway, or road authorities.
- Protecting the public safety.
- Protecting public and private property.

2.3. When moving heavy equipment on or across major highways, Contractor shall provide roadway protection and shall provide flagmen to warn traffic approaching from either direction.

2.4. Contractor shall verify with Company Representative that all necessary approvals have been secured before undertaking any work at railway, highway, or road crossings. In addition, Contractor shall ensure that required notice is given to jurisdictional authorities in conformance with approval or permit conditions.

2.5. Crossing approvals and agreements from various owners and regulatory authorities contain specific construction requirements, methods, and procedures. Unauthorized deviation from specifications on crossing Construction Drawings is not permitted. Contractor shall conduct construction activities only within specified limits of the right-of-way (ROW).

2.6. Before construction commences at any specific crossing, Contractor shall ensure that jurisdictional authorities are given a minimum of 48 hours' notice (or advance notice as specified in applicable permit(s)), which shall not include Saturdays, Sundays, or legal holidays.

2.7. All crossings shall be installed without casing, unless casing is required by jurisdictional authorities. Highway crossings shall be drilled, bored, or open cut as permits allow. Railroad crossings shall be drilled or bored as permits allow.

2.8. If it is determined during construction that adverse conditions render the specified installation method impossible or impractical, Contractor shall inform Company Representative immediately to enable Company to pursue other installation methods and related permits/approvals.

2.9. Trench faces shall be sloped to prevent soil collapse. All such shoring and/or sloping shall be performed in compliance with applicable OSHA regulations and trenching requirements.

2.10. At road crossings (and construction sites near roadways) where workers and equipment are present, legible road warning signs, lights, and flagmen shall caution approaching traffic to reduce speed in conformance with permit requirements. Road barriers shall be installed if required by the Scope of Work, jurisdictional authorities, or the Company Representative.

2.11. Contractor shall grout any failed bore attempts.

2.12. Contractor shall install breakers in conformance with **Construction Drawing CST-P-1260-A200 – Typical Trench Breaker**. If pipeline trench has not been backfilled, the Company Representative may require Contractor to supply and operate water-pumping equipment (of capacity to protect road crossings against washout during inclement weather).

2.13. Installed pipe shall meet depth of cover requirements defined in **Major Design Installation E0100 – Pipelines (Onshore)**, or as required by permit.

2.14. Contractor is responsible to restore road ditches and ROW to original condition. Temporary devices such as culverts, plugs, and barriers shall be removed and disposed of as required by permit, or as directed by Company Representative.

3. Open Cut Crossing

3.1. Contractor shall ensure that traffic flow is maintained for all roads disturbed or otherwise affected by pipeline construction. For roads that are permitted to be closed (road allowances, trails, those encountering little or no traffic, etc.), Contractor shall ensure that required road closure signs and flagmen are posted at crossroads closest to the closures.

3.2. If detour routes are not feasible due to the lack of nearby roads, Contractor shall install a temporary crossing over the trench or construct a temporary bypass (detour ramp/roadway) near the road crossing installation as required by permit.

3.3. The Company Representative and jurisdictional authority shall approve all methods of maintaining traffic flow during road crossing installations. Contractor shall provide or construct all detours and crossing ramps as required, including supplying, hauling in, and installing necessary materials. Contractor shall remove detour ramps as soon as possible after completion of road crossings.

3.4. The pipe section (to be installed at the road crossing) shall be fabricated, inspected, and approved for installation by the Company before Contractor begins cutting the road surface. All fill and surfacing materials required to reinstate the road (following pipe installation) shall be readily available when work begins.

3.5. All roadways shall be restored to normal service as soon as practical, or as required by permit. This includes compacting and restoring road surface to meet road authority requirements. Contractor shall ensure that cleanup and restoration near roads (except seeding and/or sodding) is completed as soon as practical after returning roads to normal service.

4. Uncased Bored Crossing

4.1. Contractor shall supply pilot pipe of the same diameter as carrier pipe. This pipe shall be used solely for boring operations for the duration of the project.

4.2. To facilitate installation, a drilling mud-type lubricant may be used where dry bores are not specified. The use of petroleum-based lubricants is not permitted.

4.3. Upon completion of dry-boring and when pilot pipe has been advanced (the required distance), all boring equipment shall be removed and the carrier pipe shall be temporarily welded to the pilot pipe. Once the bore has been completed, carrier pipe shall be installed immediately unless a delay is approved by the Company Representative. Before removing pilot pipe (for reuse at the next crossing), the entire assembly shall be carefully advanced through the tunnel until carrier pipe is located in the desired position.

4.4. If allowed by permit and soil conditions, pipe may be installed by slick-bore method without use of a pilot pipe. Prior to installing carrier pipe, bore must be cleaned and swabbed.

4.5. Carrier pipe shall be left protruding from trench face to facilitate tie-ins, coating inspection, and assessment.

4.6. Before installing remaining backfill, bore pits shall be backfilled and mechanically compacted or sandbagged up to carrier pipe underside (to ensure that soil settling beneath carrier pipe is minimized) in conformance with **Typical Drawing TYP-P-0100-A035 – Typical Backfill and Pipe Support at Bored Crossings**. Supporting carrier pipe and filling any voids around pipe (resulting from boring operations) shall be performed as further described in this document.

5. Cased Bored Crossing

5.1. Company shall supply coated casing pipe for all steel carrier applications, appurtenances, insulators, and fittings that Contractor will fabricate and assemble.

5.2. Casing segments shall be welded together to the full length. Welded joints shall be coated as specified. Where a cased crossing requires additions to casing pipe during boring operations, Contractor shall exercise extreme care to ensure that straight casing is maintained. Furthermore, Contractor shall supply hoisting equipment to safely support casing during boring operations.

5.3. Full lengths of carrier pipe shall be installed within casing to minimize the number of welds within casing. Casing welds do not require radiographic inspection; however, Company Representative shall visually inspect welds to ensure that they are airtight, have full penetration, and are free from undercuts, overlaps, or abrupt ridges and valleys. Casing girth welds and any rough areas inside pipe shall be ground smooth or repaired as required by Company Representative.

5.4. Carrier pipe shall be left protruding from the casing to facilitate tie-ins, coating inspection, end seal installation, and assessment.

5.5. Casings shall be bored to achieve the required profile and alignment.

5.6. Casing insulators, end seals, and vents shall be installed in conformance with drawings. After inserting carrier pipe into casing but before tie-ins, insulation between casing and carrier pipe shall be checked by Contractor. Any shorts shall be immediately remedied (including having carrier pipe withdrawn, checked, and reinserted) until test readings are approved by the Company Representative.

5.7. Before backfilling, sandbags shall support pipe and casing at both ends of a cased crossing. Sandbag supports shall be capable of carrying pipe and backfill weight without distortion of casing end seals.

5.8. All crossings shall be backfilled immediately following carrier pipe installation, as required by permits and Company Representative. If required by jurisdictional agency or Company Representative, any voids around pipe or casing (resulting from boring operations) shall be filled or grouted.

6. Cased Tunnel Crossing

6.1. Where standard boring procedures are not possible (due to rock or boulders), and open cutting is not permitted, the Company Representative and jurisdictional agency may specifically approve installation of casing pipe by tunneling.

6.2. Company-supplied casing shall be used as a tunnel liner for all excavation (mining) work. At no time shall workers be permitted to enter uncased tunnel. Casing shall be advanced to keep pace with spoil removal and shall be kept within 2 feet of the tunnel face at all times. Air quality shall be monitored and, when required, air shall be supplied to miners per OSHA 'confined space entry' regulations.

6.3. If Company-supplied casing is too small to use as a tunnel liner, Contractor shall supply Company-approved liner of size specified in the Scope of Work or Addendum (to protect workers).

6.4. Upon completion of tunnel and installation of casing, all voids shall be grouted. Contractor shall use a 1:1 cement/sand mix, of which up to 15% of the cement by weight may be fly ash. An air-entraining agent shall be added. Contractor shall exercise care in adding water to produce a stable grout that can be pumped.

6.5. Contractor shall fill tunnel from the ends with sand or stone screenings, deposited in uniform layers not exceeding 6-inches (loose measure) in depth after casing installation. Each layer shall be firmly compacted by ramming or tamping as required by the Company Representative.

7. Rock Boring

Rock boring may be employed as an alternate method for undercrossings. Contractor shall consider requirements for sound rock necessary for successful rock bore crossing. Contractor shall consider crossing-specific requirements when preparing approach and exit pits.

Table of Contents

1. Scope

This document defines Company requirements and standards for construction of Water Crossings, including, but not limited to: Culverts and Flumes, Trenching, Weights, Concrete Coating, Pipe Installation, and Project Scheduling, etc. For Projects subject to FERC regulation and other jurisdictional agencies, additional requirements may apply, and shall supercede the basic requirements contained herein.

2. General Requirements

2.1. Contractor is responsible for installing, maintaining, and removing all access including bridges, flumes, culverts, sandbags, clean rock, or coarse granular material and riprap for temporary crossings. The width of temporary access roads across culverts and flumes and the design of approaches and ramps shall enable access for those vehicles and equipment required on the project. Ramps shall be constructed to prevent collapse of flumes. Approaches on both sides of flumes shall be feathered.

2.2. Contractor shall follow specific requirements provided in **Construction Standard C1260 - Environmental Requirements** in addition to this section.

2.3. Contractor shall not start any work until:

- Company has obtained all required permits and clearances.
- Company Representative specifically authorizes Contractor to proceed.

All equipment and materials shall be on site before trenching is allowed in the active channel. All activities shall proceed immediately and continue until trench is backfilled and stream banks are stabilized.

2.4. Contractor shall make any necessary provisions to ensure that stream flow is maintained at all crossings throughout the construction period. Where the right-of-way (ROW) crosses streams and other bodies of water, the banks shall be stabilized to prevent erosion. Construction on the ROW shall be conducted to minimize damage to shorelines, recreational areas, and fish and wildlife habitats.

2.5. At all crossings, Contractor shall comply with all permit conditions as required by Federal, State, and local maritime jurisdictional authorities (to prevent or minimize obstructions to navigation).

2.6. Unless otherwise specified on the drawings or Scope of Work, Contractor shall maintain a minimum of 4 feet of cover over pipe at the lowest point in the waterway bed, in crossing streams, gullies, creeks, rivers, ditches, and canals.

2.7. Where solid rock is encountered and when said rock is homogeneous in nature (excluding laminated rock or rock interspersed with erodible material), the minimum depth of cover shall be 2 feet (refer to **Typical Drawing TYP-P-0100-A041 – Typical Minor Waterway Crossing**).

2.8. With approval of jurisdictional authorities and the Company Representative, Contractor may install pipeline under levees, drainage and irrigation ditches, or canals by boring.

2.9. All waterway crossings shall be restored to as near original contours as possible. Restoration shall include filling excavation and bank cuts and removing surplus excavated materials from streambeds. Earth replacement adjacent to water crossings shall be at slopes equal to or less than the normal angle of repose for the soil types involved. Sandbagging, seeding, and/or other methods of soil stabilization approved by the Company Representative shall be accomplished without delay.

2.10. Minor water crossings shall be installed either wet or dry depending on seasonal conditions and as directed by permits.

2.11. Water elevations shown on crossing drawings (where available) are subject to fluctuations. Contractor shall prepare to modify the construction technique to compensate for actual water depth at the time of construction. Such modifications of plans shall be presented to the Company Representative for approval before beginning construction of the crossing.

2.12. When required by permit(s), Contractor shall supply, install, and maintain advisory signs at approaches to all watercourse crossing sites. Signs shall be removed upon completion of project.

2.13. Open Cut Crossings

Across streams and rivers, the pipeline shall be laid as nearly level as practical and, where required, the pipe shall be held in place by means of buoyancy control as directed by Construction Drawings. Location of sags and overbends on each side of the crossing shall be approved by the Company Representative.

2.14. Directional Drilled Crossings

Permits may require that installation of water body crossings be conducted by directional drilling. Directional drilled water crossings shall be installed in conformance with **Construction Standard C1160 – Directional Drilling**.

2.15. Levee Crossings

Pipeline crossings of levees adjacent to water crossings shall be designed and installed to avoid damage to the structural integrity or stability of the levees. Contractor shall strictly comply with permit requirements and specifications of jurisdictional authorities.

3. Culverts and Flumes

3.1. Where culverts or flumes are installed across the working area, Contractor is responsible for maintenance (e.g., preventing collapse, clogging, or tilting). Flumes shall extend beyond trench edges (to prevent them from being plugged or blocked due to sloughing). All flumes and culverts shall be removed after construction is completed unless otherwise approved by the Company Representative.

3.2. Contractor shall ensure that culverts and flumes installed are sized to accommodate existing and potential water flow water. Dikes shall conform to stream bottom and bank contours (to ensure a watertight barrier). Contractor shall supply all pipes or conduits, clean granular material, sandbags, and rock riprap for installing flumes and culverts. Gravel pad material may be left in the creek bed for backfill or riprap when directed and approved by the Company Representative.

3.3. Refer to **Construction Drawing CST-P-1000-A335 – Typical Water body Bridge Rockfill & Flume**.

4. Scheduling and Planning

4.1. When construction is necessary during a sensitive period, special procedures and construction methods shall be defined in the permit. Requests for deviations from these procedures must be submitted in writing to the Company Representative with lead-time to allow negotiation with regulatory authorities.

4.2. Contractor shall notify Company Representative in advance of any in-water activity, including access installation and trenching.

4.3. At all watercourse crossings, Contractor shall, before clearing, install temporary stakes along the ROW at least 10 feet from the banks (to ensure that riparian cover is maintained, where practicable, during construction).

4.4. Temporary work space, additional temporary work space areas, and any special restrictions shall be used as designated on the Construction Drawings and defined in the permits. Company shall stake the limits of these areas, and Contractor's work shall be contained within these areas before and during crossing work.

5. Trenching

5.1. Clearing and grading shall be performed on both sides of the watercourse before initiating any trenching work. Except where rock is encountered, all necessary equipment and materials for pipe installation shall be on site and assembled before commencing trenching in a watercourse. All staging areas for materials and equipment shall be located as designated on the drawings and defined in the permits.

5.2. At watercourses sensitive to sedimentation, sediment control devices shall be installed (e.g., silt fences and straw bales installed along the banks to prevent sediment from entering the watercourse). The type and quantity of sediment control devices shall conform to the specifications designated on the Construction Drawings and defined in the permits, and as directed by the Company Representative. Contractor shall supply, install, maintain, and remove these sediment control devices. All in-stream sediment control devices shall be removed upon completion of crossing construction. Refer to **Construction Drawings CST-P-1260-A180.1 – Typical Silt Fence Sediment Barrier Erosion Control**, **CST-P-1260-A180.2 – Typical Silt Fence Sediment Barrier Erosion Control**, **CST-P-1260-A190.1 – Typical Straw Bale Sediment Barrier Erosion Control**, and **CST-P-1260-A190.2 – Typical Straw Bale Sediment Barrier Erosion Control**.

5.3. Under no circumstances shall trench spoil piles be permitted to dam stream flow. Trench spoil shall be stockpiled in conformance with permit requirements.

Earth plugs shall be left in the trench on either side of watercourse until immediately prior to installation of pipe (to prevent sediment from entering the watercourse). Approach trenches shall be excavated before installing wet crossings to preserve as much dry soil as possible.

6. Installing Weights

6.1. Contractor shall install weights as specified on the Construction Drawings. Unless the weights are supplied with a blanket liner, Company-approved rock shield shall be installed under all weights (to prevent damage to the pipe coating). The Company reserves the right to:

- Modify the quantity of weights or rock shield to be installed.
- Change weight locations shown or indicated on the drawings.

Refer to **Typical Drawings TYP-P-0100-A215 – Typical Set-on Type Concrete Weight for 42" O.D. Pipeline** and **TYP-P-0100-A220 – Typical Pipeline Set-on Type Concrete Weight**.

6.2. Contractor shall install weights and/or pipeline anchors to prevent slippage along the pipeline. Contractor shall handle said weights and/or anchors by methods that will prevent injury to personnel, the weights or anchors, or the pipeline proper.

6.3. Rock shield or other Company-approved material shall be installed on pipe under river weights to protect pipe coating from direct contact with weights.

7. Continuous Concrete Coating

7.1. Contractor shall repair damage to concrete coating due to impact or mishandling. Contractor shall repair concrete coating by undercutting edges of damaged areas and building them up to the level of original coating (with a mixture of the same materials and proportions used in original coating). Contractor shall replace any length of concrete-coated pipe that the Company Representative determines to be damaged beyond repair or that fails to meet any other requirements of these standards. Replacement pipe sections shall be of equal length, and coated in conformance with Company standards. When field-applied continuous concrete coating is specified on the Construction drawings, Contractor shall supply concrete (unless specified otherwise on the Construction drawings).

7.2. Continuous concrete coating operations shall comply with the following specifications:

7.2.1. Concrete mix design shall result in a 28-day minimum strength of 3,000 psi. The Company shall take test cylinders and arrange for tests. Sulfate-resisting cement shall be used where alkaline ground water is present.

7.2.2. Coating shall be continuous (e.g., all gaps for support trestles shall be coated with a second application). Cutbacks shall not be concrete coated.

7.2.3. Coating shall be reinforced by a welded wire fabric mesh centered within the concrete thickness. Mesh sizes shall comply with the following table:

Mesh Size	Pipe Size (OD)
4.0" x 4.0" 10 gauge mesh (4x4-W4.0)	20-inch and larger
2.0" x 2.0" 14 gauge mesh (2 layers)	20-inch and larger
2.0" x 2.0" 14 gauge mesh	16-inch and smaller

Table C1150 / 7.2.3 – Continuous Concrete Coating Mesh Sizes

7.2.3.1. If required for reuse, forms may be removed when concrete has cured. Form removal shall be at Contractor's discretion and shall take into account the temperature and curing time, the season and sun exposure, and/or fast drying conditions. Finished concrete shall be wetted down until the line is installed.

7.2.3.2. In cold weather, Contractor shall provide protection and/or heating to maintain the concrete coated sections at a minimum temperature of 40° F while placing concrete and for at least 96 hours thereafter.

7.2.3.3. Repairs shall be performed in conformance with paragraph 7.1 (above).

7.2.3.4. Before moving or handling, minimum curing time (without additives) for concrete coating shall be three days.

7.3. Contractor shall obtain approval of the Company Representative before using any concrete additives or 'Rapid Set' concrete mixes (that reduce minimum curing times).

7.4. To combat attack by sulfates, the type of cement used shall be governed by analysis of water from the river, stream, or lake being crossed as follows:

Sulfate Content	ASTM C150	Portland Cement
0 - 150 ppm	Type I	Normal
150 - 1,000 ppm	Type II	High Early Strength
Over 1,000 ppm	Type III	Sulfate Resisting

Table C1150 / 7.4 – Cement vs. Sulfate Content

7.5. The following tables are based on concrete using normal weight gravel aggregates. If heavy weight aggregates are proposed for special purposes, Contractor shall submit details of the proposed mix for Company approval. Some sample concrete mixes that may be used include:

Rounded Coarse

Aggregate with Sand Type	F.M. #	Water	Cement	Sand	Stone
Fine	2.20-2.60	220 lb.	445 lb.	1,170 lb.	2,170 lb.
Medium	2.60-2.90	220 lb.	445 lb.	1,300 lb.	2,040 lb.
Coarse	2.90-3.20	220 lb.	445 lb.	1,320 lb.	2,060 lb.

Table C1150 / 7.5A – Sample Concrete Mixes – Rounded Coarse

Angular Coarse

Aggregate with Sand Type	F.M. #	Water	Cement	Sand	Stone
Fine	2.20-2.60	240 lb.	485 lb.	1,295 lb.	1,940 lb.
Medium	2.60-2.90	240 lb.	485 lb.	1,360 lb.	1,870 lb.
Coarse	2.90-3.20	240 lb.	485 lb.	1,420 lb.	1,825 lb.

F.M. = Fineness Modulus of Sand

Table C1150 / 7.5B – Sample Concrete Mixes – Angular Coarse

8. Major Water Crossings

8.1. Company shall provide Contractor with a general survey and records of the original slope and bottom contours of the watercourse. Contractor shall perform the work to ensure maximum safety and minimum obstruction to other vessels. Contractor shall comply with all agency regulations and/or other jurisdictional authorities. Contractor shall also comply with the requirements of other on-site utilities in relocating and protecting these utilities.

8.2. Precautions shall be taken to protect against bank erosion during construction. If necessary, cribbing or sheet piles shall be installed. Trench spoil shall be deposited only at designated temporary storage locations (as specified on the Construction drawings) or hauled away as directed by the Company Representative.

8.3. A Company-supplied diver may check the excavated pipe trench to ensure that it is free of obstructions and that it will provide uniform support for the pipe. Contractor shall provide manual assistance in launching and removing diver's equipment from the water. The diver shall confirm that pipe and/or concrete is not damaged, that the pipe has uniform support on the trench bottom, and that the correct alignment and profile has been achieved. Contractor shall perform any additional work or remedial measures to conform to the specified project requirements.

8.4. The pipe shall be pulled into position with sufficient buoyancy control to prevent lateral displacement by currents or nosing of the pipe into the trench bottom.

8.5. The pipeline shall be backfilled with materials approved by the Company Representative. The bottom contours and slope of the watercourse shall be reestablished and banks and slopes restored and re-vegetated as specified in the Construction Drawings or crossing permits.

9. Pipe Installation

9.1. All field welds in submerged crossings shall be visually inspected and tested by radiographic inspection. Pre-testing and continuous concrete coating shall be performed as indicated on the drawings or as directed by the Company Representative.

9.2. Pipe shall be installed as shown on the drawings.

9.3. Contractor shall inspect trench profile to confirm that specified cover and required bottom support has been achieved before the pipe is installed. In rock trench, the ditch shall be padded with clean granular material to provide continuous pipe support.

10. Backfill

10.1. At locations where the excavated native material is not Company-approved for backfill or must be supplemented, Contractor shall provide Company-approved granular material. Stream banks and bottom contour shall be reestablished after pipe installation.

10.2. Top of backfill shall be covered with rock riprap where specified in the Scope of Work. Where sediment control devices are specified, they shall be maintained during backfill operations.

11. Stabilizing Banks and Slopes

11.1. The original contour of watercourse crossings shall be reestablished during cleanup operations. Where necessary, banks shall be stabilized with rock riprap, gabions, stabilizing cribs, or equivalent measures (to protect backfill) before reestablishing vegetation as specified in permit.

11.2. Slopes shall be graded to an acceptable slope for the particular soil type. Surface runoff shall be controlled by slope breakers. Where necessary, slope breaker integrity shall be ensured by lining slope with sod or erosion-control blankets. Slopes on both sides of all water crossings shall be restored and protected.

Table of Contents

1. Scope

This document defines the Company's requirements for Horizontal Directional Drilling (HDD). For Projects subject to FERC regulation, additional requirements may apply, and shall supercede the basic requirements contained herein.

2. General

2.1. Horizontal Directional Drilling shall be performed only by Contractors experienced in, and equipped for, the specified directional drilling crossings. Contractor shall be able to document/demonstrate prior experience with pipe size and terrain similar to present project.

2.2. All work shall be accomplished in strict conformance with:

- All applicable Federal, State, and local codes.
- All jurisdictional regulatory agencies.
- The project Scope of Work.

2.3. Contractor shall comply with all environmental requirements in the Scope of Work and Company-supplied permits. Refer to **Construction Standard C1260 – Environmental Requirements**.

2.4. Prior to mobilization, Contractor shall review the drilling alignment preliminary geotechnical survey, if available, and conduct a site inspection (to determine if further site preparations are required). Contractor shall provide the results of the site inspection to the Company Representative.

2.5. Contractor shall ensure that all supervisors and personnel (involved in **any** directional drilling operations) are experienced in horizontal directional drilling (under the conditions encountered at each crossing). Contractor shall provide all required support needed for the drilling operation (including drilling tools, survey systems, mud cleaning, and disposal, water hauling and other support systems).

2.6. To prevent damaging above grade and below grade facilities, and before drilling operations commence, Contractor shall:

- Contact 'One Call' utility locating service specific to each site.
- Positively locate and stake all existing below grade facilities.
- Modify drilling practices and downhole assemblies.

Contractor is responsible for locating all existing below grade facilities (regardless of Company's previous activities in this regard).

2.7. Company shall provide work space and site access as indicated on the Construction drawings or permits. All activities shall be confined to the work space provided.

2.8. At all times Contractor shall provide for the safety of pipeline construction personnel and the public by:

- Restricting access of the immediate drilling operations area to only those personnel engaged in drilling operations.
- Performing all work in conformance with the Company **Contractor Environmental/Safety Manual**.

2.9. Contractor shall take precautions to maintain/preserve all benchmarks, survey monuments, and any other positioning stations in and around the drill site.

3. Drilling Fluids and Water

3.1. Contractor shall use only benign polymers in composition of drilling fluids. The composition of drilling mud, cement, cement-related additives, and liquid for mixing shall be environmentally safe, approvable by jurisdictional authorities, and pre-approved by the Company Representative.

3.2. Contractor shall maximize recirculation of drilling fluid surface returns. Contractor shall provide solids control and fluid cleaning equipment of a configuration and capacity to process surface returns and produce drilling fluid acceptable for reuse. Company retains the option to specify standards for:

- Equipment performance
- Treating excess drilling fluid and drilled spoil

3.3. The Contractor is responsible for containing, transporting, and disposing of excess drilling fluid in conformance with environmental regulations, right-of way (ROW) and work space agreements, and permit requirements. Disposal of excess drilling fluid shall not be conducted without prior approval of the Company Representative.

3.4. At all times during drilling operations Contractor shall maintain full annular circulation of drilling fluids. Drilling fluid return at locations other than entry and exit points shall be minimized. If annular circulation is lost, Contractor shall take immediate action to restore circulation. In the event of an inadvertent surface return of drilling fluids, Contractor shall take immediate action to contain and collect return fluids in conformance with governing environmental regulations. In the event surface return fluid volumes are present, drilling operations shall be suspended until volumes are contained.

3.5. The Company is responsible for acquiring water withdrawal permits (to procure water for drilling operations) as required by Federal, State, and local jurisdictional agencies. Company will supply Contractor with copies of all required water withdrawal permits. Contractor shall keep water withdrawal permits on-site at all times during drilling operations. Any water obtained shall comply with permit requirements. Note: In some instances, required quantities of water (sufficient to complete drilling operations) may not be available from permitted water sources at the time of drilling. In addition, water withdrawal rates may be limited by the permit. Under no circumstances shall any other water source be used without prior authorization of the Company Representative.

3.6. Contractor is responsible for containing and disposing of all drilling water in conformance with governing permits and/or the line list.

4. Instrumentation

4.1. At all times during drilling operation, Contractor shall provide and maintain instrumentation that will:

- Locate the pilot hole.
- Measure the drill string axial.
- Measure torsional loads.
- Measure drilling fluid discharge pressure and volume.

Contractor shall provide Company Representative access to instrumentation and instrument readings at all times.

4.2. Contractor shall provide all necessary directional drilling equipment, including Company-approved guidance system and readout instrumentation. Contractor shall provide operators experienced in operating the directional drill equipment.

4.3. Contractor shall monitor drill string location at approximately 10-foot intervals using downhole survey instruments. Contractor shall compute positions in the X, Y, and Z axis relative to ground surface. Contractor shall maintain this information and provide same (in a form allowing independent calculation of pilot hole profile) to Company Representative upon request. Coordinate tabulation shall be referenced to the drilled entry point and accurately describe the pilot hole location.

5. Pilot Hole Drill Tolerances

5.1. The pilot hole shall be drilled along the axis shown on the plan and profile drawing in conformance with the following tolerances:

5.1.1. Entry Point Location: Pilot hole shall initially penetrate ground surface at the exact location shown on the drawings and as staked in the field.

5.1.2. Exit Point Location: Pilot hole shall exit ground surface within plus-or-minus 5 feet of the alignment and plus-or-minus 10 feet of the length shown on the drawings and staked in the field.

5.1.3. Elevation - Plus 0.0 feet, minus 10 feet.

5.1.4. Axial – Plus-or-minus 10 feet (except where pilot hole incurs within 10 feet of the ROW limits or any below grade utility or structure).

5.1.5. Curve Radius - Pilot hole shall be drilled with a curve radius no less than that shown on Construction drawings.

5.2. If a pilot hole exceeds these tolerances, deviations shall be subject to approval by the Company. If required, Contractor shall redirect or drill another hole as directed by the Company Representative. If it becomes necessary to abandon the hole, it shall be sealed by installing a full-length grout plug or as specified by the Company Representative.

5.3. Upon completing pilot hole drilling, Contractor shall provide a tabulation of coordinates (referenced to the drilled entry point) that accurately describes pilot hole location, pilot hole entry and exit points, and pilot hole profile, including curvature radii. Contractor shall inspect all tool components and ensure that all tool components are removed from hole. The downhole surveyed data points shall be used to collect this information. Contractor shall further provide an as-built drawing and tabulation (that defines and locates the three-dimensional drilled hole coordinates). The drilled hole shall be straight along its axis with direction changes in gradual curves; sudden reverse curves are not acceptable.

6. Pipe Installation and Pull-Back Operations

6.1. Contractor shall determine the number of reaming passes. Contractor shall minimize vibration during hole-reaming passes using centralizers or stabilizers. After the last reaming pass is completed, Contractor and Company Representative shall assess the hole to determine if swabbing passes shall be made or if the pipe may be pulled.

6.2. Pre-Installation pressure tests shall be performed as specified on construction drawings. Water discharges from pre-installation pressure tests shall be discharged in conformance with State or local permits or as specified in the Scope of Work. Pre-Installation tests do not preclude the requirement for final tests.

6.3. During pull-back, the pull section shall be supported on rollers, and/or with additional equipment, to provide straight entry into the drilled hole. The pipe shall be supported so that it does not touch the ground between support points as it enters the drilled hole. Once Contractor has commenced the pull-back operations, work shall proceed continuously until installation is complete.

6.4. While installing the pull section, Contractor shall inspect 100 percent of the section length for holidays in pipe coating after the last cradle. Any coating damage shall be repaired in conformance with Company standards.

6.5. For pipe less than 20-inches in diameter, tensile loads imposed on the pipeline shall not exceed a load capable of producing stress equal to or greater than 75 percent of the Specified Minimum Yield Strength (SMYS) of any portion of the pipe being pulled. For pipe 20-inches or greater in diameter, tensile loads imposed on the pipeline shall not exceed a load capable of producing stress equal to or greater than 50 percent of the SMYS of any portion of the pipe being pulled. A swivel-type connection shall be used between the reaming assembly and the pull section to minimize torsional stress imposed on the pipeline pull section.

6.6. Elastic bend radius shall be calculated based on stress limitation established by ASME B31.8. Refer to **Major Design Installation E0100 – Pipelines (Onshore), Directional Drilling**. The drilled crossing path shall follow the pilot hole path, but in no case shall the curve radius induce bending stresses greater than that calculated.

6.7. If tie-in welds are necessary during the pull, field joints shall be welded, coated, and inspected in conformance with the Scope of Work. Contractor shall allow time for curing corrosion coatings first, and then allow additional time for curing abrasion coatings.

6.8. Requested modifications to Contractor's pull-back buoyancy procedure shall be reviewed with, and approved by, the Company Representative. Contractor is responsible for any damage to the pull section resulting from errant buoyancy control.

6.9. The pull section shall be installed in the reamed hole to minimize external pressures (to prevent pipe collapse). Upon completing the pull-back, but prior to acceptance, Contractor shall pass a Company-approved electronic caliper pig or sizing plate through the pipeline.

6.10. Contractor shall ensure that all trenched and excavated areas on the work site are backfilled and reclaimed in conformance with permits and the Scope of Work. Only Company-approved materials shall be used for backfill, as per **Construction Standard C1100 - Backfilling**. If banks are disturbed, banks shall be restored to original condition.

Table of Contents

1. Scope

This document defines the Company standards for Environmental Requirements during construction of all Pipelines, Meter Stations, Compressor Stations and Gas Processing and Treating Facilities. For Projects subject to FERC regulation, additional requirements may apply, and shall supercede the basic requirements contained herein.

2. Permit Compliance

Contractor shall perform all construction work in compliance with applicable permits, authorizations, and clearances. Applicable Federal, State, County, or municipal permits shall supercede the requirements contained in this standard.

The Company shall prepare documentation and submit reports as required for compliance with permits and/or FERC requirements.

The Project Manager may designate in the Scope of Work that the Contractor is responsible for obtaining environmental permits or authorizations. Contractor shall provide copies of all permit applications or authorization requests, prior to submitting to agencies, for review by the Environmental, Safety and Health Department.

3. General Best Management Practices (BMP's)

3.1. All construction activities shall be conducted to minimize adverse environmental impacts. Contractor shall conduct all construction activities in an environmentally-sensitive manner in conformance with this standard and in compliance with applicable Federal, State, or local environmental regulations.

The Contractor shall employ construction methods and preventive measures (in all construction and support areas) to control dust generation, soil erosion, siltation of water bodies and wetlands, and spills of fuels, solvents, or other materials. Contractor shall install, inspect, and maintain said preventative measures required for any construction-related activities. Contractor shall comply with all requirements of this standard, which is the **minimum** performance requirement.

3.2. Contractor shall install control structures at locations along the right-of-way (ROW). Contractor shall select the BMP's that provide compliance with applicable environmental requirements. Typical BMP's include:

- Hay bale berms. Refer to Company Construction Drawings **CST-P-1260-A190.1 – Typical Straw Bale Sediment Barrier Erosion Control** and **CST-P-1260-A190.2 – Typical Straw Bale Sediment Barrier Erosion Control**
- Silt fences. Refer to Company Construction Drawings **CST-P-1260-A180.1 – Typical Silt Fence Sediment Barrier Erosion Control** and **CST-P-1260-A180.2 – Typical Silt Fene Sediment Barrier Erosion Control**

- Temporary slope breakers. Refer to CompanyConstruction Drawings **CST-P-1260-A220.1 – Typical Slope Breaker** and **CST-P-1260-A220.2 – Typical Slope Breaker**.
- Sediment logs/waddles. Refer to Company Drawing (to be developed as needed in future)

3.3. Contractor shall install, inspect, and maintain BMP's in conformance with Manufacturer specifications and in compliance with permits, the Scope of Work, and Construction Drawings. Contractor shall install BMP's immediately after initial soil disturbance, and shall maintain BMP's until restoration is completed or such time as the Company authorizes BMP removal. When identified as necessary (e.g., by an inspection) and until BMP's are replaced or restoration is completed, Contractor shall reinstall or modify BMP's as soon as practicable or as required by conditions of permits.

3.4. Unless determined otherwise by the Company Representative, the following spacing requirements shall apply to temporary and permanent slope and trench breakers as minimum requirements for the ROW:

Slope (%)	Spacing (ft)
5 to 15	300
>15 to 30	200
>30	100

Table C1260 / 3.4 – Right-of-Way Slope %

3.5. Permanent Slope Breakers

Refer to Company Construction Drawings **CST-P-1260-A220.1 – Typical Slope Breaker** and **CST-P-1260-A220.2 – Typical Slope Breaker**.

Unless otherwise directed by the Company Representative, or where an area is residential or normally cultivated, Contractor shall install permanent slope breakers at the same minimum spacing as temporary slope breakers.

3.6. Contractor shall install terraces at the base of all slopes adjacent to water bodies, near boundaries between Company-designated wetlands, and adjacent to disturbed upland areas. Contractor shall also install terraces at locations specified by the Company Representative.

3.7. Temporary Trench Plugs

Refer to Company **Construction Drawing CST-P-1150-A275 – Typical Flowing Waterbody Crossing Open Cut Trenced**.

The Company Representative shall determine requirements for, and spacing of, trench plugs. If not specified, Contractor shall leave hard trench plugs (undisturbed soil) on either side of water body crossings and drain tiles. Topsoil shall not be used for trench plugs.

3.8. Trench Breakers

Refer to Company **Construction Drawing CST-P-1260-A200 – Typical Trench Breaker**.

The Company Representative shall determine requirements for, and spacing of, trench breakers.

3.8.1. Trench breakers shall be installed at the same spacing as, and upslope of, terraces and/or permanent slope breakers.

3.8.2. In agricultural fields and residential areas where slope breakers are not typically required, trench breakers shall be installed at the same spacing as if permanent slope breakers were required.

3.8.3. Trench breakers shall be installed at the base of slopes greater than 5% where the base of the slope is less than 50 feet from a water body or wetland.

3.8.4. Trench breakers shall be installed where needed to avoid draining a water body or wetland (to prevent sediment flow into wetlands).

3.8.5. Trench breakers shall not be constructed of topsoil.

3.9. Revegetation (Temporary)

Disturbed areas shall be re-seeded in conformance with Scope of Work, Construction drawings, ROW line list, or permit requirements.

3.10. Revegetation (Permanent)

Disturbed areas shall be re-seeded in conformance with Scope of Work, Construction drawings, ROW line list or permit requirements.

3.11. Mulch

Refer to Company **Construction Drawing CST-P-1260-A215 – Typical Straw Mulch Erosion Control**.

Mulch shall be applied on all slopes (except in actively-cultivated cropland) prior to, concurrent with, or immediately after seeding where necessary to stabilize the soil surface and to reduce wind and water erosion. Asphalt or asphalt-and-resin emulsions shall be applied in conformance with Manufacturer's recommendations. Mulch shall be applied in conformance with Scope of Work, Construction drawings, ROW line list, or permit requirements.

3.12. Jute Thatching or Bonded Fiber Blankets

Jute thatching or bonded fiber blankets may be installed on water body banks (to stabilize seeded areas and other critical areas where the use of mulch and anchoring tools is impractical). Fabric shall be anchored with pegs or staples per Manufacturer's specifications.

3.13. Sediment Basins

Sediment basins shall be constructed in conformance with Scope of Work, Construction drawings, ROW line list, or permit conditions.

3.14. Contractor shall prevent litter, construction debris and construction chemicals that could be exposed to storm water from becoming a pollutant source in storm water discharges.

4. Access Roads

4.1. Unless otherwise specified, access to the ROW shall be from existing, commonly used public roads. The Company Representative shall review and approve any Contractor arrangements to use private roads or undeveloped public roadways as ROW access roads.

4.2. Contractor shall maintain safe and accessible conditions at all road crossings and access points during construction. Contractor shall remove (by periodic sweeping and scraping) all sediment tracked onto public roads as a requirement of work.

4.3. ROW access points at public road crossings shall be subject to local permit conditions and restrictions. If required by the Company Representative or local permit, Contractor shall install crushed stone access pads on either side of the public road at ROW crossings and/or other access road entrances. In residential or active agricultural areas, such stone access pads shall be placed on synthetic fabric (to facilitate stone removal). Refer to Company **Construction Drawing CST-P-1000-A145 – Typical Temporary Paved Road Access Pad**.

4.4. Temporary access roads and final disposition shall be identified in the Scope of Work, Construction drawings, or ROW line list.

5. Upland Construction Activities

5.1. The nominal construction ROW width shall be limited by ROW agreements with landowners, regulatory certificates, and permit or agency requirements. No access or activities are permitted outside ROW limits, Company-approved access roads, or pre-approved staging and work areas.

5.2. The Company Representative shall approve use of any additional areas that are not identified in the Scope of Work, Construction drawings, ROW line list, or permit conditions.

5.3. Topsoil Segregation

Refer to Company Construction Drawings **CST-P-1260-A250 – Typical Full Topsoil Separation Side Hill Construction**, **CST-P-1260-A255 – Typical Topsoil Separation Trench & Spoilside Method**, **CST-P-1260-A260**, **CST-P-1260-A265 – Typical Topsoil Separation Trench Plus 4' Method**, and **CST-P-1260-A270 – Typical Full Topsoil Separation Side Hill Construction Spoilside Travel Lane**.

Topsoil shall be segregated for linear facilities construction or for temporary use areas in actively-cultivated or rotated croplands and pastures, residential areas, hayfields, and other areas when requested by landowners or jurisdictional agencies. Soil segregation shall be in conformance with Scope of Work, agency requirements, ROW line list, or conditions of permits. Salvaged topsoil and subsoil shall be maintained separately throughout all construction activities. Segregated topsoil shall not be used for padding the pipe.

6. Trenching

6.1. Tile lines encountered during trenching operations shall be protected and repaired after trenching. Refer to Company **Construction Drawing CST-P-1000-A305 – Typical Undercrossing of Tile Drainlines**.

6.2. Contractor shall cover open ends of cut tile to prevent the entrance of dirt or animals. Contractor shall immediately mark damaged tile locations using lath with colored ribbon flagging, or with alternate methods approved by the Company Representative. Lath markers shall not be removed except when tile repair crews reopen and repair tiles. Where necessary (to maintain drainage during construction), a temporary pipe bridge or temporary soft trench plugs shall be installed on both sides of the tile.

6.3. Qualified personnel shall test and repair drain tiles. After trenching, Contractor shall probe all drainage tile systems within the disturbed area to check for damage to the tile system. If damage is noted, locations of damage shall be marked as in previous paragraph 6.2 (above).

6.4. Contractor shall perform permanent drain tile repair or replacement (to original or better condition) as required by the Company Representative, landowner, and all applicable jurisdictional agencies.

6.5. Contractor shall make every effort to limit the amount of construction equipment traveling over repaired areas, especially in wet conditions.

6.6. For new pipelines in areas where drain tiles exist (or are planned), Contractor shall ensure that the depth of cover (over the pipeline) avoids interference with drain tile systems. For adjacent pipeline loops in agricultural areas, Contractor shall install new pipeline with at least the same depth of cover as the existing pipeline(s).

6.7. Contractor shall install trench plugs at all water body crossings and drainage tiles, unless directed otherwise by the Company Representative.

6.8. Trench dewater shall be filtered to prevent silt-laden water being discharged into any wetland or water body or in conformance with permit requirements. The filtration system shall be installed on the approved/authorized ROW or within areas approved by the

Company Representative. Refer to Company **Construction Drawing CST-P-1000-A165 – Typical Geotextile Filter Bag for Dewatering**.

7. Water Body Crossings

7.1. Contractor shall install water body crossings in conformance with the Scope of Work, Construction drawings, or permit conditions. Any changes in work areas require pre-approval by the Company Representative.

7.2. Until equipment bridges are installed, Contractor shall limit the number of water body crossings by heavy equipment to one stream or wetland crossing per piece of equipment. For construction across wetlands or other water bodies, Contractor shall comply with permit conditions.

7.3. Contractor shall limit the use of equipment within streams. Only equipment required to complete water crossings or as specified by permit conditions shall be allowed in-stream.

7.4. General work area requirements:

7.4.1. Contractor shall use equipment bridges to cross waterbodies. Refer to Company Construction Drawings **CST-P-1000-A335 – Typical Water Body Bridge Rockfill & Flume**, **CST-P-1000-A340 – Typical Portable Water Body Bridge**, **CST-P-1000-A345**, **CST-P-1000-A350 – Typical Portable Water Body Bridge with Culvert Support**, and **CST-P-1000-A355 – Typical Flexi-Float Water Body Bridge**.

7.4.2. Contractor shall only use extra work areas (such as staging areas and additional spoil storage areas) identified in the Scope of Work or Construction drawings as permit conditions allow.

7.4.3. Contractor shall limit vegetation clearing between extra work areas and edges of water bodies to the Company-authorized construction ROW.

7.4.4. Contractor shall limit the size of extra work areas to no more than is necessary for construction of water body crossings.

7.4.5. Company Representative shall approve extra work areas prior to use.

7.4.6. For wetland or stream crossings, Contractor shall have on site at least one spill kit with equipment and supplies capable of containing releases of fuel, oil, or other substances. At a minimum, the spill kit shall contain plastic sheeting, sorbent material, and spill booms.

7.5. General crossing procedures and requirements:

7.5.1. Contractor shall comply with Section 404, Nationwide Permit Program Terms and Conditions (33 CFR Part 330) or as directed by the Company Representative.

7.5.2. Contractor shall maintain flow rates to protect aquatic life and prevent interruption of existing downstream water use.

7.5.3. Concrete coating activities, and/or the storage of hazardous materials, chemicals, fuels, or lubricating oils, is not allowed within 100 feet of any water body or within any designated municipal watershed area (except at locations designated for these purposes by a jurisdictional agency).

7.5.4. Except when site conditions prevent access, Contractor shall refuel all construction equipment at least 100 feet from any water body). If refueling of construction equipment is required within 100 feet of a water body, Contractor shall comply with the project-specific Spill Prevention and Response Procedure.

7.5.5. Contractor shall place all spoil from water body crossings and upland spoil from major water body crossings in the construction ROW at least 10 feet from the water's edge or in extra work areas designated by the Company Representative. Contractor shall install sediment barriers to prevent spoil from flowing into any water body.

7.5.6. Contractor shall design, install, and maintain equipment bridges to withstand and pass the highest flow rate that could be expected to occur while the bridge is in service. Contractor may not use soil to construct or stabilize equipment bridges. Contractor shall construct equipment bridges using one of the following methods as allowed by permit conditions:

- Equipment pads and culvert(s). Refer to Company **Construction Drawing CST-P-1000-A145 – Typical Temporary Paved Road Access Pad**.
- Equipment pads or railroad car bridges without culverts. Refer to Company **Construction Drawing CST-P-1000-A350 – Typical Timber Mat Water Body Bridge**.
- Clean rock fill and culvert(s). Refer to Company **Construction Drawing CST-P-1000-A335 – Typical Water Body Bridge Rockfill and Flume**.
- Flexi-float or portable bridges. Refer to Company Construction Drawings **CST-P-1000-A340 – Typical Portable Water Body Bridge**, **CST-P-1000-A345 – Typical Portable Water Body Bridge with Culver Support**, and **CST-P-1000-A355 – Typical Flexi-Float Water Body Bridge**.
- When pre-approved by the Company Representative, alternate methods/designs (which achieve the performance objectives specified above) may be used.

7.5.7. Contractor shall maintain equipment bridges to prevent soil from entering the water body.

7.5.8. Unless the Army Corp of Engineers (or its delegated agency) authorizes a bridge as 'permanent', Contractor shall remove equipment bridges as soon as possible after permanent seeding.

7.6. Contractor shall complete water body crossings in conformance with the Scope of Work, associated site-specific drawings or permit conditions. Crossing methods include:

- Dam and pump method. Refer to site-specific Construction drawing.
- Dry-ditch method. Refer to site-specific Construction drawing.
- Flume crossing method. Refer to site-specific Construction drawing.
- Horizontal directional drill method. Refer to site-specific Construction drawing.

7.7. Contractor shall install sediment barriers immediately after disturbing the water body (or adjacent upland) to prevent soil erosion or sedimentation from flowing into the wetland or water body. Sediment barriers shall be maintained throughout construction and reinstalled when necessary (such as after backfilling the trench), until they are replaced by permanent erosion controls and/or adjacent upland areas are completely restored.

7.8. Trench dewater shall be filtered to prevent heavily silt-laden water discharge into any wetland or water body. The filtration system shall be installed on the ROW or within areas approved by the Company Representative. Refer to Company Construction Drawings **CST-P-1000-A165 – Typical Geotextile Filter Bag for Dewatering** and **CST-P-1000-B170 – Typical Straw Bale Dewatering Structure Large Volume**.

7.9. Water body crossing restoration activities shall be completed in conformance with the Scope of Work or site-specific permit conditions.

8. Wetland Crossings

8.1. Contractor shall install wetland crossings in conformance with the Scope of Work, Construction drawings or permit conditions. Company Representative must approve any changes in work areas.

8.2. The Contractor shall implement all construction procedures for water body crossings in the event the wetland crossing is located adjacent to or within a wetland.

8.3. General work area requirements:

8.3.1. Contractor shall only use extra work areas (such as staging areas and additional spoil storage areas) identified in the Scope of Work or Construction drawings as permit conditions allow.

8.3.2. Contractor shall limit vegetation clearing between extra work areas and the wetland edge to the Company-authorized construction ROW.

8.3.3. Contractor may use construction ROW for access only when wetland soil is stabilized to a degree that allows equipment passage without creating ruts. Stabilization of ROW may be accomplished with timber riprap, prefabricated equipment mats, or terra mats.

8.3.4. Contractor shall ensure that all construction equipment other than that necessary to install the wetland crossing shall use access roads located in upland areas. Prior to placement of wetland matting, and where access roads in upland areas do not provide reasonable access, Contractor shall limit all other construction equipment to one pass through the wetland using the construction ROW.

8.3.5. Company Representative shall approve extra work areas prior to use.

8.4. General wetland crossing procedures and requirements:

8.4.1. Contractor shall comply with Section 404, Nationwide Permit Program Terms and Conditions (33 CFR Part 330) or as directed by the Company Representative.

8.4.2. Contractor shall assemble pipeline in an upland area unless the wetland is dry enough to support skids and pipe. Where water and other site conditions allow, Contractor shall use 'push-pull' or 'float' techniques to place the pipe in trench.

8.4.3. Contractor shall minimize the duration of construction-related disturbance within wetlands as allowed by permit.

8.4.4. Contractor shall not store hazardous materials, chemicals, fuels, or lubricating oils in a wetland or within 100 feet of any wetland boundary. Contractor shall not perform concrete coating activities in a wetland or within 100 feet of any wetland boundary.

8.4.5. Except when site conditions prevent access, Contractor shall refuel all construction equipment in upland areas at least 100 feet from a wetland boundary. If refueling of construction equipment is required in a wetland or within 100 feet of any wetland boundary, Contractor shall comply with the project-specific Spill Prevention and Response Procedure.

8.4.6. Contractor shall limit construction equipment operating in wetland areas to that necessary to clear the ROW, dig trench, fabricate and install pipeline, backfill trench and restore ROW. All other construction equipment shall use approved access roads located in upland areas. Where access roads in upland areas do not provide reasonable access, Contractor shall limit all other construction equipment to one pass through the wetland using the ROW.

8.4.7. Contractor shall clear vegetation by cutting it off at the ground level, leaving existing root systems in place. Contractor shall remove cut vegetation from the wetland for disposal.

8.4.8. Contractor shall limit grading activities and removing tree stumps to areas directly over the trench line. Contractor shall not grade or remove stumps or root systems from other wetland areas of the ROW unless the Company Representative determines that safety-related construction constraints require the removal of tree stumps from the working side of the ROW.

8.4.9. Contractor shall segregate the top foot of topsoil from the area disturbed by trenching. In areas with less than 12-inches of topsoil, Contractor shall segregate the entire topsoil layer disturbed by trenching. Soil separation is not required where standing water or soils are saturated or frozen. Immediately after backfilling is completed, Contractor shall restore segregated topsoil to its original location.

8.4.10. In standing water or saturated soils, Contractor shall use low ground-weight construction equipment or operate normal equipment from timber riprap, prefabricated equipment mats, terra mats, or equivalent (to prevent mixing of topsoil and subsoil).

8.4.11. Contractor shall not cut trees outside the construction ROW to obtain timber riprap or equipment mats. Contractor shall use no more than two layers of timber riprap to stabilize ROW.

8.4.12. Contractor shall remove all timber riprap, prefabricated equipment mats, or other material used to support equipment on the construction ROW when restoring to pre-construction conditions.

8.4.13. Contractor shall remove water from the trench to prevent heavily silt-laden water from flowing into any wetland. Contractor shall remove dewatering structures as soon as possible after dewatering activities are completed. Refer to Company Construction Drawings **CST-P-1000-A165 – Typical Geotextile Filter Bag for Dewatering** and **CST-P-1000-B170 – Typical Straw Bale Dewtering Structure Large Volume**.

8.4.14. Contractor shall install sediment barriers across the entire construction ROW immediately upslope of the wetland boundary at all wetland crossings (to prevent sediment flow into adjacent wetlands).

8.4.15. Contractor shall install sediment barriers along the edge of the construction ROW (to prevent sediment flow into adjacent wetlands and contain spoil and sediment within the ROW).

8.4.16. Contractor shall remove all sediment barriers during ROW cleanup.

8.5. Restoration of wetland crossings shall include:

8.5.1. Contractor shall construct trench breakers and/or seal the trench bottom (to maintain the original wetland hydrology).

8.5.2. To avoid transporting sediment into wetlands, Contractor shall install:

- Permanent slope breakers across the construction ROW.
- Trench breakers at the base of slopes greater than 5% where the base of the slope is less than 50 feet from the wetland boundary.
- Trench breakers between wetlands and adjacent disturbed upland area, where required.

In areas adjacent to wetlands, earthen berms may be used as sediment barriers when approved by the Company Representative.

8.5.3. Contractor shall comply with the wetland restoration plan as directed by Company Representative. Contractor shall prevent the introduction or spread of undesirable exotic vegetation.

8.5.4. When final revegetation and stabilization of upland areas are accepted (in conformance with applicable standards) by the Environmental Inspector or Company Representative, the Company (or Contractor, if designated) shall remove all remaining temporary sediment barriers.

9. Hydrostatic Testing

9.1. Contractor shall use water sources and at locations only as permitted in the Scope of Work or as approved by the Company Representative.

9.2. Contractor shall discharge hydrotest water at locations only as permitted in the Scope of Work or as approved by the Company Representative.

9.3. Contractor shall keep the Company Representative informed of testing schedules, so that required notifications to agencies or landowners are completed in compliance with permit conditions.

9.4. Contractor shall notify Company Representative immediately upon a hydrotest failure, so that required notifications to agencies or landowners are completed in compliance with permit or other statutory requirements.

9.5. Contractor shall pre-clean facilities, dispose of waste, and dry facilities in conformance with the Scope of Work and waste regulations.

9.6. The following general requirements shall be met for all hydrotesting projects:

9.6.1. Contractor shall perform radiographic inspection in compliance with **Construction Standard C1070 - Non-Destructive Examination Requirements** before installation under water bodies or wetlands.

9.6.2. If pumps used for hydrostatic testing are located within 100 feet of any water body or wetland, Contractor shall operate and refuel pumps in compliance with the project's Spill Prevention and Response Procedure.

9.6.3. Contractor shall screen the intake hose to prevent entraining fish.

9.6.4. Contractor shall maintain flow rates to protect aquatic life, provide for all water body uses, and provide for downstream water withdrawals by existing users.

9.6.5. Contractor shall locate hydrostatic test manifolds outside wetlands and riparian areas to the maximum extent practicable.

9.7. Contractor shall regulate discharge rates, use energy dissipation devices, and install sediment barriers as necessary to prevent erosion, streambed scour, sediment suspension, or excessive stream flow in compliance with permit conditions. Refer to Company Construction Drawings **CST-P-1260-A180.1 – Typical Silt Fence Sediment Barrier Erosion Control**, **CST-P-1260-A180.2 – Typical Silt Fence Sediment Barrier Erosion Control**, **CST-P-1260-A190.1 – Typical Straw Bale Sediment Barrier Erosion Control** and **CST-P-1260-A190.2 – Typical Straw Bale Sediment Barrier Erosion Control**.

10. Cleanup Procedures

10.1. Contractor shall commence cleanup operations immediately following backfill operations.

10.2. Unless otherwise approved by the Company Representative, Contractor shall complete final cleanup and install permanent erosion control structures within 14 days (10 days in residential areas) after trench is backfilled or construction on surface facilities is completed.

10.2.1. If seasonal or other weather conditions prevent compliance with Cleanup deadlines, all temporary erosion-control structures shall be maintained as originally installed until conditions allow cleanup completion as approved by the Company Representative.

10.3. Contractor shall backfill and regrade to restore final grade (pre-construction contours) and leave soil in condition for planting.

10.4. In agricultural fields and residential areas where slope breakers are not typically required, Contractor shall install trench breakers at the same spacing as if permanent slope breakers were required. If the Company determines that additional trench breakers are required, Contractor shall install breakers as directed.

10.5. Rock excavated from the trench may be used to backfill the trench only to the top of the existing bedrock profile. Rock that is not returned to the trench shall be considered removable construction debris, unless approved for alternate use by the landowner or land managing agency.

10.6. Segregated topsoil shall not be used to pad the pipeline.

10.7. Contractor shall de-compact subsoil and topsoil as identified in the Scope of Work, Construction drawings, or ROW line list. Contractor shall test for de-compaction in conformance with permit conditions or landowner request.

10.8. Contractor shall remove excess rock from at least the top 12-inches of soil in all actively cultivated or rotated cropland and pastures, hayfields, residential areas, and in other areas at the landowner's request.

10.9. Geomorphic features such as embankments, terraces, and slopes shall be restored. BMP's shall be used to stabilize streambeds and banks, natural drainage ways, and steep grades in conformance with permit requirements.

10.10. Contractor shall construct and maintain permanent slope breakers in all areas except cultivated areas and lawns using the spacing recommendations in <u>Table C1260 / 3.4</u> (above).

10.10.1. If a local soil conservation authority or land-managing agency requires additional slope breakers, Contractor shall install additional slope breakers as directed.

10.11. Contractor shall mulch all slopes adjacent to wetlands and waterbodies with 3 tons per acre of weed-free hay or straw for a minimum of 10 feet on either side of the wetland or water body.

10.12. Contractor shall leave a travel lane open along the ROW to allow construction traffic access. The travel lane shall be restored when access to the ROW is no longer required for construction or revegetation.

10.13. Contractor shall collect all trash, litter, and foreign debris for disposal as directed by Company Representative and in conformance with State and local regulations. Trash, litter, and construction material debris shall **not** be discarded in the trench or along the ROW.

10.14. Contractor shall repair all structures, fences, hedges, buildings, and/or other property damaged during construction as required by the landowner and/or Company Representative. Contractor shall **immediately** repair all damage incurred during construction when such repair is too urgent to be relegated to a cleanup crew.

10.15. Contractor shall install permanent slope breakers (terraces) along the ROW where requested by the Company Representative, specified in this Section, or in conformance with the Scope of Work. Concentrations of surface flow shall be diverted to stabilized outlets using slope breakers with a 2% to 8% outslope directed toward energy-dissipating devices located off the ROW. Refer to Company Construction Drawings **<u>CST-P-1260-A220.1 – Typical Slope Breaker</u>** and **<u>CST-P-1260-A220.2 – Typical Slope Breaker</u>**.

11. Revegetation

11.1. Contractor shall perform revegetation activities in conformance with the Scope of Work, Construction drawings, ROW line list, or permit conditions, including:

- Fertilize and amend areas
- Prepare seedbed
- Seed with specified seed mixtures
- Install mulch or temporary cover
- Remove temporary erosion control structures where revegetation is accepted by the Company Representative

11.2. Contractor shall perform seeding in all areas except actively-cultivated croplands and surface facilities as directed by the Company Representative.

11.3. Contractor shall continue using temporary erosion-control measures, if seeding cannot be done within recommended seeding dates as directed by Company Representative.

11.4. Contractor shall mulch all slopes (except in actively-cultivated cropland) concurrently or immediately after seeding (where necessary to stabilize the soil surface and to reduce wind and water erosion).

11.4.1. Contractor shall mulch before seeding if:

- Final grading and installation of permanent erosion-control measures will not be completed within 14 days after the trench in that area is backfilled (10 days in residential areas)
- Construction or restoration activity is interrupted for extended periods (e.g. when seeding cannot be completed due to seeding period restrictions)

11.4.2. Jute thatching or bonded fiber blankets shall be accepted as alternatives to straw mulch. Biodegradable erosion control fabric shall be used on water body banks to stabilize seeded areas and other sensitive areas (where using mulch and anchoring tools is impractical).

11.5. Contractor shall install and maintain vehicle control measures as directed by the Company Representative. These measures may include, but are not limited to:

- Signs
- Fences with locking gates
- Slash and timber barriers, pipe barriers, or line of boulders across the ROW
- Conifers or other specified trees or shrubs planted across the ROW

APPENDIX E – Connecticut Drainage Manual Excerpts

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6.9 Rational Method

6.9.1 Introduction

The rational method is recommended for estimating the design storm peak runoff for areas as large as 81 ha (200 ac). This method, while first introduced in 1889, is still used in many engineering offices in the United States. Even though it has frequently come under criticism for its simplistic approach, no other drainage design method has received such widespread use.

6.9.2 Application

Some precautions should be considered when applying the rational method.

- The first step in applying the rational method is to obtain a good topographic map and define the boundaries of the drainage area in question. A field inspection of the area should also be made to determine if the natural drainage divides have been altered.
- In determining the runoff coefficient C value for the drainage area, thought should be given to future changes in land use that might occur during the service life of the proposed facility that could result in an inadequate drainage system.
- The charts, graphs and tables included in this section are not intended to replace reasonable and prudent engineering judgment which should permeate each step in the design process.

6.9.3 Characteristics

Characteristics of the rational method which limit its use to 81 ha (200 ac) include:

(1) The rate of runoff resulting from any rainfall intensity is a maximum when the rainfall intensity lasts as long or longer than the time of concentration. That is, the entire drainage area does not contribute to the peak discharge until the time of concentration has elapsed.

This assumption limits the size of the drainage basin that can be evaluated by the rational method. For large drainage areas, the time of concentration can be so large that constant rainfall intensities for such long periods do not occur and shorter more intense rainfalls can produce larger peak flows. For this reason, the rational method is inappropriate for watersheds greater than about 81 ha (200 ac).

(2) The frequency of peak discharges is the same as that of the rainfall intensity for the given time of concentration.

Frequencies of peak discharges depend on rainfall frequencies, antecedent moisture conditions in the watershed, and the response characteristics of the drainage system. For small and largely impervious areas, rainfall frequency is the dominant factor. For larger drainage basins, the response characteristics control. For drainage areas with few impervious surfaces (less urban development), antecedent moisture conditions usually govern, especially for rainfall events with a return period of 10 years or less.

(3) The fraction of rainfall that becomes runoff (C) is independent of rainfall intensity or volume.

The assumption is reasonable for impervious areas, such as streets, rooftops and parking lots. For pervious areas, the fraction of runoff varies with rainfall intensity and the accumulated volume of rainfall. Thus, the art necessary for application of the rational method involves the selection of a coefficient that is appropriate for the storm, soil and land use conditions. Many guidelines and tables have been established, but seldom, if ever, have they been supported with empirical evidence.

(4) The peak rate of runoff is sufficient information for the design.

Modern drainage practice often includes detention of urban storm runoff to reduce the peak rate of runoff downstream. With only the peak rate of runoff, the rational method severely limits the evaluation of design alternatives available in urban and in some instances, rural drainage design.

6.9.4 Equation

The rational formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area, runoff coefficient and mean rainfall intensity for a duration equal to the time of concentration (the time required for water to flow from the most remote point of the basin to the location being analyzed). The rational formula is expressed as follows:

$$Q = 0.00278\ CIA \qquad (Q = CIA) \tag{6.1}$$

where: Q = maximum rate of runoff, m^3/s (ft^3/s)
C = runoff coefficient representing a ratio of runoff to rainfall
I = average rainfall intensity for a duration equal to the time of concentration, for a selected return period, mm/h (in/h)
A = drainage area tributary to the design location, ha (acres)

6.9.5 Infrequent Storm

The runoff coefficients given in Tables 6-3 through 6-5 are applicable for storms of 2-year to 10-year frequencies. Less frequent, higher intensity storms will require modification of the runoff coefficient because infiltration and other losses have a proportionally smaller effect on runoff (Wright-McLaughlin 1969). The adjustment of the rational method for use with major storms can be made by multiplying the right side of the rational formula by a frequency factor C_f. The rational formula now becomes:

$$Q = 0.00278\ CC_fIA \qquad (Q = CC_fIA) \tag{6.2}$$

C_f values are listed in Table 6-2. The product of C_f times C shall not exceed 1.0.

Table 6-2 Frequency Factors For Rational Formula

Recurrence Interval (years)	C_f
25	1.1
50	1.2
100	1.25

6.9.6 Procedures

The results of using the rational formula to estimate peak discharges are very sensitive to the parameters that are used. The designer must use good engineering judgment in estimating values that are used in the method. Following is a discussion of the different variables used in the rational method.

Time Of Concentration

The time of concentration is the time required for water to flow from the hydraulically most remote point of the drainage area to the point under investigation. Use of the rational formula requires the time of concentration (t_c) for each design point within the drainage basin. The duration of rainfall is then set equal to the time of concentration and is used to estimate the design average rainfall intensity (I).

Appendix C (Travel Time Estimation) at the end of this chapter describes the method based on the NRCS Technical Release No. 55 (2nd Edition). This method shall be used for the rational method. Note: under certain circumstances, where tributary areas are very small or completely paved, the computed time of concentration would be very short. For design purposes the minimum time of concentration for paved areas shall be 5 minutes and 10 minutes for grassed areas.

Common Errors

Two common errors should be avoided when calculating t_c. First, in some cases runoff from a portion of the drainage area which is highly impervious may result in a greater peak discharge than would occur if the entire area were considered. In these cases, adjustments can be made to the drainage area by disregarding those areas where flow time is too slow to add to the peak discharge. Sometimes it is necessary to estimate several different times of concentration to determine the design flow that is critical for a particular application.

Second, when designing a drainage system, the overland flow path is not necessarily perpendicular to the contours shown on available mapping. Often the land will be graded and swales will intercept the natural contour and conduct the water to the streets which reduces the time of concentration.

Rainfall Intensity

The rainfall intensity (I) is the average rainfall rate mm/h (in/h) for a duration equal to the time of concentration for a selected return period. Once a particular return period has been selected for design and a time of concentration calculated for the drainage area, the rainfall intensity can be determined from Rainfall-Intensity-Duration curves. The rainfall intensity can be determined from rainfall-intensity-duration Table B-2 which can be found in Appendix B.

Runoff Coefficient

The runoff coefficient C is the variable of the rational method least susceptible to precise determination and requires judgment and understanding on the part of the designer. While engineering judgment will always be required in the selection of runoff coefficients, a typical coefficient represents the integrated effects of many drainage basin parameters, the following discussion considers only the effects of soil groups, land use and average land slope.

Methods for determining the runoff coefficient are presented based on hydrologic soil groups and land slope (Table 6-3), land use (Table 6-4) and a composite coefficient for complex watersheds (Table 6-5).

Table 6-3 gives the recommended coefficient C of runoff for pervious surfaces by selected hydrologic soil groupings and slope ranges. From this table the C values for non-urban areas such as forest land, agricultural land, and open space can be determined. Soil properties influence the relationship between runoff and rainfall since soils have differing rates of infiltration. Infiltration is the movement of water through the soil surface into the soil. Based on infiltration rates, the NRCS has divided soils into four hydrologic soil groups as follows:

Group A Soils having a low runoff potential due to high infiltration rates. These soils consist primarily of deep, well drained sands and gravels.

Group B Soils having a moderately low runoff potential due to moderate infiltration rates. These soils consist primarily of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

Group C Soils having a moderately high runoff potential due to slow infiltration rates. These soils consist primarily of soils in which a layer exists near the surface that impedes the downward movement of water or soils with moderately fine to fine texture.

Group D Soils having a high runoff potential due to very slow infiltration rates. These soils consist primarily of clays with high swelling potential, soils with permanently high water tables, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious parent material.

The NRCS has developed detailed soil surveys for all counties within Connecticut. From these documents, the designer can determine the nature and relative percentages of the soils within a given watershed. It is important to note that the level of effort required in the determination of soil types is commensurate with the size of the watershed and the design objectives. Normally, in the computation of discharge quantities for gutter flow analysis and related storm drainage design, a detailed evaluation of soil types is not necessary, as contributing areas adjoining highways are usually relatively small. However, in the design of cross culverts, channels or interceptor ditches the determination of soil types will provide valuable assistance to the design engineer in the evaluation of the runoff potential from a particular watershed.

The second factor for consideration in the determination of a runoff coefficient is land use. As unimproved areas are developed, the potential for increased runoff becomes greater due to the loss of vegetative cover, the reduction in retention by surface depressions and the increase in impervious surface area. Table 6-4 lists recommended ranges for the runoff coefficient value classified with respect to the general character of the tributary area. **The potential for future watershed development should be considered by the designer.**

The final element to be factored into the determination of runoff coefficients is the land slope. As the slope of the drainage basin increases, the selected C value should also increase. This is caused by the fact that as the slope of the drainage area increases, the velocity of overland and channel flow will increase allowing less opportunity for water to infiltrate the ground surface. Thus, more of the rainfall will become runoff from the drainage area.

In summary, it should be reiterated that in assigning a value to the runoff coefficient for use in the rational method, the engineer must rely heavily on experience and judgement.

Table 6-3 Recommended Coefficient Of Runoff For Pervious Surfaces By Selected Hydrologic Soil Groupings And Slope Ranges

Slope	A	B	C	D
Flat (0 - 1%)	0.04-0.09	0.07-0.12	0.11-0.16	0.15-0.20
Average (2 - 6%)	0.09-0.14	0.12-0.17	0.16-0.21	0.20-0.25
Steep (Over 6%)	0.13-0.18	0.18-0.24	0.23-0.31	0.28-0.38

Source: Storm Drainage Design Manual, Erie and Niagara Counties Regional Planning Board.

Table 6-4 Recommended Coefficient Of Runoff Values For Various Selected Land Uses

Description of Area		Runoff Coefficients
Business: Downtown areas		0.70-0.95
Neighborhood areas		0.50-0.70
Residential:	Single-family areas	0.30-0.50
	Multi units, detached	0.40-0.60
	Multi units, attached	0.60-0.75
	Suburban	0.25-0.40
Residential (0.5 ha (1.2 ac) lots or more)		0.30-0.45
Apartment dwelling areas		0.50-0.70
Industrial:	Light areas	0.50-0.80
	Heavy areas	0.60-0.90
Parks, cemeteries		0.10-0.25
Playgrounds		0.20-0.40
Railroad yard areas		0.20-0.40
Unimproved areas		0.10-0.30

Table 6-5 Coefficients For Composite Runoff Analysis

Surface		Runoff Coefficients
Street:	Asphalt	0.70-0.95
	Concrete	0.80-0.95
Drives and walks		0.75-0.85
Roofs		0.75-0.95

Appendix B - Rainfall

RAINFALL – DURATION – FREQUENCY RELATIONSHIPS FOR CONNECTICUT

DURATION	RETURN FREQUENCY (Years)					
	2	**5**	**10**	**25**	**50**	**100**
Min	RAINFALL IN MM (INCHES)					
5	9.1(0.36)	11.4(0.45)	13.0(0.51)	15.2(0.60)	17.2(0.67)	18.5(0.73)
15	18.3(0.72)	22.6(0.89)	25.9(1.02)	30.5(1.20)	34.0(1.34)	37.6(1.48)
60	33.0(1.3)	43.2(1.7)	50.8(2.00)	58.4(2.30)	65.3(2.57)	71.1(2.80)
Hrs						
2	40.6(1.60)	54.6(2.15)	63.5(2.50)	72.4(2.85)	82.6(3.25)	91.4(3.60)
3	44.5(1.75)	61.0(2.40)	69.9(2.75)	82.6(3.25)	90.2(3.55)	101.6(4.00)
6	59.7(2.35)	74.9(2.95)	87.6(3.45)	101.6(4.00)	115.6(4.55)	127.0(5.00)
12	69.9(2.75)	90.2(3.55)	101.6(4.00)	123.2(4.85)	135.9(5.35)	152.4(6.00)
24	82.6(3.25)	106.7(4.20)	125.7(4.95)	146.1(5.75)	161.3(6.35)	177.8(7.00)
	24 HOUR RAINFALL BY COUNTY					
Fairfield	83.8(3.3)	109.2(4.3)	127.0(5.0)	144.8(5.7)	162.6(6.4)	182.9(7.2)
Hartford	81.3(3.2)	104.1(4.1)	119.4(4.7)	139.7(5.5)	157.5(6.2)	175.3(6.9)
Litchfield	81.3(3.2)	104.1(4.1)	119.4(4.7)	139.7(5.5)	157.5(6.2)	177.8(7.0)
Middlesex	83.8(3.3)	106.7(4.2)	127.0(5.0)	142.2(5.6)	160.0(6.3)	180.3(7.1)
New Haven	83.8(3.3)	106.7(4.2)	127.0(5.0)	142.2(5.6)	160.0(6.3)	180.3(7.1)
New London	86.4(3.4)	109.2(4.3)	127.0(5.0)	144.8(5.7)	160.0(6.3)	180.3(7.1)
Tolland	81.3(3.2)	104.1(4.1)	121.9(4.8)	139.7(5.5)	157.5(6.2)	175.3(6.9)
Windham	81.3(3.2)	106.7(4.2)	121.9(4.8)	139.7(5.5)	157.5(6.2)	175.3(6.9)

Sources:

1. "Rainfall Frequency Atlas of the United States", Technical Paper No. 40, U.S. Department of Commerce, Weather Bureau.
2. NOAA Technical Memorandum "NWS Hydro-35", June 1977, U.S. Department of Commerce, National Weather Service.

Table B-1

DURATION (min)	DURATION (hr)	RAINFALL INTENSITY (mm/hr)					
		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
5	0.08	117	139	153	171	185	197
6	0.10	112	133	147	165	178	190
7	0.12	107	127	141	158	172	184
8	0.13	101	122	134	152	165	177
9	0.15	96	116	128	145	159	171
10	0.17	91	110	122	139	152	164
11	0.18	87	106	118	135	147	159
12	0.20	83	102	114	130	143	155
13	0.22	80	98	109	126	138	150
14	0.23	76	94	105	121	134	146
15	0.25	72	90	101	117	129	141
16	0.27	70	88	99	115	127	138
17	0.28	69	86	97	113	124	136
18	0.30	67	84	95	110	122	133
19	0.32	66	83	93	108	120	131
20	0.33	64	81	91	106	117	128
21	0.35	63	79	89	104	115	126
22	0.37	61	77	87	102	113	123
23	0.38	60	75	85	99	110	121
24	0.40	58	73	83	97	108	118
25	0.42	57	71	81	95	106	116
26	0.43	55	69	79	93	103	113
27	0.45	54	68	77	91	101	111
28	0.47	52	66	75	88	99	108
29	0.48	51	64	73	86	96	106
30	0.50	49	62	71	84	94	103

(I-D-F Curve Generation for Latitude 41° 35' – Longitude 72° 42')
Rainfall Intensity/Duration/Frequency Relationships for Connecticut (Metric Units)
Table B-2

Source: Young, G.K., et al., Hydrain-Integrated Drainage Design Computer System: Version 6.0, Volume II-Hydro, Federal Highway Administration Report No. FHWA-SA-96-064, 1996

DURATION (min)	DURATION (hr)	RAINFALL INTENSITY (mm/hr) 2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
31	0.52	48	61	70	83	93	102
32	0.53	48	60	69	82	92	101
33	0.55	47	60	69	81	91	100
34	0.57	46	59	68	80	90	98
35	0.58	46	58	67	79	89	97
36	0.60	45	57	66	78	87	96
37	0.62	45	57	65	77	86	95
38	0.63	44	56	64	76	85	94
39	0.65	43	55	64	75	84	93
40	0.67	43	54	63	74	83	91
41	0.68	42	54	62	73	82	90
42	0.70	41	53	61	72	81	89
43	0.72	41	52	60	71	80	88
44	0.73	40	51	59	70	79	87
45	0.75	40	51	59	70	78	85
46	0.77	39	50	58	69	76	84
47	0.78	38	49	57	68	75	83
48	0.80	38	48	56	67	74	82
49	0.82	37	47	55	66	73	81
50	0.83	36	47	54	65	72	80
51	0.85	36	46	54	64	71	78
52	0.87	35	45	53	63	70	77
53	0.88	34	44	52	62	69	76
54	0.90	34	44	51	61	68	75
55	0.92	33	43	50	60	67	74
56	0.93	33	42	49	59	65	73
57	0.95	32	41	49	58	64	71
58	0.97	31	41	48	57	63	70
59	0.98	31	40	47	56	62	69
60	1.00	30	39	46	55	61	68

Rainfall Intensity/Duration/Frequency Relationships for Connecticut (Metric Units)
Table B-2 continued

DURATION (min)	DURATION (hr)	RAINFALL INTENSITY (mm/hr)					
		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
61	1.02	30	39	46	55	61	68
62	1.03	30	38	45	54	60	67
63	1.05	29	38	45	54	59	66
64	1.07	29	38	44	53	59	66
65	1.08	29	37	44	53	58	65
66	1.10	28	37	44	52	58	65
67	1.12	28	37	43	52	57	64
68	1.13	28	36	43	51	57	63
69	1.15	28	36	43	51	56	63
70	1.17	28	36	42	50	56	62
71	1.18	27	35	42	50	55	62
72	1.20	27	35	41	50	55	61
73	1.22	27	35	41	49	55	61
74	1.23	27	35	41	49	54	60
75	1.25	26	34	40	48	54	60
76	1.27	26	34	40	48	53	59
77	1.28	26	34	40	48	53	59
78	1.30	26	34	40	47	52	58
79	1.32	26	33	39	47	52	58
80	1.33	25	33	39	47	52	58
81	1.35	25	33	39	46	51	57
82	1.37	25	32	38	46	51	57
83	1.38	25	32	38	45	50	56
84	1.40	25	32	38	45	50	56
85	1.42	24	32	37	45	50	55
86	1.43	24	32	37	44	49	55
87	1.45	24	31	37	44	49	55
88	1.47	24	31	37	44	49	54
89	1.48	24	31	36	43	48	54
90	1.50	24	31	36	43	48	53

Rainfall Intensity/Duration/Frequency Relationships for Connecticut (Metric Units)
Table B-2 continued

DURATION (min)	DURATION (hr)	RAINFALL INTENSITY (mm/hr)					
		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
91	1.52	23	30	36	43	48	53
92	1.53	23	30	36	43	47	53
93	1.55	23	30	35	42	47	52
94	1.57	23	30	35	42	47	52
95	1.58	23	30	35	42	46	52
96	1.60	23	29	35	41	46	51
97	1.62	22	29	34	41	46	51
98	1.63	22	29	34	41	45	50
99	1.65	22	29	34	41	45	50
100	1.67	22	29	34	40	45	50
101	1.68	22	28	33	40	44	49
102	1.70	22	28	33	40	44	49
103	1.72	22	28	33	39	44	49
104	1.73	21	28	33	39	43	48
105	1.75	21	28	33	39	43	48
106	1.77	21	27	32	39	43	48
107	1.78	21	27	32	38	43	48
108	1.80	21	27	32	38	42	47
109	1.82	21	27	32	38	42	47
110	1.83	21	27	32	38	42	47
111	1.85	20	27	31	37	42	46
112	1.87	20	26	31	37	41	46
113	1.88	20	26	31	37	41	46
114	1.90	20	26	31	37	41	45
115	1.92	20	26	31	37	41	45
116	1.93	20	26	30	36	40	45
117	1.95	20	26	30	36	40	45
118	1.97	20	25	30	36	40	44
119	1.98	19	25	30	36	40	44
120	2.00	19	25	30	35	39	44

Rainfall Intensity/Duration/Frequency Relationships for Connecticut (Metric Units)
Table B-2 continued

DURATION (min)	DURATION (hr)	RAINFALL INTENSITY (mm/hr)					
		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
121	2.02	19	25	30	35	39	44
122	2.03	19	25	29	35	39	43
123	2.05	19	25	29	35	39	43
124	2.07	19	25	29	35	38	43
125	2.08	19	24	29	34	38	43
126	2.10	19	24	29	34	38	42
127	2.12	19	24	28	34	38	42
128	2.13	18	24	28	34	38	42
129	2.15	18	24	28	34	37	42
130	2.17	18	24	28	33	37	41
131	2.18	18	24	28	33	37	41
132	2.20	18	23	28	33	37	41
133	2.22	18	23	28	33	37	41
134	2.23	18	23	27	33	36	41
135	2.25	18	23	27	33	36	40
136	2.27	18	23	27	32	36	40
137	2.28	18	23	27	32	36	40
138	2.30	17	23	27	32	36	40
139	2.32	17	23	27	32	35	39
140	2.33	17	22	27	32	35	39
141	2.35	17	22	26	32	35	39
142	2.37	17	22	26	31	35	39
143	2.38	17	22	26	31	35	39
144	2.40	17	22	26	31	34	38
145	2.42	17	22	26	31	34	38
146	2.43	17	22	26	31	34	38
147	2.45	17	22	26	31	34	38
148	2.47	17	22	25	30	34	38
149	2.48	17	21	25	30	34	37
150	2.50	16	21	25	30	33	37

Rainfall Intensity/Duration/Frequency Relationships for Connecticut (Metric Units)
Table B-2 continued

DURATION (min)	DURATION (hr)	RAINFALL INTENSITY (mm/hr) 2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
151	2.52	16	21	25	30	33	37
152	2.53	16	21	25	30	33	37
153	2.55	16	21	25	30	33	37
154	2.57	16	21	25	30	33	37
155	2.58	16	21	25	29	33	36
156	2.60	16	21	24	29	32	36
157	2.62	16	21	24	29	32	36
158	2.63	16	21	24	29	32	36
159	2.65	16	20	24	29	32	36
160	2.67	16	20	24	29	32	35
161	2.68	16	20	24	29	32	35
162	2.70	15	20	24	28	32	35
163	2.72	15	20	24	28	31	35
164	2.73	15	20	24	28	31	35
165	2.75	15	20	23	28	31	35
166	2.77	15	20	23	28	31	34
167	2.78	15	20	23	28	31	34
168	2.80	15	20	23	28	31	34
169	2.82	15	19	23	27	30	34
170	2.83	15	19	23	27	30	34
171	2.85	15	19	23	27	30	34
172	2.87	15	19	23	27	30	34
173	2.88	15	19	23	27	30	33
174	2.90	15	19	22	27	30	33
175	2.92	15	19	22	27	30	33
176	2.93	15	19	22	27	30	33
177	2.95	14	19	22	27	29	33
178	2.97	14	19	22	26	29	33
179	2.98	14	19	22	26	29	32
180	3.00	14	19	22	26	29	32

Rainfall Intensity/Duration/Frequency Relationships for Connecticut (Metric Units)
Table B-2 continued

		RAINFALL INTENSITY (in/hr)					
DURATION (min)	DURATION (hr)	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
5	0.08	4.6	5.5	6.0	6.7	7.3	7.8
6	0.10	4.4	5.2	5.8	6.5	7.0	7.5
7	0.12	4.2	5.0	5.5	6.2	6.8	7.2
8	0.13	4.0	4.8	5.3	6.0	6.5	7.0
9	0.15	3.8	4.6	5.1	5.7	6.2	6.7
10	0.17	3.6	4.3	4.8	5.5	6.0	6.5
11	0.18	3.4	4.2	4.7	5.3	5.8	6.3
12	0.20	3.3	4.0	4.5	5.1	5.6	6.1
13	0.22	3.1	3.8	4.3	5.0	5.4	5.9
14	0.23	3.0	3.7	4.2	4.8	5.3	5.7
15	0.25	2.8	3.5	4.0	4.6	5.1	5.5
16	0.27	2.8	3.5	3.9	4.5	5.0	5.4
17	0.28	2.7	3.4	3.8	4.4	4.9	5.4
18	0.30	2.7	3.3	3.8	4.4	4.8	5.3
19	0.32	2.6	3.2	3.7	4.3	4.7	5.2
20	0.33	2.5	3.2	3.6	4.2	4.6	5.1
21	0.35	2.5	3.1	3.5	4.1	4.5	5.0
22	0.37	2.4	3.0	3.4	4.0	4.4	4.9
23	0.38	2.3	2.9	3.4	3.9	4.3	4.8
24	0.40	2.3	2.9	3.3	3.8	4.2	4.7
25	0.42	2.2	2.8	3.2	3.7	4.2	4.6
26	0.43	2.2	2.7	3.1	3.7	4.1	4.5
27	0.45	2.1	2.7	3.0	3.6	4.0	4.4
28	0.47	2.0	2.6	3.0	3.5	3.9	4.3
29	0.48	2.0	2.5	2.9	3.4	3.8	4.2
30	0.50	1.9	2.4	2.8	3.3	3.7	4.1

Rainfall Intensity/Duration/Frequency Relationship for Connecticut (English Units)
Table B-2.1

		RAINFALL INTENSITY (in/hr)					
DURATION	DURATION	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
31	0.52	1.9	2.4	2.8	3.3	3.6	4.0
32	0.53	1.9	2.4	2.7	3.2	3.6	4.0
33	0.55	1.8	2.4	2.7	3.2	3.6	3.9
34	0.57	1.8	2.3	2.7	3.2	3.5	3.9
35	0.58	1.8	2.3	2.6	3.1	3.5	3.8
36	0.60	1.8	2.3	2.6	3.1	3.4	3.8
37	0.62	1.7	2.2	2.6	3.0	3.4	3.7
38	0.63	1.7	2.2	2.5	3.0	3.4	3.7
39	0.65	1.7	2.2	2.5	3.0	3.3	3.7
40	0.67	1.7	2.1	2.5	2.9	3.3	3.6
41	0.68	1.6	2.1	2.4	2.9	3.2	3.6
42	0.70	1.6	2.1	2.4	2.8	3.2	3.5
43	0.72	1.6	2.1	2.4	2.8	3.1	3.5
44	0.73	1.6	2.0	2.3	2.8	3.1	3.4
45	0.75	1.5	2.0	2.3	2.7	3.1	3.4
46	0.77	1.5	2.0	2.3	2.7	3.0	3.3
47	0.78	1.5	1.9	2.2	2.6	3.0	3.3
48	0.80	1.5	1.9	2.2	2.6	2.9	3.2
49	0.82	1.5	1.9	2.2	2.6	2.9	3.2
50	0.83	1.4	1.8	2.1	2.5	2.8	3.2
51	0.85	1.4	1.8	2.1	2.5	2.8	3.1
52	0.87	1.4	1.8	2.1	2.5	2.8	3.1
53	0.88	1.4	1.8	2.0	2.4	2.7	3.0
54	0.90	1.3	1.7	2.0	2.4	2.7	3.0
55	0.92	1.3	1.7	2.0	2.3	2.6	2.9
56	0.93	1.3	1.7	1.9	2.3	2.6	2.9
57	0.95	1.3	1.6	1.9	2.3	2.5	2.8
58	0.97	1.2	1.6	1.9	2.2	2.5	2.8
59	0.98	1.2	1.6	1.8	2.2	2.5	2.7
60	1.00	1.2	1.5	1.8	2.1	2.4	2.7

Rainfall Intensity/Duration/Frequency Relationship for Connecticut (English Units)
Table B-2.1 continued

		RAINFALL INTENSITY (in/hr)					
DURATION	DURATION	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
61	1.02	1.2	1.5	1.8	2.1	2.4	2.7
62	1.03	1.2	1.5	1.8	2.1	2.4	2.6
63	1.05	1.2	1.5	1.8	2.1	2.4	2.6
64	1.07	1.1	1.5	1.7	2.1	2.3	2.6
65	1.08	1.1	1.5	1.7	2.1	2.3	2.6
66	1.10	1.1	1.5	1.7	2.0	2.3	2.6
67	1.12	1.1	1.5	1.7	2.0	2.3	2.5
68	1.13	1.1	1.4	1.7	2.0	2.3	2.5
69	1.15	1.1	1.4	1.7	2.0	2.2	2.5
70	1.17	1.1	1.4	1.6	2.0	2.2	2.5
71	1.18	1.1	1.4	1.6	2.0	2.2	2.4
72	1.20	1.1	1.4	1.6	1.9	2.2	2.4
73	1.22	1.1	1.4	1.6	1.9	2.2	2.4
74	1.23	1.1	1.4	1.6	1.9	2.1	2.4
75	1.25	1.0	1.4	1.6	1.9	2.1	2.4
76	1.27	1.0	1.4	1.6	1.9	2.1	2.4
77	1.28	1.0	1.3	1.6	1.9	2.1	2.3
78	1.30	1.0	1.3	1.5	1.8	2.1	2.3
79	1.32	1.0	1.3	1.5	1.8	2.1	2.3
80	1.33	1.0	1.3	1.5	1.8	2.0	2.3
81	1.35	1.0	1.3	1.5	1.8	2.0	2.3
82	1.37	1.0	1.3	1.5	1.8	2.0	2.2
83	1.38	1.0	1.3	1.5	1.8	2.0	2.2
84	1.40	1.0	1.3	1.5	1.8	2.0	2.2
85	1.42	1.0	1.3	1.5	1.7	2.0	2.2
86	1.43	1.0	1.3	1.5	1.7	2.0	2.2
87	1.45	1.0	1.2	1.4	1.7	1.9	2.2
88	1.47	0.9	1.2	1.4	1.7	1.9	2.1
89	1.48	0.9	1.2	1.4	1.7	1.9	2.1
90	1.50	0.9	1.2	1.4	1.7	1.9	2.1

Rainfall Intensity/Duration/Frequency Relationship for Connecticut (English Units)
Table B-2.1 continued

		RAINFALL INTENSITY (in/hr)					
DURATION	DURATION	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
91	1.52	0.9	1.2	1.4	1.7	1.9	2.1
92	1.53	0.9	1.2	1.4	1.7	1.9	2.1
93	1.55	0.9	1.2	1.4	1.7	1.9	2.1
94	1.57	0.9	1.2	1.4	1.6	1.8	2.1
95	1.58	0.9	1.2	1.4	1.6	1.8	2.0
96	1.60	0.9	1.2	1.4	1.6	1.8	2.0
97	1.62	0.9	1.2	1.3	1.6	1.8	2.0
98	1.63	0.9	1.1	1.3	1.6	1.8	2.0
99	1.65	0.9	1.1	1.3	1.6	1.8	2.0
100	1.67	0.9	1.1	1.3	1.6	1.8	2.0
101	1.68	0.9	1.1	1.3	1.6	1.8	2.0
102	1.70	0.9	1.1	1.3	1.6	1.7	1.9
103	1.72	0.9	1.1	1.3	1.5	1.7	1.9
104	1.73	0.8	1.1	1.3	1.5	1.7	1.9
105	1.75	0.8	1.1	1.3	1.5	1.7	1.9
106	1.77	0.8	1.1	1.3	1.5	1.7	1.9
107	1.78	0.8	1.1	1.3	1.5	1.7	1.9
108	1.80	0.8	1.1	1.2	1.5	1.7	1.9
109	1.82	0.8	1.1	1.2	1.5	1.7	1.9
110	1.83	0.8	1.1	1.2	1.5	1.7	1.8
111	1.85	0.8	1.1	1.2	1.5	1.6	1.8
112	1.87	0.8	1.0	1.2	1.5	1.6	1.8
113	1.88	0.8	1.0	1.2	1.4	1.6	1.8
114	1.90	0.8	1.0	1.2	1.4	1.6	1.8
115	1.92	0.8	1.0	1.2	1.4	1.6	1.8
116	1.93	0.8	1.0	1.2	1.4	1.6	1.8
117	1.95	0.8	1.0	1.2	1.4	1.6	1.8
118	1.97	0.8	1.0	1.2	1.4	1.6	1.8
119	1.98	0.8	1.0	1.2	1.4	1.6	1.7
120	2.00	0.8	1.0	1.2	1.4	1.6	1.7

Rainfall Intensity/Duration/Frequency Relationship for Connecticut (English Units)
Table B-2.1 continued

		RAINFALL INTENSITY (in/hr)					
DURATION	DURATION	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
121	2.02	0.8	1.0	1.2	1.4	1.6	1.7
122	2.03	0.8	1.0	1.1	1.4	1.5	1.7
123	2.05	0.8	1.0	1.1	1.4	1.5	1.7
124	2.07	0.7	1.0	1.1	1.4	1.5	1.7
125	2.08	0.7	1.0	1.1	1.3	1.5	1.7
126	2.10	0.7	1.0	1.1	1.3	1.5	1.7
127	2.12	0.7	1.0	1.1	1.3	1.5	1.7
128	2.13	0.7	1.0	1.1	1.3	1.5	1.7
129	2.15	0.7	0.9	1.1	1.3	1.5	1.6
130	2.17	0.7	0.9	1.1	1.3	1.5	1.6
131	2.18	0.7	0.9	1.1	1.3	1.5	1.6
132	2.20	0.7	0.9	1.1	1.3	1.5	1.6
133	2.22	0.7	0.9	1.1	1.3	1.4	1.6
134	2.23	0.7	0.9	1.1	1.3	1.4	1.6
135	2.25	0.7	0.9	1.1	1.3	1.4	1.6
136	2.27	0.7	0.9	1.1	1.3	1.4	1.6
137	2.28	0.7	0.9	1.1	1.3	1.4	1.6
138	2.30	0.7	0.9	1.0	1.3	1.4	1.6
139	2.32	0.7	0.9	1.0	1.2	1.4	1.6
140	2.33	0.7	0.9	1.0	1.2	1.4	1.6
141	2.35	0.7	0.9	1.0	1.2	1.4	1.5
142	2.37	0.7	0.9	1.0	1.2	1.4	1.5
143	2.38	0.7	0.9	1.0	1.2	1.4	1.5
144	2.40	0.7	0.9	1.0	1.2	1.4	1.5
145	2.42	0.7	0.9	1.0	1.2	1.4	1.5
146	2.43	0.7	0.9	1.0	1.2	1.4	1.5
147	2.45	0.7	0.9	1.0	1.2	1.3	1.5
148	2.47	0.7	0.9	1.0	1.2	1.3	1.5
149	2.48	0.7	0.9	1.0	1.2	1.3	1.5
150	2.50	0.6	0.8	1.0	1.2	1.3	1.5

Rainfall Intensity/Duration/Frequency Relationship for Connecticut (English Units)
Table B-2.1 continued

		RAINFALL INTENSITY (in/hr)					
DURATION	**DURATION**	**2 Yr**	**5 Yr**	**10 Yr**	**25 Yr**	**50 Yr**	**100 Yr**
151	2.52	0.6	0.8	1.0	1.2	1.3	1.5
152	2.53	0.6	0.8	1.0	1.2	1.3	1.5
153	2.55	0.6	0.8	1.0	1.2	1.3	1.5
154	2.57	0.6	0.8	1.0	1.2	1.3	1.4
155	2.58	0.6	0.8	1.0	1.1	1.3	1.4
156	2.60	0.6	0.8	1.0	1.1	1.3	1.4
157	2.62	0.6	0.8	1.0	1.1	1.3	1.4
158	2.63	0.6	0.8	0.9	1.1	1.3	1.4
159	2.65	0.6	0.8	0.9	1.1	1.3	1.4
160	2.67	0.6	0.8	0.9	1.1	1.3	1.4
161	2.68	0.6	0.8	0.9	1.1	1.3	1.4
162	2.70	0.6	0.8	0.9	1.1	1.3	1.4
163	2.72	0.6	0.8	0.9	1.1	1.2	1.4
164	2.73	0.6	0.8	0.9	1.1	1.2	1.4
165	2.75	0.6	0.8	0.9	1.1	1.2	1.4
166	2.77	0.6	0.8	0.9	1.1	1.2	1.4
167	2.78	0.6	0.8	0.9	1.1	1.2	1.4
168	2.80	0.6	0.8	0.9	1.1	1.2	1.4
169	2.82	0.6	0.8	0.9	1.1	1.2	1.3
170	2.83	0.6	0.8	0.9	1.1	1.2	1.3
171	2.85	0.6	0.8	0.9	1.1	1.2	1.3
172	2.87	0.6	0.8	0.9	1.1	1.2	1.3
173	2.88	0.6	0.8	0.9	1.1	1.2	1.3
174	2.90	0.6	0.8	0.9	1.0	1.2	1.3
175	2.92	0.6	0.8	0.9	1.0	1.2	1.3
176	2.93	0.6	0.7	0.9	1.0	1.2	1.3
177	2.95	0.6	0.7	0.9	1.0	1.2	1.3
178	2.97	0.6	0.7	0.9	1.0	1.2	1.3
179	2.98	0.6	0.7	0.9	1.0	1.2	1.3
180	3.00	0.6	0.7	0.9	1.0	1.2	1.3

Rainfall Intensity/Duration/Frequency Relationship for Connecticut (English Units)
Table B-2.1 continued

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Attachment H

Part 2- Hydrologic and Hydraulic Consistency Worksheet (DEP-IWRD-APP-105B)

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Attachment H: Engineering Documentation

Part 2: Hydrologic and Hydraulic Consistency Worksheet

Inland Water Resources Division Permit Activities

This worksheet has four sections; only complete the section(s) applicable to the proposed project. Where a question requires a "Yes" or "No" answer, select the appropriate response and explain your response, if required, in the space provided.

Section I: **Floodplain Management** *(if the proposed project involves a structure, obstruction, encroachment or work in a watercourse, floodplain, or coastal high hazard area)*

Section II: **Stormwater Management** *(if the proposed project involves stormwater drainage or stormwater runoff)*

Sections III: **State Grants and Loans** and **Section IV: Disposal of State Land** *(only if the applicant is a state agency seeking flood management certification approval for state grants and loans or disposal of state land)*

Contents:

Definitions of terms used in these worksheets are found in Section 25-68b of the Connecticut General Statutes and Section 25-68h-1 of the Regulations of Connecticut State Agencies and in the National Flood Insurance Program Regulations (44 CFR, Chapter 1, Subchapter B, Part 59.1).

Section I: Floodplain Management

Section I: Floodplain Management

Name of Applicant: **Tennessee Gas Pipeline Company, LLC**

Name of Proposed Project: **Northeast Energy Direct**

1. *General Criteria*

a. *Critical Activity* - Does the proposed project involve the treatment, storage and disposal of hazardous waste or the siting of hospitals, housing for the elderly, schools or residences, in the 0.2 per cent [500 year] floodplain? ☐ Yes ☒ No

If yes, the base flood for the critical activity shall have a recurrence interval equal to the 500 year flood event; if no, the base flood for the activity shall have a recurrence interval equal to the 100 year flood event.

b. *Nonintensive Floodplain Uses* - Will the proposed project promote development in floodplains or will utilities servicing the project be located so as to enable floodplain development?

☐ Yes ☒ No

Explain:

No new development associated with the proposed pipeline is within any floodplain.

c. *National Flood Insurance Program* (NFIP) - Will the proposed project be located within an area of special flood hazard designated by the Federal Emergency Management Agency (FEMA)?

☒ Yes ☐ No If yes, list the FEMA flood zone(s):

Zone AE 100-Year Flood Zone

Does the proposed project meet the NFIP minimum standards established in 44 CFR, Chapter 1, Subchapter B, Part 60.3, floodplain management criteria for flood-prone areas?

☒ Yes ☐ No

d. *Municipal Regulations* - Has the municipality in which the proposed project is to be located adopted floodplain regulations containing requirements that are more restrictive than the NFIP floodplain management criteria for flood-prone areas? ☐ Yes ☒ No

If yes, describe the more restrictive requirements:

Does the proposed project comply with the more restrictive standards of the municipality?

☐ Yes ☐ No

Section I: Floodplain Management (continued)

2. Flooding and Flood Hazards

a. *Flooding* - Will the proposed project pose any hazard to human life, health or property in the event of a base flood? ☐ Yes ☒ No

If yes, explain:

b. *Flood Velocities* - Will the proposed project cause an increase in flow velocity or depth during the base flood discharge? ☐ Yes ☒ No

If yes, the increase in velocity is: fps
and/or the increase in depth is: ft.

Will such increase in velocity or depth cause channel erosion or pose any hazard to human life, health or property? ☐ Yes ☒ No

Explain:

c. *Flood Storage* - Will the proposed project affect the flood storage capacity or flood control value of the floodplain? ☐ Yes ☒ No

If yes, describe the effects:

d. *Degrading or Aggrading Stream Beds* - Is the streambed currently degrading or aggrading?

☐ Degrading ☐ Aggrading ☒ Neither

Has the project design addressed degrading or aggrading streambed conditions?

☐ Yes ☒ No

e. *Ice Jams* - Is the watercourse prone to ice jams or floods due to ice? ☐ Yes ☒ No

Has the project design considered ice jams or floods due to ice? ☐ Yes ☒ No

Section I: Floodplain Management (continued)

f. *Storage of Materials & Equipment* - Will the construction or use of the proposed project involve the storage of materials below the 500 year flood elevation that are buoyant, hazardous, flammable, explosive, soluble, expansive or radioactive, or the storage of any other materials which could be injurious to human, animal or plant life in the event of a flood?

☒ Yes ☐ No

If yes, describe the materials and how such materials will be protected from flood damage, secured or removed from the floodplain to prevent pollution and hazards to life and property.

No storage of any such materials is proposed during operation of the proposed pipeline. During construction, petroleum and/or paint products may be temporarily stored in such areas. A project specific Flood Contingency Operation Plan will be prepared by the construction contractor. General information related to flood contingency planning is presented in Attachment I which states the following: All contractors working in floodplain areas will be responsible for ensuring that all materials and equipment are appropriately protected from potential flooding impacts. The Project construction contractor will be responsible to stay apprised of weather conditions that may indicate a threat of flooding and will inform all subcontractors of the threat of flood emergency. Further, the construction contractor will also be expected to maintain on the Project site, or have readily available, a sufficient supply of materials and personnel to implement the Flood Contingency Operation Plan.

Storage of materials that could be injurious to human health or the environment in the event of flooding is prohibited below the elevation of the 500 year flood. Other material or equipment may be stored below the 500 year flood elevation provided that such material or equipment is not subject to major damage by floods, and provided that such material or equipment is firmly anchored, restrained or enclosed to prevent it from floating away or that such material or equipment can be removed prior to flooding.

g. *Floodwater Loads* - Will structures, facilities and stored materials be anchored or otherwise designed to prevent floatation, collapse, or lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy? ☒ Yes ☐ No

3. *Standards for Structures in Floodplains or Coastal High Hazard Areas*

Does the proposed project involve a new or substantially improved structure or facility located within a floodplain or coastal high hazard area? ☐ Yes ☒ No

If yes, complete this subsection; if no, skip to subsection 4 (***Topography Changes within Floodplain***).

a. *Structures in Coastal High Hazard Areas* - Will the structure or facility be located within an NFIP coastal high hazard area? ☐ Yes ☐ No

If no, skip to paragraph 3(b); if yes:

1. Will the structure or facility be located landward of the reach of mean high tide?

   ☐ Yes ☐ No

2. Will a new structure or facility be located on an undeveloped coastal barrier beach designated by FEMA? ☐ Yes ☐ No

3. If the structure or facility is/will be located within a coastal high hazard area, the structure or facility must be elevated on pilings or columns so that the bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to at least one foot above the base flood level and the pile or column foundation and structure attached thereto must be anchored to resist floatation, collapse and lateral movement due to the effects of wind, velocity waters, hurricane wave wash, and base flood water loads acting simultaneously on all building components.

   Does the proposed structure or facility meet these standards? ☐ Yes ☐ No

   The base flood elevation is: ft. (Datum:)

   The elevation of the lowest horizontal structural member is: ft. (Datum:)

Section I: Floodplain Management (continued)

4. Will the space below the lowest floor be either free of obstruction or constructed with non-supporting breakaway walls? ☐ Yes ☐ No

5. Will fill be used for structural support of any buildings within coastal high hazard areas?

   ☐ Yes ☐ No

b. *Structures in Floodplain Areas* - Are the structures residential or nonresidential?

☐ Residential ☐ Nonresidential If *nonresidential*, skip to paragraph 3(d) below.

c. *Residential Structures* - If the structure or facility is for human habitation will the lowest floor of such structure or facility, including its basement, be elevated one foot above the level of the 500 year flood?

☐ Yes ☐ No

The 500 year flood elevation is: ft. (Datum:)

The elevation of the lowest floor, including basement, is: ft. (Datum:)

d. Non-residential Structures - If the structure or facility is not intended for residential uses, will the lowest floor of such structure or facility, including its basement, be elevated to or above the 100 year flood height or be floodproofed to that height, or in the case of a critical activity, the 500 year flood height?

☐ Yes ☐ No

If yes, the structure will be: ☐ Elevated ☐ Floodproofed

The base flood elevation is: ft. (Datum:)

The elevation of the lowest floor, including basement, is: ft. (Datum:)

The structure is floodproofed to: ft. (Datum:)

Note: for insurance purposes nonresidential structures must be floodproofed to at least one foot above the base flood elevation. DEP strongly encourages that the height of floodproofing incorporate one foot of freeboard.

e. *Utilities* - Will service facilities such as electrical, heating, ventilation, plumbing, and air conditioning equipment be constructed at or above the elevation of the base flood or floodproofed with a passive system? ☐ Yes ☐ No

f. *Water Supply Systems* - Does the proposed project include a new or replacement water supply system? ☐ Yes ☐ No

If yes, is the water supply system designed to prevent floodwaters from entering and contaminating the system during the base flood? ☐ Yes ☐ No

g. *Sanitary Sewage Systems* - Does the proposed project include a new or replacement sanitary sewage or collection system? ☐ Yes ☐ No

If yes, is the sanitary sewage system designed to minimize or eliminate the infiltration of flood waters into the systems and discharges from the systems into flood waters during the base flood?

☐ Yes ☐ No

h. *Foundation Drains* - Are foundation drains of buildings designed to prevent backflow from the 100 year frequency flood into the building?

☐ Yes ☐ No ☐ No foundation drains

Section I: Floodplain Management (continued)

4. *Activity within Floodplain*

Does the proposed project involve activity in a floodplain including but not limited to filling, dumping, construction, excavating, or grading?

☒ Yes ☐ No If no, skip to subsection 5 ***(Alterations of Watercourses)***.

If yes, does the proposed project include encroachments, including fill, new construction, substantial improvements, or other development within a NFIP adopted regulatory floodway?

☐ Yes ☒ No If yes, skip to paragraph 4(b) below.

a. *No Regulatory Floodway* - The NFIP requires that until a regulatory floodway is designated, that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zones A1-30 and AE unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point. (If no regulatory floodway has been adopted, project impacts may be evaluated by considering an equivalent conveyance loss on the opposite side of the river from the proposed project.)

Is the proposed project consistent with this requirement? ☒ Yes ☐ No

b. *Floodway Encroachments* - Will the proposed encroachment into the floodway result in any increase in flood levels during either the 100 year or 10 year discharges?

100 year: ☐ Yes; the increase is: (in 1/100ths of a foot) ☒ No

If yes, has the applicant received approval of such increase in accordance with 44 CFR, Chapter 1, Subchapter B, Part 65.12? ☐ Yes ☐ No

10 year: ☐ Yes; the increase is: (in 1/100ths of a foot) ☒ No

c. *Coastal Areas* - Flood hazard potential in coastal areas shall be evaluated considering surface profiles of the combined occurrence of tides, storm surges, and peak runoff. The starting water surface elevation for the base flood in watersheds with time of concentrations of over 6 hours shall be the 10 year frequency tidal surge level.

If the proposed project is in a coastal area, have the hydraulic analyses incorporated these criteria?

☐ Yes ☐ No ☒ Not in Coastal Area

5. *Alterations of Watercourses*

Does the proposed project include the construction or alteration to a natural perennial watercourse or man-made channel?

☐ Yes ☒ No If no, skip to subsection 6 ***(Culverts and Bridges)***; if yes, complete the following subsection:

a. *Topography Change* - Is the watercourse or channel located within a regulatory floodway or Zone A1-30 or AE as designated by the NFIP? ☐ Yes ☐ No

b. *Hydraulic Capacity* - Does the channel have a minimum flow capacity of a flood equal to at least the 25 year frequency flood? ☐ Yes ☐ No

The channel capacity is designed for the: year flood.

Does the channel have an inner channel with a capacity of a 2 year frequency flood? ☐ Yes ☐ No

Section I: Floodplain Management (continued)

c. *Aquatic Habitat* - Channel alterations should be designed to create aquatic habitats suitable for fisheries, including suitable habitat for maintaining fish populations and to enable fish passage, and to maintain or improve water quality, aesthetics, and recreation.

Has the applicant had any pre-application meetings or correspondence with DEP Fisheries?

☐ Yes ☐ No

Check each of the following criteria that have been incorporated into the project design:

☐ 1. artificial channel linings have been avoided;

☐ 2. the channel will encourage ecological productivity and diversity;

☐ 3. the channel and its banks will be compatible with their surroundings;

☐ 4. the channel will vary in its width, depth, invert elevations, and side slopes to provide diverse aquatic habitat;

☐ 5. straightening existing channels and thereby decreasing their length has been avoided;

☐ 6. the channel will not create barriers to upstream and downstream fish passage;

☐ 7. the channel will contain pools and riffles and a low flow channel to concentrate seasonal low water flows;

☐ 8. the channel will contain flow deflectors, boulders and low check dams to enhance aquatic habitat;

☐ 9. stream bank vegetation will be preserved where feasible and disturbed stream bank areas will be replanted with suitable vegetation;

☐ 10. clean natural stream bed materials of a suitable size will be incorporated in the new channel; and

☐ 11. construction of the proposed project will be scheduled to minimize conflicts with spawning, stocking, and recreational fishing seasons.

Describe how the above aquatic habitat design criteria have been incorporated into the project design:

Section I: Floodplain Management (continued)

6. Culverts and Bridges

Does the proposed project involve the repair or new construction of a culvert or bridge?

☐ Yes ☒ No If no, go to subsection 7 ***(Temporary Hydraulic Facilities)***.

If yes, complete this subsection:

a. *Fish Passage* - Does the culvert design allow for the passage of fish? ☐ Yes ☒ No

If yes, describe the specific design provisions for fish passage:

b. *Depressed Structural Floors* - Is the rigid structural floor of the culvert or bridge depressed below the normal stream bed to allow a natural stream bed to form over the floor?

☐ Yes ☐ No ☐ No rigid structural floor

c. *Multiple Openings* - The use of a single large culvert or bridge opening is preferred over the use of multiple small openings. Has the design minimized the use of multiple small openings?

☐ Yes ☐ No

If no, explain:

d. *Sag Vertical Curves* - Does the design utilize solid parapet walls in the sag part of a vertical curve?

☐ Yes ☐ No ☐ Not located in a sag vertical curve

e. *Debris Blockage* - Is the culvert or bridge prone to blockage by debris? ☐ Yes ☐ No

If yes, has the project design incorporated measures to minimize the potential for debris blockage?

☐ Yes ☐ No

f. *Topography Change* - Is the culvert or bridge located within a regulatory floodway or Zone A1-30 or AE as designated by the NFIP? ☐ Yes ☐ No

Section I: Floodplain Management (continued)

g. *State Highways* - Does the watercourse pass under a state roadway?

☐ Yes ☐ No If no, skip to paragraph 6(g)(2).

If yes, culverts and bridges for state highways shall be designed in accordance with the Connecticut Department of Transportation (DOT) Drainage Manual and all applicants should refer to it for specific design criteria. In general, however, the Drainage Manual requires the following:

(Place a check mark for all applicable criteria utilized)

☐ *Minor Structures* - Minor structures have a drainage area of less than one square mile in which there is no established watercourse. They shall be designed to pass the 25 year frequency discharge.

☐ *Small Structures* - Small structures have a drainage area of less than one square mile in which there is an established watercourse. *They* shall be designed to pass the 50 year frequency discharge.

☐ *Intermediate Structures* - Intermediate structures have a drainage area greater than one square mile and less than 10 square miles. They *shall* be designed to pass the 100 year frequency discharge with reasonable underclearance.

☐ *Large Structures* - Large structures have a drainage area greater than 10 square miles and less than 1000 square miles. They shall be designed to pass the 100 year frequency discharge with an underclearance not less than two feet.

☐ *Monumental Structures* - Monumental structures *have* a drainage area greater than 1000 square miles. They shall be designed to meet the requirements of the Connecticut Department of Environmental Protection, U.S. Army Corps of Engineers, and the U.S. Coast Guard.

☐ *Tidal Structures* - Tidal structures are subject to tidal action and shall be classified as minor, small, intermediate, etc. depending on their drainage area. These structures shall be designed in accordance with the previously listed *classifications*. However if the highway is subject to frequent tidal flooding, the design storm may be made consistent with the frequency of flooding by tidal action. The proposed culvert or bridge is classified as:

☐ Tidal, minor

☐ Tidal, small

☐ Tidal, intermediate

☐ Tidal, large

☐ Tidal, monumental

1. Has the structure been designed in accordance with the criteria established in the DOT Drainage Manual? ☐ Yes ☐ No

   If no, describe the lower design standards and the reasons for not complying with the DOT Drainage Manual:

Section I: Floodplain Management (continued)

2. Will the proposed culvert or bridge increase upstream water surface elevations in the event of a base flood above that which would have been obtained in the natural channel if the highway embankment were not constructed? ☐ Yes ☐ No

   If yes, is the increase in elevation more than one foot? Describe:

3. Will the proposed culvert or bridge be designed so that flooding during the design discharge does not endanger the roadway or cause damage to upstream developed property? (NOTE: The design discharge for culverts and bridges on state highways should be that which was determined by FEMA. If the applicant judges that the FEMA discharge is inappropriate, the project should be analyzed for both the applicant's computed flow and the FEMA discharge. The project, however, must still meet the standards of the NFIP.) ☐ Yes ☐ No

   Explain:

h. *Local Roads & Driveways* - Local roads (not state highways) and driveways may be designed for flood frequencies and underclearances less stringent than those specified in the DOT Drainage Manual when (check all that have been incorporated into the project design):

☐ 1. the road is at or close to the floodplain grade

☐ 2. water surface elevations are not increased by more than one foot nor cause damage to upstream properties

☐ 3. provisions are made to barricade the road when overtopped

☐ 4. the road or driveway is posted as being subject to flooding

☐ 5. the road or driveway has low traffic volume

☐ 6. alternate routes are available

The culvert or bridge has been designed to pass the: year frequency discharge with an underclearance of: feet.

Utilizing the DOT Drainage Manual classifications listed under paragraph 6(g) above, the culvert or bridge is classified as a: structure.

Section I: Floodplain Management (continued)

h. If the culvert or bridge is designed to standards lower than which is stipulated in the DOT Drainage Manual, list such standards and the reasons for the lower design standards:

i. *Downstream Peak Flows* - Will the proposed culvert or bridge increase downstream peak flows by decreasing existing headwater depths during flooding events? ☐ Yes ☐ No

If yes, describe the selected design criteria and the impacts to downstream properties:

7. *Temporary Hydraulic Facilities*

Temporary hydraulic facilities include all channels, culverts or bridges which are required for haul roads, channel relocations, culvert installations, bridge construction, temporary roads, or detours. They are to be designed with the same care which is used for the primary facility.

If the proposed activity involves a temporary hydraulic facility(s), has such facility been designed in accordance with Chapter 6, Appendix F, "Temporary Hydraulic Facilities," of the DOT Drainage Manual?

☐ Yes ☒ No ☐ No temporary hydraulic facilities

If yes, the design flood frequency is the: year flood.

Describe the temporary facilities:

Temporary equipment bridges will be installed as needed across stream crossings and will be installed as per the details on the construction plans submitted as part of the soil erosion and sediment control plan.

Section II: Stormwater Management

Name of Applicant: **Tennessee Gas Pipeline Company, LLC**

Name of Proposed Project: **Northeast Energy Direct**

1. *Stormwater Runoff*

The proposed project will (check all that apply):

- ☒ Increase the area of impervious surfaces
- ☒ Increase runoff coefficients
- ☐ Alter existing drainage patterns
- ☐ Alter time of concentrations
- ☐ Change the timing of runoff in relation to adjacent watersheds

Will the proposed project impact downstream areas by increasing peak flow rates, the timing of runoff, or the volume of runoff? ☐ Yes ☒ No

If yes, describe the downstream impacts for the 2, 10 and 100 year frequency discharges:

There are new permanent access roads on the project that will slightly increase the impervious area. The downstream impacts have been calculated for the various locations of the access roads and the results show an insignificant increase in runoff for the 2, 10 and 100-year storm events. The increase in runoff will not affect downstream or adjacent properties or water resources. The drainage areas were limited to the access roads and the typical sections for the roads will promote overland sheet flow and will not have a point discharge.

The pre and post development peak flow rates at the downstream design point are as follows:

Return Frequency (Year)	Peak Discharges (CFS)	
	Pre-Development	Post-Development
2		
10		
100		

The above peak discharges were computed utilizing the: **N/A** hour duration storm. This duration storm was selected because:

There are several new access roads for the project, each with a pre- and post-construction peak flow rate calculation. Refer to Appendix A of the Engineer's Report, "Design of Best Management Practices (BMPs) Along the Connecticut Pipeline and Associated Access Roads" for the complete results of the pre- and post-construction flow rate calulations.

The Rational Method was utilized to compute the peak discharges for the access roads. Rainfall intensities for the computed time of concentration were utilized in the formula to determine the peak discharges.

Section II: Stormwater Management (continued)

Describe the location of the design point and why this location was chosen:

The design point for each calculation is the down gradient point along the new access road. The area is analyzed with the watershed limits being the limits of the access road.

2. *Stormwater Detention Facilities*

Does the proposed project include the construction of any stormwater detention facilities?

☐ Yes ☒ No If no, skip to subsection 3 ***(Storm Drainage Systems)***.

If yes, has the DEP determined whether a dam construction permit is required? ☐ Yes ☐ No

The pre and post development peak flow rates at the downstream design point are as follows:

Return Frequency (Year)	Peak Discharges (CFS)		
	Pre-Development	Post-Development (without detention)	Post-Development (with detention)
2			
10			
100			

The above peak discharges were computed utilizing the: hour duration storm. This duration storm was selected because:

Describe the location of the design point and why this location was chosen:

Section II: Stormwater Management (continued)

If the proposed project increases peak flow rates for the 2, 10 or 100 year frequency discharges, describe the impacts to downstream areas:

Will the detention facility aggravate erosion along the downstream channel? ☐ Yes ☐ No

In certain situations, detention of stormwater aggravates downstream flooding. This occurs when the discharge from a subwatershed is delayed by a detention facility so that it adds to the peak discharge from another subwatershed. Adding the hydrographs of the two subwatersheds results in a higher peak discharge over that which would occur if detention were not present.

Is the location of the detention facility within the watershed suitable for detention? ☐ Yes ☐ No

Explain:

3. ***Storm Drainage Systems***

Does the proposed project include the construction of subsurface storm drainage systems?

☐ Yes ☒ No If no, you have completed Section II of the worksheets.

If yes, complete this subsection:

a. *DOT Standards* - Is the proposed storm drainage system designed in accordance with the Connecticut Department of Transportation's (DOT) Drainage Manual? ☐ Yes ☐ No

If no, describe the lower design standards and the reasons for not complying with the Drainage Manual:

b. *Design Storm* - Is the storm drainage system designed for a ten year frequency storm without closing the use of the facility? ☐ Yes ☐ No

c. *Future Development* - Has the design of the system considered future development of adjacent properties? ☐ Yes ☐ No

Section II: Stormwater Management (continued)

d. *Outlet Protection* - Have the outlets from the system been designed to minimize the potential for downstream erosion? ☐ Yes ☐ No

e. *Overland Flow* - Has the use of curbing been minimized to encourage overland dispersed flow through stable vegetated areas? ☐ Yes ☐ No

f. *Vegetated Filter Strips* - Has the design incorporated the use of vegetated filter strips or grass swales to improve the quality of water outletting from the storm drainage system? ☐ Yes ☐ No

g. *Stormwater Treatment* - Describe features of the stormwater collection system intended to improve the quality of stormwater runoff prior to its discharge to surface waters.

h. *E & S Control Plan* - Has the design and installation of the storm drainage system been coordinated with the soil erosion and sediment control plan prepared in accordance with the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control? ☐ Yes ☐ No

Explain:

Attachment I

Flood Contingency Plan

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ATTACHMENT I

Flood Contingency Plan

November 2015

TABLE OF CONTENTS

1.0 CONSTRUCTION OPERATION PLAN

Flooding concerns for the Northeast Energy Direct Project ("NED Project" or "Project") are generally those related to construction work within the floodplain(s) of the Farmington River, Degrayes Brook, and Rippowam River. Tennessee will continue to consult with federal, state and local agencies to identify any additional areas where flooding is a concern that may not be currently mapped by the Federal Emergency Management Agency ("FEMA"). Work associated with the Project includes tree and brush clearing, and excavation for installation of the new pipeline that will be constructed as part of the Project. Following construction, grades will be restored to pre-construction conditions and revegetated.

All contractors working in floodplain areas will be responsible for ensuring that all materials and equipment are appropriately protected from potential flooding impacts. The Project construction contractor will be responsible to stay apprised of weather conditions that may indicate a threat of flooding, and will inform all subcontractors of the threat of a flooding emergency. Prior to the start of construction activities in floodplains, a Flood Contingency Operation Plan shall be developed by the construction contractor that includes, but is not limited to the following:

- Name, address and telephone number of the construction contractor, including emergency numbers;
- Method(s) of determining when a threat of flooding exists;
- Notification procedure for on-site personnel, any subcontractors, the Project proponent, and other off-site persons or agencies that require notification, including all pertinent information required for contact (e.g., emergency/weekend telephone numbers);
- A procedure to ensure that, to the greatest extent possible, all construction materials which are not anchored, restrained or otherwise secure are removed from flood prone areas and/or protected from flood damage;
- Field investigation of all existing erosion and sedimentation control measures, with maintenance as necessary;
- Implementation of additional measures necessary to prevent the migration of sediment from unstable areas of the Project site; and
- A procedure to address the site after a flood event and identify and mitigate any damage sustained.

The construction contractor will also be expected to maintain on the Project site, or have readily available, a sufficient supply of materials and personnel to implement the Flood Contingency Operation Plan.

2.0 POST-CONSTRUCTION OPERATION PLAN

No permanent structures or ancillary facilities are proposed within any floodplains in Connecticut. A new pipeline will be installed through the above-mentioned floodplains and returned to pre-existing grades and revegetated. The Project right-of-way ("ROW") and adjacent properties subject to flooding will not be adversely affected by the installation of the new pipeline segment.

The Project ROW will remain vegetated and pervious to stormwater flows and will not require the installation of a stormwater management system. All disturbed areas will be permanently stabilized and revegetated after work is complete to prevent sedimentation of any adjacent watercourse.

Attachment J

Soil Scientist Report

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ATTACHMENT J

Soil Scientist Report For The Connecticut Portion of the

Northeast Energy Project

Prepared for:

Tennessee Gas Pipeline Company, L.L.C.
1001 Louisiana Street
Houston, Texas 77002

November 2015

TABLE OF CONTENTS

LIST OF TABLES

Please Refer to Attachment A

LIST OF FIGURES

Please Refer to Attachment B

1.0 INTRODUCTION

This report describes, and lists the soil characteristics and soil-based constraints associated with the construction and operation of the Connecticut portion of the proposed Northeast Energy Direct Project ("NED Project" or "Project"). The proposed project, as currently configured, would involve the construction of approximately 420-miles of new pipeline and pipeline looping (i.e., the installation of additional pipe to adjacent to the existing pipeline) in Pennsylvania, New York, Massachusetts, New Hampshire and Connecticut. The entire proposed NED Project facilities are as follows:

- Approximately 41 miles of pipeline looping on Tennessee's 300 Line in Pennsylvania;
- Approximately 133 miles of new pipeline, of which 102 miles are proposed to be generally co-located with the certificated Constitution Pipeline Project ("Constitution")[1] in Pennsylvania and New York (extending from Tennessee's existing 300 Line near Auburn, Pennsylvania to Wright, New York);
- Approximately 54 miles of pipeline generally co-located with Tennessee's existing 200 Line and an existing utility corridor in New York;
- Approximately 64 miles of pipeline generally co-located with an existing utility corridor in Massachusetts;
- Approximately 70 miles of pipeline generally co-located with an existing utility corridor in New Hampshire (extending southeast to Dracut, Massachusetts);
- Approximately 58 miles of various laterals and a pipeline loop segment in Massachusetts, New Hampshire, and Connecticut to serve local markets;
- Construction of nine new compressor stations and 15 new meter stations, and modifications to an existing compressor station and 14 existing meter stations throughout the Project area; and
- Construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

The Project is proposed by Tennessee Gas Pipeline Company (Tennessee), a wholly-owned subsidiary of Kinder Morgan, Inc. and a major supplier of natural gas to utilities and power generators in the Northeast. The Connecticut portion of the Project includes the 300 Line Connecticut Loop. The 300 Line Connecticut Loop consists of approximately 14.80 miles of new 24-inch-diameter pipeline generally located within or directly adjacent to Tennessee's existing 300 Line's right-of-way ("ROW"). Additional NED Project facilities include use of access roads and contractor yards.

Soil and wetland scientists identified wetlands and watercourses between November 10, 2014 and September 15, 2015, along the 300 Line Connecticut Loop that are subject to state or federal jurisdiction, based on the Connecticut Inland Wetlands and Watercourses Act (Section 22a-36 through 45 of the Connecticut General Statutes) and the Federal Clean Water Act ([CWA]; 33 U.S.C. 1344). Detailed

[1] On December 2, 2014, the Commission issued an Order Issuing Certificates and Approving Abandonment, Constitution Pipeline Company, LLC, 149 FERC 61,199 (2014), for the Constitution Pipeline Project, which adopted the recommendations from the Constitution "Final Environmental Impact Statement: Constitution Pipeline and Wright Interconnect Projects," FERC Environmental Impact Statement ("EIS") No. 0249F, Docket Numbers CP13-499-000, CP13-502-000, and PF12-9-000 ("Constitution Final EIS ["FEIS"]") issued October 24, 2014.

descriptions of employed methodologies are described in Tennessee's report "*Inventory and Delineation of Wetlands and Watercourses along the Connecticut Portion of the Northeast Energy Direct Project, November 2015*". Connecticut defines a wetland based on the presence of poorly drained, very poorly drained, alluvial and floodplain soils as defined by the National Cooperative Soils Survey. Therefore, this Soil Scientist Report was developed as an addendum to the wetland report and identifies, describes, and lists in greater detail the soil characteristics and soil-based constraints associated with the construction and operation of the proposed 300 Line Connecticut Loop and its associated facilities for both wetland and upland portions of the Project. Soil characteristics traversed by the Project are based on U.S. Department of Agriculture ("USDA") Natural Resource Conservation Service ("NRCS") information for Hartford County, Connecticut. This includes information available from the NRCS Web Soil Survey (USDA-NRCS 2014a).

2.0 SOILS ANALYSIS

In general, soils that exhibit similar horizon composition, thickness, and arrangement make up a Soil Series. The layout of these series on the landscape provides useful information, such as drainage class and geologic origin. Series can be subdivided into map units or phases, with similar physical and chemical properties that can affect the management of a soil. These properties can include slope, stoniness, acidity, wetness, and depth to bedrock. Series and phases are used together to classify and map specific soil types on a landscape.

In the following sections, each soil series map unit crossed by the Connecticut Loop alignment, Access Roads and Pipe Yards are described in detail, and summarized for the entire project. This information was obtained from the USDA-NRCS's Web Soil Survey information for the Hartford County Soil Survey Area available on-line (USDA-NRCS 2014a). In addition, Tables in Attachment A display characteristics of each soil series map unit, including erosion potential, capability class, drainage class, wind erodibility group and depth to water table. This information is important for directing Best Management Practices ("BMPs") that will minimize impacts associated with erosion of important soils such as prime farmlands and preventing transport of those soils into adjacent wetlands and watercourses. Figures of the proposed pipeline corridor, access roads, and contractor yards in relation to field delineated wetlands and NRCS Soil Series' are included in Attachment B.

2.1 SOIL SERIES SUMMARY

The Connecticut Loop is located within the New England Uplands Section of the New England physiographic province (Figure 1). The Connecticut Loop lies within the Central Valley of the New England Uplands, a north-south trending area between the Western and Eastern Uplands (Fenneman 1938). It is a broad, flat valley developed on fairly weak, tilted, stratified rocks, which are Triassic in age. The topography in the area is the product of continental glaciers moving through the region. As these glaciers melted, they dropped sediments resulting in a large amount of till remaining throughout the Connecticut Valley. The Connecticut Valley consists of flood plains along the Connecticut and Farmington Rivers, with nearly level to sloping terraces, low glacial upland hills, and narrow ridges of basalt. Elevations in the region range from 10 feet above sea level on the flood plain of the Connecticut River to 500 feet on the highest basalt ridges (USDA 2008).

Pipeline Corridor

Soils along the Project route in Hartford County (Figures 2 and 3; Table 2-1) formed within a variety of parent materials. However, loamy and silty till deposits are the most prevalent along the pipeline corridor making up approximately 54% of the corridor. These soils tend to be moderately well drained to well drained except for the poorly drained Wilbraham silt loam. Many of these soils formed from outwash of sandstone, conglomerates, and red parent materials. Other soils within the pipeline corridor formed in eolian (wind-blown) deposits over glacial till. Glaciofluvial material (including outwash plains, and terraces on valleys, and kames) deposits account for approximately 26% of the pipeline corridor. The glaciofluvial deposits were laid down by melt water from retreating glaciers and the texture of this material generally ranges from fine to coarse sand to gravel due to the relatively high energy of the melt water from glaciers. Some of the other soils found along the project route are glaciolacustrine in nature including the poorly drained Scitico, Shaker, and Maybid soils which are clayey hydric soils.

Approximately 15 percent of the pipeline corridor is mapped as poorly and very poorly drained wetland soils, of which approximately 5 percent is considered alluvial-floodplain by the NRCS. The only floodplain soil mapped by the NRCS along the alignment as well drained is the Occum fine sandy loam, which makes up approximately less than 1 percent of the pipeline corridor. NRCS has not mapped any poorly drained to very poorly drained hydric soils within the corridor that were formed in organic material (i.e., Histic Epipedons [8-16 inches thick] or Histosols [16-32 inches thick]) among various stages of decomposition (i.e., sapric, hemic or fibric). Poor drainage is more associated with landscape position, and a predominance of fine-textured soils that can result in restrictive layers and perched water tables.

Table 2-2 tabulates soils-specific information for each of the delineated wetland areas along the Project ROWs, identifying each in terms of Project-specific number, location, wetland classification, mapped soil and drainage classification (per the NRCS data), and hydric soil indicators observed during the delineations. As a result of the mapping scale used in creating NRCS maps (typically 1:25,000), more than one NRCS mapping unit is usually associated with an individual wetland. However, field information generally supported that information previously determined by the NRCS, coinciding with soils mapped as poorly drained and very poorly drained.

Prime farmland and farmland of statewide importance are identified for their high soil quality, adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks, which results in high productivity of food, feed, fiber, forage, and oil seed crops. Due to the depositional nature and parent material of soils located within the pipeline corridor, approximately 45 percent of the lands are designated as prime farmland and farmland of statewide importance.

Access Roads

Construction access to the Project areas and ancillary facilities will be by way of the construction ROW and existing roads. Tennessee anticipates utilizing temporary and permanent access roads during the construction of each portion of the Project. Where public road access is unavailable, Tennessee has identified private access roads. Locations of access roads proposed for the Project are shown in Figures 1 and 2.

Access roads include temporary roads that have been previously utilized for prior Tennessee projects and additional locations identified by Tennessee. Soil characteristics for access roads are included in Table 2-3.

Contractor Yards

Tennessee has 14 identified sites to be utilized as contractor yards in Hartford County. Locations of contractor yards proposed for the Project are shown in Figures 1 and 2. Contractor yards are locations that were used for prior Tennessee projects and additional locations identified by Tennessee. These areas will be used for storage of equipment, pipe, and construction materials, as well as temporary field offices and pipe preparation/field assembly. Soil characteristic for proposed contractor yards are included in Table 2-4. Based on field delineated hydric soil boundaries, photo interpreted LiDAR data, and publically available data from USFWS – NWI, the contractors yards are proposed only on upland soils and will not result in any wetland impacts. Soil conditions observed adjacent to the contractor yards are consistent with NRCS soils data.

Aboveground and Appurtenant Facilities

Tennessee is proposing to modify three existing meter stations, as well as to install three mainline valves ("MLVs") and one pig launcher, in Connecticut (Figures 1 and 2). The MLVs and pig facilities are sited within the proposed permanent easements, fencelines of existing stations, or within the permanent ROW of the pipeline, to the extent practicable. Soil series map units temporarily disturbed by development of the aboveground facilities and appurtenant facilities have been identified in Table 2-5. The table includes a summary of the soil characteristics, including identification of prime farmland soils. Tennessee has sited aboveground facilities outside of sensitive soils to the extent practicable.

2.2 SOIL SERIES DESCRIPTIONS

2.2.1 Fairfield County

Canton and Charlton soil, 15 to 35 percent slopes, extremely stony (62D): These moderately steep or steep soils are very deep and well drained in hills on uplands. Permeability moderately rapid to very rapid, water capacity is high, and the depth to seasonal water table is greater than 6 feet.

2.2.2 Hartford County

Belgrade silt loam, 0 to 5 percent slopes (27A): This nearly level to gently sloping soil is very deep and moderately well drained. It is on terraces on lake plains. The seasonal high water table is at a depth 18 to 43 inches. Depth to bedrock is more than 72 inches. Permeability is moderate. Water capacity is very high.

Bradford silt loam, 3 to 8 percent slopes (30B): This gently sloping soil is very deep and well drained. It is on terraces and outwash plains on valleys. The seasonal high water table is at a depth greater than 6 feet. Depth to bedrock is more than 72 inches. Permeability is moderate to very rapid. Water capacity is high.

Broadbrook silt loam, 3 to 8 percent slopes (82B): This gently sloping soil is very deep and well drained. It is on till plains, hills, and drumlins on uplands. The seasonal high water table is at a depth 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very to moderate. Water capacity is moderate.

Broadbrook silt loam, 8 to 15 percent slopes (82C): This strongly sloping soil is very deep and well drained. It is on till plains, hills, and drumlins on uplands. The seasonal high water table is at a depth 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very to moderate. Water capacity is moderate.

Broadbrook silt loam, 15 to 25 percent slopes (82D): This moderately steep soil is very deep and well drained. It is on till plains, hills, and drumlins on uplands. The seasonal high water table is at a depth 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very to moderate. Water capacity is moderate.

Catden and Freetown soils (18): This unit consists of nearly level, very deep, and very poorly drained soils in depressions. This unit is about 40 percent Catden soil, 40 percent Freetown soil, and 20 percent other soils. Permeability is moderate or moderately rapid. Water capacity is very high. Depth to bedrock is more than 72 inches. The seasonal high water table is between the surface and a depth of 12 inches; ponding in possible on the surface.

Cheshire fine sandy loam, 3 to 8 percent slopes (63B): This gently sloping soil is very deep and well drained. It is on till plains and hills on uplands. The seasonal high water table is at a depth greater than 6 feet. Depth to bedrock is greater than 72 inches. Permeability is very to moderate to moderately rapid. Water capacity is high.

Elmridge fine sandy loam, 0 to 3 percent slopes (28A): This nearly level soil is very deep and moderately well drained. It is terraces on lake plains. The seasonal high water table is at a depth of 18 to 30 inches. Water capacity is high. Depth to bedrock is more than 72 inches. Permeability is very slow to moderately rapid.

Hartford sandy loam, 0 to 3 percent slopes (33A): This nearly level soil is very deep and somewhat excessively drained. It is on terraces and outwash plains on valleys. The seasonal high water table is at a depth of greater than 6 feet. Depth to bedrock is greater than 72 inches. Permeability is moderately rapid to very rapid. Water capacity is moderate.

Haven and Enfield soils, 3 to 8 percent slopes (32B): This gently sloping, very deep and well-drained soil is located in terraces and outwash plains on valleys. Permeability is moderate to very rapid, water capacity is moderate, and depth to seasonal water table is greater than 6 feet.

Hinckley gravelly sandy loam, 3 to 15 percent slopes (38C): This gently sloping to strongly sloping soil is very deep and excessively drained. It is on terraces, outwash plains, eskers, and kames on valleys. The seasonal high water table is at a depth greater than 6 feet. Depth to bedrock is more than 72 inches. Permeability is rapid to very rapid. Water capacity is very low.

Hinckley gravelly sandy loam, 15 to 45 percent slopes (38E): This moderately steep to steep soil is very deep and excessively drained. It is on terraces, outwash plains, eskers, and kames on valleys. The seasonal high water table is at a depth greater than 6 feet. Depth to bedrock is more than 72 inches. Permeability is rapid to very rapid. Water capacity is very low.

Holyoke-Rock outcrop complex, 3 to 15 percent slopes (78C): This gently slope to strongly sloping soil is shallow to moderately deep and well drained. It is on bedrock-controlled hills and ridges on uplands. Stones cover the surface. This unit is about 50 percent Holyoke soil, 25 percent Rock outcrop, and 25 percent other soils. The seasonal high water table is at a depth greater than 6 feet. Depth to bedrock is 10 to 20 inches. Permeability is moderate. Water capacity is low.

Holyoke-Rock outcrop complex, 15 to 45 percent slopes (78E): This moderately steep to steep soil is shallow to moderately deep and well drained. It is on bedrock-controlled hills and ridges on uplands. Stones cover the surface. This unit is about 50 percent Holyoke soil, 25 percent Rock outcrop, and 25 percent other soils. The seasonal high water table is at a depth greater than 6 feet. Depth to bedrock is 10 to 20 inches. Permeability is moderate. Water capacity is low.

Ludlow silt loam, 2 to 15 percent slopes, extremely stony (42C): This nearly level to strongly sloping soil is very deep and moderately well drained. It is on hills and drumlin on uplands. Stones cover the surface. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is moderate. Water capacity is moderate.

Ludlow silt loam, 3 to 8 percent slopes (40B): This gently sloping soil is very deep and moderately well drained. It is on hills and drumlin on uplands. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is moderate. Water capacity is moderate.

Manchester gravelly sandy loam, 3 to 15 percent slopes (37C): This gently sloping to strongly sloping soil is very deep and excessively drained. It is on terraces, eskers, kames, and outwash plains on valleys. The seasonal high water table is at a depth of greater than 6 feet. Depth to bedrock is greater than 72 inches. Permeability is rapid to very rapid. Water capacity is low.

Merrimac sandy loam, 0 to 3 percent slopes (34A): This nearly level soil is very deep and somewhat excessively drained. It is on terraces, kames, and outwash plains on valleys. The seasonal high water table is at a depth of greater than 6 feet. Depth to bedrock is greater than 72 inches. Permeability is rapid to very rapid. Water capacity is moderate.

Merrimac sandy loam, 3 to 8 percent slopes (34B): This gently sloping soil is very deep and somewhat excessively drained. It is on terraces, kames, and outwash plains on valleys. The seasonal high water table is at a depth of greater than 6 feet. Depth to bedrock is greater than 72 inches. Permeability is moderately rapid to very rapid. Water capacity is moderate.

Occum fine sandy loam (101): This nearly level soil is very deep and well drained. It is in floodplains. The seasonal high water table is at a depth of 60 to 72 inches. Depth to bedrock is greater than 72 inches. Permeability is moderately to very rapid. Water capacity is high.

Rainbow silt loam, 0 to 3 percent slopes (43A): This nearly level soil is very deep and moderately well drained. It is on drumlins and hills on uplands. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very slow to moderate. Water capacity is moderate.

Rainbow silt loam, 3 to 8 percent slopes (43B): This gently sloping soil is very deep and moderately well drained. It is on drumlins and hills on uplands. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very slow to moderate. Water capacity is moderate.

Raynham silt loam (10): This nearly level soil is very deep and poorly drained. It is in drainage-ways and depressions on lake plains. The seasonal high water table is at a depth of 0 to 12 inches. Depth to bedrock is greater than 72 inches. Permeability is very slow to moderate. Water capacity is very high.

Raypol silt loam (12): This nearly level soil is very deep and poorly drained. It is in drainage-ways and depressions on outwash plains. The seasonal high water table is at a depth of 0 to 12 inches. Depth to bedrock is greater than 72 inches. Permeability is moderate to very rapid. Water capacity is high.

Rippowam fine sandy loam (103): This nearly level soil is very deep and poorly drained. It is in floodplains. The seasonal high water table is at a depth of 0 to 18 inches. Depth to bedrock is greater than 72 inches. Permeability is moderate to very rapid. Water capacity is high.

Rock outcrop-Holyoke complex, 3 to 45 percent slopes (79E): This gently sloping to steep complex consists of shallow to moderately deep and well drained Holyoke and areas of Rock outcrop. This complex is about 55 percent Rock outcrop, 35 percent Hoyloke soils, and 20 percent minor soils. The seasonal high water table is at a depth greater than 6 feet. Depth to bedrock is 10 to 20 inches. Permeability is moderate. Water capacity is low.

Saco silt loam (108): This nearly level soil is very deep and poorly drained. It is in floodplains. The seasonal high water table is at a depth of 0 to 6 inches. Ponding can occur at the surface from 0 to 19 inches. Depth to bedrock is greater than 72 inches. Permeability is moderate to very rapid. Water capacity is very high.

Scarboro muck, 0 to 3 percent slopes (15): This nearly level soil is very deep and very poorly drained. It is on terraces, drainage-ways, and depressions on outwash plains. The seasonal high water table is at a depth of 0 to 6 inches. Ponding can occur above the surface from 0 to 6 inches. Depth to bedrock is greater than 72 inches. Permeability is moderately rapid to very rapid. Water capacity is moderate.

Scitico, Shaker, and Maybid soils (9): This unit is nearly level and very deep soils are on terraces and depressions and drainage-ways on lake plains. This unit is about 55 percent poorly drained Scitico soils, 30 percent poorly drained Shaker soils, 15 percent very poorly drained Maybid soils, and 15 percent minor soils. Depth to bedrock is greater than 72 inches. Permeability is very slow to moderate in the Scitico and Maybid soils and very slow to moderate rapid in the Shaker soil. Water capacity is very high in all soils. The seasonal high water table is at a depth 0 to 12 inches in the Scitco soil and 0 to 18 inches in the Shaker soil. The Maybid soil has a seasonal water table that is at a depth of 0 to 6 inches. Ponding can occur above the surface from 0 to 6 inches.

Sudbury sandy loam, 0 to 5 percent slopes (23A): This nearly level to gently sloping soil is very deep and moderately well drained. It is on outwash plains and terraces on valleys. The seasonal high water table is at a depth of 18 to 36 inches. Depth to bedrock is greater than 72 inches. Permeability is moderately rapid to very rapid. Water capacity is moderate.

Udorthents, smoothed (308): This nearly level to steep soil consists of very deep and moderately well drained. The seasonal high water table is at a depth of 24 to 54 inches. Depth to bedrock is greater than 72 inches. Permeability is very slow to very rapid. Water capacity is high.

Udorthents, flood control (309): This nearly level to steep soil is very deep and moderately well drained. It is on artificial levees. The seasonal high water table is at a depth of 24 to 54 inches. Depth to bedrock is greater than 72 inches. Permeability is very slow to very rapid. Water capacity is high.

Udorthents-Urban land complex (306): This nearly level to moderately steep complex consists of very deep and well drained Udorthents and areas of Urban land. This complex is about 50 percent Udorthents, 35 percent Urban land, and 15 percent minor soils. The seasonal high water table is at a depth of 54 to 72 inches. Depth to bedrock is greater than 72 inches. Permeability is very slow to very rapid. Water capacity is high.

Walpole sandy loam (13): This nearly level soil is very deep and poorly drained. It is on drainage-ways or depressions on terraces or drainage-ways and terraces on outwash plains. Permeability is moderately rapid to very rapid and water capacity is moderate. Depth to seasonal water table is 0 to 12 inches.

Watchaug fine sandy loam, 3 to 8 percent slopes (55B): This gently sloping soil is very deep and moderately well drained. It is on till plains and hills on uplands. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is greater than 72 inches. Permeability is moderate to moderately rapid. Water capacity is high.

Wethersfield loam, 3 to 8 percent slopes (87B): This gently sloping soil is very deep and well drained. It is on hills and drumlins on uplands. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very slow to moderate. Water capacity is moderate.

Wethersfield loam, 8 to 15 percent slopes (87C): This strongly sloping soil is very deep and well drained. It is on hills and drumlins on uplands. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very slow to moderate. Water capacity is moderate.

Wethersfield loam, 15 to 25 percent slopes (87D): This moderately steep soil is very deep and well drained. It is on hills and drumlins on uplands. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very slow to moderate. Water capacity is moderate.

Wethersfield loam, 3 to 8 percent slopes, very stony (88B): This gently sloping soil is very deep and well drained. It is on hills and drumlins on uplands. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very slow to moderate. Water capacity is moderate.

Wethersfield loam, 3 to 15 percent slopes, extremely stony (89C): This gently sloping to strongly sloping soil is very deep and well drained. It is on hills and drumlins on uplands. Stones cover the surface. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very slow to moderate. Water capacity is moderate.

Wethersfield loam, 15 to 35 percent slopes, extremely stony (89D): This moderately steep to steep soil is very deep and well drained. It is on hills and drumlins on uplands. Stones cover the surface. The seasonal high water table is at a depth of 18 to 30 inches. Depth to bedrock is 20 to 40 inches. Permeability is very slow to moderate. Water capacity is moderate.

Wilbraham and Menlo soils, extremely stony (6): This unit is nearly level and very deep soils are on depressions and drainage-ways on uplands. Stones cover the surface. This unit is about 60 percent poorly drained Wilbraham soils, 25 percent very poorly drained Menlo soils, and 15 percent minor soils. Depth to bedrock is 20 to 36 inches in both the Wilbraham and Menlo soils. Permeability is very slow to moderate in both soils. Water capacity is moderate in both soils. The seasonal high water table is at a depth 0 to 18 inches in the Wilbraham soil and 0 to 12 inches in the Menlo soil.

Wilbraham silt loam (5): This nearly level soil is very deep and poorly drained. It is on drainageways and depressions on uplands. Stones cover the surface. The seasonal high water table is at a depth of 0 to 18 inches. Depth to bedrock is 20 to 36 inches. Permeability is very slow to moderate. Water capacity is moderate.

Windsor loamy sand, 0 to 3 percent slopes (36A): This nearly level soil is very deep and excessively drained. It is on kames, outwash plains and terraces on valleys. The seasonal high water table is greater than 6 feet. Depth to bedrock is greater than 72 inches. Permeability is rapid to very rapid. Water capacity is low.

Windsor loamy sand, 3 to 8 percent slopes (36B): This gently sloping soil is very deep and excessively drained. It is on kames, outwash plains and terraces on valleys. The seasonal high water table is greater than 6 feet. Depth to bedrock is greater than 72 inches. Permeability is rapid to very rapid. Water capacity is low.

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Attachment A

Tables

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Table 2-1
Summary of Soil Characteristics for the Pipeline Facilities

Soil Map Symbol	Soil Unit Name	% of Total Line	Water Erosion Potential[1]	Capability Class[2]	Wind Erodibility Group[3]	Poor Drainage Potential[4]	Prime Farmland, Rare or Unique Soils of Statewide Importance
Connecticut							
5	Wilbraham silt loam	1.43	Slight	4w	5	Poorly drained	Farmland of statewide importance
6	Wilbraham and Menlo soils, extremely stony	3.45	Slight	7s	5	Poorly drained	Not prime farmland
9	Scitico, Shaker, and Maybid soils	6.29	Slight	4w	6	Poorly drained	Farmland of statewide importance
10	Raynham silt loam	1.10	Slight	4w	5	Poorly drained	Farmland of statewide importance
12	Raypol silt loam	1.75	Slight	4w	5	Poorly drained	Farmland of statewide importance
15	Scarboro muck, 0 to 3 percent slopes	0.29	Slight	5w	2	Very poorly drained	Not prime farmland
18	Catden and Freetown soils	0.44	Slight	5w	2	Very poorly drained	Not prime farmland
101	Occum fine sandy loam	0.23	Slight	1	3	Well drained	All areas are prime farmland
103	Rippowam fine sandy loam	0.44	Slight	4w	3	Poorly drained	Farmland of statewide importance
108	Saco silt loam	0.26	Slight	6w	5	Very poorly drained	Not prime farmland
306	Udorthents-Urban land complex	2.41	Moderate	3e	5	Well drained	Not prime farmland
308	Udorthents, smoothed	0.34	Moderate	4e	5	Moderately well drained	Not prime farmland
309	Udorthents, flood control	2.22	Moderate	4e	5	Moderately well drained	Not prime farmland
23A	Sudbury sandy loam, 0 to 5 percent slopes	3.73	Slight	2w	3	Moderately well drained	All areas are prime farmland
27A	Belgrade silt loam, 0 to 5 percent slopes	0.50	Slight	2w	5	Moderately well drained	All areas are prime farmland
28A	Elmridge fine sandy loam, 0 to 3 percent slopes	0.09	Slight	2w	3	Moderately well drained	All areas are prime farmland
29A	Agawam fine sandy loam, 0 to 3 percent slopes	0.07	Slight	2s	3	Well drained	All areas are prime farmland
32B	Haven and Enfield soils, 3 to 8 percent slopes	0.05	Slight	2e	5	Well drained	All areas are prime farmland
34A	Merrimac sandy loam, 0 to 3 percent slopes	8.53	Slight	1	3	Somewhat excessively drained	All areas are prime farmland
34B	Merrimac sandy loam, 3 to 8 percent slopes	1.57	Slight	2e	3	Somewhat excessively drained	All areas are prime farmland
36A	Windsor loamy sand, 0 to 3 percent slopes	3.02	Slight	2s	2	Excessively drained	Farmland of statewide importance
36B	Windsor loamy sand, 3 to 8 percent slopes	3.72	Slight	2s	2	Excessively drained	Farmland of statewide importance
36C	Windsor loamy sand, 8 to 15 percent slopes	0.29	Slight	3e	2	Excessively drained	Farmland of statewide importance
37C	Manchester gravelly sandy loam, 3 to 15 percent slopes	1.24	Slight	4e	5	Excessively drained	Farmland of statewide importance
38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	1.59	Slight	4e	5	Excessively drained	Farmland of statewide importance
38E	Hinckley gravelly sandy loam, 15 to 45 percent slopes	0.47	Moderate	6e	5	Excessively drained	Not prime farmland
40B	Ludlow silt loam, 3 to 8 percent slopes	0.26	Slight	2e	5	Moderately well drained	All areas are prime farmland
42C	Ludlow silt loam, 2 to 15 percent slopes, extremely stony	2.96	Moderate	7s	5	Moderately well drained	Not prime farmland

Table 2-1
Summary of Soil Characteristics for the Pipeline Facilities

Soil Map Symbol	Soil Unit Name	% of Total Line	Water Erosion Potential[1]	Capability Class[2]	Wind Erodibility Group[3]	Poor Drainage Potential[4]	Prime Farmland, Rare or Unique Soils of Statewide Importance
43A	Rainbow silt loam, 0 to 3 percent slopes	0.17	Slight	2w	5	Moderately well drained	All areas are prime farmland
43B	Rainbow silt loam, 3 to 8 percent slopes	0.27	Slight	2e	5	Moderately well drained	All areas are prime farmland
55B	Watchaug fine sandy loam, 3 to 8 percent slopes	0.27	Slight	2w	3	Moderately well drained	All areas are prime farmland
63B	Cheshire fine sandy loam, 3 to 8 percent slopes	1.35	Slight	2e	3	Well drained	All areas are prime farmland
78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	12.00	Moderate	6s	N/A	Well drained	Not prime farmland
78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	9.36	Slight	7s	5	Well drained	Not prime farmland
79E	Rock outcrop-Holyoke complex, 3 to 45 percent slopes	5.93	Slight	8	N/A	NA	Not prime farmland
82B	Broadbrook silt loam, 3 to 8 percent slopes	2.62	Slight	2e	5	Well drained	All areas are prime farmland
82C	Broadbrook silt loam, 8 to 15 percent slopes	3.07	Moderate	3e	5	Well drained	Farmland of statewide importance
82D	Broadbrook silt loam, 15 to 25 percent slopes	3.08	Severe	4e	5	Well drained	Not prime farmland
83B	Broadbrook silt loam, 3 to 8 percent slopes, very stony	0.09	Slight	6s	5	Well drained	Not prime farmland
87B	Wethersfield loam, 3 to 8 percent slopes	1.63	Slight	2e	5	Well drained	All areas are prime farmland
87D	Wethersfield loam, 15 to 25 percent slopes	0.83	Severe	4e	5	Well drained	Not prime farmland
89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	6.99	Slight	7s	5	Well drained	Not prime farmland
89D	Wethersfield loam, 15 to 35 percent slopes, extremely stony	3.13	Slight	7s	5	Well drained	Not prime farmland
W	Water	0.45	N/A	N/A	N/A	NA	Not prime farmland

Source: Natural Resources Conservation Service (NRCS 2014b) - SSURGO Soils (County Based)

[1] The erosion potential for each of the soils was determined by reviewing the erosion properties provided by the NRCS's Web Soil Survey. The NRCS has evaluated soils based on slope and soil erosion factor K_W.

- A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions.
- A rating of "moderate" indicates that some erosion is likely and that erosion control measures may be needed.
- A rating of "severe" indicates that erosion is very likely and that erosion control measures, including revegetation of bare areas are advised.
- A rating of "very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion control measures are costly and generally impractical.

[2] Capability class refers to the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. Soil Capability Subclasses are designated by adding e, w, or s to the Capability Class designation. The letter "e" shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; the letter "s" denotes that the soil is limited mainly because it is shallow, droughty, or stony' "w" indicates that water in or on the soil interferes with plant growth or cultivation.

- Capability Class 1: Soils have slight limitations that restrict their use.
- Capability Class 2: Soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Capability Class 3: Soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.
- Capability Class 4: Soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.
- Capability Class 5: Soils are not likely to erode but have other limitations, impractical to remove, that limit their use.
- Capability Class 6: Soils have severe limitations that make them generally unsuitable for cultivation.

Table 2-1
Summary of Soil Characteristics for the Pipeline Facilities

Soil Map Symbol	Soil Unit Name	% of Total Line	Water Erosion Potential[1]	Capability Class[2]	Wind Erodibility Group[3]	Poor Drainage Potential[4]	Prime Farmland, Rare or Unique Soils of Statewide Importance

- Capability Class 7: Soils have very severe limitations that make them unsuitable for cultivation.
- Capability Class 8: Soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

[3] The potential wind erodibility group classification for each of the soils was determined by reviewing the physical soil properties data provided by the NRCS's Web Soil Survey. The NRCS has grouped soils that have similar properties affecting their susceptibility to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. N/A "Not Applicable" - referring to water crossings, urban soils and/or other no-soil features.
[4] Poor Drainage Potential are soils identified by soils characteristics with varying frequency and duration of wet periods.

Table 2-2
Soil Series Map Units Associated with Field Delineated Wetlands along the Connecticut Portion of the Project

Milepost[1] Begin	Milepost[1] End	Wetland ID[2]	Wetland Class[3]	Soil Map Symbol	Soil Units Mapped	Drainage Class	Hydric Soil Indicator[4]
Pipeline Facilities							
6.56	6.57	BL-O-W001	PFO	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Well drained	F3
6.72	6.74	BL-O-W003	PFO	78C, 89C	Holyoke-Rock outcrop complex 3 to 15 percent, Wethersfield loam 3 to 15 percent	Well drained, Well drained	F3
7.12	7.14	BL-B-W007	PEM	40B	Ludlow silt loam 3 to 8 percent	Moderately well drained	F3
7.28	7.40	BL-B-W006	PEM-PFO	5, 56B, 82B	Wilbraham silt loam, Watchaug fine sandy loam 2 to 8 percent, Broadbrook silt loam 3 to 8 percent	Poorly drained, Moderately well drained, Well drained	F3, F21
7.40	7.98	BL-B-W005	PEM-PFO	43B, 5, 82B, 78C	Rainbow silt loam 3 to 8 percent, Wilbraham silt loam, Broadbrook silt loam 3 to 8 percent, Holyoke-Rock outcrop complex 3 to 15 percent	Moderately well drained, Poorly drained, Well drained, Well drained	F3, F2
7.63	7.78	BL-B-W004	PFO	87D, 82D, 6, 77C	Wethersfield loam 15 to 25 percent, Broadbrook silt loam 15 to 25, Wilbraham and Menlo soild, Cheshire-Holyoke complex 3 to 5 percent	Well drained, Well drained, Poorly drained, Well drained	S4
7.96	8.13	BL-B-W002	PEM	5, 82C	Wilbraham silt loam, Broadbrook silt loam 8 to 15 percent	Poorly drained, Well drained	F3
7.97	7.98	BL-O-W004	PEM	5	Wilbraham silt loam	Poorly drained	F21
8.47	8.63	BL-B-W001	PEM-PFO	9, 5, 82C	Scitico, Shaker, and Maybid soils, Wilbraham silt loam, Broadbrook silt loam 8 to 15 percent	Poorly drained, Poorly drained, Well drained	F3, A12
8.67	8.74	BL-P-W002	PEM-PFO	9 37C	Scitico, Shaker, and Maybid soils, Manchester gravelly sandy loam, 3 to 15 percent	Poorly drained, Excessively drained	F3
8.74	9.68	BL-P-W001	PEM-PFO	9, 10, 27A, 37C	Scitico, Shaker, and Maybid soils, Raynham silt loam, Belgrade silt loam 0 to 5 percent slope, Manchester gravelly sandy loam, 3 to 15 percent	Poorly drained, Poorly drained, Moderately well drained, Excessively drained	F3,S4
9.68	10.18	BL-P-W005	PFO	9, 42C, 63B	Scitico, Shaker, and Maybid soils, Ludlow silt loam 2 to 15 percent, Cheshire fine sandy loam 3 to 10 percent	Poorly drained, Moderately well drained, Well drained	F3
10.17	10.36	BL-P-W006	PEM-PFO	63B, 28A, 89D, 9	Cheshire fine sandy loam 3 to 8 percent, Elmridge fine sandy loam 0 to 8 percent, Wethersfield 15 to 35 percent, Scitico, Shaker, and Maybid	Well drained, Moderately well drained, Well drained, Poorly drained	F3
10.98	11.00	BL-N-W006	PEM-PFO	23A	Sudbury sandy loam, 0 to 5 percent	Moderately well drained	F3,F21

Table 2-2
Soil Series Map Units Associated with Field Delineated Wetlands along the Connecticut Portion of the Project

Milepost[1]		Wetland ID[2]	Wetland Class[3]	Soil Map Symbol	Soil Units Mapped	Drainage Class	Hydric Soil Indicator[4]
Begin	End						
11.12	11.14	BL-N-W007	PEM	36C, 36B, 34A	Windsor loamy sand, 8 to 15 percent, Windsor loamy sand, 3 to 8 percent, Merrimac sandy loam, 0 to 3 percent	Excessively drained, Excessively drained, Somewhat excessively drained	F3
11.28	11.36	BL-N-W003	PFO	23A, 108, 38E	Sudbury sandy loam, 0 to 5 percent, Saco silt loam, Hinkley gravelly sandy loam	Moderately well drained, Excessively drained Very poorly drained	F3
11.40	11.41	BL-N-W002	PFO	34B	Merrimac sandy loam, 3 to 8 percent slopes	Somewhat excessively drained	F3
13.97	13.99	WI-P-W001	PEM	82B	Broadbrook silt loam, 3 to 8 percent slopes	Well Drained	
14.11	14.26	EG-P-W001	PFO	55B, 23A, 12	Watchaug fine sandy loam 3 to 8 percent, Sudbury sandy loam, 0 to 5 percent, Raypol silt loam	Moderately well drained, Moderately well drained, Poorly drained	F3
Access Roads							
7.43		BL-O-W004	PEM	5	Wilbraham silt loam	Poorly drained	Other
7.43		BL-B-W005	PFO	43B, 5, 82B	Rainbow silt loam 3 to 8 percent, Wilbraham silt loam, Broadbrook silt loam 3 to 8 percent	Moderately well drained, Poorly drained, Well drained	F2
9.02		BL-P-W001	PEM	9, 10, 27A, 37C	Scitico, Shaker, and Maybid soils, Raynham silt loam, Belgrade silt loam 0 to 5 percent slope, Manchester gravelly sandy loam, 3 to 15 percent	Poorly drained, Poorly drained, Moderately well drained, Excessively drained	F3

1. Mileposts Access Roads are given as nearest MP, which indicates the point at which the Access Road or Contractor Yard connects with the pipeline construction ROW, or closest MP to the construction ROW if there is no direct connection
2. Wetland series number generated to identify wetlands within and adjacent to the Project corridor;
3. Wetlands classification according to Cowardin et al 1979; PEM = Palustrine Emergent Wetland; PFO = Palustrine Forested Wetland; PSS = Palustrine Scrub-Shrub Wetland; POW = Palustrine Open Water.
4. Hydric Soil Indicators from United States Army Corps of Engineers ("USACE") Regional Supplement (January 2012). A1: Histosol, A2: Histic Epipedon, A3: Black Histic, A5: Stratified Layers, A11: Depleted Below Dark Surface, A12: Thick Dark Surface, F2: Loamy Gleyed Matrix, F3: Depleted Matrix, S5: Sandy Redox, S6: Stripped Matrix.

Table 2-3
Summary of Soil Characteristics and Potential Impacts for Access Roads in Connecticut

Access Road Name	Nearest Milepost[2]	Soil Map Symbol	Soil Unit Name	Water Erosion Potential[3]	Capability Class[4]	Wind Erodibility Group[5]	Poor Drainage Potential[6]
NED-TAR-S-0100	0.07	89D	Wethersfield loam, 15 to 35 percent slopes, extremely stony	Slight	7s	5	Well drained
NED-TAR-S-0100	0.07	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained
TGP-TAR-S-0100	0.70	89D	Wethersfield loam, 15 to 35 percent slopes, extremely stony	Slight	7s	5	Well drained
TGP-TAR-S-0100	0.70	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained
TGP-TAR-S-0100	0.70	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained
TGP-TAR-S-0100	0.70	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained
TGP-TAR-S-0100	0.70	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained
TGP-TAR-S-0100	0.70	89D	Wethersfield loam, 15 to 35 percent slopes, extremely stony	Slight	7s	5	Well drained
TGP-TAR-S-0100	0.70	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained
TGP-TAR-S-0100	0.70	18	Catden and Freetown soils	Slight	5w	5	Very poorly drained
TGP-TAR-S-0100	0.70	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained
TGP-TAR-S-0100	0.70	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained
TGP-TAR-S-0100	0.70	79E	Rock outcrop-Holyoke complex, 3 to 45 percent slopes	Slight	8	5	NA
TGP-TAR-S-0100	0.70	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained
TGP-TAR-S-0100	0.70	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained
TGP-TAR-S-0100	0.70	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained
TGP-TAR-S-0100	0.70	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained
TGP-TAR-S-0100	0.70	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained
TGP-TAR-S-0100	0.70	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained
TGP-TAR-S-0100	0.70	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained
TGP-TAR-S-0100	0.70	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained
NED-TAR-S-0101	3.62	308	Udorthents, smoothed	Moderate	4e	5	Moderately well drained
NED-TAR-S-0101	3.62	303	Pits, quarries	Slight	8	5	NA
NED-TAR-S-0101	3.62	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained
TGP-TAR-S-0200	7.43	82B	Broadbrook silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained
TGP-TAR-S-0200	7.43	5	Wilbraham silt loam	Slight	4w	5	Poorly drained
TGP-TAR-S-0200	7.43	82B	Broadbrook silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained
NED-TAR-S-0300	7.80	82B	Broadbrook silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained
NED-TAR-S-0300	7.80	43B	Rainbow silt loam, 3 to 8 percent slopes	Slight	2e	5	Moderately well drained
TGP-TAR-S-0300	9.02	27A	Belgrade silt loam, 0 to 5 percent slopes	Slight	2w	5	Moderately well drained
TGP-TAR-S-0300	9.02	87B	Wethersfield loam, 3 to 8 percent slopes	Slight	2e	5	Well drained
TGP-TAR-S-0300	9.02	87C	Wethersfield loam, 8 to 15 percent slopes	Moderate	3e	5	Well drained
TGP-TAR-S-0300	9.02	30B	Branford silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained

Table 2-3
Summary of Soil Characteristics and Potential Impacts for Access Roads in Connecticut

Access Road Name	Nearest Milepost[2]	Soil Map Symbol	Soil Unit Name	Water Erosion Potential[3]	Capability Class[4]	Wind Erodibility Group[5]	Poor Drainage Potential[6]
TGP-TAR-S-0400	10.71	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained
TGP-TAR-S-0400	10.71	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained
NED-TAR-S-0400	11.72	38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	Slight	4e	5	Excessively drained
NED-TAR-S-0400	11.72	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	5	Somewhat excessively drained
NED-TAR-S-0400	11.72	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	5	Somewhat excessively drained
NED-TAR-S-0400	11.72	38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	Slight	4e	5	Excessively drained
NED-TAR-S-0400	11.72	38E	Hinckley gravelly sandy loam, 15 to 45 percent slopes	Moderate	6e	5	Excessively drained
NED-TAR-S-0400	11.72	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	5	Somewhat excessively drained
NED-TAR-S-0400	11.72	82B	Broadbrook silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained
NED-TAR-S-0400	11.72	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	5	Somewhat excessively drained
NED-TAR-S-0500	13.21	12	Raypol silt loam	Slight	4w	5	Poorly drained
NED-TAR-S-0500	13.21	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	5	Somewhat excessively drained
NED-TAR-S-0500	13.21	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	5	Excessively drained
NED-TAR-S-0600	13.39	23A	Sudbury sandy loam, 0 to 5 percent slopes	Slight	2w	3	Moderately well drained
NED-TAR-S-0600	13.39	87B	Wethersfield loam, 3 to 8 percent slopes	Slight	2e	3	Well drained
NED-TAR-S-0600	13.39	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	3	Excessively drained
NED-TAR-S-0700	14.49	12	Raypol silt loam	Slight	4w	5	Poorly drained
NED-TAR-S-0700	14.49	306	Udorthents-Urban land complex	Moderate	3e	5	Well drained
NED-TAR-S-0800	14.80	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	2	Excessively drained
NED-TAR-S-0800	14.80	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	2	Somewhat excessively drained
NED-TAR-S-0800	14.80	306	Udorthents-Urban land complex	Moderate	3e	2	Well drained
NED-TAR-S-0900	14.80	25B	Brancroft silt loam, 3 to 8 percent slopes	Slight	2e	6	Moderately well drained
NED-TAR-S-0900	14.80	108	Saco silt loam	Slight	6w	6	Very poorly drained
NED-TAR-S-0900	14.80	9	Scitico, Shaker, and Maybid soils	Slight	4w	6	Poorly drained

Source: Data set utilized for soils is "Natural Resources Conservation Service (NRCS 2014a) - SSURGO Soils (County Based)."

N/A - "Not Applicable" as the Soil category does not meet the defined criteria as stated in the footnotes.

[1] Each segment is associated with its own set of mileposts starting at MP 0.00.

[2] Nearest milepost indicates the point at which the access road connects with the pipeline ROW, or closest milepost to ROW if there is no direct connection.

Table 2-3
Summary of Soil Characteristics and Potential Impacts for Access Roads in Connecticut

Access Road Name	Nearest Milepost[2]	Soil Map Symbol	Soil Unit Name	Water Erosion Potential[3]	Capability Class[4]	Wind Erodibility Group[5]	Poor Drainage Potential[6]

[3] The erosion potential for each of the soils was determined by reviewing the erosion properties provided by the NRCS's Web Soil Survey. The NRCS has evaluated soils based on slope and soil erosion factor K_W.

- A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions.
- A rating of "moderate" indicates that some erosion is likely and that erosion control measures may be needed.
- A rating of "severe" indicates that erosion is very likely and that erosion control measures, including revegetation of bare areas are advised.
- A rating of "very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion control measures are costly and generally impractical.

[4] Capability class refers to the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. Soil Capability Subclasses are designated by adding e, w, or s to the Capability Class designation. The letter "e" shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; the letter "s" denotes that the soil is limited mainly because it is shallow, droughty, or stony' "w" indicates that water in or on the soil interferes with plant growth or cultivation.

- Capability Class 1: Soils have slight limitations that restrict their use.
- Capability Class 2: Soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Capability Class 3: Soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.
- Capability Class 4: Soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.
- Capability Class 5: Soils are not likely to erode but have other limitations, impractical to remove, that limit their use.
- Capability Class 6: Soils have severe limitations that make them generally unsuitable for cultivation.
- Capability Class 7: Soils have very severe limitations that make them unsuitable for cultivation.
- Capability Class 8: Soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

[5] The potential wind erodibility group classification for each of the soils was determined by reviewing the physical soil properties data provided by the NRCS's Web Soil Survey. The NRCS has grouped soils that have similar properties affecting their susceptibility to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. N/A "Not Applicable" - referring to water crossings, urban soils and/or other non-soil features.

Table 2-4
Summary of Soil Characteristics and Potential Impacts within the Contractor Yards in Connecticut

Contractor Yard Name	Nearest Milepost[1]	Soil Map Symbol	Soil Unit Name	Water Erosion Potential[2]	Capability Class[3]	Wind Erodibility Group[4]	Poor Drainage Potential[5]	Prime Farmland, Rare or Unique Soils of Statewide Importance
NED-S-0400	3.63	303	Pits, quarries	Slight	8	NA	NA	Not prime farmland
NED-S-0400	3.63	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	NA	Well drained	Not prime farmland
NED-S-0400	3.63	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	NA	Well drained	Not prime farmland
NED-S-0001	7.87	43B	Rainbow silt loam, 3 to 8 percent slopes	Slight	2e	5	Moderately well drained	All areas are prime farmland
NED-S-0001	7.87	82B	Broadbrook silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained	All areas are prime farmland
NED-S-0002	11.83	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained	All areas are prime farmland
NED-S-0002	11.83	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	3	Excessively drained	Farmland of statewide importance
NED-S-0002	11.83	38E	Hinckley gravelly sandy loam, 15 to 45 percent slopes	Moderate	6e	3	Excessively drained	Not prime farmland
NED-S-0100	13.25	13	Walpole sandy loam, 0 to 3 percent slopes	Slight	4w	5	Poorly drained	Farmland of statewide importance
NED-S-0100	13.25	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	5	Excessively drained	Farmland of statewide importance
NED-S-0100	13.25	36B	Windsor loamy sand, 3 to 8 percent slopes	Slight	2s	5	Excessively drained	Farmland of statewide importance
NED-S-0200	14.59	306	Udorthents-Urban land complex	Moderate	3e	5	Well drained	Not prime farmland
NED-S-0300	14.80	108	Saco silt loam	Slight	6w	5	Very poorly drained	Not prime farmland
NED-S-0300	14.80	28A	Elmridge fine sandy loam, 0 to 3 percent slopes	Slight	2w	5	Moderately well drained	All areas are prime farmland

Source: Data set utilized for soils is Natural Resources Conservation Service (NRCS 2014a) - SSURGO Soils (County Based) Accessed January 17, 2014.

N/A - "Not Applicable" as the Soil category does not meet the defined criteria as stated in the footnotes.

[1] Mileposts for Contractor Yards are given as nearest MP, which indicates the point at which the Access Road or Contractor Yard connects with the pipeline construction ROW, or closest MP to the construction ROW if there is no direct connection

[2] The erosion potential for each of the soils was determined by reviewing the erosion properties provided by the NRCS's Web Soil Survey. The NRCS has evaluated soils based on slope and soil erosion factor K_W.

- A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions.
- A rating of "moderate" indicates that some erosion is likely and that erosion control measures may be needed.
- A rating of "severe" indicates that erosion is very likely and that erosion control measures, including revegetation of bare areas are advised.

[3] Capability class refers to the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. Soil Capability Subclasses are designated by adding e, w, or s to the Capability Class designation. The letter "e" shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; the letter "s" denotes that the soil is limited mainly because it is shallow, droughty, or stony' "w" indicates that water in or on the soil interferes with plant growth or cultivation.

- Capability Class 1: Soils have slight limitations that restrict their use.
- Capability Class 2: Soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Table 2-4
Summary of Soil Characteristics and Potential Impacts within the Contractor Yards in Connecticut

Contractor Yard Name	Nearest Milepost[1]	Soil Map Symbol	Soil Unit Name	Water Erosion Potential[2]	Capability Class[3]	Wind Erodibility Group[4]	Poor Drainage Potential[5]	Prime Farmland, Rare or Unique Soils of Statewide Importance

- Capability Class 3: Soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.
- Capability Class 4: Soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.
- Capability Class 5: Soils are not likely to erode but have other limitations, impractical to remove, that limit their use.
- Capability Class 6: Soils have severe limitations that make them generally unsuitable for cultivation.
- Capability Class 7: Soils have very severe limitations that make them unsuitable for cultivation.
- Capability Class 8: Soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

[4] The potential wind erodibility group classification for each of the soils was determined by reviewing the physical soil properties data provided by the NRCS’s Web Soil Survey. The NRCS has grouped soils that have similar properties affecting their susceptibility to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. N/A "Not Applicable" - referring to water crossings, urban soils and/or other no-soil features.

[5] Poor Drainage Potential are soils identified by soils characteristics with varying frequency and duration of wet periods

Table 2-5
Summary of Soil Characteristics and Potential Impacts for the Aboveground and Appurtenant Facilities in Connecticut

Facility Name	Facility Type	Nearest Milepost	Soil Map Symbol	Soil Unit Name	Potential Water Erosion[1]	Capability Class[2]	Wind Erodibity Group[3]	Poor Drainage Potential[4]	Prime Farmland, Rare or Unique Soils of Statewide Importance
MLV-S-01[7]	Mainline Valve	0.00	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained	Not prime farmland
PL-S-01[7]	Pig Launcher	0.00	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained	Not prime farmland
MLV-S-02[7]	Mainline Valve	6.97	82D	Broadbrook silt loam, 15 to 25 percent slopes	Severe	4e	5	Well drained	Not prime farmland
North Bloomfield (20453)	Meter Station	10.86	38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	No	4e	5	Excessively drained	Farmland of statewide importance
MLV-S-03[7]	Mainline Valve	14.80	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance
Easton (20853)	Meter Station	Existing Facility	62C	Canton and Charlton soils, 3 to 15 percent slopes, extremely stony	No	7s	5	Well drained	Not prime farmland
Easton (20853)	Meter Station	Existing Facility	62D	Canton and Charlton soils, 15 to 35 percent slopes, extremely stony	No	7s	5	Well drained	Not prime farmland
Easton (20853)	Meter Station	Existing Facility	60B	Canton and Charlton soils, 3 to 8 percent slopes	No	2e	5	Well drained	All areas are prime farmland
Milford (20425)	Meter Station	Existing Facility	30B	Branford silt loam, 3 to 8 percent slopes	No	2e	5	Well drained	All areas are prime farmland
Milford (20425)	Meter Station	Existing Facility	29C	Agawam fine sandy loam, 8 to 15 percent slopes	No	3e	3	Well drained	Farmland of statewide importance

Source: Natural Resources Conservation Service (NRCS 2014a) - SSURGO Soils (County Based)

[1] The erosion potential for each of the soils was determined by reviewing the erosion properties provided by the NRCS's Web Soil Survey. The NRCS has evaluated soils based on slope and soil erosion factor K.

- A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions.
- A rating of "moderate" indicates that some erosion is likely and that erosion control measures may be needed.
- A rating of "severe" indicates that erosion is very likely and that erosion control measures, including revegetation of bare areas are advised.
- A rating of "very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion control measures are costly and generally impractical.

[2] Capability class refers to the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. Soil Capability Subclasses are designated by adding e, w, or s to the Capability Class designation. The letter "e" shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; the letter "s" denotes that the soil is limited mainly because it is shallow, droughty, or stony' "w" indicates that water in or on the soil interferes with plant growth or cultivation.

- Capability Class 1: Soils have slight limitations that restrict their use.
- Capability Class 2: Soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Capability Class 3: Soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.
- Capability Class 4: Soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.
- Capability Class 5: Soils are not likely to erode but have other limitations, impractical to remove, that limit their use.
- Capability Class 6: Soils have severe limitations that make them generally unsuitable for cultivation.
- Capability Class 7: Soils have very severe limitations that make them unsuitable for cultivation.

Table 2-5
Summary of Soil Characteristics and Potential Impacts for the Aboveground and Appurtenant Facilities in Connecticut

Facility Name	Facility Type	Nearest Milepost	Soil Map Symbol	Soil Unit Name	Potential Water Erosion[1]	Capability Class[2]	Wind Erodibity Group[3]	Poor Drainage Potential[4]	Prime Farmland, Rare or Unique Soils of Statewide Importance

- Capability Class 8: Soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

[3] The wind erodibility group classification for each of the soils was determined by reviewing the physical soil properties data provided by the NRCS's Web Soil Survey. The NRCS has grouped soils that have similar properties affecting their susceptibility to wind erosion. The soils assigned to group 0 do not have data available, those assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

[4] Poor Drainage Potential are soils identified by soils characteristics with varying frequency and duration of wet periods

Attachment B

Figures

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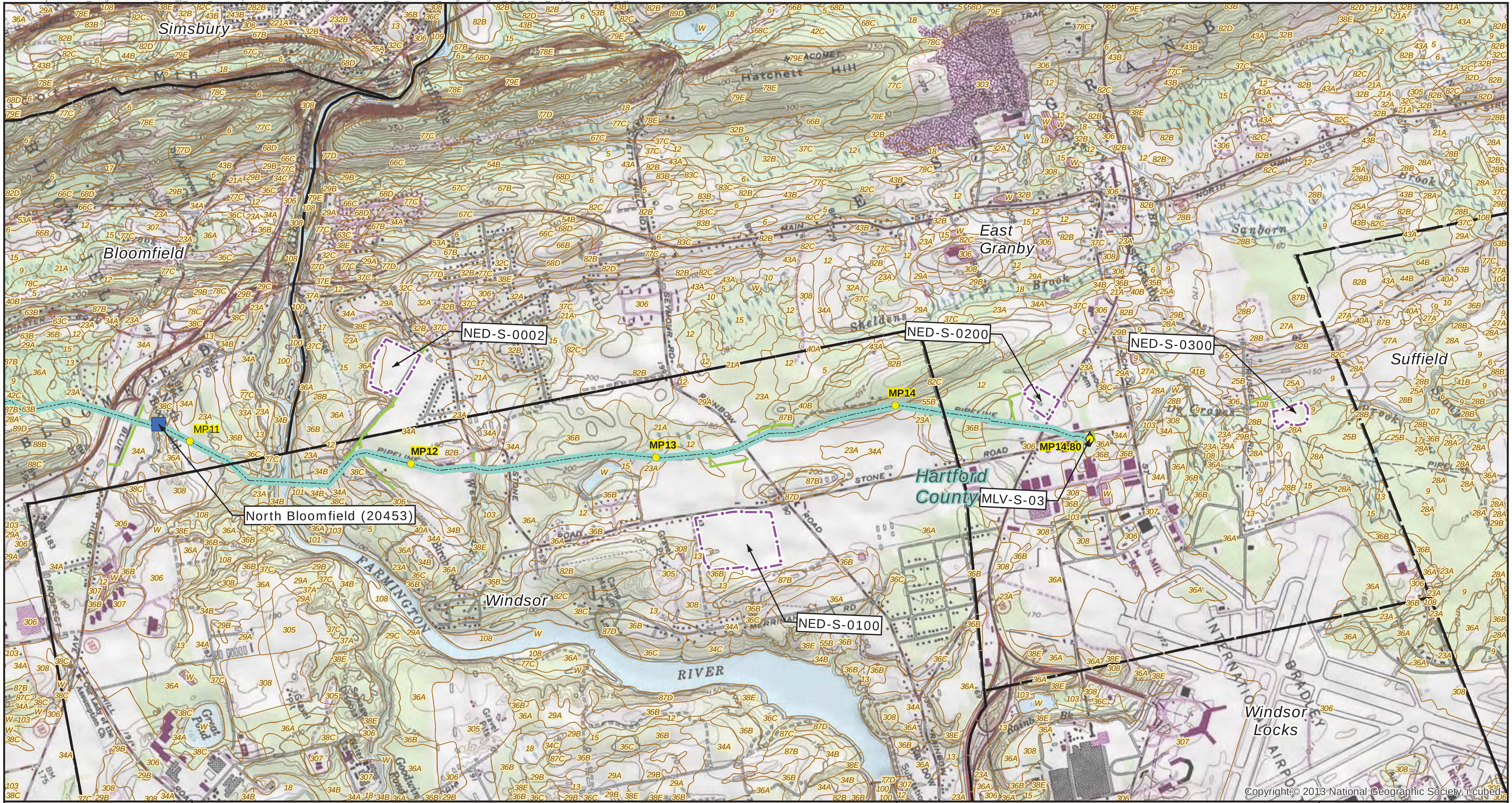

Index Map

Legend

- NED Loop 317-3
- NED Loop 319-3
- NED PA to Wright Pipeline Segment
- NED Wright to Dracut Pipeline Segment
- NED Maritimes Delivery Line
- NED Lynnfield Lateral
- NED Peabody Lateral
- NED Haverhill Lateral
- NED Fitchburg Lateral Extension
- NED 300 Line CT Loop
- Access Road
- Milepost (MP)
- Mainline Valve (MLV)
- Pig Facility (PB, PL, PR, TB)
- Compressor Station
- Meter Station
- Contractor Yard
- Town Boundary
- County Boundary
- State Boundary
- Soil Mapping Unit

0 0.25 0.5 1 Miles

1 inch = 2,000 feet

Tennessee Gas Pipeline Company, L.L.C.

Northeast Energy Direct Project

Soil Map Units Crossed by the Project in Connecticut

Tennessee Gas Pipeline Company, L.L.C.
a Kinder Morgan company

AECOM

Sheet 1 of 4

November 2015

FIGURE 2

Map Projection: NAD83 UTM18N Ft.

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Index Map

Legend

- NED Loop 317-3
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- NED Maritimes Delivery Line
- NED Lynnfield Lateral
- NED Peabody Lateral
- NED Haverhill Lateral
- NED Fitchburg Lateral Extension
- NED 300 Line CT Loop
- Access Road
- Milepost (MP)
- Mainline Valve (MLV)
- Pig Facility (PB, PL, PR, TB)
- Compressor Station
- Meter Station
- Contractor Yard
- Town Boundary
- County Boundary
- State Boundary
- Soil Mapping Unit

Tennessee Gas Pipeline Company, L.L.C.

Northeast Energy Direct Project

Soil Map Units Crossed by the Project in Connecticut

0 0.25 0.5 1 Miles

1 inch = 2,000 feet

Tennessee Gas Pipeline Company, L.L.C. a Kinder Morgan company

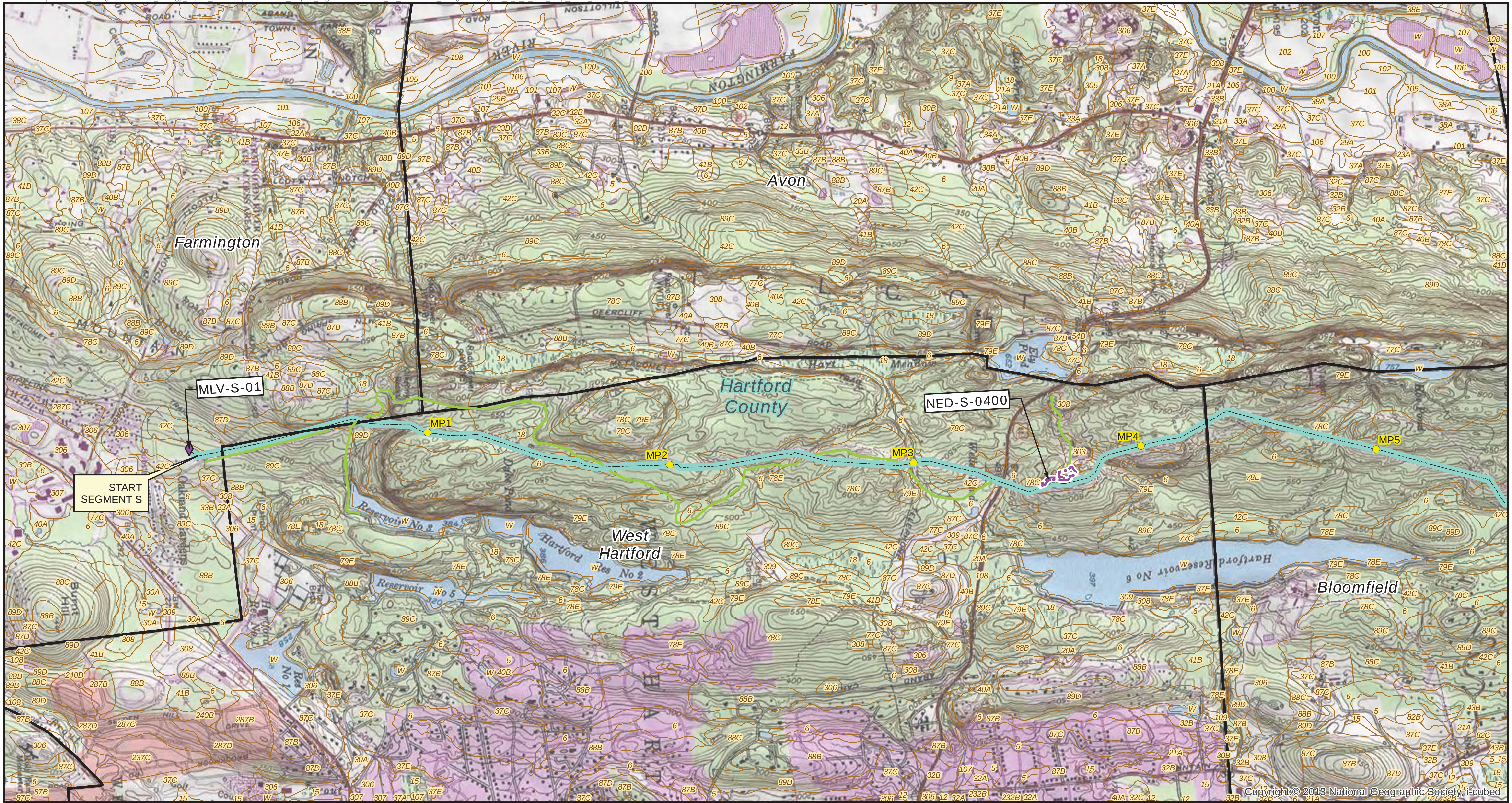
AECOM

Sheet 2 of 4

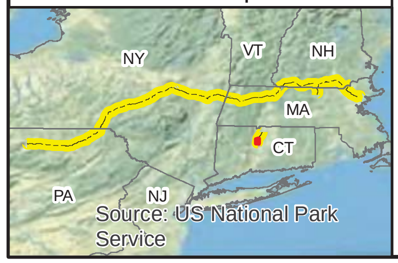
November 2015

FIGURE 2

Map Projection: NAD83 UTM18N Ft.



Index Map



Legend

- NED Loop 317-3
- NED Loop 319-3
- NED PA to Wright Pipeline Segment
- NED Wright to Dracut Pipeline Segment
- NED Maritimes Delivery Line
- NED Lynnfield Lateral
- NED Peabody Lateral
- NED Haverhill Lateral
- NED Fitchburg Lateral Extension
- NED 300 Line CT Loop
- Access Road
- Milepost (MP)
- Mainline Valve (MLV)
- Pig Facility (PB, PL, PR, TB)
- Compressor Station
- Meter Station
- Contractor Yard
- Town Boundary
- County Boundary
- State Boundary
- Soil Mapping Unit

Tennessee Gas Pipeline Company, L.L.C.

Northeast Energy Direct Project

Soil Map Units Crossed by the Project in Connecticut

0 0.25 0.5 1 Miles

1 inch = 2,000 feet

Tennessee Gas Pipeline Company, L.L.C. a Kinder Morgan company

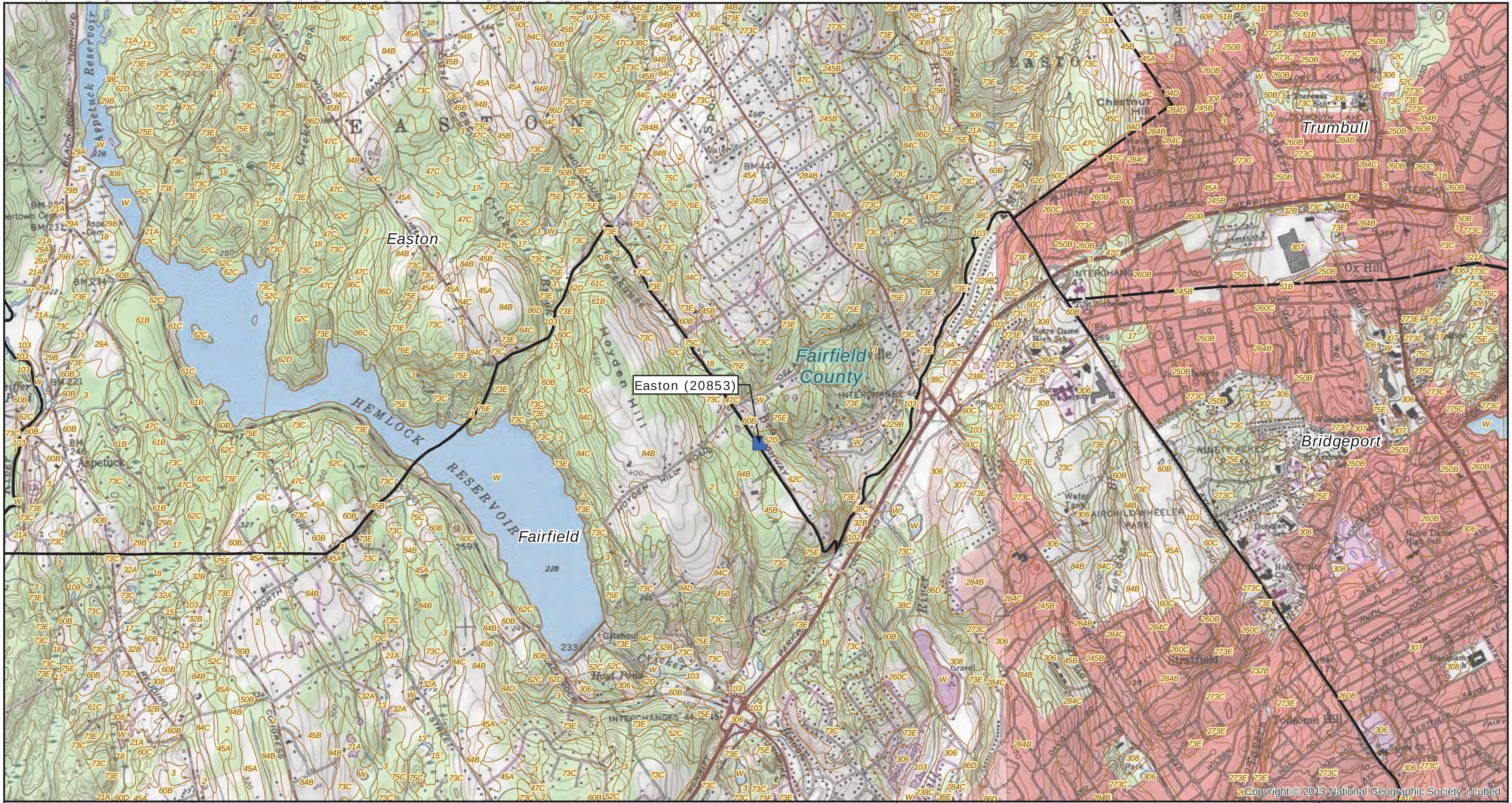
AECOM

Sheet 3 of 4

November 2015

FIGURE 2

Path: Y:\Projects\Kinder_Morgan\Northeast_Energy_Direct_NED\Maps\Resource_Report_Figures\MXD\2015_11_November_Filing\RR7\Figure_7_1_1_Soil_Map_Units_sheets_1_99.mxd



Index Map

Legend

- NED Loop 317-3
- NED Loop 319-3
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- NED Wright to Dracut Pipeline Segment
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- NED Lynnfield Lateral
- NED Peabody Lateral
- NED Haverhill Lateral
- NED Fitchburg Lateral Extension
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N W E S

Tennessee Gas Pipeline Company, L.L.C.

Northeast Energy Direct Project

Soil Map Units Crossed by the Project in Connecticut

0 0.25 0.5 1 Miles

1 inch = 2,000 feet

Tennessee Gas Pipeline Company, L.L.C. a Kinder Morgan company

AECOM

Sheet 4 of 4

November 2015

FIGURE 2

Map Projection: NAD83 UTM18N Ft.

Attachment K

Environmental Assessment Report

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ATTACHMENT K

ENVIRONEMNTAL ASSESSMENT FOR THE NORTHEAST ENERGY DIRECT PROJECT

Submitted By:

Tennessee Gas Pipeline Company, L.L.C.
1001 Louisiana Street
Houston, TX 77002

November 2015

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") is filing an application seeking the issuance of a certificate of public convenience and necessity from the Federal Energy Regulatory Commission ("Commission" or "FERC") for the construction and operation of the proposed Northeast Energy Direct Project ("NED Project" or "Project"). Tennessee proposes to expand and modify its existing pipeline system in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. The NED Project is being developed to meet the increased demand in the Northeast United States ("U.S.") for transportation capacity of natural gas.

The NED Project will provide new firm natural gas transportation capacity to meet the growing energy needs in the Northeast U.S., particularly in New England. The Supply Path Component, as defined below, will transport up to 1.2 billion cubic feet per day ("Bcf/d") of natural gas, and the Market Path Component, as defined below, will transport up to 1.3 Bcf/d of natural gas.[1] For the purposes of this Environmental Assessment, the Project volume will be referred to as up to 1.3 Bcf/d. The proposed Project involves the following facilities:

- Approximately 41 miles of pipeline looping on Tennessee's 300 Line in Pennsylvania;
- Approximately 133 miles of new pipeline, of which 102 miles are proposed to be generally co-located with the certificated Constitution Pipeline Project ("Constitution")[2] in Pennsylvania and New York (extending from Tennessee's existing 300 Line near Auburn, Pennsylvania to Wright, New York);
- Approximately 54 miles of pipeline generally co-located with Tennessee's existing 200 Line and an existing utility corridor in New York;
- Approximately 64 miles of pipeline generally co-located with an existing utility corridor in Massachusetts;
- Approximately 70 miles of pipeline generally co-located with an existing utility corridor in New Hampshire (extending southeast to Dracut, Massachusetts);
- Approximately 58 miles of various laterals and pipeline looping segments in Massachusetts, New Hampshire, and Connecticut to serve local markets;
- Construction of nine new compressor stations and 15 new meter stations, and modifications to an existing compressor station and 14 existing meter stations throughout the Project area; and

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[1] The reason for the difference in the capacity volumes of the two Project components is that Tennessee is assuming a certain amount of volumes to flow on the Market Path component facilities from sources other than the Supply Path component.

[2] On December 2, 2014, the Commission issued an Order Issuing Certificates and Approving Abandonment, Constitution Pipeline Company, LLC, 149 FERC 61,199 (2014), for the Constitution Pipeline Project, which adopted the recommendations from the Constitution "Final Environmental Impact Statement: Constitution Pipeline and Wright Interconnect Projects," FERC Environmental Impact Statement ("EIS") No. 0249F, Docket Numbers CP13-499-000, CP13-502-000, and PF12-9-000 ("Constitution Final EIS ["FEIS"]") issued October 24, 2014. Information contained within this report related to the Constitution Pipeline Project was based on the updated routing included in the FEIR, as approved by the certificate order.

- Construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

To the extent that it is practicable, feasible, and in compliance with existing law, Tennessee proposes to locate proposed pipeline facilities (either pipeline looping segments or co-located pipeline facilities) generally within or adjacent to its existing right-of-way ("ROW") associated with its existing 300 Line in Pennsylvania and Connecticut; its existing 200 Line in New York and Massachusetts; and existing utility (pipeline and powerline) corridors in Pennsylvania, New York, Massachusetts, and New Hampshire.

Pipeline loops are those pipeline segments which are laid parallel to, and connected to, another pipeline and used to increase capacity along existing pipeline facilities. These lines are connected to move larger volumes of gas through a single pipeline segment.

Co-located pipelines are those that are laid parallel to another existing pipeline or linear utility. The current route of Tennessee's proposed NED Project, in large part, is located parallel and adjacent to, and, in many cases, overlaps existing utility easements (either pipeline or powerlines). This paralleling/overlapping of easements is commonly referred to as co-location. Refinement to the routing, of the NED Project, including locations of permanent easement and temporary construction workspaces, has occurred as the NED Project was developed during the pre-filing process and will continue as necessary through the certificate processes, incorporating information gained from field surveys, and landowner and stakeholder input, including input from power companies that have existing easements in areas where Tennessee is proposing to co-locate the Project pipelines.

Tennessee is requesting issuance of a certificate order for the Project in November 2016 and proposes to commence construction activities in January 2017, in anticipation of placing the Project facilities in-service by November 2018 (with the exception of the proposed pipeline looping segment in Connecticut, which will be placed in-service by November 2019), consistent with the terms and conditions of the precedent agreements executed with Project Shippers.

This Environmental Assessment Report pertains only to those Project facilities, conditions, and impacts within Connecticut.

2.0 GENERAL SITE DESCRIPTION

The proposed Project pipeline facility in Connecticut includes the 300 Line Connecticut Loop. The 300 Line Connecticut Loop consists of approximately 14.80 miles of new 24-inch-diameter pipeline generally located within or directly adjacent to Tennessee's existing 300 Line's right-of-way ("ROW") in the towns of Avon, Bloomfield, East Granby, Farmington, Simsbury, West Hartford, and Windsor. This proposed loop segment will be designed for a MAOP of 800 and a MOP of 719 psig.

Meter station modifications will occur in Connecticut and are as follows:

- Easton – Fairfield County, Connecticut: This project is an upgrade to an existing meter station. Modifications include the installation of a new 4-inch rotary meter in place of the existing meter by-pass run.
- North Bloomfield – Hartford County, Connecticut: This project is an upgrade to an existing meter station. Modifications include the installation of a new station tap assembly, replacement of the station inlet piping, addition of a filter-separator, replacement of the existing meter run headers, replacement and/or addition to the station metering.
- Milford – New Haven County, Connecticut: This project is an upgrade to an existing meter station. Modifications include the replacement of the station inlet piping and the replacement of an existing 2-inch turbine meter run.

Tennessee has identified locations to be utilized for contractor yards for the Project. These areas will be used for equipment, pipe, and material storage and staging, as well as temporary field offices and pipe preparation/field assembly areas. Contractor yards proposed represent locations that were utilized for prior Tennessee projects, and additional areas identified by Tennessee. Locations of proposed contractor yards are depicted on the USGS topographic maps and aerial alignment sheets provided in Attachment Q.

Contractor yards that are proposed to be used for the Project include those located in previously disturbed areas such as open fields, sand and gravel pits, parking lots and industrial facilities. Tennessee will select contractor yard sites considering any environmental impacts identified during environmental field surveys and obtain the appropriate regulatory permits prior to utilizing these sites.

2.1 TOPOGRAPHY AND GEOLOGY

2.1.1 Connecticut

The pipeline facilities in Connecticut are located in Hartford County within the New England Upland Section of the New England Physiographic Province. In Connecticut, the Project area lies within the north-south trending Central Valley of the New England Upland Section (Fenneman 1938).

The New England Upland Section is characterized as an area of maturely dissected plateau with narrow valleys and has been greatly modified by glaciation. It is the most widespread of the geomorphic sections in the New England Province, extending from Canada through New England (Fenneman 1938).

Numerous hills and mountains rise above the general level of the upland and except in the presence of mountains, the horizon of the regional landscape is fairly level.

The Seaboard Lowland Section of the New England Physiographic Province is characterized by gently rolling topography with low relief and subtle breaks between major landforms. Bedrock depths range from surface level to more than 200 feet below the surface in deep fluvial valleys. The upland hills consist of drumlins and ground moraines composed of glacial till. The valley areas consist of level to steep rolling landforms consisting of glacial fluvial, lacustrine, and swamp deposits. Irregular configuration of bedrock surface and varied glacial and postglacial deposits caused this section's topographic diversity (Griffith et al. 2009).

The Central Valley of the New England Uplands, a north-south trending valley between the Western and Eastern Uplands (Fenneman 1938), is a broad, flat valley developed on fairly weak, tilted, stratified rocks, which are Triassic in age. The topography in the area is the product of continental glaciers moving through the region, as these glaciers melted they dropped sediments resulting in a large amount of till remaining throughout the Connecticut Valley. The Connecticut Valley consists of floodplains along the Connecticut and Farmington Rivers, with nearly level to sloping terraces, low glacial upland hills, and narrow ridges of basalt. Elevations in the region range from 10 feet above sea level on the flood plain of the Connecticut River to 500 feet on the highest basalt ridges (USDA 2008).

The 300 Line Connecticut Loop is dominated by Holyoke Basalt and Portland Arkose Formations. To a lesser degree the Project facilities also cross Shuttle Meadow Formation, Talcott Basalt, East Berlin Formation, and Hampden Basalt. The Hampden and Holyoke Basalts are fine to coarse-grained rocks, grading from basalt near contacts to fine-grained gabbro in the interior. Portland Arkose consists of sedimentary arkose rock types (Riese 2014). East Berlin and Shuttle Meadow Formations consist of sedimentary types with siltstone, shale, and conglomerate sedimentary rocks. Talcott Basalt is similar to Holyoke Basalt and consists of basalts and gabbro rock (Riese 2014).

2.2 SOILS DESCRIPTION

In Connecticut, the Project crosses 44 unique map units consisting of one or more soil series that cross 14.80 miles. The 300 Line Connecticut Loop, also known as Segment S of the Project, is located in central Hartford County. Table 2-1 summarizes the soils crossed by the Project in Connecticut and provides a brief description of the soils characteristics. A detailed Soil Report identifying and describing soils along the Project right-of-way ("ROW") in Connecticut is provided in Attachment J of this Section 401 application.

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Table 2-1
Soils Crossed by the Project in Connecticut

Segment[1]	Milepost		Soil Map Symbol	Soil Unit Name	Erosion Potential (Water Factor K_w)[2]	Capability Class[3]	Wind Group[4]	Drainage (Flooding Potential)	Prime Farmland, Rare or Unique Soils of Statewide Importance
	Begin	End							
Hartford County, Connecticut									
S	0.00	0.09	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained	
S	0.09	0.12	42C	Ludlow silt loam, 2 to 15 percent slopes, extremely stony	Moderate	7s	5	Moderately well drained	
S	0.12	0.44	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained	
S	0.44	0.70	89D	Wethersfield loam, 15 to 35 percent slopes, extremely stony	Slight	7s	5	Well drained	
S	0.70	1.18	79E	Rock outcrop-Holyoke complex, 3 to 45 percent slopes	Slight	8	0	TBD	
S	1.18	1.27	18	Catden and Freetown soils	Slight	5w	2	Very poorly drained	
S	1.27	1.28	79E	Rock outcrop-Holyoke complex, 3 to 45 percent slopes	Slight	8	0	TBD	
S	1.28	1.43	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	1.43	1.71	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained	
S	1.71	2.14	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	2.14	2.19	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained	
S	2.19	2.20	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained	
S	2.20	2.24	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained	
S	2.24	2.38	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	2.38	2.49	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained	
S	2.49	2.51	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained	
S	2.51	2.55	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained	
S	2.55	2.60	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	2.60	2.62	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained	
S	2.62	2.94	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	2.94	2.99	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained	
S	2.99	3.17	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	3.17	3.25	42C	Ludlow silt loam, 2 to 15 percent slopes, extremely stony	Moderate	7s	5	Moderately well drained	
S	3.25	3.32	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained	
S	3.32	3.35	309	Udorthents, flood control	Moderate	4e	5	Moderately well drained	
S	3.35	3.36	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained	
S	3.36	3.44	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained	
S	3.44	3.74	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	3.74	3.82	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained	
S	3.82	3.95	79E	Rock outcrop-Holyoke complex, 3 to 45 percent slopes	Slight	8	0	TBD	

Table 2-1
Soils Crossed by the Project in Connecticut

Segment[1]	Milepost		Soil Map Symbol	Soil Unit Name	Erosion Potential (Water Factor K_w)[2]	Capability Class[3]	Wind Group[4]	Drainage (Flooding Potential)	Prime Farmland, Rare or Unique Soils of Statewide Importance
	Begin	End							
S	3.95	4.60	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained	
S	4.60	4.77	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	4.77	5.46	78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	Slight	7s	5	Well drained	
S	5.46	5.60	89D	Wethersfield loam, 15 to 35 percent slopes, extremely stony	Slight	7s	5	Well drained	
S	5.60	5.72	42C	Ludlow silt loam, 2 to 15 percent slopes, extremely stony	Moderate	7s	5	Moderately well drained	
S	5.72	5.79	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained	
S	5.79	5.85	79E	Rock outcrop-Holyoke complex, 3 to 45 percent slopes	Slight	8	0	TBD	
S	5.85	6.07	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	6.07	6.09	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained	
S	6.09	6.15	79E	Rock outcrop-Holyoke complex, 3 to 45 percent slopes	Slight	8	0	TBD	
S	6.15	6.32	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained	
S	6.32	6.41	79E	Rock outcrop-Holyoke complex, 3 to 45 percent slopes	Slight	8	0	TBD	
S	6.41	6.71	89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	Slight	7s	5	Well drained	
S	6.71	6.76	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	6.76	6.81	82B	Broadbrook silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained	All areas are prime farmland
S	6.81	6.87	82D	Broadbrook silt loam, 15 to 25 percent slopes	Severe	4e	5	Well drained	
S	6.87	6.87	82C	Broadbrook silt loam, 8 to 15 percent slopes	Moderate	3e	5	Well drained	Farmland of statewide importance
S	6.87	6.95	82D	Broadbrook silt loam, 15 to 25 percent slopes	Severe	4e	5	Well drained	
S	6.95	7.04	82C	Broadbrook silt loam, 8 to 15 percent slopes	Moderate	3e	5	Well drained	Farmland of statewide importance
S	7.04	7.09	82B	Broadbrook silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained	All areas are prime farmland
S	7.09	7.14	40B	Ludlow silt loam, 3 to 8 percent slopes	Slight	2e	5	Moderately well drained	All areas are prime farmland
S	7.14	7.29	82B	Broadbrook silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained	All areas are prime farmland
S	7.29	7.37	5	Wilbraham silt loam	Slight	4w	5	Poorly drained	Farmland of statewide importance
S	7.37	7.42	82B	Broadbrook silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained	All areas are prime farmland
S	7.42	7.48	5	Wilbraham silt loam	Slight	4w	5	Poorly drained	Farmland of statewide importance
S	7.48	7.48	43B	Rainbow silt loam, 3 to 8 percent slopes	Slight	2e	5	Moderately well drained	All areas are prime farmland
S	7.48	7.55	82B	Broadbrook silt loam, 3 to 8 percent slopes	Slight	2e	5	Well drained	All areas are prime farmland
S	7.55	7.59	82C	Broadbrook silt loam, 8 to 15 percent slopes	Moderate	3e	5	Well drained	Farmland of statewide importance
S	7.59	7.61	43A	Rainbow silt loam, 0 to 3 percent slopes	Slight	2w	5	Moderately well drained	All areas are prime farmland
S	7.61	7.67	6	Wilbraham and Menlo soils, extremely stony	Slight	7s	5	Poorly drained	

Table 2-1
Soils Crossed by the Project in Connecticut

Segment[1]	Milepost		Soil Map Symbol	Soil Unit Name	Erosion Potential (Water Factor K_w)[2]	Capability Class[3]	Wind Group[4]	Drainage (Flooding Potential)	Prime Farmland, Rare or Unique Soils of Statewide Importance
	Begin	End							
S	7.67	7.73	82D	Broadbrook silt loam, 15 to 25 percent slopes	Severe	4e	5	Well drained	
S	7.73	7.89	87D	Wethersfield loam, 15 to 25 percent slopes	Severe	4e	5	Well drained	
S	7.89	8.17	82D	Broadbrook silt loam, 15 to 25 percent slopes	Severe	4e	5	Well drained	
S	8.17	8.37	78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	Slight	6s	5	Well drained	
S	8.37	8.45	82C	Broadbrook silt loam, 8 to 15 percent slopes	Moderate	3e	5	Well drained	Farmland of statewide importance
S	8.45	8.58	5	Wilbraham silt loam	Slight	4w	5	Poorly drained	Farmland of statewide importance
S	8.58	8.63	9	Scitico, Shaker, and Maybid soils	Slight	4w	6	Poorly drained	Farmland of statewide importance
S	8.63	8.84	37C	Manchester gravelly sandy loam, 3 to 15 percent slopes	Slight	4e	5	Excessively drained	Farmland of statewide importance
S	8.84	8.87	9	Scitico, Shaker, and Maybid soils	Slight	4w	6	Poorly drained	Farmland of statewide importance
S	8.87	8.89	10	Raynham silt loam	Slight	4w	5	Poorly drained	Farmland of statewide importance
S	8.89	8.93	27A	Belgrade silt loam, 0 to 5 percent slopes	Slight	2w	5	Moderately well drained	All areas are prime farmland
S	8.93	9.00	10	Raynham silt loam	Slight	4w	5	Poorly drained	Farmland of statewide importance
S	9.00	9.02	27A	Belgrade silt loam, 0 to 5 percent slopes	Slight	2w	5	Moderately well drained	All areas are prime farmland
S	9.02	9.05	10	Raynham silt loam	Slight	4w	5	Poorly drained	Farmland of statewide importance
S	9.05	9.76	9	Scitico, Shaker, and Maybid soils	Slight	4w	6	Poorly drained	Farmland of statewide importance
S	9.76	9.96	42C	Ludlow silt loam, 2 to 15 percent slopes, extremely stony	Moderate	7s	5	Moderately well drained	
S	9.96	10.25	63B	Cheshire fine sandy loam, 3 to 8 percent slopes	Slight	2e	3	Well drained	All areas are prime farmland
S	10.25	10.26	28A	Elmridge fine sandy loam, 0 to 3 percent slopes	Slight	2w	3	Moderately well drained	All areas are prime farmland
S	10.26	10.35	9	Scitico, Shaker, and Maybid soils	Slight	4w	6	Poorly drained	Farmland of statewide importance
S	10.35	10.40	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance
S	10.40	10.53	23A	Sudbury sandy loam, 0 to 5 percent slopes	Slight	2w	3	Moderately well drained	All areas are prime farmland
S	10.53	10.60	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance
S	10.60	10.65	306	Udorthents-Urban land complex	Moderate	3e	5	Well drained	
S	10.65	10.81	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained	All areas are prime farmland
S	10.81	10.85	38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	Slight	4e	5	Excessively drained	Farmland of statewide importance
S	10.85	10.90	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance
S	10.90	10.93	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained	All areas are prime farmland
S	10.93	11.05	23A	Sudbury sandy loam, 0 to 5 percent slopes	Slight	2w	3	Moderately well drained	All areas are prime farmland
S	11.05	11.16	36B	Windsor loamy sand, 3 to 8 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance
S	11.16	11.22	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained	All areas are prime farmland

Table 2-1
Soils Crossed by the Project in Connecticut

Segment[1]	Milepost		Soil Map Symbol	Soil Unit Name	Erosion Potential (Water Factor K_w)[2]	Capability Class[3]	Wind Group[4]	Drainage (Flooding Potential)	Prime Farmland, Rare or Unique Soils of Statewide Importance
	Begin	End							
S	11.22	11.27	38E	Hinckley gravelly sandy loam, 15 to 45 percent slopes	Moderate	6e	5	Excessively drained	
S	11.27	11.33	108	Saco silt loam	Slight	6w	5	Very poorly drained	
S	11.33	11.42	23A	Sudbury sandy loam, 0 to 5 percent slopes	Slight	2w	3	Moderately well drained	All areas are prime farmland
S	11.42	11.45	34B	Merrimac sandy loam, 3 to 8 percent slopes	Slight	2e	3	Somewhat excessively drained	All areas are prime farmland
S	11.45	11.50	W	TBD	TBD	TBD	TBD	TBD	TBD
S	11.50	11.50	103	Rippowam fine sandy loam	Slight	4w	3	Poorly drained	Farmland of statewide importance
S	11.50	11.54	101	Occum fine sandy loam	Slight	1	3	Well drained	All areas are prime farmland
S	11.54	11.57	34B	Merrimac sandy loam, 3 to 8 percent slopes	Slight	2e	3	Somewhat excessively drained	All areas are prime farmland
S	11.57	11.60	23A	Sudbury sandy loam, 0 to 5 percent slopes	Slight	2w	3	Moderately well drained	All areas are prime farmland
S	11.60	11.63	38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	Slight	4e	5	Excessively drained	Farmland of statewide importance
S	11.63	11.65	34B	Merrimac sandy loam, 3 to 8 percent slopes	Slight	2e	3	Somewhat excessively drained	All areas are prime farmland
S	11.65	11.69	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained	All areas are prime farmland
S	11.69	11.71	23A	Sudbury sandy loam, 0 to 5 percent slopes	Slight	2w	3	Moderately well drained	All areas are prime farmland
S	11.71	11.73	38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	Slight	4e	5	Excessively drained	Farmland of statewide importance
S	11.73	11.75	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained	All areas are prime farmland
S	11.75	11.77	38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	Slight	4e	5	Excessively drained	Farmland of statewide importance
S	11.77	11.83	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained	All areas are prime farmland
S	11.83	11.88	38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	Slight	4e	5	Excessively drained	Farmland of statewide importance
S	11.88	12.27	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained	All areas are prime farmland
S	12.27	12.31	15	Scarboro muck, 0 to 3 percent slopes	Slight	5w	2	Very poorly drained	Not prime farmland
S	12.31	12.38	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained	All areas are prime farmland
S	12.38	12.88	36B	Windsor loamy sand, 3 to 8 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance
S	12.88	12.98	12	Raypol silt loam	Slight	4w	5	Poorly drained	Farmland of statewide importance
S	12.98	13.04	23A	Sudbury sandy loam, 0 to 5 percent slopes	Slight	2w	3	Moderately well drained	All areas are prime farmland
S	13.04	13.14	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance

Table 2-1
Soils Crossed by the Project in Connecticut

Segment[1]	Milepost		Soil Map Symbol	Soil Unit Name	Erosion Potential (Water Factor K_w)[2]	Capability Class[3]	Wind Group[4]	Drainage (Flooding Potential)	Prime Farmland, Rare or Unique Soils of Statewide Importance
	Begin	End							
S	13.14	13.19	12	Raypol silt loam	Slight	4w	5	Poorly drained	Farmland of statewide importance
S	13.19	13.30	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance
S	13.30	13.42	34A	Merrimac sandy loam, 0 to 3 percent slopes	Slight	1	3	Somewhat excessively drained	All areas are prime farmland
S	13.42	13.42	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance
S	13.42	13.72	87B	Wethersfield loam, 3 to 8 percent slopes	Slight	2e	5	Well drained	All areas are prime farmland
S	13.72	14.03	82C	Broadbrook silt loam, 8 to 15 percent slopes	Moderate	3e	5	Well drained	Farmland of statewide importance
S	14.03	14.07	55B	Watchaug fine sandy loam, 3 to 8 percent slopes	Slight	2w	3	Moderately well drained	All areas are prime farmland
S	14.07	14.13	23A	Sudbury sandy loam, 0 to 5 percent slopes	Slight	2w	3	Moderately well drained	All areas are prime farmland
S	14.13	14.25	12	Raypol silt loam	Slight	4w	5	Poorly drained	Farmland of statewide importance
S	14.25	14.28	36A	Windsor loamy sand, 0 to 3 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance
S	14.28	14.34	36B	Windsor loamy sand, 3 to 8 percent slopes	Slight	2s	2	Excessively drained	Farmland of statewide importance
S	14.34	14.80	306	Udorthents-Urban land complex	Moderate	3e	5	Well drained	

Source: Natural Resources Conservation Service (NRCS 2014b) - SSURGO Soils (County Based)
TBD - "To Be Determined." Information related to soil characteristics and potential impacts for the project pipeline will be provided at a later date.
[1] Each segment is associated with its own set of mileposts beginning at MP 0.00.
[2] The erosion potential for each of the soils was determined by reviewing the erosion properties provided by the NRCS's Web Soil Survey. The NRCS has evaluated soils based on slope and soil erosion factor K_W.

- A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions.
- A rating of "moderate" indicates that some erosion is likely and that erosion control measures may be needed.
- A rating of "severe" indicates that erosion is very likely and that erosion control measures, including revegetation of bare areas are advised.
- A rating of "very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion control measures are costly and generally impractical.

[3] Capability class refers to the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. Soil Capability Subclasses are designated by adding e, w, or s to the Capability Class designation. The letter "e" shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; the letter "s" denotes that the soil is limited mainly because it is shallow, droughty, or stony' "w" indicates that water in or on the soil interferes with plant growth or cultivation.

- Capability Class 1: Soils have slight limitations that restrict their use.
- Capability Class 2: Soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Capability Class 3: Soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.
- Capability Class 4: Soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.
- Capability Class 5: Soils are not likely to erode but have other limitations, impractical to remove, that limit their use.
- Capability Class 6: Soils have severe limitations that make them generally unsuitable for cultivation.
- Capability Class 7: Soils have very severe limitations that make them unsuitable for cultivation.
- Capability Class 8: Soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

[4] The wind erodibility group classification for each of the soils was determined by reviewing the physical soil properties data provided by the NRCS's Web Soil Survey. The NRCS has grouped soils that have similar properties affecting their susceptibility to wind erosion. The soils assigned to group 0 do not have data available, those assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

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2.3 DESCRIPTION OF UPLANDS

2.3.1 Connecticut

The Connecticut portion of the Project is located within the Northeastern Coastal Zone ecoregion (USEPA 2013). Land use mainly consists of forests, woodlands, and higher concentrations of human populations within urban and suburban development, with only some minor areas of pasture and cropland. Landforms in the region include irregular plains, and plains with high hills, but relatively low elevations ranging from 165 to 700 feet. The climate in this ecoregions is characterized by moderately long and somewhat severe winters that may restrict agriculture. Snow is typically on the ground all winter. However, climates in this area typically have more than 120 days with temperatures above 50°F and average temperatures between 35 and 50°F (USDA 2005). The 300 Line CT Loop (Segment S) is located within the Connecticut Valley sub-region.

The more northern 300 Line CT Loop (Segment S) is dominated by central and transitional hardwoods with mixed oak and oak-conifer forests including northern red oak, black oak, chestnut oak, and oak-hemlock-white pine forest. Transition forests are typically red oak-sugar maple dominated. Some rich mesic forests with sugar maple (*Acer saccharum*), white ash (*Fraxinu Americana*), basswood (*Tilia sp*.), bitternut hickory (*Carya cordiformis*), and hop hornbeam (*Ostrya virginiana*) also may be present in the Connecticut Valley. Some pitch pine (*Pinus rigida*) and scrub oaks occur on ridge tops and some areas of sandy xeric outwash. Pignut hickory-white ash forest, some areas of chestnut oak (*Quercus prinus*), and some eastern red cedar woodland are found on trap Rock Ridges (Griffith et al. 2009).

Upland Forests

Hardwood forests are prevalent along the proposed ROW throughout Connecticut. Northern hardwood forests are generally found between 1,000 to 2,500 feet elevation and occur regionally between transitional hardwoods and spruce-fir forests (Sperduto and Nichols 2004). Typical species include American beech (*Fagus grandifolia*), birch (*Betula* spp.), and sugar maple.

Central hardwood forest regions exhibit more oak-pine dominated communities and are found in low elevations of Connecticut. Species composition includes red and white oak (*Quercus alba*), mixed with species such as shagbark hickory (*Carya ovata*), musclewood (*Carpinus caroliniana*), sassafras (*Sassafras albidum*), and black cherry (*Prunus serotina*). Tuliptree (*Liriodendron tulipifera*) also may be present on lower slopes of oak forests throughout Connecticut (Rhodes and Block 2005; Swain and Kearsley 2011).

Upland forests provide food resources, cover, and nesting habitat for a wide variety of mammals, birds, amphibians, reptiles, and invertebrates. The tree and shrub layers provide food and cover for many birds and larger mammals such as white-tailed deer (*Oedicoileus virginianus*) and black bear (*Ursus americanus*) throughout the region. Environmental complexity created by micro-topography and detritus found on the forest floor (e.g., leaf litter and fine and coarse woody debris) provides food and cover for invertebrates, amphibians, and reptiles. Obligate vernal pool species such as the spotted salamander (*Ambystoma maculatum*) and the wood frog (*Lithobates sylvatica*) require forested uplands and coarse woody debris for moisture and thermoregulation, summer foraging, and overwintering. Smaller mammals, such as the gray squirrel (*Sciurus carolinensis*), Eastern chipmunk (*Tamias striatus*), and raccoons (*Procyon lotor*) utilize fallen logs for cover and nest cavities. Conifer-dominated forests are important overwintering areas for deer and moose where movement in light snow cover and grazing on low-lying vegetation is easier.

The predominance of oak plays an important role in the ecology of upland forests as a significant food source when mast productions of acorns feed a wide variety of small and large mammals, birds, and even invertebrates. Examples include gray squirrel, white-tailed deer, black bear, and wild turkey (*Meleagris gallopavo*). Predatory species such as raptors and red fox (*Vulpes vulpes*) also are attracted to oak-dominated forests and their edges by the abundance and diversity of prey species.

Open Lands

Swain and Kearsley (2011) identify a number of communities that are sustained as open land through natural environmental conditions as opposed to those maintained through anthropogenic disturbances. These areas are defined as sparse vegetation with less than about 25 percent tree, shrub, and herbaceous cover.

Many of these communities are limited to maritime dunes, cliffs, and beaches of the Gulf of Maine Coastal Lowlands, Cape Cod, and the Islands, but there also are other communities associated with rocky summits, rock outcrops, and rock cliffs. These occur in acidic and circumneutral rock of the Taconic Mountains, Monadnock/Worcester Plateau and Coastal Plain sub-regions, in calcareous rock in Western New England Marble Valley and Connecticut Valley sub-regions, and serpentine rock in the Berkshire Highlands and Berkshire Transition sub-regions. These communities typically occur in discrete locations in the landscape and are not described in detail here (Swain and Kearsley 2011).

Swain and Kearsley (2011) recognize one human-created and maintained open community for its conservation interest. Cultural grassland, normally maintained by mowing, is an important grassland bird community. A grassland community generally occurs on sand or other droughty, low nutrient soils. Surroundings in many areas include pitch pine/scrub oak communities. Many small airports with surrounding grasslands were built on sand plains. Pastures and hayfields occur in all areas, and surroundings reflect the regional variations. Airports, cemeteries, pastures, and hayfields provide different habitats and support different species of plants and animals. Grasslands at many smaller airports are dominated by graminoids, usually little blue stem grass, Pennsylvania sedge, and poverty grass, and many non-native species. Some cultural grasslands do have some mix of herbaceous species, such as goldenrods and milk weeds including butterfly weed (*Asclepias* spp. and *A. tuberosa*).

Agricultural Lands

Agricultural land uses vary considerably among ecological sub-regions. The Taconic Mountains and Worcester/Monadnock Plateau sub-regions are primarily limited to minor pasture/hayland and cropland in narrow valleys. Livestock grazing and dairy farming is typical throughout the state, with hay and corn for silage, some vegetables, and apple orchards, nursery and greenhouse products in the Western New England Marble Valleys, Vermont Piedmont, and Connecticut Valley sub-regions. The Connecticut Valley also is listed as providing some poultry, vegetables, sweet corn, potatoes, and tobacco.

Developed Lands

Developed land includes commercial, industrial, and residential areas, sand and gravel, roadways and railways, and other special uses. Disturbed areas such as industrial/commercial areas and roadways are typically devoid of undisturbed vegetation or consist of impervious surfaces (Zimmerman et al. 2012). If vegetation is present in these areas it may include a wide variety of native and invasive species and landscape cultivars. Vegetation cover in residential lands generally consists of mowed lawns and landscaped areas (Zimmerman et al. 2012).

2.4 VEGETATIVE COMMUNITIES OF SPECIAL CONCERN

Vegetative communities of special concern include sensitive or protected vegetation types, natural areas and unique plant communities. This section reviews agency consultations with the Connecticut Department of Energy and Environmental Protection ("CTDEEP") Natural Diversity Database ("CTNDDB") regarding sensitive and unique communities known to occur in and near the Project area. Tennessee will continue to document rare or unique plant communities during environmental field surveys as more parcels become available for access, including wetland delineations and biological and botanical surveys.

2.4.1 Connecticut

Agencies contacted with regards to federal- or state-listed Threatened or Endangered ("T&E") plant species (including federal and state species of concern) or their designated rare, sensitive, or unique natural communities include the United States Fish and Wildlife Service ("USFWS") New England Field Office, and CTDEEP/CTNDDB.

The CTNDDB program conducted a preliminary review of state-listed species occurrences along the Project corridor (Riese 2014). In March 2015, the CTNDDB provided a more comprehensive list that includes 13 species of plants with information on habitat requirements, and flowering periods (DeBarros 2015; McKay 2015), but no natural communities were included. The USFWS did not identify the presence of any federal-listed plants or significant natural communities in Connecticut (Chapman 2015). Information regarding rare plants is presented in Sections 3.4. Tennessee submitted updates to the Project associated with facilities and ARs in June 2015, and is awaiting a response.

In order to prevent impacts to state-listed plant species, the CTNDDB is recommending that botanical field surveys of the Project area be performed by qualified botanists when each of the target plant species is identifiable, and reports summarizing survey results be submitted to the CTNDDB (DeBarros 2015; McKay 2015). A Rare Plant Survey Protocol was submitted to the CTNDDB for review on July 23, 2015. DeBarros (2015) provided maps demarcating survey limits for each plant species. Therefore, surveys will be conducted by qualified botanists and biologists on parcels where access has been obtained once survey protocols are approved. Results of biological and botanical surveys, including observations of previously undocumented natural communities of special concern, will be provided directly to the CTNDDB.

Although the correspondence did not identify any specific natural communities according to Metzler and Barrett (2006), broad cover types and biophysical categories that describe primary habitats for each species are provided (e.g., wet meadows, alluvial banks, floodplains, trap rock outcrops, and calcareous ledges). The CTDEEP correspondence also identifies habitats associated with wildlife that may be associated with unique or special concern natural communities including vernal pools, grassland habitats, and sand barrens.

In addition to the correspondence, the Connecticut Environmental Conditions Online ("CTECO") has developed a critical habitats Geographic Information System ("GIS") data layer (CTECO 2009) that is based on the Connecticut Comprehensive Wildlife Conservation Strategy (CTDEEP 2005). The GIS layer depicts 25 rare and specialized habitats in the state such as acidic Atlantic white cedar swamps, sand barrens, and dry subacidic forests identified as having the greatest conservation need. Plant-associated habitat areas identified through consultation and desktop review will be targeted during 2015 biological and botanical surveys.

Based on critical habitat mapping (CTDEEP 2009), the Project crosses floodplain forest habitats adjacent to the Farmington River in Windsor, Connecticut. These habitats are mapped on both sides of the river for a total of approximately 670 feet. This area also is mapped by the CTNDDB for the presence of state-listed species. Tennessee is currently planning a 1,570-foot Horizontal Directional Drill ("HDD") beneath these habitats and the Farmington River; therefore, no impacts to floodplain forest habitats are expected. HDD methodology is further described in Section 3.4.2.4.

2.4.1.1 Vernal Pools

In Connecticut, vernal pools are considered watercourses and are regulated by each respective town's inland wetlands agency under the Connecticut Inland Wetlands and Watercourses Act ("IWWA"), Connecticut General Statutes ("CGS") Sections 22a-36 through 22a-45. The IWWA mandates that each town within Connecticut respectively regulate any activities that include the operation or use of a wetland or watercourse involving removal or deposition of material, or any obstruction, construction, alteration or pollution, of such wetlands and watercourses. Areas surrounding vernal watercourses also are regulated to varying degrees depending on the town's bylaws (CTDEEP 2015). In addition, vernal pools are protected at the federal level by the United States Army Corps of Engineers ("USACE") New England District under the Connecticut Programmatic General Permit ("CT PGP"). Vernal pools must be delineated and surveyed, with results being reported to the USACE. As described in the Massachusetts and New Hampshire PGPs, impacts to surrounding upland habitats must be minimized to the extent practicable in Connecticut as well (CT PGP 2011).

During the spring of 2015, all potential vernal pools ("PVPs") were surveyed for evidence of breeding by obligate vernal pool species on parcels where access was available. Surveys included any temporarily flooded palustrine wetlands and flooded isolated depressions encountered in the field that might support vernal pool communities. Biologists followed survey and documentation procedures outlined by the USACE – New England District, "Vernal Pool Assessment Guidelines" and completed the USACE "Vernal Pool Characterization Form" for each pool encountered. A total of 103 parcels in Connecticut were surveyed for the presence of vernal pools. A total of 23 vernal pools on 12 parcels were documented.

Detailed impact assessments are required by the CTDEEP and the USACE New England District for proposed work within and adjacent to vernal pools. This will include an evaluation of impacts to the vernal pool, the vernal pool envelope (landscape within 0-100 feet from the pool edge) and the critical terrestrial habitats (landscape within 100-750 feet from the pool edge). The process of identifying vernal pools, evaluating impacts and avoiding and minimizing impacts to the extent practicable will continue as access to more parcels become available. Additional vernal pool surveys are scheduled for the spring of 2016, and the results of these surveys will be communicated in subsequent submittals.

2.5 DESCRIPTION OF INLAND WETLANDS AND WATERCOURSES

Tennessee identified, located, classified, and delineated wetland resources within and adjacent to the Project area through field surveys conducted in 2014 and 2015. Jurisdictional wetlands crossed by the Project in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut were field delineated in accordance with the USACE Wetlands Delineation Manual (USACE 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (USACE 2012). Tennessee intends to implement the Project-specific Procedures, incorporated into the Project-specific Environmental Construction Plan (“ECP”) for Connecticut (Attachment Q to the 401 application), for any wetland area regardless of jurisdictional status, provided that the wetland area in question meets all criteria described in the USACE *Wetlands Delineation Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions* (USACE 2012). Field surveys will continue throughout the 2015 field season, as survey access permission is granted. For properties without negotiated survey access, the schedule for the completion of field surveys may extend past the issuance of a Certificate of Public Convenience and Necessity should the Project be approved by the Commission.

The U.S. Fish and Wildlife Service (“USFWS”) wetland classification system described by Cowardin et al. (1979) was used to classify the wetlands that will be affected by the Project. The wetlands in the Project area were identified as palustrine forested (“PFO”), palustrine scrub-shrub (“PSS”), palustrine emergent (“PEM”), palustrine open water (“POW”), or a combination of these four cover types. Palustrine systems include all non-tidal wetlands that are dominated by trees, shrubs, persistent emergents, and emergent mosses or lichens and all wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent. The palustrine system was developed to group vegetated wetlands, commonly referred to as marshes, swamps, bogs, and prairies. This system includes ponds and may be situated shoreward of lakes, river channels, estuaries, and river floodplains or in isolated catchments or on slopes (Cowardin et al. 1979). All of the resource areas identified along the Project alignment are classified as palustrine systems.

PFO wetland types include freshwater wetlands dominated by woody vegetation greater than 20 feet in height. PSS wetlands include freshwater wetlands dominated by woody vegetation less than 20 feet in height. The species found in PSS wetlands include true shrubs, saplings, young trees, and trees or shrubs that are small or stunted because of environmental conditions. PEM wetlands are non-tidal wetlands characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. PEM wetlands usually are dominated by perennial plants. POWs include permanently flooded areas, where water covers the land surface through the year in all years or is intermittently exposed in years of extreme drought. Open water vegetation is comprised of obligate hydrophytes (Cowardin et al. 1979).

2.5.1 Connecticut

Tables 1 and 2 in Attachment A of this application identify each wetland crossed or impacted in the Project area in Connecticut, including its identification number given by the environmental field crews, mileposts ("MPs"), and cover type(s) as described by Cowardin et al. (1979). The data sets utilized for wetlands are a combination of field surveyed data, publicly available data, and photo interpreted light detection and ranging ("LiDAR") data. The publicly available data is from USFWS-NWI (2014). The publicly available data and photo interpreted LiDAR data is utilized in areas where surveys have not been completed due to denied landowner permissions.

Connecticut regulates inland wetlands under the IWWA (Section 22a-36 through 45 of the CGS). These state statutes are implemented through the Inland Wetlands and Watercourse Regulations as administered by the individual municipalities. Under Section 2 of the IWWA, a wetland is defined as "land, including submerged land…which consists of poorly drained, very poorly drained, alluvial and floodplain soils as defined by the National Cooperative Soil Survey ("NCSS"). Such areas may include filled, graded, or excavated sites which possess an aquatic (saturated) moisture regime as defined by the USDA Cooperative Soil Survey." The IWWA assigns no bearing to vegetation when performing wetland delineation activities. According to the CTDEEP website, approximately 17 percent of the state's land area is comprised of wetlands under the Connecticut wetland definition; however, "under the federal definition only roughly half of this same area will be classified as wetlands".

The IWWA defines wetlands based primarily on soil characteristics; therefore, the following vegetative community classifications and descriptions are based on the USFWS wetland classification system described by Cowardin et al. (1979) and the Classification of the Natural Communities of Massachusetts (Swain and Kearsley 2011).

In total, the Project workspace and facilities impact 105 wetlands and 54 watercourses in Connecticut. Descriptions of specific wetlands and watercourses are found in the Wetlands / Watercourses Report prepared by AECOM provided in Attachment A of this report. Soils specific information for the delineated wetland areas can be found in the Soil Scientist Report in Attachment J of the Section 401 application.

2.5.2 Palustrine Forested Wetlands

Forested wetlands are characterized by woody vegetation that is six meters (approximately 20 feet) tall or taller with diameters of 4 inches or more, and normally include a moderate to dense canopy or overstory layer of trees, an understory of young trees or shrubs, and an herbaceous layer. The forested wetland canopy species in the Project area typically are dominated by red maple, green ash (*Fraxinus pennsylvanica*), eastern hemlock, eastern white pine yellow birch, elms, and swamp white oak. The density and composition of the understory vegetation varies from site to site. Subcanopy layers are typically dominated by northern arrowwood, silky dogwood and highbush blueberry. Dominant plants in the herbaceous layer included sensitive fern, cinnamon fern, royal fern, and jewelweed.

Red Maple Swamp

Red maple swamps or acidic forested swamps with red maple dominant in the overstory occur in a variety of settings. Three basic types include hillside seeps, seasonally flooded basin swamps, and alluvial swamps. Red maple is usually strongly dominant in the overstory, and often provides more than 90 percent of the canopy cover. A variable mixture of tree species co-occurs with red maple, including yellow birch, black gum, white ash (*Fraxinus americana*), white pine, American elm, hemlock, pin oak, and swamp white oak. The shrub layer of red maple swamps is often dense and well-developed, generally with greater than 50 percent cover but it can be variable. In richer areas, northern arrow-wood, speckled alder, nannyberry (*Viburnum lentago*), and poison sumac (*Toxicodendron vernix*) also occur. The herbaceous layer is highly variable, but ferns are usually abundant. Cinnamon fern is common; other ferns include sensitive fern, royal fern, marsh fern, and spinulose wood fern. Graminoids are common, mixed with a variety of herbaceous species. Some of the most common herbaceous species are skunk cabbage, false hellebore, jewelweed, swamp dewberry (*Rubus hispidus*), marsh marigold (*Caltha palustris*), and the bugleweeds (*Lycopus* spp.). Rich variants of red maple swamps occur apparently associated with groundwater seepage (Swain and Kearsely 2011).

Alluvial Red Maple Swamp

Alluvial red maples swamps experience overbank flooding, but they appear to be more poorly drained than true floodplain forests. Soils are typically silt loams with pronounced soil mottling and a surface organic layer. The overstory of alluvial red maple swamps is characterized by a mixture of red maple and silver maple (*Acer saccharinum; particularly along riverbanks*) with lesser amounts of green ash and / or swamp white oak. Red oak (*Q. rubra*), white pine, and black cherry (*Prunus serotina*) occur in elevated sections. Unlike true floodplain forests, alluvial swamp forests have well-developed shrub layers composed of northern arrow-wood, silky dogwood, and the non-native plant European buckthorn. The herbaceous layer is often dominated by sensitive fern, and false nettle (*Boehmeria cylindrica*) mixed with a rich assemblage of herbaceous species that commonly includes royal fern, awned sedge (*Carex crinita*), and bugleweeds (Swain and Kearsely 2011).

Transitional Floodplain Forest

Transitional floodplain forests have a vegetation association intermediate between major-river and small-river floodplain forests. Silver maple is dominant in the canopy, but unlike in major-river forests, cottonwood (*Populus deltoides*) is typically absent, and green ash and American elm are present. A shrub layer is generally lacking; however, saplings of overstory trees are common. The herbaceous layer is typically an even mixture of wood-nettle, ostrich fern (*Matteuccia struthiopteris*), sensitive fern, and false nettle. Transitional floodplain forests often contain meander scars or slough that can function as vernal pools and provide important amphibian breeding habitat (Swain and Kearsely 2011).

2.5.3 Palustrine Scrub-Shrub Wetlands

PSS wetlands are generally dominated by woody vegetation less than six meters (approximately 20 feet) tall. Scrub-shrub wetlands typically are not as structurally diverse as forested wetlands due to the lack of taller mature trees. They contain vegetation that is characteristically low and compact. Under normal conditions, the vegetative structure is influenced by surface water inundation or the presence of high groundwater for extended periods of time. PSS wetlands also can be maintained by periodic maintenance activities (such as along existing ROWs) that remove larger tree species. Common wetland shrubs observed in the Project area include meadowsweet (*Filipendula ulmaria*), northern arrowwood (*Viburnum dentatum*), willow, wild raisin (*Viburnum nudum*), silky dogwood (*Cornus amomum*), and highbush blueberry (*Vaccinium corymbosum*).

Shrub Swamp

Shrub swamps are common and widespread. They occur in basin depressions, at pond margins, and along river and streamsides. They can be found in any flat area where the water table is at or above the soil surface for most of the year. Soils are generally well-decomposed organic mucks that are permanently saturated but only seasonally or temporarily inundated. Shrub swamps are often found in the transition zone between emergent marshes and swamp forests.

Shrub swamps are highly variable communities. Shrub swamps typically have a mixture of the following shrub species: speckled alder, smooth alder (*Alnus serrulata*), highbush blueberry, meadowsweet, buttonbush, winterberry, sweet gale (*Myrica gale*), swamp azalea, silky dogwood (*Cornus amomum*), northern arrowwood (*Viburnum dentatum* var. *lucidum*), maleberry (*Lyonia ligustrina*), and the non-native shrub European alder-buckthorn (*Rhamnus frangula*). Scattered red maple or gray birch (*Betula populifolia*) saplings also occur. Richer shrub swamps in areas with circumneutral water are often dominated by spicebush. Some shrub swamps are dominated by a single species, such as black willow (*Salix nigra*), riverside thickets (which may best be included with floodplain forests), highbush blueberry thickets, or buttonbush swamps. Since shrubs often form dense thickets, the herbaceous layer of shrub swamps is often sparse and species-poor. A mixture of the following species is typical: common arrowhead (*Sagittaria latifolia* var. *latifolia*), skunk cabbage (*Symplocarpus foetidus*), cinnamon fern, sensitive fern, and royal fern *(Osmunda regalis*), sedges (*Carex* spp.), and Sphagnum spp. moss (Swain and Kearsely 2011).

2.5.4 Palustrine Emergent Wetlands

Emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes, not including mosses and lichens. These wetlands maintain the same appearance year after year, are typically dominated by perennial plants, and the vegetation of these wetlands is present for the majority of the growing season. Persistent emergent wetlands are characterized by species that typically remain standing until the beginning of the next growing season. Dominant vegetation within the PEM wetlands along the alignment of the Connecticut portion of the Project include tussock sedge, woolgrass (*Scirpus cyperinus*), soft rush, rough-stemmed goldenrod (*Solidago rugosa*), common reed (*Phragmites australis*), common reed (*Phragmites australis*), and sensitive fern.

Shallow Emergent Marsh

Shallow emergent marshes occur in similar settings to deep emergent marshes, i.e., in broad, flat areas bordering low-energy rivers and streams, often in backwater sloughs, or along pond and lake margins. Unlike deep emergent marshes, shallow marshes commonly occur in abandoned beaver flowages, and in some states they are named “Abandoned beaver meadows” or “beaver flowage communities.” The soils are a mixture of organic and mineral components. There is typically a layer of well-decomposed organic muck at the surface overlying mineral soil. There is standing or running water during the growing season and throughout much of the year, but water depth is less than deep emergent marshes and averages less than 6 inches.

Vegetation composition is similar to deep emergent marshes except that shorter grasses, sedges, and rushes dominate. Cattails, phragmites, and wool-grass, the dominants of deep emergent marshes, can occur but are never dominant. Tussock forming species, like tussock sedge and Canada bluejoint (*Calamagrostis canadensis*), often cover broad areas and form a hummock-hollow topography. Reed canary grass can also occur. It is common to see tussock sedge-dominated marshes in old beaver flowages mixed with scattered shrubs like alder and spiraea. The shallow water typically has a mixture of bur-reeds (*Sparganium* spp.), sedges (*Carex* spp.), and rice cut-grass. Floating leaved plants, like the water-lilies (*Nymphaea odorata* and *Nuphar* spp.), and submergents, like pondweeds (*Potamogeton* spp.), occur in open areas, and duckweed (*Lemna* spp.) is abundant in still water. Based on species composition alone, it can be difficult to differentiate shallow emergent marshes and wet meadows, but they occur in different physical settings and hydrologic regimes (see concept description for wet meadows (Swain and Kearsely 2011).

Deep Emergent Marsh

Deep emergent marshes generally form in broad, flat areas bordering low-energy rivers and streams or along pond and lake margins. The soils are a mixture of organic and mineral components. There is typically a layer of well-decomposed organic muck at the surface overlying mineral soil. There is standing or running water during the growing season and throughout much of the year. Water depth averages between 6 inches and 3 feet. Deep emergent marshes are associated with shrub swamps, and the two communities intergrade.

Tall graminoids, like broad-leaved cattail (*Typha latifolia*) and phragmites (*Phragmites australis*), often form extensive dense stands. Other characteristic graminoids include wool-grass, common threesquare (*Scirpus pungens*), Canada bluejoint, rice cut-grass, and tussock-sedge. Herbaceous associates include arrow-leaf tearthumb (*Polygonum sagittatum*), bulblet water-hemlock (*Cicuta bulbifera*), swamp-candles (*Lysimachia terrestris*), beggar-ticks (*Bidens* spp.), bedstraw (*Galium* spp.), common arrowhead, slender-leaved goldenrod (*Euthamia tenuifolia*), and marsh fern. Nutrient-rich sites typically have cattails mixed with soft-stemmed bulrush (*Scirpus tabernaemontani*), hard-stemmed bulrush (*S. acutus*), river-horsetail (*Equisetum fluviatile*), marsh-cinquefoil (*Comarum palustre*), sweet-flag, bristly sedge (*Carex comosa*), lakeside sedge (*C. lacustris*), and giant bur-reed (*Sparganium eurycarpum*) among others (Weatherbee, 1996) (Swain and Kearsely 2011).

Wet Meadow

Wet meadows occur in lake basins, wet depressions, along streams, and in sloughs and other backwater areas with impeded drainage along rivers. The mucky mineral soils are permanently saturated and flood occasionally; standing water is not present throughout the growing season as in deep and shallow emergent marshes. As these communities flood only temporarily, continued disturbance is necessary to prevent encroachment by woody plants.

Tussock-forming sedges, such as tussock-sedge or marsh-sedge (*Carex lacustris*), are often dominant, with over 50 percent of the cover, with variable proportions of other graminoids and herbaceous species. Canada bluejoint, wool-grass, slender woolly-fruited sedge (*Carex lasiocarpa* var. *americana*), slender spike-sedge (*Eleocharis tenuis*), stalked wool-grass (*Scirpus pedicellatus*), rice cut-grass, and brown beak-sedge (*Rhynchospora capitellata*) are typical of wet meadows. Characteristic herbaceous associates include erect water smartweed (*Polygonum amphibium* var. *emersum*), pickerel-weed (*Pontederia* *cordata* var. *cordata*), river-horsetail, nodding bur-marigold (*Bidens cernua*), spotted joe-pye-weed (*Eupatorium maculatum*), northern blue flag (*Iris versicolor*), and sweet flag (*Acorus calamus*).

Woodland Vernal Pool

Woodland vernal pools are small, shallow depressions that are isolated from other surface waters. These pools flood in the spring and sometimes in the fall, but are typically dry in the summer. These pools often have hydric soils. When dry, woodland vernal pools can often be recognized by a layer of stained leaves covering the dry depression. Woodland vernal pools often have little or no vegetation, but they are ringed by upland trees or shrubs, such as sweet pepperbush (*Clethra alnifolia*). Other forested and non-forested wetland community types can function as vernal pool habitat if they have long periods of standing water, i.e., 2 to 3 months (Swain and Kearsely 2011).

2.6 FLOODPLAINS AND FLOODWAYS

Tennessee reviewed the National Flood Insurance Program Flood Insurance Rate Maps ("FIRMs") issued by the Federal Emergency Management Agency ("FEMA") to identify proposed crossings of areas subject to flooding and high volume flows. The Connecticut portion of the Project crosses the flood zones of the Farmington River, Degrayes Brook, and Rippowam River. Tennessee will continue to consult with federal, state, and local agencies to identify any additional areas where flooding is a concern that may not be currently mapped by FEMA. FEMA Special Flood Hazard Areas ("SFHAs") are those areas subject to flooding by the 1 percent annual chance flood (100-year flood).

2.7 RARE SPECIES

2.7.1 Federally-listed Species

Section 7 of the federal Endangered Species Act ("ESA") (16 USC Subsection 1531-1543) requires each federal agency to ensure that any action authorized, funded, or carried out by the agency does not jeopardize the continued existence of federal-listed threatened or endangered species, or result in the destruction or adverse modification of the designated critical habitat for any federal-listed threatened or endangered species. The Commission, as the lead agency in the review of the proposed Project, consults and/or confers with the USFWS to determine whether any federal-listed species or species proposed for federal listing, or their designated critical habitat may occur in the Project area, and to determine the Project's potential effects on these species and/or critical habitats.

The Project will traverse areas under the jurisdiction of the Pennsylvania, New York, and New England Field Offices of the USFWS; therefore, consultation is ongoing with each of these offices. Consultation letters regarding federal-listed and proposed endangered or threatened species also were sent to the National Marine Fisheries Service ("NMFS"). Tennessee has received updated consultations based on the Project route reflected in the January 2015 correspondence from the Pennsylvania, New York, and New England Field Offices of the USFWS, and updated correspondence from USFWS Pennsylvania Field Office based on the June 2015 Project route. Species are identified in the following sections, and survey locations and schedules are provided in Table 2.7-1.

Northern Long-Eared Bat

The Northern long-eared bat (*Myotis septentrionalis*) is a Federally-listed species as of May 4, 2015. Northern Long-eared bats hibernate during winter in caves or in abandoned mines. During hibernation, they require cool, humid caves with stable temperatures, under 50° F but above freezing. These hibernation requirements are generally uncommon and results in very few areas within the range of these species having suitable conditions. After emerging from hibernation, Northern Long-eared bats migrate to their summer habitat in wooded areas where they usually roost under loose tree bark on dead or dying trees. These species may also use the crevices and cavities created by large well developed trees such as shagbark hickory or other species. During summer, males roost alone or in small groups, while females roost in larger groups of up to 100 bats or more. Northern Long-eared bats also forage in or along the edges of forested areas. “Edge” habitats typically created by linear infrastructure corridors, such as natural gas pipelines combined with other edge habitats created by stream corridors and associated cover type changes, results in habitat conditions that may be suitable for these species (USFWS 2013).

The CTNDDB has suggested that seasonal tree cutting restrictions and/or acoustic surveys may be required in Connecticut for the northern long-eared bat (McKay 2015). However, because this is a federal-listed species, Tennessee has already begun surveys in Connecticut in order to avoid and minimize impacts to critical habitats. In addition, Tennessee has committed to winter tree clearing in areas identified as summer roosting and maternal colony habitats.

Dwarf Wedgemussel

The dwarf wedgemussel was identified in Hartford County, Connecticut by the CTNDDB (McKay 2015; Riese 2014) and the New England USFWS Field Office (Chapman 2015). Although Tennessee is currently proposing to HDD beneath the Farmington River to avoid and minimize impacts, surveys were conducted for this species in 2015; no dwarf wedgemussels were located during the survey. Additional surveys may be necessary; however, Tennessee will continue to correspond with CTNDDB and New England USFWS to identify appropriate habitats, conduct surveys, and develop impact avoidance and minimization measures as needed.

Table 2.7-1
Federally-listed Rare (Threatened or Endangered) Animal Species Potentially Occurring in Vicinity of the Project in Connecticut

Species	Scientific Name	Federal Status[1]	Habitat Type
Dwarf Wedgemussel	*Alasmidonta heterodon*	E	Streams and rivers, prefers stable substrates in slow or moderate currents, often found near the banks among roots and sandy substrates
Northern Long-Eared Bat	*Myotis septentrionalis*	T	Winter in caves or underground mines; uses dead trees and trees with loose bark in forested areas for summer roosting sites and small nursery/maternity colonies

Source: Zimmerman 2014; Chapman 2015; Shellenberger 2015a, 2015b; Sullivan 2015.
[1] E = Endangered; T = Threatened; SC = Special Concern;
BGEPA = Bald and Golden Eagle Protection Act.

2.7.2 Connecticut

In Connecticut, rare species are protected under the Connecticut Endangered Species Act ("CESA") (Connecticut General Statutes ["CGS"] Section 26-303). The CTDEEP administers the CESA through the CTNDDB, which identifies the state's most significant natural areas through a comprehensive inventory of rare plant and animal species, and natural communities of special concern.

To determine whether the Project may affect protected species in Connecticut, consultation requests were sent to the CTDEEP and the CTNDDB in October 2014, January 2015, and June 2015. Tennessee is currently awaiting responses on the Project's revised alignment for the June 2015 consultation requests. The list of threatened and endangered species will be updated as necessary, and Tennessee will incorporate any pending survey requirements, recommendations and guidance into a subsequent filing.

The CTDEEP responded with a preliminary list of rare plant, animals, and natural communities (Riese 2014), and the CTNDDB program followed with more detailed information in March 2015 (DeBarros 2015; McKay 2015). Table 2.7-2 provides the list of species identified by the CTDEEP and CTNDDB as occurring in or near the proposed Project alignment and a brief description of each species habitat requirements.

Table 2.7-2
State-Listed Species Potentially Occurring in the Vicinity of the Project in Connecticut

Common Name	Scientific Name	State Status[1]	Habitat Type
Plants			
Virginia Copperleaf	*Acalypha virginica*	SC	Dry, open soils
Sedge	*Carex bushii*	SC	Moist meadows, floodplains, or lake/river shores. Often on calcareous soils
Davis' Sedge	*Carex davisii*	T	Floodplain forests
American Bittersweet	*Celastrus scandens*	SC	Forest edges, forests, shores of rivers or lakes, talus and rocky slopes
Narrow-leaved Glade Fern	*Diplazium pycnocarpon*	E	Rich, moist, wooded slopes and ravines, on limestone and traprock
Goldie's Fern	*Dryopteris goldiana*	SC	Rich, moist woods. Often among rocks, sometimes at the base of cliffs or talus slopes
Meadow Horsetail	*Equisetum pratense*	E	Alluvial banks and wet woods
Low Frostweed	*Helianthemum propinquum*	SC	Dry, open, sandy soil
Featherfoil	*Hottonia inflata*	SC	Shallow water and ditches
Swamp Lousewort	*Pedicularis lanceolata*	T	Moist fields, swamp edges, wet ground, wet meadows, open swamps, stream edges
Tall Cinquefoil	*Potentilla arguta*	SC	Dry roadsides, pastures and ledges; often on traprock and marble
Starry Champion	*Silene stellata*	T	Rocky woodlands

Table 2.7-2
State-Listed Species Potentially Occurring in the Vicinity of the Project in Connecticut

Common Name	Scientific Name	State Status[1]	Habitat Type
Narrow False Oats	*Trisetum spicatum*	E	Calcareous ledges and traprock outcrops
Animals			
Jefferson Salamander "complex"	*Ambystoma jeffersoniaum*	SC	Undisturbed second growth deciduous forests with steep, rocky topography, rotten logs and heavy duff layer, breeds in vernal pools
Blue-spotted Salamander	*Ambystoma laterale*	E	Breed in swamps and marshes with a weak to moderate water flow that directly connect to a lake, stream or small river
Eastern Hognose Snake	*Heterodon platirhinos*	SC	Areas of well drained sandy/gravelly soils along the edges of second-growth deciduous forest
Eastern Box Turtle	*Terrapene c. carolina*	SC	Old field and deciduous forest habitats, including powerlines and logged woodlands
Eastern Ribbon Snake	*Thamnophis sauritus*	SC	Areas with shallow water, grassy or shrubby areas bordering streams and wooded swamps
Silver-haired Bat	*Lasionycteris noctivagans*	SC	Forest with large coniferous and deciduous trees
Hoary Bat	*Lasiurus cinereus*	SC	Forest with large coniferous and deciduous trees
Northern Long-eared Bat	*Myotis septentrionalis*	E[2]	Winter in caves or underground mines; uses dead trees and trees with loose bark in forested areas for summer roosting sites and small nursery colonies
American Kestrel	*Falco sparverius*	SC	Hunts over pastures, parks, and other open field habitats, nests on the edges of open habitat in abandoned woodpecker holes in trees
Other			
Dwarf Wedgemussel	*Alasmidonta heterodon*	E[2]	Streams and rivers, prefers stable substrates in slow or moderate currents, often found near the banks among roots sandy substrates
Eastern Pond Mussel	*Ligumia nasuta*	SC	Coastal lakes and ponds, in slackwater areas of rivers, slow moving streams, and canals in a wide range of substrates
Pine Barrens Tiger Beetle	*Cicindela formosa generosa*	SC	Open, dry, loose shifting sand barrens and blowouts, sandy agricultural fields

Source: Riese 2014; DeBarros 2015; McKay 2015.
[1] E = Endangered; T = Threatened; SC = Special Concern; NL = Not Listed; PR = Proposed for listing in 2015.
[2] The Northern long-eared bat also is a Federal-listed Threatened species

2.8 AMPHIBIANS

During the spring of 2015, PVPs were surveyed for evidence of breeding by obligate vernal pool species on parcels where access was available. Surveys included any temporarily flooded palustrine wetlands and flooded isolated depressions encountered in the field that might support vernal pool communities. Biologists followed survey and documentation procedures outlined by the USACE – New England District, “Vernal Pool Assessment Guidelines” and completed the USACE “Vernal Pool Characterization Form” for each pool encountered. A total of 103 parcels in Connecticut were surveyed for the presence of vernal pools. A total of 23 vernal pools on 12 parcels were documented. The vernal pool report is provided in Attachment B to this report.

2.9 CULTURAL RESOURCES

In Connecticut, the Project includes approximately 14.80 (23.82 kilometers OR “K M”) of proposed pipeline construction. Archaeological surveys began in July 2015 and are ongoing. To date, Tennessee crews have surveyed 5.78 miles (9.3 km) or 38.9 percent of the Project route in Connecticut, excavated 1,693 shovel tests, and identified one new historic archaeological site. Four isolated finds were also identified. Tennessee considers the historic site TS 2401-01 and the four isolates to be not eligible for listing in the National Register of Historic Places (“NRHP”) and recommends that no further action is required for the isolates. Seven stone features have also been recorded.

Architectural site file research revealed three previously recorded aboveground historic resources are located within a 0.8-kilometer (0.5-mile) radius of the proposed centerline. All three of the resources are listed in the NRHP. Field reconnaissance conducted in June 2015 identified 45 previously undocumented historic resources in the survey area. To date, preliminary evaluation has identified eight properties for further research. It is the opinion of Tennessee that the remaining 37 are not eligible.

The Commission and Tennessee have been in communication with four Native American tribes that expressed an interest in ongoing communications regarding the Project in Connecticut. Continued communications regarding interest in the Project have been disseminated through formal notification letters, weekly e-mails, telephone conversations, and in-person discussions at group Project meetings. The Commission and Tennessee have held three group Project meetings with Native American tribes in response to interest in the Project. The Mashantucket Pequot, Mohegan Tribe of Indians of Connecticut, Narragansett Indian Tribe, and Wampanoag Tribe of Gay Head (Aquinnah) are consulting with the Commission regarding resources of concern, the unanticipated discoveries plan, and cultural resource investigations for the Project in Connecticut. The Wampanoag Tribe of Gay Head (Aquinnah) has participated cultural resource field investigations in Connecticut.

3.0 POTENTIAL PROJECT EFFECTS AND MITIGATION

Work activities will take place primarily within or adjacent to existing Tennessee easements, and will be associated primarily with pipeline installation and access road construction and upgrades. All appurtenant facilities will be constructed within the proposed workspace in the pipeline ROW and will not require additional impacts. Tennessee will utilize standard techniques to construct the aboveground facilities, and work will be conducted in accordance with Tennessee's Project-specific Plan and Procedures (Attachment Q), the ECP for Connecticut, and Tennessee's construction best management practices ("BMPs") to minimize impacts.

The Project facilities will be designed, constructed, tested, operated, and maintained to conform with applicable federal, state, and local requirements, including U.S. Department of Transportation ("USDOT") regulations at 49 CFR Part 192, "Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards" and Commission regulations at 18 CFR Section 380.15, "Siting and Maintenance Requirements". In addition, unless otherwise authorized through a variance granted by the Commission, Tennessee will comply with the Commission's Plan and Procedures, as well as a variety of plans being developed for the Project by Tennessee, including an Unanticipated Discovery Plan for cultural resources, Waste Management Plan, and typical construction workspace layout drawings.

Following construction, vegetation within the permanent ROW will be maintained in an herbaceous state, except in wetlands and adjacent to perennial streams, where maintenance clearing of woody vegetation will be limited. Here, a 10-foot wide corridor centered over the pipeline will be permanently maintained in an herbaceous state while the remaining temporary and permanent ROW will revert to its pre-construction land use/land cover once construction is complete. In addition, trees that are located within 15 feet of the pipeline that might otherwise compromise the integrity of the pipeline coating may be selectively cut and removed from the permanent ROW. Crop production will be allowed to continue in agricultural areas.

3.1 SOIL IMPACT

Land clearing and grading efforts to prepare for the pipeline installation will result in temporary, minor impacts on soils along the Project route. Soil disturbances such as grading activities will be minimized to prevent compaction and mitigated through implementation of Tennessee's Project-specific Plan and Procedures.

In order to minimize impacts to soils, BMPs will be incorporated into the Project design, implemented prior to the start of construction, and maintained until final stabilization is achieved. Minor impacts to soil resources will occur during the construction period and/or post-construction monitoring period. Depending on soil conditions, impacts can include loss of excavated soil from water and wind erosion, soil compaction from construction equipment, and mixing of rock into soil or mixing of wetland topsoil and subsoil. The soil characteristics, such as potential vegetative cover and slope are important factors in determining the potential for construction-related impacts to occur. During construction, Tennessee will implement a Spill Prevention and Response Plan ("SPRP") which specifies prevention and cleanup procedures in the event of a spill or leaks of fuel, lubricants, coolants, or solvents. Implementation of the

SPRP will prevent and minimize the potential for soil contamination during construction. A copy of the SPRP is provided in Tennessee's Project-specific ECP for Connecticut.

During operations, the pipeline and aboveground facilities will be patrolled on a routine basis, and personnel qualified to recognize impacts to soils such as erosion or failure of revegetation will handle maintenance as needed. During operations, there is the potential for increased runoff of stormwater as a result of compacted soils. The Project area will be monitored to maintain erosion control structures and repair any eroded areas. Tennessee has developed a Storm-Water Pollution Prevention Plan ("SWPPP") to address stormwater runoff. Mitigation measures to prevent soil impacts during construction are discussed in Section 3.2, below.

3.2 SOIL IMPACT MITIGATION

This section provides information pertaining to specialized construction methods, sensitive areas, and specialized reclamation recommendations along the pipeline ROW. These measures mitigate impacts to soils including erosion and sedimentation, soil segregation to prevent and mitigate erosion prone soils, compaction in areas with hydric soils, rocky soils and rocks introduced into topsoil, shallow depth to bedrock, low revegetation potential, poor drainage, ground heaving and prime farmland in addition to inspections and timing. Temporary soil impacts will be limited to the pipeline ROW during the period of construction and mitigated through implementation of Tennessee's Project-specific Plan and Procedures and Tennessee's Connecticut ECP (Attachment Q to the 401 application).

Additional conservation and mitigation measures are established for Connecticut in Tennessee's Project-specific ECP guidance documents to minimize impacts to soils. The ECP include procedures for soil conservation measures which will be implemented during construction and operation of the proposed Project.

3.2.1 Erosion and Sedimentation Control

Soil disturbance activities such as soil clearing, trenching, backfilling grading, high winds, or heavy rain events can lead to erosion and sedimentation. Construction will temporarily alter surface drainage and temporarily increase the potential for compaction, erosion, sedimentation, mixing of soil horizons, heaving, and rutting. The Project will be constructed in a manner that will minimize environmental impacts and conditions specific to the construction area and are in accordance with local and state regulations. Tennessee's objective is to minimize the potential for erosion and sedimentation during construction and to effectively restore the ROW and other disturbed areas. Tennessee will meet this objective by employing the erosion and sedimentation control measures contained in Tennessee's Project-specific Plan and Procedures and ECP for Connecticut (Attachment Q to the 401 application). Tennessee has also established a SWPPP to prevent soil erosion and sedimentation associated with the Project. The SWPPP includes typical drawings describing man-made erosion control structures, stormwater inspections, and recordkeeping procedures during construction, including timetables for groundcover establishment, appropriate seed mixes, and acknowledgment of the appropriate growing seasons. The SWPPP is provided in Tennessee's Project-specific Plan and Procedures.

Contours will be restored back to original contours as closely as possible as conditions permit. Sometimes this cannot always be achieved due to severity of slope, rock bluffs, etc. However, these areas will be restored to a contour or slope where successful restoration can be achieved. Erosion control and sedimentation measures will be implemented through construction of slope breakers or water bars and terraces diagonally across the ROW on slopes to reduce runoff. If additional material is needed, displaced material from other project locations may be imported or local area supplies may be used if necessary. Water diverted by the water bars will be channeled to well-vegetated areas. Erosion control barriers consisting of silt fences, hay/straw bales, and/or sandbags may be temporarily used in place of water bars. As a general practice, erosion control barriers will be installed immediately after soil disturbances in the following areas:

- At water bar outlets, if vegetation is incapable of filtering effectively;
- Between graded ROW and waterbodies after clearing (along banks);
- Downslope of stockpiled soils near waterbodies and wetlands;
- At the base of slopes adjacent to road crossings, and at downslope boundaries of construction areas where runoff is not controlled with a water bar; and
- In the ROW at boundaries between wetlands and adjacent disturbed uplands.

Tennessee intends to implement the following soil decompaction measures to prevent or mitigate for soil decompaction where the Project crosses agricultural and residential land as needed. The measures, as outlined in the state-specific ECPs, and Soil Protection and Subsoil Decompaction Mitigation Plans may include, but are not limited to:

- Prevention of compaction and mixing of topsoil in agricultural lands utilizing full ROW topsoil segregation.
- Prevention of compaction and mixing of topsoil in residential lands implementing ditch plus spoil-side topsoil segregation.
- Upon completion of backfilling operations, topsoil will be placed over the graded areas.
- Following regrading of residential and agricultural lands, the topsoil and subsoil will be tested for compaction. Compaction tests will be conducted at intervals and frequencies sufficient to determine the need for decompaction based on the soil type and as described in the state-specific ECPs.

Subsequent to soil compaction testing of regraded residential and agricultural lands, ROW locations found to be subject to compaction will be decompacted with deep tillage by such devices as the deep-shank heavy-duty subsoiler, paraplow, paratill, or other landowner-specified technique.

3.2.2 Soil Compaction

Subsoil compaction of agricultural lands, and severely compacted residential areas, will be relieved in two phases. First, the subsoil will be deep ripped at times of appropriately low soil moisture, with uplifted stone removal, using standard rock-picking equipment prior to replacement of the segregated topsoil. Following topsoil replacement, a second phase of decompaction will occur that utilizes Paratill® deep sub-soiling and supplemental excess stone removal from the ROW, including from the topsoil storage area.

3.2.3 Proposed Topsoil Segregation Methods

Topsoil segregation methods will be used in maintained lawn or landscaped areas within residential lands and on managed or rotated agricultural lands, cultivated pastures, hayfields, and other areas at the landowner's or land managing agency's request. The Contractor will strip and segregate topsoil from over the trench and from the spoil and subsoil storage areas in residential lands unless otherwise authorized in writing by the landowner. In residential areas, the Contractor may replace topsoil (i.e., import topsoil) if approved by the Environmental Inspector ("EI"). The EI will oversee and approve all imported material as required and ensure that the Contractor adheres to the restoration and mitigation plans defined for residential construction. Tennessee will implement its Project-specific Plan and Procedures. The Plan and Procedures, along with any required additional conservation measures, are provided in Tennessee's Project-specific ECP for Connecticut.

In order for topsoil to be restored in disturbed areas to their former productivity levels, Tennessee will employ the following topsoil segregation techniques from its Project-specific Plan and Procedures.

- 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 Tennessee's Project-specific Plan and Procedures.
- Segregate at least 12 inches of topsoil in areas with more than 12 inches of topsoil. In soils with less than 12 inches of topsoil, every effort will be made to segregate the entire topsoil layer.
- Where topsoil segregation is required, maintain separation of salvaged topsoil and subsoil throughout all construction activities.
- Areas where topsoil is windrowed per landowner agreement will be stabilized in accordance with BMPs and state-specific ECPs.
- Where there is a known potential for ground heaving, methods of reducing expansive soil danger include replacing the top 3 to 4 feet of expansive soil with non-expansive soils or compacting existing expansive soil.
- Leave gaps in the topsoil piles for the installation of temporary interceptor dikes to allow water to be diverted from the ROW.
- Topsoil replacement (i.e., importation of topsoil) may be used to improve the soil medium when plant establishment and vegetation growth is desired and previously existing subsoil is less than 6 inches and on slopes of 2:1 or flatter as an alternative to topsoil segregation if approved by the landowner and the Lead Environmental Inspector ("LEI").
- Imported topsoil will be used to fill depressions in areas where trench settling occurs after initial topsoil spreading.
- Topsoil from the ROW or adjacent agricultural land will not be used to backfill depression. Imported topsoil will be used to fill each area where trench settling occurs after the segregated topsoil has been used.
- Never use topsoil for padding, backfill, or trench plugs.

For hydric soils in wetlands, segregate the top 12 inches of topsoil within the ditchline, except in areas where standing water is present or soils are saturated. Where there is standing water, or the soil is too saturated for segregation, no topsoil segregation will be conducted.

3.2.4 Introduction of Rock into Topsoil

Stony or rocky soils can cause damage to agricultural equipment. Rock material 4 inches in size or larger, including blasted rock, if necessary, will be disposed of in one or more of the following ways to avoid the introduction of rock into the topsoil at the completion of construction activities:

- 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 managed agricultural lands, wetlands, and residential areas, rock may only be backfilled to the top of the existing bedrock profile;
- Windrowed per written landowner agreement with Tennessee;
- Used as a fenceline or all-terrain vehicle ("ATV") deterrent along property lines as practicable and per written landowner agreement with Tennessee;
- Removed and disposed of at an appropriately approved site; and
- Used as riprap for stream bank stabilization where allowed by an applicable regulatory agency(ies).

3.2.5 Revegetation

On disturbed land, restored workspaces, and locations with poor revegetation potential, soil quality may be affected by the spread of soil pests, noxious weeds, and invasive or non-native plant species. Proper management of soils and use of appropriate seed mixes will reduce the potential for soil pests and the spread of noxious weeds and invasive plants along Project workspaces. Seed specifications that stabilize soils and naturally improve upland and grassland habitat will be followed. Tennessee will implement the procedures outlined in Tennessee's Project-specific Plan and Procedures.

Disturbed areas will be mulched with straw and/or hay and will be anchored or tackified immediately after application. A tractor-drawn implement may be used to "crimp" the straw or hay into the soil - about 3 inches. This method will be limited to slopes no steeper than 3H:1V. The machinery will be operated along the contour, parallel to the side slope. Crimping of hay or straw by running over it with tracked machinery is not recommended. Tackifiers may be applied after mulch is spread or sprayed into the mulch as it is being blown onto the soil. Applying straw and tackifier together is generally more effective. Synthetic or chemical tackifiers will be used as recommended by the manufacturer to anchor mulch, provided sufficient documentation is available to show they are non-toxic to native plant and animal species. In addition, biodegradable jute matting, fiber netting, natural wood excelsior, or similar materials may be used to anchor and stabilize the surface of the soil during the critical period of vegetative establishment. Matting or netting materials will be applied to sensitive areas including, but not limited to, steep slopes, banks of waterbodies, swales, and other areas of concentrated water flow. Matting or netting materials will also be applied to areas where temporary/permanent vegetation is establishing at inadequate rates or densities to assist in protecting the seed bank, and establish the necessary ground cover, such that soil stabilization is achieved.

Wetlands and upland areas along the ROW will be seeded with the seed mix prescribed by local agency recommendations and Tennessee's Project-specific Plan and Procedures at 40 pounds per acre ("lbs/acre") (unless standing water is present or local seed mixes are provided or requested by the landowner) to stabilize the area until indigenous species are re-established. Amendments such as fertilizer and lime will not be permitted in wetlands unless otherwise stated. If there are adverse weather conditions, the ROW will be mulched in accordance with local USDA-NRCS or other local soil conservation authority recommendations until reseeding can resume. The ROW will generally be seeded within six working days of final grading, weather and soil conditions permitting. Slopes steeper than 3:1 will be seeded immediately after final grading, weather and soil conditions permitting.

Stabilization of the soil will be necessary until vegetation is established using temporary measures such as mulching, matting, or netting. If construction is completed 30 days or more before the seeding season for perennial vegetation, areas adjacent to waterbodies will be mulched with 3 tons per acre of straw at a minimum of 100 feet on either side, excluding the temporary travel lane within the construction ROW.

USDA-NRCS Standards and Specifications available on the electronic Field Office Technical Guides (“eFOTG”) contain conservation practice standards for correct seed mixes and plantings for restoration (USDA-NRCS 2015b). Tennessee will incorporate recommendations from these documents in their restoration activities, specifically the USDA-NRCS Conservation Practice Standard Critical Area Planting Code 342 (USDA-NRCS 2015c).

Through implementation of the recommended BMPs outlined in Tennessee’s Project-specific Plan and Procedures and ECP for Connecticut (Attachment Q to the 401 application), including fertilizing, seeding, and mulching requirements, and taking the necessary precautions to avoid and mitigate as outlined above, it is anticipated that long-term impacts to soils caused by the Project will be avoided.

3.2.6 Environmental Inspection

Environmental monitoring and agricultural inspections will control soil health along the Project by preventing the spread of noxious weeds and invasive or non-native plant species and soil pests throughout the proposed project during construction and restoration activities. During construction and restoration, Tennessee will employ EIs who will be responsible for ensuring that contractors implement and maintain erosion and sediment control and proper revegetation and seed mixes. For construction compliance oversight, EIs will coordinate with the appropriate state, Commonwealth, and local agencies to meet the minimum requirements.

3.3 WETLANDS AND WATERCOURSES IMPACTS

Tennessee has worked closely with design engineers and constructability experts to avoid and minimize impacts to environmentally sensitive areas to the extent practicable. To minimize or avoid adverse effects to wetlands, Tennessee has attempted to tweak the pipeline alignment to the extent practicable and has sited the alignment within or adjacent to existing Tennessee ROW. Where practicable, Tennessee has attempted to site access roads and facilities within upland areas to avoid wetland and watercourse crossings. However, Project activities will have unavoidable temporary, permanent and secondary effects on wetlands and watercourses in Connecticut. These impacts are summarized in Table 3.3-1.

Table 3.3-1
Wetland Impact Summary by Wetland Type in Connecticut

County	Town	Palustrine Emergent (acres affected)		Palustrine Forested (acres affected)		Palustrine Scrub-Shrub (acres affected)		Other Wetland[3] (acres affected)		Town Total (acres affected)	
		Const.[1]	Oper.[2]	Const.[1]	Oper.[2]	Const.[1]	Oper.[2]	Const.[1]	Oper.[2]	Const.[1]	Oper.[2]
Hartford	Farmington	0.07	0.00	0.18	0.07	0.17	0.05	0.00	0.00	0.42	0.12
	West Hartford	1.54	0.00	3.72	1.11	1.04	0.20	0.22	0.00	6.52	1.31
	Bloomfield	7.57	0.00	10.70	3.65	0.15	0.04	0.00	0.00	18.42	3.69
	Windsor	0.69	0.00	1.92	0.69	0.41	0.01	0.00	0.00	3.02	0.70
	East Granby	0.00	0.00	0.35	0.09	0.00	0.00	0.00	0.00	0.35	0.09
Total Area Affected in Connecticut		**9.87**	**0.00**	**16.87**	**5.61**	**1.77**	**0.30**	**0.22**	**0.00**	**28.73**	**5.91**

Source: The data sets utilized for wetlands is a combination of field surveyed data, photo interpreted LiDAR data, and publically available data. Field surveyed data was used wherever there was parcel access, photo interpreted LiDAR data was used where there was no parcel access, and publically available data was used where there was no parcel access and no photo interpreted aerial coverage. The publically available data is from the USFWS - NWI (2014).

[1] Construction Acreage = all workspace during construction activities (TWS, ATWS, and permanent easement) that impacts wetlands. Workspace was laid out to maintain a 75 foot construction ROW through wetlands. Any construction ROW impacts greater than 75 feet are detailed in the Project specific ECP.
[2] Operation Acreage = 10-foot wide corridor permanently maintained in herbaceous vegetative cover through PSS wetlands, and 30-foot wide corridor permanently maintained through PFO wetlands where trees taller than 15 feet that could damage the pipeline coating will be selectively cut and removed. The permanently maintained corridors represent a change in cover type from PFO to PSS and PEM or PSS to PEM; there is no operation impact on PEM wetlands, since there is no change in pre- and post-construction wetland vegetation cover type. Operational acreage represents areas of new permanent easement and does not include overlap with TGP's existing pipelines. The existing permanent easement for TGP's existing pipelines are not included in the operational wetland impacts.
[3] Wetland type not classified by NWI as PEM, PSS, or PFO.

Construction of the Project pipeline facilities will temporarily alter approximately 28.73 acres of wetlands in Connecticut, of which approximately 5.91 acres of PFO and PSS wetlands will be permanently maintained post-construction in an emergent or low scrub-shrub vegetated cover type (Table 3.3-1). Tennessee will provide a conceptual mitigation plan for these conservative estimates in coordination with the CTDEEP, and USACE requirements. Actual impacts to wetlands are likely to be less than these estimated values due to impacts generated from aerial imaging of the tree canopy, which may not result in the removal of all trees as estimated. Temporary wetland impacts may include soil disturbance, temporary alteration of hydrology, and loss of vegetation during construction. Upon completion of construction, topsoil, contour elevations, and hydrologic patterns will be restored, and all disturbed areas will be reseeded or replanted to promote the re-establishment of native hydrophytic vegetation. All temporary workspace ("TWS") and additional temporary workspace ("ATWS") areas will be restored to pre-construction grades and contours, and reseeded and/or replanted during restoration activities.

Following construction and restoration, all TWS and ATWS areas will not be maintained during operation of the proposed facilities and will be allowed to revert back to their pre-construction land use and vegetation cover type.

All wetlands will be substantially restored to their pre-construction grades, contours, and drainage patterns. As such, the permanent impacts on wetlands associated with the Project will consist of a conversion of PFO wetlands to PSS or PEM wetland vegetation cover types. Woody vegetation within the new permanent ROW will be allowed to regenerate within such ROW except for a 10-foot wide area centered over the pipeline that will be maintained in an herbaceous/scrub-shrub state to allow for inspection and maintenance of the pipeline once the Project is in-service. In addition, trees within 15 feet of the pipeline that could damage the pipeline coating may be selectively cut and removed from the new permanent ROW.

If required and in compliance with federal and state regulatory permitting frameworks relative to wetland protection, Tennessee would develop Project-specific wetland Mitigation Plans (per state) prior to construction. The Mitigation Plan(s) would detail measures to avoid, minimize, and mitigate for temporary and permanent wetland impacts associated with the Project. Tennessee will consult with the applicable federal and state regulatory agencies for guidance during the development of the proposed mitigation measures and plans, to incorporate specific recommendations of the agencies.

3.4 WETLANDS AND WATERCOURSES IMPACT MITIGATION

Tennessee will implement the Project-specific Plan and Procedures and the Connecticut ECP to protect sensitive habitats during construction, including wetlands and watercourses.

3.4.1 Waterbody Construction and Minimization/Mitigation Procedures

Tennessee anticipates that waterbodies not crossed using trenchless methods will be crossed by one of the open cut methods described. To minimize temporary impacts on installation of the pipeline facilities, Tennessee will implement the waterbody construction procedures, erosion control measures, and post-construction restoration activities identified in the Procedures and incorporated into the Project-specific ECP for Connecticut. Tennessee's preferred methodology for restoration is the use of natural stream restoration techniques where flow velocities allow. In the case of proposed use of boulder, rip-rap, gabion, or other hard non-native stream bank erosion control restoration structures will require review and permit approval by the USACE and CTDEEP prior to implementation. Descriptions of stream restoration techniques, including natural restoration techniques, are included in Tennessee's Project-specific ECP for Connecticut (Attachment Q to the 401 application).

Tennessee is proposing to provide a minimum depth of cover of five feet over the pipeline across waterbodies. The proposed cover will generally provide adequate scour protection from high flows and flooding. Prior to construction, field observations will be conducted to determine stability of the banks and appropriate bank stabilization techniques. Some crossings will only require replacement of natural streambed materials while others may require more extensive stabilization such as riprap stabilization, branch packing, brush mattresses, or an equivalent measure.

Tennessee will conduct post-construction field inspections along the pipeline corridor to ensure that disturbed locations are restored in accordance with the procedures detailed in the Project-specific Plan and Procedures and incorporated into the Project-specific ECP for Connecticut.

Tennessee will attempt to minimize impacts to waterbodies present within the construction ROW but not directly crossed by the pipeline. If waterbodies cannot be avoided, impacts will be limited to minor disturbances associated with the installation of equipment crossings (where necessary) and/or potential impacts related to the clearing of adjacent vegetation. Waterbodies located within the construction ROW that cannot be avoided due to constraints associated with site access or construction workspace configurations, will be traversed via equipment crossings consisting of temporary equipment mats supported by temporary culverts or equipment bridges in accordance with the Project-specific Procedures, incorporated into the Project-specific ECP for Connecticut. In locations where equipment crossing impacts can be avoided, Tennessee will attempt to maintain a 15-foot undisturbed vegetated buffer between the waterbodies and the construction workspace, except where maintaining this offset will result in greater impacts to wetlands or waterbodies. Sediment barriers will be installed, inspected, and maintained in accordance with the Project-specific Procedures, incorporated into the Project-specific ECP for Connecticut, at the time of clearing, parallel to the banks of all waterbodies located within the construction ROW. To further minimize potential impacts to waterbodies during construction, Tennessee will implement the following setbacks (to the extent practicable):

- Cleared and grubbed material (e.g., slash, wood chips, stumps, etc.) will be stacked a minimum of 50 feet from the edge of a waterbody;
- Any excavated material from the trench line will be placed a minimum of 10 feet from the top of the waterbody bank;
- Equipment will be parked overnight and/or fueled at least 100 feet from a waterbody boundary;
- Hazardous materials, including chemicals, fuels, and lubricating oils, will not be stored within 100 feet of a waterbody boundary; and
- Concrete coating activities will not be performed within 100 feet of a waterbody boundary, unless the location is an existing industrial site designated for such use.

3.4.2 Waterbody Crossings

Tennessee proposes to use the following methods for crossing waterbodies:

- Wet open cut method;
- Dry crossing method;
  - Flume crossing;
  - Dam and pump;
  - Cofferdam; and
  - Dry open cut (conventional trenching of waterbodies that are dry or frozen at the time of crossing during periods of no flow).
- Conventional bore;
- HDD; and
- Direct pipe method.

For waterbodies with discernible flow at the time of crossing, one of the above dry crossing methods will be used, unless otherwise approved by applicable agencies. For waterbodies with no discernible flow at the time of crossing, the dry open cut method will be used. In cases where continuous standing water is present across the work area, but there is no discernible flow, a dry crossing (flume crossing, dam and pump, or cofferdam) method will be implemented in the field to allow for excavation and installation of the pipe under dry conditions. Field determinations will be made at the time of crossing. The necessary equipment to perform dry crossings under these circumstances will be available on-site during construction. The wet open cut method will only be used when all dry crossing methods have been deemed infeasible and the methodology has been approved by applicable agencies. To minimize temporary impacts on installation of the pipeline facilities, Tennessee will implement the waterbody construction procedures, erosion control measures, and post-construction restoration activities identified in the Procedures and incorporated into the Project-specific ECP for Connecticut.

3.4.2.1 Method 1: Conventional Trenching (Wet Open Cut)

Wet open cut crossings will be performed by using excavation equipment to trench across the waterbody. Equipment used to dig the trench will work from the waterbody banks, equipment crossings, or by straddling the trenchline where the width of the waterbody prohibits excavations solely from the banks. The depth of trench will be sufficient to allow a minimum of five feet of cover over the pipeline below the streambed, provided rock is not encountered. Consistent with the Procedures, incorporated into the Project-specific ECP for Connecticut, Tennessee plans to complete construction activities within 24 hours at minor wet open cut crossings and within 48 hours at intermediate wet open cut crossings.

The following additional stipulations will apply to wet open cut crossings:

- Use of equipment operating in the waterbody will be limited to that needed to construct the crossing.
- Material excavated from the trench will be stockpiled in the construction ROW at least 10 feet from the water’s edge or in ATWS (located at least 50 feet from the water’s edge).
- Material excavated from the trench generally will be used as backfill, unless federal or state permits specify otherwise.

- Any excess material will be removed from the waterbody.
- The waterbody bottom will be returned to its original contour.

3.4.2.2 Method 2: Dry Crossings

Flumed Crossing

A flumed waterbody crossing redirects the water flow through one or more pipes to allow for the trenching and pipe installation to occur in dry conditions. The number, length, and diameter of the pipes are dependent on estimated stream flow for the waterbody being crossed. This method allows for drier trenching, pipe installation, and restoration, while maintaining continuous downstream flow and passage for aquatic organisms. Soil types must have characteristics that allow stable stream bank conditions, and stream flow must be low enough for this method to be used successfully and safely. The flume pipe(s) must be long enough to account for the potential for the ditch width to increase during excavation (due to sloughing) and over-sized somewhat to accommodate the possibility of high flow conditions. An effective seal must be created around the flume(s) at both the inlet and outlet ends, so water will not penetrate and potentially compromise the channelized dam. Tennessee will implement the following measures where the dry flume crossing method is utilized:

- The flume pipe will be installed before or after blasting (as necessary), but before any trenching;
- An effective seal will be created around the flume pipe with sandbags or an equivalent seal mechanism;
- The flume pipe(s) will be aligned parallel with natural water flow to prevent scouring of the bank, preventing erosion and sedimentation;
- The flume pipe will not be removed during trenching, pipe-laying, backfilling activities, or initial streambed restoration efforts, except in rare conditions where a severe flow event causes conditions that make it unsafe for the pipe to remain; and
- Flume pipes and dams that are not associated with an equipment bridge will be removed as soon as final cleanup of the stream bed and bank is complete.

Weather will be monitored to determine if heavy precipitation events are forecasted for the construction area(s) where waterbody crossings are planned. Attempts will be made to conduct dry open cut crossings outside of any forecasted heavy precipitation events. In waterbodies where no discernible flow is observed and no by-pass system is installed, supplies will be on-site to construct a by-pass system if precipitation occurs and the stream begins to show a discernible flow. If an unexpected heavy precipitation event occurs during construction at a dry crossing location, resulting in discernible flow in the waterbody channel, an alternate dry crossing method using the by-pass system will be employed. For proposed crossings where there is a discernible flow, if forecasted precipitation amounts are determined to potentially overwhelm the proposed by-pass system, the crossing will be postponed until the rain event has passed and it has been determined that the by-pass systems can safely flow water volume and velocity of the waterbody.

To facilitate construction of the Project, temporary equipment bridges will be required to be installed across waterbodies along the ROW to allow for construction equipment to move along the pipeline ROW. Flume pipe or dam and pump crossings will generally be used in conjunction with temporary equipment bridge crossings at waterbodies. Flume pipes or dam and pump crossings required to install the pipeline will be removed once work is complete and the waterbody bottom and banks have been restored. However, temporary equipment bridge crossings may still be required to facilitate ongoing construction equipment access along the ROW. Once all of the Project facilities are constructed and restoration is complete, temporary equipment bridges and associated flume pipes and dams will be removed.

Dam and Pump Method

The dam and pump method may be used for waterbody crossings where pumps and hoses can adequately transfer stream flow volumes from upstream of the work area to downstream of the work area, and there are no concerns with preventing the passage of aquatic organisms. Tennessee will implement the following measures where the dam and pump method is utilized:

- Sufficient pump size, horsepower ("hp") and hose capacity, including on-site backup pumps, will be used to maintain downstream flows;
- Cofferdams will be constructed with "clean" materials to prevent pollutants from entering the waterbody (e.g., sandbags or clean gravel with plastic liner);
- Water intakes will be suspended in the water column above the stream bed and will be screened to reduce entrainment of aquatic organisms or particles that may clog the pump;
- Pumps will be located within secondary containment structures to catch and prevent petroleum liquids from entering the waterbody during refueling or if a pump failure occurs;
- Large volume and strong velocity discharges will use water dispersion structures placed at the downstream discharge location to prevent streambed scour; and
- The coffer dam, pumps, and hoses will be monitored and maintained when necessary to ensure proper operation for the duration of the waterbody crossing.

Cofferdam

A cofferdam is a temporary barrier that is installed across or at the limits of the workspace within waterbodies to isolate it during construction and allow for dry working conditions. Cofferdams will be used for waterbody crossings with high flow volumes that preclude the use of a flume crossing or dam and pump. This method will consist of installing the pipeline across the waterbody in multiple stages, typically two, using a cofferdam to divert the waterbody around the workspace in each stage. The first stage would involve installation of one-half to two-thirds of the crossing, and the second stage would consist of completing the remainder of the crossing. Typical cofferdam materials include, but are not limited to, sandbags, sheet piling, timber lagging, and inflatable dams.

The typical installation procedure will consist of the following:

- Installing turbidity curtains around the work area;
- Installing the cofferdam;
- Dewatering the work area and maintaining it in a dewatered state;
- Excavating the trench;
- Installing the pipeline and an anti-seep collar, or equivalent, near the end of the pipe to help prevent water from traveling along the trench and flooding the work area;
- Backfilling the trench and restoring the waterbody bed and banks;

- Removing all equipment from the work area;
- Filling the area with water from outside the cofferdam;
- Remove the cofferdam and turbidity curtain; and
- Repeating the procedures above to construct the remainder of the crossing. Stage two may require installation of multiple sump pits to keep the trench line dewatered while the pipe sections are welded together.

All cofferdam crossings will be designed in accordance with applicable federal and state guidelines to ensure that the cofferdam can withstand maximum anticipated waterbody flows during the time of the crossing. All dewatering operations will require silt laden water to be discharged to an appropriate dewatering device (e.g., silt bags) prior to discharge back to the waterbody.

All cofferdams that require driving materials into the waterbody bottom for support (e.g., sheet piling) will require a modification when constructing Stage Two of the cofferdam over the pipe that was installed during stage one. Driving of the cofferdam will not be permitted within five feet of either side of the pipe installed during Stage one. The modification may include, but is not limited to, driving steel H-piles on either side of the pipe and constructing a barrier between them to prevent water from entering the work area. The barrier will not be allowed to be driven into the waterbody bed over the pipe. Any gaps that remain between the bottom of the barrier and the waterbody bottom will be sealed with sandbags or an equivalent material. As noted above, an anti-seep collar or equivalent will be installed during Stage O to help prevent flooding the work area.

Dry Open Cut

A dry open cut will be utilized for all waterbodies that are dry or frozen during the time of the crossing with no discernible or anticipated flow. This method will utilize conventional construction techniques with no temporary diversion structures (e.g., flume pipes, cofferdams) required during construction of the crossing. Consistent with the Project-specific Procedures, incorporated into the Project-specific ECP for Connecticut, Tennessee plans to complete construction activities within 24 hours at minor open cut waterbody crossings and within 48 hours at intermediate open cut crossings. A minimum cover depth of five feet will be maintained over the pipeline for all designated waterbodies crossed with the dry open cut method.

Temporary diversion structures will be required to be available on-site in the event that an unexpected precipitation event occurs and the waterbody crossing is not complete.

3.4.2.3 Method 3: Conventional Bore

Conventional bore may be used at sensitive crossings including highways, wetlands, and waterbodies. Boring consists of creating a shaft/tunnel for a pipe or conduit to be installed below streambeds (or wetland) without directly disrupting the in-stream channel or wetland soils. This is accomplished by first excavating a bore pit on one side of the waterbody and a receiving pit on the other side. The bore pit is excavated to a depth equal to the depth of the ditch and is graded such that the bore will follow the proposed slope of the pipe. A boring machine is then lowered to the bottom of the bore pit to tunnel under the waterbody using a cutting head mounted on an auger. The auger rotates through a bore tube, both of which are pushed forward as the hole is cut. The pipeline is then installed through the bored hole and welded to the adjacent pipeline.

3.4.2.4 Method 4: Horizontal Directional Drilling

HDD is an advanced, controllable trenchless boring method of installing underground pipes, conduits, and cables in a shallow arc along a predetermined bore path. HDD will be used in areas where trenching or excavating is not practical. The decision to install waterbody crossings by HDD instead of by conventional means, at specific locations on the Project, will depend on the following:

- Crossing location;
- Environmental sensitivity and associated constraints;
- Geotechnical concerns;
- Substrate composition; and
- Hydrological data.

The HDD process consists of drilling a pilot hole with a cutting head along the predetermined path and then enlarging the pilot hole with a larger cutting tool (back reamer) to the diameter required to install the casing, pipe, or conduit. The HDD process is done with the help of a viscous fluid known as drilling fluid. The fluid generally consists of a mixture of water and usually bentonite. The fluid is pumped through holes in the cutting heads to facilitate the removal of cuttings, stabilize the bore hole, cool the cutting head, and lubricate the passage of the pipe. The fluid is recycled throughout the drilling process.

This method of installation will require a large amount of ATWS and is only used in areas where boring and conventional open cut methods are not suitable. The large amount of TWS is directly related to the required drilling fluid pits and pipe stringing corridor. The pipe stringing corridor is required to pre-connect the pipe so that it can be pulled through the bore hole in one piece. Pulling the pipe in one piece greatly increases the probability of a successful HDD.

Tennessee has investigated specific waterbody and wetland crossings to determine the feasibility of using HDD based on the specific conditions at the crossing location.

3.4.2.5 Direct Pipe Method

"Direct Pipe"® is another trenchless method that combines the advantage of established laying methods of microtunnelling and HDD. A single continuous working operation allows the trenchless laying of pre-fabricated pipeline and the simultaneous development of the required bore hole. Earth excavation is performed by means of a microtunnelling machine (equipped w/ cutterhead) which is navigable and uses a flushing circuit (pipes) method to transport the earthen materials to the surface. The pressure that is necessary for the boring process is transferred along the pipeline to the cutterhead. Modern and proven controlled pipejacking techniques ensure accurate measurement of the current pipe position along the intended route. The pressure that is necessary for the boring process is transferred along the pipeline to the cutterhead. The "Pipe Thruster" is the equipment that exerts the force required to feed the pipeline forward.

Direct pipe installations may be much shorter and shallower than HDD installations because the excavation is continuously cased, reducing the risk of hole collapse and subsequent settlement. The length limitation for the Direct Pipe technology (for a 30-inch O.D. pipeline) is currently roughly 900 feet due to the requirements of the hydraulic motors in the smaller diameter tunneling machines. Soils with abundant, strong, and/or abrasive boulders may present risk to the Direct Pipe method.

3.4.3 <u>Wetland Construction and Minimization Measures</u>

Tennessee will protect and minimize potential adverse impacts on wetlands using construction procedures specified within Tennessee's Project-specific Plan and Procedures and incorporated into the Project-specific ECP for Connecticut. Tennessee will utilize one of the following methods for installing the pipeline within wetlands during construction. The proposed construction methods within wetlands include:

- Standard pipeline construction (Method I);
- Conventional wetland construction (Method II);
- Push-pull technique; and
- HDD.

3.4.3.1 Standard Pipeline Construction (Method I)

The standard pipeline construction method will be utilized in wetlands where soils are non-saturated and able to support construction equipment at the time of crossing. This method requires segregation of topsoil from subsoil along the trenchline. Where present, a maximum of 12 inches of topsoil will be segregated from the area disturbed by trenching, except where standing water is present or if soils are super-saturated. Topsoil segregation is followed by trench excavation, pipe laying, backfilling, and grade restoration. Immediately after backfilling is complete, the segregated topsoil is restored to its original location. Erosion control measures, including site-specific contouring, silt fence, hay-bale barriers, permanent slope breakers, mulching, and reseeding or sodding with soil-holding vegetation will be implemented. Contouring will be accomplished using acceptable excess soils from construction.

3.4.3.2 Conventional Wetland Construction (Method II)

The Conventional Wetland Construction method will be used for crossing wetlands with saturated soils or soils unable to support construction equipment without significant soil disturbance.

Prior to crossing and movement of construction equipment through these wetlands, the ROW will be stabilized using timber mats to allow for a stable, safe working condition. Unless soils are inundated or super-saturated, up to the top 12 inches of wetland topsoil over the trenchline will be segregated. Trench spoil will be temporarily stockpiled in a ridge along the pipeline trench. Gaps in the spoil pile will be left at appropriate intervals to provide for natural circulation or drainage of water. Before the trench is dug, the pipeline will be assembled in a staging area located in an upland area. After the pipeline is lowered into the trench, wide track bulldozers or backhoes supported on timber mats will be used for backfill, final cleanup, and grading. This method will minimize the amount of equipment and travel in wetland areas.

3.4.3.3 Push-Pull Technique

Construction in saturated/inundated wetland areas may involve the "push-pull technique". The push-pull technique is used in large wetland areas where sufficient water is present for floating the pipeline in the trench and grade elevation over the length of the push/pull area. It will not require damming to maintain adequate water levels for floatation of the pipe. Push-pull techniques involve pushing the prefabricated pipe from the edge of the wetland or pulling the pipe with a winch from the opposite bank of the wetland into the trench. During implementation of this technique, initial clearing within the wetland will be minimized. The width of the ROW cleared will be limited to only that necessary to install the pipeline. Grading in inundated wetlands will be held to a minimum and generally will not be necessary due to the level topography and the absence of rock outcrops in such areas. Timber mats may be placed over existing vegetation where grading is not required. Trees and brush will be cut at ground level by hand, with low ground pressure equipment, or with equipment supported by timber mats. Tennessee will not use dirt, rock, pulled tree stumps, or brush rip-rap to stabilize the travel lane and sediment barriers will be installed prior to grading, as needed, to protect adjacent wetland areas.

The trench will be excavated using amphibious excavators (pontoon mounted backhoes) or tracked backhoes (supported by fabricated timber mats or floats). The excavated material will be stored adjacent to the trench (if possible). If storage of excavated material next to the trench is not possible, the material will be temporarily stored in one of the following locations: (1) in upland areas of the ROW as near to the trench as possible; (2) in construction vehicles; or (3) transported to an approved off-site staging location until needed for backfilling. The pipe will be stored and joined at staging areas (push-pull sites) located outside the wetland. Floats may be attached temporarily to give the pipe positive buoyancy. After floating the pipe into place, these floats will be cut and the negatively buoyant pipe will settle to the bottom of the ditch. This operation will be repeated, with pipe sections fabricated, pushed into place, and welded together, until the wetland crossing is complete. The excavated material will then be placed over the pipe to backfill the trench.

3.4.3.4 Horizontal Directional Drilling

HDD is an advanced, controllable trenchless boring method of installing underground pipes, conduits and cables in a shallow arc along a predetermined bore path. HDD will be used in areas where trenching or excavating is not practical. Refer to Section 3.4.2.4 for additional information on the HDD crossing methodology.

3.4.4 <u>Minimization of Impacts</u>

To minimize impacts on wetlands, Tennessee will implement the wetland construction BMPs described in Tennessee's Project-specific Plan and Procedures and the Project-specific Connecticut ECP. Workspace is limited to wetlands within 75 feet in width, unless topographic conditions or other safety concerns require additional workspace. These site-specific areas will be identified and approved prior to construction. During operation of the Project, 10 feet of the permanent ROW, centered over the Project pipeline, will be maintained within wetlands identified as PEM wetland in accordance with Tennessee's requirements. In PFO wetlands, Tennessee will minimize tree clearing to the maximum extent practicable while maintaining safe construction conditions. Tree clearing within wetlands during operation of the pipeline will be limited to selectively clearing trees within 15 feet of the pipeline that may damage the pipeline coating.

Access within the ROW across wetlands will only be permitted where soils are non-saturated and able to support construction equipment at the time of crossing, during frozen soil conditions (for winter tree clearing), or with the use of timber mats to avoid rutting of the wetland soil. If mats are not used, the EI will record the pre- and post-construction soil density using a penetrometer to determine if the soil has been inadvertently compacted during construction or access.

Impacts to wetlands will be minimized by segregating up to the top 12 inches of soil from the area disturbed by trenching activities, except in super saturated areas or when soils are frozen. The topsoil will be restored to its original location immediately after backfilling is complete to preserve the existing seedbank and promote revegetation of the disturbed area. Seed mixes spread on the restored topsoil for temporary stabilization will include annual rye grass (*Lolium multiflorum*) at a rate of 40 pounds per acre (unless standing water is present) or appropriate mixes recommended by the landowner, state agency, or county conservation districts. The use of fertilizers will not be permitted. Mulch will only be used within wetlands as required by state agencies. Utilizing recommended seed mixes containing native plants will control the import of invasive and/or exotic plant species to the site. Erosion controls, including silt fence and/or staked hay bales, also will be installed to protect wetlands from sediment disturbed in adjacent uplands during construction. Post-construction, the disturbed area will be monitored to ensure long-term stabilization of the site.

Tennessee will protect and minimize potential adverse impacts to wetlands by expediting construction in and around wetlands, by restoring wetlands to their original configurations and contours, by segregating topsoil during excavation, by permanently stabilizing upland areas near wetlands as soon as possible after backfilling, by inspecting the ROW periodically during and after construction, and by repairing any erosion control or restoration features until permanent revegetation is successful. Tennessee will comply with the applicable permit conditions issued by federal, state, and local permitting agencies with respect to construction and operation of the Project facilities within wetlands.

3.5 FLOODPLAINS AND FLOODWAYS

Tennessee reviewed National Flood Insurance Program FIRMs issued by FEMA to identify proposed crossings of areas subject to flooding and high volume flows. The Connecticut portion of the Project crosses the flood zones of the Farmington River, Degrayes Brook, and Rippowam River. Tennessee will continue to consult with federal, state, and local agencies to identify any additional areas where flooding is a concern that may not be currently mapped by FEMA. SFHAs are those areas subject to flooding by the 1 percent annual chance flood (100-year flood).

For construction and restoration of the Project facilities, Tennessee will implement BMPs outlined in the Project-specific Plan and Procedures and incorporated into the Project-specific ECP for Connecticut, which are intended to be used to avoid, minimize, and/or mitigate impacts from the Project. BMPs applicable to floodplains include the control of erosion and sedimentation through installation of structural erosion and sedimentation facilities within and at the limits of the Project workspace. BMPs will comply with Connecticut standards for erosion and sediment control, including specifications for flooding frequency and volume. Additionally, the amount of vegetation cleared during construction will be limited to the removal of the minimum amount necessary for safe construction. Tennessee will restore and revegetate TWS areas to minimize impacts on vegetated areas. Restoration and revegetation will comply with state and federal regulations and monitoring requirements. The construction workspace will be restored to pre-construction contours after construction and will not result in increased flood heights or encroachment within floodways. Tennessee will apply for and obtain applicable regulatory permits and approvals related to land use regulations prior to construction of the proposed facilities.

To protect the integrity of the pipeline during flood events, the Project facilities will be designed, constructed, tested, operated, and maintained to conform with applicable federal, state, and local requirements, including USDOT regulations at 49 CFR Part 192 and 18 CFR Section 380.15. To increase the overall safety of the pipeline facilities and protect the public from any system failures due to natural catastrophes, including severe flooding, the pipeline will include a variety of design and equipment features.

Temporary and permanent impacts associated with construction will be minimized to the extent practicable, and Tennessee and its contractors will comply with mitigation measures detailed in the Project-specific Plan and Procedures and required as part of the permits and orders or conditions required for the Project, which will be incorporated into the Project-specific ECP for Connecticut (Attachment Q to the 401 application). Tennessee will continue to consult with the applicable agencies relative to measures recommended to protect fisheries resources and water quality within streams crossed by the proposed Project.

3.6 RARE SPECIES

As mentioned in previous sections, the CTNDDB has provided Tennessee with a list of rare plant and animals located in the vicinity of the Project (DeBarros 2015; McKay 2015; Riese 2014). In addition, the CTNDDB also provided impact avoidance/minimization and mitigation recommendations and information regarding state-listed plants and animals, including appropriate habitat and survey windows for each plant species.

The CTDEEP is concerned with the species of grasses and other plants found within erosion control and conservation seed mixes out-competing the native Connecticut state-listed species; and therefore, recommended that disturbed areas be allowed to revegetate naturally without the addition of conservation or erosion control seed mixes where possible. Tennessee is evaluating this and other recommendations from the NRCS SWCDs to determine the appropriate seed mixture and/or mixtures. Determinations will be based on the local habitat cover types, presence of rare species, and other environmental constraints (i.e., physical or biological).

The CTNDDB has indicated the presence of two state-listed Special Concern bat species, the hoary bat and the silver-haired bat (McKay 2015). According to the CTNDDB, these bats are solitary and give birth in the May through July time frame. The CTNDDB did not specifically request surveys for these species, but recommended that forest clearing activities be conducted outside of the natal period to avoid direct negative impacts. Tennessee has committed to winter tree clearing in areas identified as summer roosting and maternal colony bat habitats and direct negative impacts to these species will be minimized. Long-term impacts can be minimized by retaining large diameter coniferous and deciduous trees whenever possible.

As described above, Tennessee is performing Phase 2 acoustic surveys Project-wide where potential summer roosting and maternal colony bat habitats are identified. Although these surveys target habitats for the federal-listed northern long-eared bats, there is some degree of spatial overlap in summer habitat preferences for all of these species. Therefore, it is likely that hoary and silver-haired bats will be detected during these surveys. These observations will be reported to the CTDEEP.

To prevent negatively affecting the eastern ribbon snake, the CTDEEP recommends avoiding wetlands in one specific location in Bloomfield, Connecticut. Further, the CTDEEP recommends that Tennessee incorporate into the design of the Project a minimum buffer of 100 feet between proposed activities and the eastern ribbon snake's preferred habitats.

To prevent impacts to state-listed plants, the CTDEEP has provided maps demarcating survey limits for each plant species and recommend that botanical surveys be performed in the vicinity of the Project by a qualified botanist when each of the respective species is identifiable (DeBarros 2015; Riese 2014). Tennessee is currently developing its botanical survey protocol and will perform botanical surveys where access to the Project area is permitted. A report summarizing the findings of the botanical study will be provided to the CTDEEP and the Commission upon completion of the surveys.

The CTDEEP has requested that a freshwater mussel biologist perform surveys for endangered and threatened mussels in the vicinity of the proposed Project alignment within one particular river (McKay 2015; Riese 2014). Although Tennessee currently plans to cross this river utilizing HDD technology and therefore, does not anticipate impacts to freshwater mussels or their habitats, surveys will be performed by qualified biologists following approved protocols.

Additionally, the CTDEEP recommends that a herpetologist familiar with the habitat requirements of blue-spotted and Jefferson salamanders survey the proposed construction footprint for the presence of these two species, as well as potential preferable blue-spotted and Jefferson salamander habitat between the months of April and September. Further surveys were recommended for the eastern box turtle and the eastern hog nose snake during these species' active period between April 1 and November 1 (McKay 2015; Riese 2014). Tennessee conducted vernal pool surveys during the spring of 2015 where access to the Project area is permitted.

According to the CTDEEP, there are numerous grassland bird species that occur within the Project area in Windsor, East Granby, and Bloomfield. If construction occurs during the breeding season of these species, between May and August, the CTDEEP recommends that an ornithologist perform surveys for this suite of grassland birds in order to determine whether or not they are nesting within the Project area. The CTDEEP recommends that if tree cutting is performed within American kestrel habitat between the months of March and July, an ornithologist will conduct surveys between April and July to determine whether or not there is a breeding pair of kestrels within the vicinity of the Project (McKay 2015; Riese 2014).

According to CTDEEP, habitat for the pine barrens tiger beetle occurs within portions of Hartford County in dry open fields and loose sandy areas. The CTDEEP recommends that an entomologist perform surveys to determine the presence of this species. The CTDEEP further indicates that a CTDEEP Wildlife Division permit may be required by the entomologist to perform the survey (McKay 2015; Riese 2014).

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Attachment L

Wetland Mitigation and Invasive Species Control

Attachment L1

Conceptual Wetland Mitigation Plan

This Appendix was formatted in its entirety as part of the USACE Section 404 Permit Application; therefore, appendix references and page numbers contained within this document are not consistent with this permit application.

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Conceptual Compensatory Mitigation Plan for the Northeast Energy Direct Project

Submitted by:

Tennessee Gas Pipeline Company, L.L.C.
1001 Louisiana Street
Houston, Texas 77002

November 2015

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

This Conceptual Mitigation Plan ("Plan") describes the methods that will be implemented during construction of the Tennessee Gas Pipeline Company, L.L.C. ("Tennessee") Northeast Energy Direct ("NED Project" or "Project") to minimize, avoid, and mitigate for the temporary and permanent impacts to wetlands and other waterbodies. This Plan includes a description of impacts for each state.

The enclosed plan is conceptual in nature and the final Compensatory Wetland Mitigation Plan will be developed to follow the United States Army Corps of Engineers ("USACE") Compensatory Mitigation Guidance and Checklist Instructions contained therein. The Plan includes a description of Project impacts, objectives, and preliminary mitigation strategies. Additional information pertaining to the anticipated impacts and construction sequencing are available in the Project's permit authorization requests. This Plan includes state-specific compensatory mitigation programs to offset the resource impacts associated with the Project in each state. Tennessee intends to expand upon this conceptual Plan, as based on consultation with and comments from USACE, United States Environmental Protection Agency ("USEPA"), state and local regulatory authorities, and other stakeholders in the compensatory wetland mitigation discussions.

2.0 PROJECT DESCRIPTION

Tennessee, a subsidiary of Kinder Morgan and a major supplier of natural gas to utilities, distribution companies and power generators in the northeast, plans to construct, install, and operate the NED Project. Tennessee proposes to expand and modify its existing pipeline system in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. The NED Project is being developed to meet the increased demand in the Northeast United States ("U.S.") for transportation capacity of natural gas. The Project includes the following facilities:

- Approximately 41 miles of pipeline looping on Tennessee's 300 Line in Pennsylvania;
- Approximately 133 miles of new pipeline, of which 99 miles are proposed to be generally co-located with the certificated Constitution Pipeline Project ("Constitution")[1] in Pennsylvania and New York (extending from Tennessee's existing 300 Line near Auburn, Pennsylvania to Wright, New York);
- Approximately 54 miles of pipeline generally co-located with Tennessee's existing 200 Line and an existing utility corridor in New York;
- Approximately 64 miles of pipeline generally co-located with an existing utility corridor in Massachusetts;
- Approximately 70 miles of pipeline generally co-located with an existing utility corridor in New Hampshire (extending southeast to Dracut, Massachusetts);
- Approximately 58 miles of various laterals and a pipeline loop segment in Massachusetts, New Hampshire, and Connecticut to serve local markets;
- Construction of nine new compressor stations and 15 new meter stations, and modifications to an existing compressor station and 14 existing meter stations throughout the Project area; and
- Construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

Right-of-way ("ROW") widths vary along the proposed Project corridor. Construction ROW widths vary from 75 to 120 feet in Massachusetts and 75 to 120 feet in New Hampshire. Construction ROW widths in Connecticut are 90 feet for the entire proposed alignment. Operational ROW width is 50 feet for the entire proposed alignment through New York, Massachusetts, New Hampshire, and Connecticut.

To the extent that it is practicable, feasible, and in compliance with existing law, Tennessee proposes to locate proposed pipeline facilities (either pipeline looping segments or co-located pipeline facilities) generally within or adjacent to its existing ROW associated with its existing 300 Line in Pennsylvania

[1] On December 2, 2014, the Commission issued an Order Issuing Certificates and Approving Abandonment, Constitution Pipeline Company, LLC, 149 FERC 61,199 (2014), for the Constitution Pipeline Project, which adopted the recommendations from the Constitution "Final Environmental Impact Statement: Constitution Pipeline and Wright Interconnect Projects," FERC Environmental Impact Statement ("EIS") No. 0249F, Docket Numbers CP13-499-000, CP13-502-000, and PF12-9-000 ("Constitution Final EIS ["FEIS"]") issued October 24, 2014. Information contained within this Application related to the Constitution Pipeline Project was based on the updated routing provided by Constitution to FERC in January 2015.

and Connecticut; its existing 200 Line in New York and Massachusetts; and existing utility (pipeline and powerline) corridors in Pennsylvania, New York, Massachusetts, and New Hampshire.

Pipeline loops are those pipeline segments which are laid parallel to another pipeline and used as a way to increase capacity along what is possible on one line. These lines are connected to move a larger flow of gas through a single pipeline segment. Tennessee is proposing to minimize impacts by looping its own existing facilities in Pennsylvania and Connecticut.

Co-located pipelines are those that are laid parallel to another existing pipeline or linear utility. The current route of Tennessee's proposed NED Project, in large part, is located parallel and adjacent to, and, in many cases, overlaps existing utility easements (either pipeline or powerlines). This paralleling/overlapping of easements is commonly referred to as co-location. Refinement to the routing, including locations of permanent easement and temporary construction workspaces, has occurred as the NED Project was developed during the pre-filing process and will continue as necessary through the certificate process, incorporating information gained from field surveys and landowner and stakeholder input, including input from power companies that have existing easements in areas where Tennessee is proposing to co-locate the Project pipelines.

For areas of the NED Project pipeline alignment that are proposed to be co-located with existing powerline easements, Tennessee is proposing that the centerline of the pipeline will be installed generally five feet outside the existing powerline easement boundary.

For all areas of co-location with powerline easements, Tennessee is proposing that the permanent easement be centered generally on the proposed pipeline and that 20 feet of the proposed 50 foot permanent easement overlap the existing powerline easement. Further, Tennessee is proposing that the temporary construction workspace for the Project for these areas of co-location will overlap the existing powerline easement between 30 to 60 feet. The amount of overlap of temporary construction easements and the existing powerline easements will depend ultimately on the location of the closest powerline towers and facilities, which will dictate the amount of available space on the powerline easement.

Tennessee is requesting issuance of a certificate order for the Project in the fourth quarter of 2016 and proposes to commence construction activities in January 2017, in anticipation of placing the Project facilities in-service by November 2018 (with the exception of the proposed pipeline looping segment in Connecticut, which would be placed in-service by November 2019), consistent with the terms and conditions of the precedent agreements executed with Project Shippers.

Tennessee's existing pipeline infrastructure consists of approximately 11,900 miles of pipeline designated as the 100, 200, 300, 400, 500, and 800 Lines, based on the region they serve. The proposed NED Project focuses on the existing 200 and 300 Lines. The 200 Line consists of multiple pipelines varying from 24 inches to 36 inches in diameter beginning on the suction side of Compressor Station 200 in Greenup County, Kentucky, and extending east through Ohio, Pennsylvania, New York, and Massachusetts. The 300 Line system consists of two pipelines (24 inches and 30 inches in diameter) beginning on the discharge side of Compressor Station 219 in Mercer County, Pennsylvania, traveling east through Pennsylvania, New Jersey, New York, Connecticut, and terminating as a 16-inch-diameter pipeline at Compressor Station 261 in Hampden County, Massachusetts.

According to USACE regulations, the fundamental objective of compensatory mitigation is to offset environmental losses resulting from unavoidable impacts to waters of the United States (33 CFR 332.3[a]). The criteria for compensatory mitigation are set forth in the USACE's mitigation regulations, the USEPA's" companion Clean Water Act ("CWA") regulations (40 CFR 230) and in the "USACE's New England District ("NE District") Compensatory Mitigation Guidance (July 2010)"; or in the CWA regulations (40 CFR 110, 112, 116, *et al.*.) and in the "USACE's New York District ("NY District") Compensatory Mitigation Guidance (January 10, 2005)". Both the USACE and the USEPA have established a national goal of no overall loss of wetland functions, as detailed in the agencies' 1990 Memorandum of Understanding and respective mitigation regulations (33 CFR Parts 325 and 332; 40 CFR 230). The USACE NE and NY District Compensatory Mitigation Guidance incorporates these mitigation requirements, as well as those contained in the "USACE's Regulatory Guidance Letter No. 08-03: Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving Restoration, Establishment, and/or Enhancement of Aquatic Resources (October 10, 2008)" (USACE 2008). In addition to these federal requirements, Connecticut and Massachusetts have each established general goals and objectives for compensatory mitigation of aquatic resource impacts that the Conceptual Wetland Mitigation Plans are intended to address.

3.0 WETLANDS

Tennessee is currently in the process of acquiring access permission and conducting field delineations along the proposed Project route. During field delineations, all wetlands crossed by the Project were field delineated in accordance with the USACE Wetlands Delineation Manual (USACE 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (USACE 2012). For those areas where field delineations have not occurred, the Project route was photointerpreted to estimate locations and area of wetlands and upland habitats using stereo imaging software. The LiDAR derived 1-foot contours were overlain on project specific orthophotos to supplement the photointerpretation. Additional resources were referenced for supporting information including National Wetland Inventory ("NWI") maps, hydric soil maps, hydrology maps, topographic maps, and additional publicly available aerial photographs as needed to confirm a feature. Due to aquatic vegetation not being visible at the time of the imagery flight, aquatic beds were mapped from publicly available orthophotos.

The United States Fish and Wildlife Service ("USFWS") wetland classification system described by Cowardin et al. (1979) was used to classify the wetlands that would be affected by the Project. The wetlands in the Project area were identified as Palustrine Forested ("PFO"), Palustrine Scrub-Shrub ("PSS"), Palustrine Emergent ("PEM"), Palustrine Open Water ("POW"), or a combination of these four cover types. Palustrine systems include all non-tidal wetlands that are dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent. The palustrine system was developed to group vegetated wetlands commonly referred to as marshes, swamps, bogs, and prairies. This system includes ponds and may be situated shoreward or lakes, river channels, estuaries, river floodplains, in isolated catchments or on slopes (Cowardin et al. 1979).

3.1 WETLANDS CROSSED BY THE PROJECT

Field surveys and photo interpretation were used to identify wetlands along the proposed Project route.

3.1.1 Pipeline Facilities

Pennsylvania

The proposed wetland crossings by Project facilities in Pennsylvania are listed in Section 1, Attachment 2, which includes wetlands crossed by the pipeline and/or the limits of temporary workspace. Along Loops 317-3 and 319-3 the majority of these wetlands are PEM within the existing ROW and PFO, with some areas of PSS, outside of the existing ROW. Along the Pennsylvania to Wright Segment the alignment crosses all three wetland strata types. Crossing lengths vary within Pennsylvania but range from 10 to 800 feet.

New York

The proposed wetland crossings by Project facilities in New York are listed in Section 2, which includes wetlands crossed by the pipeline and/or the limits of temporary workspace. Along the Pennsylvania/New

York border to Wright segment and the Wright to New York/Massachusetts border segment, the majority of these wetlands are PEM within the existing ROW and PFO, with some areas of PSS, outside of the existing ROW. Along these segments the alignment crosses all three wetland strata types. Crossing lengths vary within New York but range from 4 to 1,447 feet.

Massachusetts

The proposed wetland crossings by Project facilities in Massachusetts are listed in Section 3, Attachment 2, which includes wetlands crossed by the pipeline and/or the limits of temporary workspace. The majority of these wetlands are PEM within the existing ROW and PFO, with some areas of PSS. Crossing lengths vary within Massachusetts but range from one to 961 feet.

New Hampshire

The proposed wetland crossings by Project facilities in New Hampshire are listed in Section 3, Attachment 2, which includes wetlands crossed by the pipeline and/or the limits of temporary workspace. Along Segments I, J, P, and Q of the pipeline, the majority of wetlands were observed to be PEM within the existing ROW while the majority of wetlands outside the existing ROW are PFO, with some areas of PSS. Within Segments I, J, P, and Q, the alignment crosses all three wetland strata types. Crossing lengths vary within New Hampshire but range from one to 1,580 feet.

Connecticut

The proposed wetland crossings by Project facilities in Connecticut are listed in Section 3, Attachment 2, which includes wetlands crossed by the pipeline and/or the limits of temporary workspace. The majority of these wetlands are PEM within the existing ROW and PFO in the areas outside of the existing ROW. Crossing lengths vary within Connecticut but range from two to 2,424 feet.

3.2 WETLAND IMPACTS AND MITIGATION

Construction of the Project pipeline facilities will result in temporary impacts to numerous waterbodies. Tennessee is investigating the feasibility to utilize Horizontal Directional Drilling ("HDD") to avoid impacts associated with a number of locations along the Project alignment, including: the Farmington River in Connecticut, the Deerfield River, Connecticut River, Merrimack River, and Spicket River in Massachusetts, the Merrimack River in New Hampshire, the Hudson River and Schoharie Creek in New York, and the Susquehanna River in Pennsylvania.

Construction of the proposed Project pipeline facilities will result in temporary impacts to emergent and scrub-shrub wetlands as well as forested wetlands. After construction, a portion of forested wetlands will be permanently converted to and maintained as scrub-shrub and/or emergent wetlands. Woody vegetation within the new permanent ROW will be allowed to regenerate within the ROW except for a 10-foot wide area centered over the pipeline that will be maintained in an herbaceous/scrub-shrub state to allow for inspection and maintenance of the pipeline once the Project is in-service. In addition, trees with roots that could compromise the integrity of pipeline coating within 15 feet of the pipeline may be selectively cut and removed from the new permanent ROW.

3.2.1 Mitigation and Restoration Measures

Construction and mitigation activities in wetlands will be conducted in accordance with the Project-specific Plan and Procedures (“Plan and Procedures”), Tennessee management practices (“BMPs”), and the Environmental Construction Plan(s) (“ECPs”) for each individual state. In addition, all applicable state documents and past project experiences were utilized in the development of the state specific ECPs.

Following construction and restoration, the temporary workspace (“TWS”) areas will not be maintained during operation of the proposed facilities and will be allowed to revert back to its pre-construction land use and vegetation cover types. All wetlands will be substantially restored to their pre-construction grades, contours, and drainage patterns, and reseeded or replanted with native hydrophytic vegetation species as identified in the Final Mitigation Plan.

In accordance with USACE general guidance, compensatory mitigation will be provided at a minimum one-for-one ratio for wetland losses. Tennessee will propose mitigation that will result in no net loss of wetland area or functions. While Tennessee anticipates that there will be no permanent loss to wetlands or waterbodies as a direct result of placement of the pipeline, the potential exists that there may be permanent losses associated with new roads or other ancillary facilities. Tennessee is currently evaluating final design alternatives for the proposed access road and ancillary facilities to avoid and minimize potential losses to wetlands. Tennessee proposes to accomplish at least a 3:1 replacement ratio for permanent impact to forested wetlands, and at least 2:1 for shrub and herb-dominated wetlands. Tennessee recognizes that the ratios will depend on many factors including the type of wetlands restored or established and the mitigation approach. Unavoidable conversion from forested to scrub-shrub and emergent wetlands will also occur as a result of Project construction. While conversion does not constitute a loss of wetland area, wetland structure and function are affected and this must be addressed as part of the Mitigation Plan. Tennessee also recognizes that temporal impacts (temporary loss of wetlands during construction) need to be compensated as part of the mitigation. Tennessee will identify compensatory mitigation projects that are in the same HUC-8 watersheds as unavoidable impacts and, as much as possible, achieve in-kind replacement or better of wetland resources unless alternative locations and methods are preferred by the regulatory agencies.

Tennessee’s plan for impacts to wetlands and watercourses follows the requirements of 33 CFR Part 332. As the Final Mitigation Plan and measures are developed for the Project they will be provided as supplemental information to this plan.

The goal of the Conceptual Mitigation Plan (Plan) is to restore, establish (create), and/or enhance wetland hydrology, hydrophytic vegetation, and hydric soil conditions to adequately offset the loss of function and value to the jurisdictional wetlands resulting from Project implementation. Even with the avoidance and minimization measures in place, there will be some unavoidable impacts to wetlands; however, Tennessee’s multi-facetted approach will endeavor to design a mitigation package that will fully compensate for impacts to wetlands with no net loss of function or values as explained in this Plan. Revisions to this Plan will be incorporated during the course of the USACE and state-specific permitting process. This Plan will take into account the site-specific cumulative loss of biological function provided by the impacted wetlands, as well as public value.

3.3 COMPENSATORY WETLAND MITIGATION NEEDS AND OPTIONS

In developing and preparing the wetland mitigation strategy for the Project, the Tennessee relied upon the 2008 federal Compensatory Mitigation for Losses of Aquatic Resources; Final Rule (4/10/08; 33 CFR Parts 325 and 332 [Mitigation Rule]) (USACE 2008) and the USACE Regulatory Guidance Letter 08-03; Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources (USACE 2003).

Categories of mitigation techniques available to Tennessee range from mitigation banking to preservation, each requiring different design and mandating different mitigation ratios and construction methods. The major categories of mitigation techniques in descending order of preference are:

- Avoidance and Minimization;
- Mitigation Banking;
- In-lieu fee (ILF);
- Restoration (Rehabilitation or Reestablishment);
- Establishment (Creation);
- Enhancement; and
- Preservation.

3.3.1 Pennsylvania

Tennessee will consult with the USACE – Baltimore District and Pennsylvania Department of Environmental Protection ("PADEP") Northcentral and Northeast Regional Offices for guidance during development of the proposed mitigation measures and plans, and will incorporate specific recommendations of the agencies.

3.3.2 New York

In addition to following the major categories of mitigation techniques in descending order of preference listed above, to compensate for those wetland benefits lost from the Project activities associated with impacts to NYSDEC state-regulated Freshwater Wetlands, the wetland mitigation plan will meet the following provisions as outlined in 6 NYCRR 663.5(g)(1)(i) through (iii), including:

a. The mitigation must occur on or in the immediate vicinity of the site of the proposed project;
b. The area affected by the proposed mitigation must be regulated by the Act and this Part after mitigation measures are completed; and
c. The mitigation must provide substantially the same or more benefits than will be lost through the proposed activity.

3.3.3 Massachusetts

In addition to following the major categories of mitigation techniques in descending order of preference listed above, Tennessee considered the NE District Compensatory Mitigation Guidance document (USACE 2010) as well as the In-lieu fee programs for Massachusetts. These programs/guidelines incorporate both the 2008 federal Compensatory Mitigation for Losses of Aquatic Resources; Final Rule

(4/10/08; 33 CFR Parts 325 and 332 ["Mitigation Rule"]) (USACE 2008) and the USACE Regulatory Guidance Letter 08-03; Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources (USACE 2003).

The USACE NE District and the Massachusetts Department of Fish and Game ("MADFG") signed an ILF program agreement in 2014 providing an alternative form of compensatory mitigation for permittees required to compensate for project impacts to aquatic resources, wetlands and waters of the U.S. in Massachusetts for eligible projects authorized under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act. The ILF option is available to the permit applicant instead of completing permittee-responsible mitigation by making a monetary payment in-lieu of or in addition to doing the required mitigation themselves. Use of the ILF program is contingent upon USACE NE District approval. The MADFG administers the ILF in Massachusetts and assumes legal responsibility for implementing required mitigation accomplished by aggregating and expending the in-lieu funds received from permittees for mitigation projects. The goal is the substantially increase the scope and quality of restoration and protection of aquatic resources and their related buffers and uplands. By aggregating the fees from multiple permit impacts, the ILF program can use the fees to develop larger compensatory projects that offer greater ecological benefits than smaller permittee-conducted mitigation contributing to watershed level conservation goals within Massachusetts. Projects in Massachusetts follow the NE District guidance described in detail in Section 3.3.1.5 for Connecticut.

3.3.4 New Hampshire

In addition to following the major categories of mitigation techniques in descending order of preference listed above, Tennessee recognizes that an inland wetland in-lieu program has been developed in New Hampshire that is closely aligned with the Federal In Lieu Fee Program ("ILFP"). NHDES and the USACE determine the credits required for authorized projects case-by-case using guidance and/or rules developed by each agency. The Federal ILFP administered by the USACE, is closely aligned with the New Hampshire in lieu fee program, and the Aquatic Resources Mitigation ("ARM") Fund. Land acquisitions are also considered by Tennessee to be viable mitigation options, provided the details and accounting process for this type of utility project can be developed in an acceptable manner. Land acquisition in the form of preservation may be used to provide compensatory mitigation for activities authorized by the USACE permits when the following criteria are met:

- The resources to be preserved provide important physical, chemical, or biological functions for the watershed;
- The resources to be preserved contribute significantly to the ecological sustainability of the watershed. In determining the contribution of those resources to the ecological sustainability of the watershed, the district engineer must use appropriate quantitative assessment tools, where available;
- Preservation is determined by the district engineer to be appropriate and practicable;
- The resources are under threat of destruction or adverse modifications; and,
- The preserved site will be permanently protected through an appropriate real estate or other legal instrument.

Tennessee recognizes that the ARM FUND has been established on a watershed basis to meet the 2008 Compensatory Mitigation Rule. The USACE ILFP is developed as a programmatic response to the historic loss of and continuing threat to aquatic resources in the region. This ILFP was designed to provide high quality mitigation and offer an alternative to USACE permittee-responsible, on-site compensatory mitigation. Historically, a portion of nationwide permittee-responsible wetland mitigation projects were unsuccessful, as they either were not completed or monitored; and/or monitoring revealed failure to meet project success criteria. The implementation of the ILFP will allow a transfer of compensatory mitigation responsibility to ensure that high-quality wetland habitats are created and successfully established. Again, this compensatory mitigation option is closely aligned with the Aquatic Resources Mitigation (ARM) Fund, administered by the Department of Environmental Services ("NHDES"). However, at the state level, engaging the local community in which wetlands impacts are incurred is the initial requirement. Local municipalities must be engaged by the project proponent to obtain information on any options for mitigation in any of several forms. The default option is the ARM fund program which then requires close coordination with the Federal ILFP. The administering agencies have a proven history of successfully completing wetland habitat restoration projects. Land acquisition at the federal level is focused on meeting specific impact ratios and translating mitigation credits to mitigate lost functions and values of wetlands by preserving similar functions and values on parcels. The ratios are based upon:

- Complexity of the system impacts;
- Likelihood of success;
- Degree to which acres/linear feet and functions are replaced; and
- Temporal losses for certain functions.

Under an ILFP, a permittee purchases mitigation credits for impacts within a specific area. These credits are paid to the administering agency that assumes the legal responsibility for compensatory mitigation implementation success and cover all costs associated with land acquisitions, engineering, permitting, construction, long term monitoring, and administrative costs for the mitigation areas, as well as a contingency amount to provide for any necessary corrective actions. In New Hampshire, Tennessee has initiated the engagement process with local communities by circulating a letter to the local boards in order to obtain information relative to mitigation opportunities. As such, Tennessee is in the process of meeting with local boards to obtain more detailed information relative to preferred mitigation options.

3.3.5 Connecticut

In addition to following the major categories of mitigation techniques in descending order of preference listed above, Tennessee considered the NE District Compensatory Mitigation Guidance document (USACE 2010) as well as the In Lieu Fee Programs for Connecticut.

Accordingly, compensation sites should be located to provide the desired water resource functions and values, taking into consideration factors such as watershed location, aquatic habitat diversity, connectivity, and, for wetlands and streams, a balance of wetlands and uplands. Options include water resource restoration, creation, enhancement, and preservation. Of these, the NE District Compensatory Mitigation Guidance states a preference for restoration but also acknowledges that "good restoration sites can be hard to find in New England".

In providing compensatory mitigation, Tennessee's overall goal for the Project is to provide no net loss of existing wetland functional values and statutory interests within the affected watersheds through the preservation, restoration, enhancement, and/or creation of wetlands. As detailed in the Compensatory Mitigation Guidance, the NE District has developed standard compensatory mitigation ratios to provide a framework for compensatory mitigation. The compensation ratios focus on direct permanent impacts, with additional mitigation required to address temporary fill impacts and secondary impacts, such as conversion of forested wetlands to scrub-shrub or emergent wetlands. While these ratios are the starting point for developing appropriate compensatory mitigation, there is flexibility on a project-by-project basis in order to achieve the most appropriate mitigation for a specific project. Tables 3.3-1 and 3.3-2 reproduce the USACE NE District guidance regarding compensatory mitigation ratios for permanent and temporary / secondary impacts, respectively. Note that these ratios do not fully account for pipeline construction that primarily impacts emergent wetlands and provides in-place restoration.

Table 3.3-1
USACE NE District Recommended Compensatory Mitigation Ratios for Direct Permanent Impacts (Table 1 in the NE District Compensatory Mitigation Guidance)

Mitigation/ Impacts	Restoration[1] (reestablishment)	Creation (establishment)	Enhancement (rehabilitation)	Preservation (protection/ management)
Emergent Wetlands (ac)	2:1	2:1 to 3:1	3:1 to 10:1[2]	15:1
Scrub-shrub Wetlands (ac)	2:1	2:1 to 3:1	3:1 to 10:1[2]	15:1
Forested Wetlands (ac)	2:1 to 3:1	3:1 to 4:1	5:1 to 10:1[2]	15:1
Open Water (ac)	1:1	1:1	project specific[3]	project specific
Submerged Aquatic Vegetation (ac)	5:1	project specific[4]	project specific[5]	N/A
Streams[6] (lf)	2:1[7]	N/A	3:1 to 5:1[8]	10:1 to 15:1[9]
Mudflat (ac)	2:1 to 3:1	2:1 to 3:1	project specific	project specific
Upland[10] (ac)	≥10:1[11]	N/A	project specific	15:1[12]

[1] Assumes no irreversible change has occurred to the hydrology. If there has been such a change, then the corresponding creation ratio should be used.

[2] Based on types of functions enhanced and/or degree of functional enhancement.

[3] Might include planting submerged and/or floating aquatics and/or removal of invasive species.

[4] Rare cases, e.g., removal of uplands, old fill, etc.

[5] E.g., remove pollutant source such as an outfall, remove moorings.

[6] Note that this assumes both banks will be restored/enhanced/protected. If only one bank will be restored/ enhanced/protected, use half the linear foot credit.

[7] E.g., daylighting stream, elimination of concrete channel.

[8] Enhancement of denuded banks and channelized streams = 3:1.

Enhancement of denuded banks when there is a natural channel = 4:1.

Enhancement when there are vegetated banks but the stream has been channelized = 5:1.

[9]Preserving buffer within the 100-foot minimum from channel = 10:1.

Preserving additional buffer 100 to 250 feet from channel = 15:1.

[10] This is when upland is used for wetland mitigation, NOT mitigation for upland impacts, which are not regulated.

[11] Only applies if existing condition is pavement or structure AND should complement aquatic functions.

[12] 100' upland buffer recommended for restoration, creation, and enhancement sites would be credited here.

Table 3.3-2
Recommended Compensatory Mitigation for Temporary and/or Secondary Impacts
(Excerpted from Table 2 in the NE District Compensatory Mitigation Guidance)

Impact	% Of Standard[1] Amount[2]
Temporary fill (swamp mats, fill over membrane) in forested wetlands; area to revegetate to forest.	10-25%
Temporary fill in emergent or scrub-shrub; area to revert to previous condition.	5-20%
Temporary fill in forest and will be permanently converted to scrub-shrub or emergent.	15-45%[3]
Permanent conversion of forested wetlands to other cover types.	15-40%
Removal of forested wetland cover for new corridor.	Project specific
Removal of forested cover of vernal pool buffer (w/in 250' of pool) when percentage of disturbance exceeds 25% of the total VP buffer area.	Project specific[4]
Streams – clearing of upland forest and/or scrub-shrub vegetation within 100' of stream bank or outermost channel of braided stream.	Project specific[5]

[1] "Standard" refers to amount of compensation that would be recommended under either the Corps' mitigation ratios for permanent fill (TABLE 1) or that required in In-lieu fee payments using the standard calculation.
[2] Percentages may be reduced if appropriate project-specific BMPs are incorporated into the project.
[3] For widening existing corridors only, not new. This does not take into account fragmentation impacts.
[4] Considerations in determining appropriate mitigation for secondary impacts to vernal pools should be on overall impact to the upland vernal pool buffer and how this affects the functions of the pool.
[5] Considerations in determining appropriate mitigation for secondary impacts to streams from loss of upland buffer should be on overall impact to the upland stream buffer and how this affects the functions of the stream.

Under the permittee-responsible mitigation option, to compensate for the Project's impacts to aquatic resource areas, Tennessee will develop a final mitigation plan that includes various measures of *in-situ*/in-kind wetland restoration, land preservation, and/or other wetland enhancement measures.

On-ROW mitigation will occur in each state and will involve the restoration of wetlands and watercourses temporarily affected by Project construction activities, such as the installation of temporary fills (e.g., timber swamp mat access roads, timber work pads). Such water resources will be restored and stabilized to pre-existing conditions to the extent practicable during the Project ROW restoration efforts.

To minimize the effects of the unavoidable impacts to state and Federally-regulated wetland resource areas during construction, Tennessee will implement BMPs as outlined in the Project's ECPs and Invasive Species Plan. The invasive species plan identifies the invasive wetland plant species that are of concern in the Project region. Although not all of the delineated wetlands proximate to the pipeline ROWs will be affected as a result of Project construction activities, those that will be disturbed could be more susceptible to colonization by invasive species. In addition, movement of construction equipment and materials through wetlands that presently contain invasive plants could promote the spread of invasive species to nearby, un-infested wetlands. The overall objective of the invasive species plan is to define the procedures to be used during Project construction to preserve the value and functions of wetlands along the Project ROWs that presently do not contain invasive species and to minimize the further spread of invasive plants within wetlands that already contain them. Construction best management practices (BMPs) will also be employed throughout the final design and implementation of the project, consistent with the procedures documented in submittals to the USACE as part of the Section 404 application.

4.0 REFERENCES

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USACE. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station. [Online WWW]. Available URL: http://el.erdc.usace.army.mil/elpubs/pdf/wlman87.pdf . [Accessed December 12, 2014]

USACE. 2008. Compensatory Mitigation for Losses of Aquatic Resources; Final Rule 4/10/08; 33 CFR Parts 325 and 332 ("Mitigation Rule") (**http://www.usace.army.mil/CECW/Pages/final_cmr.aspx**)

USACE. 2003. Regulatory Guidance Letter 08-03: Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources (**http://www.usace.army.mil/CECW/Documents/cecwo/reg/rgls/rgl08_03.pdf**)

USACE. 2010. New England District Compensatory Mitigation Guidance. U>S> Army Corps of Engineers, New England District Regulatory Division. 7-20-2010, 94pp Available online: http://www.nae.usace.army.mil/Portals/74/docs/regulatory/Mitigation/CompensatoryMitigationGuidance.pdf,

USACE, ed. J. S. Wakeley, R. 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0),), ed. J. S. Wakeley, R. W. Lichvar, C. V. Noble, and J. F. Berkowitz. ERDC/EL TR-12-1. Vicksburg, MS: U.S. Army Engineer Research and Development Center. [Online WWW]. Available URL: http://www.usace.army.mil/Portals/2/docs/civilworks/regulatory/reg_supp/NCNE_suppv2.pdf. [Accessed 2015].

Attachment O

Applicant Background Information Form (DEP-APP-008)

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Connecticut Department of
Energy & Environmental Protection

Applicant Background Information

Check the box by the entity which best describes the applicant and complete the requested information. **You must choose one of the following: corporation, limited liability company, limited partnership, general partnership, voluntary association and individual or business type.**

☐ **Corporation**

☐ Check the box if additional sheets are necessary. If so, label and attach additional sheet(s) to this sheet with the required information.

1. Parent Corporation

   Name:

   Mailing Address:

   City/Town: State: Zip Code:

   Business Phone: ext.:

   Contact Person: Phone: ext.

   E-mail:

2. Subsidiary Corporation:

   Name:

   Mailing Address:

   City/Town: State: Zip Code:

   Business Phone: ext.:

   Contact Person: Phone: ext.

   E-mail:

3. Directors:

   Name:

   Mailing Address:

   City/Town: State: Zip Code:

   Business Phone: ext.:

   E-mail:

4. Officers:

   Name:

   Mailing Address:

   City/Town: State: Zip Code:

   Business Phone: ext.:

   E-mail:

Applicant Background Information (continued)

☒ **Limited Liability Company**

☒ Check the box if additional sheets are necessary. If so, label and attach additional sheet(s) to this sheet with the required information.

1. List each member.

Name: **Tennessee Gas Pipeline Company, L.L.C.**
Mailing Address: 1001 Louisiana Street, Suite 1000
City/Town: Houston State: Texas Zip Code: 77002
Business Phone: 713-369-9000 ext.:
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
E-mail:

2. List any manager(s) who, through the articles of organization, are vested the management of the business, property and affairs of the limited liability company.

Name: **Steven J. Kean**
Mailing Address: 1001 Louisiana Street, Suite 1000
City/Town: Houston State: Texas Zip Code: 77002
Business Phone: 713-369-9000 ext.:
E-mail:

Name: **David R. DeVeau**
Mailing Address: 1001 Louisiana Street, Suite 1000
City/Town: Houston State: Texas Zip Code: 77002
Business Phone: 713-369-9000 ext.:
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
E-mail:

Applicant Background Information (continued)

☐ **Limited Partnership**

☐ Check the box if additional sheets are necessary. If so, label and attach additional sheet(s) to this sheet with the required information.

1. General Partners:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
Contact Person: Phone: ext.
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
Contact Person: Phone: ext.
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
Contact Person: Phone: ext.
E-mail:

2. Limited Partners:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
Contact Person: Phone: ext.
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
Contact Person: Phone: ext.
E-mail:

Applicant Background Information (continued)

☐ **General Partnership**

☐ Check the box if additional sheets are necessary. If so, label and attach additional sheet(s) to this sheet with the required information.

1. General Partners:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
Contact Person: Phone: ext.
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
Contact Person: Phone: ext.
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
Contact Person: Phone: ext.
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
Contact Person: Phone: ext.
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
Contact Person: Phone: ext.
E-mail:

Applicant Background Information (continued)

☐ **Voluntary Association**

☐ Check box if additional sheets are necessary. If so, label and attach additional sheet(s) to this sheet with the required information.

1. List authorized persons of association or list all members of association.

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
E-mail:

Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
E-mail:

☐ **Individual or Other Business Type**

☐ Check the box, if additional sheets are necessary. If so, label and attach additional sheet(s) to this sheet with the required information.

1. Name:
Mailing Address:
City/Town: State: Zip Code:
Business Phone: ext.:
E-mail:

2. State other names by which the applicant is known, including business names.
Name:

Attachment N

Applicant Compliance Information Form (DEP-APP-002)

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Connecticut Department of
Energy & Environmental Protection

DEEP ONLY
App. No. ______________________
Co./Ind. No. ______________________

Applicant Compliance Information

Applicant Name: Tennessee Gas Pipeline Company, L.L.C.

Mailing Address: **1001 Louisiana Street**

City/Town: **Houston** State: **TX** Zip Code: **77002**

Business Phone: ext.:

Contact Person: **Michael Letson** Phone: **713.420.5360** ext.

*E-mail: **Michael_letson@kindermorgan.com**

If you answer *yes* to any of the questions below, you must complete the Table of Enforcement Actions on the reverse side of this sheet as directed in the instructions for your permit application.

A. During the five years immediately preceding submission of this application, has the applicant been convicted in any jurisdiction of a criminal violation of any environmental law?

☐ Yes ☒ No

B. During the five years immediately preceding submission of this application, has a civil penalty been imposed upon the applicant in any state, including Connecticut, or federal judicial proceeding for any violation of an environmental law?

☐ Yes ☒ No

C. During the five years immediately preceding submission of this application, has a civil penalty exceeding five thousand dollars been imposed on the applicant in any state, including Connecticut, or federal administrative proceeding for any violation of an environmental law?

☐ Yes ☒ No

D. During the five years immediately preceding submission of this application, has any state, including Connecticut, or federal court issued any order or entered any judgement to the applicant concerning a violation of any environmental law?

☐ Yes ☒ No

E. During the five years immediately preceding submission of this application, has any state, including Connecticut, or federal administrative agency issued any order to the applicant concerning a violation of any environmental law?

☐ Yes ☒ No

Table of Enforcement Actions

(1) Type of Action	(2a) Date Commenced	(2b) Date Terminated	(3) Jurisdiction	(4) Case/Docket/ Order No.	(5) Description of Violation

☐ Check the box if additional sheets are attached. Copies of this form may be duplicated for additional space.

Attachment P

Coastal Consistency Review Form (DEP-APP-004)
***Not required as part of this application.**